

2016 Sec 4 Biology

Examguru

Free Biology 2016 Paper 1

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4	Victoria School P2
5	Catholic High School P2
6	Bukit Panjang Government High School P2
7	Paya Lebar Methodist Girls' School P2
8	Kranji Secondary School P2
9	Geylang Methodist Secondary School P1&P2
10	Bukit Batok Secondary School P1 & P2
11	Chong Boon Secondary School P1 & P2
12	Fuhua Secondary School P1 & P2
13	Bishan Park Secondary School P2
14	Bowen Secondary School P2

Name	Index Number	Class
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**BISHAN PARK SECONDARY SCHOOL
PRELIMINARY EXAMINATIONS (II) 2016
SECONDARY FOUR EXPRESS**

PURE BIOLOGY

Paper 2

5158/02
23 Aug 2016
1 hour 45 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A (50 marks)

Answer all questions.
Write your answers in the spaces provided on the Question Paper.

Section B (30 marks)

Answer all questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
At the end of examination fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Setter: Ms Lim Sin Yee

This document consists of 20 printed pages and 0 blank page.

[Turn Over]

Section A

Answer all the questions.

Write your answer in the spaces provided.

- 1 (a) Define the following genetic terms.

heterozygous

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recessive allele

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.....

[4]

- (b) Fig. 1.1 represents some alleles on part of the sex chromosomes of a woman and of a man.

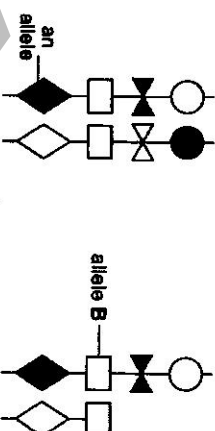


Fig. 1.1

- (i) In the space below, draw these alleles as they might appear in a sperm cell that carries the Y chromosome.

[1]

Fig. 1.2 shows how the alleles on one of the chromosomes might appear in a cell taken from somewhere else in the man's body. Allele B shows a mutation.

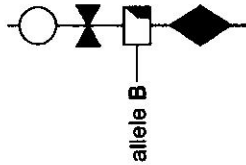


Fig. 1.2

Ultra-violet ray from the sun is a type of ionising radiation that could be a possible cause of the mutation shown in Fig. 1.2.

(ii) Suggest one other possible cause of the mutation.

..... [1]

(iii) Fig. 1.3 shows sun-cream being applied by a man to protect his skin from the sun's ultra-violet ray.

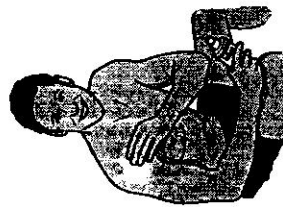


Fig. 1.3

Suggest how using sun-cream reduces the damaging effect of the Sun's rays.

.....
.....
..... [1]

(c) Fig. 1.4 shows the hand of a person who suffers from a mutation that results in people having more than five digits on each hand (polydactyly).



Fig. 1.4

The mutation that results in this condition is dominant.

Fig. 1.5 shows how the condition is inherited in a family.

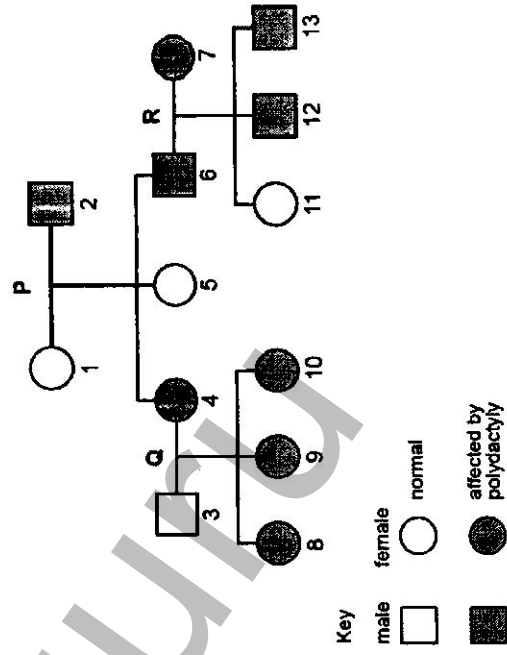


Fig. 1.5

- (i) State the genotype of the individuals shown in Fig. 1.5.
Use DD, Dd or dd.

Write your answers in Table 1.1.

Table 1.1

numbered person on Fig. 1.5	genotype of person
1	
2	
3	
9	

- (ii) Using evidence from Fig. 1.5, state which of the couples, P, Q or R, provides proof that the mutation is not recessive.

couple

[1]

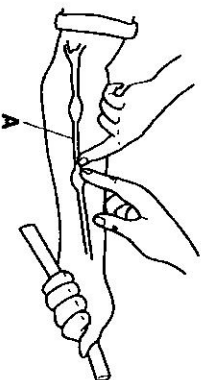
- (iii) Explain the reason for your answer.

.....

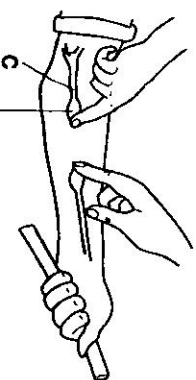
 [2]

[Total: 13]

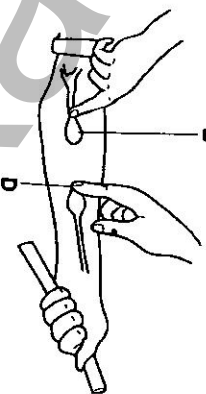
- 2 Fig. 2.1 shows a demonstration related to blood circulation.



Both fingers are pressed firmly on blood vessel A.



Both fingers remain pressing on the blood vessel. The finger on the left is then drawn along the blood vessel and stops when it reaches B. It is then removed and replaced at C.



The finger on the right continues to press firmly on the blood vessel. The finger on the left is then pushed gently but firmly towards B which increases in size.

Fig. 2.1

- (a) (i) Name the type of blood vessel labelled A in Fig. 2.1.

[1]

- (ii) In the space below, draw a longitudinal section (cut along its length) through the blood vessel as it appears at position B.

[2]

(b) Suggest why, at the end of the demonstration, the blood vessel is no longer visible between positions B and D.

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[4]

(c) Suggest why a rod was repeatedly gripped tightly before carrying out this demonstration.

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.....

[2]

[4]

[Total: 13]

(d) Use your knowledge of how blood moves through the circulatory system to suggest an explanation for why, after a few minutes, the chair with the student falls forward similar to the chair in Fig. 2.2(b).

.....

.....

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Fig. 2.2(a) shows a chair leaning against a wall, carefully balanced and with a scale pan hanging from the front of the seat. Fig. 2.2(b) shows what happens when a mass is then added to the scale.

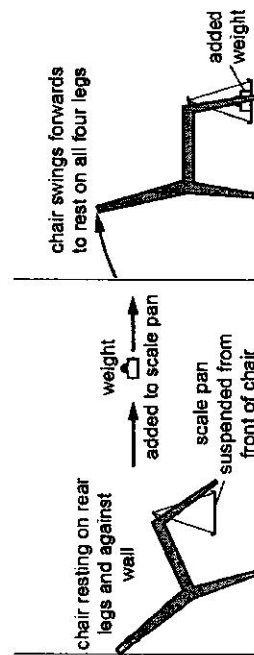


Fig. 2.2(a)

Fig. 2.2(b)

A student sits on a chair, leaning against a wall as shown in Fig. 2.2(a), and remains perfectly still.

4 Pitcher plants, similar to the one shown in Fig. 4.1, trap insects in their pitchers and digest them in solutions which they secrete into their pitchers.

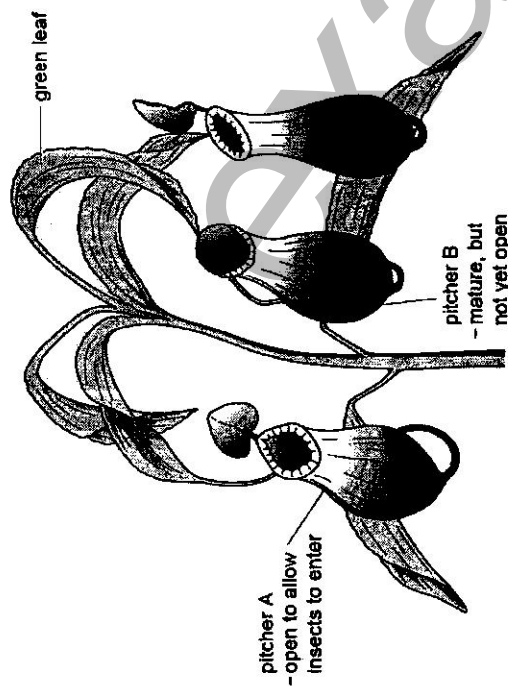


Fig. 4.1

A student wanted to investigate the nature of the solutions found inside the pitchers. Table 4.1 summarises the contents of the six test-tubes which were set up.

Table 4.1

test-tube M	test-tube N	test-tube O
2cm ³ water 1cm ³ raw meat	2cm ³ liquid from pitcher B 1cm ³ raw meat	2cm ³ boiled and cooled liquid from pitcher B 1cm ³ raw meat
test-tube P	test-tube Q	test-tube R
2cm ³ water 1cm ³ butter	2cm ³ liquid from pitcher B 1cm ³ butter	2cm ³ boiled and cooled liquid from pitcher B 1cm ³ butter

Five hours later, the only visible change was that the cube of meat in test-tube N was much smaller.

(a) State the purpose of

test-tubes M and P

..... [1]

test-tubes O and R

..... [1]

(b) At the end of the experiment, which chemical would be present in test-tube N, but not in any of the other test-tubes? Explain your answer.

.....

.....

.....

.....

.....

..... [3]

Some pitcher plants attract small mammals such as bats to spend their resting hours comfortably in the opening to their pitchers.

Others attract small tree shrews by releasing a sweet, nectar-like substance from glands on the pitcher lids, as shown in Fig. 4.2.

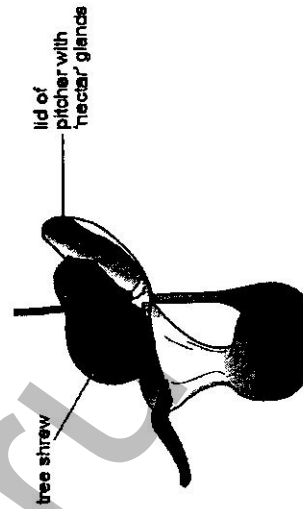


Fig. 4.2

- (c) (i) Name the process used by the pitcher plant to manufacture the nectar-like substance before it is released.

[1]

- (ii) Describe how that substance is translocated to the glands on the pitcher lids.

[2]

- (d) The pitcher plant that attracts the tree shrew is called the lavaloy plant. These pitcher plants that attract small mammals rarely catch and digest many insects. Suggest and describe how these plants may benefit from the presence of tree shrews and bats.

[4]

[Total: 12]

Section B
Answer three questions.

Question 7 is in the form of an Either/Or question. Only one part should be answered.

- 5 A student carried out an investigation to find the effect of carbon dioxide concentration on the rate of photosynthesis of an aquatic plant.

The apparatus that the student used is shown in Fig. 5.1. The student counted the number of bubbles produced by the cut end of the stem.

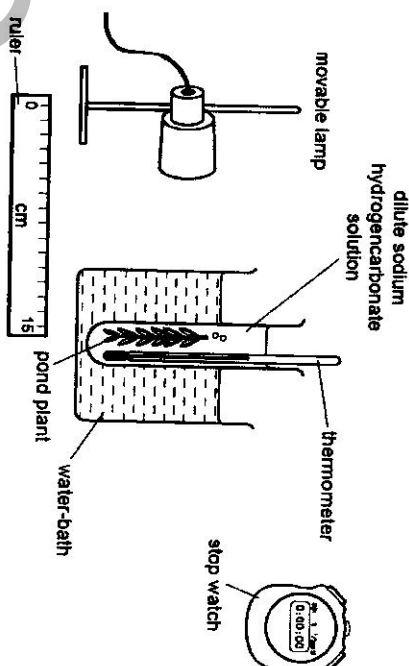


Fig. 5.1

- (a) Explain why the student included the beaker of water and the thermometer in the apparatus.

[3]

(b) The results obtained by the student are shown in Fig. 5.2.

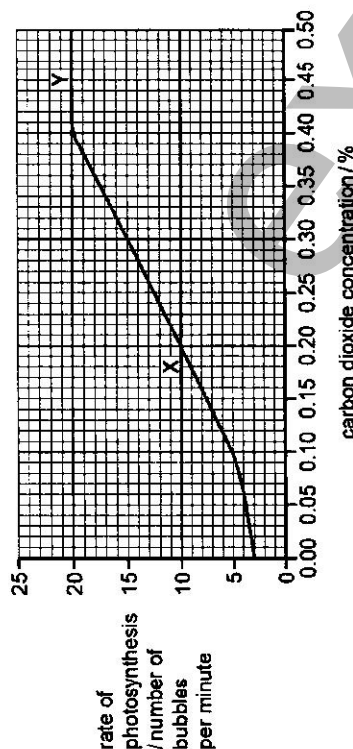


Fig. 5.2

- (i) State the factor that is limiting the rate of photosynthesis in region X of the graph. [1]
- (ii) Suggest and explain the reasons for the shape of the graph in region Y. [3]

(c) Counting bubbles may not be the best way to measure the rate of photosynthesis. The volume of bubbles is not always exactly the same.

Suggest and describe one alternative way of measuring the gas given off to solve this problem.

..... [3]

[Total: 10]

- 6 Two students carried out an investigation to determine the effect of exercise on their breathing and pulse rates. They each performed five minutes of vigorous exercise. Tables 6.1 and 6.2 show the effects, after exercise, on their breathing rates and pulse rates respectively.

Table 6.1

Student	Before exercise	Breathing rate / breaths per minute				
		At minute interval after exercise				
John	12	30	22	15	12	12
Peter	16	45	38	32	22	16

Table 6.2

Student	Before exercise	Pulse rate / beats per minute				
		At minute interval after exercise				
John	62	110	81	63	62	62
Peter	75	150	140	125	100	75

- (a) Explain why would exercise lead to an increase in both the breathing and pulse rate.

[3]

- (b) From the results obtained, which student is likely to be a better athlete? Explain your answer.

[2]

- (c) Describe in detail, the route taken by a molecule of carbon dioxide after it is released by respiring muscle tissues in the leg to the time it reaches the lungs.

[5]

[Total: 10]

7 Either

- (a) Describe how carbon in dead leaves is taken up by a flowering plant to form plant proteins.**

[4]

- (b) Explain the importance of mitosis and meiosis in plant reproduction.**

[5]

- (b)** Changes have been taking place among living things on Earth for millions of years due to a natural process of selection. Suggest how this process may have caused giraffes to evolve from a short-necked species to the present long-necked species.

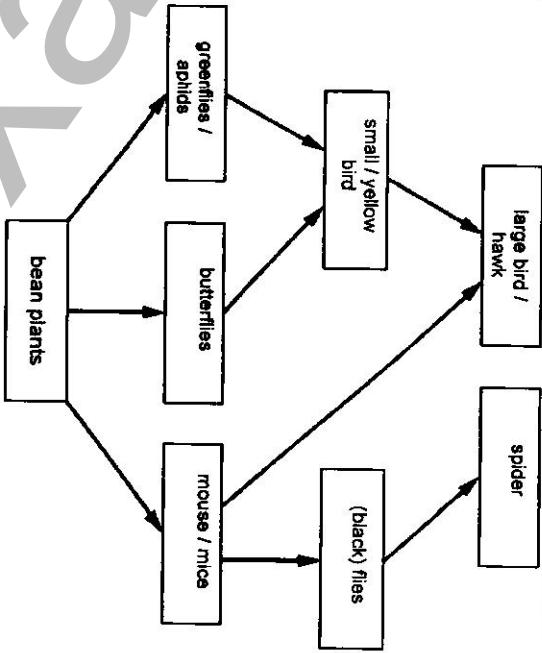
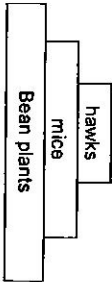
[5]

- End of Paper -

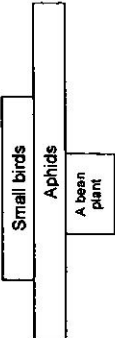
Paper 2
Section A

Bishan Park Secondary School
Sec 4E Pure Biology 5158
2016 Prelims 2 - Mark Scheme

Qns	Answer	Marks
1a	Heterozygous An organism is heterozygous for a trait if the two alleles controlling the trait/gene are different; -or- Having two different alleles / a dominant allele and a recessive allele; of a particular gene. Ignore: symbols alone e.g. Hh Recessive allele Alternative form of a gene; does not express itself in heterozygous condition / only expresses itself in a homozygous recessive condition.	2m
1bi	 CAO 1m	1m
1bii	Chemical or mutagenic chemical named (i.e. mustard gas, benzene, tar); (sun-cream) absorbs / blocks / stops Sun's rays; prevents ionising radiation / harmful Sun's rays from reaching skin / cells / body; R: repels / reflects radiation	1m Max 1m
1ci	1: dd; 2: Dd; 3: dd; 9: Dd;	4√ = 3m 3√ = 2m 2√ = 1m 1√ = 0m
1cii	Couple R A: individuals 6 and 7	1m
1ciii	If mutation was recessive, all their offspring would have shown the condition; but individual 11 / AVV is normal, so the mutation must be dominant / AVV;	2m
2ai	Vein:	1m
2aii	a valve shown with flaps touching; vessel widest at correct side of valve + walls shown both before and after valve;	2m
2b	Blood has been pushed out of (vein). Hence, the blood vessel/vein is empty/ no blood is flowing through; * blood cannot flow back (due to valve / from B); * finger on the right / at D + prevents blood from entering (vein); Walls of vein is thin thus not visible beneath skin/ AVV; *compulsory points	Max 4m

2c	Muscle + contraction(s); Helps to increase blood pressure; This in turn increases circulation / blood flow / helps fill (vein) with blood;	Max 2m
2d	Blood (is flowing to) + legs/feet of the student; When he sits perfectly still, there is no use of his leg muscle / no muscular contraction in his leg; The blood in his veins; is not pushed from one set of valves to the next; Thus, this increases the mass/weight of the (lower) leg;	Max 4m
3a	 <pre> graph TD BP[bean plants] --> GB[greenflies / aphids] BP --> BF[butterflies] BP --> MM[mouse / mice] GB --> SYB[small / yellow bird] BF --> SYB BF --> LBH[large bird / hawk] BF --> S[spider] BF --> F[(black) flies] SYB --> LBH S --> F MM --> F </pre>	4m
3b	Food web: one mark per trophic level in any order; overall web correct (correct order);	CAO, 1m
3ci	correct shape, upright pyramid (A: smooth-sided or stepped pyramid);  all three levels correctly labelled; (upside-down pyramid with producer at top = 1 mark)	2m

	for growth / repair; Carbon dioxide released from respiration of the small animals; • can be used by the plant for photosynthesis; • to make glucose / carbohydrate; <i>*mark once only</i>	
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3cii	correct shape;  all three levels correctly labelled; (A: for ONE mark, correct shape with no labels OR correct shape with wrong but plausible labels. Correct shape + implausible labels = 0)	2m
3d	Accept reverse arguments for marking points. (By keeping the surrounding temperature close to the animal body temperature) less energy is required; to raise body temperature / keep body warm / thermoregulation; (By restricting the activity of animals) The animals have less muscle activity/use; requiring lower rate of respiration; Hence, more energy is available + increase biomass/ to grow; (farmer) increased productivity / profit / lower feeding costs / (consumer) lower cost to buy;	Max 3m
4a	test-tubes M and P act as control for the experiment / prove that the digestion took place because of the presence of the liquid from the pitcher plant; test-tubes Q and R to prove that the liquid from the pitcher plant contains enzyme(s);	2m
4b	Amino acids + as raw meat contains protein; Water cannot digest meat; Boiling the liquid cause enzymes to denature;	3m
4ci	Photosynthesis;	CAO, 1m
4cii	(The substance) is translocated as sucrose; in solution; via the phloem;	Max 2m
4d	Tree shrews and bats may egest their waste/ faeces, and urine / nitrogenous waste (into the pitcher plant); These waste undergo decomposition; by bacteria; releasing carbon dioxide; • for photosynthesis; • to make glucose / carbohydrate; Enzymes (in the liquid of pitcher plant) can also break down the egested waste / nitrogenous waste; Releasing nitrates / salts / ions; which can be absorbed by the pitcher plant; and be used to make proteins / amino acids;	Max 4m

Paper 2
Section B

Qns	Answer	Marks
5a	As temperature is a controlled variable: The beaker of water helps absorb heat from the lamp/ act as a heat shield/ maintain constant temperature. The thermometer is required to measure/ check/ monitor/ record water temperature, in order to prevent temperature change, which will influence/change the results/ rate of photosynthesis.	Max 3m
5bi	Carbon dioxide concentration/ level: R: amount of carbon dioxide	1m
5bii	[Compulsory 1m] carbon dioxide (concentration), is no longer a limiting factor / AW. Max 2m [S] light intensity/ level, could be limiting / AW; [E] reference to light providing energy required for photosynthesis; -or- [S] temperature could be limiting / AW; [E] reference to temperature influencing the activity of enzymes; -or- [S] chloroplast / chlorophyll / number of leaves / size of plant, could be limiting factor; [E] reference to amount of light energy trapped for photosynthesis.	Max 3m
5c	measure volume (of oxygen / gas): by using an inverted test-tube / measuring cylinder / syringe (barrel), filled with water + gas collects at the top and pushes out the water / downward displacement of water; -or- gas syringe attached by delivery tube to, flask / AW; -or- oxygen sensor/ data logger for any other suitable electronic method; reference to time period; A rate = volume divided by time	Max 3m
6a	Exercise increase the demand for energy required by muscle cells; rate of (aerobic) respiration increases (to meet demand of energy); Breathing rate increases to bring in more* oxygen + expel / breath out more carbon dioxide; Pulse rate increases to pump more* oxygen and glucose to respiring muscle cells; *mention at least once	Max 3m
6b	John: He requires a shorter time for both his breathing and pulse rate to return the initial level / the level before exercise. -or- He is able to repay his oxygen debt faster than Peter.	2m
6c	Carbon dioxide released from respiring muscle tissues will <u>diffuse</u> across the blood capillary wall; into the blood and enters the red blood cells; In the RBCs, carbon dioxide will combine with water to form carbonic acid in the presence of carbonic anhydrase enzyme; The carbonic acid will dissociate into hydrogen carbonate ions; The hydrogen carbonate ions will then diffuse out of the RBCs and be carried in the blood plasma (in the veins); to the vena cava into the heart; and out of the pulmonary artery to the lungs.	Max 5m

7E(a)	Microorganisms decompose dead leaves releasing carbon dioxide into the (atmospheric) air; Carbon dioxide diffuses into the leaves of the (flowering) plants and are used for photosynthesis; forming glucose; Glucose reacts with nitrate (ions) to form amino acids; Amino acids condensed / combined to form (plant) proteins.	Max 4m
7E(b)	Mitosis Important in plant's asexual reproduction; for the development of shoots and roots in storage organs like rhizomes / bulbs; Allows the production of genetically identical offspring with desirable traits from the parent plant.	Max 6m
7C(a)	Meiosis Important in the production of haploid gametes; which fuse together during fertilisation to restore / produce diploid cells during sexual reproduction; Meiosis results in genetic variations in gametes due to crossing over at prophase I, and during independent assortment of chromosomes at metaphase I; These variations increase the chance of survival of the plant species during changes in the environment.	Max 5m
7C(b)	Sheep with better wool quality, are used for reproduction/are crossed/selectively breed; The gene (coding for better wool) is passed down to the offspring; The wool amongst the offspring may vary; due to mutation; Offspring of better wool quality are (again) artificially selected to survive / selective breeding / process repeated; Improving the quality of wool + over many generations.	Max 5m
7C(b)	Mutation give rise to variations in the length of neck among the giraffes; A change in the environment favoured those giraffes with longer necks / ref. to longer necked giraffes are able to reach and feed on leaves that the shorter necked giraffes would not have been able to / longer necked giraffes have an advantage in the competition for food; Due to natural selection, the long necked giraffes survived longer; to reproduce / have more (long necked) offspring; Short necked giraffes (which are not naturally selected) lived shorter life span and leave behind fewer offspring; Over many generations (ref. to a long period of time), the number of long necked giraffes outnumbered the number of short necked ones;	Max 5m

Symbols used to mark answers and student marks:

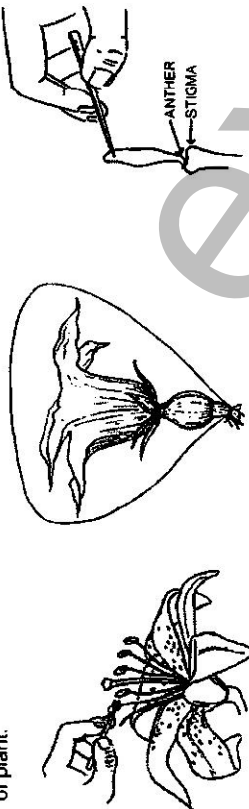
/ separates different responses for a marking point
B.O.D. Benefit Of Doubt
O.A.T. or words to that effect
O.V.T.T.E. or words to that effect
A.V.P. answer/ makes appropriate reference to additional valid point (e.g. in comments)
A.W. additional valid point (e.g. in comments)
C.A.O. Correct Answer Only
E.C.F. Error Carried Forward
A. correct response
R. reject - this is marked with a cross and any following correct statements do not gain any marks
I. ignore / irrelevant / inadequate - this response gains no mark, but any following correct statements can gain marks
U. the word / phrase in brackets is not required to give marks but sets the context of the response for credit, e.g. (vary) circle. Vary not needed but if it was described as a cellulose circle then no mark is awarded
U.N.D. Underscored words - this word only
Any valid point

PAPER 2
Section A

Answer all questions.

Write your answers in the spaces provided on the question paper.

- 1 Fig. 1.1 shows some of the steps carried out by a farmer in the reproduction of a certain species of plant.



- Step 1 :** removal of immature anthers
- Step 2 :** enclose the flower in a plastic bag
- Step 3 :** transferring pollen from anther of another flower to the stigma

Fig. 1.1

- (a) What is the purpose of

(i) removing the immature anthers.

.....[1]

(ii) covering the flower with a plastic bag?

.....[1]

- (b) Describe the main events that lead to the formation of the zygote after pollen grains are brushed onto the stigma.

.....[5]

- (c) Suggest the advantage of employing the procedure by means shown in the above diagrams for reproducing the plant.

.....[3]

- 2 Fig. 2.1 shows the changes in the mass of DNA from a haploid nucleus of a mammalian egg to the time, after fertilization, when it undergoes cell division to form into an embryo.

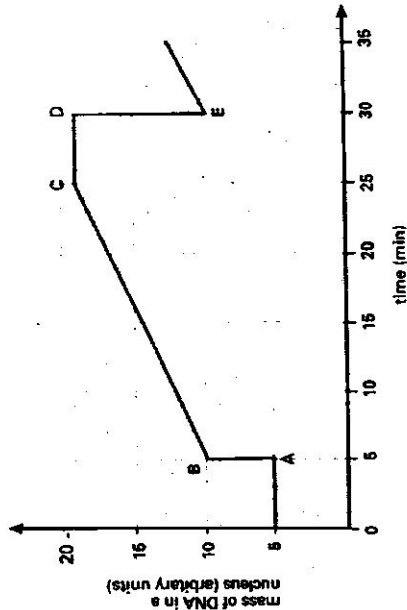


Fig. 2.1

- (a) What is the relationship between chromosome and DNA?

.....[2]

(b) Describe and explain the changes in mass of DNA at each of the following stages:

(i) from A to B :

(ii) from B to C :

(iii) from D to E :

3 Fig. 3.1 shows the processes which take place at a sewage treatment plant.

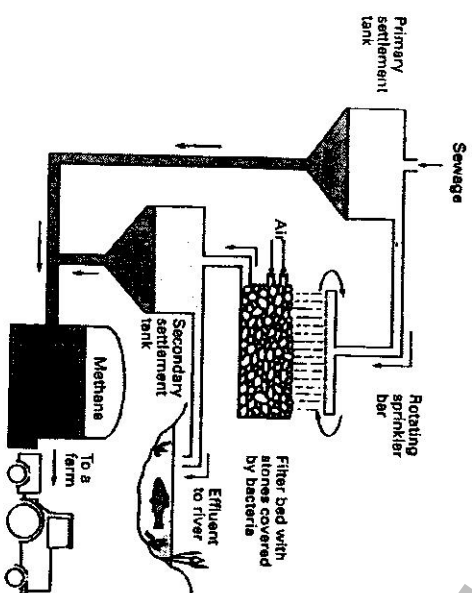


Fig. 3.1

(a) Explain the function of bacteria in the filter bed.

(b) In view of conservation, suggest how two of the products of sewage treatment can be used.

(c) If a large quantity of disinfectant entered the sewage treatment plant, what effect could this have on the efficiency of the process? Explain your answer.

4 Type 2 diabetes (insulin-independent diabetes) is a non-infectious disease.

If not treated, this disease is characterised by large fluctuations in the concentration of glucose in the blood.

Maltase is an enzyme that completes the digestion of starch in humans. Molecules of maltase are bound to the membranes of the microvilli of epithelial cells in the small intestine.

Ascorbate is a drug used in the treatment of type 2 diabetes. Molecules of ascorbate have a very similar shape to that of the **substrate for maltase**.

(a) Explain how ascorbate acts to slow down the action of these membrane-bound enzymes.

.....[3]

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(b) Suggest why ascorbate can be used to treat people who have type 2 diabetes.

.....[2]

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5 Esther went hiking along the Marang Trail at the Southern Ridges on a hot afternoon.

After walking for half an hour, Esther's face became flushed.

(a) (i) Explain why Esther's face was flushed after walking for half an hour.

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.....

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.....[3]

(ii) Why is this response important?

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.....[2]

(b) After 4 hours of walking, she had drunk all the water she brought along and her sweat production became greatly reduced. Her body temperature increased significantly. This might lead to heatstroke. Account for the rise of her body temperature.

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.....[2]

- (c) Table 5.1 provides some information on the weather conditions at the Southern Ridges on three afternoons:

day	temperature (°C)	relative humidity (%)	ultra-violet light intensity	wind speed (km/h)
1	32.8	90	medium	5
2	33.1	72	high	15
3	32.6	80	high	31

Table 5.1

On which afternoon would a person have the highest risk of developing heatstroke if he went hiking along the Marang Trail at the Southern Ridges? Justify your answer by stating two special features of the weather of that afternoon as compared with the other two afternoons.

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[3]

- 6 Fig. 6.1 shows a kidney and its associated structures. The arrows show the direction of flow of fluids in these structures.

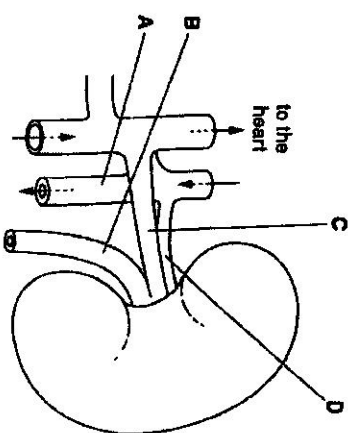


Fig. 6.1

- (a) (i) Name the structure labelled A in Fig. 6.1. [1]
- (ii) Name the chamber of the heart through which blood in structure A last passed. [1]

- (b) Table 6.1 shows the relative concentrations of various substances in structures B and C. Complete the table to show the possible concentrations of these substances in structure D. [5]

substance	relative concentration in structure		
	B	C	D
amino acids	0.00	0.05	
glucose	0.00	0.10	
mineral ions	1.50	0.72	
proteins	0.00	8.00	
urea	2.00	0.03	

Table 6.1

- (c) Explain how the relative concentrations of glucose might change in structures B, C and D in a person with diabetes. [4]

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.....

[4]

Section B
Answer all the questions.

Question 9 is in the form of an Either/Or question.
Answer only question 9 Either or question 9 Or.

Write your answers in the spaces provided.

- 7 Four experiments were carried out to investigate the distribution of stomata on the upper and lower surfaces of the leaf of a leafy shoot. Fig. 7.1 shows the set up for these experiments.

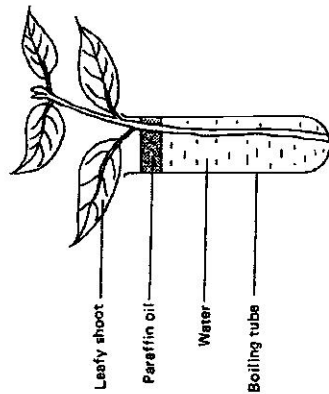


Fig. 7.1

Each set up was left in a windy place and weighed at 4-hour intervals for 24 hours.

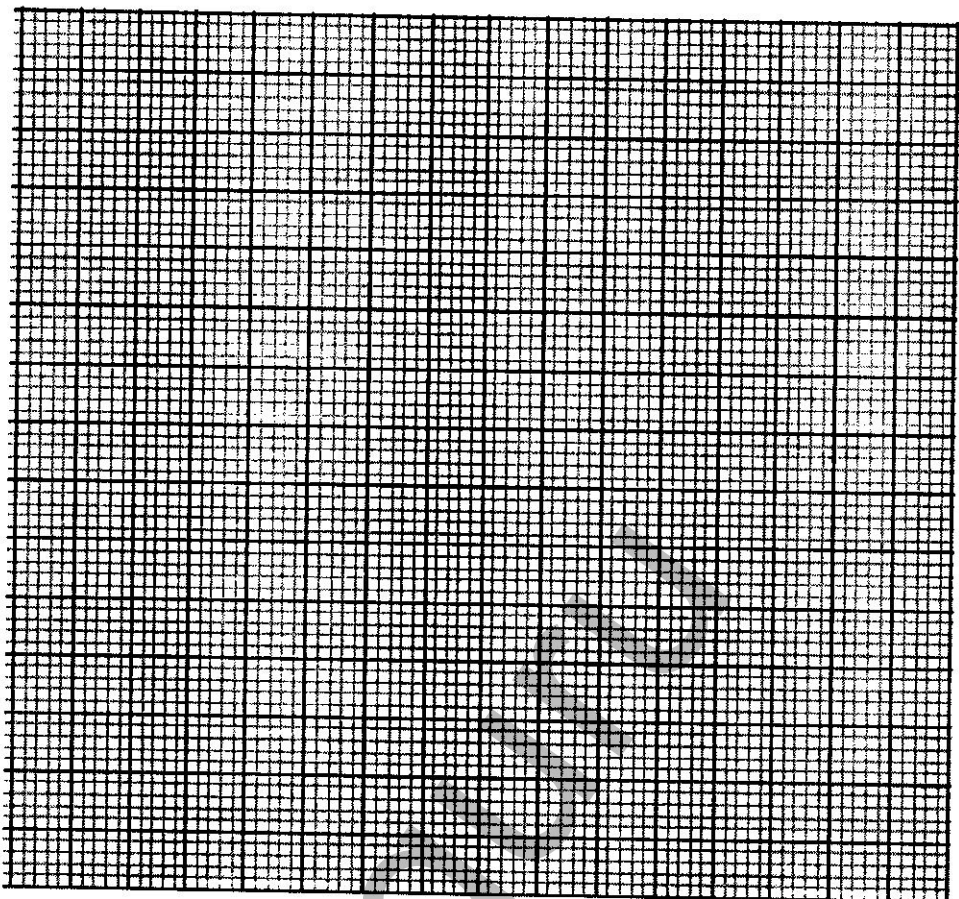
Table 7.1 records the treatment of the plants and the weights of each set up during the 24 hours.

set-up	treatment on leaves	weight of the set-ups (g)							
		0 h	4 h	8 h	12 h	16 h	20 h	24 h	
A	no treatment	72	68	60	56	52	52	48	
B	upper leaf surface smeared with vaseline	74	72	68	66	64	64	62	
C	lower leaf surface smeared with vaseline	76	75	73	72	71	71	70	
D	both upper and lower leaf surfaces smeared with vaseline	78	78	78	78	78	78	78	

Table 7.1

(a) Plot a graph to show the results of the four set-ups.

[4]



(b) What conclusion can be drawn from set-ups B and C? Explain your answer.

[3]

(c) How will the graphs for set-ups A, B and C change if they are placed under a bell jar?

[3]

100

100

100

100

100

100

100

100

— — — — —

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— — — — —

— — — — —

21

[4]

[9]

PAPER 1 [40 MARKS]

1.	C	11.	A	21.	A	31.	B
2.	D	12.	A	22.	C	32.	A
3.	C	13.	D	23.	A	33.	D
4.	A	14.	B	24.	B	34.	C
5.	A	15.	A	25.	C	35.	A
6.	B	16.	C	26.	A	36.	A
7.	B	17.	C	27.	A	37.	C
8.	A	18.	C	28.	B	38.	B
9.	C	19.	B	29.	D	39.	A
10.	D	20.	A	30.	D	40.	D

PAPER 2
SECTION A [50 MARKS]

Question 1				
a	i	prevent self-pollination or idea of self-pollination ;		1
	ii	prevent undesired (OWTTE) pollen grains from reaching the stigma / prevent pollination by insects or wind ;		1
b		mature stigma secretes sugary fluid + pollen tube germination (R) growth ; pollen tube produces enzymes to digest and grows down (stigma), style and (ovary) ; pollen tube enters ovule [(R) ovary] through <u>micropyle</u> ; tip of pollen tube bursts and releases (male) gametes ; nucleus of male gamete fuses with ovum / nucleus of female gamete / female nucleus to form a zygote ;		5
c		one mark for process : cross pollination is ensured/selective or cross breeding ; any two advantages : gives rise to genetic variation / increases the adaptability of offspring (to changes in environment) / inherit desired traits from parents / lower probability of harmful recessive alleles being expressed ;		3
			total	10
Question 2				
a		chromosome is made of DNA ; winding round (histone) proteins ;		2
b	i	mass of DNA has doubled / increased by 5 units ; due to fusion of the nuclei (penalize only once – check answer to Qn 1b) of the male and female gametes at fertilization ;		2
	ii	mass of DNA has (almost) doubled / increased by 8 ; due to DNA replication at interphase [(R) any other phases in mitosis] ;		2
	iii	mass of DNA has halved ; due to formation of two daughter cells during cytokinesis/teelophase/mitosis ;		2
			total	8

Question 3				
a		bacteria decompose/breakdown [(R) digestion] the organic matter in the waste ; to harmless inorganic compounds / minerals / substances ; methane can be burnt as fuel / used as fuel to generate electricity [(R) if just mention generate electricity] ; liquid effluent can be used to irrigate crops / provide minerals ; sludge added to soil as (organic) fertilizer / release minerals for crops ; water goes through reverse osmosis and desalination to become NEWater ; efficiency of the process will be lowered ; because the bacteria in the filter bed will be killed ;		2
b				any 2
c				2
			total	6
Question 4				
a		(ascorbate) complementary (shape) to active site of maltase/ same shape as maltose ; binds to / fits into / enters active site ; so substrate / maltose, cannot enter / cannot bind ; (A) no / few, ES complex, (A) prevents formation of ES complexes competes with substrate / competitive inhibition ; less maltase for reaction/ less maltase for digestion of maltose ; (R) 'stops the reaction', (R) if in context of starch inhibits / slows down / prevents, hydrolysis / digestion [(R) breakdown], of maltose (to glucose) ; (f) starch less glucose is absorbed / passes across membranes / enters blood ;		max 3
b			total	5
Question 5				
a	i	heat generated by muscle contraction during the hike/heat absorbed by body ; vasodilation of skin arterioles takes place ; more blood flows to the skin surface ; to maintain a constant body temperature ; more warm blood flow to skin surface for heat to be lost through convection, radiation and conduction / to prevent denaturation of enzymes when body temperature gets too high [(R) overheating/prevent heatstroke]		3
	ii			2
b		NB: parts (i) and (ii) can be marked together as one whole question. the amount of heat gain in the body is greater than the amount of heat loss ; less sweat production leads to less latent heat loss by evaporation of water from sweat ;		2
c		day 1 ; higher humidity + lower wind speed ; much less water in the sweat produced can evaporate + less latent heat (of vaporization) is removed from body ;		3
			total	10

Question 6				
a	I (dorsal aorta)			1
b	II left ventricle			1
	relative concentration in structure			5
	substance	B	C	D
	amino acids	0.00	0.05	0.05
	glucose	0.00	0.10	0.10 – 0.15
	mineral ions	1.50	0.72	0.72 – 2.22
	proteins	0.00	8.00	8.00
	urea	2.00	0.03	0.03 – 2.03
	B, C and D would contain some / more / high glucose (A) numerical representation ; lack of insulin ; excess glucose would not be converted into glycogen (by liver) (R) direct conversion by insulin) ; kidney unable to/doesn't reabsorb all glucose ;			4
	total			11

Question 7				
PAPER 2				
SECTION B (30 MARKS)				
a				4
b	correctly labelled axes ; correctly plotted points ; appropriate scale ; 4 labelled graphs labels ; drop in weight of set-up B is greater than that of C / gradient of graph B is steeper than that of graph C / numerical citation of mass drop ; lower leaf surface loses more water than upper leaf surface ((R) reference to set ups rather than leaf surfaces) ; lower leaf surface has more stomata than upper surface ; all 3 lines will be raised slightly / graphs have gentler slopes or are less steep ; higher humidity in bell jar + lowers water vapour concentration/diffusion gradient, between intercellular air space and atmosphere ; reduces rate of transpiration + less weight loss ;			3
total				10
Question 8				
a	ciliary muscles + relax ; suspensory ligaments + tighten / become taut / pulled AW ; increased tension / pull on lens ; lens long + thin / flatter / less fat / convex ; light refracted / bent (by lens) ; (light) converges / (produces image) on retina / fovea ; nervous system quicker AW / hormones slower ; electrical / impulses ; via neurones / nerve cells ; hormones are chemical ; carried / transported via blood ;			6
b				max 4
total				10

2016 BIOLOGY PRELIMINARY EXAMINATION MARKING SCHEME

Question 9 Either	
a	continuous variation + discontinuous variation ; any two for continuous variation : gradual change / range / intermediate phenotypes ; between extremes ; genes + environment ; any two for discontinuous variation : few and distinct/clear cut differences ; controlled by genes alone ; any correct example of one or the other correctly linked ; [R] if one e.g. correct, the other incorrect
	1
	max 4
	total 5
	max 5
	total 10
Question 9 Or	
a	blood goes through heart twice (in one complete circuit of the body) ; circulation to / from lungs / pulmonary ; circulation to / from (rest of) body / systemic ; lungs + low pressure ; body + high pressure ;
	max 4
b	two sides to the heart / heart completely divided / septum ; our chambers / two atria + two ventricles / all 4 named chambers + beats continually ; right side / atrium + receives blood from body ; right side / ventricles + pumps blood to lungs ; left side / atrium receives blood from lungs ; left side / ventricle + pumps blood to (rest of) body ; left ventricle thicker-walled / more muscular + than right ventricle ; ventricles thicker-walled / more muscular + than atria ; further to pump blood / generate higher pressure ; ref. valves + one-way flow / prevent backflow ;
	max 6
	total 10

Name:	Index Number:	Class:
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CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

A1

BIOLOGY

Paper 2

Friday 16 September 2016

1 hour 45 minutes

Additional Materials: -

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
 Write in dark blue or black pen.
 You may use a pencil for any diagrams, graphs or rough working.
 Do not use staples, paper clips, glue or correction fluid.
DO NOT WRITE ON THE MARGINS.

Section A

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use only:

Section A	/ 50
Section B	/ 30

This paper consists of 20 printed pages.

Turn over

Section A

Answer all questions.

Write your answer in the spaces provided.

- 1 Figure 1.1 shows the alimentary canals of two mammals, an insect-eating bat, which is a carnivore, and a rabbit, which is a herbivore.

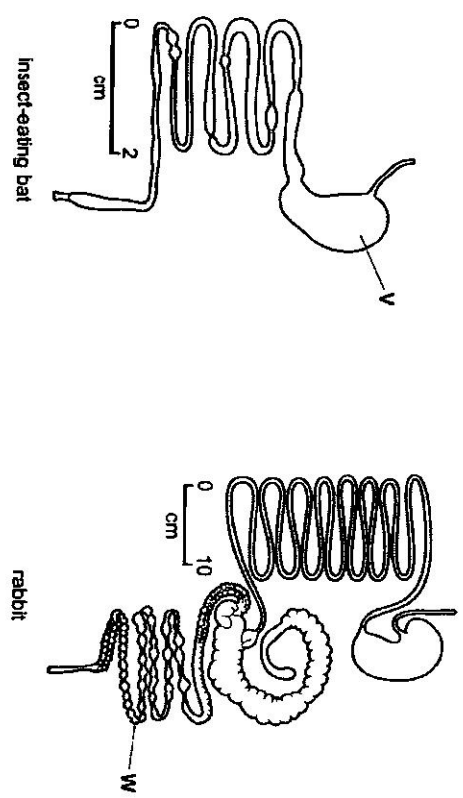


Figure 1.1

- (a) Name the organs labelled V and W.

[2]

- (b) Explain the role of mechanical digestion.

[3]

Scientists investigated digestion in different species of mammal. The mammals that they studied ranged in size from an elephant shrew, *Elephantulus edwardii*, with a mass of 50 g to an ox, *Bos taurus*, with a mass of 220 kg.

The scientists added indigestible particles to the animals' food and timed how long the particles stayed in the digestive system. The results for 24 different mammal species are shown in Figure 1.2.

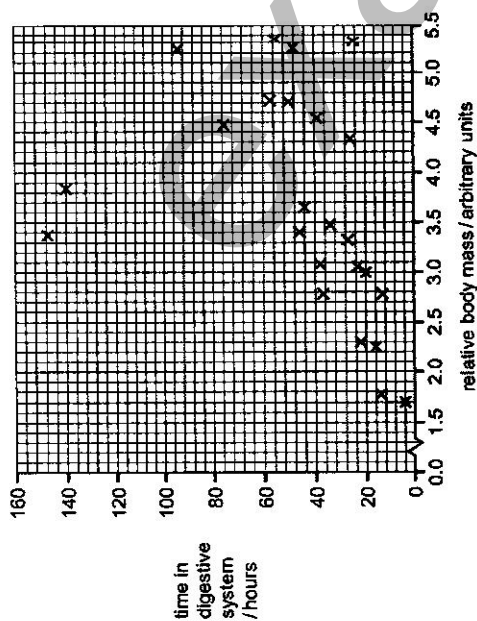


Figure 1.2

The scientists concluded that food stays longer in the digestive systems of larger mammals compared with smaller mammals.

(c) Discuss the evidence from Figure 1.2, for and against the statement that food stays longer in the digestive systems of larger mammals. [4]

[illegible]

[Total: 9 marks]

7

2 (a) Figure 2.1 shows the human heart and the main blood vessels. The functions of the parts of the heart and some of the blood vessels are given in Table 2.1.

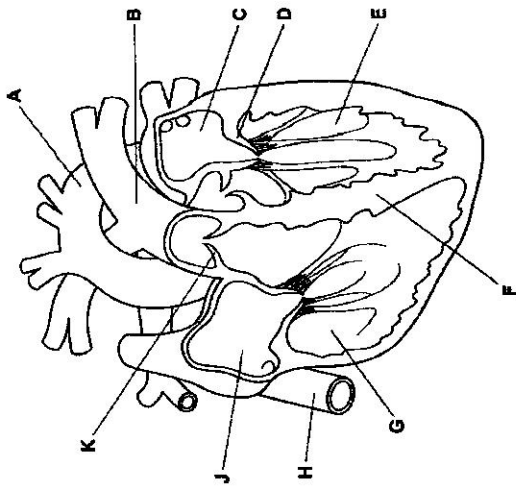


Figure 2.1

Complete Table 2.1.

Table 2.1

function	letter on Figure 2.1	name
structure that separates oxygenated and deoxygenated blood		
structure that prevents backflow of blood from ventricle to atrium		
blood vessel that carries deoxygenated blood		
chamber of the heart that contains deoxygenated blood		

[4]

- (b) A group of students used a heart monitor to record the pulse rate of an athlete during a 5000-metre race. The recordings started just before the race began and ended just after it had finished, as shown in Figure 2.2.

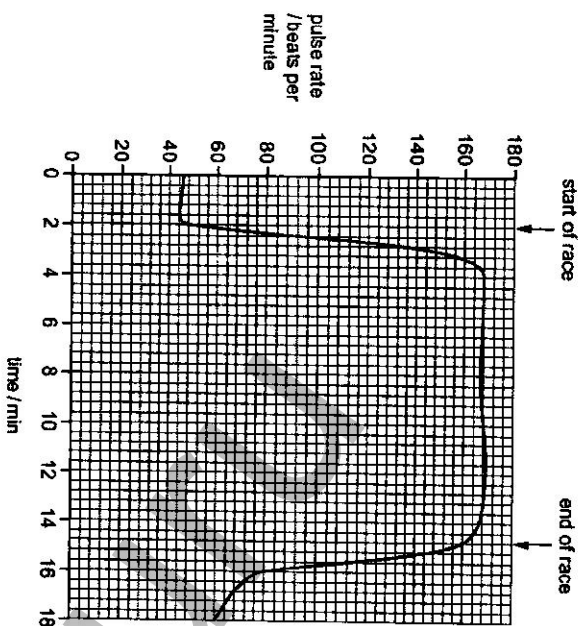


Figure 2.2

- (i) Use data from Figure 2.2 to describe the effect of exercise on the pulse rate of the athlete. [3]

- (ii) Explain the change in pulse rate between 2 minutes and 3 minutes after the recordings started. [4]

[Total: 11 marks]

- 3 Catalase is an enzyme that breaks down hydrogen peroxide inside cells. Red blood cells contain catalase.

Some dogs have an inherited condition in which catalase is not produced. This condition is known as acatalasia and it is caused by a mutation in the gene for catalase.

- (a) Define the terms gene and gene mutation. [2]

gene _____

gene mutation _____

(b) A geneticist was asked to investigate the inheritance of acatalasia in dogs. The normal allele is represented by **B** and the mutant allele is represented by **b**.

The geneticist made the diagram in Figure 3.1 to show the inheritance of acatalasia in a family of dogs. The shaded symbols indicate the dogs with acatalasia.

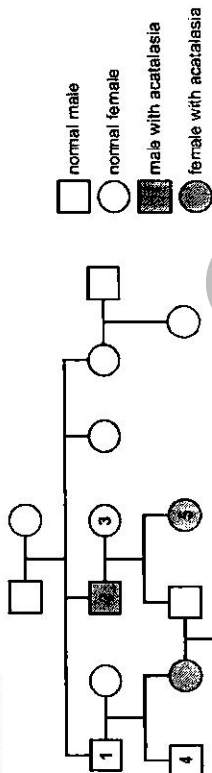


Figure 3.1

- (i) State the genotypes of the dogs identified as 1, 2 and 3 in Figure 3.1.
- 1 2 3
- (ii) The geneticist crossed dog 4 with dog 5. Approximately half of the offspring had acatalasia and half the offspring did not have acatalasia. Construct a genetic diagram to show how this is possible.

(iii) State the name given to the type of cross that you have completed in (b)(ii).

[Total: 10 marks]

- End of Section A1 -

2

28

Name:		Index Number:		Class:	
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CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

A2

BIOLOGY

Paper 2

5158/02

Friday 16 September 2016

1 hour 45 minutes

Additional Materials:

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE ON THE MARGINS.

Section A

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45

minutes on Section B.

The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use only:

Section A	/ 50
Section B	/ 30

This paper consists of 20 printed pages.

Turn over

4 Excretion is the process of removing waste products of metabolism from the body.

(a) Name the two main products of metabolism that need to be excreted from the human body. [2]

1 _____

2 _____

(b) The kidney is one of the main excretory organs of the body. Its role is to filter the blood. Some substances leave the blood and are removed from the body in the urine. The concentration of protein in the blood entering the kidneys in the renal arteries is 83 g dm^{-3} .

State the concentration of protein that you would expect in the urine of a healthy person and explain your answer. [2]

concentration _____ g dm^{-3}

explanation _____

(c) Dialysis can be used to treat people whose kidneys do not function properly. Figure 4.1 shows dialysis treatment.

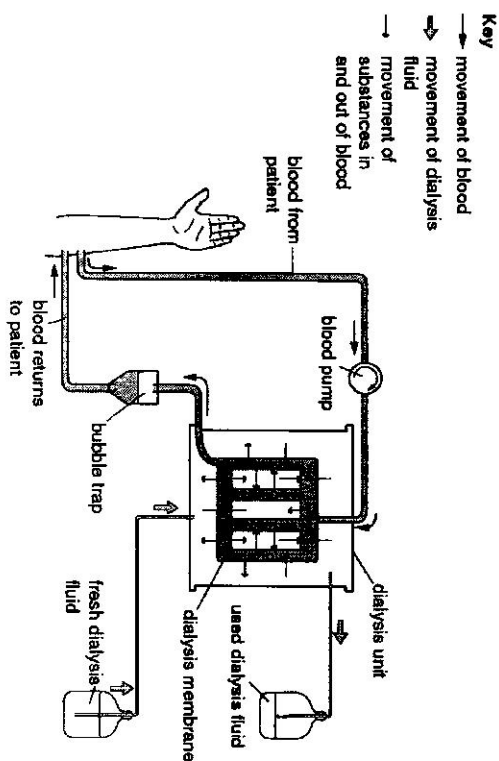


Figure 4.1

Use Figure 4.1 to describe the process of dialysis and explain changes that occur in a person's blood.

[5]

29

(d) Some people with kidney failure are given a kidney transplant.

State one advantage and one disadvantage of having a kidney transplant instead of dialysis treatment. [2]

advantage _____

disadvantage _____

[Total: 11 marks]

5 Figure 5.1 shows the stages in the process of genetic engineering to produce the hormone insulin.

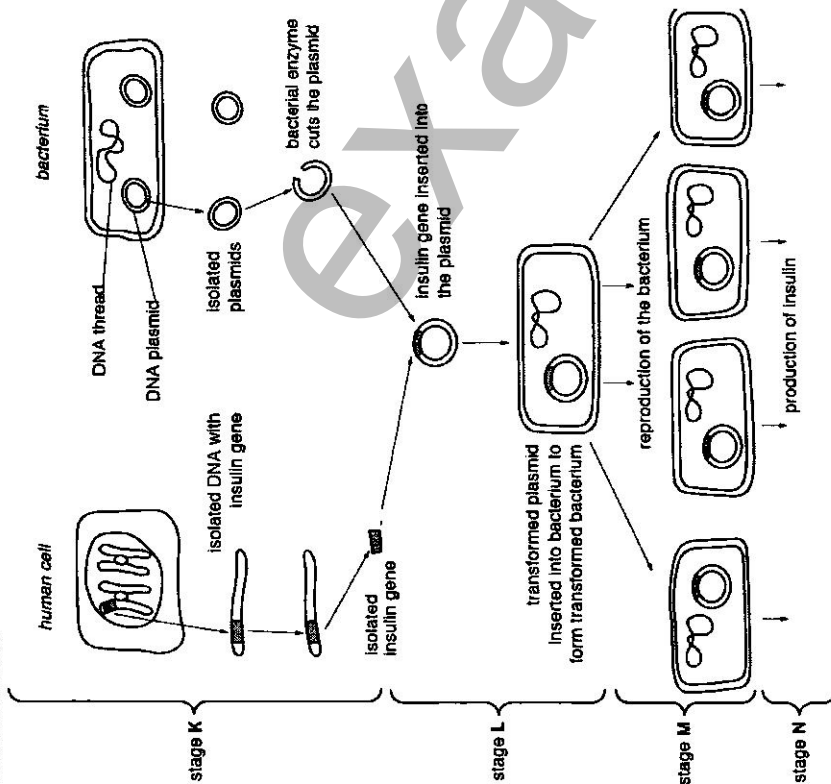


Figure 5.1

(a) Describe how the location and organisation of genetic material in the human cell shown in stage K of Figure 5.1 is different from that in the bacterial cell shown.

(b) Use your knowledge of cells to name two structures that the transformed plasmid must pass through to form a transformed bacterium in stage L of Figure 5.1.

 and

(c) State the type of reproduction that takes place in stage M of Figure 5.1. Use your knowledge of the process of cell division to explain why it is important that this type of reproduction occurs.

type of reproduction

explanation

(d) Name the condition in humans that is treated using insulin produced by the bacteria in stage N of Figure 5.1.

[Total: 9 marks]

- End of Section A2 -

Name:	Index Number:	Class:
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CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

B

BIOLOGY

Paper 2

5158/02
Friday 16 September 2016

Additional Materials: - **1 hour 45 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE ON THE MARGINS.

Section A

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

The number of marks is given in brackets [] at the end of each question or part question.

For examiner's use only:

Section A	/ 50
Section B	/ 30

This paper consists of 20 printed pages.

[Turn over

Section B

Answer three questions.

Question 8 is in the form of an **Either/Or** question. Only one part should be answered.

6 In an investigation into the effects of alcohol on the nervous system, people were asked to carry out a test on their reaction time.

The person being tested looked at a coloured block on a computer screen. As soon as the colour changed they pressed a button. The time taken to press the button was recorded by the computer. This was their reaction time.

Twenty people were tested before and after consuming a drink containing the same concentration of alcohol.

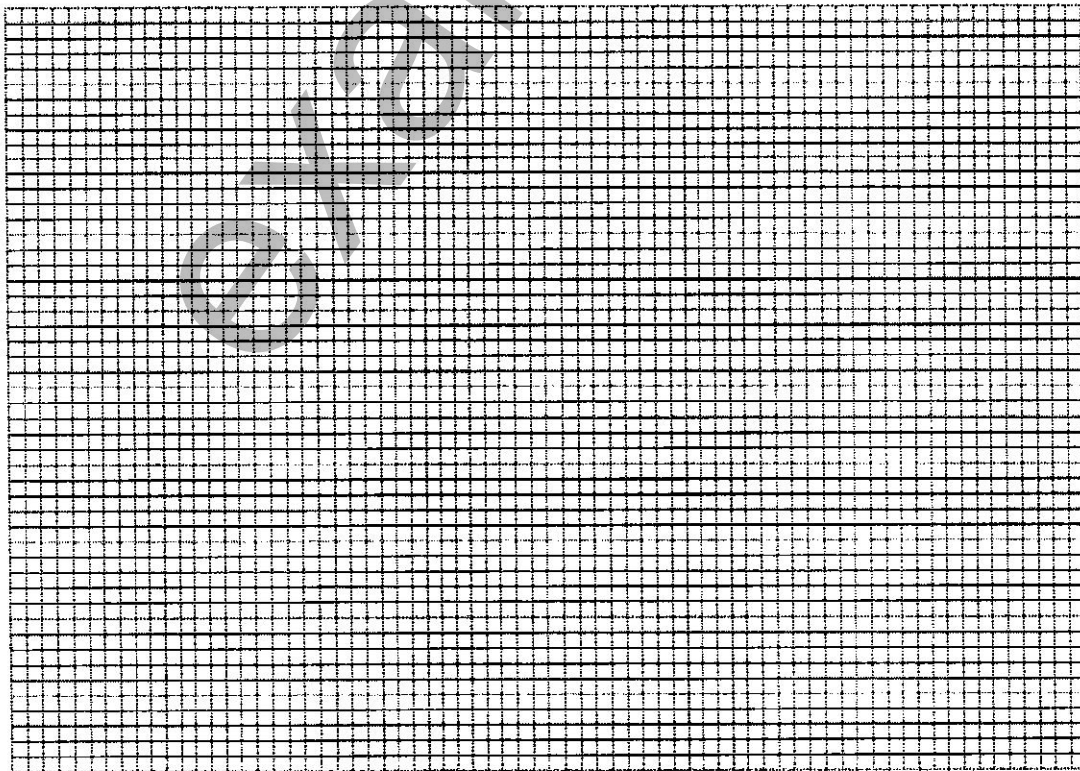
Table 6.1 shows the results of this investigation.

Table 6.1

test person	reaction time before consuming alcohol / milliseconds	reaction time after consuming alcohol / milliseconds
1	272	322
2	310	350
3	225	270
4	243	290
5	240	308
6	284	315
7	201	238
8	262	300
9	225	262
10	235	278
11	225	253
12	247	271
13	226	266
14	194	220
15	206	239
16	309	340
17	223	261
18	243	286
19	270	316
20	180	225
mean	240	

(a) Calculate the mean for the reaction time after consuming alcohol. [1]
Write your answer in Table 6.1.

(b) Plot a bar chart to show the mean reaction time of the people tested before and after consuming alcohol. [4]



(c) The range of reaction times recorded before consuming alcohol is 180-310 milliseconds. Use Table 6.1 to identify the range of reaction times recorded after consuming alcohol. [1]

(d) Describe effects on the body of long-term, excessive consumption of alcohol. [3]

(e) Suggest one social implication of alcohol misuse. [1]

[Total: 10 marks]

7 Figure 7.1 shows an area of forest where some of the trees have been cut down.



Figure 7.1

- (a) Explain the reasons why forests may be cut down as shown in Figure 7.1. [2]

- (b) The loss of forests from parts of the world is assessed by satellite imagery. Table 7.1 shows data on the forests in Indonesia and Malaysia, two countries in South-East Asia which have large areas of forest.

Table 7.1

country	type of forest	area / thousands of hectares			
		1990	2000	2005	2010
Indonesia	natural forest	118 545	96 737	94 158	90 993
Malaysia	natural forest	20 420	19 932	19 317	18 649

Calculate the percentage loss of natural forest in Indonesia between 1990 and 2010 (Show your working and express your answer to the nearest whole number). [2]

- (c) Many hectares of natural forest have been cleared in countries such as Malaysia and Indonesia for oil palm plantations. Both countries have also replanted forests to grow timber and other forest products. [2]

Suggest why replanted forests and plantations are less useful for conservation than natural forest.

- (d) Discuss the effects of deforestation on areas of land. [4]

[Total: 10 marks]

8 Either

- (a) Many flowering plants can reproduce sexually and asexually. Define the term asexual reproduction. [3]

(b) If an embryo implants in the uterus, the embryo secretes a hormone known as hCG that stimulates the reproductive organs of the woman to continue to secrete progesterone. Describe what happens after fertilisation until the time that the embryo secretes hCG.

Sl. No.	Name of the Candidate	Grade	Score	Remarks
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
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93	93	93	93	93
94	94	94	94	94
95	95	95	95	95
96	96	96	96	96
97	97	97	97	97
98	98	98	98	98
99	99	99	99	99
100	100	100	100	100

[Total: 10 marks]

8 Or

(a) Describe what happens at ovulation.

1. The first part of the document is a title page. It contains the title of the report, the author's name, and the date of the report. The title is "The Impact of Climate Change on the Environment". The author is "John Doe". The date is "10/10/2023".

2. The second part of the document is an abstract. It provides a brief summary of the report's findings. The abstract states that the report discusses the impact of climate change on the environment, including the effects of rising temperatures, sea level rise, and extreme weather events. It also mentions that the report includes a list of references and a list of figures.

3. The third part of the document is the main body of the report. It is divided into several sections. The first section is an introduction. It discusses the importance of understanding the impact of climate change on the environment. The second section is a literature review. It discusses the current state of research on the impact of climate change on the environment. The third section is a methodology section. It describes the methods used to collect and analyze data. The fourth section is a results section. It presents the findings of the study. The fifth section is a conclusion. It summarizes the main findings of the study and provides recommendations for future research.

4. The fourth part of the document is a list of references. It contains a list of all the sources cited in the report. The references are listed in alphabetical order. The list includes books, journal articles, and websites.

5. The fifth part of the document is a list of figures. It contains a list of all the figures included in the report. The figures are listed in alphabetical order. The list includes line graphs, bar charts, and maps.

[Total: 10 marks]

- End of Section B -

2016 SECONDARY 4 BIOLOGY PRELIMINARY EXAMINATION 3

Mark Scheme

5158/01 (40 marks)

1	A	2	B	3	B	4	B	5	A
6	C	7	C	8	C	9	A	10	C
11	D	12	C	13	A	14	C	15	B
16	C	17	D	18	C	19	B	20	D
21	C	22	C	23	B	24	C	25	A
26	D	27	B	28	A	29	B	30	C
31	D	32	D	33	D	34	A	35	A
36	D	37	C	38	D	39	B	40	A

5158/02

Section A (50 marks)

- 1 (a) V – stomach [1]
W – large intestine / colon / rectum [1]
I: intestine unqualified
- 1 (b) mp 1 breaks up food into small(er) pieces [1]
mp 2 without chemical change [1]
mp 3 by teeth / muscles [1]
mp 4 to mix (with digestive juice) [1]
mp 5 increases surface area [1]
mp 6 for enzyme action [1]
mp 7 speeds up chemical digestion [1]
mp 8 easier to swallow [1]
[max 3]
- 1 (c) for
mp 1 positive correlation / as (relative) body mass increases + time in digestive system increases [1]
mp 2 any two or more figures from the graph (units must be quoted at least once) [1]
against
mp 3 two/one/few/some + are outliers/anomalies (e.g. either outlier quoted) [1]
mp 4 any figure(s) from the graph [1]
mp 5 (description of) some mammals do not fit the + pattern/trend [1]
mp 6 any example from the graph [1]

- mp 7 only information about 26 species of mammal / small sample size [1]
mp 8 idea about unknown validity [1]
mp 3-8 [max 3]

mp 1-2 + mp 3-8 [max 4]

2 (a)

function	letter on	name
structure that separates oxygenated and deoxygenated blood	F	septum
structure that prevents backflow of blood from ventricle to atrium	D	bicuspid/mitral/atrioventricular + valve A: "A V valve"
blood vessel that carries deoxygenated blood	B	R: right atrioventricular valve
chamber of the heart that contains deoxygenated blood	H	pulmonary artery
	J	vena cava
	G	right atrium
		right ventricle

2 (b) (i)

- mp 1 pulse rate increases and remains constant [1]
mp 2 immediate/sudden/sleep/rapid/AW + increase in pulse rate [1]
mp 3 increases from 44–48 bpm to 164–170 bpm / increases by 120–126 bpm / by 3.5 to 4 times or approx 4 [1]
mp 4 maximum / 164–170 bpm + at 4 min(utes) / 2 min(utes) after race starts [1]
R: no units used
[max 3]

2 (b) (ii)

- mp 1 adrenaline stimulates increase in + heart/pulse rate [1]
mp 2 increase in blood + carbon dioxide (concentration) / acidity + detected [1]
A: decrease in pH
mp 3 nerves stimulate heart to beat faster [1]
mp 4 ref to muscle contraction / AW [1]
mp 5 muscles require more energy / muscles are doing more work [1]
mp 6 (rate of aerobic) respiration increases [1]
R: 'produce' energy
mp 7 increase demand for + oxygen / glucose [1]
mp 8 ref to removal of + carbon dioxide / lactic acid / heat [1]
mp 9 more + blood / carbon dioxide + to lungs (per unit time) [1]
mp 10 more + blood / oxygen / glucose + to muscles [1]
mp 11 AVP (e.g. ref to ATP / vasodilation in muscles) [1]
[max 4]

3 (a)

- gene – a length of DNA that codes for a protein [1]
R: chromosome / molecule of / genome
gene mutation – a change in base sequence of DNA [1]

3 (b) (i)

- 1 – Bb [1]
2 – bb [1]
3 – Bb [1]

3 (b) (ii)

- phenotype of parents: unaffected (by acatalasia) x affected (by acatalasia) [1]

- A: normal/carrier (in place of "unaffected")
 R: father/mother/male/female/sick
 Bb x bb [1]
 B, b, b [1]
 R: lines are not drawn / not correctly aligned
 Bb, Bb, bb, bb [1]
 phenotype of offspring: unaffected, unaffected, affected, affected [1]
 R: "F1/F2 generation"
 [max 4]
- genotype of parents:
 gametes:
 phenotype of offspring:
 R: "F1/F2 generation"
 [max 4]
- 3 (b) (iii) test (cross) [1]
 carbon dioxide [1]
 urea [1]
- 4 (b) $0 / 0.0 \text{ (g dm}^{-3}\text{)}$ [1]
 proteins too big, to pass through the capillary wall (in glomerulus) / to be filtered (from the blood) / out of the glomerulus [1]
- 4 (c) mp 1 blood flows into the (dialysis) machine / blood is returned to the patient [1]
 mp 2 blood passes over a dialysis membrane / countercurrent flow described [1]
 mp 3 the dialysis membrane separates the person's blood and the dialysis fluid [1]
 mp 4 dialysis fluid contains + glucose / salts / no urea [1]
 mp 5 movement (across membrane) by diffusion / down a concentration gradient [1]
 mp 6 urea leaves the blood / enters the dialysis fluid [1]
 mp 7 dialysis fluid is refreshed [1]
 mp 8 excess/some salt + leaves the blood / enters the dialysis fluid [1]
 mp 9 excess/some water + leaves the blood / enters the dialysis fluid [1]
 mp 10 glucose/salts in dialysis fluid same concentration as (should be) in blood [1]
 mp 11 no net loss of glucose [1]
 [max 5]
- 4 (d) advantage
 no need to visit hospital [1]
 no need for dialysis / time not taken up with dialysis [1]
 no need for a restricted diet [1]
 no long term discomfort / pain [1]
 improved quality of life / lead a normal life [1]
 [max 1]
- disadvantage
 rejection of kidney [1]
 difficult to find suitable donor [1]
 risk associated with operation [1]
 need to take immunosuppressant drugs [1]
 [max 1]
- 5 (a) DNA
 in nucleus (human) / within nuclear membrane [1]
 in cytoplasm (bacteria) [1]

presence of plasmid(s) (bacteria) [1]
 correct reference to chromosomes / AW (human) [1]
 genes / chromosomes paired (human) [1]
 [max 3]

5 (b) (cell) wall [1]
(cell) membrane [1]

5 (c) type:
asexual / binary fission / mitosis [1]

explanation:
 genetically + identical (cells produced) OR clones [1]
 all capable of producing insulin / same product [1]
 A: to produce insulin in large quantities / to produce a large number of bacteria / produce bacteria quickly

5 (d) diabetes [1]

Section B (30 marks)

6 (a) 280 [1]

6 (b) A axes labelled

y-axis: (mean) reaction time / ms

x-axis: before drinking alcohol and after drinking alcohol / before and after / or key given

x-axis labels approximately under each bar

S columns at least half the grid on y-axis + even scale [1]

P both plots accurate $\pm \frac{1}{2}$ small square [1]

C columns not touching + of same width [1]

6 (c) 220–350 + milliseconds [1]

6 (d) cirrhosis (of liver) / (chronic) liver disease [1]

cancer of the liver / stomach / mouth (oral) / throat [1]

pancreatitis / kidney failure / liver failure [1]

stomach ulcers [1]

brain damage [1]

heart disease / heart failure / heart attack / stroke / high blood pressure [1]

reduced fertility [1]

depression / AW [1]

addiction / dependence [1]

[max 3]

6 (e) violent crime / domestic violence [1]

road accidents / drink driving [1]

(petty) crime / vandalism [1]

family breakdown / divorce / relationship breakdown [1]

impaired performance at work / unemployment / difficulty getting a job [1]
[max 1]

7 (a) timber/paper + manufacture / AW [1] A: wood unqualified
firewood [1] A: fuel

clearance for
agriculture [1]
urbanisation / roads / housing / factories / industry / leisure developments [1]
extraction of minerals / for other natural resources [1]
[max 2]

7 (b) $118\,545 - 90\,883 = 27\,662$
 $27\,662 / 118\,545 \times 100 [1]$
 $23 + \underline{26} [1]$

7 (c) planted forest + has one (dominant) species [1]
loss of biodiversity [1]
qualification of biodiversity loss (e.g. habitats / example / extinction of a species) [1]
I: homes / organisms die
(plantation) susceptible to pest / disease [1]
nutrients removed / soils become infertile [1] A: use of chemicals
ref to alien / foreign / invasive / non-indigenous species [1]
AVP (e.g. vegetation is removed / lower canopy / all immature) [1]
[max 2]

7 (d) mp 1 roots die so do not bind the soil [1]
mp 2 loss of soil / soil erosion [1]
mp 3 silting of rivers [1]
mp 4 reduced (soil) fertility [1]
A: loss of + minerals/ions/nutrients
mp 5 no trees to absorb the water [1]
mp 6 increased risk of flooding [1]
mp 7 increased rate of evaporation / land is exposed to drying [1]
A: drought / decreased rainfall
mp 8 desertification / decreased soil water [1]
mp 9 loss of + habitat / places where organisms live / described [1]
I: home

mp 10 disruption to food chain / described [1]
mp 11 endangered / extinction, of species or loss of biodiversity [1]
I: organisms die
mp 12 AVP – named example of affected 'land' organism in context / removed
trees cause nutrient cycling disruption / lack of decomposition [1]
[max 4]

8 E (a) production of genetically identical offspring [1]
from one parent [1]
no gametes
ref to (only) mitosis [1]
[max 2]

8 E (b) name of correct organism / crop / technique (e.g. cutting, micro-propagation, tubers,
bulbs, layering, runners) [1]

advantage
mp 1 fast [1]
mp 2 always an exact / similar copy [1]
mp 3 known characteristics / more certain outcome / AW [1]
mp 4 only one parent/individual needed [1]
mp 5 can be conducted in controlled conditions [1]
mp 6 not reliant on pollination (agent) [1]
mp 7 colonise new areas quickly / if the parent is well adapted to the environment the
offspring will be also / [1]
mp 8 higher yield / AW [1]
[max 5]

disadvantage
mp 9 little/no + variation [1]
mp 10 disease / change in environmental conditions + likely to kill all organisms / AW
[1]
mp 11 limited ability to adapt to environmental changes / AW [1]
mp 12 no dispersal + so competition (with parent / others) likely [1]
[max 3]

I: advantage/advantage not qualified
[max 8]

8 O (a) release of an, egg / ovum / oocyte [1]
either

from + follicle/ovary
or

into + oviduct / fallopian tube [1]

8 O (b)

mp 1 zygote / fertilised egg + divides [1]
mp 2 mitosis / cell division [1]

I: embryo forming after implantation
mp 3 forms + an embryo [1]

A: blastocyst / blastula

mp 4 (hollow) ball / collection / group / AW + of cells [1]
mp 5 goes/moves + down oviduct / down fallopian tube / towards uterus [1]

mp 6 by ciliary action / peristalsis / muscle contraction [1]
mp 7 implants / AW + into lining of the uterus / uterine lining / endometrium [1]
A: "embeds"

R: "uterus"

mp 8 growth / development + of placenta [1] R: zygote implants

mp 9 follicle becomes + yellow body / corpus luteum / remains of follicle / AW [1]

mp 10 corpus luteum / ovary / AW + secretes/releases/produces progesterone [1]

mp 11 progesterone maintains + endometrium / uterine lining / lining of uterus [1]
R: "wall"

mp 12 progesterone + prevents menstruation [1]

- 8 O (c)
- mp 13 inhibition of FSH (secretion / release) [1]
 - mp 14 prevents + production of more eggs / production of follicles [1]
[max 7]
 - (named) drug (e.g. FSH / clomiphene / clomid) + injected/taken [1]
stimulates + production/development/maturation/release + follicles/eggs/ova/oocytes [1]
more eggs are released [1]
 - A: inhibits action of oestrogen
 - A: makes sure that FSH concentration is high enough
 - A: LH stimulates + ovulation / release of eggs
[max 1]

Examguru

Name: _____ () Class: _____



INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, class and register number in the spaces provided on the cover page.

Section A

Answer all questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer all three questions. The last question is in the form of Either / Or.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's use	
Section A	/ 50
Section B	/ 30
Total	/ 80

Set by: Ms Karen Wong

This question paper consists of 15 printed pages (including cover page).

Turn over

Section A (50 marks)

Answer all questions in the spaces provided.

Girdling is an agricultural technique used to force fruit-bearing plants, such as mango and apple, to bear larger fruits. The farmer would remove a ring of living tissue from a branch or stem of the plant as shown in Fig 1.1.

Fig 1.2 shows part of a cross-section of the different tissues in the stem of an apple tree. Usually, the outer bark and tissue R are removed during girdling, leaving the other tissues intact.

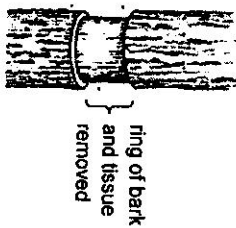


Fig 1.1

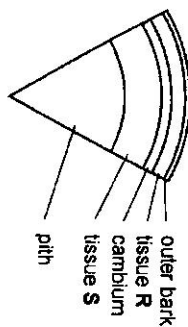


Fig 1.2

(a) Name tissues R and S.

[2]

R: _____

S: _____

(b) Which tissue, R or S, is involved in the synthesis of amino acids in the leaf cell? Explain your answer.

(c) Explain how girdling an apple tree can help improve fruit yield.

[2]

[2]

- (d) During girdling, tissue S may be damaged if the cut made was too deep. Predict what would happen to the tree and explain why.

[2]

2 Fig 2.1 shows a kidney nephron and its blood supply.

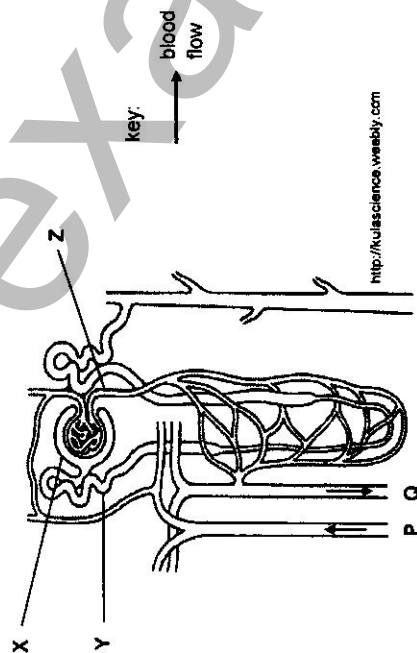


Fig 2.1

- (a) Name structures X, Y and Z. [3]
- X: _____
- Y: _____
- Z: _____
- (b) Name the blood vessel which brings blood toward and away at points P and Q respectively. [2]
- P: _____
- Q: _____
- (c) Using an 'X', indicate on the structure(s) in Fig 2.1, where the anti-diuretic hormone (ADH) act(s) on during homeostasis. [1]

- (d) Table 2.1 below shows the composition of the plasma and glomerular filtrate in the nephron.

substance	composition / arbitrary units	
	plasma	glomerular filtrate
glucose	0.18	0.18
salts	0.4	0.4
urea	0.05	0.05
protein	9.0	0

Table 2.1

- (i) Account for the difference between the composition of plasma and glomerular filtrate. [2]
- _____
- _____
- _____
- (ii) The average rate of the formation of glomerular filtrate is 27.5 litres per hour, whereas average rate of the formation of urine is 0.05 litres per hour. Name and describe the process which results in this difference and explain why this process is important. [3]
- _____
- _____
- _____
- _____

A 10-year-old girl suffers from a rare inherited condition that leaves people with an inability to feel physical pain. This is known as congenital analgesia. About one in a million people are thought to be born without a sense of pain. She also has type 1 diabetes since the age of three and requires daily insulin injections.

[4]

3]

2)

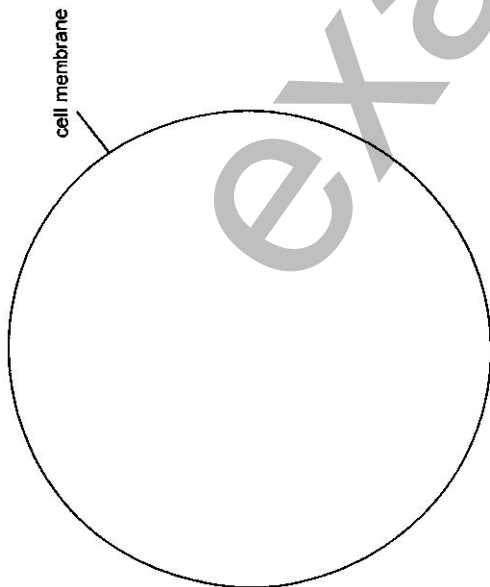
12

A diagram of a cell in metaphase. The cell is represented by a circle. Inside, several chromosomes are aligned at the metaphase plate. A label 'P' points to the centromeres of one of the chromosomes. A label 'nuclear envelope' points to the cell boundary.

(a) What is a "homologous pair" of chromosomes?

[4]

- (c) In the space below, draw a labelled diagram to show the key features in this animal cell during **metaphase II**. (Note: crossing over **did not** occur in this cell) [3]



- 5 Fig 5.1 shows the percentage of infants born at low and very low birthweights in a study on mothers who are cigarette smokers and non-smokers.

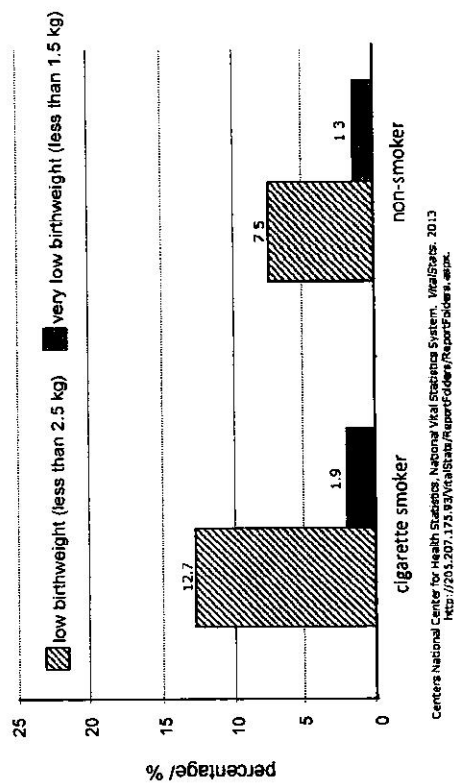


Fig 5.1

- (a) Describe the relationship between cigarette smoking and birth weight as presented in Fig 5.1.

- (b) Explain why smoking has an effect on birthweight.

6 The information below illustrates the activities that occur in a freshwater pond.

- I. Water plants absorb light energy from the sun.
- II. Pond snails, tadpoles and mayfly nymphs feed on water plants.
- III. Water spiders feed on mayfly nymphs.
- IV. Water beetles feed on tadpoles and pond snails.
- V. Fish and frogs both feed on water beetles and water spiders.
- VI. Kingfishers feed on fish and frogs.

(a) (i) Define the ecological term 'community'.

(ii) Using the information above, construct a food web showing the relationship between the members of the pond community. [3]

(b) After the construction of a vegetable farm, insecticides were washed into the pond. This killed the population of the mayfly nymphs. Suggest how this pollution will eventually kill the kingfishers even though they have no direct contact with the water.

9

Section B (30 marks)

Answer all THREE questions in the spaces provided.
The last question is in the form of Either / Or and only one of the alternatives should be attempted.

7 During a clinical trial, a man's heart rate and core body temperature were recorded at rest, warm up and exercise within a 10-minute duration. Table 7.1 and Fig 7.1 show the results recorded during the trial.

time/ min	heart rate/ beats per min
0	60
1	80
2	100
3	140
4	150
5	156
6	160
7	162
8	166
9	170
10	170

Table 7.1

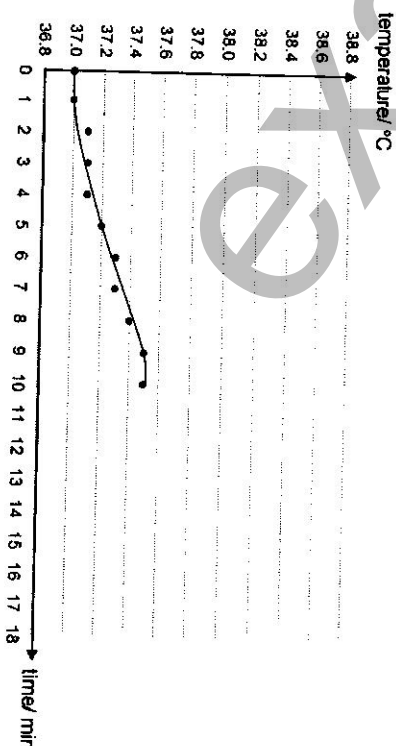
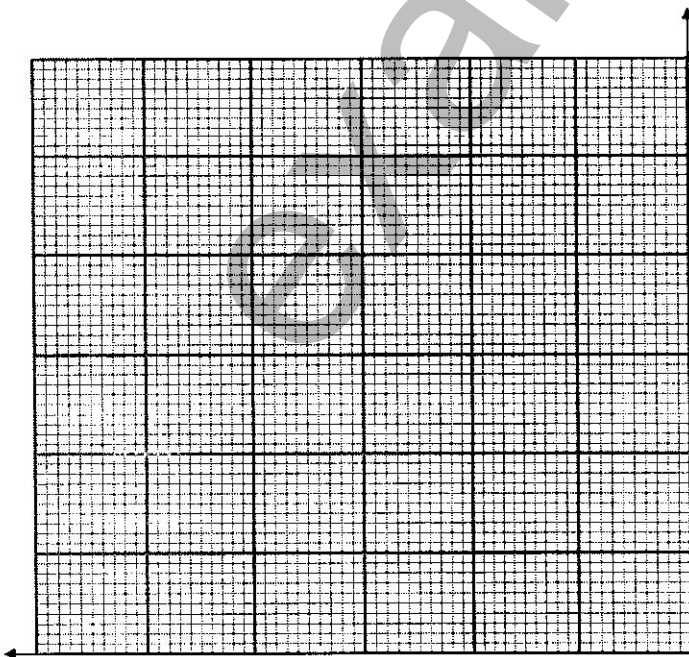


Fig 7.1

10

- (a) Using Table 7.1, plot a graph of heart rate against time in the grid below. [3]



- (b) Using the graph in (a), calculate the percentage change in heart rate before and during exercise. [1]

- (c) Explain why there is a change in heart rate before and during exercise.

[3]

- (d) Explain the rise in temperature and describe how his body regulates his body temperature.

[4]

- (e) Predict, by drawing on Fig 7.1, how the core body temperature would change when the man stops exercising for the next 8 minutes. [1]

8

Geranium species are cultivated for horticultural use and for pharmaceutical products. Geranium plants produce a unique chemical compound in its petals to defend itself from Japanese beetles. Within 30 minutes of ingestion, the chemical paralyses the herbivore. Fig 8.1 shows a flower of one of the Geranium species.



Fig 8.1

- (a) Suggest the agent of pollination and list two observable features to support your answer.

[3]

(b) Briefly suggest how Geranium plants evolved to become pest-resistant.

[3]

(c) With the use of genetic engineering, scientists have created transgenic plants which are also pest-resistant. Name an example of a pest-resistant transgenic plant and explain why it is transgenic.

[2]

Either

9

Cystic fibrosis is a common disease associated with the production of thick, sticky mucus that can lead to blocked pancreatic and bile ducts. Hence, this reduces the amount of enzymes released or slow down enzymatic reactions in the digestive system.

(a) Describe, in detail, how digestion and other related parts of the body will be affected if the pancreatic ducts and bile ducts continue to be blocked.

(b) Other than the enzymes involved in the digestive system, name two other enzymes produced by the body and describe their respective roles.

[6]

Or

9 Carbon flows through the ecosystem in the carbon cycle whereas energy flows in a non-cyclical manner.

(a) Explain how carbon, in the form of organic matter in the producer, flows through the ecosystem.

[8]

(b) List two other differences between the flow of carbon and energy in a food chain.

[2]

PAPER 2 (80 marks)

/ alternative answers for the same point

R reject

A accept (for answers correctly cued by the question, or by extra guidance)

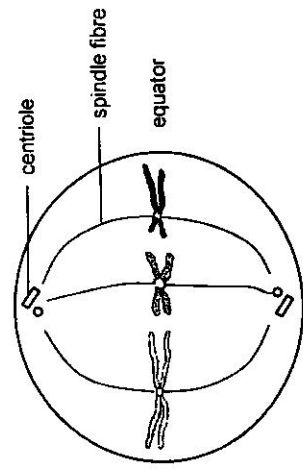
underline actual word given must be used by candidate (grammatical variants excepted)
max indicates the maximum number of marks that can be given

Section A (50 marks)

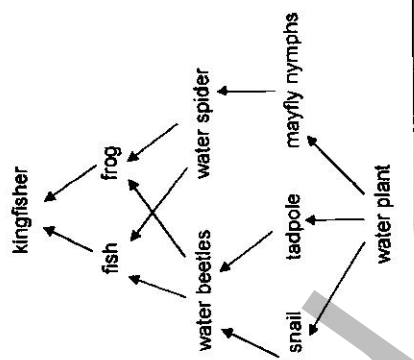
1	(a)	R: phloem S: xylem (No marks awarded for wrong spelling)	1	1
	(b)	<u>Tissue S</u> transports mineral salts/ nitrates In the leaf cell, amino acids form from <u>glucose</u> and <u>nitrates/ nitrogen</u> rich minerals OR <u>glucose</u> combines with <u>nitrates/ nitrate ions/ nitrogen</u> rich minerals to form amino acids in the leaf cell. Food made in the leaves, eg. Sugars/ sucrose/ amino acids, will not be transported/ translocate down the stem to the roots. More food will be transported above the cut and fruits will grow larger as food is stored in the fruits	1	1
	(c)	Water is not able to be transported up tissue S at the stem where the cutting is made	1	1
	(d)	Some parts of the tree/ leaves will <u>wilt/ leaf</u> cells become <u>flaccid</u>	1	1
2	(a)	X: Bowman's capsule/ renal capsule Y: Proximal convoluted tubule Z: Efferent arteriole	1	1
	(b)	P: Renal artery Q: Renal vein	1	1

	(c)	2 crosses along the distal convoluted tubule and collecting duct	1
	(d) (i)	Glomerular filtrate has <u>no proteins</u> compared to plasma	1
		The proteins are too large to pass through the partially permeable capillary wall/ basement membrane/ 1 cell thick wall of the Bowman's capsule.	1
	(d) (ii)	<u>Selective reabsorption</u> Much of the water is reabsorbed back by <u>osmosis</u> and amino acids/ glucose is reabsorbed by <u>active transport</u> , occurs at the kidney tubules and collecting duct Body cells will have sufficient water and nutrients/ the water and nutrients will not be lost in the urine/ water is required for hydrolysis/ medium for chemical reaction, etc.	1
3	(a)	Her islets of Langerhans fail to secrete <u>insulin/ no</u> functioning cells in the islets of Langerhans to secrete insulin. <u>Insulin</u> helps to convert <u>excess glucose</u> to <u>glycogen</u> , after meals and <u>stored in the liver</u> and <u>muscles</u> Insulin also <u>increases permeability</u> of the cells membrane to <u>glucose/ promotes</u> the utilization of glucose in the cells This helps to <u>maintain/ regulate</u> glucose level in her blood/ keep blood glucose level <u>within narrow limits</u> , after meals	1
	(b)	<u>Nerve impulse</u> transmitted along <u>sensory neuron</u> To the relay neurone in the <u>spinal cord</u> (reflex) / To another relay neurone to the brain <u>Motor neuron</u> in the arm <u>muscles contract</u> and move arm away from the stimuli (reflex) / <u>motor neurone</u> in the chest (muscles/ diaphragm) to contract and pass air to the vocal cords and shout	1

Answer Key

(c)	Hormonal – slower effect / Nervous – faster response OR Hormonal – long lasting/ Nervous – short lived Insulin: transported in the bloodstream Nervous system: electric impulse is transmitted through neurones Insulin: carry out the effects until it is destroyed by the liver Nervous system: transmission of electric impulse will stop once it reaches target organ.	Any 2 of 3 points, 1m
(d)	No as there is no pain felt and not aware of the danger/ stop doing the activity The person might suffer from internal bleeding without knowing its painful/ The person might fracture bones, resulting in poor healing of bones/ body will be hurt	1 1
(a)	Homologous chromosomes are similar in shape and size (with the exception of sex chromosomes). They have exactly the same sequence of gene loci/ genes occupy the same loci	1 1
(b)	Deoxyribonucleic acid Basic unit is a nucleotide/ made of polynucleotide and has a double helix structure complementary base pairing where adenine pairs with thymine guanine with cytosine sugar phosphate backbone/ anti-parallel arrangement of nucleotides	1 1 1 1
(c)	Drawing (3 chromosomes with appropriate colouration at the equator) Draws two other features (centriole/ spindle fibre) Name one of the feature (eg. centriole/ spindle fibre/ equator)	1 1 1
		

Answer Key

5	(a)	There is a higher percentage of babies having low birthweight from mothers who smoke compared to those who don't smoke State % difference: eg. $12.7 - 7.5 = 5.2\%$ (difference) or $5.2 / 12.7 \times 100 = 41\%$ (Percentage increase) OR There is a higher percentage of babies having very low birthweight from mothers who smoke compared to those who don't smoke (state % or difference) eg. $1.9 - 1.3 = 0.6\%$ (difference) or $0.6 / 1.9 \times 100 = 31.5\%$ increase	1 1
(b)		Carbon monoxide inhaled binds with mother's haemoglobin to form carboxyhaemoglobin instead of oxygen/ Haemoglobin has a higher affinity for carbon monoxide and lesser oxygen binds with it Supply of oxygen to foetus decreases R: no oxygen, hence less energy released by cells in foetus for growth/ Slows down the development of foetus resulting in lower birth weight	1 1
6	(a)(i)	All population of organisms living and interacting with one another in a particular habitat.	1
(a)(ii)			3 (any error -1m)
(b)		Insecticide is passed along the food chain as consumers/ water spider feed on contaminated/ dying mayflies cannot be excreted from the body as it is fat soluble/ not water soluble increasing in concentrations along the trophic levels/ food chain kills the kingfisher known as bioaccumulation	1 1 1

Section B (30 marks)

7	(a)	Both axes labelled with units Points plotted correctly with correct scale used best fit line with / no extrapolation heart rate/ beats per min <table border="1"> <caption>Data points for heart rate graph</caption> <thead> <tr> <th>Time (min)</th> <th>Heart rate (beats per min)</th> </tr> </thead> <tbody> <tr><td>0</td><td>60</td></tr> <tr><td>1</td><td>75</td></tr> <tr><td>2</td><td>85</td></tr> <tr><td>3</td><td>95</td></tr> <tr><td>4</td><td>105</td></tr> <tr><td>5</td><td>115</td></tr> <tr><td>6</td><td>125</td></tr> <tr><td>7</td><td>135</td></tr> <tr><td>8</td><td>145</td></tr> <tr><td>9</td><td>155</td></tr> <tr><td>10</td><td>165</td></tr> </tbody> </table>	Time (min)	Heart rate (beats per min)	0	60	1	75	2	85	3	95	4	105	5	115	6	125	7	135	8	145	9	155	10	165	1 1 1
Time (min)	Heart rate (beats per min)																										
0	60																										
1	75																										
2	85																										
3	95																										
4	105																										
5	115																										
6	125																										
7	135																										
8	145																										
9	155																										
10	165																										
	(b)	(Highest reading on line – lowest reading in graph) / lowest reading X 100 Eg. $(170 - 60) / 60 \times 100 = 183\%$	1																								
	(c)	More energy required for muscle contractions in the his legs Increase in demand for oxygen/ more oxygen required for tissue <u>respiration</u> during exercise Heart rate increases/ contract and relax faster to <u>pump/ transport</u> more oxygenated blood to the muscles	1 1 1																								
	(d)	During cellular respiration, energy used for muscle contractions and lost as heat and increases body temp Hypothalamus detects the increase in body temp, stimulates the corrective mechanism Sweat glands become more active and produce sweat to cool down and maintain body, <u>water</u> in the sweat evaporates and remove latent heat Vasodilation occurs, more blood flow to the capillaries under the skin	1 1 1 1 1																								

	(e)	<table border="1"> <caption>Data points for temperature graph</caption> <thead> <tr> <th>Time (min)</th> <th>Temperature</th> </tr> </thead> <tbody> <tr><td>0</td><td>36.8</td></tr> <tr><td>1</td><td>36.9</td></tr> <tr><td>2</td><td>37.0</td></tr> <tr><td>3</td><td>37.1</td></tr> <tr><td>4</td><td>37.2</td></tr> <tr><td>5</td><td>37.3</td></tr> <tr><td>6</td><td>37.4</td></tr> <tr><td>7</td><td>37.5</td></tr> <tr><td>8</td><td>37.6</td></tr> <tr><td>9</td><td>37.7</td></tr> <tr><td>10</td><td>37.8</td></tr> <tr><td>11</td><td>37.7</td></tr> <tr><td>12</td><td>37.6</td></tr> <tr><td>13</td><td>37.5</td></tr> <tr><td>14</td><td>37.4</td></tr> <tr><td>15</td><td>37.3</td></tr> <tr><td>16</td><td>37.2</td></tr> <tr><td>17</td><td>37.1</td></tr> <tr><td>18</td><td>37.0</td></tr> </tbody> </table>	Time (min)	Temperature	0	36.8	1	36.9	2	37.0	3	37.1	4	37.2	5	37.3	6	37.4	7	37.5	8	37.6	9	37.7	10	37.8	11	37.7	12	37.6	13	37.5	14	37.4	15	37.3	16	37.2	17	37.1	18	37.0	1
Time (min)	Temperature																																										
0	36.8																																										
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16	37.2																																										
17	37.1																																										
18	37.0																																										
8	(a)	Insect/ Bee/ Butterfly Nectar guides/ non-feathery stigma/ large petals/ non-pendulous stamens (R. colourful/ sweet smelling/ nectar present as these are not observable)	1 Any 2 of the 4 features, 1m																																								
	(b)	Spontaneous mutation takes place, resulting in variation in the organisms. Natural selection occurs where best adapted organisms, with favourable traits, survive These plants reproduce and pass on their favourable genes to their offspring.	1 1 1																																								
	(c)	BI Corn Gene from a bacteria, <i>Bacillus thuringiensis</i> (Bt), which codes for the protein/ toxin, is inserted into <u>maize/ corn</u> plant	1																																								

Answer Key

E9	(a)	Pancreatic duct: lesser <u>pancreatic juice</u> secreted into duodenum Digestive enzymes: Trypsin (protein -> polypeptide) Amylase (starch -> maltose) Lipase (fat -> fatty acids + glycerol) If only mention T.A.L but not specific in terms of substrate and products / or Lesser digestion of starch/ protein/ fat with no mention of specific enzymes (1m only) Bile duct: Lesser <u>bile</u> released/ secreted Emulsification of fat reduced/ lesser Fats broken to smaller fat globules, reducing fat digestion by lipase OR *Stomach acids might burn the internal lining of the duodenum as not neutralised by the alkaline pancreatic juice and bile	1 1 1 1 1 1 1	
E9	(b)	carbonic anhydrase in the red blood cell ; Carbon dioxide converted to carbonic acid ; (Carbonic acid dissociates into hydrogen carbonate ions and diffuse out into the plasma of the blood) alcohol dehydrogenase in liver ; Alcohol is broken down into acetyl aldehyde and then into water and carbon dioxide (detoxification) ; Thrombokinas released by damaged tissue and platelets ; Converts prothrombin to thrombin ; Thrombin ; Converts fibrinogen to Soluble fibrinogen to insoluble fibrin ; Catalase ; Break down hydrogen peroxide into oxygen and water ;	(Max: 6 m) Any two enzymes, 4 m	
O9	(a)	Plants contain carbon in the form of organic matter such as <u>starch/ protein/ fat/ cellulose</u> Glucose in the <u>plant</u> is used/oxidised during <u>respiration</u>, releasing carbon dioxide into the <u>atmosphere</u> Animal feed on plant and carbon is incorporated into body tissues (fats, proteins, glycogen) Glucose in the <u>animal</u> is used/oxidised during <u>respiration</u> to release carbon dioxide into the atmosphere	1 1 1 1	

Answer Key

		Death of animal/ plant result in decomposition respiration by <u>decomposers</u> release carbon dioxide into the atmosphere Combustion of fossil fuels, formed from animals/ plants, release carbon dioxide into the atmosphere <u>Photosynthesis</u> by green plants remove/use carbon in the carbon dioxide gas in the atmosphere to form glucose/ organic matter again	1 1 1 1	
O9	(b)	Principal source of energy is the sun/ Light energy converted to chemical energy Vs Carbon is found in organic matter and inorganic carbon dioxide Loss of energy (90%) from one trophic level to the next as heat/undigested matter/ uneaten parts Vs there is no loss of carbon, only a transfer/ conversion between organisms or environment	1 1	



Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2016
Secondary 4 Express

CANDIDATE NAME	CLASS	CLASS INDEX NUMBER
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CENTRE NUMBER	INDEX NUMBER
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BIOLOGY (SPA) **5158/02**

Paper 2 **19 August 2016**

1 hour 45 min

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
 Write in dark blue or black pen on both sides of the paper.
 You may use a soft pencil for any diagrams, graphs or rough working.
 Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions in the spaces provided in the question paper.

Section B

Answer all three questions, the last question is in the form either/or.
 Write your answers on the lined paper in this booklet and, if necessary, continue on separate answer paper.

At the end of the examination, submit Section A and B separately.
 The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
6	
7	
8	
Total	

This paper consists of 17 printed pages including the cover page.

Turn over

Section A
[50 marks]

Answer all questions in this section.

Write your answers in the spaces provided.

1 Fig. 1.1 shows a type of plant cell.

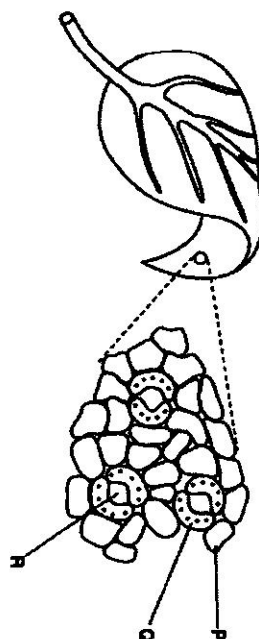


Fig. 1.1

(a) Fig. 1.1 shows the lower surface of a leaf. Label P, Q and R. [3]

P :

Q :

R :

(b) Fig. 1.2 below shows the enlarged diagram of Cell Q.

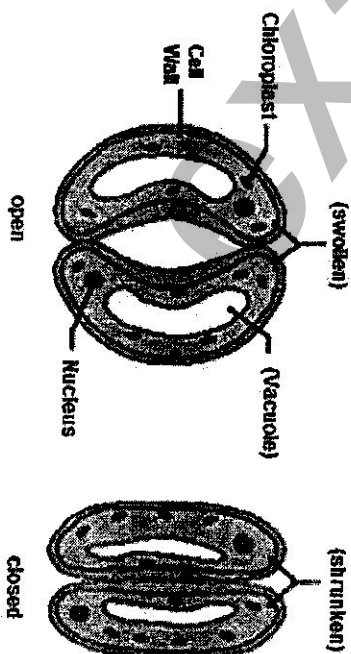


Fig. 1.2

Open

Close:

[2]

(iii) Using Cell Q as an example, compare and contrast how coordination and responses are different in animals and plants.

[Total: 11m]

Turn over

(a) Complete Table 2 to show the percentage of carbon dioxide and oxygen found in inhaled and exhaled air. [2]

Gas	Carbon dioxide / %	Oxygen / %
Inhaled Air		
Exhaled Air		

Table 2

(b) Explain how oxygen reaches a muscle cell from the alveoli and how it is used by the muscle cells.

(c) Explain what happens in a muscle cell when it lacks oxygen.

[2]

(d) At higher altitude, oxygen is less available than it is at low altitudes. Suggest modifications of the circulatory and respiratory systems that might help people that live for many years at high altitude.

[4]

[Total: 12m]

neighbouring tree

ghost plant

part of root of ghost plant

Fungus

part of tree root

Flow of nutrients from tree to ghost plant

ghost plant magnified

small, white, scale-like leaves

Flower of the ghost plant (magnified)

small, upright,
scale-like leaves

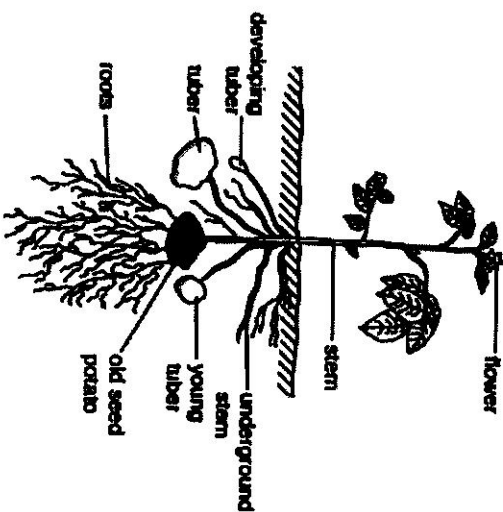
ghost plant magnified

Flower of the ghost plant (magnified)

- [2]

- [c]

(c) Fig. 3.2 shows a potato plant grown from a tuber. The tubers that potato plants are grown from are common referred to as seed potatoes.



Potatoes can reproduce asexually by means of tubers. The parent plant produces underground stems, which eventually form tubers. With reference to Fig. 3.2, describe how tubers are formed from the underground stems in potatoes.

[2]

[Total: 7m]

- 4 Fig. 4.1 shows two varieties of moth, *Biston betularia* with pale speckled wings and a second variety with black wings. There are no intermediate forms. Equal numbers of both varieties were released into a forest made up of trees with light-coloured bark.



Fig.4.1

After two weeks, scientists tried to catch as many moths as possible and the results are as shown in Table 4.2.

wing colour of moth	number of moths released	number of moths caught
pale, speckled	100	87
black	100	34

Table 4.2

- (a) Account for the difference in the number of varieties of moths caught, in relation to the colour of the bark.

.....

.....

.....

.....[2]

- (b) A scientist experimented and inter-bred two moths of the same phenotype and found out that he was able to get many more pale speckled moths as compared to black moths in the next generation.
- (i) Using the letters **G** and **g** to represent the dominant and recessive alleles respectively, determine the genotypes of the two moths he had inter-bred.[1]
- (ii) In the space below, construct a genetic diagram to predict the proportion of black-winged moths present in the next generation.[4]

- (c) In the early 19th century, the moth were mostly pale speckled wing. By 1895, due to factories that covered the land with sooty black smoke, 95% of the moths were black. Describe and explain what leads to the phenomenon described in the above paragraph.

.....

.....

.....

.....

.....[3]

[Total: 10m]

5 Fig. 5.1 shows a section through a person's head. Fig. 5.2 shows the same person swallowing a bolus of food.

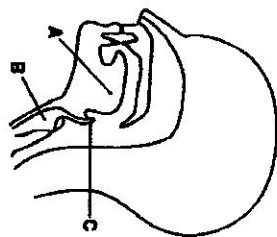


Fig. 5.1

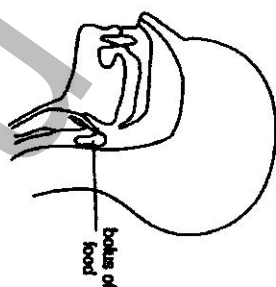


Fig. 5.2

(a) Identify structure A and B as shown on Fig. 5.1

A [2]
B

(b) Name the process that will carry the bolus to the stomach.

..... [1]

(c) Describe and explain what happens to structure C when the person swallows the bolus.

.....
.....
.....
.....
.....
..... [3]

(d) John suffers from high blood pressure and his doctor advised him to reduce his intake of salt and water in case it leads to kidney failure. Explain why his doctor advised him to reduce intake of water and salt.

.....
.....
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.....
.....
.....
.....
..... [4]

End of Section A

[Total: 10m]

Turn over

DETACH THIS SECTION AND SUBMIT SEPARATELY
Preliminary Examination 2016
Secondary 4 Express

CANDIDATE NAME		CLASS		CLASS INDEX NUMBER	
CENTRE NUMBER		INDEX NUMBER			

Section B
[30 marks]

Answer three questions.

Question 8 is in the form of an Either / Or question. Only one part should be answered.

- 6 Table 6 below shows heat production and heat loss by a person over 50 minutes during and after vigorous exercise.

Time/min	Heat production / arbitrary units	Heat loss/ arbitrary units
0	20	20
5	80	80
10	180	130
15	280	220
20	300	250
25	260	200
30	190	160
35	140	120
40	100	80
45	70	70
50	50	60

Table 6

- (a) Plot and draw graphs on the space given in Page 12 to show the heat loss and production over 50 min. [5]

- (b) Based on the graph, suggest when the exercise occurs and explain the changes in temperature of the person over the 50 minutes.

[5]

- 7 Fig. 7.1 below shows a food chain.

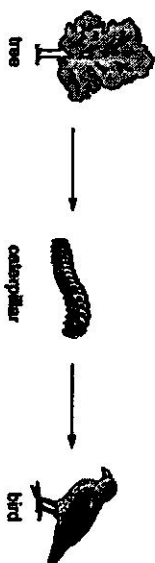


Fig. 7.1

- (a) Describe and explain how a carbon atom in the atmosphere can become part of a glycogen molecule in the bird.

[7]

8 EITHER

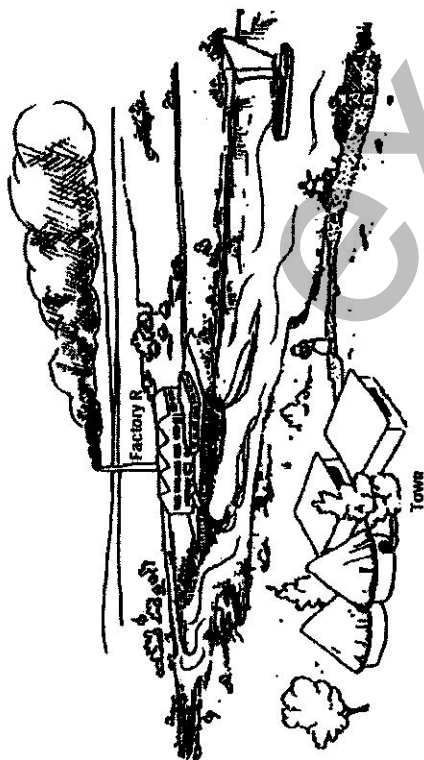


Fig. 7.2

Factory R has been disposing traces of mercury into the river which flows into the town and provides fish for the people living in the town. Explain why there are reports of people in the town who suffers from mercury poisoning.

- (b) Compare the advantages of asexual reproduction in plants to genetic variation with reference to a commercial application.

.....[6]
[Total: 10m]

©

(b) Outline the processes of artificial selection and compare the advantages and disadvantages of it with genetic engineering.

5

[Total: 10m]

Turn over

Sec 4 Exp Bio Preliminary Exam 2016

Marking Scheme

Paper 2

Mark schemes will use these abbreviations:

- ; separates marking points
- / alternatives
- 0 contents of brackets are not required but should be implied
- R reject
- A accept (for answers correctly cued by the question, or guidance for examiners)
- AW alternative wording (where responses vary more than usual)
- AVP alternative valid point (where a greater than usual variety of responses is expected)
- ORA or reverse argument
- underline actual word underlined must be used by candidate (grammatical variants excepted)
- max Indicates the maximum number of marks that can be given
- + statements on both sides of the + are needed for that mark

Sec A

No.	Expected Answer	Mark	Remarks
1a	P: Epidermal cell Q: Guard cell R: Stoma	Max 3	R: Stomata
Bi	Open: potassium ions lowers the water potential of the cell Q, causing water molecules to move into the guard cell by osmosis. This causes the guard cells to be turgid and hence opening the stoma. Close: Potassium ions leaving the cell Q increases the water potential, causing water molecules to move out of the cell by osmosis. This causes the guard cells to be plasmolysed and hence closing the stoma	1 1 1 1 1 1 Max 2 each	

		Total 4	
Bii	Cell Q has cell wall of unequal thickness. / Thicker on the inside , thinner on the outside. Cell wall is a rigid structure that does not change shape easily . This allows the cell to expand more on the outside and less on the inside when it is turgid, causing the stomata to be open or close.	1 1 1 Max 2	Must state one property and how it helps Allow for large central vacuole, allowing the changes in water potential
biil	Both have the ability to respond to a stimulus . Animals have a nervous system that transmit nerve impulses to effector for response, but plants do not have a nervous system and response to changes by changing the turgor pressure in their cells .	1 1 1 Max 2	A: Speed of responses Complexity of coordination
	Total	10	
2(a)	Inhaled – CO ₂ 0.03 % and O ₂ 21% Exhaled – CO ₂ 4% and O ₂ 16%	1 1	Either 1 or 2 marks only. Allow 3 – 4% for CO ₂
(b)	O ₂ diffuses from the alveoli into the haemoglobin of RBC at the blood capillaries surrounding the alveoli Oxygen rich blood is transported to the heart and Then blood pumped by the heart to the muscles At the muscles, (aerobic) respiration; release energy from glucose; for contraction;		R produce AW energy
C	anaerobic (respiration); less energy released; (produces) lactic acid; (muscle) becomes fatigued / tired / ref. cramp / pain.	Max 4 Max 2	
d	rapid breathing mechanism / deeper breathing; modified lung structure or described; more (efficient) haemoglobin/increase O ₂ carrying capacity more efficient blood supply to organs / tissues or e.g.; larger heart/thicker heart muscles/ more red blood cells; faster heart rate / faster circulation of blood;		
	Total	12	

6a	A labelling of axes; [Time : temperature/°C; Y : heat loss/production S scale; [needs to be even and to fill more than half of the printed grid] P plot; [+/- half a small printed square] L line; [an accurate curve connecting all points or joined point to point by a ruled line and no extrapolation]	max. 5m
B	During vigorous exercise, from 0 min to 20 min respiration occurs at a higher rate to release large amounts of energy. 1 Some of the energy is lost as heat energy, causing the body temperature to rise 1 This cause the thermoreceptor send a nervous impulse to the hypothalamus which starts a corrective mechanism for heat loss to decrease body temperature back to normal 1 Vasodilation of arterioles near the skin - Increase blood flow to the skin - heat can be lost through conduction, convection & radiation 1 Production of sweat - Removes heat through latent heat of vapourisation 1 As the heat production is higher than heat loss, as the person stop exercising, heat production decrease and heat loss continues to be higher than heat production to bring body temperature back to normal. Max 5m Total 10	
7a	Mesophyll cells uses the carbon dioxide For photosynthesis	1

	Lower concentration of carbon dioxide in the intercellular air space of leaf and higher concentration of carbon dioxide in the atmosphere Carbon dioxide diffuse the leaf through the stomata into the intercellular air space Dissolve in the thin film of moisture and enter into the mesophyll cells Glucose is formed by photosynthesis and stored as starch in the leaf Caterpillar ingest the leaf and takes in the starch Starch is digested by the caterpillar and used to build new body cells, or stored. Caterpillar is ingested by the bird, protein is digested to amino acids Excess amino acid is deaminated and converted to urea and glucose, glucose is stored as glycogen.	1 1 1 1 1 1 1 1 1
	Mercury is taken in by the fish/organisms/ plants found in the river Fish eats the plants/ other fish Mercury cannot be excreted is stored in tissues of fish Passed down via food chains The concentration of mercury increases as we move along the trophic level. Results in the bioaccumulation of mercury in people who are the top consumers and hence they suffer from mercury poisoning as the concentration is high	1 1 1 1 1 Max 3
8a	Mitosis maintains chromosome number /diploid AW; whereas for meiosis chromosome number halved / haploid AW;	Total: 10M 1 1

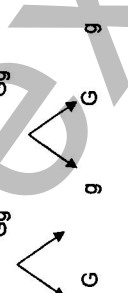
	Mitosis produces 2 daughter cells meiosis produces 4 daughter cells Mitosis occurs in all organs/body cells whereas meiosis is only in gamete producing cells Mitosis is for growth / asexual reproduction whereas meiosis is for production of gametes Mitosis produces genetically identical offspring / clones/ whereas meiosis results in genetic variation	[max. 4]	
(b)	For asexual reproduction, always an exact copy for production of a named crop(s.e.g. rice/maze) known characteristics / flavour AW ; not reliant on pollination (agent) ; only one parent needed ; quick(er) ; Although variations increase the chances of survival of the species during changes in the environment. asexual reproduction allows for more controlled production of crops which less expensive / greater profit / higher yield / more offspring in a controlled environment.	1 1 1 1 1 1	
8a	Molecular genetics can be used to Mass produce insulin for patients suffering from Type 1 diabetes The insulin gene is isolated, cut using restriction enzymes. Inserted the gene into the vector DNA the recombinant plasmids is inserted into bacteria The transgenic bacteria is cultured in large amounts in fermenters Insulin produced through this method is better as previously used animal insulin is different from human insulin.	1 1 1 1 1 1	Total 10 M

	While GE is more efficient as transgenic organisms grow faster and may require less food Selective / artificial breeding can also result in inbreeding, and an accumulation of recessive alleles in the population. The recessive alleles are not expressed in the heterozygous parents. They are more likely to be passed down to the offspring. If the recessive alleles code for a genetic disease, the homozygous offspring will suffer from the disease.	1	
		Max 5	

Sec A

No.	Expected Answer	Remarks
1a	P: Epidermal cell Q: Guard cell R: Stoma	Many candidates wrote in plural form which is not accepted. The line is only pointing to one cell.
Bi	Open: potassium ions lowers the water potential of the cell Q, causing water molecules to move into the guard cell by osmosis. This causes the guard cells to be turgid and hence opening the stoma. Close: Potassium ions leaving the cell Q increases the water potential, causing water molecules to move out of the cell by osmosis. This causes the guard cells to be flaccid and hence closing the stoma	Most candidates were able to get some marks, however, some confused this with the reverse process having not read the question properly. Question stated that in the day, K ⁺ is pumped into Cell Q whereas at night it is pumped out.
Bii	Cell Q has cell wall of unequal thickness. / Thicker on the inside, thinner on the outside. Cell wall is a rigid structure that does not change shape easily. This allows the cell to expand more on the outside and less on the inside when it is turgid, causing the stomata to be open or close.	Must describe one property and how it helps Allow for large central vacuole, allowing the changes in water potential. Many candidates gave incomplete answers and did not describe properly.
biil	Both have the ability to respond to a stimulus. Animals have a nervous system that transmit nerve impulses to effector for response, but plants do not have a nervous system and response to changes by changing the turgor pressure in their cells.	Speed of responses and complexity of coordination also accepted.
2(a)	Inhaled – CO ₂ 0.03 % and O ₂ 21% Exhaled – CO ₂ 4 % and O ₂ 16%	Either 1 or 2 marks. No half marks awarded
(b)	O ₂ diffuses from the alveoli into the haemoglobin of the red blood cells at the blood capillaries surrounding the alveoli to form oxyhaemoglobin. Oxygen rich blood is transported to the heart and then blood pumped by the heart to the muscles At the muscles, (aerobic) respiration: release energy from glucose for contraction of muscles	Produce energy not acceptable. Most candidates were able to explain how oxygen binds with haemoglobin but were not able to link from the lungs to the heart to the muscles.

C	Anaerobic respiration would occur and less energy released. Lactic acid would be produced and the muscle becomes fatigued / tired / ref. cramp / pain;	Most candidates were able to explain that anaerobic respiration, but many did not make the comparison of how LESS energy is released.
d	There might be faster breathing, or deeper breathing. There could be bigger lung capacity (or other described modified structures that) that could allow more air to be taken in, for higher oxygen intake. More (efficient) haemoglobin/increase O ₂ carrying capacity and also more efficient blood supply to organs / tissues such as larger heart/thicker heart muscles/ more red blood cells; faster heart rate / faster circulation of blood;	Common mistake made by candidates includes - more blood could be transported. Idea is for more oxygen to be transported more quickly instead of volume of blood increasing.
3a	The ghost plant has no chlorophyll and therefore could not carry out photosynthesis and cannot make carbohydrates. Carbohydrates has to be obtained from other organism and nutrients from the nearby green plants. Fungi function as a link for nutrients to reach ghost plant.	Most candidates were able to draw the link that there were no chlorophyll but many candidates focused on how fungi are decomposers instead of how it could link to the neighbouring tree as seen in the diagram.
B	Insect / self ; reason (insect): Stigma and anthers are enclosed within the flowers and the insect helps to transfer the pollen grain when they brush past the stigma after the anther. Anthers / stamens are small unlike those pollinated by wind. While colour may attract (insects) ; reason (self): Anthers and stigma close together allowing pollen grain to reach stigma easily. Flowers are not brightly coloured and might not attract (insects);	There could be either self-pollination or insect-pollination. Diagram clearly shows that stigma and anthers are enclosed within flowers but some candidates still see that anthers are pendulous to fit description of wind-pollinated flowers. Candidates need to refer more closely to the diagram.
C	Sucrose is transported to underground stems through phloem via translocation. Sucrose is converted to starch and stored, causing the stem to swell and form tubers.	Candidates again need to refer to diagram and to read the question properly on what exactly forms tubers. Clue is that it is formed from underground stems

4(a)	More black moths are consumed by their predators and hence not caught by the scientists. This is because the black moths are not able to camouflage / blend in with the tree bark.	Most candidates who got it wrong, did not refer to the diagram and explained how the black moth is better camouflaged. Black moth is less camouflaged than the speckled according to the diagram.
Bi	Both moths have a heterozygous genotype, Gg;	
bii	(i) Parental phenotype: pale speckled moth Parental genotype: Gg Gametes: G, g Random fertilisation: 	Need to have the proper labels in order to gain the full marks, including the proportion. Proportion of black moth: 1/4 or 25%
C	The trees were blackened with soot air pollution; White moth more easily seen and get eaten by predators. Black moth adapt better to the environment as they are better camouflaged. Black moths survive to reproduce and pass on their alleles to the next generation. Frequency of alleles for black pigment increases as natural selection selects for these alleles causing an increasing number of black moth over many generations.	Reverse argument applies. Many candidates were able to explain up till the moths were able to reproduce, but did not explain how the numbers increase due to an increase in the frequency of the alleles over generations. This is necessary as it shows how the proportion of the population changes. Note that the differences in the moth colours occurred as a result of an earlier mutation and not due to the soot. Furthermore, the soot covering the moth, does not cause the moth to be permanently black and to produce offspring that are black if their genotype does

			not have alleles that codes for black pigment.
5a	A – tongue; B – larynx/voice box;		
b	peristalsis;		
C	The epiglottis closes/covers the trachea/air passage/larynx/voice box/B. It is helped by raising of larynx AW. This helps to prevent the entry of food / preventing food going to lungs or respiratory system and this prevents choking AW / allows food to enter oesophagus		Most candidates were able to answer this.
d	High blood pressure might damage the vessels/glomerulus/basement membrane of the kidney and causes the kidney to be unable to carry out ultrafiltration Lowering water intake, will lower the blood pressure, as volume of blood decreases This reduces the pressure of the blood flowing to the kidney, hence reducing damage of glomerulus at kidney Salt reduces the blood water potential, hence causing more ADH to be released to increase reabsorption of water, causing the volume of blood to increase and increase pressure. Hence salt intake should be reduced.		Many candidates were unable to gain full marks because they did not link the points together. Key point in this question is that blood pressure is affected by volume of blood. When volume increase, blood pressure increase. Candidates also need to link how it is that high blood pressure damages the kidney.

Section B

No.	Answer	Marker's remarks
6a	Refer to graph attached	
b	Exercise occurs from 0 to 20 minutes. Respiration occurs at a higher rate during this period, releasing large amounts of energy as seen by the increase of heat production from 20 to 300 units. Some of the energy is lost as heat energy, causing the body temperature to rise. This causes the thermoreceptor (in the hypothalamus) to send nerve impulses to the effectors to carry out corrective mechanisms to promote heat loss to decrease the body temperature to normal. Some of the corrective mechanisms carried out are vasodilation of the arterioles near the skin to increase blood flow to the skin so that heat can be lost via conduction, convection and radiation. Production of sweat also occurs which removes heat through latent heat of vaporization. As the person stops exercising, both heat production and heat loss decreases. From 45 – 50 min, the heat loss continues to be higher than heat production to bring the body temperature back to normal.	Many candidates focused on describing the graph (w data) but did not explain the changes as asked in the qn. Common mistakes: - 'temperature change detected by skin receptors'. This is incorrect as exercise causes an internal body temperature increase detected by the hypothalamus. Skin receptors detect external changes in temperature. - candidates incorrectly mentioned mechanisms that reduce heat gain (e.g. decrease in metabolic rate, relaxation of hair erector muscles) - Several candidates did not emphasise vasodilation of arterioles, hence did not score of the mark. - Candidates need to be more careful in their phrasing to describe heat loss via evaporation of sweat. - many failed to mention that heat loss occurs until temperature returns to normal. - Negative feedback is not relevant in this qn as body temperature has not returned to normal yet.
7a	Carbon atom exists in the atmosphere as carbon dioxide. There is a lower concentration of carbon dioxide in the intercellular spaces of the leaf and a higher concentration of carbon dioxide in the atmosphere.	Many candidates did not describe the intake of carbon dioxide into the leaf. Common mistakes: - Many students focused their answer on starch in the leaf and stated that the glucose, that is stored as glycogen in the

Carbon dioxide diffuses into the intercellular spaces of the leaf via the stomata. It dissolves in the thin film of moisture and diffuses into the mesophyll cells. Glucose is form during photosynthesis in the mesophyll cells. Glucose reacts with the nitrates to form amino acids/proteins. The amino acids are used for form protoplasm/ new cells and for growth in the tree. The caterpillar ingests the leaf and takes in the protein. Protein is digested by the caterpillar to amino acids and is used to build new body cells. The bird ingests the caterpillar and the protein is again digested to amino acids. Excess amino acids are deaminated and converted to urea and glucose. The excess glucose is converted to glycogen.	caterpillar, is digested by the bird. This is untrue as the carbon atom is passed from the caterpillar to the bird in the form of protein. - Some candidates did not state specific carbon compounds. - Glucose cannot be digested as it is in its simplest form. - Starch cannot be stored in the caterpillar/bird; only in plants. - Candidates that focused their answer on energy transfer did not gain marks. - Some candidates failed to state that excess glucose is converted to starch
Mercury is absorbed by the aquatic plants in the river. These plants are eaten by the fish, which are then eaten by humans. Mercury is non-biodegradable and cannot be excreted, thus is stored in fatty tissues of organisms. The mercury is passed down the food chain and this is known as bioaccumulation. The concentration of mercury increases as it moves up the trophic levels and it results in bioamplification in the top consumers, in this case the people causing them to suffer from mercury poisoning.	Candidates who simply mentioned terms such as bioaccumulation and bioamplification without explaining the process were not awarded marks.

8E a	Mitosis maintains chromosome number /diploid whereas for meiosis chromosome number halved / haploid. Mitosis produces 2 daughter cells meiosis produces 4 daughter cells Mitosis occurs in all organs/body cells whereas meiosis is only in gamete producing cells Mitosis is for growth / asexual reproduction whereas meiosis is for production of gametes. Mitosis produces genetically identical cells / clones/ whereas meiosis results in genetically different cells.	Mitosis and meiosis are cellular processes/ nuclear divisions. Hence description of processes should be done in terms of daughter/parent cells, not offspring. Candidates should compare one difference at a time, not group multiple differences into a single point. The phrase 'Genetically similar' should be avoided, as it is not the same as genetically identical.
b	For asexual reproduction, offspring are genetically identical to the parent, hence will always express the advantageous traits of the parent plant. Unlike genetic variation where offspring may or may not exhibit the advantageous traits of the parent plant. For example, maize which are disease resistant, when reproduced asexually will produce offspring that are also resistant to the disease. However, offspring produced by sexual reproduction will show genetic variation and may not be disease resistant. (provide one e.g. of a viable commercial plant for both scenarios) Asexual reproduction also requires only one parent plant, however genetically variable offspring may require more than one parent plant for sexual reproduction. Asexual reproduction is a faster process as it is not dependent on pollination, however genetic variation in plants produced by sexual reproduction require pollination to occur.	Candidates who did not compare the processes with focus on how asexual reproduction is advantageous over genetic variation did not gain marks. Some candidates confused asexual reproduction with self-pollination.

	However, genetic variation is plants increases their survival when there are changes in the environment. Thus asexual reproduction allows for more controlled production of crops which is less expensive/ allows greater profit/ produces higher yield/ produces more offspring in a controlled environment.	
8O a	Molecular genetics can be used to mass produce Insulin for patients suffering from Type 1 diabetes. The human Insulin gene is isolated and cut using restriction enzymes to produce sticky ends. A plasmid/ vector DNA from bacteria is cut using the same restriction to produce complementary sticky ends. The human insulin gene is inserted into the plasmid and the ends are joined together by DNA ligase. The recombinant plasmid is inserted into bacteria. The transgenic bacteria are cultured in mass quantities in fermenters. Insulin produced through this method is better as previously used animal insulin is different from human insulin. Development of antibodies against the animal insulin after prolonged treatment will not occur. This method will also prevent diseases may be transferred from animals to humans.	Most candidates were able to provide the steps to produce transgenic bacteria, although some were lacking specific terms such as recombinant plasmid, DNA ligase, restriction enzymes, transgenic bacteria in their answers. Most students were unable to describe how this benefited humans. Students who provided other commercial applications (other than insulin which is prescribed in the syllabus) were unable to provide specific details to gain marks. Bacteria is plural, Bacterium is the singular term. Some candidates stated that insulin produces would be cheaper, but this must be accompanied by the idea that it is because it is produced in mass quantities, thus making is affordable and available. The process itself is expensive.
b	In artificial selection, organisms with desired traits are selected by humans for selective breeding. Alleles that code for desired traits are passed to offspring. Traits of the offspring may vary due to different allele combinations. Offspring	Most candidates were unable to appropriately describe the process of artificial selection. Some candidates general gave differences without specifying if it

with the desired traits are selected again for breeding and this process is repeated over many generations until all the organisms express the desired trait. The advantages of selective breeding are that farmers can afford it, unlike genetic engineering (GE) where the modified plants/animals are more expensive and not affordable for the poorer farmers. There is also lesser risk of genes that code for antibiotic resistance may be accidentally incorporated into bacteria that cause human diseases, which may occur in GE organisms. The disadvantages are that there is a possibility that defective genes will be transmitted to offspring in artificial selection. Artificial selection can also result in inbreeding, and an accumulation of recessive alleles in the population. The recessive alleles are not expressed in the heterozygous parents. They are more likely to be passed down to the offspring. If the recessive alleles code for a genetic disease, the homozygous offspring will suffer from the disease. Whereas in GE, selection of the desired gene before transfer eliminates the risk of transferring a defective gene. Artificial breeding is a slow process that involves several generations whereas GE is a process, which uses individual cells that reproduce rapidly in a small container in a laboratory. Artificial breeding is less efficient as organisms grow more slowly and may require more food. While GE is more efficient as transgenic organisms grow faster and may require less food.	was an advantage or disadvantage. Also some focused on GE without providing the advantages of artificial selection, as required by the qn. When comparing affordability, some students had the misconception that GE was a cheaper process; this is untrue as the technology involved is expensive. Stating differences without description/ explanation did not gain marks.
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SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME

CLASS

4

REGISTER
NUMBER

CENTRE NUMBER

O-LEVEL
INDEX NUMBER

BIOLOGY

5158/02

Paper 2 Theory

Wednesday

3 August 2016

1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer all questions.

Section B

Answer all questions, the last question has a choice of parts to answer.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This question paper consists of 23 printed pages.

Turn over

Section A

Answer all questions.

Write your answers in the spaces provided.

- 1 Fig. 1.1 shows a diagram that represents the mode of action of enzymes.

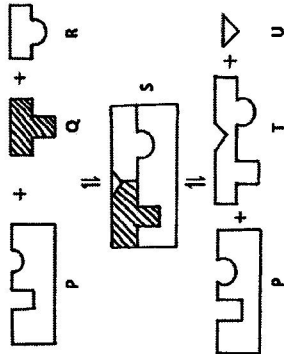


Fig. 1.1

Table 1.1 shows the relative amounts of molecules P, Q, R and T involved in a series of experiments undertaken at 35 °C and an optimum pH.

Table 1.1

Experiment	Number of P	Number of Q	Number of R	Number of T
A	1	1	1	1
B	2	2	2	2
C	3	3	4	3
D	4	3	4	3
E	4	4	4	4

- (a) Which molecule will remain in the same numbers at the start and end of each experiment? Explain your answer. [1]

- (b) Using information from Table 1.1, deduce which molecule is the limiting factor. Explain your answer. [3]

2 Some symptoms of complete liver failure include:

- (a) oily faeces
- (b) absence of urea in the urine
- (c) dizziness and slower reflexes after drinking very little alcohol

Explain how each of the symptoms is associated with the roles of the liver. [3]

(a)

(b)

(c)

3 Fig. 3.1 shows an experimental set-up to investigate the process of transpiration in a green plant placed in a well-lit room. Water droplets are seen on the inner surface of the bell jar after a period of time.

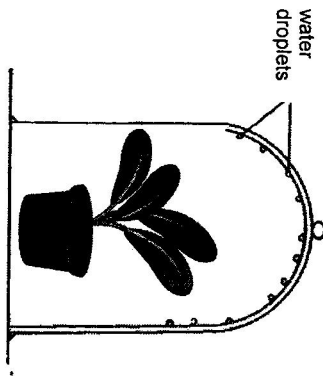


Fig. 3.1

(a) (i) During setting up, the edge of the bell jar is covered with a layer of wax. Explain the purpose. [1]

.....

(ii) This experimental result may not be conclusive. Suggest a modification to the set-up that would make the results more conclusive. Explain your rationale. [2]

Modification	Rationale for modification

(iii) Describe a test to confirm that the liquid droplets are water. [1]

.....

4 Fig. 4.1 shows the changes in pressure in the left side of the heart during the cardiac cycle.

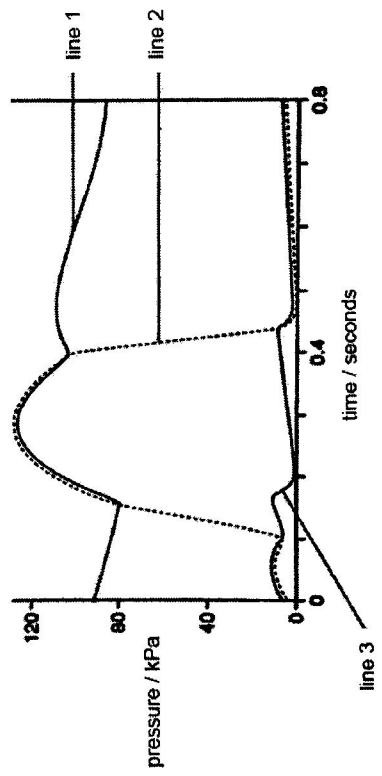


Fig. 4.1

(a) Using the information in Fig. 4.1, state the ratio of the duration of the atrial systole to the ventricular diastole. [1]

(b) On Fig. 4.1, label X when the semi-lunar valves first open. [1]

(c) Using your answer in (b), describe the change in pressure in line 1 from 0.15 s to 0.3 s and state the importance of this change. [2]

(d) State one difference in pressure if line 2 is recorded in the right side of the heart. [1]

(e) Explain the change in pressure from 0.1 s to 0.2 s in line 3. [1]

(b) Describe how you would set up a control for this experiment. [1]

(c) (i) Predict the observations when the set-up in Fig. 3.1 is moved to a dark room for 24 hours. [1]

(ii) Explain your answer in (c)(i). [3]

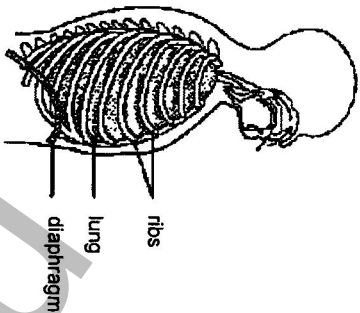


Fig. 5.1

- (a) Draw an arrow each on Fig. 5.1 to indicate the direction of movement during inhalation for
- (i) the ribs, and
 - (ii) the diaphragm.
- [1]

A pupil wants to compare the breathing of a normal person at rest and during strenuous exercise.

Table 5.1 shows information recorded by the pupil.

Table 5.1

Quantity measured	at rest	during strenuous exercise
Volume of air inhaled per breath / cm ³	600	620
.....		

- (b) Suggest what further information can be included by the pupil in Table 5.1 and the approximate values that may be recorded in order to achieve a more significant comparison.
- [2]

Chronic kidney failure often starts from prolonged glomerular damage in the kidney nephrons. Fig. 6.1 shows what happens during glomerular damage and the body's response towards it. Table 6.1 shows some information about the blood in normal and damaged kidneys respectively.

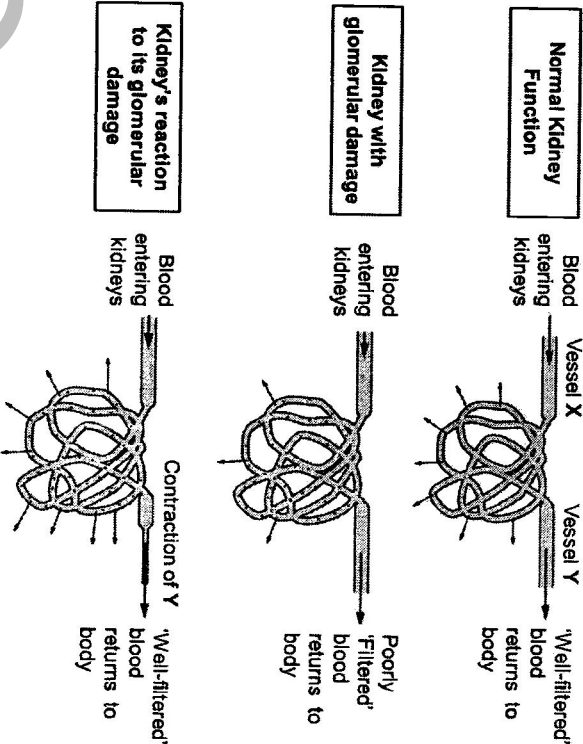


Fig. 6.1

Number of → indicates the relative amount of fluid being filtered

Table 6.1

	Normal kidneys	Kidneys with damaged glomeruli
Percentage of blood filtered (%)	100	80 – 90
Presence of proteins in urine?	No	Yes

(a) Using information from Fig. 6.1 and Table 6.1, suggest and explain how damaging the glomerulus in the kidney nephrons leads to kidney failure after a prolonged period of time. [4]

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(b) Suggest why patients who suffer from glomerular damage will often also

(i) develop a high blood pressure in the kidneys [1]

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(ii) have traces of blood in their urine. [1]

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7 Fig. 7.1 shows the structures of two flowers, X and Y.

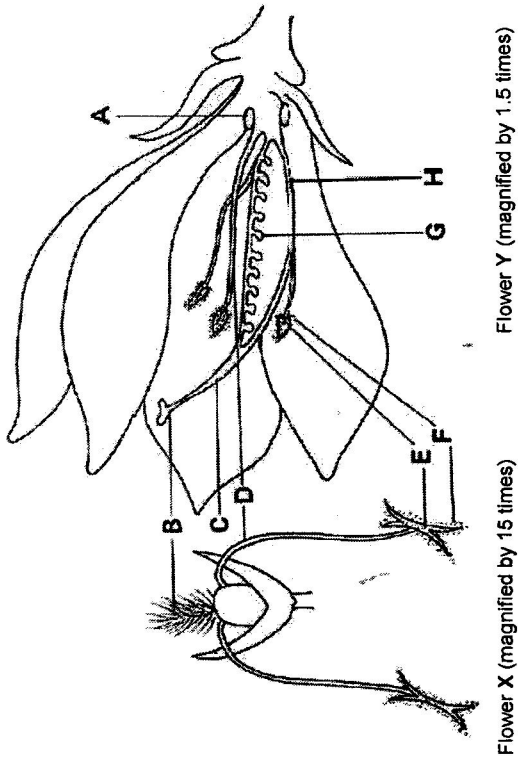


Fig. 7.1

(a) Name the labelled structures below. [2]

- A
- C
- G
- H

(b) With reference to Fig. 7.1, suggest how the following common parts assist in the process of pollination for each flower. [2]

	Flower X	Flower Y
Structure B		
Structure D		

- (c) Fig. 7.2 shows the incomplete changes in genetic (DNA) content in a single cell leading to the formation of cell F.

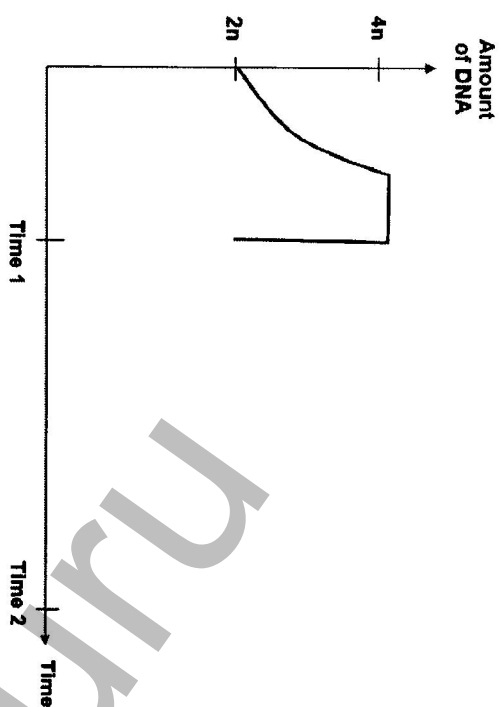


Fig. 7.2

- (i) Complete the line from Time 1 to Time 2 on Fig. 7.2 to show the formation of a cell F. [1]
- (ii) Label on the graph the point at which cell F is first formed, with the words "formation of cell F". [1]
- (iii) Using a diploid number of four chromosomes, illustrate in the spaces below the metaphase stage in cell E and the metaphase I stage in cell F during cell division. [2]

metaphase in E	metaphase I in F
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8

- Fig. 8.1 shows a mammalian foetus developing in its mother's womb.

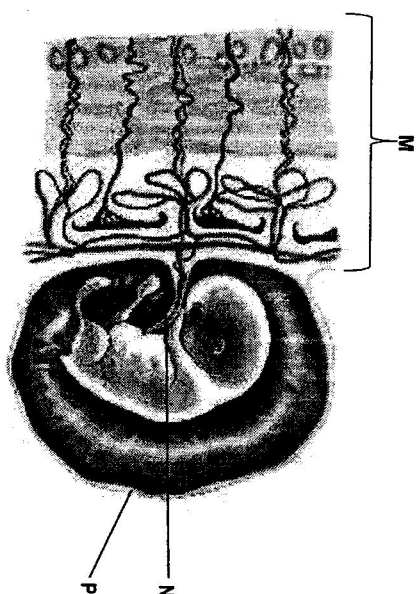


Fig. 8.1

- (a) Name the parts labeled M, N and P. [2]
- M
- N
- P
- (b) Structure M is also an endocrine gland. Describe the role of M as an endocrine gland and explain its importance. [1]
-
- (c) Explain how the foetus is affected when structure M fails to develop normally. [2]
-
-
-
- (d) State one role of the fluid found in structure P. [1]
-
-

Fig. 9.1 shows a food web in an ecosystem.

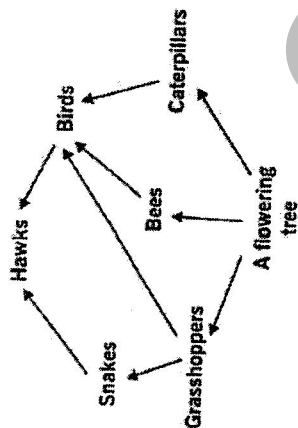


Fig. 9.1

(a) Draw a pyramid of numbers for a food chain involving caterpillars. [1]

(b) Which of the organisms, bees or caterpillars, are biologically beneficial to the tree? Explain your answer. [2]

(c) Explain the following observations:

(i) The bee population remains relatively constant when there is a sudden decrease in the population of caterpillars. [1]

(ii) The grasshopper population increases initially but decreases afterwards when snakes are removed from the food web. [1]

Section B

Answer three questions.

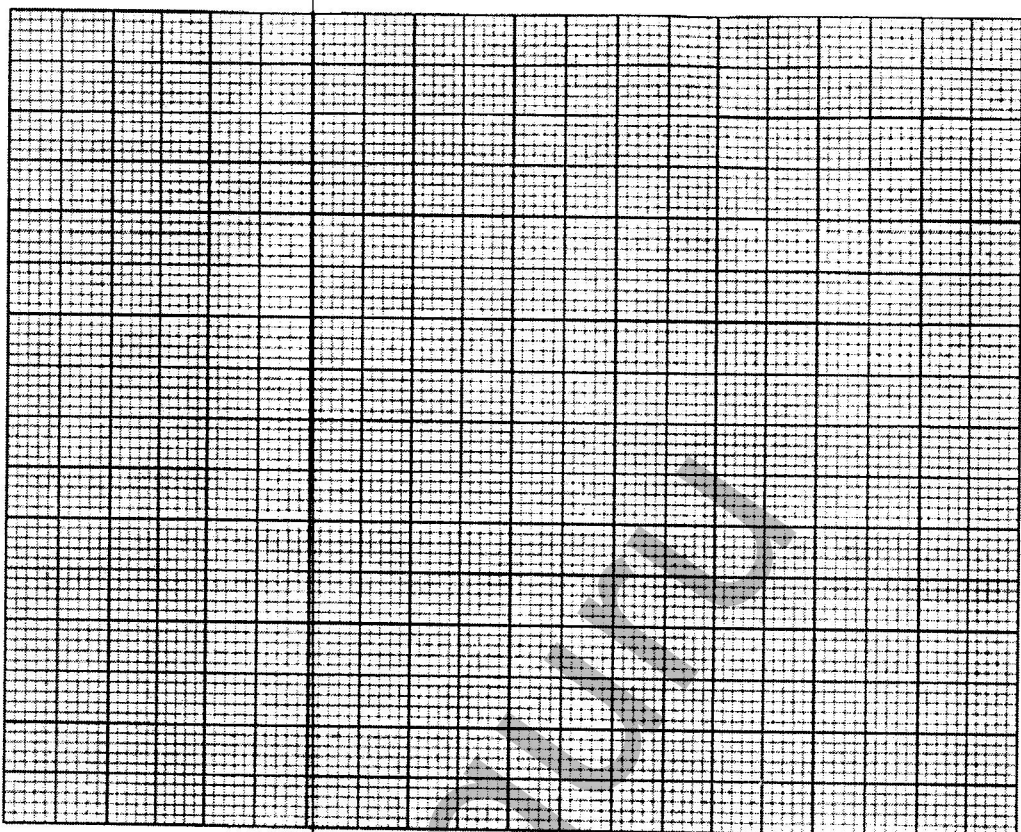
Question 12 is in the form of an Either / Or question. Only one part should be answered.

- 10 The rate at which blood glucose concentration changes is affected by the food eaten by a person. In an experiment, a healthy person ate two slices of white bread.
- The increase in her blood glucose concentration from her initial concentration was recorded over the next 120 minutes. The experiment was then repeated with two slices of wholemeal bread. The results of the experiment are shown in Table 10.1.

Table 10.1

Time (minutes)	Increase in blood glucose concentration from initial concentration in mg/100cm ³ of blood	
	white bread	wholemeal bread
20	4.4	2.8
40	8.0	6.0
60	11.4	5.2
80	12.0	4.8
100	6.0	0.0
120	0.0	0.0

- (a) Plot suitable line graphs using the grid given below to represent the data in Table 10.1. [4]



- (b) Using information from Table 10.1, contrast the changes in blood glucose concentration when the person ate the white bread and the wholemeal bread. [4]

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- (c) Explain why wholemeal bread is a better choice for diabetics. [2]

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11 Actions can be coordinated by different nervous pathways. Two such actions are shown below:

Action 1	A student is touching a kettle of water to feel whether it is hot.
Action 2	A student accidentally touches a kettle of hot water and withdraws his hand immediately.

(a) Outline three ways in which Action 1 is different from Action 2. [3]

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Fig. 11.1 displays the structures in the human eye after it is dissected.

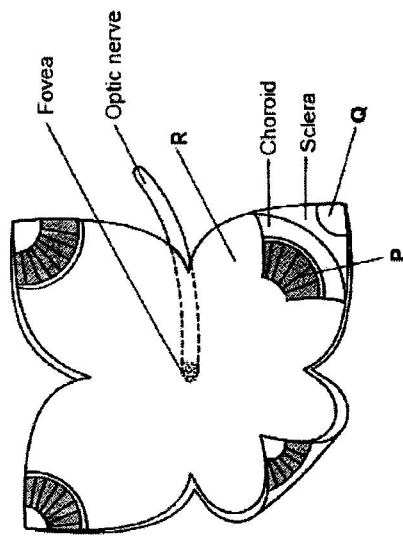


Fig. 11.1

(b) Explain how P, Q and R would respond when the eye is exposed to increased light intensity. [4]

Identify P, Q and R in your answers.

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(c) Indicate on Fig. 11.1, with a labelled arrow, the location of a muscle which is important in producing focused images of near and far objects. [1]

(d) Fig. 11.2 shows the structures of a normal eye and an eye with symptoms of glaucoma.

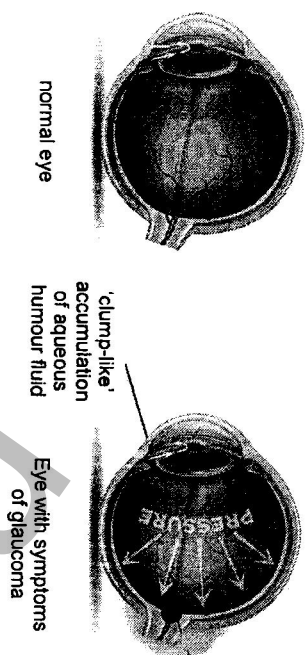


Fig. 11.2

Using information from Fig. 11.2, suggest how the following symptoms of glaucoma affect vision: [2]

- (i) 'clump-like' accumulation of aqueous humour fluid
- (ii) pressure in the vitreous humour

12 Either

(a) Distinguish between the terms *gene* and *gene mutation*. [2]

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Fig. 12.1 shows *heterochromia*, a mutation that results in a different colour of iris in each eye. The dominant eye colour is brown, and the recessive eye colour is blue.



Fig. 12.1

Fig. 12.2 shows the inheritance of heterochromia in a family.

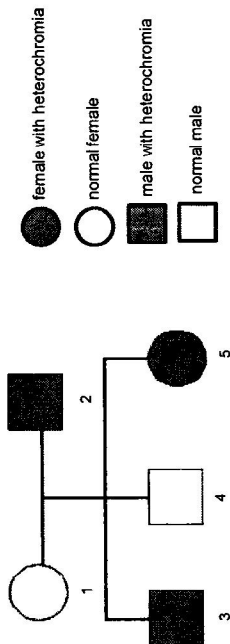


Fig. 12.2

- (b) Explain how heterochromia is passed down from individual 2 to some of his offsprings. [1]
- (c) Using suitable symbols, construct a genetic diagram to show the outcome of the offsprings if mutation did not occur at the first generation, and individual 2 remains blue-eyed. [3]

Read the following extract below regarding 'designer babies'.

The Fertility Institutes clinic in Los Angeles has just started offering prospective parents the opportunity to select physical traits of future offspring thanks to "cosmetic medicine".

But other fertility experts are outraged that the clinic is seeking to capitalise on dramatic advances in embryo cell analysis designed to identify dangerous diseases and defects in the unborn. They are angered that the so-called 'cosmetic medicine' is distracting public attention from how the pioneering medical technology can have children free of debilitating genetic conditions.

Clinic director Dr Jeff Steinberg, who as a young medic was part of the team involved in the birth in Britain in 1978 of Louise Brown, the world's first test tube baby, is undeterred.

"It's incredibly exciting," he told The Sunday Telegraph. "I live in LA and everyone here wants to have a straight nose, different and unique eye colours and high cheekbones and are perfectly happy to pay for cosmetic surgery."

"I understand the ethical concerns, but we cannot escape the fact that genetic engineering is moving forward. If I have to get smacked around by people who think it is inappropriate, then I'm willing to live with that."

Reported by Philip Sherwell for *The Telegraph*, Feb 2015

- (d) Describe how a unique trait could be utilised for designer babies given the fact that genetic engineering is moving forward'. [3]
- (e) List two 'ethical concerns' with regards to the science of designer babies. [1]

- (a) Describe how carbon in a glucose molecule in an animal's body is cycled in an ecosystem and the role of decomposers in this recycling. [4]

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- (b) Explain why it is advantageous to have short food chains. [3]

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- (c) Using suitable examples, differentiate between the terms 'bioaccumulation' and 'biomagnification'. [3]

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End Of Paper



SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME

CLASS

CENTRE
NUMBER

REGISTER
NUMBER

INDEX NUMBER

BIOLOGY

5158/02

Paper 2 Theory

Wednesday

3 August 2016

1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer all questions.

Section B

Answer all questions, the last question has a choice of parts to answer.

The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This question paper consists of 23 printed pages.

Section A

Answer all questions.

Write your answers in the spaces provided.

- 1 Fig. 1.1 shows a diagram that represents the mode of action of enzymes.

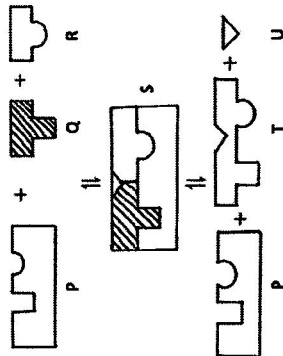


Fig. 1.1

Table 1.1 shows the relative amounts of molecules P, Q, R and T involved in a series of experiments undertaken at 35 °C and an optimum pH.

Table 1.1

Experiment	Number of P	Number of Q	Number of R	Number of T
A	1	1	1	1
B	2	2	2	2
C	3	3	4	3
D	4	3	4	3
E	4	4	4	4

- (a) Which molecule will remain in the same numbers at the start and end of each experiment? Explain your answer. [1]

P. Enzymes (quantity / shape) remain unchanged at the end of a reaction since they can be reused. [1]

- (b) Using information from Table 1.1, deduce which substance is the limiting factor. Explain your answer. [3]

Substance Q is the limiting factor [1]

- Using experiments C and D, increasing number of P does not cause the number of T (main product) to increase. [1] (Therefore P is not a limiting factor).
- Using experiments D and E, increasing number of Q will lead to an increase number of T [1] (Therefore Q is the limiting factor).

Some symptoms of complete liver failure include:

- (a) Oily faeces
- (b) Absence of urea in the urine
- (c) Dizziness and slower reflexes after drinking very little alcohol

Explain how each of the symptoms is associated with the roles of the liver.

[3]

(a) No bile was secreted to emulsify fat for faster digestion

(b) No deamination of excess amino acids to form urea

(c) Alcohol not detoxified into harmless products (acetaldehyde) (by alcohol dehydrogenase)

Fig. 3.1 shows an experimental setup to investigate the process of transpiration in a green plant placed in a well-lit room. Water droplets are seen on the inner surface of the bell jar after a period of time.

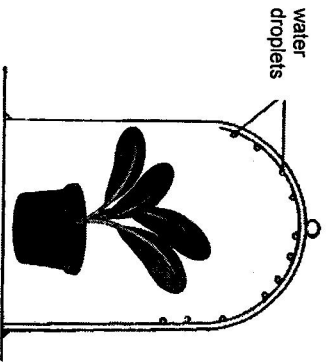


Fig. 3.1

(a) (i) During setting up, the edge of the bell jar is covered with a layer of wax. Explain the purpose.

To prevent leakage of water vapour from the bell jar to the atmosphere.

[1]

(ii) This experimental result may not be conclusive. Suggest a modification to the set-up that would make the results more conclusive. Explain your rationale.

[2]

Modification	Rationale for modification
Cover the pot/soil with plastic bag.	Prevent evaporation of water from the soil/pot.
Reject: to include sodium bicarbonate etc.	

(iii) Describe a test to confirm that the liquid droplets are water.

[1]

Use anhydrous cobalt chloride paper. It changes from blue to pink in presence of water.
OR
Use anhydrous copper(II) sulfate. It changes from white to blue in presence of water.

- (b) Describe how you would set up a control for this experiment. [1]
Set up the same experiment without the green plant/ with leaves removed from green plant.

- (c) (i) Predict the observations when the set-up in Fig. 3.1 is moved to a dark room for 24 hours. [1]
Lesser water droplets.

- (ii) Explain your answer in (c)(i). [3]

In the dark, the guard cells (which do not photosynthesize) has a higher water potential than the cells around them; water leaves via osmosis across a selectively permeable membrane; The guard cells become flaccid and stomata closes, (resulting in a lower rate of transpiration).

4 Fig. 4.1 shows the changes in pressure in the left side of the heart during the cardiac cycle.

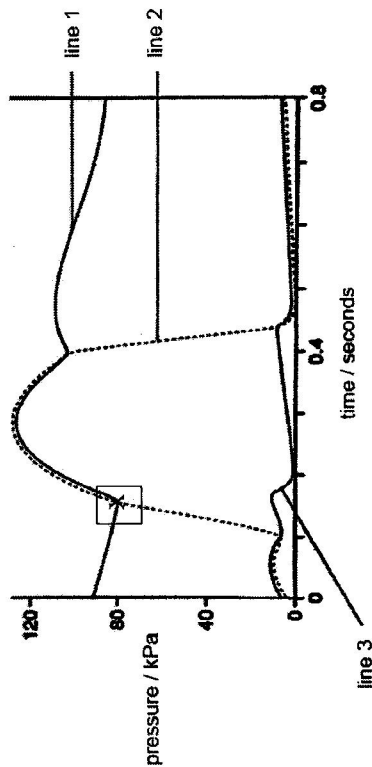


Fig. 4.1

- (a) Using the information in Fig. 4.1, state the ratio of the duration of the atrial systole to the ventricular diastole. [1]

0.1 : 0.5 or 1:5

- (b) On Fig. 4.1, label X when the semi-lunar valves first open. [1]

- (c) Using your answer in (b), describe the change in pressure in line 1 from 0.15 s to 0.3 s and state the importance of this change. [2]

Pressure in Line 1 increases.
This allows blood to flow from left ventricle to aorta (and then to all parts of the body)

- (d) State one difference in pressure if line 2 is recorded in the right side of the heart. [1]

The maximum pressure is lower in the right side.

- (e) Explain the change in pressure from 0.1 s to 0.2 s in line 3. [1]

The sudden closure of the bicuspid valves prevent the backflow of blood back into the atrium, causing the blood pressure to increase in the atrium momentarily.

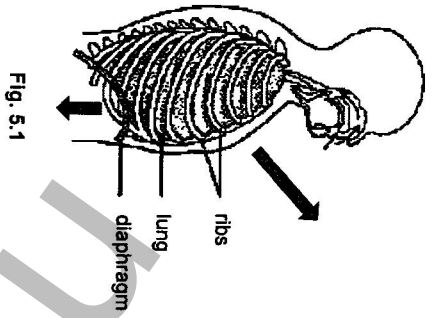


Fig. 5.1

- (a) Draw an arrow each on Fig. 5.1 to indicate the direction of movement during inhalation for
- the ribs, and
 - the diaphragm.
- [1]

A pupil wants to compare the breathing of a normal person at rest and during strenuous exercise.

Table 5.1 shows information recorded by the pupil.

Table 5.1

Quantity measured	at rest	during strenuous exercise
Volume of air inhaled per breath / cm ³	600	620
Rate of breathing OR number of breaths per min [1 mark]	Lower number	Higher number (at least 2X) Both numbers acceptable = 1 m

- (b) Suggest what further information can be included by the pupil in Table 5.1 and the approximate values that may be recorded in order to achieve a more significant comparison. [2]

Chronic kidney failure often starts from prolonged glomerular damage in the kidney nephrons. Fig. 6.1 shows what happens during glomerular damage and the body's response towards it. Table 6.1 shows some information about the blood in a normal and damaged kidney respectively.

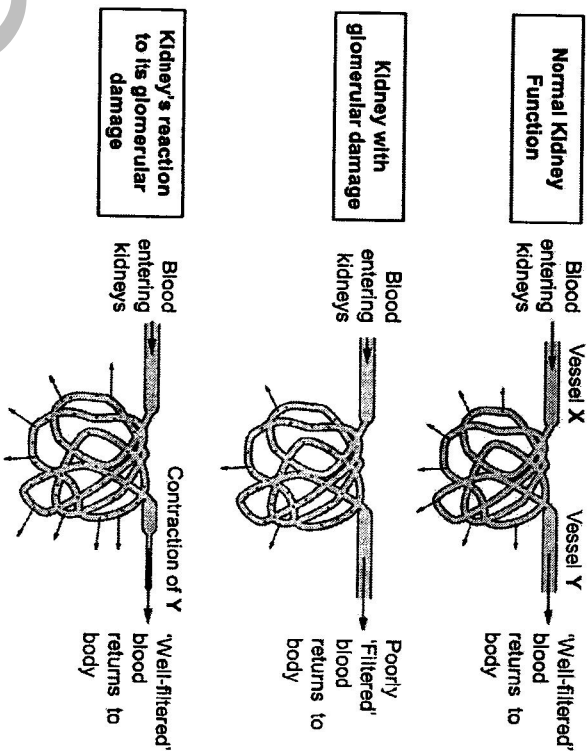


Fig. 6.1

Number of → indicates the relative amount of fluid being filtered

Table 6.1

	Normal kidneys	Kidneys with damaged glomeruli
Percentage of blood filtered (%)	100	80 – 90
Presence of proteins in urine?	No	Yes

(a) Using information from Fig. 6.1 and Table 6.1, suggest and explain how damaging the glomerulus in the kidney nephrons leads to kidney failure after a prolonged period of time. [4]

- Lower pressure causes blood not to filter out sufficiently small molecules completely from glomerulus [1]
- Y constricts and makes it harder for the blood to leave the glomerulus. [1]
- Raises blood pressure within glomerulus and hence increases the efficiency of ultrafiltration. [1]
- For prolonged period of time, the pressure become so large that bigger molecules are filtered ff and goes into the urine. This leads to kidney failure. [1]

(b) Suggest why patients who suffer from glomerular damage will often also

- (i) develop a high blood pressure in the kidneys [1]
- Higher blood pressure leaving glomerulus due to constriction of Y.

(ii) have traces of blood in their urine. [1]

- Pressure created by constriction of Y will also create greater ultrafiltration effect and allow red blood cells to be filtered out through the glomerulus into the nephron.

7 Fig. 7.1 shows the structures of two flowers, X and Y.

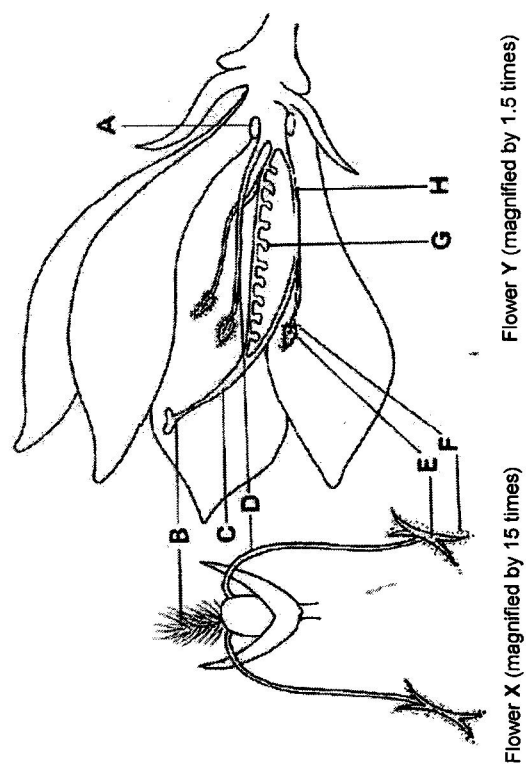


Fig. 7.1

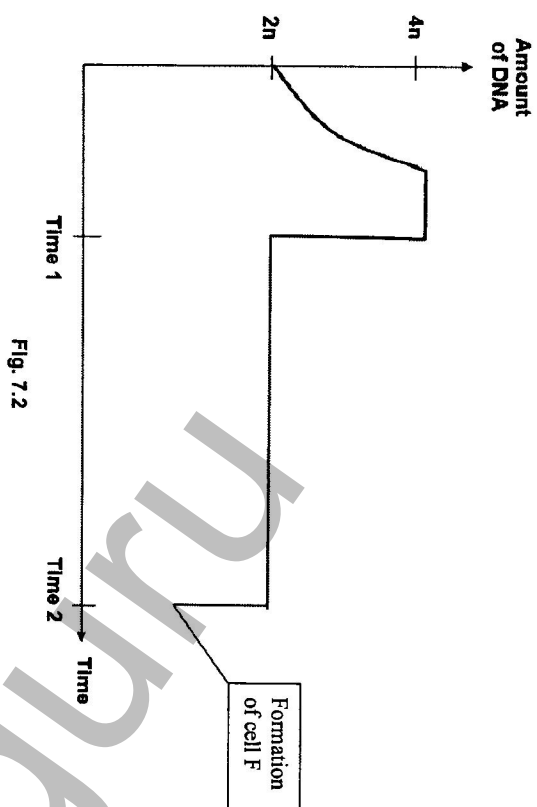
(a) Name the labelled structures below. [2]

- A
 C
 G
 H
- nectary
 style
 ovule
 ovary

(b) With reference to Fig. 7.1, suggest how the following common parts assist in the process of pollination for each flower. [2]

	Flower X	Flower Y
Structure B	Stigma is large, extended and feathery so that pollen grains from insects can be captured easily	Stigma is smaller, enclosed inside flower and has a sticky surface so that pollen grains from insect's body can stick.
Structure D	Pendulous and protrude out of petals to allow wind to assist pollen grains	Non-pendulous and does not protrude - pollen grains can stick onto insects when they search for nectar

(c) Fig. 7.2 shows the incomplete changes in genetic (DNA) content in a single cell leading to the formation of cell F.



- (i) Complete the line from Time 1 to Time 2 on Fig. 7.2 to show the formation of a cell F. [1]
- (ii) Label on the graph the point at which cell F is first formed, with the words "formation of cell F". [1]
- (iii) Using a diploid number of four chromosomes, illustrate in the spaces below, the metaphase stage in cell E and the metaphase I stage in cell F during cell division. [2]

Metaphase in E : correct no. of chromosomes and alignment [1]	
Metaphase I in F : correct no. of chromosomes, synapsis + alignment [1]	
metaphase in E	metaphase I in F

8

Fig. 8.1 shows a mammalian foetus developing in its mother's womb.

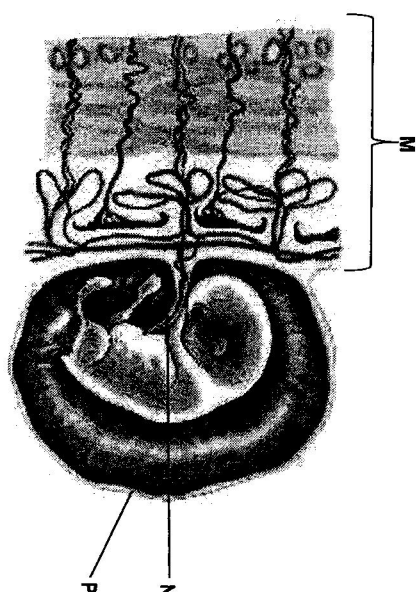


Fig. 8.1

- (a) Name the parts labeled M, N, and P. [2]
- M Placenta
- N Umbilical cord
- P Amniotic sac
- (b) Structure M is also an endocrine gland. Describe the role of M as an endocrine gland and explain its importance. [1]
- ~~Secretes progesterone to maintain the uterine lining.~~
- (c) Explain how the foetus is affected when structure M fails to develop normally. [2]
- Fetus unable to obtain nutrients/ oxygen (stated example) for development.
Fetus unable to remove waste such as CO₂ or urea and become toxic to fetus / toxins will accumulate.
- (d) State one role of the fluid found in structure P. [1]
- Supports and cushions the fetus during pregnancy/
Protects fetus from physical injury/cannot be compressed/
Lubricates and reduce friction during birth/
Allows foetus some degree of movement, i.e. muscular development/

9 Fig. 9.1 shows a food web in an ecosystem.

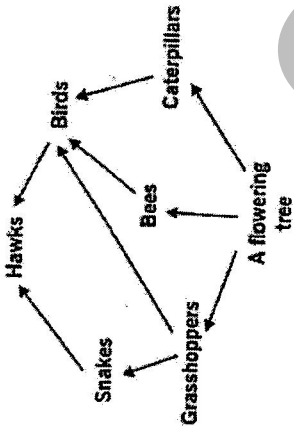


Fig. 9.1

(a) Draw a pyramid of numbers for a food chain involving caterpillars. [1]



(b) Which of the organisms, bees or caterpillars, are biologically beneficial to the tree? Explain your answer. [2]

Bees:
They help pollinate the tree, since the tree is a flowering plant.

(c) Explain the following observations:

(i) The bee population remains relatively constant when there is a sudden decrease in the population of caterpillars. [1]

They do not compete for the same type of food, i.e. bees feed on nectar while caterpillars feed on leaves.

(ii) The grasshopper population increases initially but decreases afterwards when snakes are removed from the food web. [1]

No predators (snakes) thus grasshoppers can reproduce more.
Overpopulation leads to intense competition for food, thus insufficient food to support rapid growth and population decline:

Section B

Answer three questions.

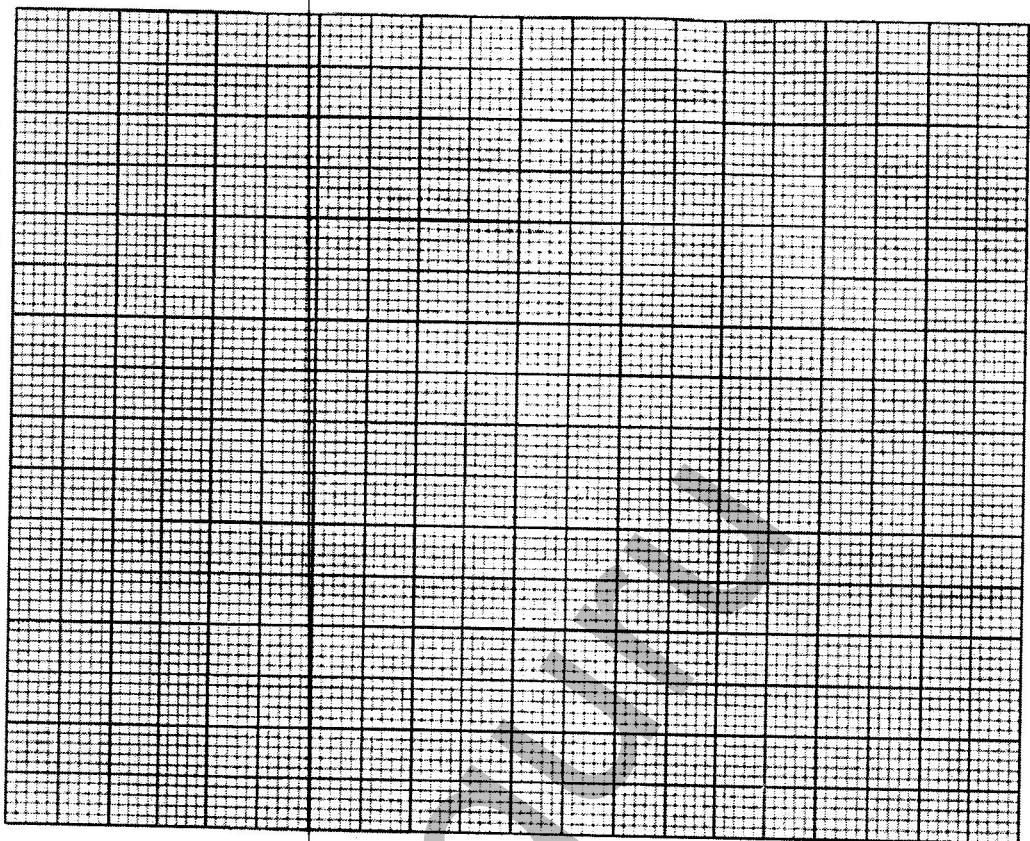
Question 12 is in the form of an Either / Or question. Only one part should be answered.

- 10 The rate at which blood glucose concentration changes is affected by the food eaten by a person. In an experiment, a healthy person ate two slices of white bread.
- The increase in her blood glucose concentration from her initial concentration was recorded over the next 120 minutes. The experiment was then repeated with two slices of wholemeal bread. The results of the experiment are shown in Table 10.1.

Table 10.1

Time (minutes)	Increase in blood glucose concentration from initial concentration in mg/100cm ³ of blood	
	white bread	wholemeal bread
20	4.4	2.8
40	8.0	6.0
60	11.4	5.2
80	12.0	4.8
100	6.0	0.0
120	0.0	0.0

(a) Plot suitable line graphs using the grid given below to represent the data in Table 10.1. [4]



- Marking scheme :
- [1] – both axes labeled
 - [1] – acceptable scale (at least 1/2 of graph paper)
 - [1] – correctly plotted points for both graph
 - [1] – smooth lines / curve

15

(b) Using information from Table 10.1, contrast the changes in blood glucose concentration when the person ate the white bread and the wholemeal bread. [4]

Contrasting points (3 marks) :		
	White bread	wholemeal bread
Maximum sugar level	doubled (12 mg)/100cm ³	6 mg / 100cm ³
Time to reach peak sugar level	slower (80 min)	faster (40 min)
Increase in blood sugar / effect	longer effect (stop after 120 min)	shorter effect (stop after 100 min)
[1 mark for use of data in 2/3 points]		

(c) Explain why wholemeal bread is a better choice for diabetics. [2]

- [Any one effect of wholemeal bread in assisting diabetics] – 1 m
- Lower maximum sugar level than white bread
 - Increase in blood sugar occurs over a shorter period of time
- [point regarding insulin] – 1 m
- Low amount of insulin present in diabetics to convert excess glucose to glycogen

16

Actions can be coordinated by different nervous pathways. Two such actions are shown below:

Action 1	A student is touching a kettle of water to feel whether it is hot.
Action 2	A student accidentally touches a kettle of hot water and withdraws his hand immediately.

(a) Outline three ways in which Action 1 is different from Action 2. [3]

Action 1	Action 2
Voluntary action	Involuntary action / Reflex action;
Brain is involved / under control of the will	Brain not involved / not under the control of the will;
Slower & deliberate action	Immediate, instantaneous action
- Involves: - brain - relay / intermediate neurone - effector / motor neurone	- Involves: - sensory / receptor neurone - relay / intermediate neurone - effector / motor neurone;
1 pair [1]. Max [3]	

Fig. 11.1 displays the structures in the human eye after it is dissected.

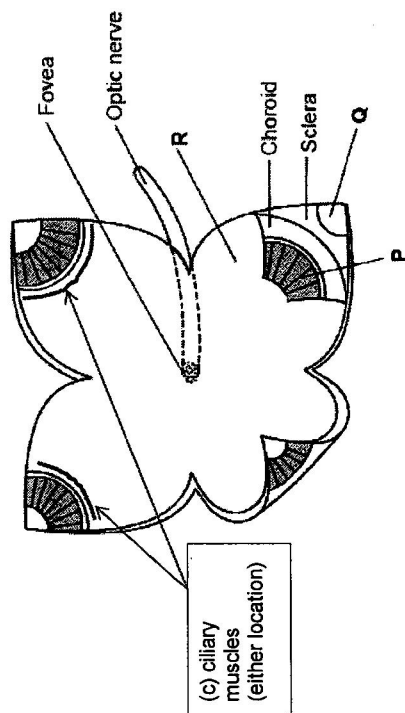


Fig. 11.1

(b) Explain how P, Q and R would respond when the eye is exposed to increased light intensity. [4]

Identify P, Q and R in your answers.

Q, which is cornea, has no response;

The circular muscles of the iris, P, will contract and the radial muscles of the iris will relax;

The pupil will constrict / aperture decreases;

Photoreceptors on R, the retina, will be stimulated (by increased light intensity) and an impulse transmitted to the brain for pupil reflex to take place.

(c) Indicate on Fig. 11.1, with a labelled arrow, the location of a muscle which is important in producing focused images of near and far objects. [1]

(c) Fig. 11.2 shows the structures of a normal eye and an eye with symptoms of glaucoma.

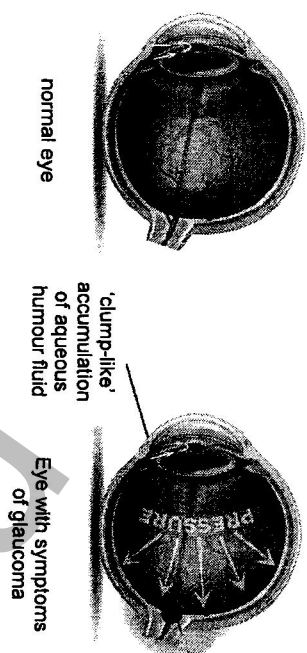


Fig. 11.2

Using information from Fig. 11.2, suggest how the following symptoms of glaucoma affect vision:

- (i) 'clump-like' accumulation of aqueous humour fluid
Front of eye is more firm and hard / uneven, and light unable to be refracted effectively into pupil (Textbook page 274)
- (ii) pressure in the vitreous humour
Increased pressure will damage / destroy retina / fovea / optic nerve (Textbook page 274)

12 Either

(a) Distinguish between the terms *gene* and *gene mutation*.

... A gene is a unit of inheritance / a sequence of bases that controls the formation of a single polypeptide
... Gene mutation is a sudden, random change in the structure of a gene.

Fig. 12.1 shows *heterochromia*, a mutation that results in a different colour of iris in each eye. The dominant eye colour is brown, and the recessive eye colour is blue.



Fig. 12.1

Fig. 12.2 shows the inheritance of heterochromia in a family.

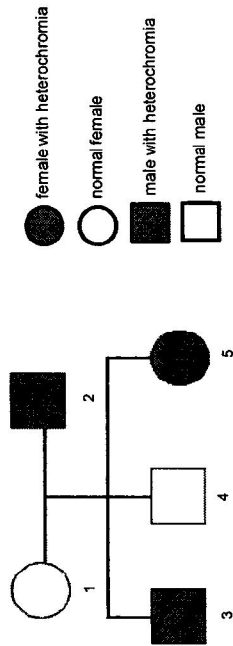


Fig. 12.2

- (b) Explain how heterochromia is passed down from individual 2 to some of his offsprings. [1]

.....
 Mutation occurs in the gametes / sperms / haploid cells, and are passed down during fertilisation (to form a diploid zygote)

- (c) Using suitable symbols, construct a genetic diagram to show the outcome of the offsprings if mutation did not occur at the first generation, and individual 2 remains blue-eyed. [3]

Let the allele for brown eye colour be T				
Let the allele for blue eye colour be t				
Parental phenotype	brown	x	blue	
Parental genotype	TT	x	tt	
Gametes	T	T	t	t
Random fertilisation				
F1 genotype	Tt	Tt	Tt	Tt
F1 phenotype	brown	brown	brown	brown
F1 ratio			100 % brown	

Read the following extract below regarding 'designer babies'.

The Fertility Institutes clinic in Los Angeles has just started offering prospective parents the opportunity to select physical traits of future offspring thanks to "cosmetic medicine".

But other fertility experts are outraged that the clinic is seeking to capitalise on dramatic advances in embryo cell analysis designed to identify dangerous diseases and defects in the unborn. They are angered that the so-called 'cosmetic medicine' is distracting public attention from how the pioneering medical technology can have children free of debilitating genetic conditions.

Clinic director Dr Jeff Steinberg, who as a young medic was part of the team involved in the birth in Britain in 1978 of Louise Brown, the world's first test tube baby, is undeterred.

"It's incredibly exciting," he told The Sunday Telegraph. "I live in LA and everyone here wants to have a straight nose, different and unique eye colours and high cheekbones and are perfectly happy to pay for cosmetic surgery."

"I understand the ethical concerns, but we cannot escape the fact that genetic engineering is moving forward. If I have to get smacked around by people who think it is inappropriate, then I'm willing to live with that."

Reported by Philip Sherwell for *The Telegraph*, Feb 2015

- (d) Describe how a unique trait could be utilised for designer babies given the fact that genetic engineering is moving forward'. [3]

- isolate desired gene using restriction enzyme
- Cut bacterial plasmid with similar restriction enzyme
- Anneal heterochromia gene into plasmid with DNA ligase
- Apply heat / electric shock to transfer transgenic plasmid into bacteria
- Allow bacteria to cultivate in fermenter
- Unique gene sequence is now available in many copies when use is desired

- (e) List two 'ethical concerns' with regards to the science of designer babies. [1]

1. Morally wrong to exploit mutation for commercial use
2. May lead to class distinctions
3. Any acceptable / logical answer

- (a) Describe how carbon in a glucose molecule in an animal's body is cycled in an ecosystem and the role of decomposers in this recycling. [4]

[During Respiration] carbon dioxide gas releases when glucose is oxidized;
 [In Photosynthesis] carbon becomes incorporated into plants as starch;
 [Feeding] starch when consumed by animals, becomes glucose again upon digestion or even stored as glycogen;
 [Decomposers] helps to release the remaining trapped carbon in a dead animal, by feeding on them and breaking them down, and releases carbon dioxide into the environment.

- (b) Explain why it is advantageous to have short food chains. [3]

{general idea of more stored energy passed on to the next level in shorter food chains}, as :
 [Fact 1] About 90% of energy is lost to the environment at every trophic level, leaving only 10% to be passed on to the next level.
 [Fact 2] energy lost as heat during respiration besides making energy [ATP], and heat energy is non-recoverable.
 [Fact 3] Undigested matter as in faeces loses energy in the form of organic matter
 [Fact 4] Excretory waste products as in urine or sweat, loses metabolic products
 [Fact 5] Uneaten body parts like bones and left to be decomposed also is a loss of organic matter

General idea + 3 Facts = 3 marks

- (c) Using suitable examples, differentiate between the terms 'bioaccumulation' and 'bioamplification'. [3]

[Idea of chemicals / insecticides when released into the environment such as soil or water may be taken up into crops or fishes].
 [Bioaccumulation] chemicals accumulate in the tissues because it is non-biodegradable or it is absorbed into the body of the organism such as into the fatty tissues, so may not be excreted. When consumer feeds on the plants/fishes, and then gets fed on, the level of insecticide just builds up;
 [Bioamplification] Predators consume many fish, resulting in the increased quantity of insecticides in their bodies;

End Of Paper

- (c) (i) Name the component of cigarette smoke that disables the function of Cell B.

[1]

- (ii) Describe how the component you have stated in (c)(i) will cause a respiratory disease.

.....

.....

.....

.....

[2]

- (d) In the smoker's lungs, cells in the lungs sometimes undergo uncontrolled cell division to form cancerous tissues.

Name the type of cell division that these cells undergo.

[1]

[Total: 10]

2

Photosynthesis is important to plants as the whole ecosystem is dependent on plants.

In nature, there are many limiting factors that affect this process. To increase yield, farmers grow their plants in greenhouses. Fig. 2.1 shows one such greenhouse.

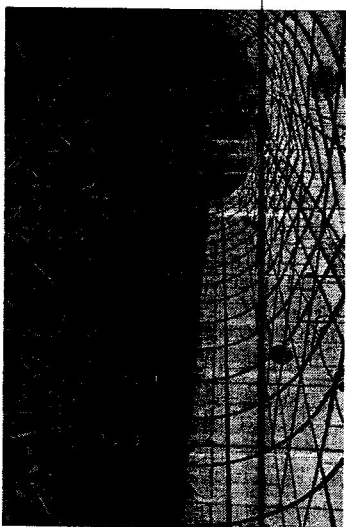


Fig. 2.1

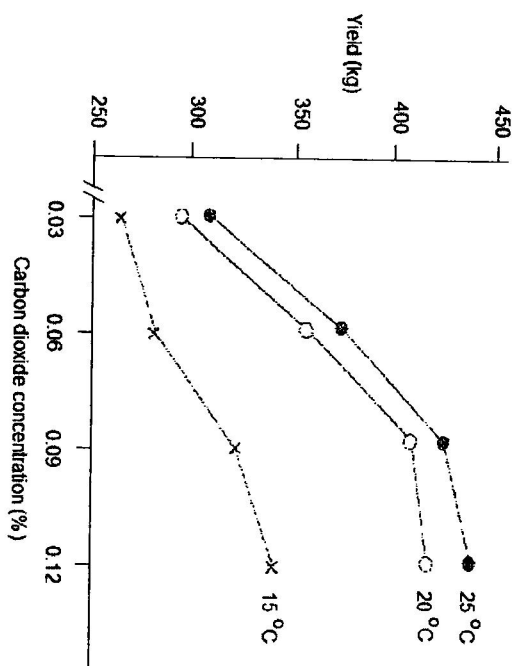
- (a) Write a balanced chemical equation for photosynthesis.

[1]

- (b) State two limiting factors of photosynthesis which can be controlled in a greenhouse.

[1]

- (c) Graph 2.1 shows the yield of the plants which are grown in a greenhouse under different conditions.



Graph 2.1

- (i) Describe the relationship between temperature and yield.

[1]

- (ii) Explain why the changes in temperature affect plant yield.

[1]

- (d) Hydroponics is a method by which plants are grown without soil. Plants are instead grown in water with dissolved nutrients.

Suggest two advantages and one disadvantage of using hydroponics.

Advantages:

.....

Disadvantage:

.....

[3]

[Total: 7]

3 Fig. 3.1 shows some of the feeding relationships in an oak woodland.

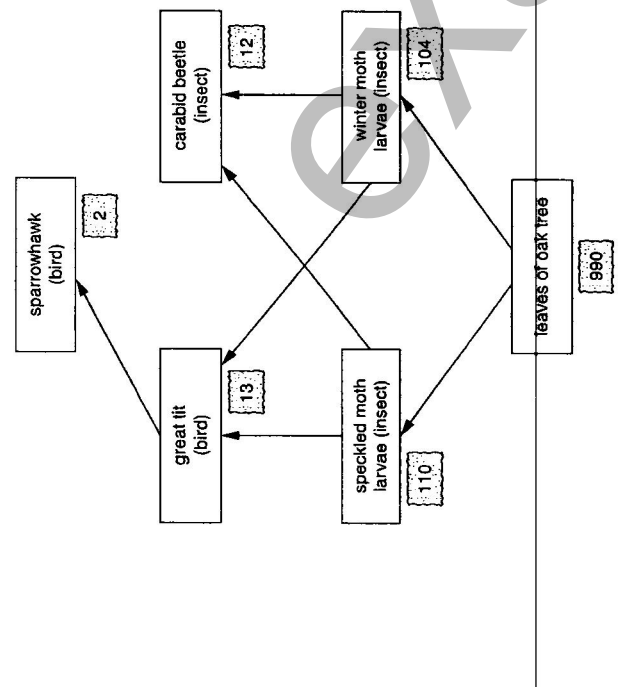


Fig. 3.1

(a) Name the following consumers in this food web.

Secondary consumer: [2]
Tertiary consumer: [2]

(b) Based on Fig. 3.1, draw a pyramid of biomass for a food chain that consists of 4 trophic levels.

[2]

(c) The leaves of the oak tree are the only part of this food web capable of trapping energy by photosynthesis.

Calculate the percentage of the energy trapped by the oak leaves, which becomes part of the tissues of the primary consumers.

Show your working clearly.

..... % [2]

(d) Suggest what will happen if there was a decline in the numbers of winter moth larvae.

.....
.....
.....
..... [2]

[Total: 8]

4 Fig. 4.1 illustrates translation, a molecular process that occurs in cells.

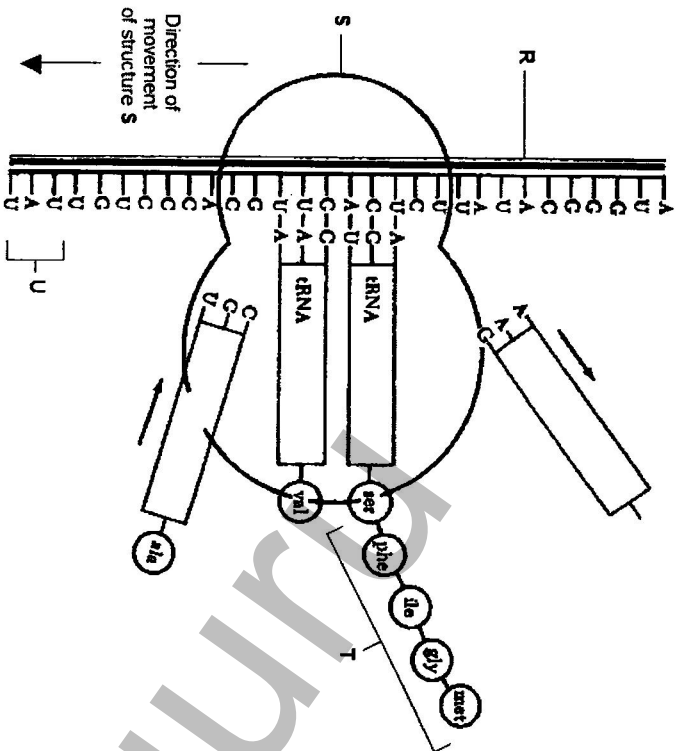


Fig. 4.1

(a) Explain where the subunits of molecule T come from.

..... [2]

(b) The base sequence of a segment of molecule R in Fig. 4.1 is given below:

AUGGCAUAUUC

Provide the corresponding base sequence on the DNA template which codes for molecule R.

..... [1]

(c) Name the following labelled structures on the figure.

R	S	
T	U	

[4]

(d) State a human cell in which translation does not occur.

..... [1]

(e) In the space below, tabulate two differences between DNA and molecule R.

[2]

[Total: 10m]

5 A small tube called a catheter is inserted into the body through a vein. It is then threaded through the heart until its tip lands in the pulmonary artery. Here, a tiny balloon at the tip is used to measure the pressure changes.

Fig. 5.1a shows a section through the heart with the catheter in place. Fig. 5.1b shows the graph of pressure changes recorded in the pulmonary artery.

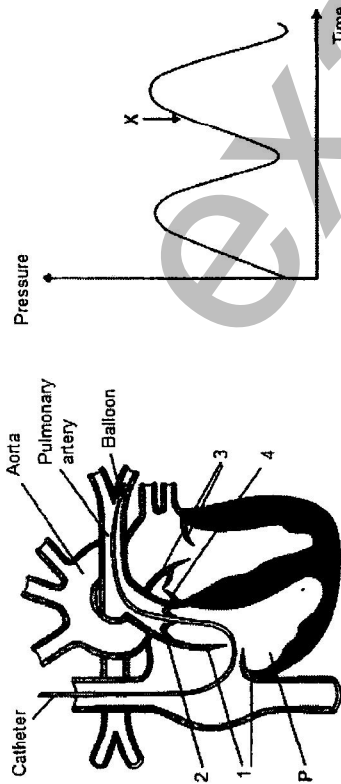


Fig. 5.1a

Fig. 5.1b

(a) Name the chamber of the heart labelled P in Fig. 5.1a.

(b) Complete the table below by placing a tick (✓) in the appropriate boxes to show which of the valves will be open at time X indicated on the graph in Fig. 5.1b.

Valve	Open
1	
2	
3	
4	

(c) Explain one way in which the pulmonary artery is adapted to cope with the condition it experiences at time X on the graph in Fig. 5.1b.

6 A delicate balance is necessary between the tendency to clot to prevent blood loss and the tendency to form clots unnecessarily.

To prevent unnecessary blood clot formation, anti-thrombin III, a protein which inhibits the formation of thrombin circulates in the blood.

(a) Explain how anti-thrombin III prevents inappropriate clot formation.

(b) In a scientific study, a group of mice were injected with a chemical that prevents the production of anti-thrombin III.

(i) A significant number of the mice died of cardiac arrest.

Explain this outcome with regards to coronary heart disease.

(ii) Another group of mice in the same scientific study as in (b)(i) were instead fed pellets containing anti-thrombin III. These mice also did not survive.

Explain what happened to the anti-thrombin III which were fed to the mice.

[Total: 7]

7 Fig. 7.1 illustrates a pedigree chart that shows the inheritance of Salla Disease (SD), a condition caused by a mutation in the SLC17A5 gene which is located on human chromosome 6.

Individual 1 of generation III is affected by SD.

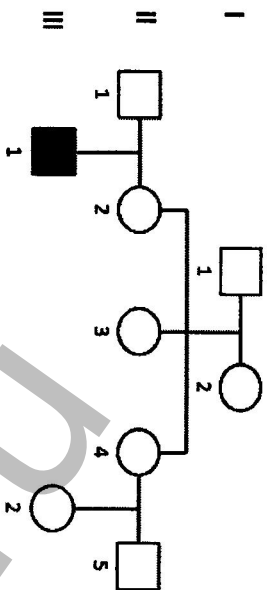


Fig. 7.1

(a) Use the evidence from the chart to prove that the disease is a recessive one.

.....

 [2]

(b) In the space below, tabulate two differences between the mutations causing SD and Down Syndrome.

[2]
 [Total: 4]

Section B (30 marks)

Answer three questions in the spaces provided.

Question 10 is in the form of an **Either / Or** question. Only one part should be answered.

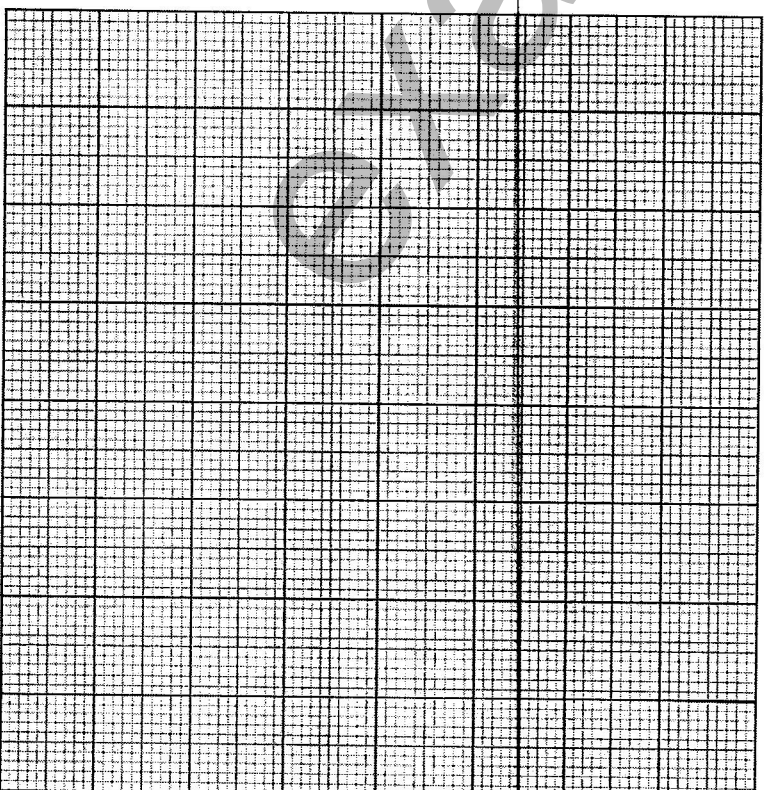
8 Table 8.1 shows the annual catches of two species of fish.

Year	Catches (thousands of tonnes)						
	1970	1974	1976	1978	1980	1982	1984
Atlantic cod	1550	1250	750	600	550	500	650
Atlantic herring	3000	1650	1250	900	750	550	700

Table 8.1

(a) Plot two point to point curves in the grid space below with the dates on the horizontal axis. Label each line.

[4]



- (b) (i) Describe the general trend in catch size of the fish from 1970 to 1984.
.....
.....
- (ii) Suggest two reasons for this trend.
.....
.....
.....
- [2]
- (c) Account for the possible change in catch size in both fish species after 1982.
.....
.....
.....
- [2]

[2]
[Total: 10]

9 With named examples for each, explain the importance of active transport in plants and humans.

- (a) In plants:
.....
.....
.....
.....
.....

[3]

(ii) Salting is a common method used in food preservation as it prevents bacterial and fungal growth. Food that is preserved in this manner is immersed in concentrated salt solution.

Explain why salting is a good method of food preservation.

.....
.....
.....
.....
.....
.....

[3]

[Total: 10]

10 Either

(a) Define *hormone*.

.....

.....

.....

.....

.....

[3]

(b) With reference to key hormones, organs and the principles of homeostasis, explain how blood sugar level is regulated when a large quantity of sugar is absorbed into the body.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

10 OR

(a) (i) State two benefits of Genetic Engineering.

.....

.....

.....

.....

.....

[2]

(ii) State a reason for the common use of plasmids in Genetic Engineering.

.....

.....

.....

.....

.....

[2]

(b) *Bacillus thuringiensis* (Bt), is a bacterium found in soil. Some strains of Bt produce lethal proteins that kill crop insects.

Genetic engineering has made it possible for plant cells to produce the same Bt lethal proteins which are then cultivated into whole plants.

Outline the steps that would have been undertaken by scientists to produce insect resistant crop plant cells.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[7]

[Total: 10]

G. Palai

[6]

[Total:10]

- End of paper -

1	(a)	The modification of features; to enable a specific/ different/ special/ unique function [R: enable function].												
	(b)	(i) Tracheal/ bronchus/ larynx												
		(ii) <table border="1"> <thead> <tr> <th>Cell A</th> <th>Cell B</th> </tr> </thead> <tbody> <tr> <td>Absence</td> <td>Folds on membrane</td> </tr> <tr> <td>Less cytosol/ cytoplasm</td> <td>More cytosol/ cytoplasm</td> </tr> <tr> <td>Less mitochondria</td> <td>More mitochondria</td> </tr> <tr> <td>More SER</td> <td>No SER</td> </tr> <tr> <td>Hour glass shaped [AW]</td> <td>Cuboidal shape</td> </tr> </tbody> </table>	Cell A	Cell B	Absence	Folds on membrane	Less cytosol/ cytoplasm	More cytosol/ cytoplasm	Less mitochondria	More mitochondria	More SER	No SER	Hour glass shaped [AW]	Cuboidal shape
Cell A	Cell B													
Absence	Folds on membrane													
Less cytosol/ cytoplasm	More cytosol/ cytoplasm													
Less mitochondria	More mitochondria													
More SER	No SER													
Hour glass shaped [AW]	Cuboidal shape													
		Remark: Any 2 pts.												
		(iii) Cell A secretes mucus; to trap dust and pathogens; Cell B sweeps the particle laden/ infected mucus upwards; out of the trachea/ preventing it from entering the lungs												
	(c)	(i) Tar/ irritants												
		(ii) Causes paralysis of cilia/ impairment of cilia structure; mucus is not swept out (of respiratory tubes); leading to blockage of tracheal/ bronchi/ bronchitis or leading to breakdown of air sac partition walls/ emphysema as a result of violent coughing.												
	(d)	Mitosis												

2	(a)	$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$ Or $6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
	(b)	Carbon dioxide concentration/ light intensity/ light duration/ air temperature/ water supply.

	(c)	(i) The higher the temperature, the higher the yield.
		(ii) Photosynthesis is an enzyme controlled reaction; increase in temperature will increase reaction.
	(d)	<u>Advantages</u> Eliminate pests which live in soil; Plants can be grown anywhere as long as their growth requirements are met; It uses much lesser water compared to soil based gardening; Provides a sterile environment for plant production; This technique does not require pesticides due to absence of soil-borne diseases; Crops grow much faster; Much smaller space needed for crop growth; Lesser labour involved; Greater control over nutrient balance; Easier to harvest the crop. Remark: Any 2 pts. <u>Disadvantage</u> Initial setup cost of hydroponic system is high/ high maintenance/ high building cost Requires constant supervision. Susceptible to power outage; in this case plants will dry out. Water-based microorganism can be easily introduced; Technical knowledge is required for growing plants through hydroponics.

3	(a)	Secondary consumer: Carabid beetle/ Great tit Tertiary consumer: Sparrow hawk
	(b)	
	(c)	$(110 + 104)/990 \times 100\%$ = 21.6%
	(d)	Both carabid beetle; and great tit; will depend on the speckled moth as the <u>only source of food</u> . moth number will decline rapidly

4	(a)	From the complete digestion; of ingested proteins (in food).												
	(b)	TAC CCG TAT AAG												
	(c)	R: mRNA S: ribosome/ rRNA T: (Segment of) polypeptide/ Protein/ U: Codon												
	(d)	Red blood cell												
	(e)	<table><tr><th>DNA</th><th>Molecule R</th></tr><tr><td>Consists of longer sequence of bases</td><td>Consists of shorter sequence of bases</td></tr><tr><td>Has A, C, T, G bases</td><td>Has A, C, U, G bases</td></tr><tr><td>Is double stranded</td><td>Is single stranded</td></tr><tr><td>Used as a template for mRNA synthesis</td><td>Used as a template for polypeptide synthesis</td></tr><tr><td>Involved in transcription</td><td>Involved in translation</td></tr></table>	DNA	Molecule R	Consists of longer sequence of bases	Consists of shorter sequence of bases	Has A, C, T, G bases	Has A, C, U, G bases	Is double stranded	Is single stranded	Used as a template for mRNA synthesis	Used as a template for polypeptide synthesis	Involved in transcription	Involved in translation
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Consists of longer sequence of bases	Consists of shorter sequence of bases													
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Used as a template for mRNA synthesis	Used as a template for polypeptide synthesis													
Involved in transcription	Involved in translation													

5	(a)	Right ventricle
	(b)	2 and 4 ticked.
	(c)	It has thick muscular walls; To prevent rupturing/ to withstand high pressure. OR It has elastic walls; to accommodate high volume of blood by stretch and recoil.

6	(a)	Prevents the formation of insoluble fibrin; which entraps red blood cells.
	(b)	(i) Blood clot occurred in coronary artery; preventing flow of blood; to cardiac tissue; which dies; due to oxygen deprivation.
		(ii) They were digested; by protease ; In the stomach/ small intestine.

7	(a)	SD only manifested in generation III/ SD skipped generations; parents of affected individual are carriers; indicating that the allele for the disease is has been masked/ suppressed.												
	(b)	<table><tr><th colspan="2">SD</th><th colspan="2">Down Syndrome</th></tr><tr><td colspan="2">Affects chromosome 6</td><td colspan="2">Affects chromosome 21</td></tr><tr><td colspan="2">Result of gene mutation</td><td colspan="2">Result of chromosomal mutation.</td></tr></table>	SD		Down Syndrome		Affects chromosome 6		Affects chromosome 21		Result of gene mutation		Result of chromosomal mutation.	
SD		Down Syndrome												
Affects chromosome 6		Affects chromosome 21												
Result of gene mutation		Result of chromosomal mutation.												

8	(a)	Axes labelled with variables and accompanying units; points plotted accurately (allow for one missing unit); point to point curves drawn.
	(b)	(i) Catch size decreased from 1970 – 1982; and then increased (slightly) from 1982 – 1984.
	(ii)	Improvement in fishing methods; overfishing; young fishes caught hence fish population cannot replace itself; pollution kills many fries.
	(c)	Breeding programs that increased fish population; banning of dynamite fishing; banning of trawling; implementation of specific fishing periods; enforcement of using nets with bigger holes; Banning of companies that flout fishing rules.

9	(a)	<u>In plants</u> The absorption of minerals in nutrient poor soil; for growth/ development/ protoplasmic increase/ nutrition chlorophyll synthesis etc. For transport of minerals into guard cell; to cause them to become turgid to cause stomatal opening. For the absorption of minerals by root hair cells; to lower its water potential for effective water absorption by osmosis. <u>In humans</u> The absorption of nutrients at small intestine; for nutrition/ for growth/ for assimilation; for the absorption of glucose by cells; for respiration. For the absorption of amino acids by cells; for enzyme synthesis.												
	(b)	(i) <table border="1"> <thead> <tr> <th>Active transport</th> <th>Diffusion</th> </tr> </thead> <tbody> <tr> <td>Energy required</td> <td>Energy not required</td> </tr> <tr> <td>Substances move against a concentration gradient</td> <td>Substances move down a concentration gradient</td> </tr> <tr> <td>Occur only in living cells</td> <td>Occurs in living cells and non living matter</td> </tr> <tr> <td colspan="2">Both occur in the presence of a concentration gradient</td> </tr> <tr> <td colspan="2">Both involve the movement of substances.</td> </tr> </tbody> </table>	Active transport	Diffusion	Energy required	Energy not required	Substances move against a concentration gradient	Substances move down a concentration gradient	Occur only in living cells	Occurs in living cells and non living matter	Both occur in the presence of a concentration gradient		Both involve the movement of substances.	
Active transport	Diffusion													
Energy required	Energy not required													
Substances move against a concentration gradient	Substances move down a concentration gradient													
Occur only in living cells	Occurs in living cells and non living matter													
Both occur in the presence of a concentration gradient														
Both involve the movement of substances.														

	(ii)	Salt is cheap/ salting is a fast method/ method of preservation can be carried out at home/ safe; salt dehydrates bacterial and fungal cells; cells need water to divide and grow by osmosis
--	-------------	--

10	Either	
	(a)	Chemicals secreted in minute quantity; by an endocrine gland/ secretory tissue; directly into the bloodstream; where it affects the function of a target organ(s); chemical is destroyed after it has exerted its effect.
	(b)	Blood sugar level increases; above norm; which is detected by the pancreas/ islets of Langerhans; which secrete insulin; which promotes rapid uptake of glucose; and promotes conversion of the glucose to glycogen by liver cells and skeletal muscle cells; And as blood sugar level decreases, insulin level decreases as well.

10	OR	
	(a)	
	(i)	Production of crops that grow in extreme conditions (To state an example); Production of crops that are pest/ insect resistant for better yield; Production of crops/ bacteria that are able to produce drugs (To state an example); Production of food products with specific nutritional goals; To increase crop yield to solve world hunger/ to increase profits/ for low cost farming;
	(ii)	It has a much shorter length of base sequence; It is much simpler in structure; It duplicates independent of bacterial cell division; Genes are easily mapped/ bases sequences are easily identified; Bacteria can also transfer plasmids to one another through a process called conjugation; Enables easy introduction into bacteria to enable transformation.

Candidate Name: _____

Class:	
Index No:	



Chong Boon Secondary School
Prelim Examination 2016
Secondary 4 Express
Pure Biology
Paper 2
5158/02

14 September 2016 (Wednesday)

1 hours 45 minutes

Additional Materials: **NIL**

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your class, register number and name on all the work you hand in.
 Write in dark blue or black pen in the spaces provided on the Question Paper.
 You may use a soft pencil for any diagrams or graphs.
 Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer three out of four questions.

Questions 8 and 9 are compulsory.

Question 10 is an EITHER/OR question. Only one part should be answered.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.
 The total marks for this paper is 80.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This document consists of 18 printed pages (including the cover page) and 2 blank pages.

Section A [50 marks]

Answer all the questions.

Write your answers in the spaces provided.

1 Many growers of crops in glasshouses use carbon dioxide enrichment to improve yields.

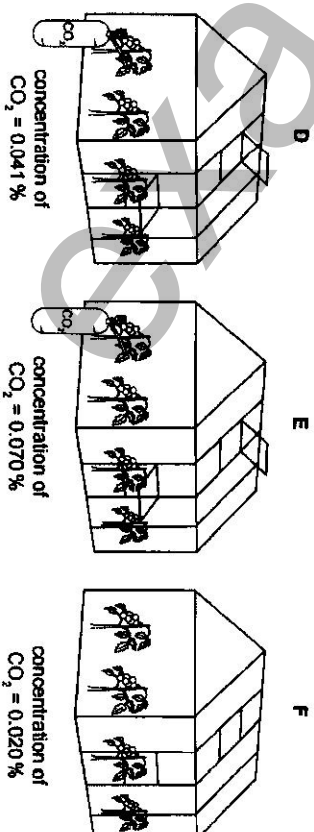
(a) Explain the advantages of carbon dioxide enrichment of glasshouses.

[2]

Fig. 1.1 shows the carbon dioxide concentrations inside three glasshouses, D, E and F, on a hot day with bright sunlight.

- Glasshouses D and E received carbon dioxide enrichment and were ventilated by opening the windows.
- Glasshouse F did not receive any extra carbon dioxide and the windows were closed.

The carbon dioxide concentrations in the glasshouses and in the atmosphere were measured. The concentration in the atmosphere was 0.039%.



The rate of uptake of carbon dioxide by the crop plants was measured in grams of carbon dioxide absorbed per square metre of glasshouse per hour.

These results are shown in Table 1.1.

Table 1.1

glasshouse	rate of uptake of carbon dioxide by crop plants / g per m ² per hour
D	2.5
E	5.7
F	1.0

(b) Suggest one reason why it may not be cost effective to maintain a high concentration of carbon dioxide in glasshouse E compared to the concentration of carbon dioxide in the atmosphere.

[1]

(c) (i) Concentrations of carbon dioxide in all three glasshouses in Fig. 1.1 increased at night. State why this happened.

[1]

(ii) Explain why it is important to ventilate glasshouses by opening the windows.

[3]

[Total: 7]

2 (a) Table 2.1 shows some of the top ten causes of death in parts of the world during 2010.

Table 2.1

cause of death	percentage of the deaths of adult males	percentage of the deaths of adult females
cancer (lung, alimentary canal, breast, prostate and others)	17	12
coronary heart disease	7	14
stroke (blood clot in brain)	17	10

Fig. 2.1 shows the data for the adult males.

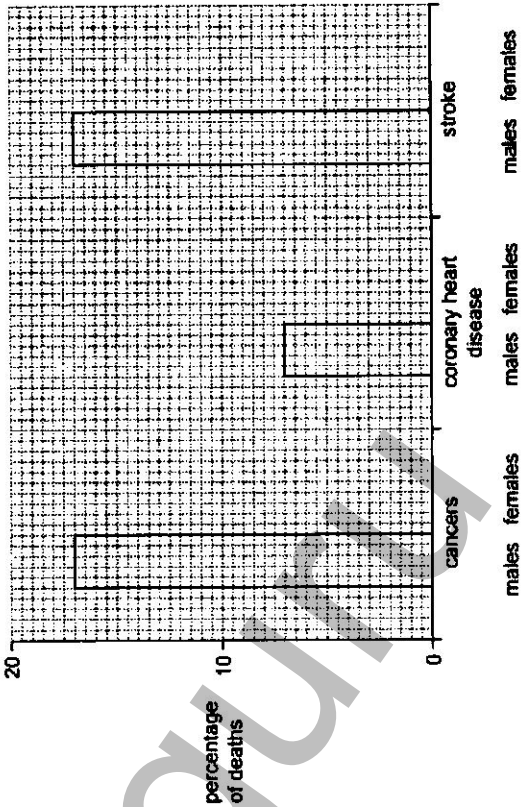


Fig. 2.1

2 (a) (i) Draw the bars for the adult females on Fig. 2.1. [1]

(ii) Calculate the percentage of males dying from causes other than those in Table 2.1.

Show your working.

(iii) State the type of cancer, listed in Table 2.1, that occurs only in males. _____ % [1]

_____ [1]

(b) The lifestyles of people can affect their risk of dying from some diseases.

(i) People with coronary heart disease (CHD) are unable to do much exercise.

State a cause of CHD and explain why people with this disorder are unable to do much exercise.

cause _____

explanation _____

_____ [3]

(ii) In 2010 2% of adult male deaths were due to liver disease.

Suggest one aspect of their life style that could have caused this.

_____ [1]

[Total: 7]

3 (a) Define hormones

_____ [2]

After a meal, the stomach produces gastric juice.

The production of gastric juice is controlled by both nervous and hormonal stimulation of glands in the stomach wall.

Fig. 3.1 shows the volumes of gastric juice produced in response to nervous stimulation (curve Y) and to hormonal stimulation (curve Z).

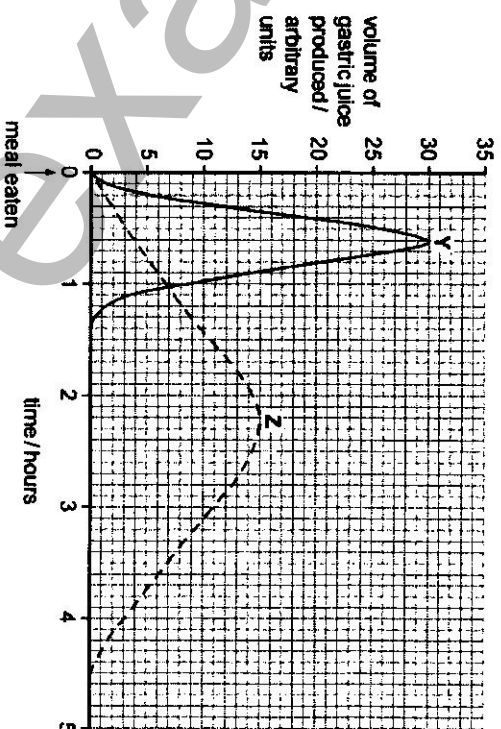


Fig. 3.1

(b) (i) Using Fig. 3.1, describe the differences in the production of gastric juice in response to nervous and to hormonal stimulation.

_____ [2]

5 Fig. 5.1 shows the results of an animal cell that is undergoing meiosis II.

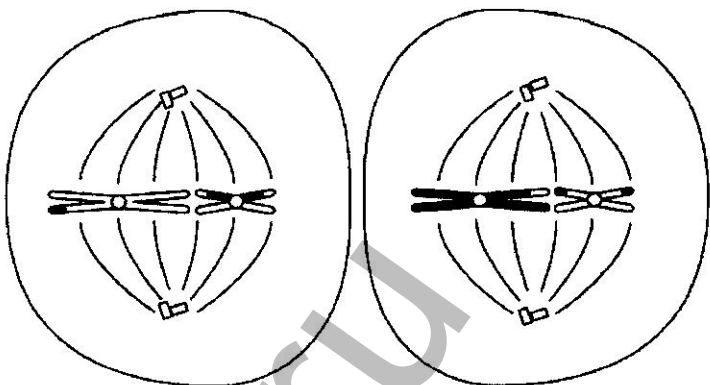


Fig. 5.1

- (a) State which stage of meiosis II is shown. [1]
- (b) Name and explain two ways in which meiosis can lead to variation. [4]

1 _____

2 _____

[4]

[Total: 5]

6 (a) Define the following genetic terms. [2]

recessive allele

heterozygous

- (b) Fig. 6.1 shows the hand of a person who suffers from a mutation that results in people having more than five digits on each hand (polydactyly). [2]



Fig. 6.1

The mutation that results in this condition is dominant.
Fig. 6.2 shows how the condition is inherited in a family.

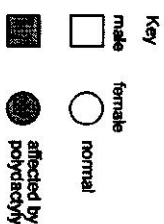
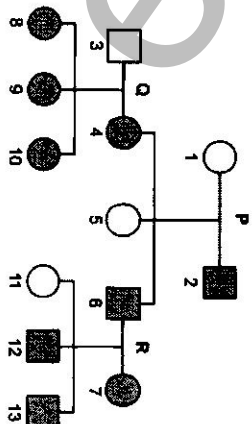


Fig. 6.2

- 6 (b) (i) State the genotype of the individuals shown in Fig. 6.2.
Use AA, Aa or aa.

Write your answers in Table 6.1.

Table 6.1

numbered person on Fig. 6.2	genotype of person
1	
2	
3	
9	

- (ii) Using evidence from Fig. 6.2, state which of the couples, P, Q or R, provides proof that the mutation is **not** recessive. [4]

couple [1]

- (iii) Explain the reason for your answer.

[2]

[Total: 9]

- 7 In 1970, scientists started counting different groups of birds living on a large island.

Fig. 7.1 shows how the numbers of four of these bird groups changed between 1970 and 2010.

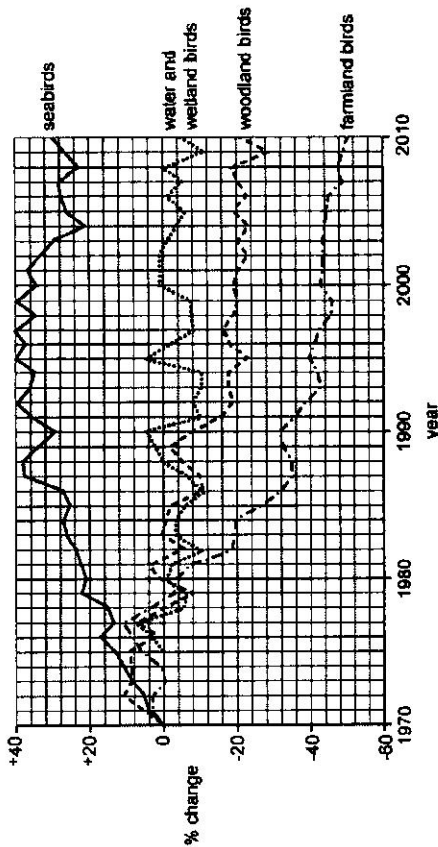


Fig. 7.1

- (a) Compare the results for seabirds with the results for woodland birds.

[2]

- (b) Suggest a reason for the change in the numbers of woodland birds since 1990.

[1]

- (c) The results for farmland birds are a particular cause for concern.
Describe why it is important to conserve species and their habitats.

[2]

[Total: 5]

Section B [30 marks]

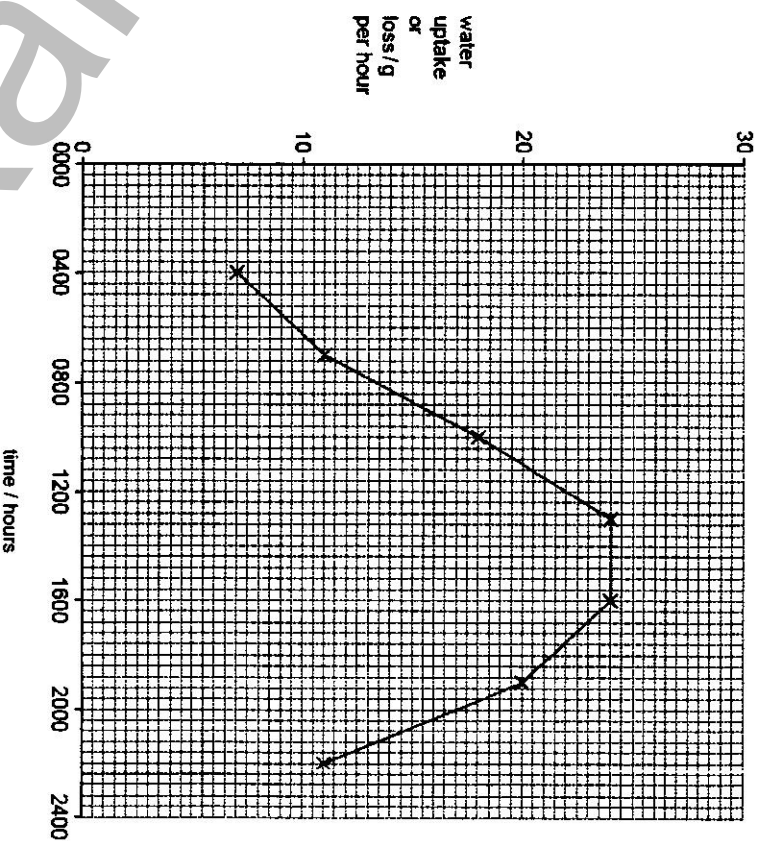
Answer three out of four questions.
Questions 8 and 9 are compulsory.
Question 10 is an EITHER/OR question. Only one part should be answered.
Write your answers in the spaces provided.

- 8 An investigation of the uptake and loss of water by a plant was carried out over 24 hours.
The results are shown in Table 8.1.

Table 8.1

time of day / hours	water uptake / g per hour	water loss / g per hour
0400	7	2
0700	11	8
1000	18	24
1300	24	30
1600	24	24
1900	20	13
2200	11	5

- 8 (a) The data for water uptake have been plotted on the grid below.



- (i) Plot the data for water loss on the same grid. Label both curves. [4]
(ii) State the process by which water is lost from the plant. [1]
(iii) State the two times at which the uptake and loss of water were the same. [1]

8 (b) Explain how a decrease in temperature and humidity would affect the water loss by this plant.

(i) temperature

[2]

(H) humidity

[2]

[Total: 10]

[3]

[Total: 10]

(a) Describe the role of natural selection in evolution.

[7]

(b) Explain, using one named example, how mutation can affect phenotype.

10 Either

- (a) Describe how the work of the kidneys is affected by changes in diet and atmospheric temperature.

diet

atmospheric temperature

- (b) If the kidneys fail, the patient may be put on a kidney machine.

Explain how a kidney machine works.

10 Or

- (a) Describe the events that occur after the body temperature falls that will return the body temperature to its normal level.

- (b) Explain what is meant by control by 'negative feedback'.

END OF PAPER

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examguru

Class	Full Name	Index Number
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Preliminary Examination I 2016

O
5158/02

BIOLOGY	
Paper 2	
Secondary 4 Express	
6 May 2016	1 h 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer all three questions, the last question is in the form either/or.

Write your answers in the spaces provided on the Question Paper.

Write an E (for Either) or an O (for Or) next to the number 9 in the grid below to indicate which question you have answered.

The use of an approved scientific calculator is expected, where appropriate.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
B7	
B8	
B9	
Total	

This document consists of 23 printed pages.

Setter: Miss Melissa Chong

Not to be completed during course of test / exam

This page will be completed under supervision of your subject teacher when reviewing the paper

Analysis of my Test / Examination Paper

1) In order of rank from 1 (most) to 5 (least), the reasons for lost marks in this paper are:

Rank	Deciphering question	Personal Proficiency	Time Management	Carelessness	Examination Strategies
	Inadequate understanding of questions and not knowing fully what question required.	Lack of deep understanding of concepts, which inevitably affects ability to apply concepts correctly.	Failed to allocate adequate time to complete all parts of paper. Answers were also not thoroughly checked.	Losing marks unnecessarily as questions were answered less than meticulously i.e. missing units, transferred answers inaccurately.	Little or no pre-determined plan on how to approach the paper in the most effective way.

2) Identify instances related to items ranked 1 & 2 above:

Rank	Short description of instances
1	
2	

3) In preparation for the next test / examination, I would do the following:

Name, Class & Signature of
Student

Acknowledged by Subject Teacher

[Turn over

SECTION A

Answer all questions in this section in the spaces provided.
The total mark for this section is 50.

A1 Fig. 1.1 shows a vertical section of the stomach, together with parts of the alimentary canal leading into and out of it.

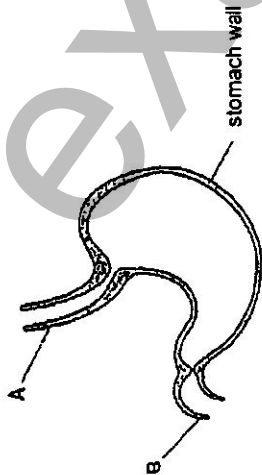


Fig 1.1

(a) Name the parts A and B.

A:

B:

The stomach is a bag-like structure with very muscular walls.

(b) Describe the role of the muscles in the stomach wall in digestion.

For Examiner's Use

For Examiner's Use

(c) Pepsin is a substance produced in the stomach. An investigation was carried out into the action of pepsin on proteins.

The test-tubes were set up as shown in Table 1.2 and placed in a water bath at 37°C for ten minutes.

Test-tube	Volume / cm ³		
	Egg white suspension	Hydrochloric acid	Sodium hydroxide
1	10	2	0
2	10	0	2

Table 1.2

At the beginning of the investigation, the contents of both test-tubes were cloudy. At the end of the experiment, only test-tube 1 became clear.

Explain the processes that caused the change in appearance of test-tube 1, but not in test-tube 2.

[2]

[4]

Turn over

Turn over

- A2** Fig. 2.1 shows an experimental setup to find the path and rate of water movement in the stem of a plant. Eosin solution is a red coloured liquid.

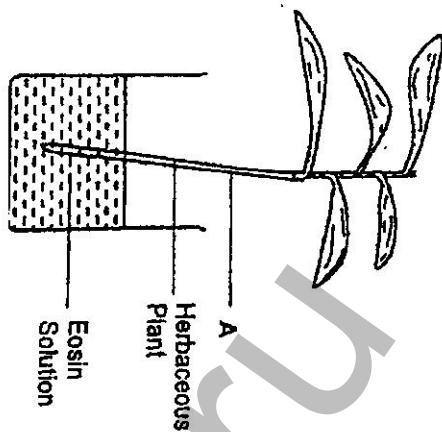


Fig. 2.1

- (a) State one important precaution in setting up this experiment. Give a reason for the precaution.

.....

.....

.....

[2]

- (b) Describe and explain how the experiment can be modified to increase the rate of water movement up the stem.

.....

.....

.....

[Total: 8]

For
Examiner's
Use

- (c) Fig. 2.2 shows a transverse section of a stem of a dicotyledonous plant.

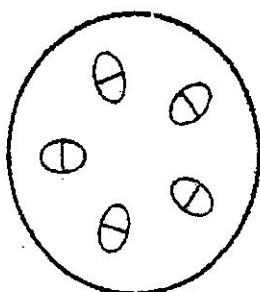


Fig. 2.2

If the plant in the experiment is cut at A as shown in Fig. 2.1, label clearly on Fig. 2.2 the position of the stained tissue.

[1]

- (d) Some weedkillers stop the plant from photosynthesising. These are often applied to the soil where the weeds are growing. Explain how the weedkiller reaches its site of action in the leaves.

.....

.....

.....

.....

.....

[4]

[Total: 9]

For
Examiner's
Use

[Turn over

[Turn over

A3 A student completed his 2.4km run for his NAPFA test in 10 minutes and then rested for another 10 minutes. Fig 3.1 shows the lactic acid and muscle glycogen concentration in blood samples of the student taken at different time intervals.

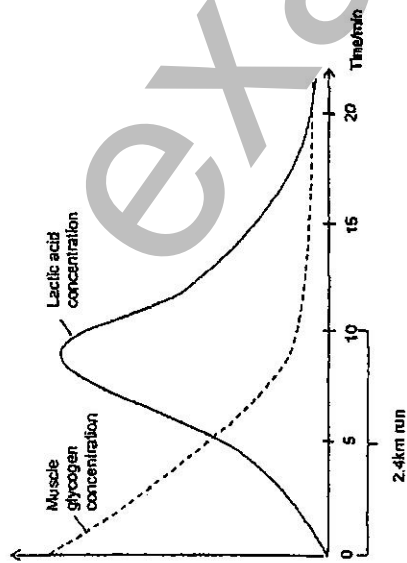


Fig. 3.1

(a) Define anaerobic respiration.

[2]

(b) Explain the decrease in muscle glycogen concentration during the 2.4 km run.

[3]

[Turn over

(c) Explain the change observed in lactic acid concentration during rest.

[4]

[Total: 9]

[Turn over

A4 Fig. 4.1 shows how the temperature of a person varies with time as he was driving.

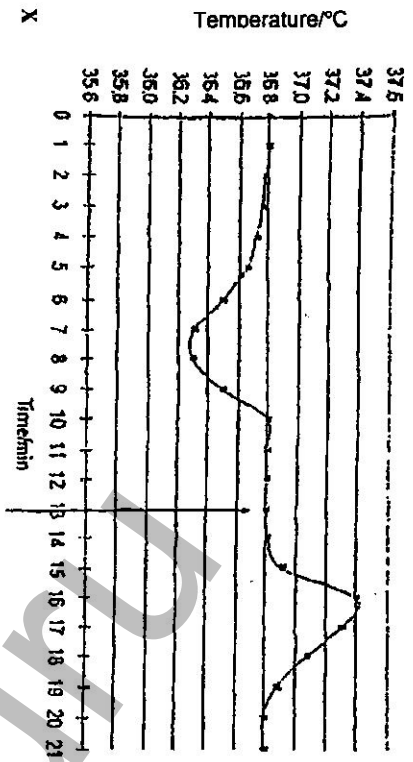


Fig. 4.1

- (a) At the 1st minute, the person switched on the air-conditioning in the car. Describe and explain one corrective mechanism in the skin that led to the change in temperature between the 8th and 10th minute.

[2]

[Turn over]

- (b) At point X, the car in front suddenly stopped, nearly causing an accident. This resulted in a change in temperature between the 14th and 16th minute. Using your knowledge of the endocrine and nervous systems, describe how this change is brought about.

[4]

- (c) Explain how the negative feedback mechanism prevents the body temperature from rising further once the danger is past.

[3]

[Total: 9]

[Turn over]

- A5** In an experiment, a person looked at the same light source from various different distances. The diameter of their pupil was measured at each position. Fig. 5.1 shows how the diameter varied.

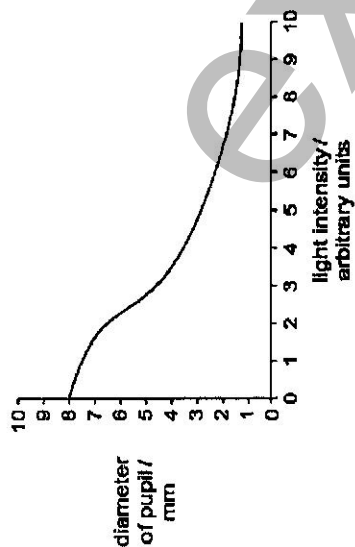


Fig. 5.1

- (a) Describe the relationship between light intensity and pupil diameter shown in Fig. 5.1.

[1]

- (b) Explain how the response in pupil diameter is brought about as the light intensity increases from 2 to 4 arbitrary units.

.....

.....

.....

.....

.....

.....

.....

[4]

[Turn over

- (c) Albino people lack colouring material (pigment) in their bodies and are advised to avoid the sun.

Suggest the reason behind this advice.

.....

.....

.....

[2]

[Total: 7]

A6

- (a) (i) State the name for chemicals that are secreted by glands into the blood and that affect organs elsewhere in the body.

[1]

- (ii) State the term used to name the organs that are affected by these chemicals.

[1]

- (b) Fig. 6.1 shows the blood glucose concentrations of three different people, G, H and J, over a 48-hour period.

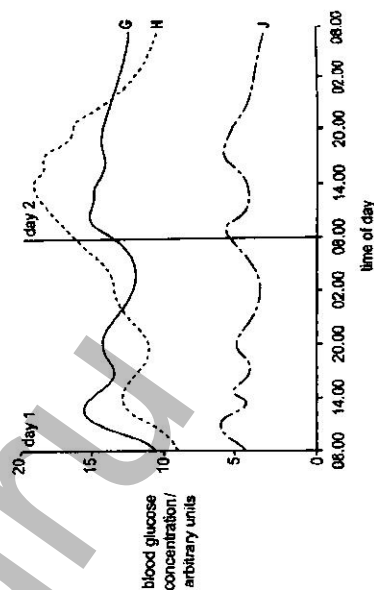


Fig. 6.1

[Turn over

Two of the people are diabetic. The pancreas of the first person produces small quantities of insulin. In the second person, the pancreas produces no insulin. The third person is not diabetic.

Using the information in Fig. 6.1 and giving a reason for your answer in each case, identify:

(i) the person without diabetes: [1]

Reason:

..... [1]

(ii) the person who produces no insulin: [1]

Reason:

..... [1]

(c) Diabetes can be treated by injection of insulin.

Insulin can now also be taken by breathing it in.

Suggest how insulin taken by breathing it in enters the blood.

..... [2]

[Total: 8]

END OF SECTION A

Turn over

SECTION B

Answer all questions in this section in the spaces provided.

Question B9 is in the form of an Either/Or question.

Only one part should be answered.

The total mark for this section is 30.

B7

The rate of a drug exiting the body via the kidneys was measured by injecting a radioactively labelled drug into a vein in the arm of a volunteer and measuring the radioactivity of urine samples collected in 1-hr intervals.

(a) Outline the shortest path a molecule can take from a vein in a person's arm to his kidneys, listing the major blood vessels and organs that the molecule will pass through.

[4]

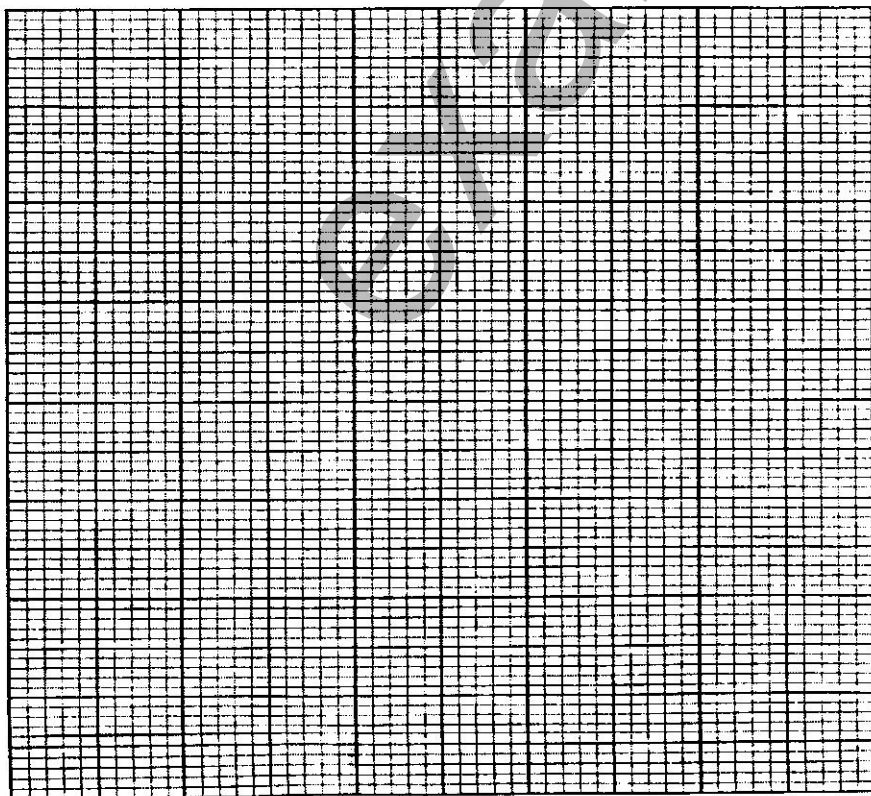
(b) The results are shown in Table 7.1.

Time / h	0	1	2	3	4	5	6
Radioactivity / arbitrary unit	0	0	10	5	2.5	1.2	0.6

Table 7.1

(i) Plot the data from Table 7.1 onto the grid on Page 15. [3]

Turn over



- (ii) Calculate the time for the radiation intensity to drop from its peak to half of [1]
the peak value.

Ans: _____

[Turn over

- (iii) The analysis of the radioactive molecules in the urine samples showed that the radioactive molecule is a fragment of the original drug molecule, and none of the original drug molecules are present.

Explain what could have occurred to lead to this observation and name the organ in the body that could have been involved in this process.

[2]

[Total: 10]

[Turn over

88

**For
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Use**

- (a)** Compare the characteristics of an insect-pollinated flower and a wind-pollinated flower. Explain the significance for the similarities and differences between the two flowers.

6

Turn over

For
Examiner's
Use

- (b) Explain why a plant species in which self-pollination usually occurs can become adapted to new surrounding better than the one that reproduces asexually, but less well than a species that is always cross-pollinated.



[4]

[Total: 10]

Turn over

19

B9 Either

- (a) Distinguish the composition of blood entering the heart at the right atrium and blood leaving the heart via the left ventricle.

For Examiner's Use

[3]

- (b) Table 9.1 compares the thickness of wall between an artery and capillary of a cat.

Thickness of wall (mm)	Artery	Capillary
	1.000	0.001

Table 9.1

Using the information in Table 9.1, explain how the difference in thickness of the wall of arteries and capillaries are related to their functions.

[3]

[Turn over

20

- (c) Mammals have a double circulation. What are the advantages of having a double circulation?

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[4]

[Total: 10]

[Turn over

A volunteer took part in a study in which his excretory remains were analysed after he was fed specific diets. During the first 24-hour period, the volunteer was fed a protein-deficient diet. In the second 24-hour period, the volunteer was fed a protein-rich diet.

The mass of all his excretory products were analysed and summarised in Table 9.2. All other variables in his lifestyle were kept constant during the span of the experiment.

substance excreted	mass of substance excreted /g	
	protein-deficient diet	protein-rich diet
urea	2.34	16.75
uric acid	0.08	0.21
ammonium ions	0.04	0.53
creatinine	0.57	0.65

Table 9.2

- (a) (i) Calculate the percentage increase in urea excreted when the volunteer switched from a protein-deficient to a protein-rich diet. Show your working.

Percentage increase: [2]

- (ii) Based on the data from the table and your calculations in (a)(i), describe the relationship between dietary protein and excretory substances produced.

.....

.....

.....

..... [2]

[Turn over

- (iii) Describe how excess protein is converted into urea.

.....

.....

.....

.....

..... [3]

- (b) Fig. 9.2 shows diagrams of nephrons from the kidneys of three different mammals, X, Y and Z.

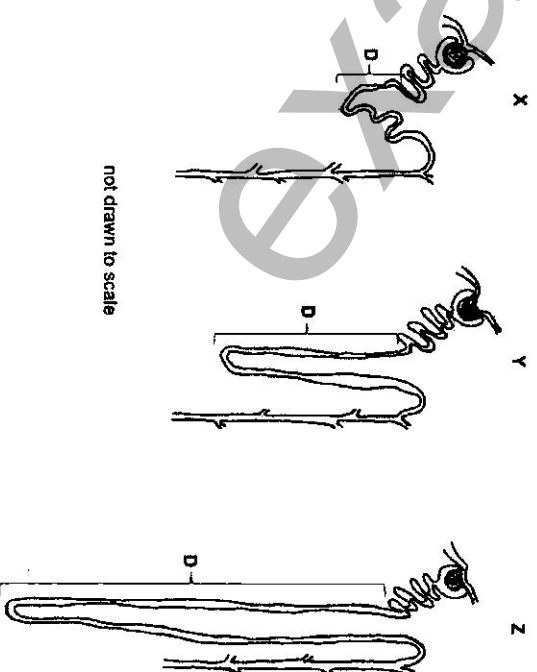
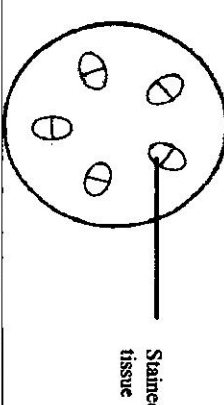


Fig. 9.2

[Turn over

A1			
(a)	A. oesophagus; B. small intestine / duodenum;	[2m]; 1m each	
(b)	- Muscles in the stomach wall undergo peristalsis; - Peristalsis helps in physical digestion as food is broken down into smaller pieces. OR - Peristalsis helps in mixing the food in stomach well with gastric juice.	[2m]	
(c)	- Tube 1 contains the enzyme pepsin in its <u>optimum pH</u> environment, due to the presence of HCl). - Thus egg white suspension will be <u>broken down</u> by pepsin and content becomes clear. - In Tube 2, in the presence of sodium hydroxide, enzyme pepsin is denatured. - Egg white suspension is not broken down by pepsin and content remains cloudy.	[4m]	
A2			
(a)	- Solution in beaker should be covered with a layer of oil; - To prevent the evaporation of solution, which will interfere with water movement in plant;	[2]	
(b)	- Place a fan in front of set-up; - Wind will blow water vapour surrounding the leaf, steepening water vapour concentration gradient, increasing transpiration;	[2]	
(c)	(or any acceptable, logical answers that suggest a steeper water vapour concentration gradient)	[1]	
(d)	 - Enters plant via the root hair cell by diffusion; - Diffuses cell to cell until weedkiller reaches xylem; - Transported up the xylem by transpiration pull; - Upon reaching xylem in leaves, diffuses from cell to cell until reaches mesophyll cells;	[4]	

[Turn over]

A3			
(a)	- Breakdown of food substances in the absence of oxygen; - releasing less energy than aerobic respiration;	[2]	
(b)	- Glycogen in muscles is converted to glucose; - Which allows an increased rate of respiration occur; - To meet the increased demand of energy during the run.	[3]	
(c)	- During rest, lactic acid concentration drops; - Lactic acid is removed from muscles and transported to liver; - where some of it is oxidised to release energy; - Energy used to convert remaining lactic acid into glucose.	[4]	
A4			
(a)	- Arterioles constrict, shunt vessels dilate; - reducing blood flow to blood capillaries beneath skin surface, reducing heat loss by conduction, convection and radiation; OR - sweat glands become less active; - less sweat produced, less sweat evaporates from surface of skin, less loss of latent heat;	[2]	
(b)	- the accident causes the hypothalamus to be stimulated; - send nerve impulses to the adrenal gland; - releasing adrenaline; - adrenaline causes an increase in metabolic rate, which led to an increase in temperature;	[3]	
(c)	- Hypothalamus detects that danger is over; - sends nerve impulses to adrenal gland; - decrease production of adrenaline;	[3]	
A5			
(a)	As light intensity increases, diameter of pupil decreases;	[1]	
(b)	Increase in light intensity is detected by photoreceptors on retina; Nerve impulses stimulated and transmitted by sensory neurone in optic nerve to brain; And subsequently transmitted by motor neuron to iris; Circular muscles contract and radial muscles relax; lack of pigment to block the light, leading to too much light falling on retina; may damage photoreceptors and lead to blindness;	[4]	
(c)		[2]	
A6			
(a)(i)	hormones	[1]	
(ii)	target organs	[1]	

[Turn over]

(b)(i)	J; smallest fluctuations / greatest control over sugar level;	[2]																						
(ii)	H; greatest fluctuations / least control over sugar levels;	[2]																						
(c)	from alveoli, diffuses through alveoli walls; diffuse through blood capillary walls into bloodstream;	[2]																						
B7																								
(a)	Vein to right atrium to right ventricle of the heart; Enters the lungs via the pulmonary artery and return to left atrium via pulmonary vein; Left atrium to left ventricle of the heart; Leaves the heart via aorta and travels to kidneys via renal artery;	[4]																						
(b)	Axes (headings / units); Appropriate scale; Shape; 1 hour; Drug molecule has travelled to the liver; Where it has been metabolised / broken down into smaller molecules;	[3]																						
		[1]																						
		[2]																						
B8																								
(a)	Similarities: • Both flowers possess stigmas, stamens and pollen; • Both flowers require the assistance of an external agent for pollination; Differences:	[5]																						
	<table><tr><th>Feature</th><th>Insect-pollinated flower</th><th>Wind-pollinated flower</th></tr><tr><td>Petals</td><td>Large and brightly-coloured/ conspicuous</td><td>Small and dull-coloured flowers/ no petals</td></tr><tr><td>Nectar</td><td>Nectar present</td><td>Nectar absent</td></tr><tr><td>Scent</td><td>Fragrant/ sweet-smelling</td><td>No scent</td></tr><tr><td>Significance :</td><td>Help insect-pollinated flowers to attract insects;</td><td>No need to attract insects</td></tr><tr><td>Stigmas</td><td>Small and compact and do not protrude out of flower</td><td>Large and feathery and protrude out of flower</td></tr><tr><td>Significance :</td><td></td><td>Provide large SA:V for wind-pollinated</td></tr></table>	Feature	Insect-pollinated flower	Wind-pollinated flower	Petals	Large and brightly-coloured/ conspicuous	Small and dull-coloured flowers/ no petals	Nectar	Nectar present	Nectar absent	Scent	Fragrant/ sweet-smelling	No scent	Significance :	Help insect-pollinated flowers to attract insects;	No need to attract insects	Stigmas	Small and compact and do not protrude out of flower	Large and feathery and protrude out of flower	Significance :		Provide large SA:V for wind-pollinated		
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Stigmas	Small and compact and do not protrude out of flower	Large and feathery and protrude out of flower																						
Significance :		Provide large SA:V for wind-pollinated																						

[Turn over]

				flower to trap pollen; Long pendulous filaments + protruding anther		
Stamens	Not pendulous and do not protrude out of flower			Pollen grains can be shaken off easily from the anthers of the wind-pollinated flowers;		
Significance :				More abundant than insect-pollinated flowers and are light and tiny with smooth surfaces		
Pollen	Fairly abundant and have large rough surfaces			Easily blown about by the wind		
Significance :	Cling onto bodies of insects			Absent		
Nectar guides	May be present					
Significance :	Guide insects towards nectar					
(b)	• Up to 2 marks for similarities (At least 1 similarity) Up to 4 marks for differences (For each difference mentioned + corresponding significance = 1 mark) In asexual reproduction, offspring are produced are genetically identical to the parent; (Hence, no variation which renders offspring less adaptable to environmental changes and challenges.) Self-pollination and cross-pollination are forms of sexual reproduction involving the fusion of genetically dissimilar gametes; This gives rise to a variety of offspring produced; However, as self-pollination only involves 1 parent plant, the offspring are less varied than those produced by cross-pollination which involves 2 parent plants; Hence, less well-adapted to new surroundings.					[4]
B9 Elther						
(a)	Blood entering atrium More carbon dioxide	right ventricle less carbon dioxide	Blood leaving left			[3]

[Turn over]

	Less oxygen More glucose / amino acids	More oxygen Less glucose / amino acids			
(b)	Artery has a thicker wall than capillary. This is because artery needs to withstand high pressure. While a thinner wall in capillary will provide a shorter distance for diffusion of materials to occur.		[3]		
(c)	Blood enters the lungs at a lower pressure compared to blood leaving the heart. This ensures that blood flows more slowly through the lungs, allowing sufficient time for blood to be well oxygenated before it is returned to the heart. Heart pumps blood at high pressure to rest of the body; oxygenated blood is distributed to the body tissues more quickly.		[4]		
Or					
	• $16.75 - 2.34 = 14.41$; • $14.41 / 2.34 \times 100 = 616\%$;		1	1	
	• The larger the intake of protein, the greater the mass of urea excreted; • An increased intake of protein has led to an 616% increase in urea excreted;		1		
	• Excess protein is first digested and absorbed as amino acids through intestinal walls; • Absorbed amino acids are transported to liver; • where the excess is deaminated, converted to urea and removed via the kidneys;		1	1	
	• Section D is the part of the kidney tubules involved in selective reabsorption of water. • The longer the section D means more water is reabsorbed and less urine is produced; • Desert living animals, like the gerbil, needs to conserve water and hence a longer section D means more water is reabsorbed and conserved;		1	1	

[Turn over

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5

9

5	(a) (i) P. right atrium Q. chordae tendinae (ii) Line drawn correctly to the opening at the end of the aortic arch (b) As left atrium relaxes, blood travels from pulmonary vein and fills left atrium Left atrium contracts, blood pushed into the left ventricle past bicuspid valve Left ventricle contracts, increasing the pressure in the ventricle. Bicuspid closes to prevent backflow of blood into the left atrium Semi lunar valve pushed opened, pressure from ventricular contraction pushes blood into the aorta (c) (i) 0.2 s / 0.3 s (ii) line 2	[2] [1] [1] [1] [1] [1]														
6	(a) Pollination is the <u>transfer of the pollen grain from the anther to the stigma.</u> (b) Each flower is dioecious/ female and male flowers are <u>separate</u> Male and female parts of flower <u>mature at different times</u> (c) When insect lands on flower, pollen grains on its body are <u>picked up</u> by the <u>stigma</u> of the flower as it moves to collect nectar. As insect moves out of flower, it <u>picks up pollen grain from anther of the flower</u> and <u>pollinates another flower.</u>	[1] [1] [1] [1] [1]														
7	(a) <table border="1"> <thead> <tr> <th>Nuclear division</th> <th>Letter of stage</th> </tr> </thead> <tbody> <tr> <td rowspan="5">Meiosis I</td> <td>B</td> </tr> <tr> <td>E</td> </tr> <tr> <td>J</td> </tr> <tr> <td>H</td> </tr> <tr> <td>F</td> </tr> <tr> <td rowspan="5">Meiosis II</td> <td>D</td> </tr> <tr> <td>G</td> </tr> <tr> <td>I</td> </tr> <tr> <td>C</td> </tr> <tr> <td>A</td> </tr> </tbody> </table> [Any 2 correct = 1m] (b) - chiasma / crossing over between homologous chromosomes in prophase I → exchange of genetic material - independent assortment of chromosomes in metaphase 1 → random combination of alleles	Nuclear division	Letter of stage	Meiosis I	B	E	J	H	F	Meiosis II	D	G	I	C	A	[4] [2]
Nuclear division	Letter of stage															
Meiosis I	B															
	E															
	J															
	H															
	F															
Meiosis II	D															
	G															
	I															
	C															
	A															

3

8	Section B (a) Total oxygen consumption = $30 \times 1.73 + 30 \times 3.25$ = 149.4 dm^3 Average consumption = $149.4/60 = 2.49 \text{ dm}^3$ per minute (b) heart beats faster → speed of blood flow increases volume of blood per beat increases more blood pumped by the heart to muscles increased demand for oxygen/glucose for increased respiration/energy release carbon dioxide and other metabolic waste products are quickly transported away from cells for excretion (c) between chambers of heart and in veins prevents the backflow of blood, blood flows in one direction only	[1] [1] [1] [any 5 = 5m]																					
9a	Let B be the dominant allele for night blindness Let b be the recessive allele for the individual with normal sight (if legend not given, - 1m) <table border="1"> <thead> <tr> <th></th><th>male</th><th>female</th></tr> </thead> <tbody> <tr> <td>Parent phenotype</td><td>night blindness</td><td>normal</td></tr> <tr> <td>Parent genotype</td><td>Bb</td><td>bb</td></tr> <tr> <td>Gametes</td><td>B b</td><td>b b</td></tr> <tr> <td>F1 genotypic ratio</td><td>Bb Bb</td><td>bb bb</td></tr> <tr> <td>F1 phenotype</td><td>night blindness</td><td>normal</td></tr> <tr> <td>F1 phenotypic ratio</td><td>2 night blindness</td><td>2 Normal</td></tr> </tbody> </table> any 1 step missing - 1m		male	female	Parent phenotype	night blindness	normal	Parent genotype	Bb	bb	Gametes	B b	b b	F1 genotypic ratio	Bb Bb	bb bb	F1 phenotype	night blindness	normal	F1 phenotypic ratio	2 night blindness	2 Normal	[1] [1] [1] [1] [1] [1]
	male	female																					
Parent phenotype	night blindness	normal																					
Parent genotype	Bb	bb																					
Gametes	B b	b b																					
F1 genotypic ratio	Bb Bb	bb bb																					
F1 phenotype	night blindness	normal																					
F1 phenotypic ratio	2 night blindness	2 Normal																					

4

Paper 1	
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. C D D B A C C D B B C	
11. 12. 13. 14. 15. 16. 17. 18. 19. 20. D D B A C C C D C B C	
21. 22. 23. 24. 25. 26. 27. 28. 29. 30. B D C C B B D A B C	
31. 32. 33. 34. 35. 36. 37. 38. 39. 40. D B B A A D B B B B	
Paper 2	
Section A	
1 (a) (i) Test tube 1: Brown Test tube 2: colourless	[1]
(ii) In tube 1, polyphenol oxidase <u>catalyses the breakdown</u> of phenol to melanin (brown compound) In tube 2, boiled polyphenol oxidase is <u>denatured by the high temperature</u> , hence the shape of active site of enzyme has changed. It loses its enzymatic property and no melanin (brown compound) will be formed.	[1]
(b) The optimum pH for polyphenol is acidic thus in tube 3, brown melanin compound is formed. In tube 4, at pH high relative to optimum, sodium hydroxide denatures polyphenol oxidase, causing the shape of active site of enzyme to change. It loses its enzymatic property and no melanin (brown compound) is formed.	[1]
(c) Tube 5 acts as a control to show that polyphenol oxidase is responsible for catalysing the breakdown of phenol to melanin (brown compound)	[1]
(d) volume of phenol substrate volume of polyphenol oxidase solution concentration of solutions [any 2/reasonable answers]	[2]

2 (a) (1.23x60) – (0.25x60) = 58.8 arbitrary units [No units - 1m]	[2]
(b) Diffusion and active transport	[1]
(c) Active transport	[1]
(d) By active transport: Fructose, Galactose, Glucose [1 mark for naming all correctly]: the amount of these sugars transported across the intestine are <u>dramatically reduced</u> in the presence of cyanide. Respiration occurs so as to release energy needed for active transport.	[1]
By diffusion: Fructose, Galactose and Glucose [1 mark for naming all correctly]: Even in the presence of cyanide, there is still some sugars absorbed by the small intestine by diffusion as the process does not require energy	[1]
3 (a) stomach produce hydrochloric acid, the <u>low pH of 2</u> which kills bacteria	[1]
(b) - Without stomach, a person will be unable to digest protein into polypeptide as efficiently as a normal person - the person will need to change his diet by consuming food with less protein - the person will need to take more frequent meals and smaller amount meals - the person will be more prone to infection of the gut as bacteria are not killed by acid in the stomach [Any 2]	[2]
(c) Assimilation refers to process whereby <u>absorbed food substances</u> are converted into new protoplasm or used to provide energy.	[1]
4 (a) Correct X and Y axis label Title, appropriate scale and size Points plotted correctly, allow for 1 error Line of best fit	[1] [1] [1] [1]
(b) Rate of transpiration falls as number of spider mites increases Rate of transpiration falls from 206 to 98 arbitrary units when the number of spider mites increases from 0 to 32	[1] [1]
(c) (i) Reduced rate of transpiration as damage level increases Number of stomata decrease as surface area of leaves is reduced	[1] [1]
(ii) Rate of photosynthesis falls as damage level increases Increase in yellow areas and dead tissues means less chlorophyll and hence, less photosynthesis	[1] [1]

Section B (30 marks)

Answer three questions.

Question 10 is in the form of an Either/Or question. Only one part should be answered.

8 Table 8.1 shows the oxygen consumption of a man when walking at different speeds.

Table 8.1

speed/km h ⁻¹	oxygen consumption / dm ³ min ⁻¹
at rest	0.35
4	1.73
12	3.25

(a) A man exercises for one hour. He alternates between walking at 4 km h⁻¹ for five minutes and running at 12 km h⁻¹ for five minutes. Calculate his total oxygen consumption during one hour and his average oxygen consumption per minute.

[3]

(b) Suggest and explain the changes taking place in the circulatory system during exercise.

[5]

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(c) In which parts of the circulatory system are valves found? Describe their role in the circulation of blood.

[2]

[Total: 10]

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BBSS / 2016 / O' Prelim / Sec 4 Exp / Biology 5158 / P2



[4]

example

[2]

END OF SECTION A.

A student investigated the flow of biomass and energy on a farm in a country where winters are very cold. The farm grows barley to feed the animals, which are kept in sheds where they are not allowed to move very much.

The student found that an area of 240 m² of barley provided 120 kg of animal feed from the barley crop.

Table 10.1

area of barley field / m ²	240
energy from the Sun that is available to the barley crop / kJ	96 000 000
biomass of animal feed from the harvested barley crop / kg	120
energy in 120 kg of animal feed / kJ	2 400 000
increase in mass of animals fed 120 kg feed / kg	48
energy in 50 kg meat that is available to humans / kJ	400 000

- (a) Table 10, shows how much energy the barley crop receives from the Sun while it is growing in the field. Suggest three reasons why only a small proportion of that energy is available in the animal feed from the harvested barley.

- 1
2
3 [3]

- (b)** Calculate the energy in the meat that is available to humans, as a percentage of the energy in the animal feed. Show your working.

answer % [2]

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- (c) Using the information in Table 10.1, explain why it is more efficient for humans to gain their food from the first trophic level rather than from the second trophic level.

[5]

[Total: 10]

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Examiner's



[4]

example

For
Examiner's

[2]

1

1

[4]

.....[1]
 Pressure in the left ventricle.
[1]
[1]
 [Total: 9]

[1]

[2]

A diagram of a flower with labels 'nectary' and 'sepal' pointing to their respective parts.

[2]

[Total: 5]

4 Table 4 shows the results of an investigation to determine the effects of a leaf-eating spider mite on rice plants.

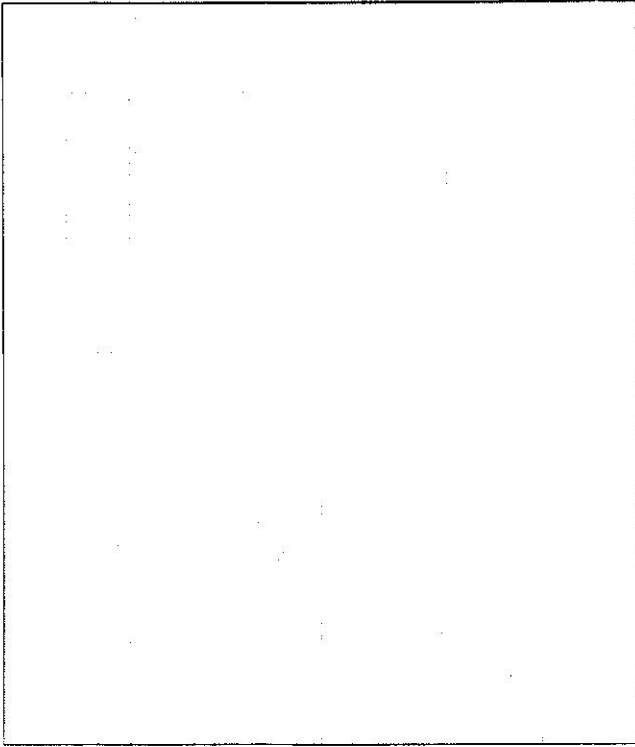
Table 4

number of spider mites per leaf	damage level	rate of photosynthesis / arbitrary units	rate of transpiration / arbitrary units
0	None	19.2	206
16	1	12.8	175
19	2	10.2	155
25	3	7.4	124
32	4	5.2	98

Damage level indicator:

1. Leaves pale green
2. Leaves with small areas of yellow mottling
3. Leaves with large yellow areas
4. Leaves with large yellow areas and dead tissue

(a) Plot a graph of number of spider mites per leaf against the rate of transpiration. [4]



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5

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(b) Describe the relationship between the number of spider mites and the rate of transpiration.

.....
.....
..... [2]

(c) Suggest a reason for the change in the

(i) rate of transpiration as the damage level increases.

.....
.....

(ii) rate of photosynthesis as the damage level increases.

.....
..... [2]

..... [2]

[Total: 10]

5 Fig 5.1 shows a vertical section of the human heart.

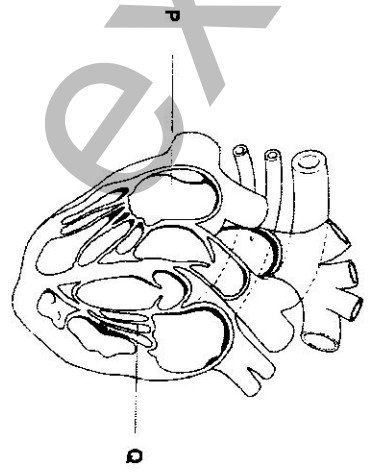


Fig 5.1

(a) (i) Name the parts labelled P and Q.

P
Q [2]

(ii) Use a label line and the letter X to label the aorta on Fig 5.1.

[1]

6

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- (b) Explain the difference in results between test tubes 3 and 4.

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- (c) State the purpose of test tube 5.

- (d) Suggest two factors that must be kept constant during the investigation.

- 2 In an experiment, a biologist measured the rate of absorption of four nutrients in a rat's small intestine before and after adding cyanide. Cyanide is a poison that interferes with the release of energy from cells. The results of his experiment are shown in Table 2.

Table 2

nutrient	rate of absorption / arbitrary units per second	
	before adding cyanide	after adding cyanide
amino acid	1.52	0.45
glucose	1.30	0.33
fructose	1.23	0.25
galactose	1.20	0.18

- (a) Calculate the difference in amount of fructose that will be absorbed by the rat's small intestine under normal and poisoned conditions, in 1 minute.

- (b) What processes are involved in the transport of sugars across the intestine?

- (c) Which of the processes is disrupted when the intestines are poisoned with cyanide?

3

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- (d) Which sugars are transported by each process you have named in (b)? Give reasons for your answer.

- 3 Read the passage below and answer the questions that follow.

For many years, doctors believed that gastric ulcer (damage and bleeding of the stomach wall) was caused by excessive acid secretion in the stomach, so they used certain chemicals to treat ulcer patients. However, after recovery, many patients might develop gastric ulcer again.

In the 1980s, an Australian doctor, Barry Marshall, observed that all his ulcer patients had a type of bacteria called *Helicobacter pylori* in their stomachs. He therefore put forward a new hypothesis about gastric ulcer. Based on this hypothesis, he treated his patients with antibiotics which are chemicals that kill bacteria. Many of his patients recovered rapidly and did not develop gastric ulcer again.

- (a) Many doctors were surprised at Marshall's observation because they thought that bacteria could not survive in the stomach. Why did they think so?

- (b) Gastric ulcer can sometimes lead to stomach cancer. Patients with stomach cancer will need to have their stomach surgically removed. Discuss the effects on the digestive function and changes to the lifestyle of such a patient.

- (c) Explain what is meant by the term assimilation.

4

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Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided.

1 Apple turns brown when it is cut. This browning involves an enzyme called polyphenol oxidase which catalyses the conversion of phenol to a brown compound called melanin.

A student carried out an investigation of the action of polyphenol oxidase on phenol. Four test-tubes were set up with different contents as follows:

Table 1.1

test tube	test tube contents
1	phenol + polyphenol oxidase solution
2	phenol + boiled polyphenol oxidase solution
3	phenol + polyphenol oxidase solution + dilute hydrochloric acid
4	phenol + polyphenol oxidase solution + aqueous sodium hydroxide
5	phenol + distilled water

Each test-tube was shaken thoroughly and then placed in a water bath that was maintained at 40°C. After some time, the observations for each test tubes were recorded.

Table 1.2

test tube	1	2	3	4	5
colour at the start of the experiment	colourless	colourless	colourless	colourless	colourless
colour at the end of the experiment			brown	colourless	colourless

(a) (i) State the colour at the end of the experiment for test tubes 1 and 2 in Table 1.2. [1]

(ii) Explain your answer for (a)(i).

.....

.....

.....

..... [2]

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40. Which one of the following would most likely happen if process 4 does **not** occur?
- A Carbon cycling would occur in the reverse direction.
 - B Carbon dioxide level in the atmosphere would decrease.
 - C The population of the grass would increase.
 - D The rate at which carbon dioxide is released would increase.

END OF PAPER.

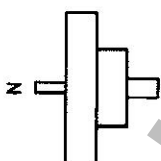
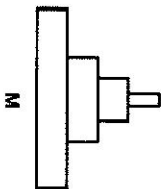
35. An artificially constructed piece of DNA comprising 2400 nucleotides is to be transcribed and translated. How many amino acids would the resulting polypeptide contain?

A 400
B 800
C 1200
D 2400

36. The non-coding strand of a particular gene contains the following sequence: GTCACTCAA. What is the sequence of the corresponding mRNA segment resulting from transcription of this gene?

A CAGTCAGTT
B CAGUCAGUU
C GTCAGTCAA
D GUCAGUCAA

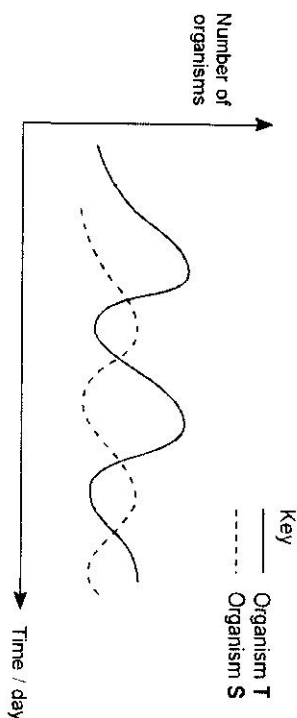
37. The diagram shows two pyramids based on food chains in which the producer is a large tree.



What do the two pyramids represent?

	M	N
A	energy	biomass
B	energy	numbers
C	numbers	biomass
D	numbers	numbers

38. The diagram shows a graph of the number of organisms against time.

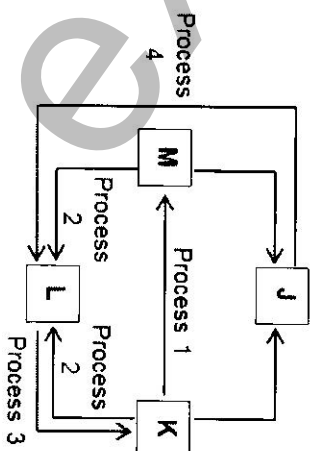


What could organism S and T be?

	S	T
A	duck	snake
B	eagle	rabbit
C	pig	tiger
D	worm	chicken

The carbon cycle can be illustrated using the following diagram. Processes 1, 2, 3 and 4 represent the processes involved in the flow of carbon compounds.

Refer to the diagram and answer Questions 39 and 40.



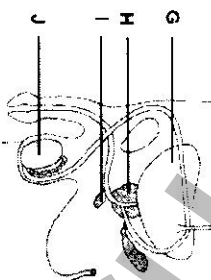
39. Which one of the following shows what each letter (J, K, L and M) could represent?

	J	K	L	M
A	atmosphere	grass	decomposers	sheep
B	decomposers	grass	atmosphere	sheep
C	decomposers	sheep	atmosphere	grass
D	sheep	atmosphere	grass	decomposers

30. A plant biologist carried out an experiment to study the wind-pollinated flowers growing in an area. The flowers were grouped into four different groups. In each group, certain structures were removed from the flowers as shown in the following table. After a period of time, which group would produce the most number of seeds?

group	receptacle	stigma	anther
A	no change	removed	no change
B	no change	removed	removed
C	removed	no change	no change
D	removed	no change	removed

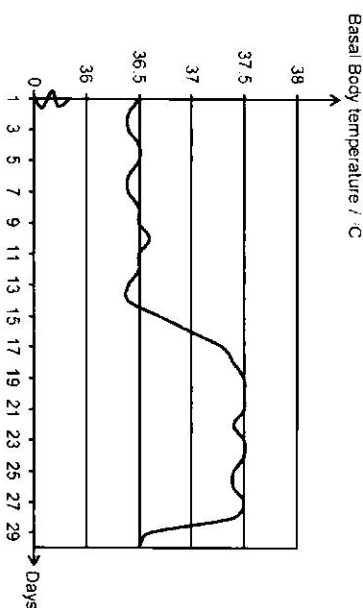
31. The diagram shows part of the male's reproductive system.



Which one of the following matches the structure to its function correctly?

	produce sperm	produce semen
A	G	J
B	H	I
C	I	H
D	J	H

32. A woman recorded her Basal Body Temperature (BBT) within the month of January and plotted the following graph to keep track of it. She was experiencing a 28-day menstrual cycle.



Which one of the following statements best describes how the woman's BBT fluctuates within the month of January?

- A Her temperature increased at the start of menstruation and decreased immediately after her menstruation has ended.
 B Her temperature increased greatly on the day of ovulation and remains high until the next menstruation.
 C Her temperature increased greatly on the day of ovulation and remains high until the next ovulation day.
 D Her temperature increased greatly on the day of ovulation and then decreased immediately after the day of ovulation.

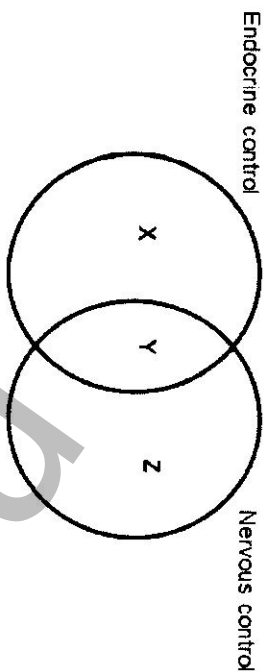
33. Tay Sachs disease, which usually causes death in young children by the age of four, is caused by an abnormal allele of a single gene. Which one of the following is the most likely reason why this disease has persisted in the human population?

- A It is caused by a dominant allele that can be passed on more successfully.
 B It is caused by a recessive allele that does not display its effect in carriers.
 C The disease can be transmitted to other individuals via means of fluid exchange.
 D The victims pass on their genes to subsequent generations.

34. When white-flowered pea plants are crossed with red-flowered pea plants, the offsprings (F₁) all have red flowers. If these F₁ plants pollinate themselves, the next generation (F₂) contains both red and white-flowered plants. Which statement explains this?

- A The allele for red flowers is dominant and the F₁ plants are heterozygous.
 B The allele for red flowers is dominant and the F₁ plants are homozygous.
 C The allele for red flowers is recessive and the F₁ plants are heterozygous.
 D The allele for red flowers is recessive and the F₁ plants are homozygous.

25. The comparison between an endocrine control and a nervous control can be illustrated using the following Venn diagram.



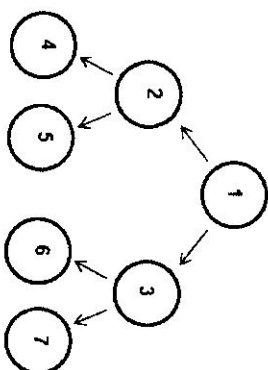
Which one of the following can fit into the regions X, Y and Z?

	X	Y	Z
A	a method of coordination within the body	always voluntary	may be voluntary or involuntary
B	always involuntary	a method of coordination within the body	may be voluntary or involuntary
C	may be voluntary or involuntary	always voluntary	a method of coordination within the body
D	may be voluntary or involuntary	a method of coordination within the body	always voluntary

26. Type 1 diabetic patients who are on rapid-acting insulin are advised not to wait more than 15 minutes to eat after taking an insulin injection. Which one of the following best explains why this is so?

- A Insulin is required for the proper absorption of nutrients from the diet.
 B The injection of insulin can lead to dangerously low blood glucose concentration.
 C The injection of insulin will prevent the body from secreting the necessary amount of insulin to maintain the blood glucose level.
 D The liver and muscle cells will be stimulated by insulin to store fats.

27. The following diagram shows a cell that is undergoing meiosis.



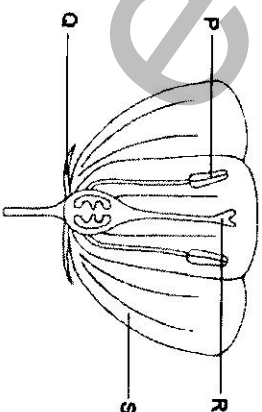
Which of the cells, if any, are genetically identical to each other?

- A 2 and 3
 B 1, 2 and 3
 C 4 and 5, 6 and 7
 D None of the cells

28. Grass carp is a type of freshwater fish and some of these fishes are triploid (they contain 3n chromosomes). Which one of the following best explains why triploid grass carps are infertile?

- A Homologous chromosomes cannot pair up to form bivalents during meiosis I, thus the organism cannot form functional gametes.
 B The chromosome number is too large, thus leading to sterility.
 C The gametes formed would be too large to be released, thus their gametes cannot fuse to form viable zygotes.
 D The fishes will not survive till reproductive age.

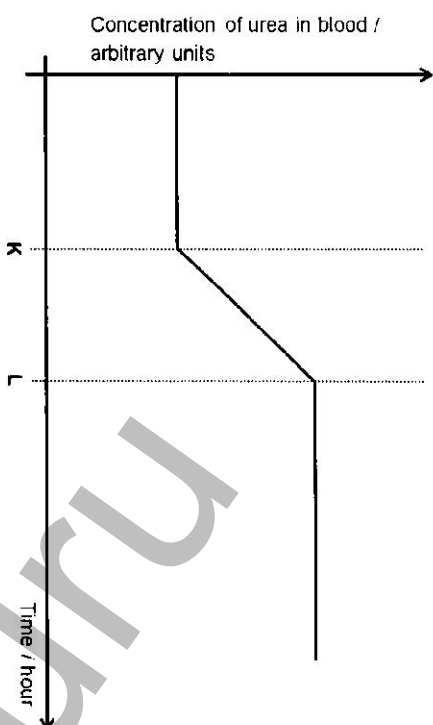
29. The following diagram shows parts of a flower.



Which one of the following correctly identifies the names of the labelled structures?

	P	Q	R	S
A	anther	petal	stigma	sepal
B	anther	sepal	stigma	petal
C	filament	petal	style	sepal
D	stigma	ovary	anther	petal

20. The following graph shows changes in the concentration of urea in a mammal's blood.



What could most likely have happened at points K and L?

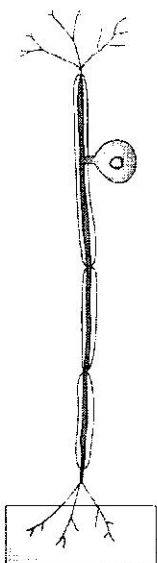
- A Both the kidneys and liver are removed at K but no organ is removed at L.
- B No organ is removed at K but both the kidneys and the liver are removed at L.
- C The kidneys are removed at K and the liver is removed at L.
- D The liver is removed at K and the kidneys are removed at L.

- 21.

Multiple sclerosis is a disease in which the body attacks and damages the myelin sheaths of neurons. What happens when there is a reduction in the amount of myelin sheath?

- A Amount of neurotransmitters released will be lowered.
- B Decrease in the efficiency of nervous transmission.
- C Rate of growth of dendrites will be lowered.
- D Transmission of nerve impulses will happen faster.

22. The diagram shows a type of nerve cell.

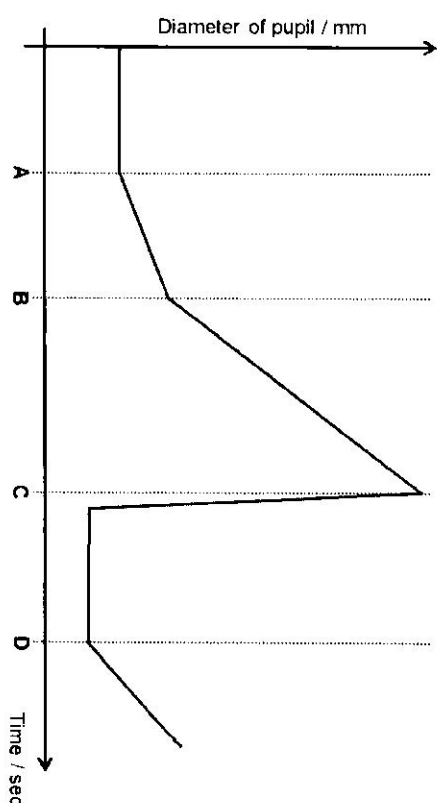


Which one of the following is a characteristic of this type of nerve cell?

- A It is found solely in the grey matter of the spinal cord.
- B It connects the motor neurons with the sensory neurons.
- C It synapses with the effector.
- D It transmits nerve impulses to the relay neurons.

- 23.

A person was wearing a pair of sunglasses on a sunny day but removed it as he prepares to enter the pool to swim. The following is a graph of the diameter of his pupil against time. At which point on the graph did he remove his sunglasses?



- 24.

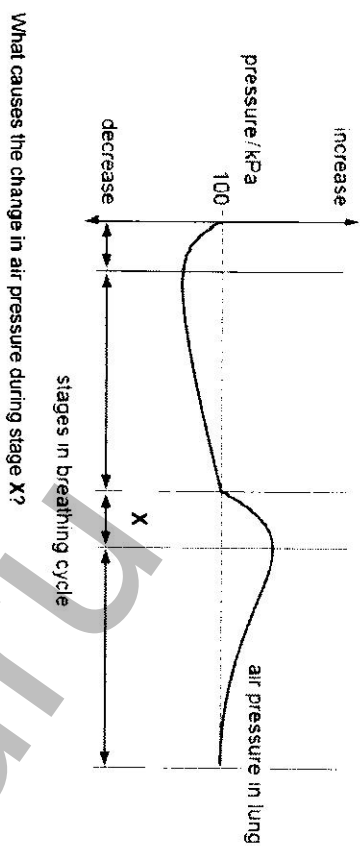
The following shows some of the events which take place in the eye. [Note that the numbers in the boxes do not represent the order which the events occur]

1. Ciliary muscles relax and suspensory ligaments become tight.	2. Lens become thicker.	3. Nerve impulse transmitted to the optic nerves and then to the brain.	4. Lens becomes thinner.
5. Photoreceptors are activated and nerve impulses are produced.	6. Radial muscles contract and circular muscles relax.	7. Nerve impulses transmitted to ciliary muscles via motor neurons.	8. Ciliary muscles contract and suspensory ligaments become loose.

What are the events that occur, and in what order do they occur, when a person is focusing on a near object?

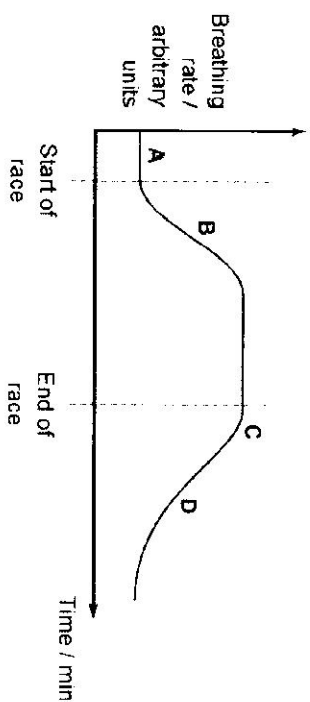
- A 5 → 3 → 1 → 6 → 2
- B 5 → 3 → 1 → 6 → 4
- C 5 → 3 → 7 → 8 → 2
- D 5 → 3 → 7 → 8 → 4

15. The graph shows changes in the air pressure within the lungs during one breathing cycle.



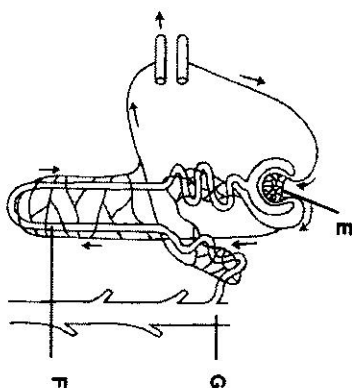
- What causes the change in air pressure during stage X?
- A contraction of diaphragm
 - B movement of ribs upwards and outwards
 - C relaxation of external intercostal muscles
 - D relaxation of internal intercostal muscles

16. A student takes part in a race. His breathing rate before, during and after the race is shown in the following graph.



- At which point does his body contain the greatest amount of lactic acid?

17. The following shows the kidney nephron and its associated features. The arrows indicate the direction of flow of fluids within it.



- Which of the following correctly states some of the component(s) found in the fluids inside E, F and G in a healthy person at any point of time?

	E	F	G
A	amino acids, salts	white blood cells, urea	amino acids, water
B	amino acids, urea	glucose, salts	platelets, water
C	red blood cells, amino acids	water, salts	urea, glucose
D	white blood cells, proteins	amino acids, salts	salts, water, urea

18. Which one of the following examples of negative feedback is incorrect?

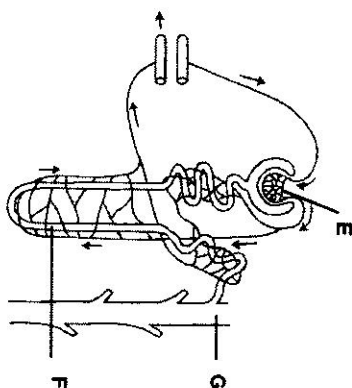
- A Cessation of shivering when body temperature has increased back to normal.
- B Decrease in the production of sweat when body temperature has decreased back to normal.
- C Decrease in the release of insulin when the blood glucose concentration has increased back to normal.
- D Decrease in the release of anti-diuretic hormone when the water potential of blood has increased back to normal.

19. A student has just completed his 2.4 km run on a hot day. How will the amount and the composition of the urine he produced change?

- I. The concentration of urine will increase.
- II. The volume of urine produced will decrease.
- III. The water potential of his urine will increase.
- IV. The amount of glucose in his urine will decrease.

- A I only
- B I and II only
- C I, II and III only
- D I, II, III and IV

17. The following shows the kidney nephron and its associated features. The arrows indicate the direction of flow of fluids within it.



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	E	F	G
A	amino acids, salts	white blood cells, urea	amino acids, water
B	amino acids, urea	glucose, salts	platelets, water
C	red blood cells, amino acids	water, salts	urea, glucose
D	white blood cells, proteins	amino acids, salts	salts, water, urea

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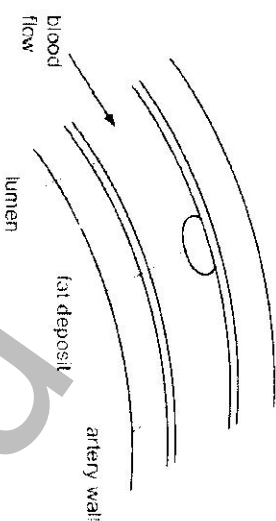
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- I. The concentration of urine will increase.
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- IV. The amount of glucose in his urine will decrease.

- A I only
- B I and II only
- C I, II and III only
- D I, II, III and IV

11. The following diagram shows a section of the coronary artery with deposition of fats that may result in a heart attack.



What best describes the events that could lead to a heart attack?

- A Hardening the artery wall preventing diffusion across the wall.
- B Further fat deposits followed by platelet destruction.
- C Further fat deposits followed by red blood cell destruction.
- D Restriction of the artery's lumen causing less oxygen supply.

12. Blood samples from three veins (X, Y and Z) of a healthy person were taken and the concentrations of carbon dioxide, oxygen and urea were measured. The results, in arbitrary units, are shown in the following table.

vein	carbon dioxide concentration / arbitrary units	oxygen concentration / arbitrary units	urea concentration / arbitrary units
X	45	34	0.3
Y	48	37	6.8
Z	33	98	5.1

Another individual who is suffering from some illness and his blood samples from the same type of veins (X, Y and Z) were taken and the concentrations of the substances were measured. The results are shown in the following table.

vein	carbon dioxide concentration	oxygen concentration	urea concentration
X	43	33	2.9
Y	47	35	6.6
Z	33	97	5.3

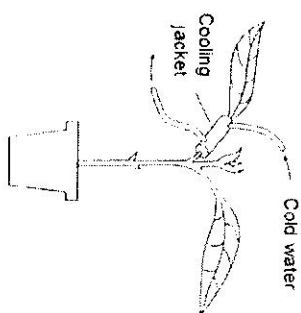
What illness could the person be suffering from?

- A atherosclerosis
- B diabetes mellitus
- C emphysema
- D kidney failure

6

HQM Applying past knowledge to new situations

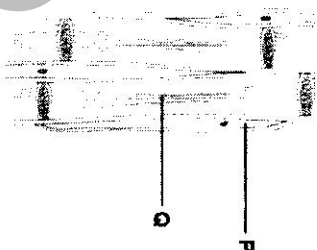
13. The petioles of a plant are chilled with a cooling jacket as illustrated in the following diagram.



What is the likely impact on the plant?

- A The rate of movement of sucrose to the roots increases.
- B The rate of movement of water to the leaves decreases.
- C The rate of respiration in the leaf cells increases.
- D The rate of photosynthesis in the leaves increases.

14. A type of plant tissue is shown in the following diagram.



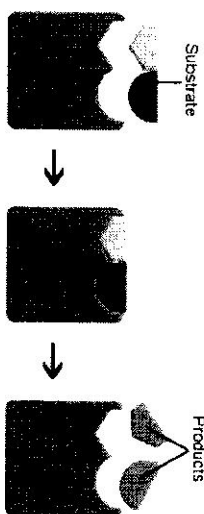
Which one of the following accurately describes the relationship between cell P and Q?

- A P carries out metabolic processes to keep Q alive.
- B P helps to filter the liquid transported by Q.
- C P produces the carbohydrates that are transported by Q.
- D Q transports sucrose while P transports water and mineral salts.

7

HQM Applying past knowledge to new situations

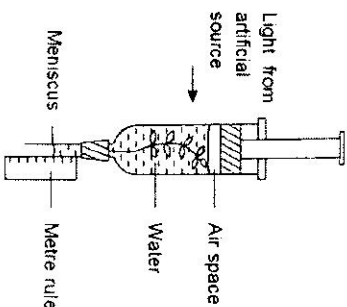
6. The following diagram illustrates an enzyme-controlled reaction. The reaction takes place at 37°C.



Which one of the following conclusions can be made from the diagram?

- A Enzymes are made up of proteins.
 - B Enzymes are affected by temperature.
 - C Enzymes remain unchanged at the end of all enzymatic reactions.
 - D The shape of the substrate must be the same as the enzyme.
7. Which one of the following would not be a likely outcome of the removal of the pancreas?
- A decrease in the amount of glycogen production in liver and muscle cells
 - B decrease in the amount of protein digested
 - C diabetes mellitus
 - D increase in the pH of duodenum

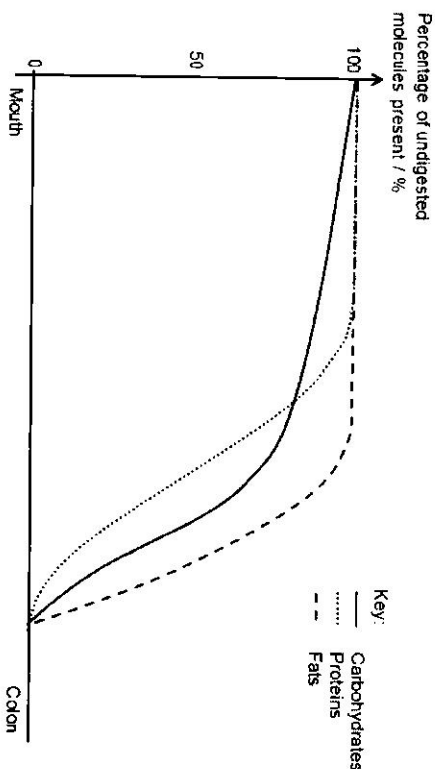
8. The following experimental set up is used to study the rate of photosynthesis.



The student decided to replace the water with equal volume of dilute sodium bicarbonate solution. Which one of the following would likely be observed?

- A The dilute sodium bicarbonate solution will turn green.
- B The meniscus will move downward at a faster rate.
- C The meniscus will move upward at a faster rate.
- D The meniscus will move upward at a slower rate.

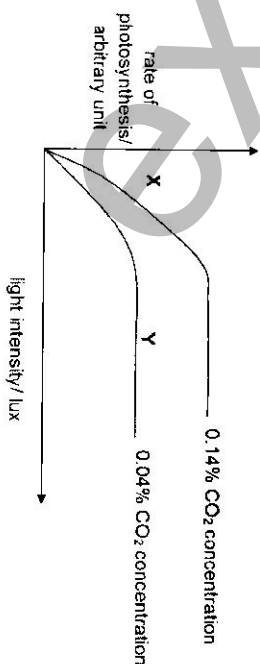
9. The following graph shows the percentage of undigested carbohydrates, proteins and fats through successive parts of the alimentary canal.



Why is this graph an inaccurate representation of the percentage of undigested molecules in the human alimentary canal?

- A Carbohydrates should not be the first to be digested.
- B It is impossible for all molecules to be completely digested.
- C Proteins should not be digested at a faster rate than carbohydrate and fats.
- D The digestion of all molecules should not be completed at the same time.

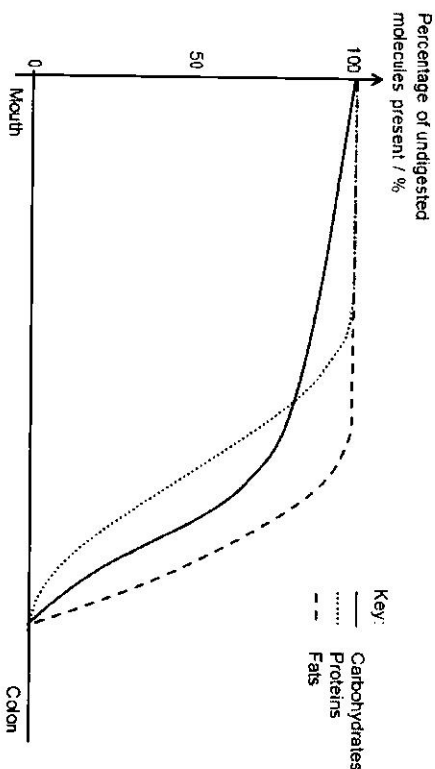
10. The following shows how the rate of photosynthesis varies with light intensity and carbon dioxide concentration.



Identify the limiting factors at points X and Y.

	X	Y
A	concentration of CO ₂	temperature
B	light intensity	chlorophyll availability
C	light intensity	concentration of CO ₂
D	temperature	light intensity

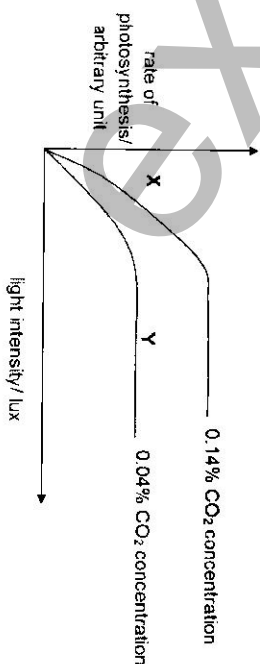
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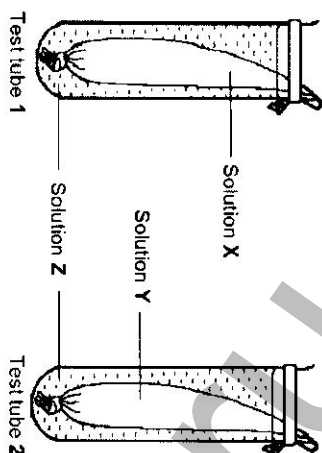
	X	Y
A	concentration of CO ₂	temperature
B	light intensity	chlorophyll availability
C	light intensity	concentration of CO ₂
D	temperature	light intensity

1. A student examined a particular plant cell throughout its various stages of growth. After making various measurements, he realized that the increase in cell size is largely due to an enlargement of the central vacuole, rather than an increase in the amount of cytoplasm.

Why might this be an advantageous strategy for the cell to enlarge its vacuole?

- A makes the cell more turgid
 B makes it unnecessary for the cell wall to stretch
 C minimizes any lowering of the surface area to volume ratio of the cytoplasm
 D requires more energy than enlarging the cytoplasm

2. The diagram shows an experimental setup.



At the end of the experiment, the Visking tubing in test tube 1 expands while the Visking tubing in test tube 2 shrinks. What could solutions X, Y and Z be?

	solution X	solution Y	solution Z
A	10% sucrose solution	20% sucrose solution	5% sucrose solution
B	20% sucrose solution	10% sucrose solution	5% sucrose solution
C	25% sucrose solution	15% sucrose solution	35% sucrose solution
D	35% sucrose solution	15% sucrose solution	25% sucrose solution

3. Which one of the following organic compounds represents a protein?

- A $C_6H_{12}O_5$
 B $(C_6H_{10}O_5)_n$
 C $C_{17}H_{35}COOH$
 D $C_{70}H_{111}NO_{22}Ni_{16}S_4$

4. The table below shows the results of some experiments performed by a student.

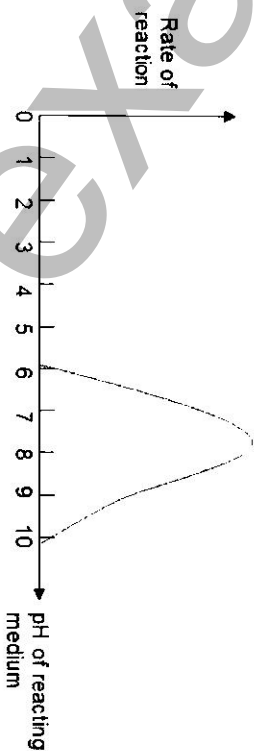
experiment no.	substances added to the test tube	temperature of water-bath / °C	food tests are carried out 20 minutes after the start of the experiment	Benedict's test
1	5 ml X + 3 ml water	37	blue-black colour	blue solution
2	5 ml X + 2 ml Y + 1 ml HCl	37	blue-black colour	blue solution
3	5 ml X + 2 ml Y + 1 ml NaOH	37	brown colour	brick-red ppt
4	5 ml X + 2 ml Y (boiled) + 1 ml water	37	blue-black colour	blue solution

Which one of the following states correctly the identity of X, Y and the product of the reaction?

	X	Y	product of the reaction
A	glycogen	saliva	non-reducing sugar
B	glycogen	saliva	reducing sugar
C	starch	gastric juice	reducing sugar
D	starch	pancreatic juice	reducing sugar

5. The graph below shows the effect on an enzyme-controlled reaction by varying the pH of the reacting medium.

For which of the following groups of mammalian gut enzymes would this graph be appropriate?

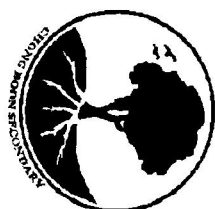


- A amylase, trypsin, lipase
 B enterokinase, rennin, amylase
 C lipase, erepsin, pepsin
 D pepsin, amylase, trypsin

Candidate Name: _____

Class: _____

Index No: _____



Chong Boon Secondary School
Prelim Examination 2016
Secondary 4 Express
Biology
Paper 1

5158/01

19 September 2016 (Monday)

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, index number and class clearly on the Answer sheet in the spaces provided.
Shade your Index number accordingly.

Multiple Choice Questions (40 marks)

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers A, B, C and D. Choose the one you consider correct and record your choice in soft pencil on the Answer sheet provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

For Examiner's Use

40

Answer **all** the questions on the Answer sheet provided.

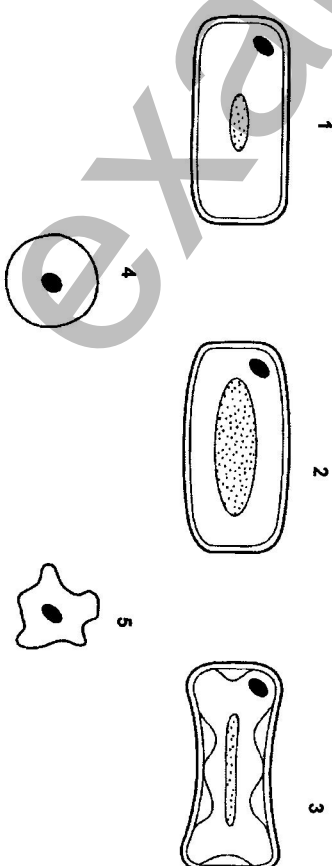
1 Two characteristics of all living organisms are

- A breathing and reproduction.
- B photosynthesis and excretion.
- C reproduction and respiration.
- D respiration and photosynthesis.

2 Which is **not** an organ?

- A blood
- B heart
- C leaf
- D vein

3 Some plant and animal cells were placed in different solutions and the results are shown.



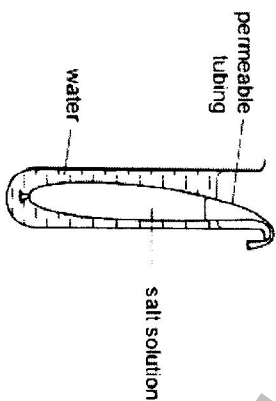
Which cells were placed in which solution?

	1.0 mol dm ⁻³ sucrose	0.1 mol dm ⁻³ salt solution
A	1 and 2	3 and 5
B	1 and 4	3
C	2 and 4	1 and 3
D	3 and 5	2 and 4

4 Which is an example of active transport?

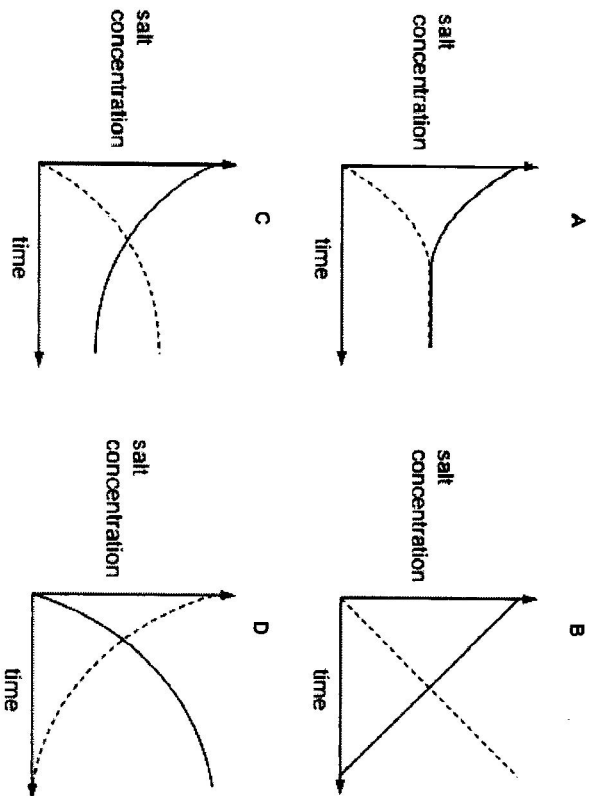
- A movement of glucose into the cells of the villi
- B movement of glucose molecules down a concentration gradient
- C movement of ions in blood plasma
- D movement of water in the transpiration stream

5 The diagram shows permeable tubing filled with salt solution in a test-tube of water. Salt is a small molecule that can pass through the tubing.



Key
 — inside the tubing
 ---- outside the tubing in the test-tube

Which graph shows this sequence of events?



6 Which row shows the elements and basic units that are used in the construction of large food molecules?

	food molecules	elements	basic units
A	fats	carbon, hydrogen, oxygen, nitrogen	glucose
B	fats	carbon, hydrogen, oxygen, nitrogen	glycerol
C	starch	carbon, hydrogen, oxygen	glucose
D	starch	carbon, hydrogen, oxygen	glycerol

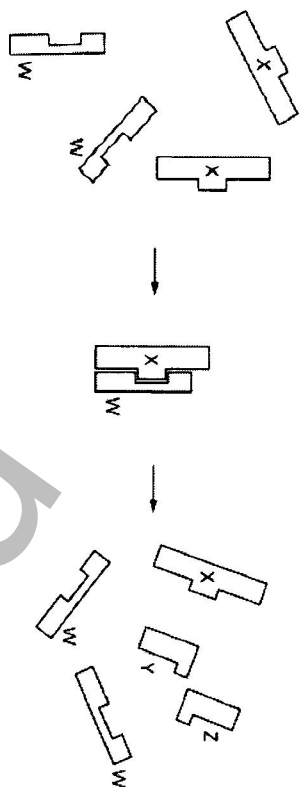
7 A student tested four samples of food, A, B, C and D, for the presence of

- fats
- protein
- reducing sugars
- starch

One of the food samples, milk, was found to contain lipid, protein and reducing sugar. Which of the food samples, shown in the results below, is milk?

sample	observations			
	adding biuret reagent	adding iodine	boiling with Benedict's solution	mixing with ethanol and adding to water
A	pale blue	blue-black	blue	colourless
B	pale blue	brown	orange precipitate	colourless
C	violet	brown	orange precipitate	cloudy emulsion
D	violet	blue-black	brick red precipitate	cloudy emulsion

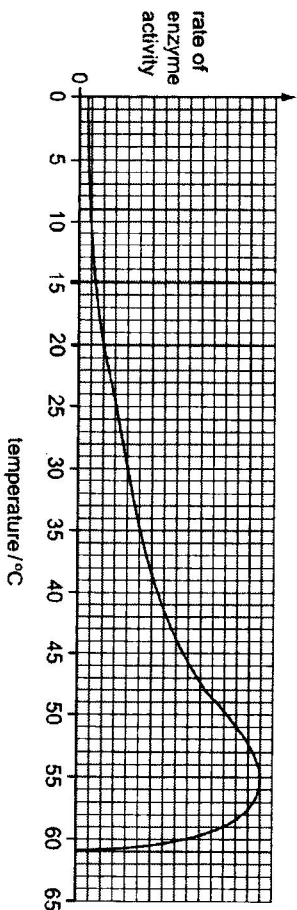
- 8 The diagram demonstrates the 'lock and key' hypothesis of enzyme action.



What are the enzyme, product and substrate in this reaction?

	enzyme	substrate	product
A	W	Y and Z	X
B	W	X	Y and Z
C	X	Y and Z	W
D	X	W	Y and Z

- 9 The graph shows how temperature affects the rate of enzyme activity of an enzyme.

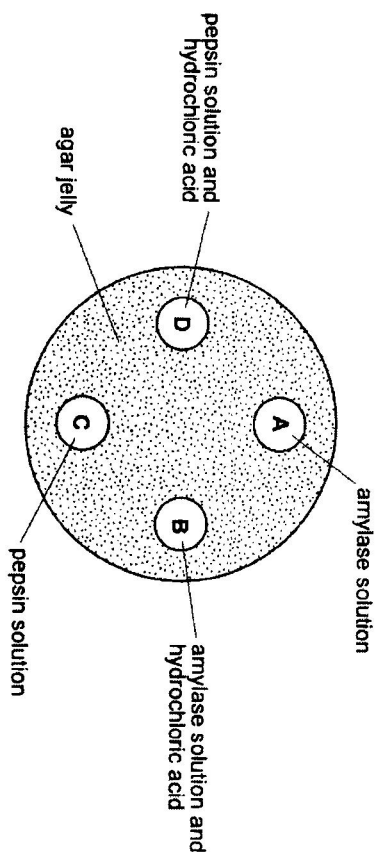


What does the graph show about this enzyme?

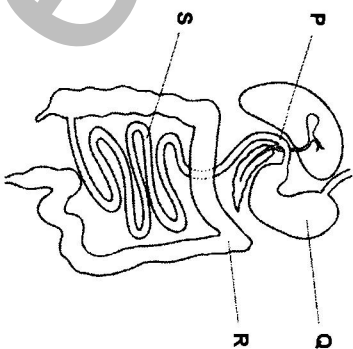
- A The enzyme is denatured only by temperatures above 65 °C.
 B The enzyme is denatured by temperatures below 10 °C.
 C The enzyme works fastest at 45 °C.
 D The rate of enzyme activity doubles when the temperature is increased from 10 °C to 20 °C.

- 10 A dish is filled with agar jelly containing starch. Four holes are cut in the jelly and each hole is filled as shown.

After 30 minutes, which hole will be surrounded by the largest area without starch?



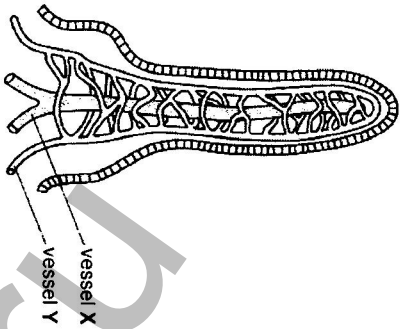
- 11 The diagram shows part of the alimentary canal.



Where is bile added and where is acid released?

	addition of bile	release of acid
A	P	Q
B	Q	R
C	R	S
D	S	P

- 12 The diagram shows a villus.



After a meal containing starch and oil, which substances are absorbed mainly into vessel X and which substances are absorbed mainly into vessel Y?

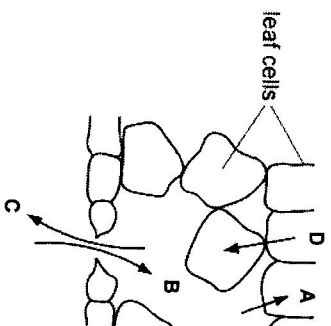
	vessel X	vessel Y
A	amino acids	water
B	fatty acids and glycerol	glucose
C	glucose	amino acids
D	water	fatty acids and glycerol

- 13 Which process is an example of assimilation?

- A formation of carbon dioxide
- B formation of cell membranes using lipids
- C formation of sweat
- D formation of urea

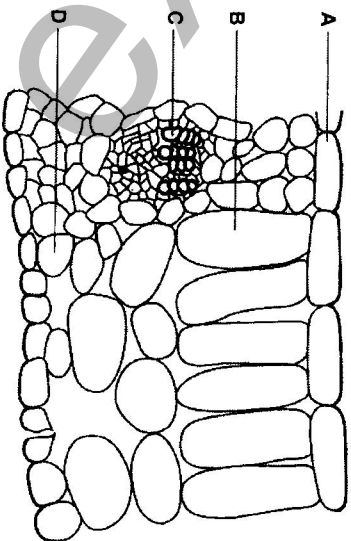
- 14 The diagram shows part of a section through a leaf.

Which arrow shows the direction of movement of water by osmosis in a leaf?

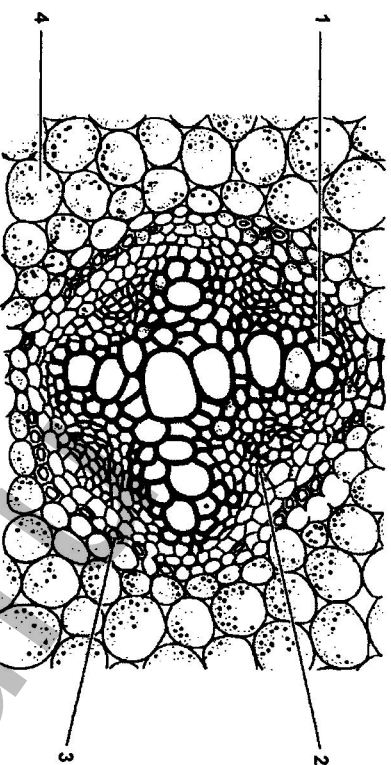


- 15 The diagram represents a cross section of part of a leaf.

Which cell type absorbs the most carbon dioxide during the day?



- 16 The diagram shows a transverse section of the central portion of a root in a dicotyledonous plant.



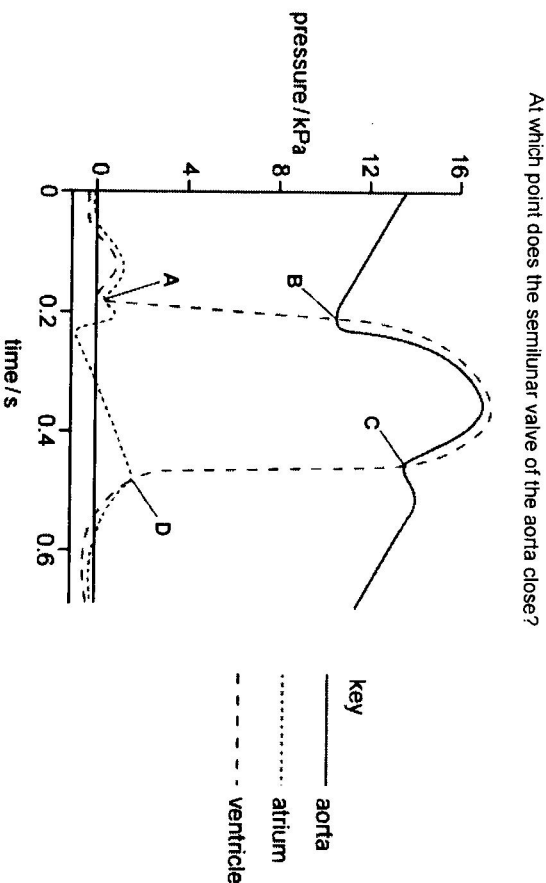
Which tissues transport amino acids and sugars?

	amino acids	sugars
A	1	3
B	2	2
C	3	4
D	4	1

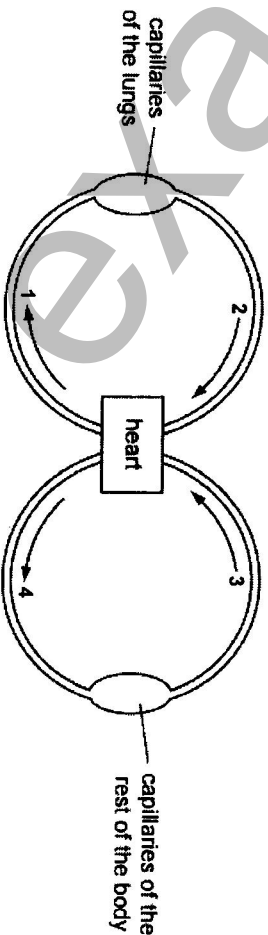
- 17 When the skin is cut, what happens to platelets in the blood?

- A They become sticky to prevent entry of bacteria.
- B They cause chemical changes that produce fibrin threads.
- C They form antibodies to destroy bacteria.
- D They seal the wound by sticking together.

- 18 The diagram gives information about blood pressure in various parts of the circulatory system during the cardiac cycle.



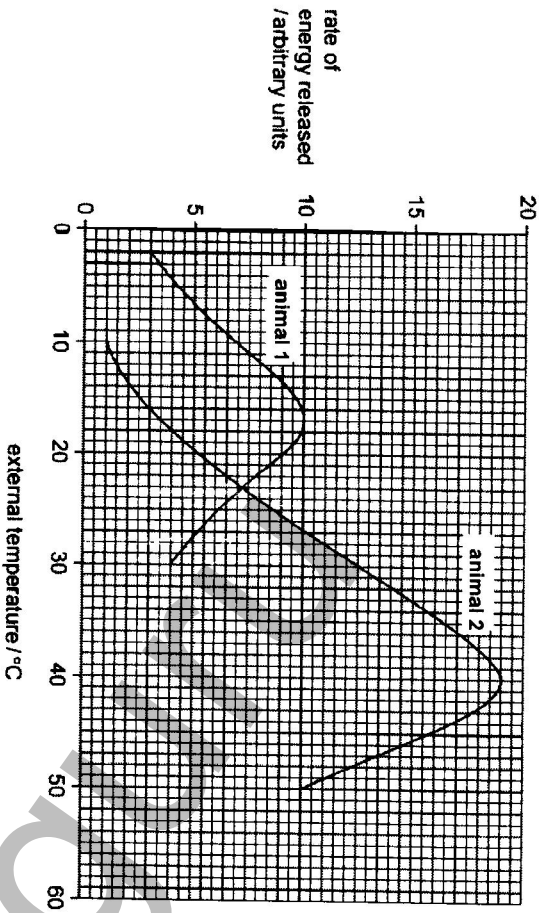
- 19 The diagram shows a double circulatory system.



Which two vessels carry blood at the highest pressure?

- A 1 and 2
- B 1 and 4
- C 2 and 3
- D 2 and 4

- 20 The graph shows the energy released by two animals through respiration as the external temperature changes.



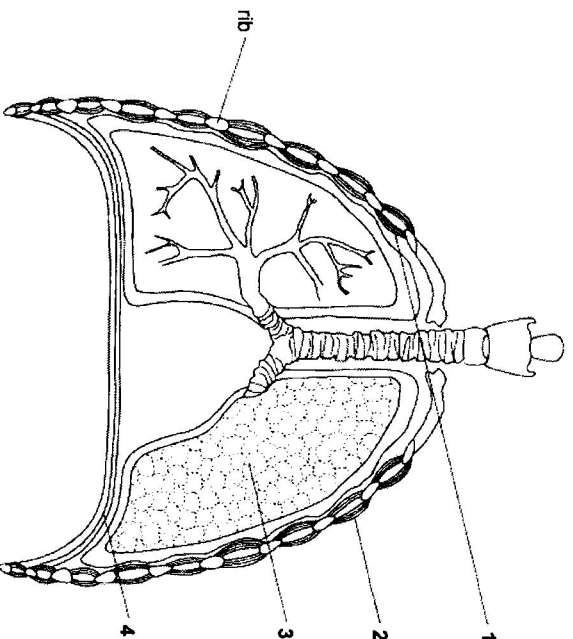
Which conclusion can be drawn from the graph?

- A Animals 1 and 2 release the least energy at 23°C.
- B Animal 2 always respire faster than animal 1.
- C As the temperature rises, respiration always increases.
- D The rate of respiration is the same for both animals at 23°C.

- 21 What results from the destruction of cilia in the trachea due to smoking?

- A Cilia cannot filter bacteria.
- B Cilia cannot trap dust.
- C Mucus cannot be carried towards the throat.
- D Mucus cannot be secreted inside the lungs.

- 22 The diagram shows a section through the thorax, showing the structures used when breathing.



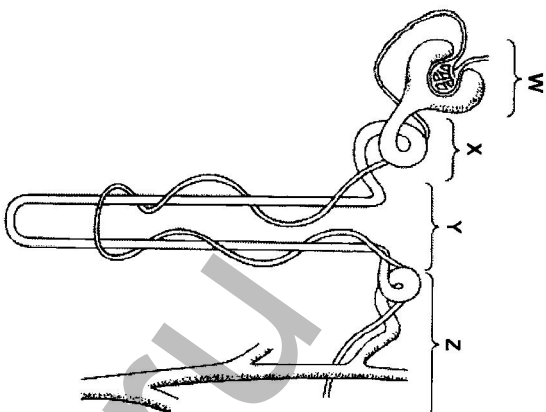
Which two structures contract when breathing in?

- A 1 and 3
- B 1 and 4
- C 2 and 3
- D 2 and 4

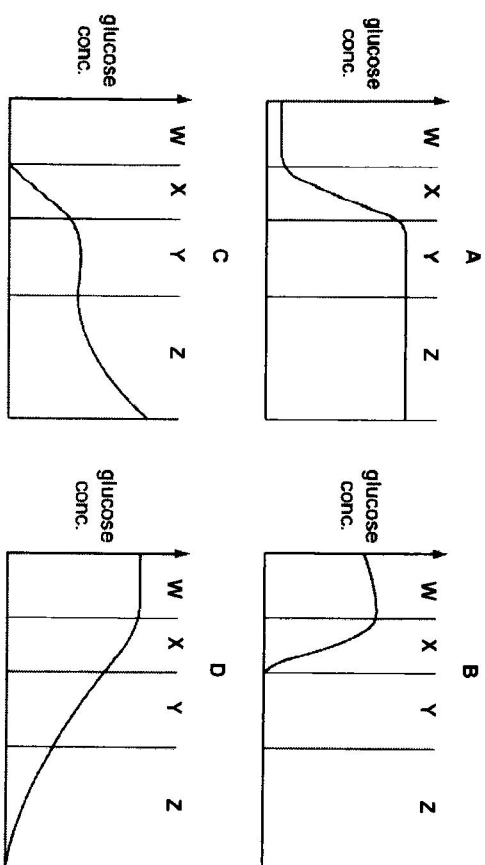
- 23 Which process does **not** result in an overall loss of energy from the organism?

- A a boy running a hundred metres
- B photosynthesis in a green plant
- C respiration in an animal
- D the germination of a seed of a flowering plant

- 24 The diagram shows a kidney tubule (nephron) and associated blood vessels.



Which graph shows the concentration of glucose present in each part of the kidney tubule?

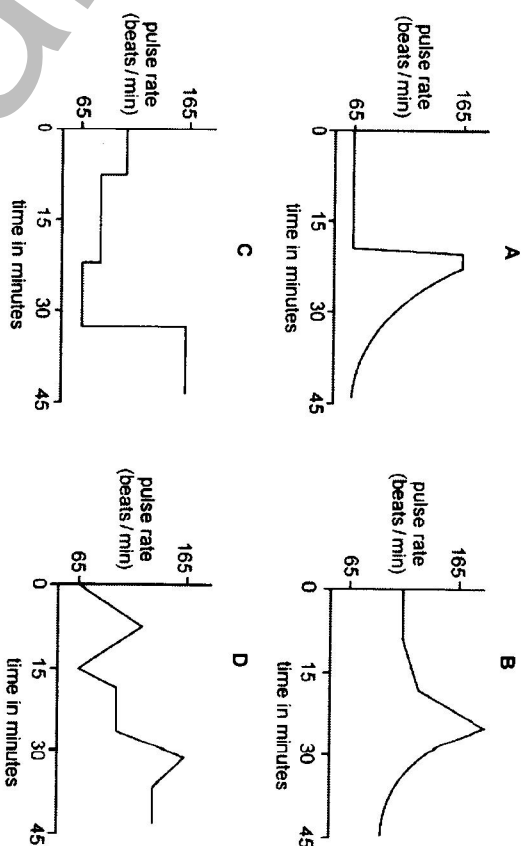


- 25 The graph shows changes in a person's pulse rate over a period of 45 minutes.

The sequence of events involves:

- waiting in a queue
- entering a sports stadium
- seeing a goal scored
- relaxing during half time.

Which graph shows this sequence of events?

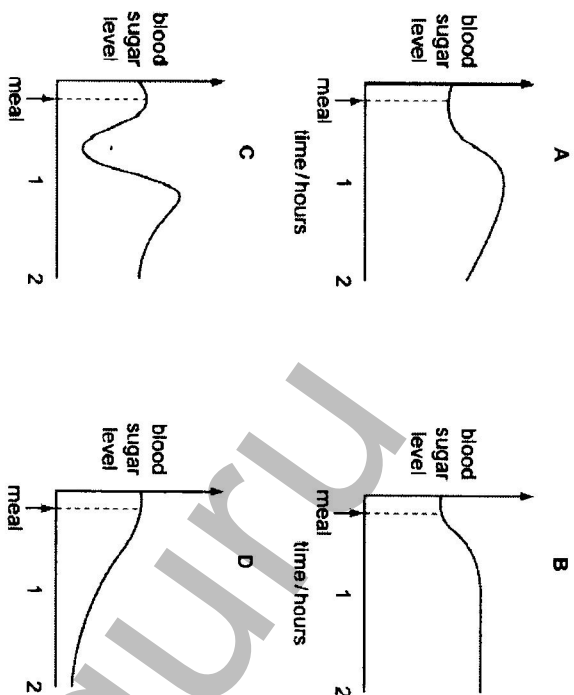


- 26 Which is part of a process of homeostasis?

- A contraction of circular muscles during peristalsis
- B focusing of the eye on a distant object
- C secretion of anti-diuretic hormone
- D secretion of digestive enzymes

- 27 A person does not eat for several hours but then has a meal rich in carbohydrate.

Which graph shows how the person's blood sugar level changes after the meal?

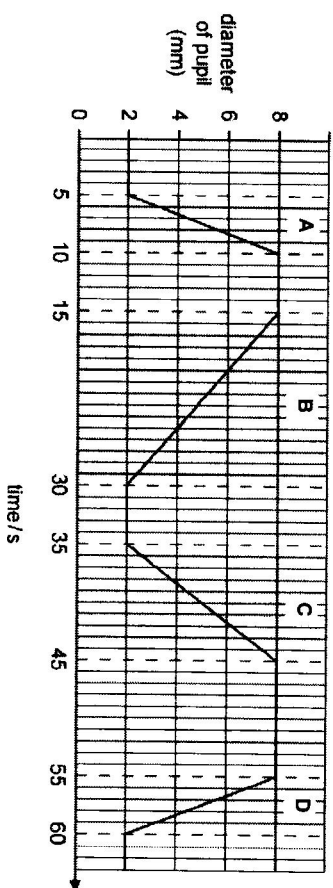


- 28 How is the shape of the lens changed when the eye focuses on a distant object?

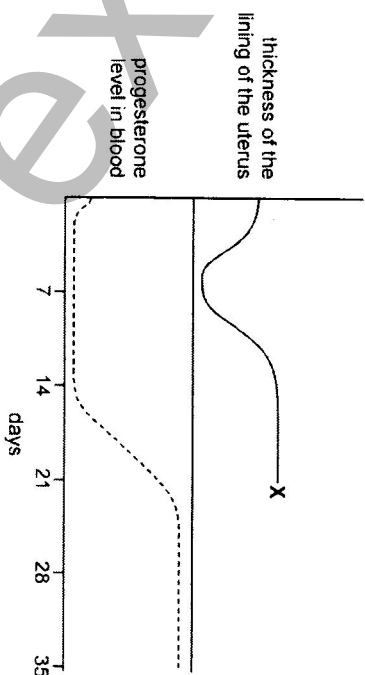
	ciliary muscles	suspensory ligaments	lens
A	contract	pulled tight	pulled thin
B	contract	slackened	allowed to bulge
C	relax	pulled tight	pulled thin
D	relax	slackened	allowed to bulge

- 29 The diameter of a person's pupil is measured as the light intensity is varied.

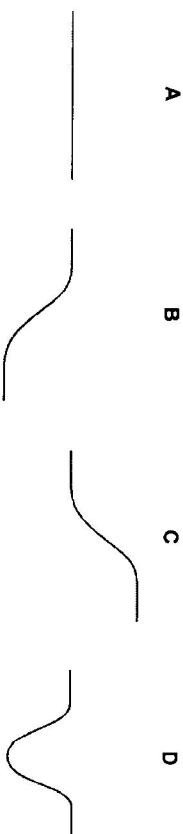
During which time period does the light intensity increase fastest?



- 30 The diagram shows the relationship between progesterone levels and the thickness of the lining of the uterus.

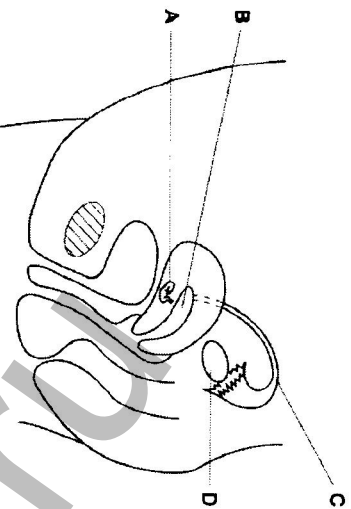


Which segment needs to be added at X to complete the diagram?

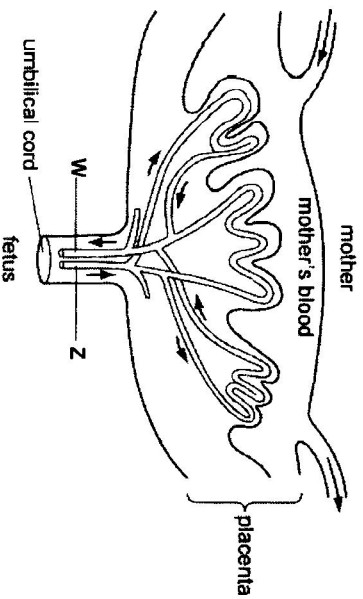


31 The diagram shows a side view of the female reproductive system with a developing embryo.

In which part is fertilisation likely to have taken place?



32 The diagram shows the placenta and umbilical cord.



How does the blood in W differ from that in Z?

	blood in W contains	blood in Z contains
A	less amino acids	more amino acids
B	less glucose	more glucose
C	less oxygen	more oxygen
D	less urea	more urea

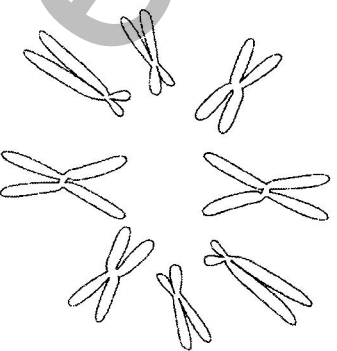
33 Which combination of structural features is found in a wind-pollinated flower?

- A anthers inside flower, smooth pollen, no scent
- B coloured petals, sticky pollen, strong scent
- C large flowers, nectaries present, light pollen
- D no petals, anthers outside flower, no nectaries

34 What is the correct order of structures through which the pollen tube must grow in order to bring about fertilisation?

	first	_____	last
A	microphyte	stigma	style
B	ovary wall	microphyte	stigma
C	stigma	style	ovary wall
D	style	ovary wall	microphyte

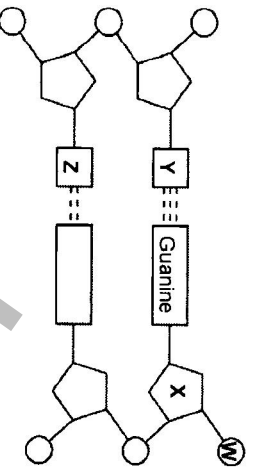
35 The diagram shows chromosomes at metaphase of mitosis.



What are the diploid and haploid numbers for this species?

	diploid	haploid
A	4	8
B	8	4
C	8	16
D	16	8

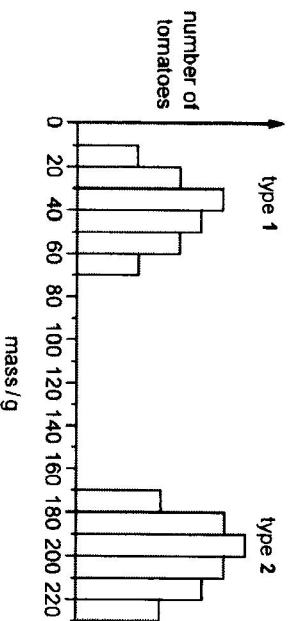
36 The diagram shows part of a DNA molecule



Which letters indicate cytosine, deoxyribose, phosphate and thymine?

	cytosine	deoxyribose	phosphate	thymine
A	W	X	Y	Z
B	Y	X	W	Z
C	Z	W	X	Y
D	Y	Z	X	W

37 The graph shows the masses of two different types of tomato.



What can be concluded from the graph?

- A** Genes do not affect the mass of tomatoes.
- B** Type 1 tomatoes show continuous variation.
- C** Type 2 tomatoes are sometimes smaller than type 1 tomatoes.
- D** Type 2 tomatoes show discontinuous variation.

CBSB 4E Biology Prelim

5158/01/O/16

19

Two species of animal are found in the same area of forest and

Two species of animal are found in the same area of forest and grassland. In the spring and summer they eat the same plant food. However, in the autumn and winter one eats nuts in the forest and the other eats roots on the grassland.

Both species are preyed upon by the same predator. Numbers of root-eating animals are reduced most by this, but they recover faster since they reproduce faster.

What can be concluded about these two species of animals?

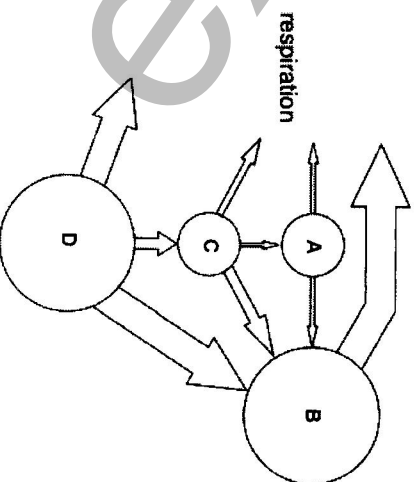
- 1 They are part of the same community.
- 2 They are at different trophic levels.
- 3 They occupy different habitats.

- A** 1 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** All of the above

39

The diagram shows the energy flow model for all the species in a forest. The width of the arrows is proportional to the amount of energy transferred.

Which circle represents the decomposers?



40

Untreated sewage can cause pollution of streams and rivers. Some changes in streams and rivers after sewage is added are shown.

- 1 fish die
- 2 the dissolved oxygen in the water decreases
- 3 the number of anaerobic organisms increases
- 4 the number of bacteria increases

What gives the order in which these events occur?

- A 1 → 2 → 4 → 3
- B 1 → 4 → 3 → 2
- C 4 → 1 → 2 → 3
- D 4 → 2 → 1 → 3

END OF PAPER

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examguru

CHONG BOON SECONDARY SCHOOL
SECONDARY 4 PURE BIOLOGY
PRELIM EXAM 2016

ANSWER

1	C	11	A	21	C	31	C
2	A	12	B	22	D	32	D
3	D	13	B	23	B	33	D
4	A	14	D	24	B	34	C
5	A	15	B	25	B	35	B
6	C	16	B	26	C	36	B
7	C	17	B	27	A	37	B
8	B	18	C	28	C	38	A
9	D	19	B	29	D	39	B
10	A	20	D	30	A	40	D

- 1 (a) carbon dioxide is required for photosynthesis ;
(more carbon dioxide) more glucose is produced ;
carbon dioxide concentration is a limiting factor ;
more carbon dioxide = faster rate of photosynthesis ;
prevents concentration falling below that of atmosphere / AW ;
ref to more, growth / yield ;
[max. 2m] [2]
- (b) carbon dioxide will diffuse out of the glasshouse ;
carbon dioxide is wasted ;
idea that extra, growth / yield, does not cover the cost of the carbon dioxide ;
[max. 1m] [1]
- (c) (i) plants respire at night and do not photosynthesise ; [1]
(ii) decrease temperature on hot days / AW / avoid plants overheating ;
denaturing of enzymes ;
avoids plants wilting ;
idea that open to allow carbon dioxide to enter during the day / ref to F ;
idea that open to allow oxygen to enter at night ;
to allow plants to respire ;
allow water vapour to escape / avoids air becoming too humid ;
reduces chances of (fungal) disease ;
[max. 3m] [3]

- 2 (a) (i) three bars plotted correctly. [1]
(ii) $17 + 7 + 17 = 41$ [1]
 $100 - 41 = 59\%$ [1]
(iii) prostate (cancer); [1]
(b) (i) cause:
blocked coronary artery / AW ;
high fat diet/ high cholesterol/ high stress levels / smoking/
sedentary life style ;
explanation:
heart muscle/ tissue, receives insufficient blood/AW ;
heart muscle/ tissue, receives insufficient oxygen/glucose ;
respiration limited ;
insufficient/poor, energy released ;
heart (muscle) can't contract sufficiently (to support exercise) ; [3]
(ii) drinking a lot of alcohol / binge drinking / drug abuse; [1]

- 3 (a) chemical produced by gland;
carried in blood to target organ ;
alters the activity of target organs;
destroyed by the liver;
any 2 [2]
- (b) (i) Y/ nervous: more rapid;
lasts for a shorter time;
peak production volume higher;
(or vice versa for Z/ hormonal) [2]
(ii) stomach is empty of food/nothing present to digest; [1]
(c) taste buds stimulated (by food);
(electrical/ nerve) impulse generated;
Travel from sensory neurone;
(transmitted to) relay / intermediate neurone;
(impulse passed along) motor neurone;
glands respond by producing gastric juice; [4]

- 4 (a) (i) less pressure ; A low pressure
less oxygen ; A deoxygenated
less glucose ; only accept more glucose if identified as liver
fewer / more, amino acids / fatty acids ;
less water / lower water potential / lower solute potential / higher osmotic
pressure / higher
fewer ions ;
more of named cell product ; e.g. insulin / glucagon / albumen / AV
(more), urea / excretory waste ; R waste unqualified [2]
- (ii) (capillary) wall is, thin/ single layer of cells / one cell thick ; → short
diffusion, pathway / distance/AV ; R 'easy' diffusion / to allow named,
substance/ cell, to leave the blood [2]
- small diameter/ small lumen/ diameter of red blood cells ;
 - slows down flow of red blood cells / (capillary / blood) close to cells ;
 - capillaries have) large, surface area/ surface area to volume ratio ;
→ idea that allows more exchange ;
ignore faster exchange [2]
- (b) (i) carbonic anhydrase [1]
- (ii) (catalyses very) fast / AV, reaction ;
(carbon dioxide as) hydrogen carbonate ions / bicarbonate ions ;
diffuse / move / leaves, out of the (red blood) cell ;
in(to) the plasma ; R 'into blood'
(so that) blood can transport more than could be transported as carbon
dioxide (in solution) / 80 – 90% CO₂ transported this way ;
idea that
reaction maintains concentration gradient for CO₂ from, tissues / tissue fluid,
to blood ;
if carbon dioxide transported then pH would decrease ;
(therefore) maintains pH / prevents pH decreasing / acts as a buffer ; [3]
- 5 (a) metaphase [1]
- (b) Independent assortment;
Different mix of maternal and paternal chromosome/chromatids
Crossing over / chiasmata formation;
Between chromatids of homologous chromosomes
Breaks up linkage group / mixes maternal and paternal alleles
Ref. different gametes produced [4]

- 6 (a) (i) recessive allele:
alternative form of a gene only expressed, in absence of the dominant
(allele)/ if homozygous ;
heterozygous:
having, two different alleles / a dominant allele and a recessive
allele of a particular gene ; [2]
- (b) (i) 1: aa ;
2: Aa ;
3: aa ;
9: Aa ; [4]
- (ii) Couple R [1]
- (iii) if it was recessive all their offspring would have shown the condition ;
but individual 11/AV is normal, so must be dominant/AV ; [2]
- 7 (a) number of seabirds has, increased / gone up (by 40%), and
decreased after 2000 ;
number of woodland birds has decreased/ gone down (by 20%) ; [2]
- (b) deforestation ;
loss of habitat ;
loss of nesting sites ;
less cover available ;
disease ;
lack of food ;
bad weather ;
increased predation ;
increased competition ;
AVP ; [2]
- (c) [Any 1] [1]
- genetic resource ;
useful resource ;
maintains food chain/web ;
(conserve habitat) to maintain biodiversity ;
idea of aesthetic value ;
AVP ; e.g. avoids extinction [2]

Candidate Name: _____

Class:	
Index No.:	

	Chong Boon Secondary School Prelim Examination 2016 Secondary 4 Express Pure Biology Paper 2 5158/02
	14 September 2016 (Wednesday) 1 hours 45 minutes

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B

Answer **three out of four** questions.
Questions 8 and 9 are compulsory.
Question 10 is an **EITHER/OR** question. Only one part should be answered.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.
The total marks for this paper is 80.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This document consists of 18 printed pages (including the cover page) and 2 blank pages.

Section A [50 marks]

Answer **all** the questions.

Write your answers in the spaces provided.

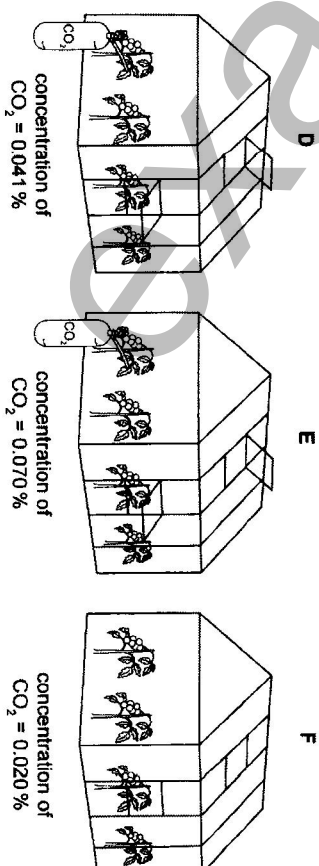
- Many growers of crops in glasshouses use carbon dioxide enrichment to improve yields.
(a) Explain the advantages of carbon dioxide enrichment of glasshouses.

[2]

Fig. 1.1 shows the carbon dioxide concentrations inside three glasshouses, D, E and F, on a hot day with bright sunlight.

- Glasshouses D and E received carbon dioxide enrichment and were ventilated by opening the windows.
- Glasshouse F did not receive any extra carbon dioxide and the windows were closed.

The carbon dioxide concentrations in the glasshouses and in the atmosphere were measured. The concentration in the atmosphere was 0.039%.



The rate of uptake of carbon dioxide by the crop plants was measured in grams of carbon dioxide absorbed per square metre of glasshouse per hour.

These results are shown in Table 1.1.

Table 1.1

glasshouse	rate of uptake of carbon dioxide by crop plants / g per m ² per hour
D	2.5
E	5.7
F	1.0

(b) Suggest **one** reason why it may **not** be cost effective to maintain a high concentration of carbon dioxide in glasshouse **E** compared to the concentration of carbon dioxide in the atmosphere.

(c) (i) Concentrations of carbon dioxide in all three glasshouses in Fig. 1.1 increased at night. State why this happened. [1]

(ii) Explain why it is important to ventilate glasshouses by opening the windows. [1]

[3]

[Total: 7]

2 (a) Table 2.1 shows some of the top ten causes of death in parts of the world during 2010.

Table 2.1

cause of death	percentage of the deaths of adult males	percentage of the deaths of adult females
cancer (lung, alimentary canal, breast, prostate and others)	17	12
coronary heart disease	7	14
stroke (blood clot in brain)	17	10

Fig. 2.1 shows the data for the adult males.

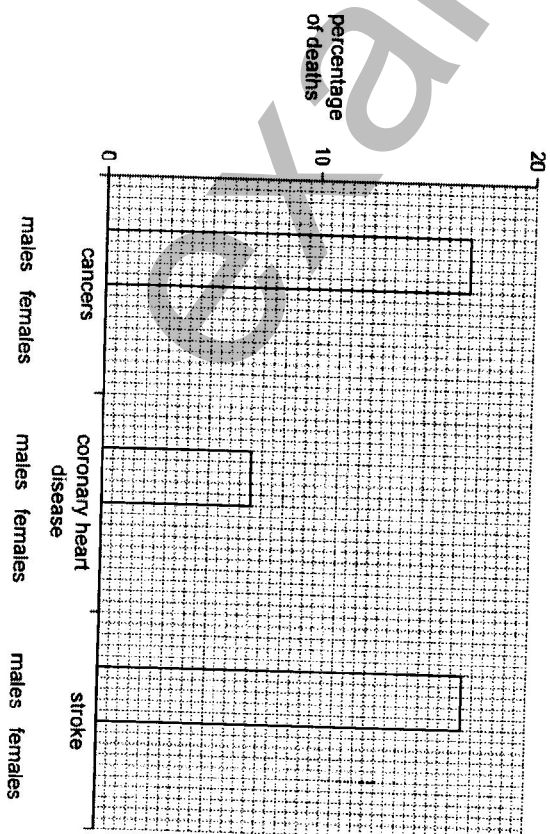


Fig. 2.1

- 2 (a) (i) Draw the bars for the adult females on Fig. 2.1. [1]

- (ii) Calculate the percentage of males dying from causes other than those in Table 2.1.

Show your working.

% [1]

- (iii) State the type of cancer, listed in Table 2.1, that occurs only in males.

[1]

- (b) The lifestyles of people can affect their risk of dying from some diseases.

- (i) People with coronary heart disease (CHD) are unable to do much exercise.

State a cause of CHD and explain why people with this disorder are unable to do much exercise.

cause

explanation

[3]

- (ii) In 2010 2% of adult male deaths were due to liver disease.

Suggest **one** aspect of their life style that could have caused this.

[1]

[Total: 7]

- 3 (a) Define *hormones*

[2]

After a meal, the stomach produces gastric juice.

The production of gastric juice is controlled by both nervous and hormonal stimulation of glands in the stomach wall.

Fig. 3.1 shows the volumes of gastric juice produced in response to nervous stimulation (curve Y) and to hormonal stimulation (curve Z).

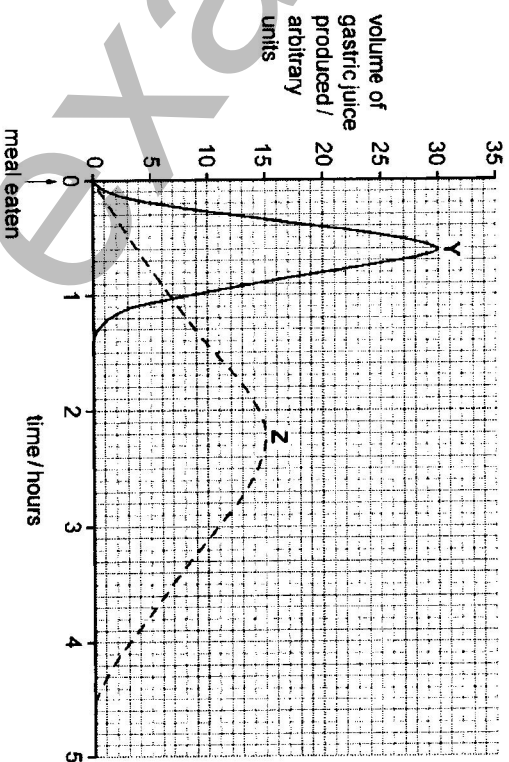


Fig. 3.1

- (b) (i) Using Fig. 3.1, describe the differences in the production of gastric juice in response to nervous and to hormonal stimulation.

[2]

- 3 (b) (ii) Suggest why gastric juice stops being produced 4.5 hours after the meal has been eaten.

[1]

- (c) The secretion of gastric juice is an example of a simple reflex.

The taste buds in the mouth are the **receptors** and the glands in the stomach are the **effectors** in this reflex.

Outline the reflex that occurs when gastric juice is produced.

[4]

[Total: 9]

- 4 Fig. 4.1 shows part of a capillary network and some cells of the surrounding tissue.

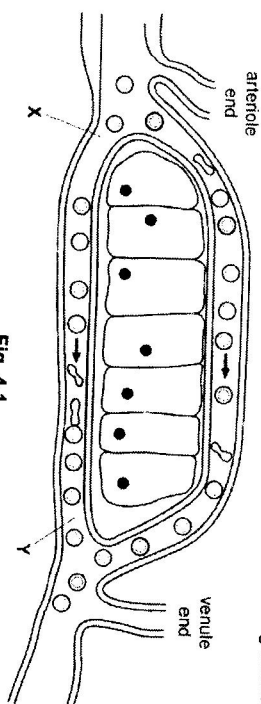


Fig. 4.1

- (a) (i) State **two** ways in which the blood at Y differs from the blood at X, other than the difference in concentration of carbon dioxide.

[2]

- (ii) Explain how capillaries are adapted for their function as exchange vessels.

[2]

Enzyme Z in red blood cells catalyses the reaction between carbon dioxide and water as blood flows through respiring tissues.



- (b) (i) Name enzyme Z that catalyses this reaction.

[1]

- (ii) Explain the significance of this reaction in the transport of carbon dioxide.

[3]

[Total: 8]

5 Fig. 5.1 shows the results of an animal cell that is undergoing meiosis II.

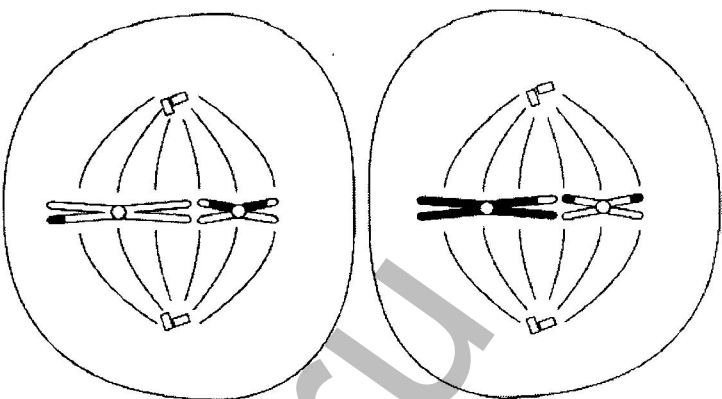


Fig. 5.1

(a) State which stage of meiosis II is shown.

[1]

(b) Name and explain two ways in which meiosis can lead to variation.

1

2

[4]

[Total: 5]

6 (a) Define the following genetic terms.

recessive allele

heterozygous

(b) Fig. 6.1 shows the hand of a person who suffers from a mutation that results in people having more than five digits on each hand (polydactyly).

[2]



Fig. 6.1

The mutation that results in this condition is dominant.

Fig. 6.2 shows how the condition is inherited in a family

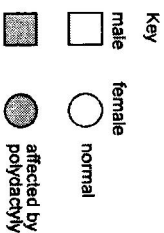
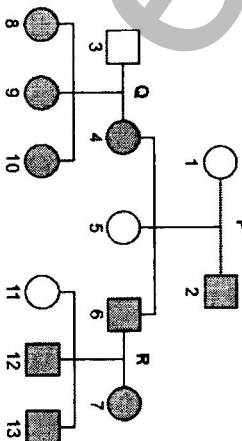


Fig. 6.2

- 6 (b) (i) State the genotype of the individuals shown in Fig. 6.2.
Use **AA**, **Aa** or **aa**.

Write your answers in Table 6.1.

Table 6.1

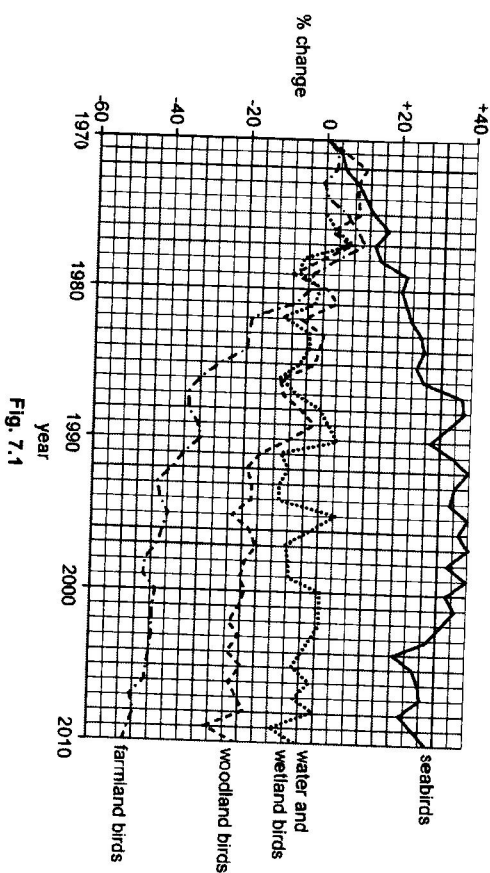
numbered person on Fig. 6.2	genotype of person
1	
2	
3	
9	

- (ii) Using evidence from Fig. 6.2, state which of the couples, **P**, **Q** or **R**, provides proof that the mutation is **not** recessive. [4]
- (iii) Explain the reason for your answer. couple [1]

[2]
[Total: 9]

- 7 In 1970, scientists started counting different groups of birds living on a large island.

Fig. 7.1 shows how the numbers of four of these bird groups changed between 1970 and 2010.



- (a) Compare the results for seabirds with the results for woodland birds. [1]
- (b) Suggest a reason for the change in the numbers of woodland birds since 1990. [2]
- (c) The results for farmland birds are a particular cause for concern. Describe why it is important to conserve species and their habitats. [1]

Section B [30 marks]

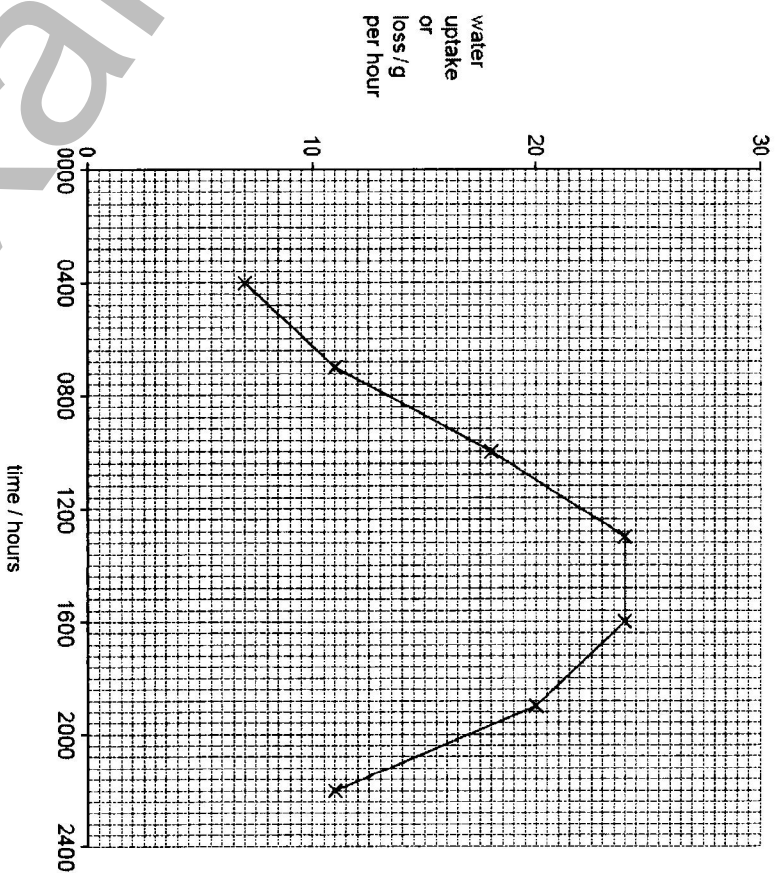
Answer three out of four questions.
Questions 8 and 9 are compulsory.
Question 10 is an **EITHER/OR** question. Only one part should be answered.
Write your answers in the spaces provided.

- 8 An investigation of the uptake and loss of water by a plant was carried out over 24 hours.
The results are shown in Table 8.1.

Table 8.1

time of day / hours	water uptake / g per hour	water loss / g per hour
0400	7	2
0700	11	8
1000	18	24
1300	24	30
1600	24	24
1900	20	13
2200	11	5

- 8 (a) The data for water uptake have been plotted on the grid below.



- (i) Plot the data for water loss on the same grid. Label **both** curves. [4]
(ii) State the process by which water is lost from the plant. [1]
(iii) State the **two** times at which the uptake and loss of water were the same. [1]

- 8 (b) Explain how a **decrease** in temperature and humidity would affect the water loss by this plant.

(i) *temperature*

[2]

(ii) *humidity*

[2]

[Total: 10]

- 9 (a) Describe the role of natural selection in evolution.

(b) Explain, using one named example, how mutation can affect phenotype.

[7]

[3]

[Total: 10]

10 Either

- (a) Describe how the work of the kidneys is affected by changes in diet and atmospheric temperature.

diet

atmospheric temperature

- (b) If the kidneys fail, the patient may be put on a kidney machine.

Explain how a kidney machine works.

[6]

[4]

[Total: 10]

10 Or

- (a) Describe the events that occur after the body temperature falls that will return the body temperature to its normal level.

- (b) Explain what is meant by control by 'negative feedback'.

[7]

[3]

[Total: 10]

END OF PAPER

8

(a) (i)

at least 4 points plotted accurately;
further 3 points plotted accurately;
points joined by a line;
both curves labelled;

(ii)

0800 ($\pm$ 15 minutes) and 1600 hours;

(iii) transpiration

(b) (i) less water loss;

(ii) decrease in diffusion / concentration gradient / rate of evaporation lower (in cooler conditions) / cooler air holds less water vapour;
water loss rises;

increase in diffusion / concentration gradient / rate of evaporation higher (in drier conditions) / drier air can hold more water;

9

(a)

individuals in population have great reproductive potential / AW;
numbers in population remain roughly constant;
many fail to survive / die;
do not reproduce;
due to environmental factors / named factor;
variation in members of population;
those best adapted survive;
reproduce / pass on alleles; R genes
genetic variation leads to change in phenotype;
ref. changes in gene pool;
over time produces evolutionary change;
new species arise from existing ones

(b)

(Chromosome mutation)

e.g. Down's syndrome
change in the structure or number of chromosomes
Humans normally have 46 chromosomes in their body cells. People with Down's syndrome have 47 chromosomes. / They have an extra copy of chromosome 21.

(Gene mutation)

change in the structure of DNA
produces variation between individuals as it results in new alleles of genes

e.g. albinism

Caused by mutation in a recessive allele
The absence of the pigment melanin results in reddish-white skin, white hair and pink eyes.

e.g. sickle-cell anaemia

Caused by mutation in the gene controlling haemoglobin production
different amino acid;
different polypeptide / different protein / non-functional protein;
Sickle-shaped red blood cells have low oxygen carrying capacity and tend to clump together.

10 E (a)

diet

- more protein (or reverse argument);
- more deamination in liver / or described;
- more urea;
- more salts in diet more have to be removed;
- more water consumed more has to be removed to maintain blood concentration;

temperature

- affects amount of sweating;
- affecting amount of water lost;
- during temperature regulation;
- affects amount of water released in urine;
- ref. loss of salts in sweat;
- adjustment of salts in urine;
- to maintain blood concentration;

(b)

- ref. to blood enters machine from patient AV;
- ref. to pump;
- blood passes along + dialysis tubing AV/wisking tubing/cellulose or cellophane tubing;
- ref. to tubing AV being semi-permeable/selectively permeable/
- ref. to fluid has same osmotic pressure. as blood;
- waste materials/excess materials + pass from blood;
- ref. to diffusion;
- ref. to bubble trap/counter flow;
- 'cleaned' blood returns + to patient's circulation/body AV;

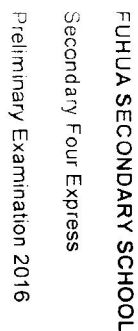
10 O (a)

- ref. hypothalamus
- nervous control/impulses/brain
- less active sweat glands/sweating stops (A inactive)
- less evaporation (of sweat) (R no evaporation)
- vasoconstriction AV
- of arteries/-erioles/blood vessels (R capillaries/veins)
- less blood to capillaries (A ref. heat loss from)
- less heat lost
- shivering generates heat/hair erection decreases heat loss (or insulates)/adrenaline
- release/higher metabolic rate

(b)

a change (in level/of set point) AV
is responsible for/triggers/causes/ref. sensor/ref. receptor
a response/reaction
(which leads to) restoration of original level max 3
(if given, accept specific examples instead of general account)

Class	Index No.
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4E

[illegible]

5158/01

2 Some processes which occur in flowering plants are listed

- 1 ion uptake by roots hairs
- 2 water uptake by root hairs
- 3 ion movement up the xylem in the stem
- 4 water vapour loss by the mesophyll cells of the leaves

Which processes are controlled by cell surface membranes?

3 Boiling potatoes destroys their cell membranes. A peeled, boiled potato strip is placed in a concentrated solution of salts.

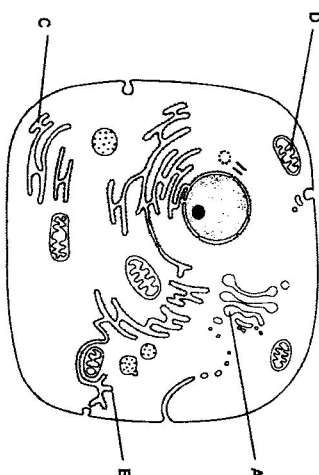


PARENT'S SIGNATURE	FOR EXAMINER'S USE
	40

Vetter: Mr Travis Neo

This question paper consists of 19 printed pages including this page

1 The diagram shows the ultrastructure of a typical animal cell



A	1 only
B	1 and 3

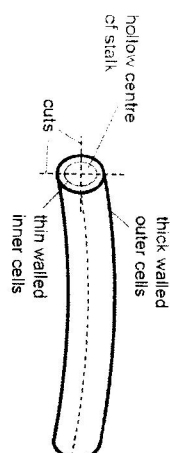
C 2 only
D 3 and 4

	osmosis	solute diffusion
A	✓	✓
B	✓	×
C	×	✓
D	×	×

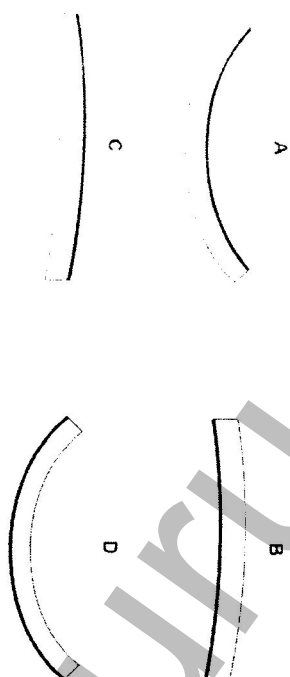
key:

- ✓ = takes place
- x = does not take place

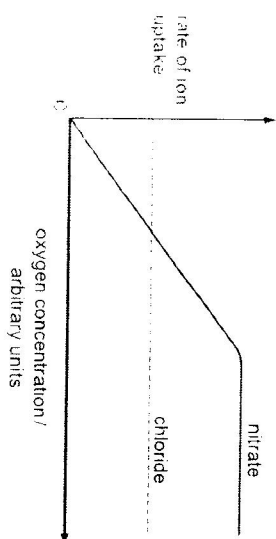
- 4 The stalk of a dandelion flower is a hollow tube. Pieces of the stalk are cut as shown and placed in sucrose solutions of different water potentials.



Which diagram shows the piece that is placed in the sucrose solution with the highest water potential?



- 5 The roots of a plant are placed in a dilute solution containing chloride and nitrate ions. The graph shows how the rate of uptake of chloride and nitrate ions by the roots of the plant varies with oxygen concentration.



What can be concluded about how chloride and nitrate ions enter the roots?

	chloride	nitrate
A	active transport	active transport
B	active transport	diffusion
C	diffusion	active transport
D	diffusion	diffusion

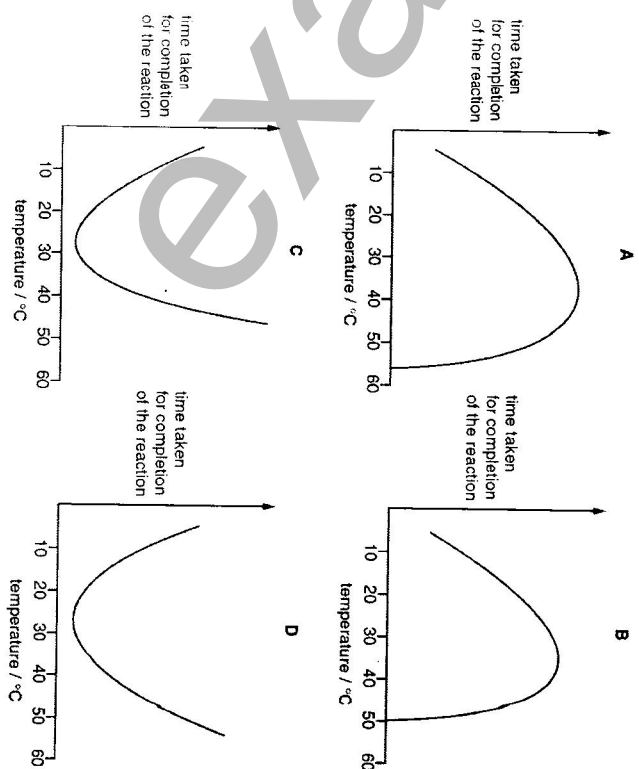
- 6 Four test-tubes containing egg white are incubated for ten minutes at 35 °C. Different substances are then added to the four test-tubes.

In which test-tube is the egg white first digested?

	substances added
A	1 cm ³ lipase solution and three drops of sodium hydroxide solution
B	1 cm ³ protease solution and three drops of dilute hydrochloric acid
C	1 cm ³ protease solution and three drops of water
D	1 cm ³ lipase solution and three drops of water

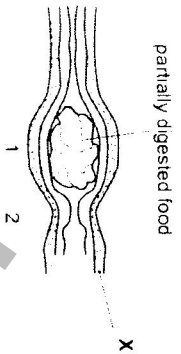
- 7 An enzyme is completely denatured at 50 °C. A fixed concentration of this enzyme is added to a fixed concentration of its substrate. The time taken for completion of the reaction is measured at different temperatures.

Which graph shows the results?



5

- 8 The diagram shows a section of the small intestine in which partially digested food is being pushed along.

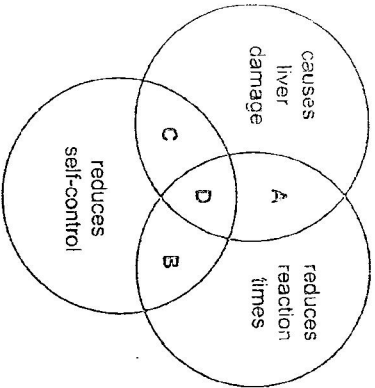


direction of movement

	1	2
A	contracted	contracted
B	contracted	relaxed
C	relaxed	contracted
D	relaxed	relaxed

What is the state of the longitudinal muscles at 1 and 2?

- 9 What are the effects of the excessive consumption of alcohol?



6

- 10 The table shows the conditions set up in an experiment.

test-tube 1	1 ml of oil	5 ml of lipase	0.05 g of bile salts	5 ml of pH 9 buffer
test-tube 2	1 ml of oil	5 ml of water	0.05 g of bile salts	5 ml of pH 9 buffer
test-tube 3	1 ml of oil	5 ml of lipase		5 ml of pH 9 buffer

Three drops of pH indicator was added to each test tube. The colour changes for the pH indicator are as follows.

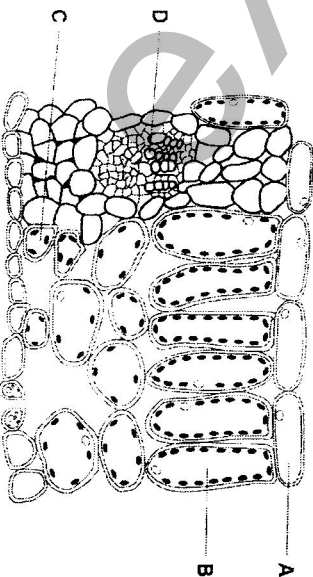
pH 3	pH 5	pH 7	pH 9
red	pink	orange	yellow

What colour would you expect to see in the test-tubes after 30 minutes?

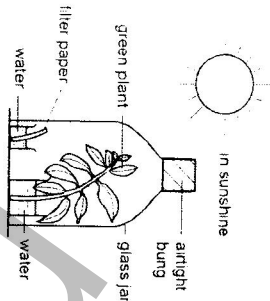
	test tube 1	test tube 2	test tube 3
A	red	red	yellow
B	orange	yellow	pink
C	pink	yellow	red
D	red	yellow	pink

- 11 The diagram shows a section through a leaf, seen under the microscope.

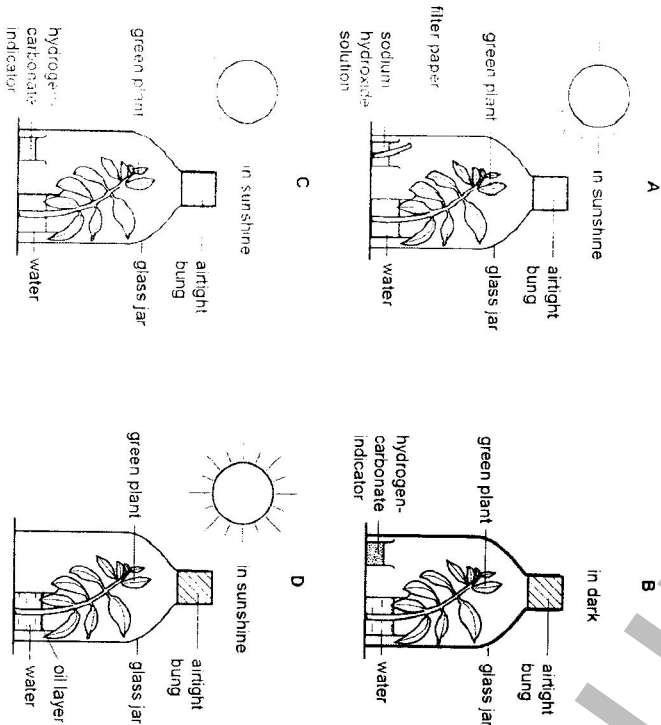
In which part is the carbon dioxide concentration lowest on a warm sunny day?



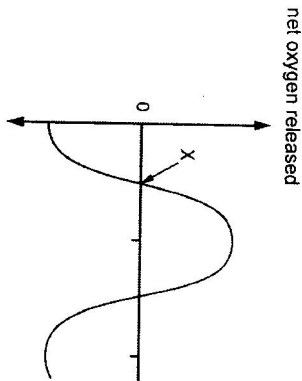
12 The diagram shows a green shoot photosynthesising under a glass jar. This was used as a control experiment in a laboratory investigation.



Which diagram shows the other experiment that should be done to investigate the need for carbon dioxide in photosynthesis?



13 The graph shows the oxygen released and taken up by a tree during a 24 hour period.



Which statement describes the situation at point X?

- A Respiration begins.
- B Photosynthesis stops.
- C The rate of respiration is equal to the rate of photosynthesis.
- D The rate of respiration is greater than the rate of photosynthesis.

14 The blood of three patients X, Y and Z were tested to determine their respective blood groups. The patients' blood samples were tested with serum samples of blood groups A and B. The results are as shown below.

patient	serum from blood group A	serum from blood group B
X		
Y		
Z		

Which of the following shows the correct blood group matching for all the patients?

	patient X	patient Y	patient Z
A	B	AB	O
B	A	O	AB
C	O	A	B
D	AB	B	A

- 15 The table below shows the composition of the blood of 3 people.

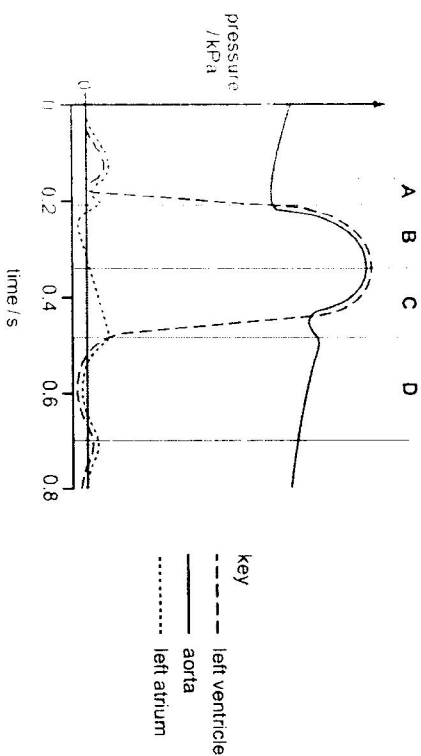
person	A	B	C
number of red blood cells per mm ³	900,000	5,000,000	7,500,000
number of white blood cells per mm ³	6,000	5,000	500
number of platelets per mm ³	255,000	500	250,000

Which of the following conclusions can be drawn from information in the table?

- I Person A is anaemic due to an iron deficiency.
 II Person B's blood is most likely to have difficulty in clotting.
 III Person C is likely to live in high altitude.
- A I and II only
 B I and III only
 C II and III only
 D I, II and III

- 16 The diagram shows the pressure changes in various structures of the left side of the heart during the cardiac cycle.

At the end of which period, A, B, C or D, is the ventricle full of blood?

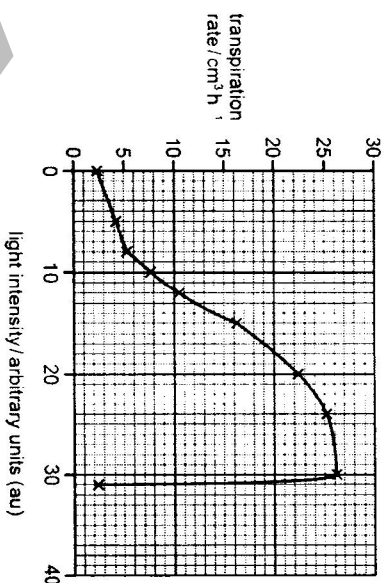


- 17 A region of a stem of a plant is heated to kill the cells in the living vascular tissues. How will this treatment affect the transport between roots and leaves via xylem and phloem?

	xylem	phloem
A	x	✓
B	x	x
C	✓	✓
D	✓	x

✓ = transport continues
 x = transport stops

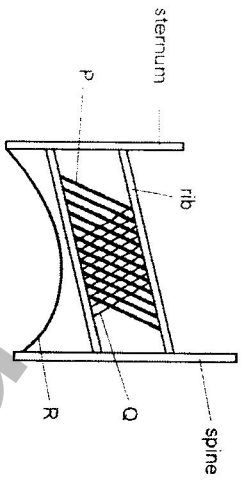
- 18 An investigation was carried out into the effect of light intensity on the rate of transpiration. All other variables were standardised. A student was asked to explain the results shown in the graph below.



Which explanation is correct?

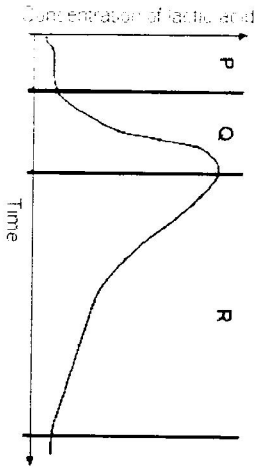
- A At light intensities above 30 au the stomata close rapidly.
 B The rate of transpiration increases as the light intensity increases.
 C The rate of transpiration never falls to 0 cm³ because some stomata are always open.
 D Water uptake by the plant increases as the light intensity increases from 0 to 30 au.

- 19 The diagram represents some of the muscles involved with breathing.

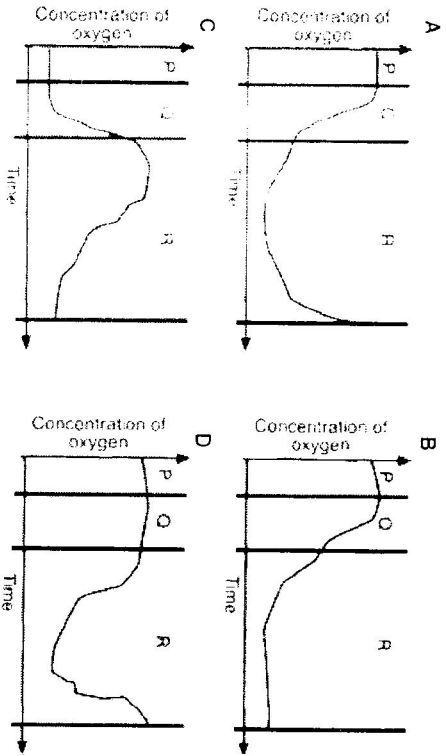


- Which muscles are contracting during breathing in?
 A P and Q B Q and R C P and R D P, Q, R

- 20 The following graph shows the concentration of lactic acid in the blood of an athlete.



Which of the following graphs correctly shows the level of oxygen in his blood?



- 21 The table shows a student's water losses on a cool day.

	water loss/cm ³
in urine	1500
in faeces	100
in expired air	400
in sweat	800
total	2800

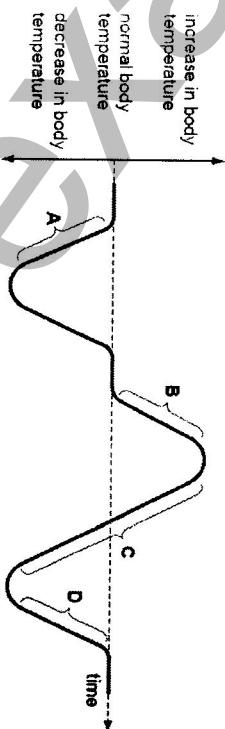
On a hot day the student's water intake was the same as on the cool day.

On the hot day, which water losses would increase and which would decrease?

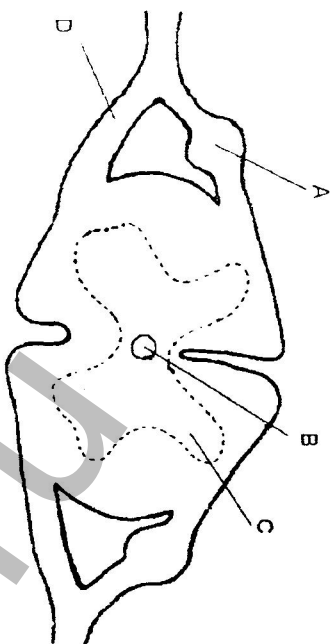
	increase	decrease
A	in sweat	in expired air
B	in sweat	in urine
C	in urine	in faeces
D	in urine	in sweat

- 22 The graph shows the variation in a person's body temperature over a period of time.

At which part of the graph is vasodilation taking place after a vigorous exercise?



- 23 The diagram below shows a section through part of the spinal cord.



A person suffered from a spinal injury to one of the following areas indicated above. Following this injury, he is only able to carry out voluntary actions but is unable to do detect sensation or to respond to a tap to his knee cap.

Which area of the spinal cord was injured?

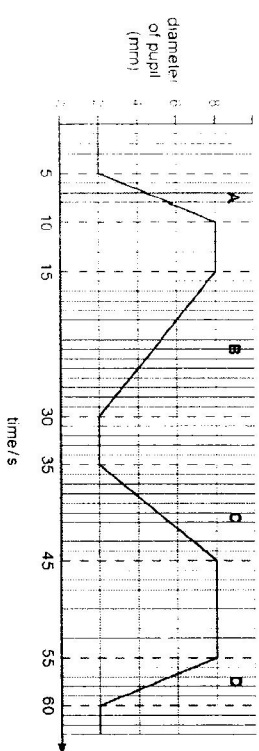
- 24 Insulin is a hormone, synthesised in the pancreas and is distributed around the body by the blood.

What describes its rate of secretion and its concentration in the blood?

	rate of secretion	concentration in the blood
A	constant	constant
B	constant	varied
C	varied	constant
D	varied	varied

- 25 The diameter of a person's pupil is measured as the light intensity is varied.

During which time period does the light intensity increase fastest?



- 26 Two polynucleotide strands make up a DNA molecule.

What is a correct description?

- A The percentage of cytosine is 50% of that of guanine in the whole molecule.
- B The percentage of cytosine is the same as that of guanine in each strand.
- C The percentage of cytosine is the same as that of guanine in the whole molecule.
- D The percentage of cytosine is the same in each strand of the molecule.

- 27 Which statement about chromosomes is correct?

- A Chromosomes are long DNA molecules called genes which are divided into sections.
- B Chromosomes include a long molecule of DNA divided into sections called genes.
- C Chromosomes include genes which are divided into sections called DNA molecules.
- D Genes include long DNA molecules called chromosomes.

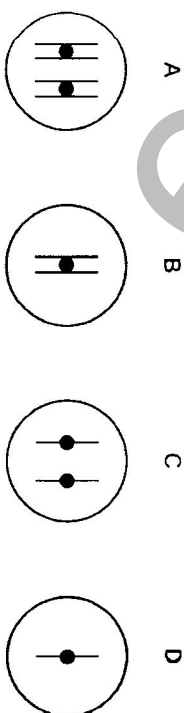
- 28 Which statements about a diploid cell are correct?

- 1 can divide by mitosis to repair itself
- 2 has two complete sets of chromosomes
- 3 can undergo a reduction division to form haploid cells
- 4 can undergo mitotic division to allow growth to occur

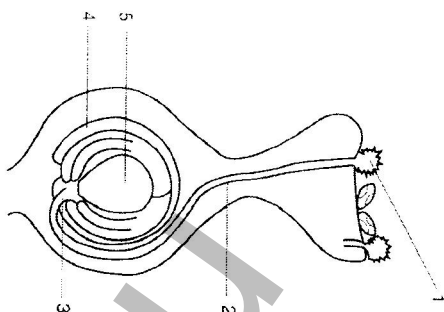
- A 1, 2 and 3 B 1, 2 and 4 C 2, 3 and 4 D 1, 2, 3 and 4

- 29 A cell with one pair of chromosomes ($2n = 2$) undergoes meiosis.

Which nucleus is formed as a result of this division?



- 30 The diagram shows a cross-section through the carpel of a flower just before fertilisation



Where are the male and female gametes just before fertilisation?

	male gamete	female gamete
A	1	5
B	1	4
C	2	4
D	3	5

- 31 A scientist takes 4 pairs of samples from a wild cherry tree.

In which pair of samples could there be cells with different genotypes?

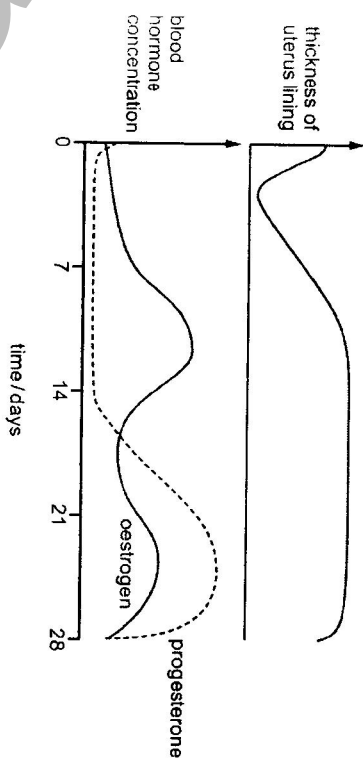
- A two fruits
- B two leaves
- C two petals
- D two root cuttings

- 32 A plant has flowers whose anthers mature and fall off before the stigma is fully developed.

What will this prevent?

- A cross-pollination
- B insect-pollination
- C self-pollination
- D wind-pollination

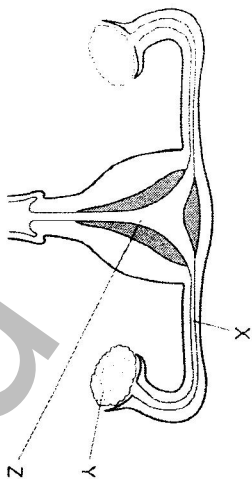
- 33 The graphs show changes that occur in a woman during the menstrual cycle.



Which statement is supported by evidence in the graphs?

- A A large increase in progesterone concentration always results in thickening of the uterus lining.
- B At ovulation, the uterus lining is at its thickest.
- C Each time the oestrogen concentration rises, the uterus lining becomes thicker.
- D Within 5 days of ovulation, the uterus lining gets thinner.

- 34 The diagram shows a section through the female reproductive system.



During pregnancy, where does mitosis occur in the cells of the embryo?

	X	Y	Z
A	✓	✓	✓
B	✓	✓	×
C	✓	×	✓
D	×	×	×

- 35 A person with Down's syndrome is born with 47 chromosomes in each cell, instead of 46.

What could cause this?

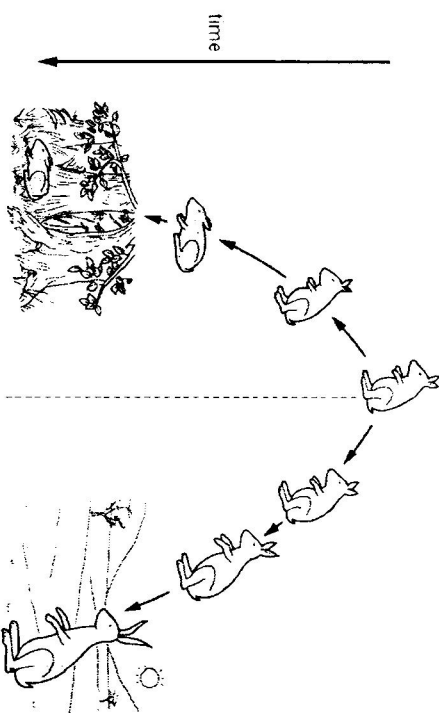
- A A mutation happened during the production of the egg cell.
- B More than one sperm fused with the egg at fertilisation.
- C Radiation caused a change in structure of a gene in the father's sperm.
- D The mother was exposed to harmful chemicals while she was pregnant.

- 36 A man of blood group A, and his wife of blood group O, had two children, both of blood group A. The man concluded that he must be homozygous for the allele I^A, since he thought that his children would be of group O if he were heterozygous.

Why was his conclusion unsound?

- A Blood group mutations are common.
- B Genetic ratios are unreliable for small numbers.
- C His wife might have been heterozygous.
- D The expected phenotypic ratio for a heterozygous father and group O mother is 3 blood group A : 1 blood group O.

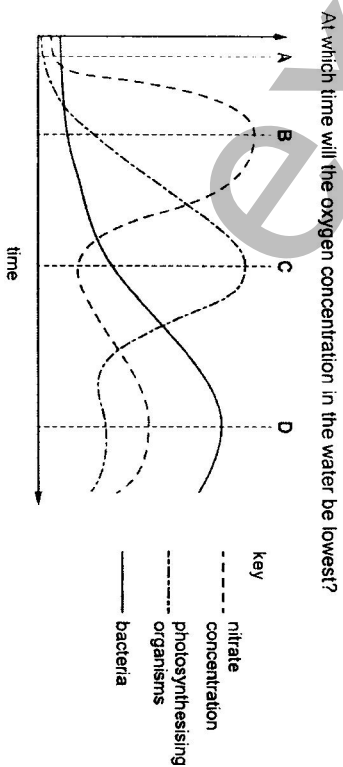
- 37 The diagram shows a species becoming modified to survive in two different habitats.



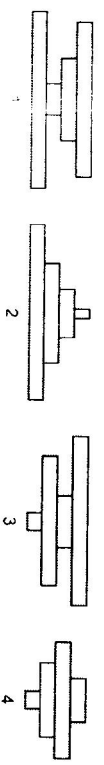
Which process is responsible for these modifications?

- A artificial selection
- B conservation
- C genetic engineering
- D natural selection

- 38 The graph shows changes in part of a lake after it has been polluted by fertilisers from a nearby farm.



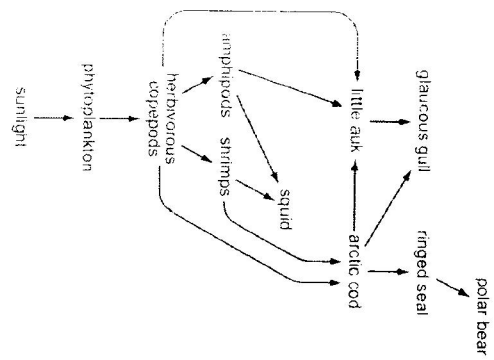
- 39 A tree has insect larvae burrowing in its leaves. The emerging insects are eaten by birds and the birds have parasitic fleas living amongst their feathers.



Which is a pyramid of biomass and which is a pyramid of numbers for this food chain?

	pyramid of mass	pyramid of numbers
A	1	3
B	1	4
C	2	3
D	2	4

- 40 The diagram shows an arctic ecosystem.



- How many trophic levels are represented?
- A 5
B 6
C 7
D 8

Candidate Name _____

Class _____ Index No. _____



FUHUA SECONDARY SCHOOL
Secondary Four Express
Preliminary Examination 2016

4E

BIOLOGY
PAPER 2

5158/02

DATE 25 AUG 2016 (THURSDAY)
TIME 1125 – 1310
DURATION 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, class and index number in the spaces provided on top of this page.
Write in dark blue or black pen.
You may use a pencil for any diagrams or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A

Answer all questions
Write your answers in the spaces provided on the Question Paper.

Section B

Answer all the questions.
Write your answers in the spaces provided on the Question Paper.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
Electronic calculator may be used.
The number of marks is given in brackets [] at the end of each question or part question.

PARENT'S SIGNATURE	FOR EXAMINER'S USE		
	Section A	Section B	Total
	50	30	80

Setter: Mr Ng Wei Ping

Verifier: Mr Travis Neo

This question paper consists of 19 printed pages including this page.

Section A

Answer all questions.

Write your answer in the spaces provided.

- 1 (a) Fig. 1.1 shows parts of the alimentary canal that lie in the upper part of the human body. Some food is found along structure N.

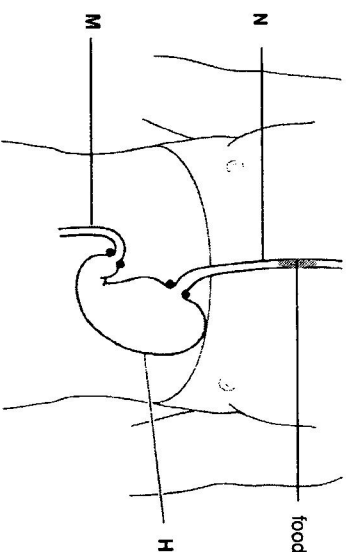


Fig. 1.1

- (i) The food consisted solely of meat and potatoes.

By placing ticks (✓) in the appropriate boxes in Table 1.1, show how the components of the food compare at structures M and N.

Table 1.1

	more at M than at N	less at M than at N	almost the same at M and N
starch			
protein			

[1]

- (ii) Suggest why the walls of structure H are normally coated with mucus.

[2]

(b) Coeliac disease is a disease of the digestive system.

A small piece of the intestine wall was removed from a patient and examined.

Fig. 1.2A shows the appearance of a normal intestine wall and an electron micrograph of cells from the lining of the small intestine. Fig. 1.2B shows the intestine wall of a coeliac sufferer.

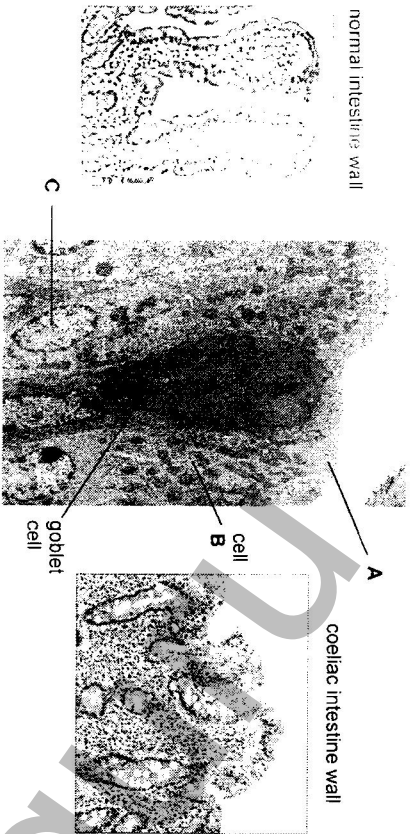


Fig. 1.2A

Fig. 1.2B

(i) Name structures A and C.

A _____ C _____ [1]

(ii) Suggest why cell B contains a large number of mitochondria.

_____ [2]

(iii) Symptoms of coeliac disease include poor growth.
With reference to Fig. 1.2, suggest why a person with coeliac disease might have this symptom.

_____ [3]

[Total: 9]

2 (a) The photomicrographs in Fig. 2.1 show stages of the mitotic cell cycle occurring in the root tip of the onion, *Allium* sp. They are all of the same magnification. Stages A to C are in the correct sequence and stages K to N are **not** in the correct sequence.

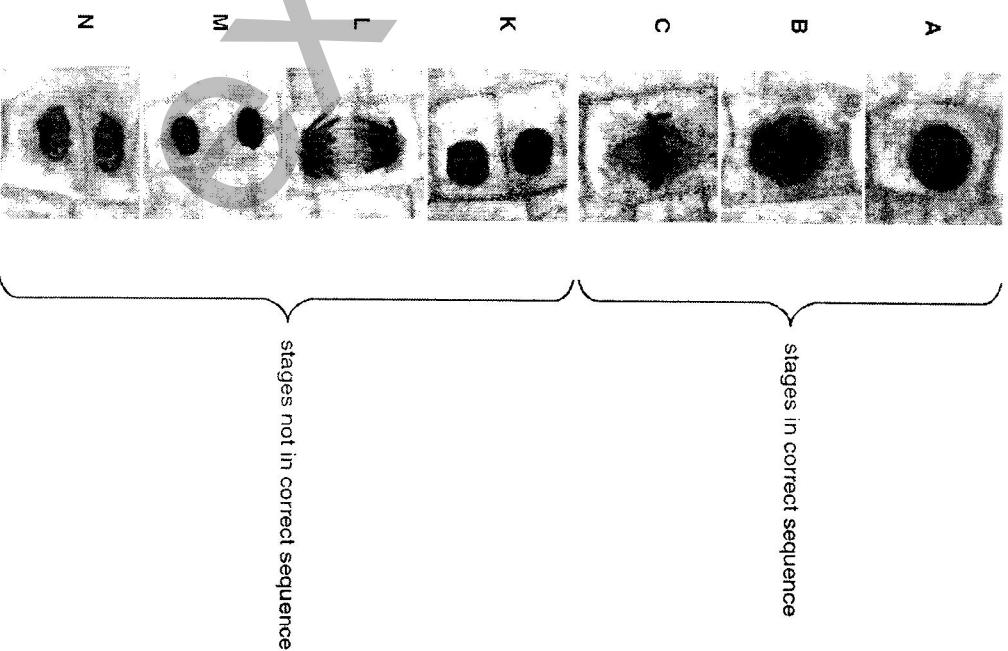


Fig. 2.1

(i) Name stages A and C.

A _____ C _____ [1]

- (ii) Arrange stages K to N in the correct sequence, starting with the stage that immediately follows stage C.



[1]

- (iii) Explain why the growth of roots, such as those of *Allium* sp., involves mitosis and not meiosis

[2]

- (b) Fig. 2.2 shows a pair of homologous chromosomes during meiosis in a flower.

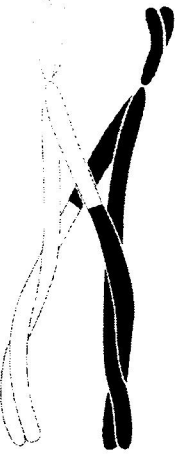


Fig. 2.2

- (i) Name **one** organ in a flower where meiosis takes place.

[1]

- (ii) Describe the stage of meiosis shown in Fig. 2.2 and explain how this can lead to variation

[2]

[Total: 7]

- 3 Fig. 3.1 shows a section through a plant organ with a micropipette inserted into tissue A.

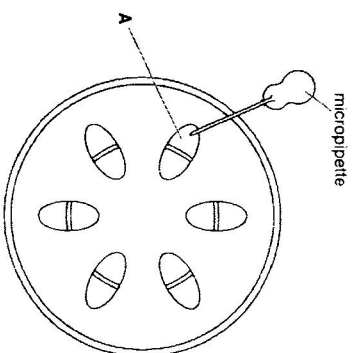


Fig. 3.1

- (a) (i) Name the plant organ shown. _____ [1]

- (ii) The micropipette is used to take samples from tissue A at regular intervals over a 24-hour period. These samples are then analysed for their content. Explain how this might provide information about the rate of photosynthesis in the plant.

[3]

- (b) Fig. 3.2 shows a photograph of a transverse section of a leaf from the same plant, showing the upper and lower surfaces.

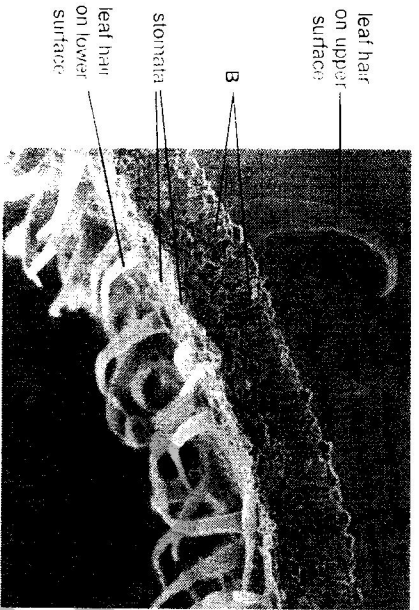


Fig. 3.2

- (i) Describe how root hair cells differ structurally from the cells labelled B in Fig. 3.2.

[1]

- (ii) Explain how the leaf hairs on the leaf surfaces help the plant to reduce its chance of wilting.

[2]

[Total: 7]

- 4 (a) Fig. 4.1 shows the external view of the heart of a person who has recovered from a mild heart attack.

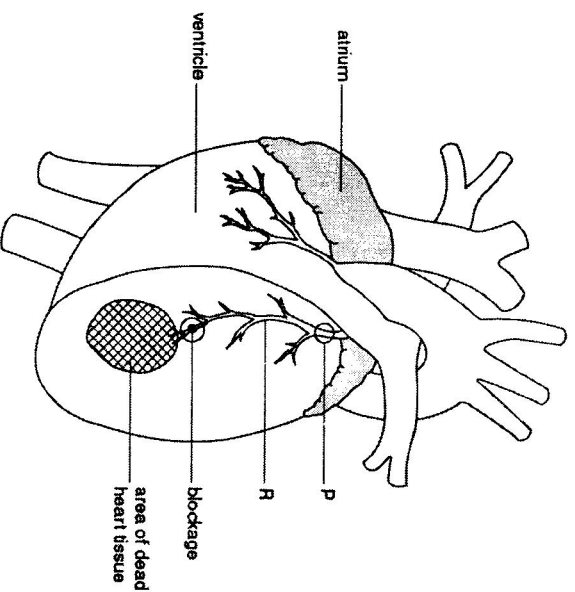


Fig. 4.1

- (i) Name blood vessel R. [1]

- (ii) Describe how blood vessel R could become blocked.

[1]

- (iii) Explain why a blockage at point P on Fig. 4.1 is likely to cause a serious, possibly fatal, heart attack.

[3]

- (b) Fig. 4.2 shows the heart rate and the cardiac output of the patient after recovering from heart surgery. The cardiac output is the volume of blood pumped out of the heart each minute.

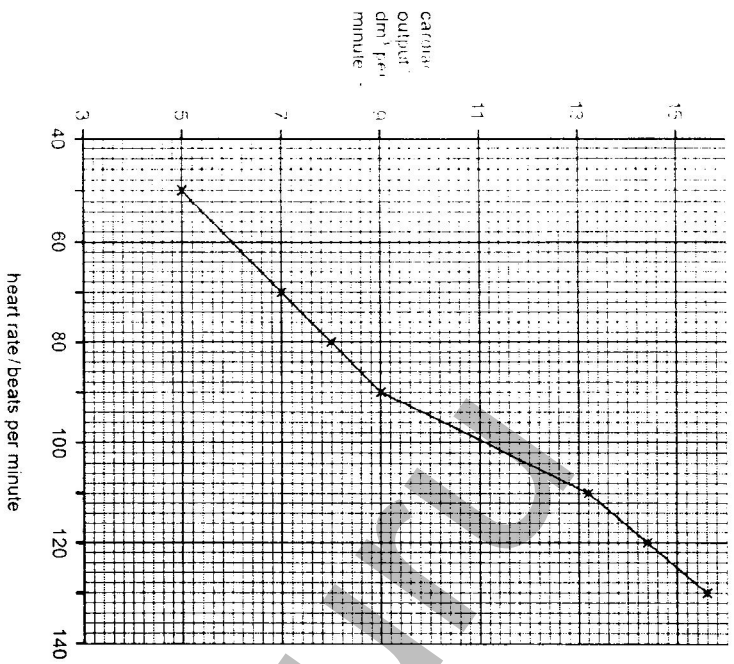


Fig. 4.2

- (i) During exercise, the heart rate increases from 70 to 120 beats per minute. Determine the change in cardiac output. _____ dm³ per minute [1]
- (ii) Explain the advantages as a result of the change in cardiac output in (b)(i) during exercise.

[3]

[Total: 9]

- 5 (a) Fig. 5.1 shows a side view of the female reproductive system.

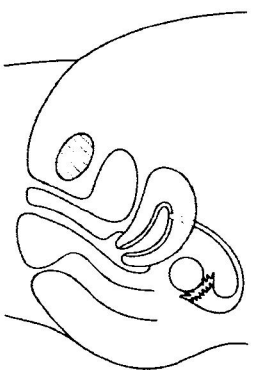


Fig. 5.1

- Using label lines and the letters given, label the following on Fig. 5.1.
- E. where an embryo would become implanted
- F. where an ovum would be fertilised normally

[1]

- (b) Fig. 5.2 shows the hand of a person who suffers from a mutation that results in people having more than five digits on each hand (polydactyly).

The mutation that results in this condition is **dominant**. Fig. 5.3 shows how the condition is inherited in a family.



Fig. 5.2

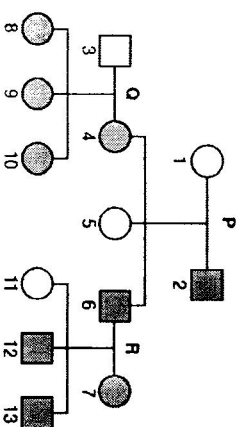
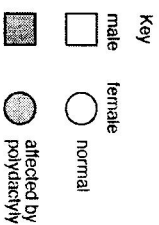


Fig. 5.3

- (i) Explain the meaning of the terms *dominant allele* and *mutation*.
dominant allele _____ [1]

mutation _____ [1]

- (ii) State the genotype of the individuals shown in Fig. 5.3

Use AA, Aa or aa. Write your answers in Table 5.1. [1]

Table 5.1

numbered person on Fig. 5.3	genotype of person
1	
9	

- (iii) Using evidence from Fig. 5.3, state which of the couples, P, Q or R, provides proof that the mutation is **not** recessive. [2]

couple _____ [1]

- (iv) Explain the reason for your answer in (b)(iii). _____

_____ [2]

[Total: 8]

- 6 Fig. 6.1 shows changes in the relative concentrations of three substances in the blood plasma of a healthy person. These changes happen when the blood flows through the renal artery, the capillaries in the kidney and the renal vein.

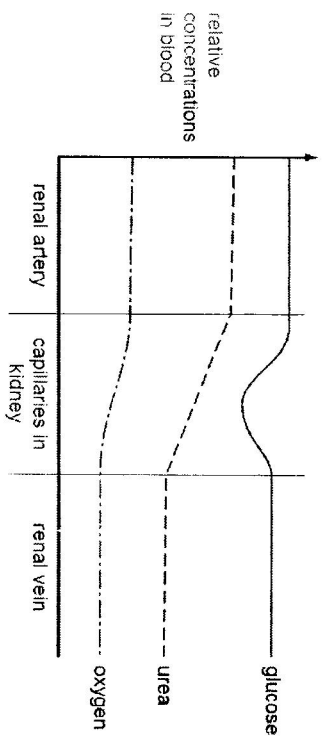


Fig. 6.1

Describe and explain the differences in the relative concentrations of each substance in blood plasma between the renal artery and the renal vein, as shown in Fig. 6.1.

glucose _____

urea _____

oxygen _____

_____ [5]

[Total: 5]

7 Fig. 7.1 shows a reflex arc involving a finger and a muscle in the arm.

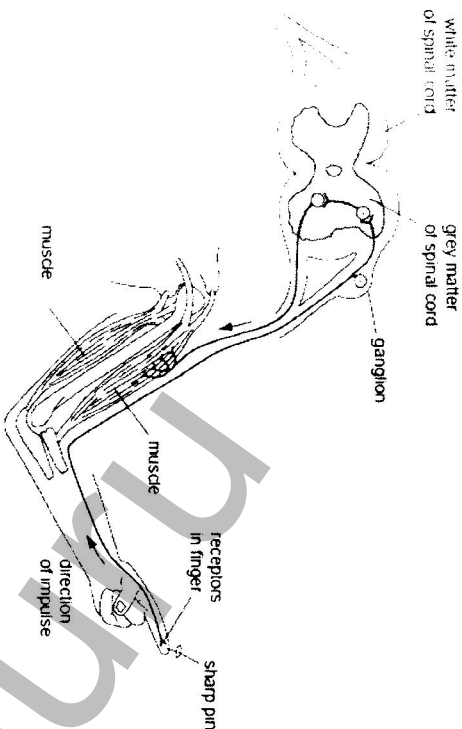


Fig. 7.1

(a) Describe the part played by the nervous system to enable the person to experience the sensation of pain.

[2]

(b) The impulse takes 0.02 seconds to pass from the finger to the spinal cord, a distance of 1.5 metres. Although the total distance the impulse travels in the reflex arc is less than 3 metres the time taken is more than 0.04 seconds.

Suggest why the time taken is more than expected.

[1]

(c) Describe two differences in the responses involving the nervous system and the effects of hormones

[2]

[Total: 5]

Section B
Answer three questions.

Question 10 is in the form of an **Either/Or** question. Only one part should be answered.

8 Fig. 8.1 shows part of a yellow maize cob, *Zea mays*.

A cob is composed of many individual fruits known as grains.



Fig. 8.1

Length of cobs

Table 8.1 shows the length of the cobs formed by a number of different maize plants. All the plants were grown from seeds from one original cob.

Table 8.1

length of cob/cm	number of cobs
8	10
9	19
10	26
11	47
12	73
13	68
14	68
15	40
16	25
17	15
18	9

(a) (i) Plot, on the grid below, the data in Table 8.1 as a histogram.



- (ii) State, with a reason, the type of variation illustrated by the cobs with length between 8 cm and 18 cm. [3]

[1]

(b) Colour of cobs

Many colours of maize grains are known. The colour is inherited. Fig. 8.3 shows part of a cob with light and dark coloured grains.

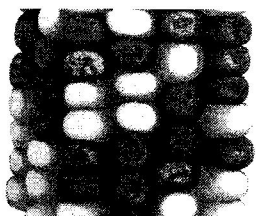


Fig. 8.3

- (i) With reference to Fig. 8.3, suggest the phenotypic ratio of light to dark coloured grains. [1]

- (ii) State the genotypes of the parent maize plants, given that D represents the allele for light colour and d represents the allele for dark colour. [1]

- (c) Maize is an important crop in some countries.

- (i) It is used as a food source for humans and livestock such as cows.

Explain why it is more efficient for humans to eat maize rather than meat from cows that have been fed on maize.

[3]

- (ii) Maize plants can be crossed to produce new varieties. One variety has disease resistance and the other variety can produce high yield in a range of different habitats.

Suggest how a new improved variety with these two characteristics could be produced.

[3]

[Total: 12]

10 OR

A patient with kidney disease may be put on a kidney machine.

(a) Explain how a dialysis machine filters blood.

[4]

(b) Heparin is added to the blood before it returns to the body from the dialysis machine. Heparin prevents a person's blood from clotting.

Describe the process of blood clotting.

[3]

(c) Kidney disease can lead to a reduction in red blood cells.

Outline how red blood cells are involved in the transport of carbon dioxide from blood capillaries near respiring cells to the lungs.

[3]

[Total: 10]

END-OF-PAPER

FHSS BIOLOGY 5158 SECONDARY 4 PRELIMINARY EXAMINATION 2016 MARK SCHEME

PAPER 1: MULTIPLE CHOICE QUESTIONS (40 MARKS)

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	C	A	C	A	C	B	C	B	C	D	E	A	C	A	C
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Answer	A	D	A	C	A	B	C	A	D	D	C	B	C	D	D
Question	31	32	33	34	35	36	37	38	39	40					
Answer	A	C	B	C	A	B	D	D	C	B					

PAPER 2 (80 MARKS)

SECTION A: STRUCTURED QUESTIONS (50 MARKS)

- 1 mark ○ ½ mark ora or reverse argument AW: Alternate wording

1(a)(i)	○ starch - almost the same at M and N ○ protein - less at M than at N	1
(ii)	Any 4 of the following (max 2) ○ ref. protection / barrier / prevents damage / breakdown / digestion of walls ○ hydrochloric acid / HCl ○ ref. protease ○ walls are made of protein ○ ref. lubrication	2
(b)(i)	○ A - microvilli ○ C - nucleus	1
(ii)	○ undergoes aerobic respiration ○ to release/provide energy ○ for active transport ○ to move substances against concentration gradient	2

Updated 16 Aug 2016

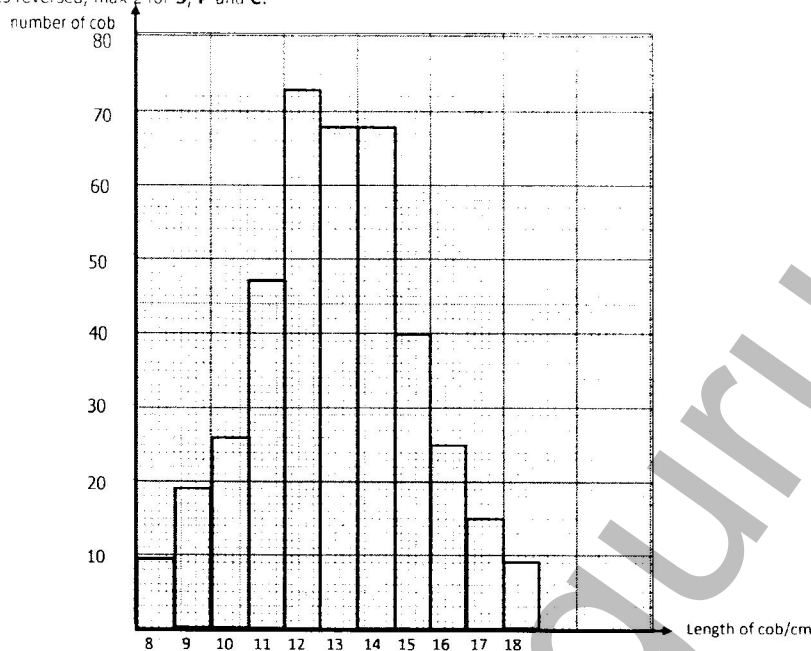
(iii)	Fewer/smaller villi for coeliac OR normal has longer/more villi Reduced surface area for absorption Reduced diffusion into blood fewer amino acids absorbed to build new proteins	3
2(a)(i)	○ A - Interphase ○ C - metaphase	1
(ii)	• (C) → L → N → M → K Award only when in correct sequential order	1
(iii)	<u>mitosis (Max 1)</u> ○ needs number of chromosomes to remain constant/diploid ○ needs all daughter cells to be genetically identical/have no genetic variation A clones ○ needs genetic stability <u>meiosis (Max 1)</u> ○ halves the number of chromosomes/diploid → haploid ; A undergoes a reduction division ○ daughter cells are all genetically different ; accept once only ○ produces genetic variation ; accept once only ○ involved in sexual reproduction (in flowering plants) not growth : A production of gametes ○ idea that cells that are genetically different will not function together in tissues ; ora	2
(b)(i)	• Ovary/anther [Ignore: gametes, ovum; Accept: ovule/stamen/carpet]	1
(ii)	○ homologous chromosomes pairing ○ crossing over ○ exchange of genetic material ○ between non-sister chromatids ○ creates new combinations of alleles when sister chromatids separate	2
3(a)(i)	• stem	1
(ii)	○ photosynthesis produces glucose ○ which is changed into sucrose ○ transport down the phloem/A ○ by translocation ○ from leaves to other parts of plants ○ concentration of sucrose varies ○ highest when photosynthesis rate is highest/AW	3
(b)(i)	○ No chloroplasts in root hair cells (1) OR root hair cells have long protrusion (1)	1

(ii)	- More leaf hairs on lower surface - Increased humidity at lower surface - Reduce transpiration rate - reduces water loss - Reduced water vapour concentration gradient	2
4(a)(i)	coronary artery	1
(ii)	Cholesterol/lipid/fatty deposits in the wall of artery (P: On the wall/surface)	1
(iii)	blockage stops flow of blood AW oxygen / glucose / nutrients would not reach muscle muscle cannot respire runs out of energy muscle cells die more muscle dies than in previous attack heart / ventricle cannot contract effectively / cannot pump blood	3
(b)(i)	+7.4 [Award only when the "+" sign is indicated]	1
(ii)	- exercise needs extra energy - increases respiration in muscle (cells) - increased delivery of oxygen - increased delivery of glucose - increased removal of carbon dioxide - increased removal of heat - reduces risk of depending on anaerobic respiration - removes any lactic acid that is produced	3
5(a)	- E : any point on surface of uterus, R : muscular wall - F : on oviduct	1
(b)(i)	<u>dominant allele</u> - alternative form of a gene - always expresses itself in the phenotype when present in heterozygous or homozygous (Or when at least one copy is present) <u>mutation</u> - a change in a gene / chromosome / DNA	1
(ii)	1 – aa 9 – Aa	2
(iii)	R	1
(iv)	- if it was recessive all their offspring would have shown the condition - but individual 11 / AW is normal, so must be dominant / AW	2

6	<u>Glucose (max 2)</u> - fall in glucose concentration then concentration rises - final concentration lower than original - Kidney filters all glucose - but is reabsorbed into blood - at proximal convoluted tubule. - some is used in respiration for energy <u>Urea</u> - fall in urea - filter urea from blood plasma - in glomerulus - but not all removed or reabsorbed <u>Oxygen</u> - fall in oxygen concentration - due to aerobic respiration	5																								
7(a)	- stimulates the (pain) <u>receptor</u> present in the hand - generates <u>nerve impulses</u> - to be transmitted along the <u>sensory neurone</u> - to the brain/CNS [Ignore refs to spinal cord]	2																								
(b)	Synapses present between neurones	1																								
(c)	Any 2 differences below <table border="1"> <thead> <tr> <th></th><th>responses involving nervous system</th><th>effects of hormones</th></tr> </thead> <tbody> <tr> <td>1</td><td>faster/fast</td><td>slower/slow</td></tr> <tr> <td>2</td><td>electrical impulses</td><td>chemical/blood</td></tr> <tr> <td>3</td><td>neurones (R: nerves)</td><td>blood/chemicals</td></tr> <tr> <td>4</td><td>muscles</td><td>glands/organs</td></tr> <tr> <td>5</td><td>temporary</td><td>more lasting</td></tr> <tr> <td>6</td><td>sometimes deliberate</td><td>less controlled</td></tr> <tr> <td>7</td><td>specified organs</td><td>more general effect</td></tr> </tbody> </table> 1 mark for each difference. Award only if both matching differences are given.		responses involving nervous system	effects of hormones	1	faster/fast	slower/slow	2	electrical impulses	chemical/blood	3	neurones (R: nerves)	blood/chemicals	4	muscles	glands/organs	5	temporary	more lasting	6	sometimes deliberate	less controlled	7	specified organs	more general effect	2
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5	temporary	more lasting																								
6	sometimes deliberate	less controlled																								
7	specified organs	more general effect																								

SECTION B: ESSAY QUESTIONS (30 MARKS)

- 8(a)(i) A₁ – (X-axis) – labelled and evenly scaled (length of cobs; label of number must be central under each column)
 A₂ – (Y-axis) – labelled with units and evenly scaled (number of cobs/cm)
 S – size to fill more than ½ of grid
 P – Plotting accurate
 C – columns of equal width and touching (if columns do not make up grid, 1½ marks for A₁ and A₂)
 Note: If line graph, maximum 2 ½ marks – A₁, S and P
 If axes reversed, max 2 for S, P and C.



3

Updated 16 Aug 2016

- (ii) continuous variation
 range of length / ref to many intermediates OR
 not in distinct groups
 R: Influenced by environment and genotype
- (b)(i) • 1:1 [Reject: 19:20]
- (ii) • Dd x dd
- (c)(i)
 - Energy is lost, along food chain/at each trophic level/between maize and cows
 - Maize at first trophic level/producers/Cows are of higher trophic level.
 - Energy from maize goes directly to humans instead of via cows/More energy to humans from maize than from cows.
 - Cows use energy or named example of how energy is used, so less available (E.g for movement)
 Examples of energy loss from cows in food chain (Any two below)
 - food not digested/absorbed
 - inedible parts
 - heat loss by respiration
 - excreted via urine
 - Egested via faeces
 [emphasis on loss of energy between trophic levels; focus on energy loss of primary consumer]
 R: quality of the nutrients in maize better than cow.
 Select plants with desired characteristics/breed varieties with one another (no marks)
 - transfer pollen from anthers/stamens of one variety onto stigma of second variety/cross pollination described
 - collect seeds and grow plants
 - select next generation of plants/discard any without one of the features-disease resistance and high yield
 - repeat process/over many generations

1

1

1

3

3

- 9(a) Enzymes/named enzyme. R: bacteria are enzymes
 secrete/release/pass out of cells/onto food/extracellular/AW/
 digest/breakdown large/complex/insoluble, (molecules) to
 small/soluble/simple, (molecules) A: smaller, simpler
 cellulose → sugar/glucose
 starch → maltose/glucose Ignore: further change e.g. to carbon
 dioxide/water
 protein → polypeptides/peptides/amino acids I further changes e.g. to
 ammonia/nitrite etc
 fats → fatty acids and glycerol
 ref to respiration
 use of oxygen
 release of carbon dioxide
 (named) products respired e.g. glucose

3

- (b) Question asks for reasons why conserving species is important – answers must
 be in this context

2

ecological

- Interdependency in food chain/food web

aesthetic

- species are unique/AW
- (eco)tourism
- ref to biodiversity
- retain genes/maintain gene pool/AW
- qualified potential use for humans e.g. in medical research
- AVP: e.g. ethical considerations/for future generations to appreciate

R: become extinct without qualification

- (c)
- some variations are advantageous
 - competition
 - in the organism's habitat / environment
 - organism survives / differential survival / ORA
 - breeds / reproduces
 - passes on the advantage / beneficial gene / allele
 - over many generations / ref. time
 - continuous adaptation to the changing environment
 - evolution / natural selection / AW
 - changes that result from the environment not so important

3

10E Asexual (max 1)

- (a)
- Only one parent needed
 - fast / quick
 - (potential) rapid spread / colonisation
 - less energy required / no gametes needed
 - less wastage of pollens
 - not reliant on pollination (agent)
 - if parent well adapted, offspring will be adapted to surroundings

2

Sexual (max 1)

- more variation
- evolution / formation of new species
- (seed) dispersal, avoid crowding with parent or others
- Better able to adapt to change in environment

(b) nutrients

- across placenta / through placenta
- diffusion
- from mother's blood into fetal blood (direction clearly stated, ref to blood)
- named substances e.g. oxygen, glucose, amino acids

6

protection (max 2)

(amnion / uterus / amniotic fluid)

- provides protection against, mechanical damage / 'knocks'
- provides sterile environment / no entry of pathogens
- backbone provides protection against jolts / AW
- placenta provides a barrier to (named) pathogen(s) / AW
- placenta prevents mixing of blood between fetus and mother

removal of metabolic waste

- across placenta / through placenta
- diffusion of
- urea / carbon dioxide
- from fetal blood into mother's blood

Award the following points only once in either nutrients or excretion category
 Correct ref to umbilical cord/umbilical artery (for excretion)/umbilical vein (for
 nutrients)

(c)	(information is) ref (different) sequence/order of bases/nucleotides (in the polynucleotide strand) A described in terms of sequence of bases DNA/gene, contains/AW, information for the synthesis of a polypeptide/protein/enzyme idea that (coded because) information becomes sequence of amino acids idea that information passed on (cell to cell parent to offspring): unit of inheritance	2
10OR (a)	dialysis membrane partially permeable salts/minerals/urea move by diffusion excess water moves by osmosis Proteins/blood cells too large to move across membrane Ref to dialysis fluid contains no urea contains some salts/glucose from blood to dialysis fluid (direction) dialysis fluid flows in opposite direction from the blood provide steep concentration gradient	4
(b)	ref to platelets (in correct context of clotting) fibrinogen converted to fibrin soluble to insoluble/fibrin is insoluble thrombin mesh/network to trap blood (cells) AVP: ref to prothrombin or involvement of, calcium ions/clotting factors	3
(c)	- Ref. diffusion (mark once) (diffuse) into red blood cell - carbonic anhydrase catalyses the formation of carbonic acid from CO_2 and water (A: equation) - carbonic acid breaks down into hydrogencarbonate ions (A: formula) which (diffuse) out - is carried in blood plasma - pumped by heart to lungs - the reverse process happens (or described) (carbon dioxide diffuses into) alveolar space	3

examguru



Geylang Methodist School (Secondary) Examination 2016 (PRACTICE 1)

Candidate
Name

Class

Index Number

----------------------	----------------------

BIOLOGY

5158/02

Paper 2

Sec 4 Express

Additional materials : writing paper, graph paper

2 hour

Setter : Mr James Kee

6 October 2016

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.

Write in dark blue or black pen in both sides of the paper.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions in the spaces provided on the question paper.

Section B

Answer **all** the questions.

Write your answers on the writing paper provided.

Write an **E** (for Either) or an **O** (for Or) next to the number 10 in the grid below to indicate which question you have answered.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes for Section B.

At the end of the examination, hand in Section A and Section B **separately**.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
14	
15	
16	
Total	115

This document consists of 25 printed pages.

[Turn over

Section A

Answer **all** questions in the spaces provided

- 1 Inspired air has a different composition to expired air.

Complete Table 1.1 to show how inspired air is different from expired air.

Table 1.1

substance	how inspired air is different from expired air
carbon dioxide	
dust particles	
oxygen	
water vapour	

[4]

[Total: 4]

2 Fig. 2.1 shows a poster that a student made for a biology lesson.

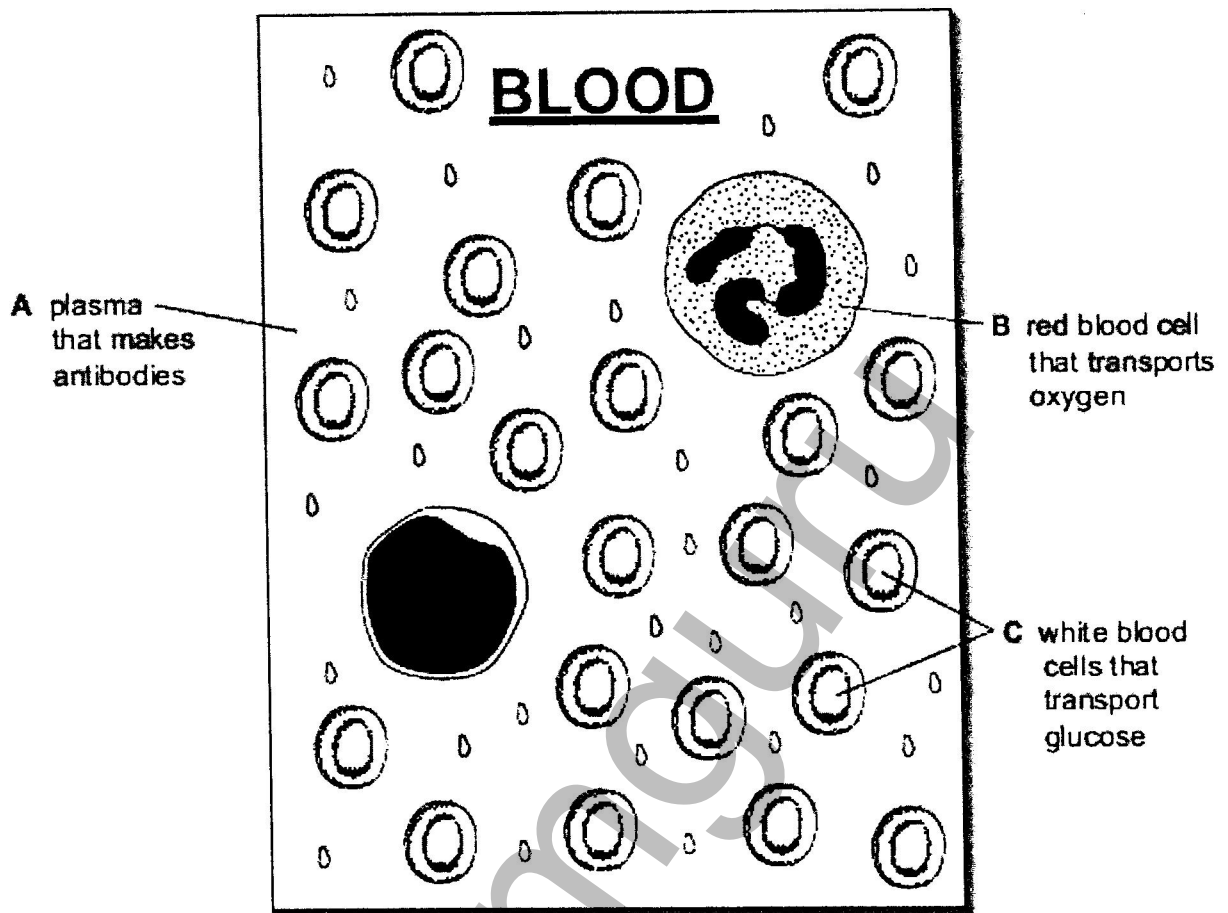


Fig. 2.1

The teacher told the class that the student had made a number of mistakes.

(a) For each of the three labels, correct the mistakes by giving the name and function of each component.

A name
function

B name
function

C name
function

[6]

(b) Name one other component of the blood that is not labelled on the poster.

State its function.

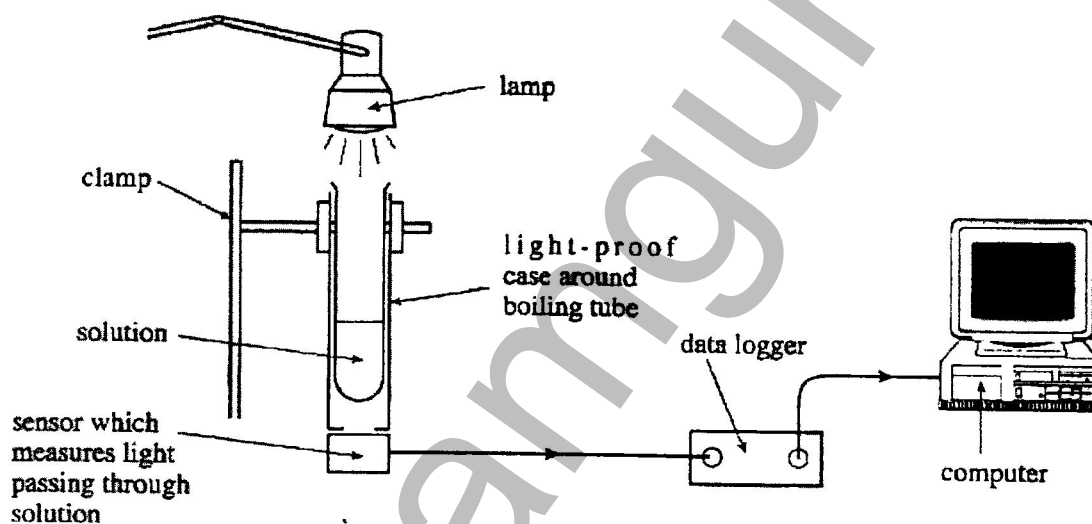
component

function

[2]

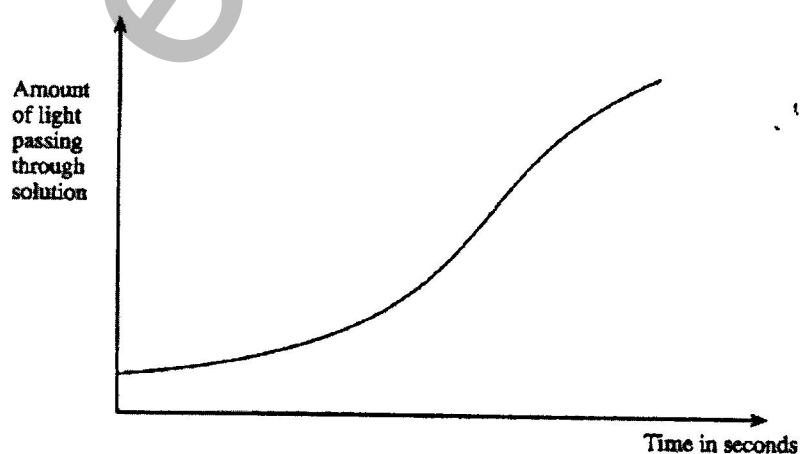
[Total: 8]

- 3 The activity of the enzyme carbohydrase on starch can be investigated using the following apparatus which measures the amount of light passing through the solution.



The solution in the boiling tube consisted of starch, carbohydrase and iodine.

The following graph appeared on the computer screen at the end of the investigation.



- (a) Iodine is used to test for starch. In the presence of starch, iodine changes colour from

..... to [1]

- (b) Describe and explain the results seen in the graph by referring to the expected colour changes and reactions taking place in the boiling tube. [6 QWC]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (c) On the graph, draw a line to show what result you would expect if boiled, cooled carbohydrase was used with a solution of starch and iodine. [1]

- (d) Describe a test that you would carry out to show the end product of the reaction taking place in the boiling tube. [2]

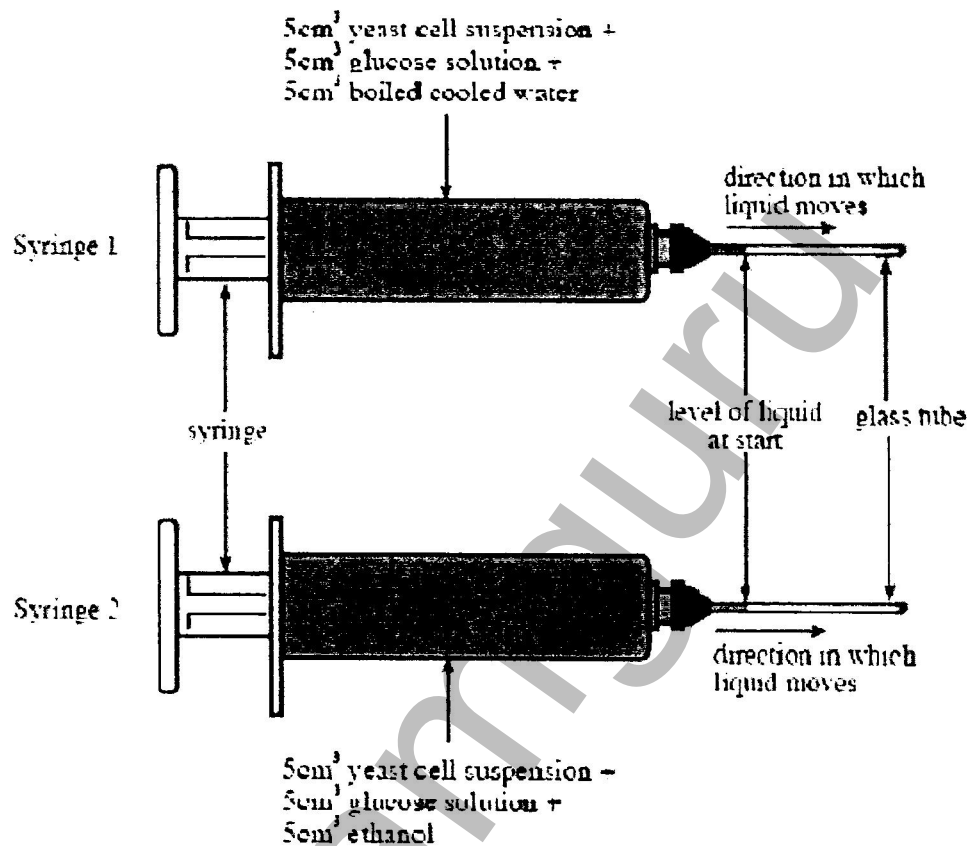
.....

.....

.....

.....

- 4 The following experiment was carried out to show the effect of ethanol (alcohol) on yeast when it fermented glucose anaerobically. The sterile syringes were prepared as shown in the diagram and left for 1 hour. At the end of the hour, the distance the liquid in the glass tube moved in each syringe was measured.



(a) Explain

- (i) why the liquid moved in the glass tube; [2]

.....

.....

.....

- (ii) why the temperature in syringe 1 was higher than that in syringe 2 at the end of one hour; [2]

.....

.....

.....

- (iii) why it is important to use sterile syringes. [1]

.....

.....

- (b) The results of the experiment were as follows:

<i>Time (min)</i>	<i>Distance moved by liquid in the glass tube (mm)</i>	
	<i>Syringe 1</i>	<i>Syringe 2</i>
0	0	0
40	30	10
50	100	16
60	220	20

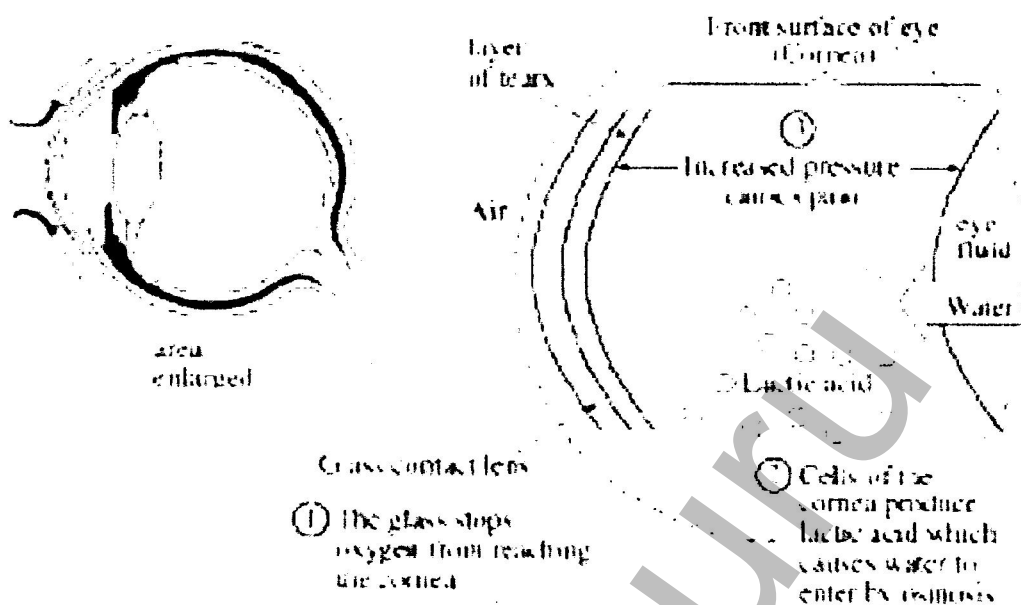
Suggest an explanation of the results.

[1]

.....

.....

- 5 The first contact lenses to be developed were made of glass. The diagram shows what happened when a glass contact lens was put on the eye.



These lenses proved to be unsuitable because they caused pain.

- (a) The diagram shows water entering the cornea of the eye by osmosis. Define osmosis. [2]

- (b) Modern contact lenses are gas permeable. Use the information in the diagram to explain why these modern contact lenses are more suitable than glass contact lenses. [4]

- 6 (a) Fig. 7.1 shows a carbon cycle.

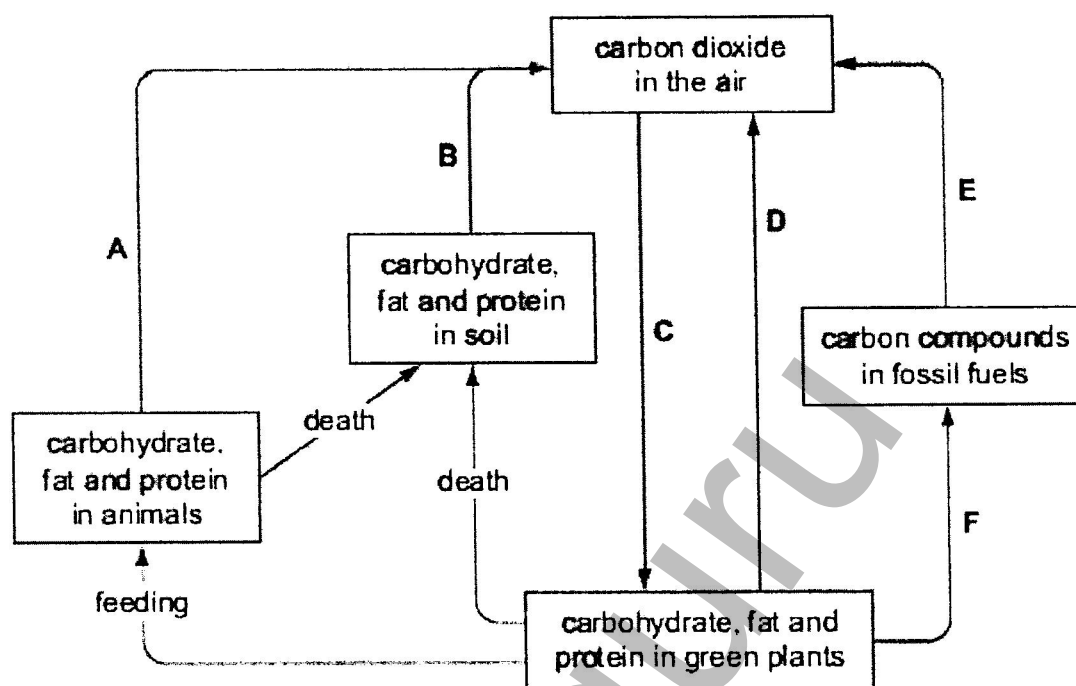


Fig. 7.1

- (i) Write the letter of an arrow, A, B, C, D, E, or F as shown in Fig. 7.1, that represents each of the following processes.

combustion

photosynthesis

respiration

[3]

- (ii) Many of the world's governments are concerned that the carbon dioxide concentration in the atmosphere keeps rising.

Explain why they are concerned about the rise in carbon dioxide concentration.

[3]

(b) Gazelles are herbivores that eat grass.

Oxpecker birds feed on ticks that live on the skin of gazelles.

Ticks suck blood from the gazelles.

(i) Draw a food chain to represent these feeding relationships.

[2]

(ii) State what the arrows represent in a food chain.

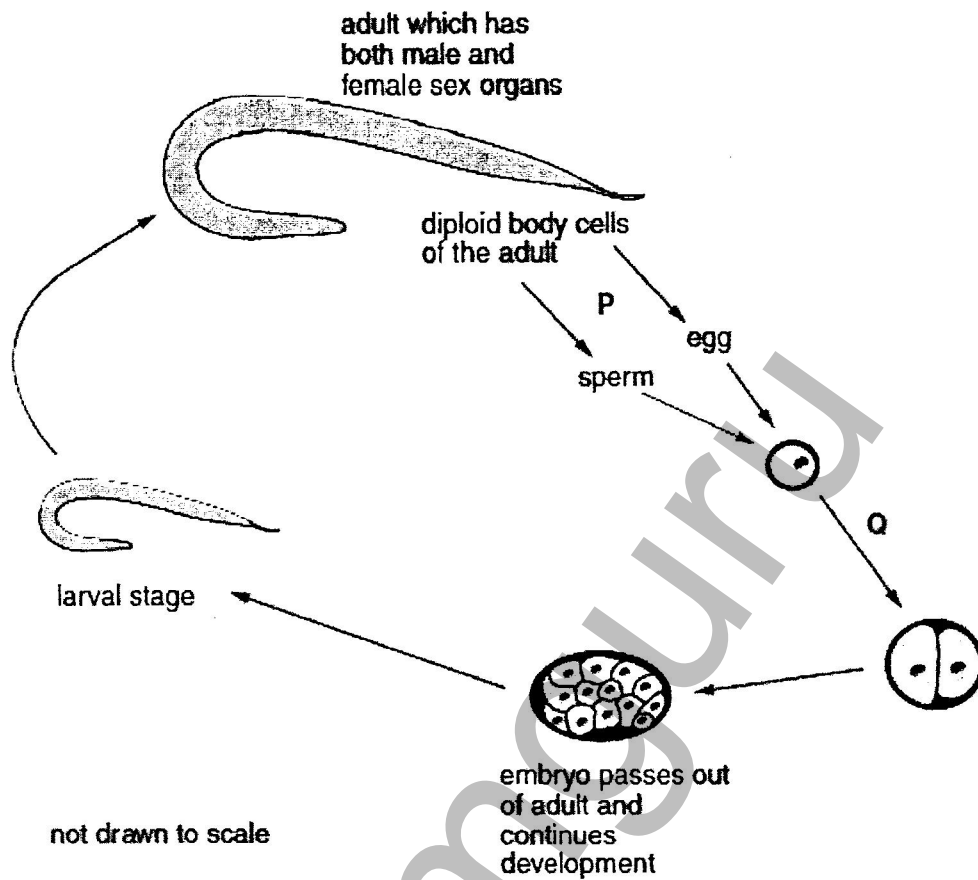
[1]

(iii) Explain why a food chain is not considered to be a cycle like the carbon cycle.

[3]

[Total: 12]

7 Figure shows the life cycle of *C. elegans*. The diploid number of this species is 12.



- (a) Suggest why there is very little genetic variation in the offspring of the adult nematode shown in Figure

.....

.....

.....

.....

.....[2]

- (b) State the haploid number of *C. elegans*.

.....[1]

- (c) Explain why meiosis occurs at P and mitosis occurs at Q.

meiosis at P

.....

.....

.....

mitosis at Q

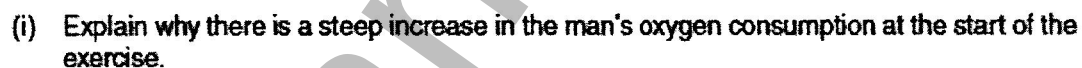
.....

.....

.....[3]

examguru

- Figure shows his oxygen uptake before and during the exercise.



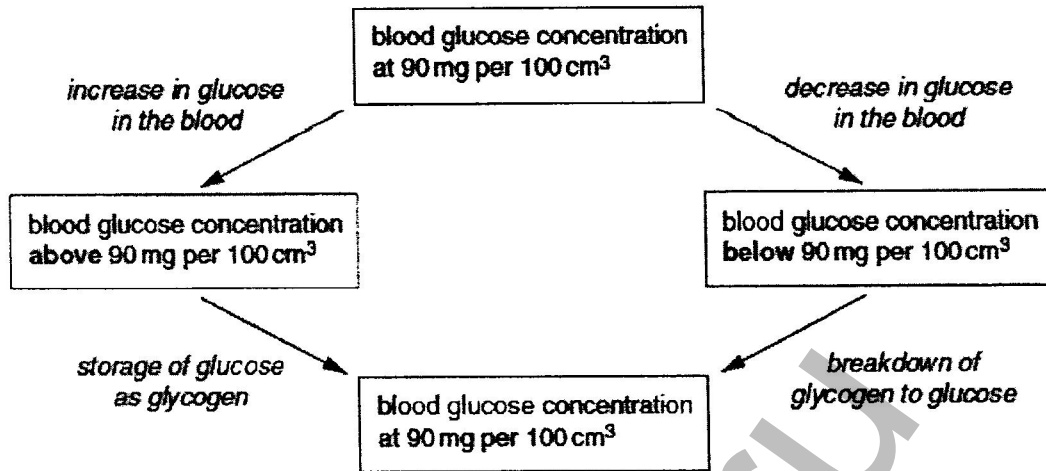
Handwriting practice lines with a large 'X' watermark.

- On Figure 1 draw a line between 20 minutes and 35 minutes to show the change in oxygen consumption after exercise has stopped. [2]

- [4]

- group A group B group AB group O
-
- The diagram illustrates the inheritance of ABO blood groups. It shows four possible genotypes: group A (AA or AO), group B (BB or BO), group AB (AB), and group O (OO). Each genotype is represented by a circle containing two vertical lines (alleles). Group A has one line with a short horizontal bar (A) and one plain line (O). Group B has one plain line (O) and one line with a short horizontal bar (B). Group AB has one line with a short horizontal bar (A) and one line with a short horizontal bar (B). Group O has two plain lines (O). Brackets above the circles group the alleles for each blood type.

10 Figure 1 is a diagram that shows the control of blood glucose concentration.



(a) (i) State one reason why the concentration of glucose in the blood increases.

.....
[1]

(ii) State one reason why the concentration of glucose in the blood decreases.

.....
[1]

(iii) Name two places in the body where glycogen is stored.

1
 2
[2]

(b) Explain how an increase in glucose concentration is controlled in the body.

.....

[3]

- (c) If the blood glucose concentration is very high there is a decrease in the water potential of the blood. This may damage the red blood cells.

Explain how a decrease in water potential of the blood may damage red blood cells.

.....

.....

.....

.....

.....

.....

.....

..... [3]

- 11 In rabbits, assume that the dominant allele (**B**) produces black fur. The allele (**b**) for white fur is recessive to **B**.

(a) What colour fur will each of the following rabbits have?

	<i>Rabbit 1</i>	<i>Rabbit 2</i>	<i>Rabbit 3</i>	<i>Rabbit 4</i>
genotype	BB	Bb	bB	bb

(a) Which of them are pure breed?

..... [1]

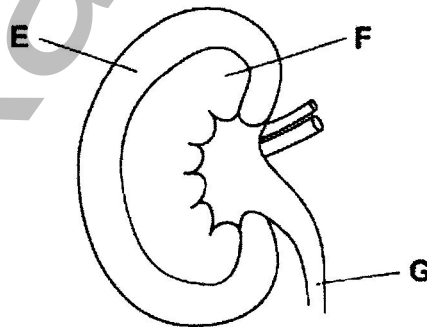
(b) If rabbits 1 and 4 were mated together and had 12 babies, how many of these would you expect to be black? Use a punette square to show your working.

[2]

- (c) If rabbits 2 and 3 are interbred and produce several litters, totalling 48 babies, how many white babies would be predicted by the laws of genetics? Use a genetic diagram to support your answer.

[4]

- 12 Figure shows a vertical section of a kidney.



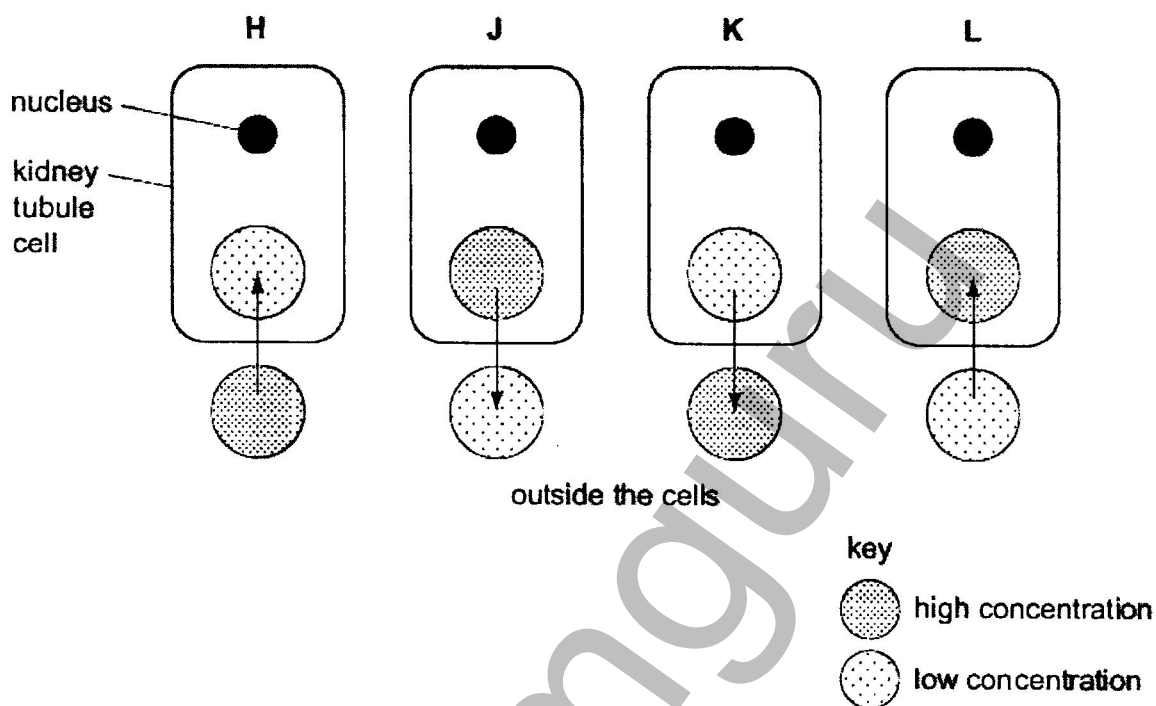
- (a) Name the parts E, F and G.

E
 F
 G [3]

(b) Substances move into and out of cells in kidney tubules.

Figure 1 shows four processes, H, J, K and L, that occur in cells lining the kidney tubule.

The net movement of substance is shown by an arrow, in each case.



(i) Complete the table by stating the letter, H, J, K or L, which identifies each of the processes. Give a reason for each answer.

process	letter	reason
diffusion of oxygen		
active uptake of sodium ions		

[4]

- (ii) Glucose is filtered from the blood. Usually all of it is reabsorbed by the kidney tubules so that there is none present in the urine.

Name the part of the kidney where filtration occurs.

[1]

- (iii) Use Fig. 3.2 to describe how kidney tubules reabsorb glucose from the filtrate.

[2]

- (c) When plants are grown in a solution that includes a poison that prevents respiration, the roots continue to absorb water, but do not absorb many ions.

Explain this result.

[3]

- 5 Fig. 5.1 shows the rate of water uptake and of water loss for a plant over a 24-hour period.

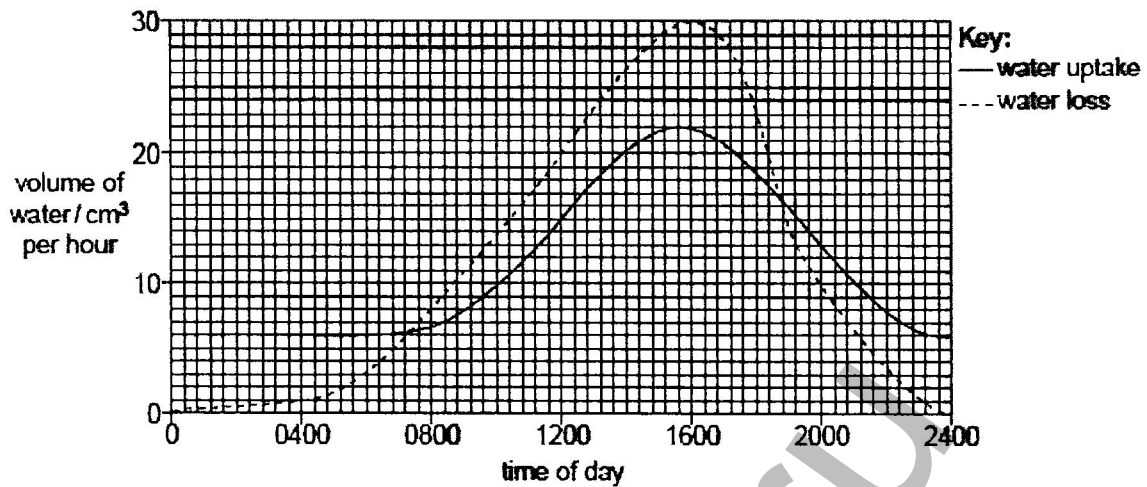


Fig. 5.1

- (a) Determine the rate of water uptake at 1200 hours. [1]
- (b) (i) Name the cells through which water is absorbed from the soil.
..... [1]
- (ii) Name the cells between which water vapour passes to the atmosphere.
..... [1]
- (c) (i) State three uses of water within a plant between midnight and 0400 hours.
1.
2.
3. [3]
- (ii) State two additional uses of water between 0800 and 1900 hours.
1.
2. [2]
- (d) Explain what may happen to the plant between 1400 and 1800 hours.
.....
.....
..... [2]

Answer only **TWO** questions

- examguru

- mguru

- ①

[4]

[illegible]

[6]

Example

examguru



Geylang Methodist School (Secondary)
Examination 2016 (PRACTICE 1)

Candidate Name

Class	Index Number	

BIOLOGY (ANSWERS) 5158/02

Paper 2

Sec 4 Express

Additional materials : writing paper, graph paper

2 hour

Setter : Mr James Kee

6 October 2016

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen in both sides of the paper.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer all questions in the spaces provided on the question paper.

Section B
Answer all the questions.

Write your answers on the writing paper provided.
Write an **E** (for Either) or an **O** (for Or) next to the number 10 in the grid below to indicate which question you have answered.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes for Section B.

At the end of the examination, hand in Section A and Section B separately.
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
14	
15	
16	
Total	115

This document consists of 23 printed pages.

[Turn over

2

GMS(S)/Bio/P2/ Practice 1/2016/4E

Section A

Answer all questions in the spaces provided

1 Inspired air has a different composition to expired air.

Complete Table 1.1 to show how inspired air is different from expired air.

Table 1.1

substance	how inspired air is different from expired air
carbon dioxide	Expired air has higher concentration of carbon dioxide (4 %) than inspired air (0.04 %)
dust particles	Expired air has less dust particles than inspired air as most of the dust particles were filtered by the nasal hair and trapped by mucus in the trachea.
oxygen	Inspired air has higher concentration (21 %) of oxygen in expired air (16%)
water vapour	Expired air has higher concentration of water vapour than inspired

[Total: 4]

2 Fig. 2.1 shows a poster that a student made for a biology lesson.

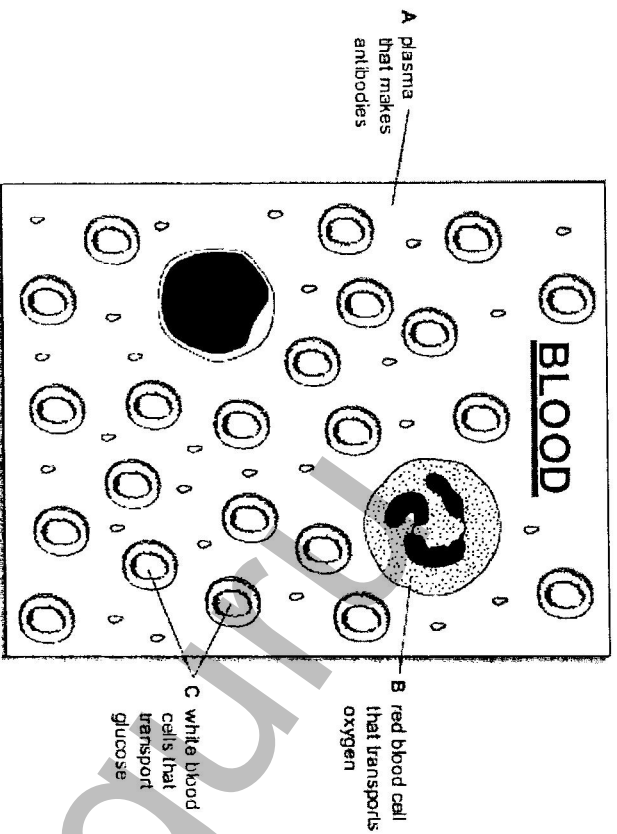


Fig. 2.1

The teacher told the class that the student had made a number of mistakes.

(a) For each of the three labels, correct the mistakes by giving the name and function of each component.

Blood plasma	
A name	To act as a medium to dissolve nutrients and waste substances, and transport them all round the body. To transport blood cells around the body for oxygen supply to tissue cells.
B name	phagocyte
function	To carry out phagocytosis to engulf invading microbes and foreign particles to protect the body from the destruction by these invaders.
C name	red blood cells
function	To carry oxygen from the lungs to all parts of the body

(b) Name one other component of the blood that is not labelled on the poster.

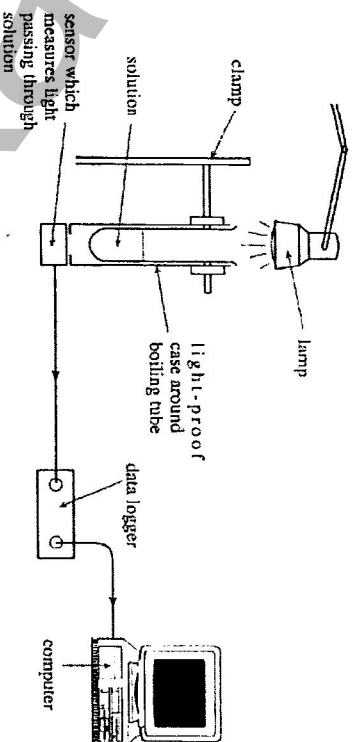
State its function.

component	platelets
function	To cause the formation of blood clot to seal the damaged blood vessels so as to prevent further bleeding.

[Total: 8]

3

The activity of the enzyme carbohydase on starch can be investigated using the following apparatus which measures the amount of light passing through the solution.



The solution in the boiling tube consisted of starch, carbohydase and iodine.

The following graph appeared on the computer screen at the end of the investigation.



- (a) Iodine is used to test for starch. In the presence of starch, iodine changes colour from

yellowish brown to ... dark blue [1]

- (b) Describe and explain the results seen in the graph by referring to the expected colour changes and reactions taking place in the boiling tube. [6 QWC]

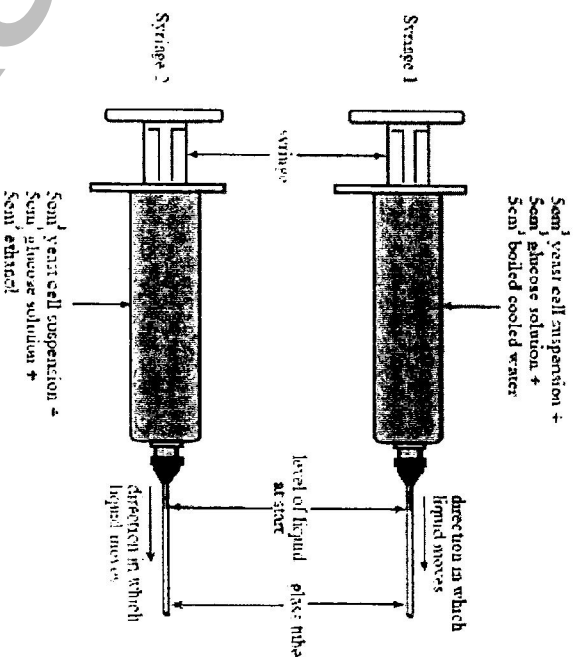
Initially, the reaction mixture is a dark blue opaque solution due to the presence of starch which reacts with iodine solution that allows very little light to pass through, to be captured by the sensor. Thus, the reading for the amount of light passing through is low. As time goes by, the carbohydrate breaks down starch to form maltose and dissolves in the solution. Maltose does not react with iodine solution to form dark blue colouration. The solution begins to fade its colour to become more transparent as more and more starch is converted to maltose. This allows more light to pass through, which is shown on the graph as a gradual increase in curve. Eventually when all the starch is digested to maltose the solution will turn

- (c) On the graph, draw a line to show what result you would expect if boiled, cooled carbohydrase was used with a solution of starch and iodine. [1]

- (d) Describe a test that you would carry out to show the end product of the reaction taking place in the boiling tube. [2]

Carry out Benedict's test on the solution in the boiling test. Add 2 cm³ of Benedict's solution to a test tube of 2 cm³ of the solution removed from the boiling tube. Shake the mixture well and place the test tube in a hot water bath for 5 minutes. If brick red precipitate indicates the end product is a reducing sugar formed the breaking down of starch by the carbohydrate. If the solution remains blue as the original Benedict's solution, reducing sugar is absent.

4 The following experiment was carried out to show the effect of ethanol (alcohol) on yeast when it fermented glucose anaerobically. The sterile syringes were prepared as shown in the diagram and left for 1 hour. At the end of the hour, the distance the liquid in the glass tube moved in each syringe was measured.



- (a) Explain (i) why the liquid moved in the glass tube; [2]

The yeast cells carry out anaerobic respiration and produce carbon dioxide and ethanol which add into the volume of the reaction mixture. The increase in the volume within the syringe causes the liquid to move into the glass tube and the liquid moves in the direction as indicated. why the temperature in syringe 1 was higher than that in syringe 2 at the end of one hour. [2]

Yeast cells carry out anaerobic respiration and produce energy in the form of heat. More heat is produced in syringe 1 than in syringe 2. This is because longer respiration process is carried out in syringe 1 as compared to syringe 2. why it is important to use sterile syringes. [1]

To prevent contamination by other microbes which will affect the growth of yeast cells in the syringe so that the experiment can be carried out

(b) The results of the experiment were as follows:

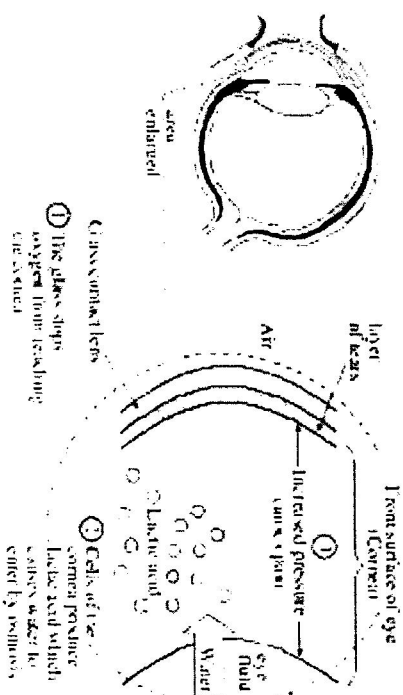
Time (min)	Distance moved by liquid in the glass tube (mm)	
	Syringe 1	Syringe 2
0	0	0
40	30	10
50	100	16
60	220	20

Suggest an explanation of the results.

[1]

Ethanol will slow down the process of anaerobic respiration and the growth of yeast cells. Therefore lesser amount of carbon dioxide and ethanol are produced in syringe 2 to cause the shorter distance moved by the liquid in the glass tube.

5 The first contact lenses to be developed were made of glass. The diagram shows what happened when a glass contact lens was put on the eye.



These lenses proved to be unsuitable because they caused pain.

(a) The diagram shows water entering the cornea of the eye by osmosis. Define osmosis.

[2]

It is the net movement of water molecules from a region of higher water potential to a region of lower water potential through a partially

(b) Modern contact lenses are gas permeable. Use the information in the diagram to explain why these modern contact lenses are more suitable than glass contact lenses.

[4]

Modern contact lens are gas permeable. It allows oxygen to pass through and enter the cornea cells. Unlike the glass contact lens which cuts off the oxygen supply completely to the cells, whereby only anaerobic respiration can be carried out. When there is oxygen supply, aerobic respiration is carried out by cornea cells and there is no production and accumulation of lactic acid in the cornea as only carbon dioxide and water are produced. Carbon dioxide can be easily transported away via blood circulation. The water potential in the cornea remains relatively constant and isotonic; thus it does not attract water to move into the cornea by osmosis. Since there is no increase in the volume of water in the cornea and there is no increase of pressure in the cornea, the eye will not feel any pain. Therefore modern lenses are more suitable than glass contact lenses.

6 (a) Fig. 7.1 shows a carbon cycle.

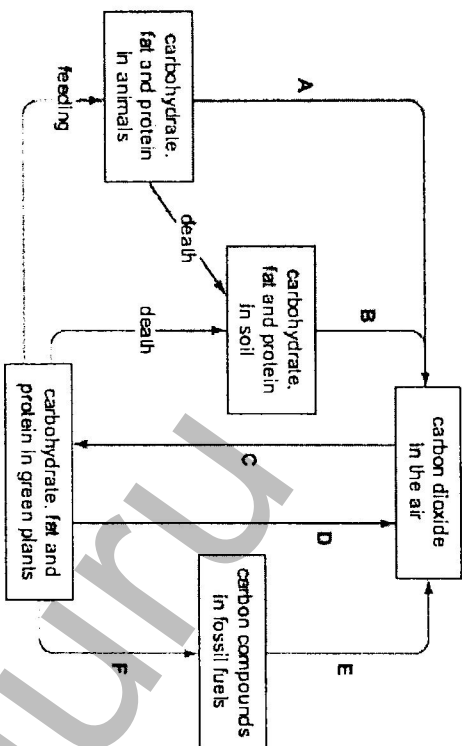


Fig. 7.1

(i) Write the letter of an arrow, A, B, C, D, E, or F as shown in Fig. 7.1, that represents each of the following processes.

- combustion E
 photosynthesis C
 respiration A, B, D

[3]

(ii) Many of the world's governments are concerned that the carbon dioxide concentration in the atmosphere keeps rising.

Explain why they are concerned about the rise in carbon dioxide concentration.

Rise of carbon dioxide concentration could give rise to global warming as the carbon dioxide is a greenhouse gas which traps excess heat on the earth. The increase in the earth's temperature can cause climate change giving rise to drought in some places and flooding in others that affect the habitats and survival of many species of organisms in an ecosystem.

The earth temperature increases could cause the glaciers present in polar-regions to melt and increases the sea level. Thus this threatens many coastal and low lying areas in the world to be submerged under the seas

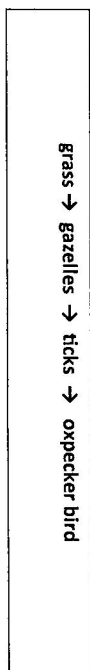
Acidification of ocean water due to high concentration of carbon dioxide could affect the health of coral reef growth and related food webs present in the habitat.

(b) Gazelles are herbivores that eat grass.

Oxpecker birds feed on ticks that live on the skin of gazelles.

Ticks suck blood from the gazelles.

(i) Draw a food chain to represent these feeding relationships.



(ii) State what the arrows represent in a food chain.

It represents the direction of the energy flow

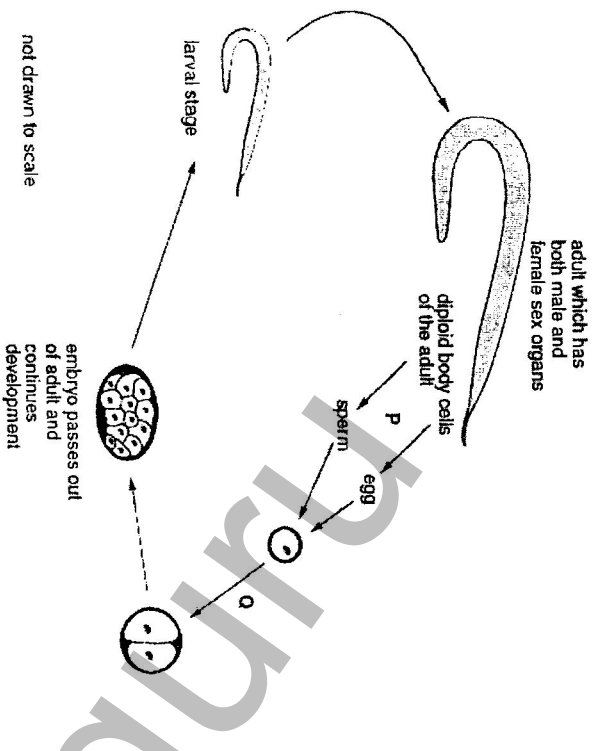
[1]

(iii) Explain why a food chain is not considered to be a cycle like the carbon cycle.

The Sun is the principal source of energy input to any ecosystem. Photosynthetic plants can trap light energy and convert it into chemical energy. Heterotrophic organisms obtain their energy by eating plants or animals that have eaten plants. So all organisms, directly or indirectly, get their energy from the Sun. The energy is passed from one organism to another in a food chain but, unlike water and elements such as carbon and nitrogen, energy does not return in a cycle. Energy obtained at each trophic level is used for metabolic activities or given out by organisms as heat loss to the environment but not returned to plants to carry out photosynthesis to manufacture food again.

[Total: 12]

7 Figure shows the life cycle of *C. elegans*. The diploid number of this species is 12.



(a) Suggest why there is very little genetic variation in the offspring of the adult nematode shown in Figure

Both male and female gametes are produced by the sex organs via meiosis from the same parent. After fertilisation, the zygote formed will have the complete set of chromosomes which are almost identical to its parent. There is only some genetic variation occurs during meiosis; hence the offspring developed from the zygote has very little genetic variation.

[2]

(b) State the haploid number of *C. elegans*.

6

[1]

(c) Explain why meiosis occurs at P and mitosis occurs at Q.

meiosis at P

This is to ensure that the gametes receive half of the number of chromosomes from the parent so that after fertilisation the zygote formed will retain and return the chromosome number back to that as found in their parent somatic cells.

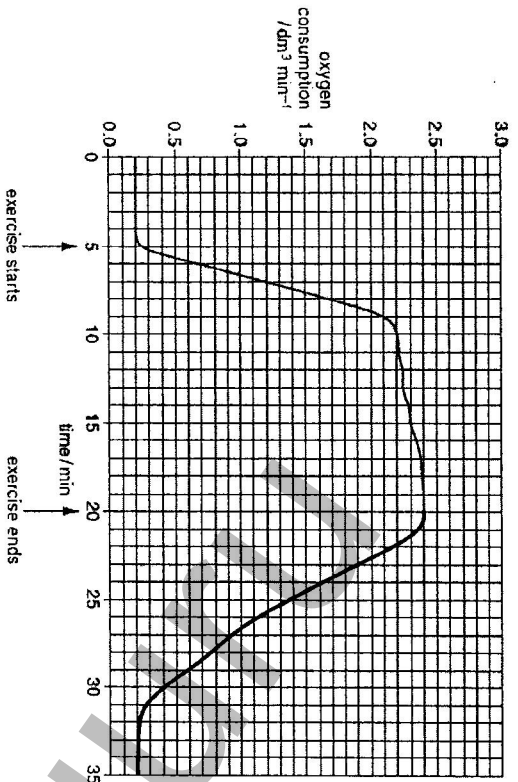
mitosis at Q

This is to ensure that more daughter cells are formed with identical set of chromosomes so that the offspring can grow and develop into adult nematode that resemble morphologically and physiologically like their parent.

[3]

8 The man has an intense workout on the rowing machine.

Figure shows his oxygen uptake before and during the exercise.



- (i) Explain why there is a steep increase in the man's oxygen consumption at the start of the exercise.

At the start of the exercise, there is more oxygen needed by the working muscles than can be supplied until the heart rate and blood pressure catch up with this initial start of activity. This oxygen is required to feed the muscles and keep them working.

More energy is needed to tone and increase the temperature of the working muscles so that the enzymes responsible for the movement can function at their optimum temperature; this will ensure that the exercise can be sustained for a period of time. Therefore more oxygen is required initially to allow respiration to be carried out fast enough to support the exercise.

[4]

- (ii) It took 10 minutes after the man had stopped rowing for his oxygen consumption to decrease to its resting value.

On Figure 1, draw a line between 20 minutes and 35 minutes to show the change in oxygen consumption after exercise has stopped. [2]

- (iii) Explain why the man's oxygen consumption did not return to the resting value immediately after exercise.

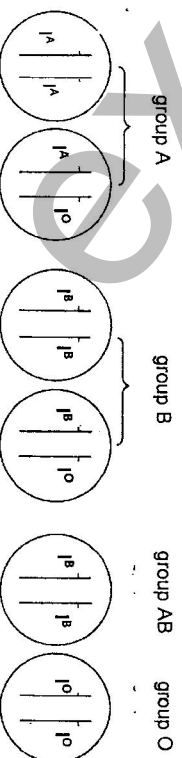
During exercise, some anaerobic respiration is carried out to produce small amount of energy to support the activity. Oxygen debt is incurred during anaerobic respiration.

When the exercise ends, large amount of oxygen is continuously taken into the body to pay off the oxygen debt and restore the body back to its normal state. Lactic acid formed from anaerobic respiration is converted into glucose to generate energy for metabolic activity in the muscles or changed to glycogen for storage in the muscles

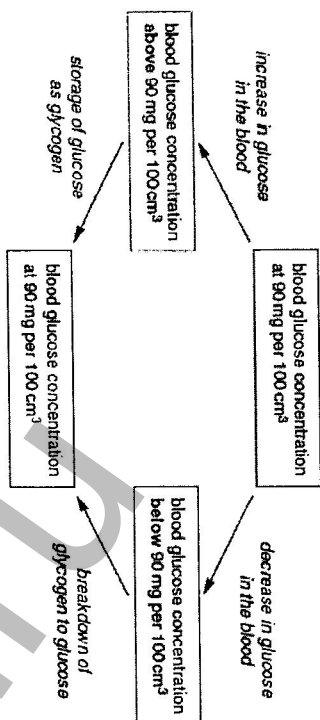
[4]

9

he alleles controlling the ABO blood groups are given the letters I^A (group A), I^B (group B) and I^O (group O). On the drawings below, write in the alleles on the chromosomes for each of the blood groups. (The first one has been done for you)



10 Figure 1 is a diagram that shows the control of blood glucose concentration.



(a) (i) State one reason why the concentration of glucose in the blood increases.

Few hours after taking a meal/ beginning of an exercise

(ii) State one reason why the concentration of glucose in the blood decreases.

Hunger/ interval before the next meal/ after a heavy exercise

(iii) Name two places in the body where glycogen is stored.

- 1 .. The liver
- 2 .. Muscles/muscle cells

(b) Explain how an increase in glucose concentration is controlled in the body.

Increase in blood glucose concentration will stimulate insulin to be released into the blood stream from the beta cells in the Islets of Langerhans of pancreas.

Insulin travels in the blood to and affect most of the body cells. Cell membranes of body cells respond to insulin by becoming more permeable to glucose and increase uptake for utilisation to generate energy through increased metabolic rate.

When insulin arrives at the liver and muscle cells, excess glucose is taken into the cells and converted into glycogen for storage. In addition, insulin stimulates the conversion of glucose to fat in adipose tissue. As excess glucose is removed from the blood via conversion to glycogen, blood glucose concentration is lowered back to normal range.

(c) If the blood glucose concentration is very high there is a decrease in the water potential of the blood. This may damage the red blood cells.

Explain how a decrease in water potential of the blood may damage red blood cells.

When the water potential in the blood plasma is lower than inside of the red blood cells, water diffuse out of red blood cells via osmosis. The cells shrink and become crenated. The deformed red blood cells will have difficulty to move along in the blood through all the blood vessels and oxygen carrying function will be compromised causing many body cells not able to receive oxygen supply timely for respiration to generate energy to support various activities.

..... [3]

11

In rabbits, assume that the dominant allele (B) produces black fur. The allele (b) for white fur is recessive to B.

(a) What colour fur will each of the following rabbits have?

	Rabbit 1	Rabbit 2	Rabbit 3	Rabbit 4
genotype	BB	Bb	bb	bb

(a) Which of them are pure breed?

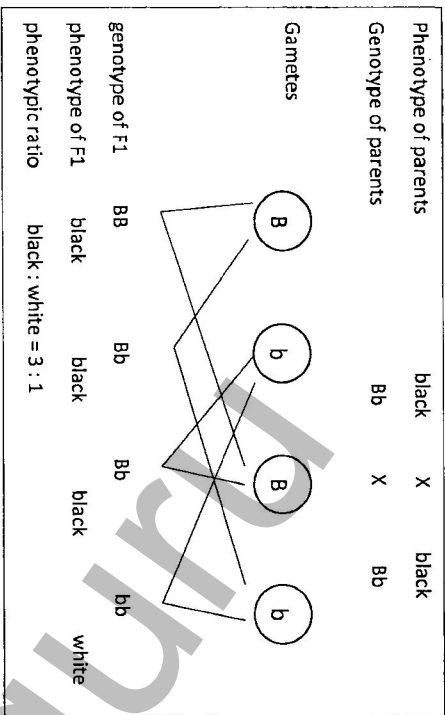
.. Rabbit 1 and rabbit 4 [1]

(b) If rabbits 1 and 4 were mated together and had 12 babies, how many of these would you expect to be black? Use a punnett square to show your working.

	B	B
b	Bb	Bb
B	Bb	Bb

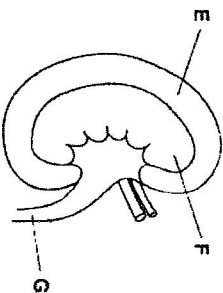
As shown in the punnett square all 12 baby rabbits will have black fur.

(c) If rabbits 2 and 3 are interbred and produce several litters, totalling 48 babies, how many white babies would be predicted by the laws of genetics? Use a genetic diagram to support your answer.



From the genetic diagram, the ratio of black-fur rabbit to white-fur rabbit is 3 to 1. The number of white rabbits is probably 12 [4]

12 Figure shows a vertical section of a kidney.



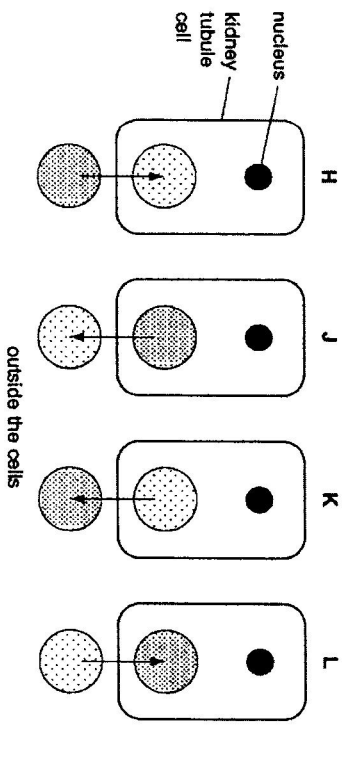
(a) Name the parts E, F and G.

- E cortex [3]
F medulla
G ureter

(b) Substances move into and out of cells in kidney tubules.

Figure shows four processes, H, J, K and L, that occur in cells lining the kidney tubule.

The net movement of substance is shown by an arrow, in each case.



(i) Complete the table by stating the letter, H, J, K or L, which identifies each of the processes. Give a reason for each answer.

process	letter	reason
diffusion of oxygen	H	The movement of oxygen is down the concentration gradient and it is transported by the blood to supply oxygen to tubule cell for aerobic respiration.
active uptake of sodium ions	L	The movement of sodium ions is against the concentration gradient and it is actively reabsorbed into tubule after the ultrafiltration process at the glomerulus.

[4]

- (ii) Glucose is filtered from the blood. Usually all of it is reabsorbed by the kidney tubules so that there is none present in the urine.

Name the part of the kidney where filtration occurs.

glomerulus

[1]

- (iii) Use Fig. 3.2 to describe how kidney tubules reabsorb glucose from the filtrate.

Glucose filtered off at the glomerulus is actively reabsorbed into the blood capillaries by active transport. Most of the glucose is reabsorbed at the proximal convoluted tubule which is located at part E (cortex) and the remaining absorbed at the loops of Henle and distal convoluted tubule located at part F (medulla).

[2]

- (c) When plants are grown in a solution that includes a poison that prevents respiration, the roots continue to absorb water, but do not absorb many ions.

Explain this result.

Absorption of mineral ions by the roots are generally by means of active transport. Active transport requires energy supply to move the ions against the concentration gradient occurs between the cell sap of root hair cell and in the soil. When respiration is prevented due to the poison, no energy will be produced via aerobic respiration. Since there is no energy supply in the root hair cells, active transport cannot be carried out. So there is no absorption of many ions. But water is continued to be absorbed by osmosis which is a physical process without the need for energy and it is moved down the water potential gradient.

[3]

- 5 Fig. 5.1 shows the rate of water uptake and of water loss for a plant over a 24-hour period.

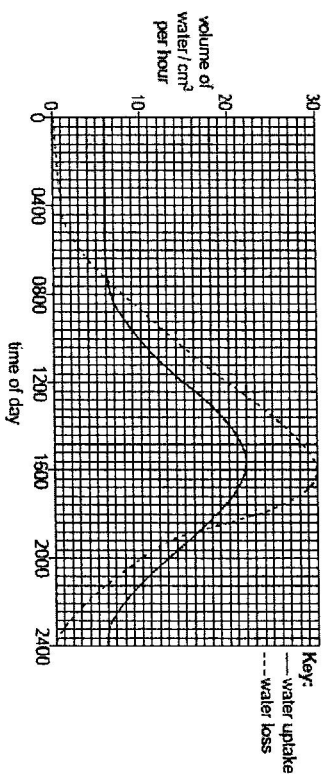


Fig. 5.1

15 cm³/hour

- (a) Determine the rate of water uptake at 1200 hours. ...

[1]

- (b) (i) Name the cells through which water is absorbed from the soil.

Root hair cells

[1]

- (ii) Name the cells between which water vapour passes to the atmosphere.

Guard cells

[1]

- (c) (i) State three uses of water within a plant between midnight and 0400 hours.

- To maintain turgidity of cells and keep the plant
- To provide aqueous medium for chemical reactions to take
- To allow transpiration pull to be carried out for water to be continuously absorbed and transported upward.

- (ii) State two additional uses of water between 0800 and 1900 hours.

- Use as a raw material to carry out photosynthesis to manufacture food
- To cool the plant by means of evaporation of water to get rid of excess heat

- (d) Explain what may happen to the plant between 1400 and 1800 hours.

The rate of water loss is higher than the rate of water uptake. The cells are plasmolysed due to too much water loss. The plant will undergo wilting and become flaccid and droop.

[2]

Section B

Answer only TWO questions

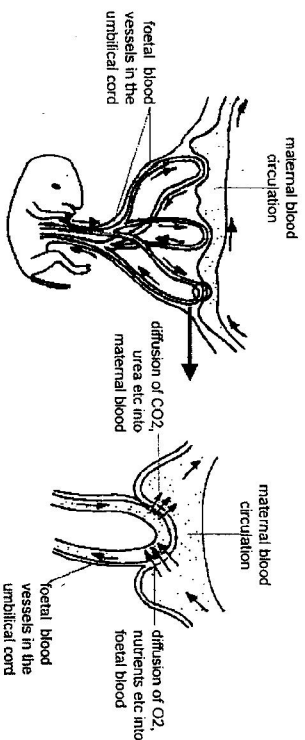
- 14 Describe how a developing foetus in the uterus obtains and uses its metabolic requirements and gets rid of its waste products.

The foetus relies completely upon its mother as it develops - protection, oxygen and nutrients supply as well as removal of wastes.

The placenta is responsible for providing oxygen and nutrients, and removing waste substances. It is a temporary organ consisting of blood vessels and membranes that unite mother and foetus, which grows into the wall of the uterus and is joined to the foetus by the umbilical cord.

The umbilical cord serves as the lifeline for the foetus. The two arteries carry blood pumped from the left ventricle of the foetal heart to the placenta to receive oxygen and nutrients from the mother. The vein returns the oxygenated blood from the placenta back to the right atrium of the foetal heart.

This blood then enters the umbilical arteries and flows into the placenta. In the placenta, carbon dioxide and waste products diffuse across the placenta from the foetus to the mother's circulatory system. Oxygen and nutrients from the mother's blood diffuse across the placenta from the mother to the foetus blood.



- 15 (a)

Describe the path taken by a molecule of oxygen as it passes from air in the lungs to a muscle cell in the body [6]

A molecule of oxygen in the air has to enter the body through breathing mechanism and gaseous exchange in the alveoli in the lungs before entering the blood stream and reach its destination at a muscle cell.

In order for the molecule of oxygen to be taken into the lungs, a difference in the pressure between the atmosphere and respiratory system must be established through several events occurring in inhalation so as to ensure the flowing of air into the body.

During inhalation, the external intercostal muscles contract and internal intercostal muscles relax which causes the ribcage to be lifted both upward and outward. The dome-shaped diaphragm contracts and become flattened as it moves downward. The volume of the thoracic cavity increases and this will lower the pressure within the cavity as compared to that in the atmosphere and causes a rush of air into the lungs via nasal passage, pharynx, larynx, trachea, bronchi, bronchioles and eventually arrives at the alveoli and oxygen dissolves in a thin layer of water moisture surrounding the inner wall of the alveoli before gaseous exchange could take place.

Oxygen diffuse across the alveolar wall into the blood capillaries due to the concentration gradient established between the alveoli and surrounding capillaries. There is higher concentration of oxygen in the alveoli than that in the blood within the capillaries. Once oxygen enters the blood plasma, it diffuses into red blood cells and combine with haemoglobin to form oxyhaemoglobin. Red blood cells move away from the lungs and return to the left atrium through pulmonary vein.

When left atrium contracts and bicuspid valves are opened, blood enters the left ventricle. During systole when left ventricle contracts and pumps the blood to the aorta with the semi-lunar valves open and bicuspid valves closed. Once in the aorta, many arteries are branched off to supply blood to various tissues and organ. As the blood travels along arteries and arterioles to muscular tissue, oxygen will dissociates from haemoglobin and leaves the red blood cells. Oxygen diffuses into tissue fluid in the interstitial space and moves into muscle cells for the latter to use it to carry respiration to generate energy.

- (b) Sometimes babies are born with a hole between the left and right sides of the heart, through which blood can pass. Explain the effect this has on the double circulation system of the baby's body [4]

Left sides (left atrium and left ventricle) of the heart contains oxygenated blood and right sides (right atrium and right ventricle) of the heart contains deoxygenated blood. When the heart contracts and relaxes, some of the blood from both sides of the heart will mix. Oxygenated blood is always mixed with certain amount of deoxygenated blood.

The mixing of blood will result in the blood being pumped out of the heart carrying lower concentration of oxygen. Thus, the efficiency of oxygen carrying capacity by the blood to all body cells is compromised due to the oxygen saturation rate of the blood is always not at its optimal. Most body cells may not receive enough oxygen to carry out respiration to generate energy for all body activities.

- 16 (a) Explain what is meant by a hormone. [4]

A hormone is a chemical substance produced by an endocrine gland and is secreted into the blood stream for transporting to specific target organs to carry out its specific function and it is destroyed at the end of its action by the liver.

- (b) Give an example of a hormone and describe how it is involved in maintaining constant conditions within the human body. [6]

Insulin is a hormone produced in the pancreas which is important in lowering the blood glucose concentration back to normal range, via negative feedback mechanism, when high blood glucose is detected.

When blood glucose concentration is higher, it signals the beta cells in the islets of Langerhans of pancreas to produce insulin to manage the level of glucose in the blood.

When insulin is produced, glucagon is suppressed. Insulin stimulates the cells throughout the body to take in glucose from the bloodstream by increasing the cell membrane permeability for glucose to enter the cells faster. Most of the body cells then use glucose as energy through respiration process. Insulin also stimulates the liver and muscle cells to increase uptake of glucose and convert it into glycogen and stored in these cells,

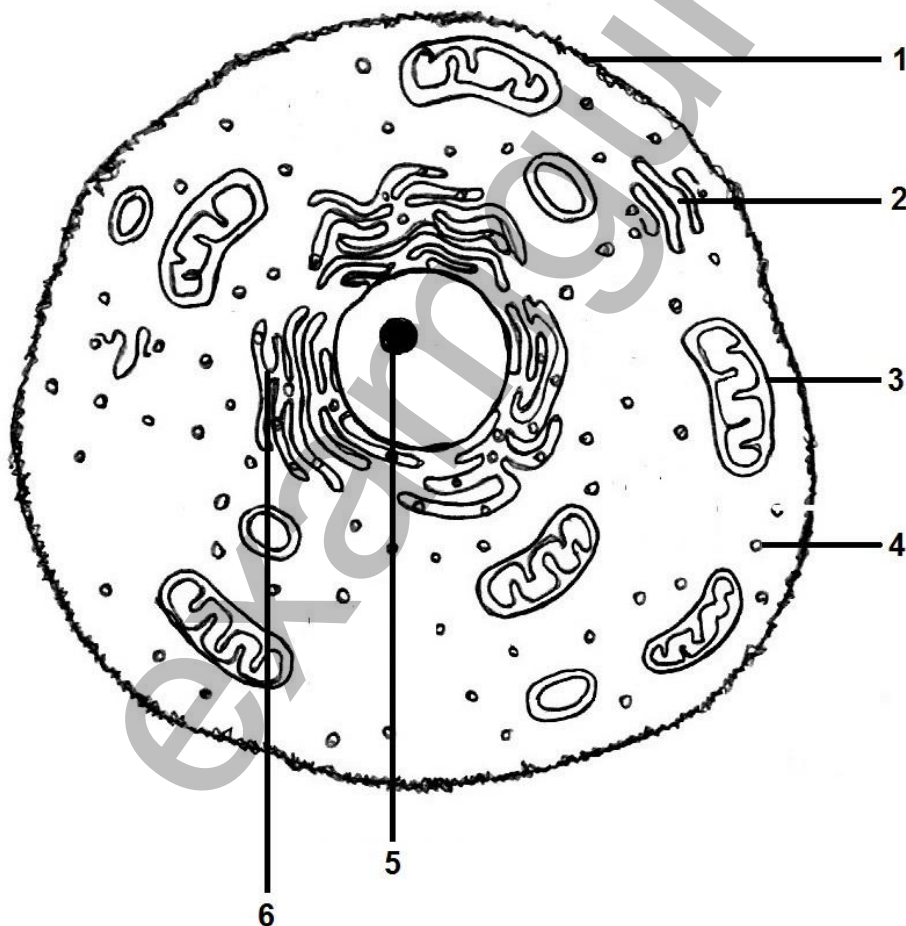
As glucose is converted to energy or stored in the liver and muscles, its levels in the blood are reduced.

1. Which of the following correctly identifies the level or organisation of these components of the human body?

- 1) blood
- 2) brain and spinal cord
- 3) eye
- 4) ovum

	cell	tissue	organ	organ system
A	1	4	2	3
B	1	4	3	2
C	4	1	2	3
D	4	1	3	2

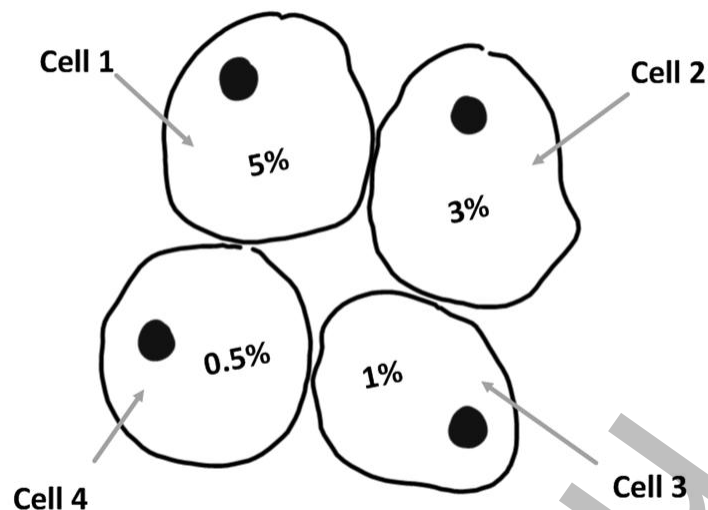
2. The diagram shows parts of an animal cell.



What is the order in which the various organelles are involved when the cell secretes a peptide hormone?

- A 6 → 2 → 4 → 1
- B 6 → 3 → 2 → 1
- C 5 → 3 → 4 → 1
- D 5 → 6 → 2 → 1

3. The diagram shows 4 cells with different solute concentrations.



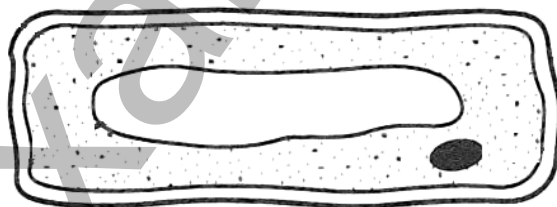
Which of the following correctly states what would happen in the cells immediately after they were placed next to each other?

- 1) Solutes would move from cell 1 to cell 4 via diffusion
- 2) Solutes would move from cell 4 to cell 1 via diffusion
- 3) Water would move from cell 2 to cell 3 via osmosis
- 4) Water would move from cell 3 to cell 2 via osmosis

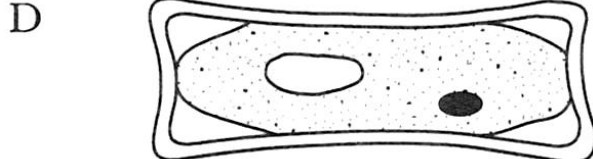
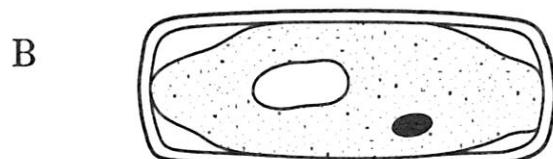
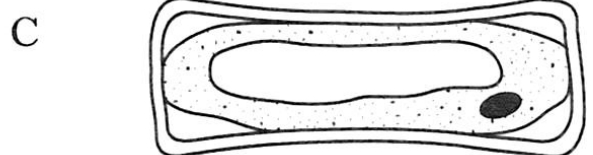
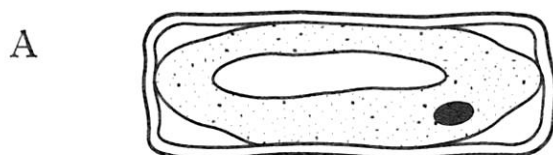
- A** 1 and 2
B 1 and 4

- C** 2 and 3
D 3 and 4

4. The diagram shows the appearance of a plant cell in an isotonic solution.



Which of the following best illustrates the cell after it was immersed in a hypertonic solution for 15 minutes?



5. Which of the following statements are true about the importance of water in the human body?

- 1) Acts as reactant in hydrolysis
- 2) Aids in transport of carbon dioxide
- 3) Enables survival in extreme cold
- 4) Protects growing foetus

A 1 and 2
B 2 and 3

C 1, 2 and 4
D 2, 3 and 4

6. Two different patients with different medical conditions are shown below:

Patient X: gall bladder removal surgery due to gallstones

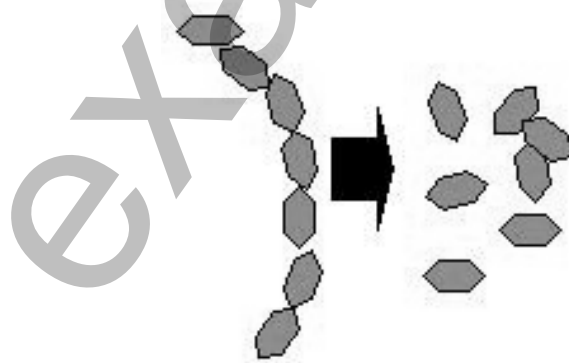
Patient Y: kidney failure due to long-term diabetes

Which of the following correctly shows the results of food tests performed on the urine and faecal sample of these two patients?

	Benedict's test		Biuret test		Ethanol emulsion test	
	X	Y	X	Y	X	Y
A	+	+	+	+	+	+
B	+	-	+	-	-	-
C	-	+	-	+	+	-
D	-	-	-	-	+	-

+ : positive result
- : negative result

7. The diagram shows changes made to a nutrient present in the human body.



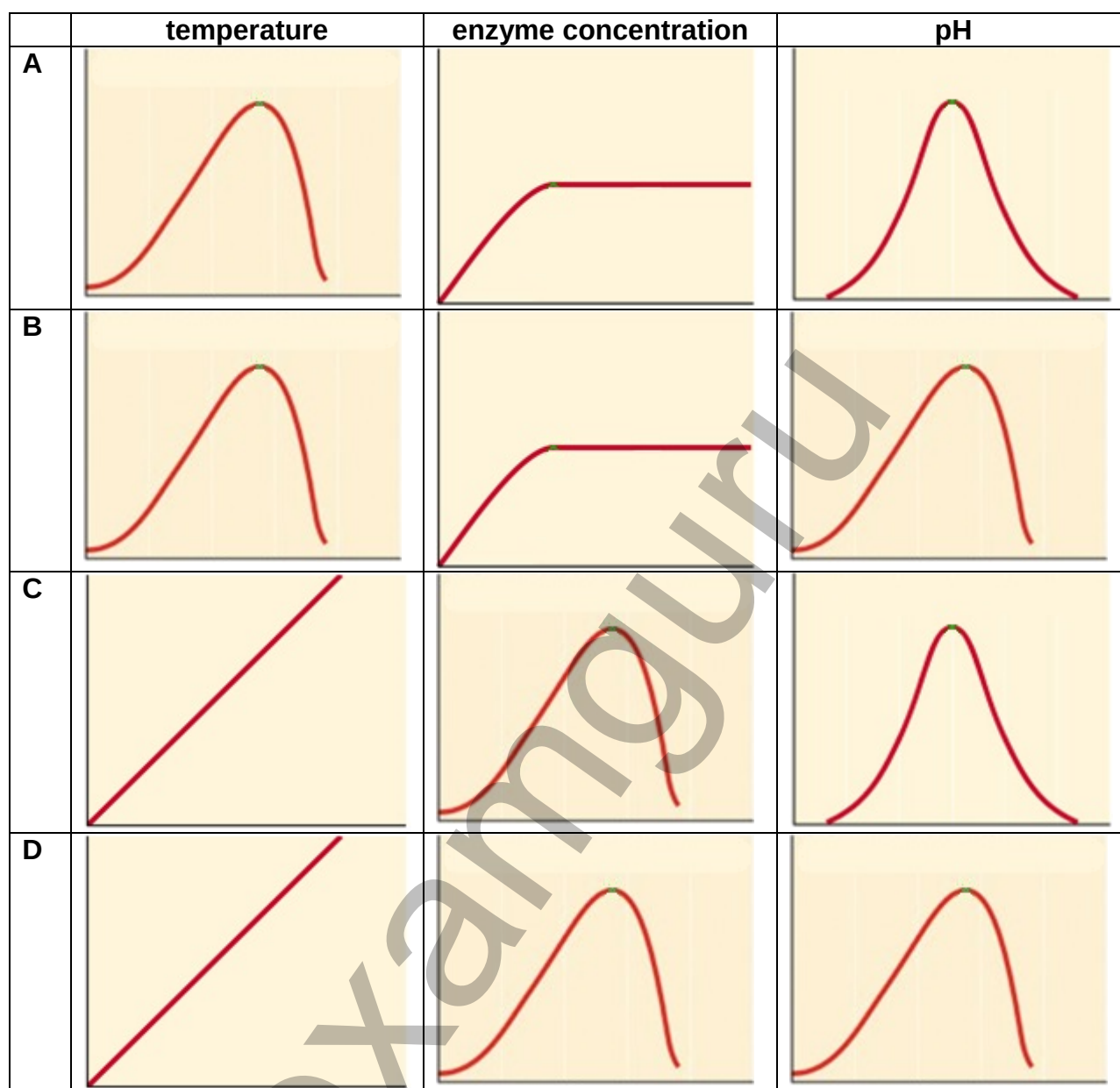
Which of the following substances may play a role in causing this change?

- 1) amylase
- 2) insulin
- 3) glucagon
- 4) lipase

A 1 and 2
B 1 and 3

C 2 and 3
D 2 and 4

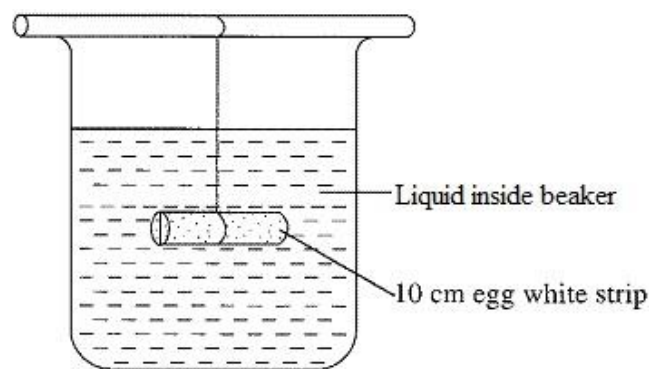
8. Which of the following graphs represents the effect on temperature, enzyme concentration and pH respectively on enzyme activity?



9. Which function of the liver is correctly paired with the chemical involved?

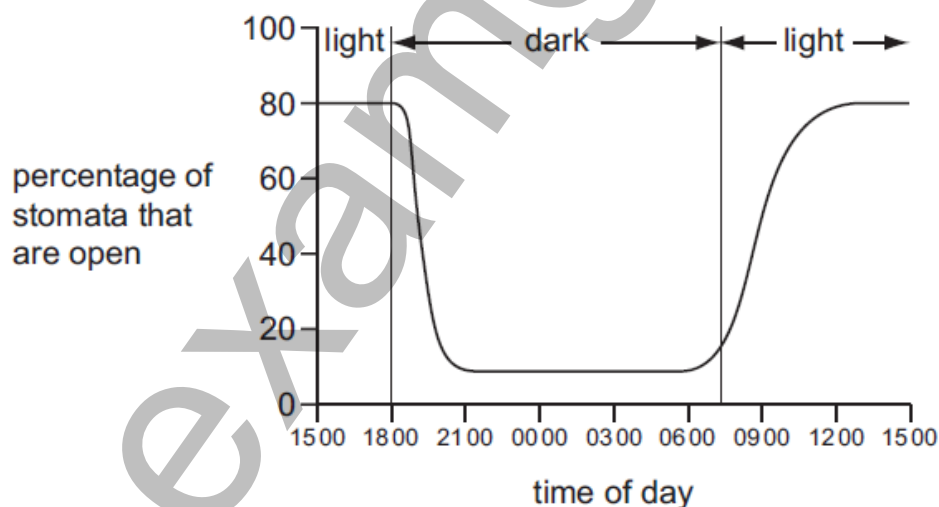
	function	chemical
A	deamination	glycogen
B	detoxification	alcohol
C	excretion	urea
D	storage	starch

10. The diagram shows an investigation about the action of digestive enzymes.



Which of the following substances when added inside the beaker will cause the greatest reduction in the length of the egg white strip?

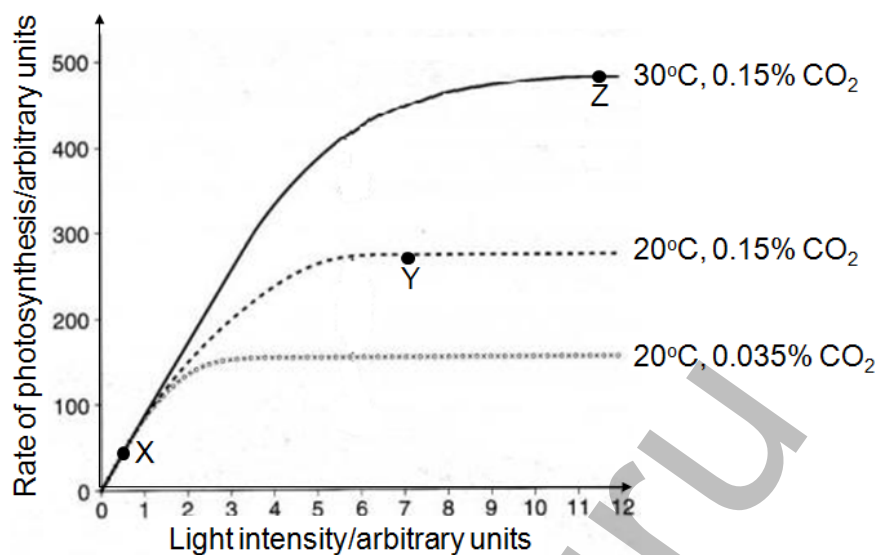
- A pepsin + distilled water
 - B pepsin + hydrochloric acid
 - C boiled pepsin + distilled water
 - D boiled pepsin + hydrochloric acid
11. The graph shows stomatal opening and closing in the leaves of a species of *Perlargonium*, over a 24-hour period.



Which conclusions can be made from the graph?

- 1) Stomata open as light intensity increases.
 - 2) Stomata open as temperature increases.
 - 3) Transpiration is faster when light intensity increases.
 - 4) Photosynthesis occurs only when there is light.
 - 5) Respiration occurs all the time.
- A 1 and 2
 - B 1 and 3
 - C 3 and 4
 - D 3 and 5

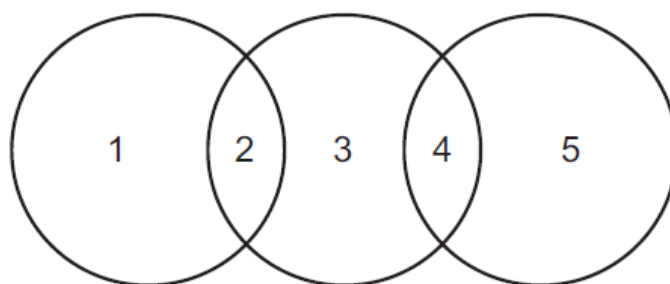
12. The graph shows some of the effects of light intensity, carbon dioxide, and temperature on the rate of photosynthesis.



Which factor is limiting the rate of photosynthesis at points X, Y and Z?

	X	Y	Z
A	light intensity	carbon dioxide concentration	temperature
B	carbon dioxide concentration	light intensity	temperature
C	temperature	carbon dioxide concentration	light intensity
D	light intensity	temperature	carbon dioxide concentration

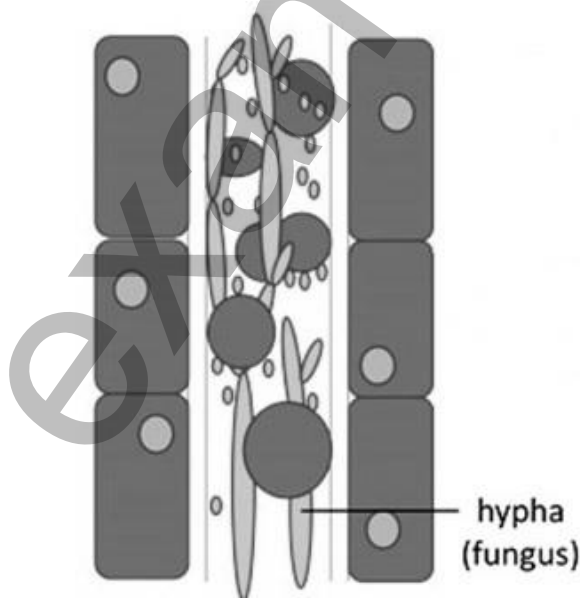
13. The Venn diagram shows the relationship between a phloem sieve tube, xylem vessel, and companion cell.



Which row is correct?

	1	2	3	4	5
A	companion cell	cytoplasm present	phloem sieve tube	nucleus absent	xylem vessel
B	companion cell	nucleus present	phloem sieve tube	cytoplasm present	xylem vessel
C	phloem vessel	mitochondria present	companion cells	nucleus present	xylem vessel
D	xylem vessel	cytoplasm absent	phloem sieve tube	vacuole present	companion cell

14. The diagram shows a longitudinal section of the vascular bundle of a plant. Some soil-borne fungi affect crop growth by growing as shown.



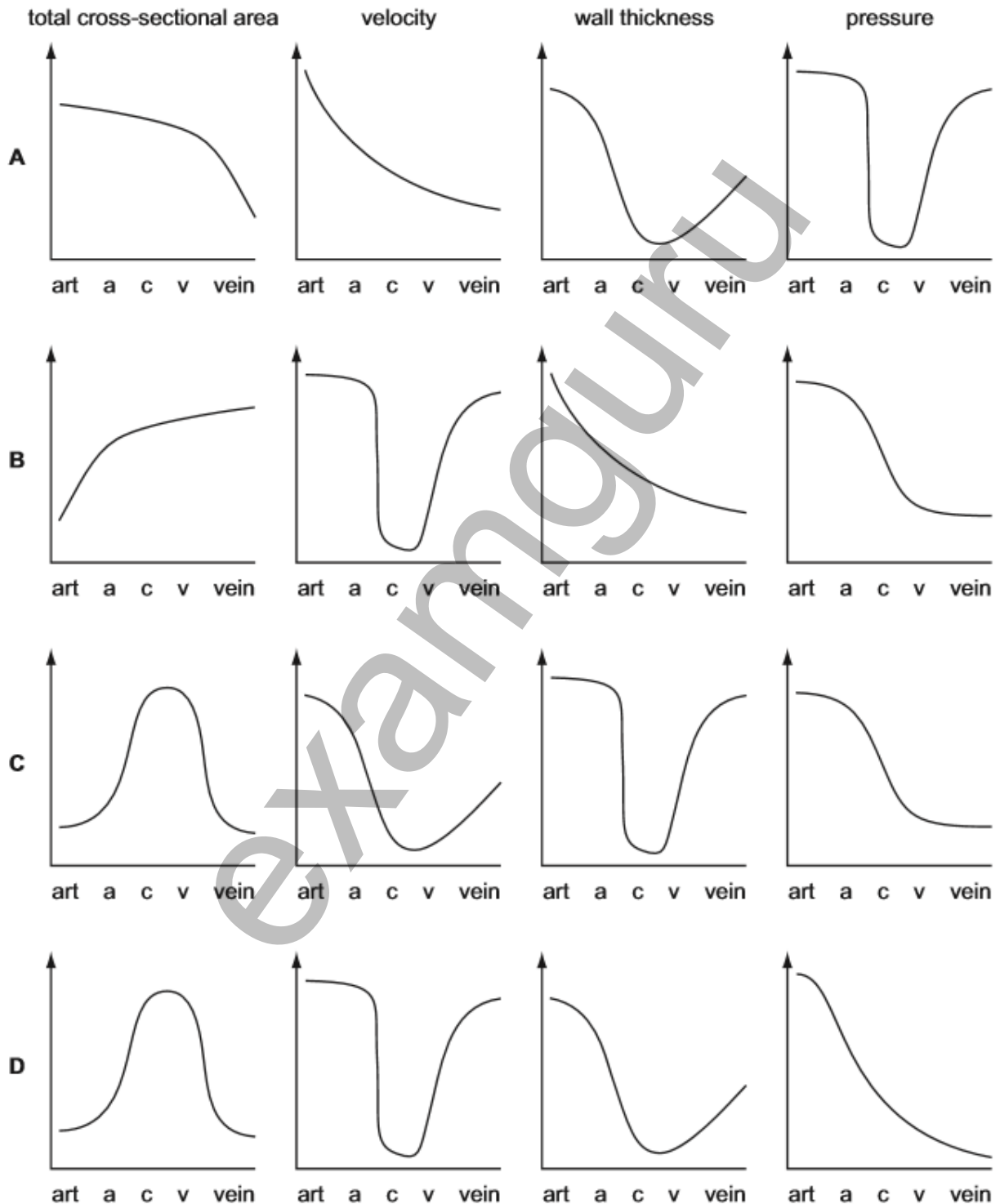
Which process will be directly affected by these fungi?

- A cohesion between water molecules
- B development of root pressure
- C flow of dissolved substances during translocation
- D uptake of water by root hair cells

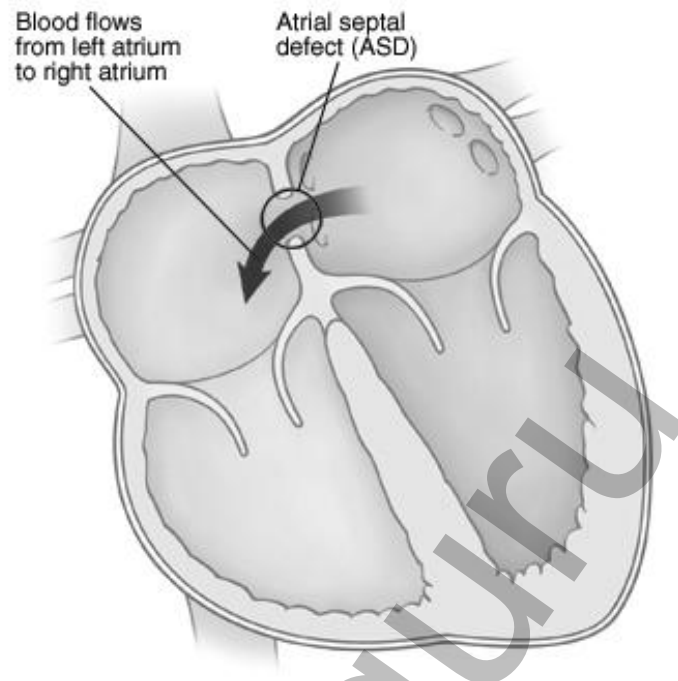
15. Each set of graphs represents data for blood vessels in the sequence:

art a c v vein
artery arterioles capillaries venules veins

Which set is correct?



16. One type of congenital heart defect is called an atrial septal defect (ASD) where the left and right atria are not completely separated.



Which row describes the effects of ASD on blood pressure and oxygenation?

	blood pressure in pulmonary artery	blood pressure in aorta	percentage oxygenation of blood in pulmonary artery
A	decreased	increased	decreased
B	decreased	increased	increased
C	increased	decreased	decreased
D	increased	decreased	increased

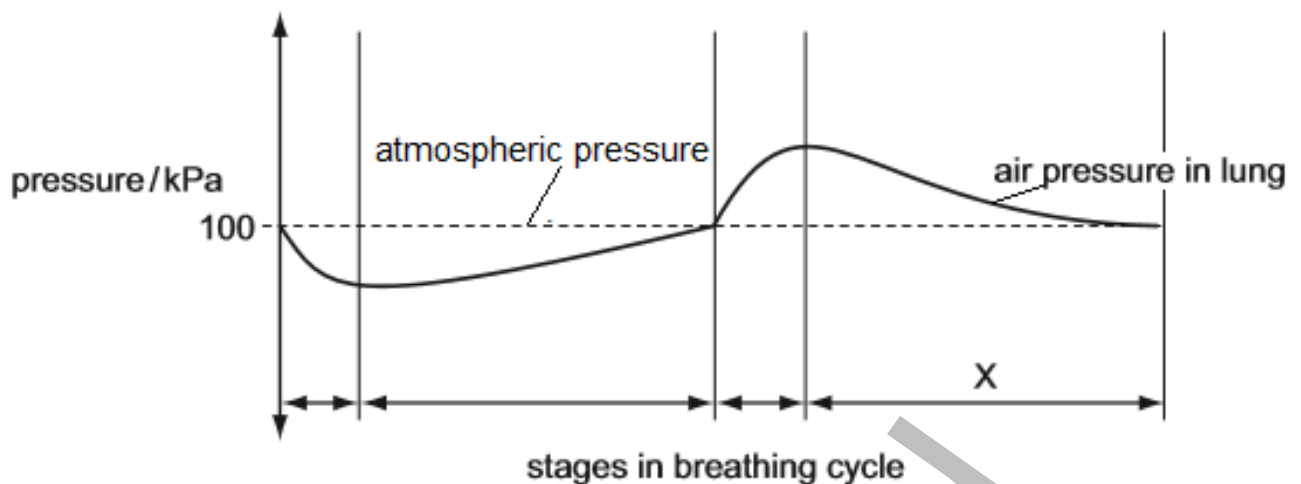
17. The following changes take place in an athlete's body during a 100-meter race.

- 1) Increased availability of oxygen to muscles
- 2) Increased breathing rate
- 3) Increased production of carbon dioxide by muscles
- 4) Increased lactic acid concentration in the blood

Which of the following shows the correct order of sequence?

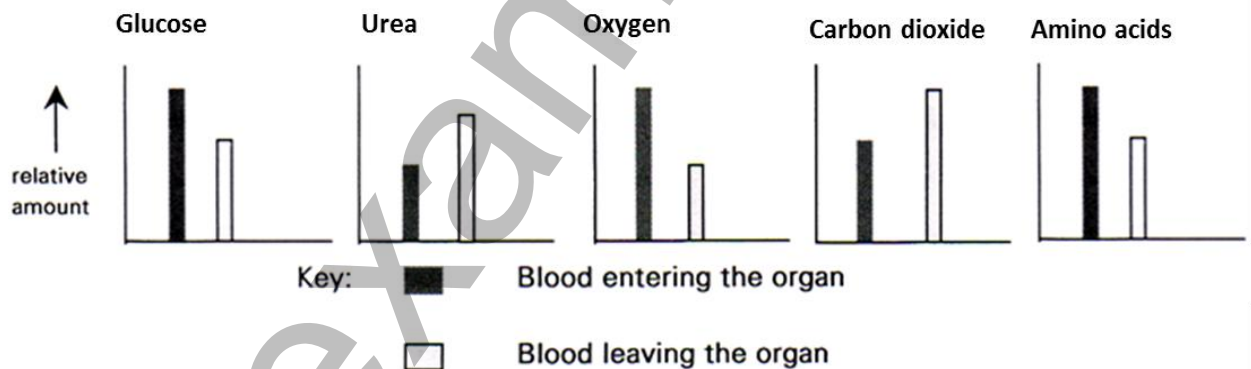
	first			last
A	2	1	3	4
B	2	3	4	1
C	3	2	1	4
D	3	1	2	4

18. The graph shows changes in the air pressure within the lungs during one breathing cycle.



What causes the change in air pressure during stage X?

- A Contraction of diaphragm muscles
 - B Outflow of air from lungs
 - C Increase in volume of lungs
 - D Relaxation of internal intercostal muscles
19. The bar charts show the relative amounts of four substances in the blood entering and leaving a certain organ in the body of a mammal:



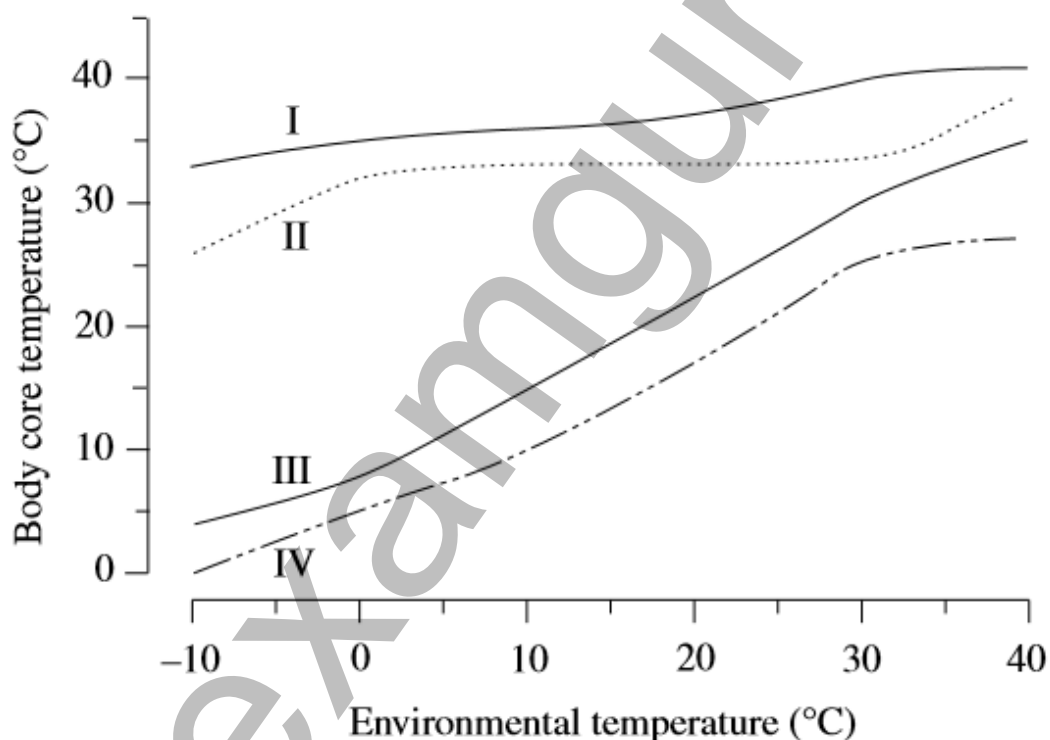
This organ is probably...

- A kidney
- B liver
- C lung
- D small intestine

20. During osmoregulation, which of the following correctly describes the body's homeostatic response to a large intake of salt solution?

	organ / region stimulated	hormone secreted	kidney tubule action	urine composition
A	hypothalamus	more anti-diuretic hormone	reabsorb more water	smaller volume of concentrated urine
B	hypothalamus	less anti-diuretic hormone	reabsorb less water	larger volume of dilute urine
C	pituitary gland	more anti-diuretic hormone	reabsorb more water	smaller volume of concentrated urine
D	pituitary gland	less anti-diuretic hormone	reabsorb less water	larger volume of dilute urine

21. Four different animals were maintained in a laboratory in habitats similar to that of their natural environment. The body core temperature of the animals was measured in response to changes in the temperature of the laboratory environment.



Which statement is best supported by the data?

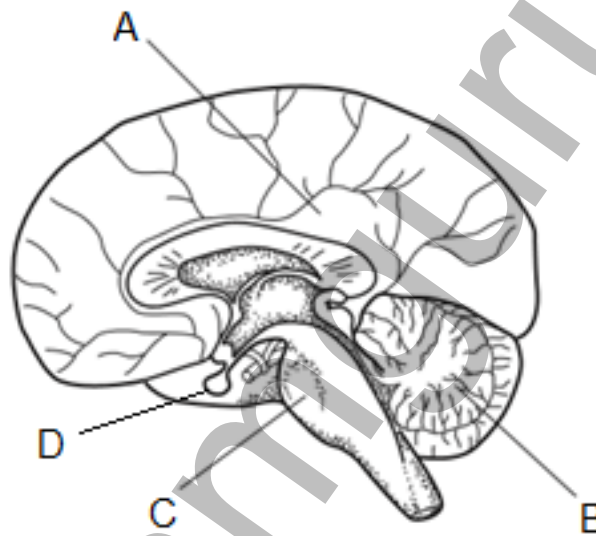
- A Animal I changes the body core temperature by shivering when the environmental temperature rises above 37°C.
- B Animal I and II are most likely mammals.
- C Animal III is able to sweat profusely when exposed to an environmental temperature higher than its body core temperature.
- D Animal IV will not be able to survive in extremely hot environments.

22. Which of the following is/are true of homeostatic control?

- 1) It is a self-regulatory process.
- 2) The regulatory centre of all homeostatic processes is the hypothalamus.
- 3) There must be a stimulus.
- 4) The receptor detects a stimulus that causes a rise above the normal condition.
- 5) The corrective mechanism will reverse the effect of the stimulus.

- A** 1 and 2 only
B 1 and 4 only
C 1, 2 and 4
D 1, 3 and 5

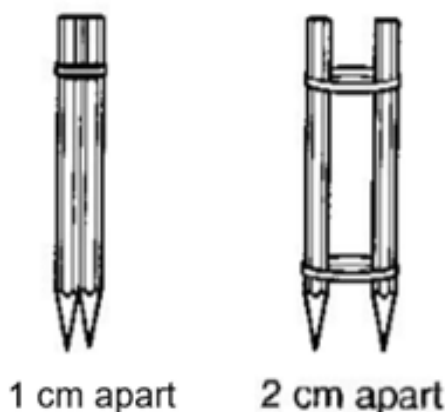
23. The diagram shows a section through the brain.



Which of the following correctly identifies the regions of the brain and its function?

	region	function
A	cerebrum	interprets sensory inputs and controls activity of skeletal muscles and conscious behaviour
B	cerebellum	involved in higher mental activities such as memory, learning and reasoning
C	medulla oblongata	centre involved in regulating body temperature and water balance.
D	hypothalamus	control of heart rate, blood pressure and ventilation.

24. During an experiment, a student was blindfolded. The skin on his fingertip, the palm of his hand and his forearm were then touched several times by two pencil points, either one centimetre or two centimetres apart.



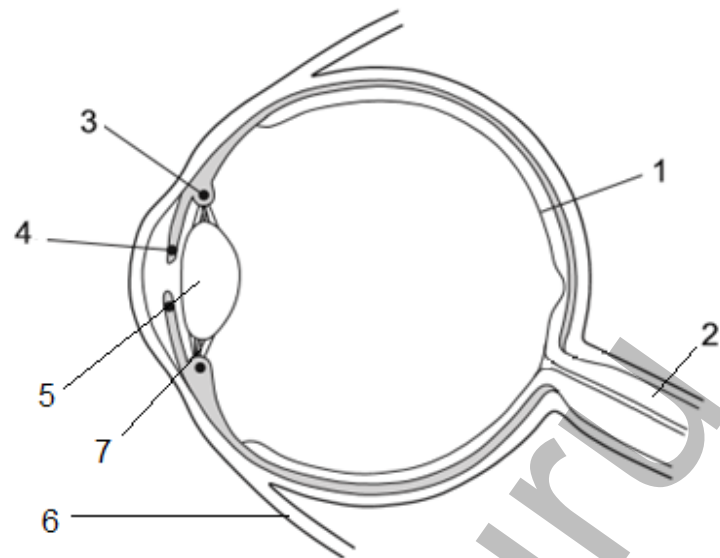
During the recording of results, there were instances when he inaccurately said he had only been touched by one point. The table below shows the number of times he accurately said that he had been touched by two points.

distance between pencil points/cm	% number of times he felt two pencil points		
	fingertip	palm	forearm
1	100	5	20
2	100	75	30

Which statement best concludes the experiment?

- A No touch receptors are present on the skin of the forearm.
- B Only a few touch receptors are present in the skin of the palm.
- C Touch receptors are densest in number in the skin of the fingertip.
- D Touch receptors are least dense in number in the skin of the palm.

The diagram shows a section through the eye. Use it to answer both questions 25 and 26.



25. Which row correctly matches the components of the pupil reflex arc?

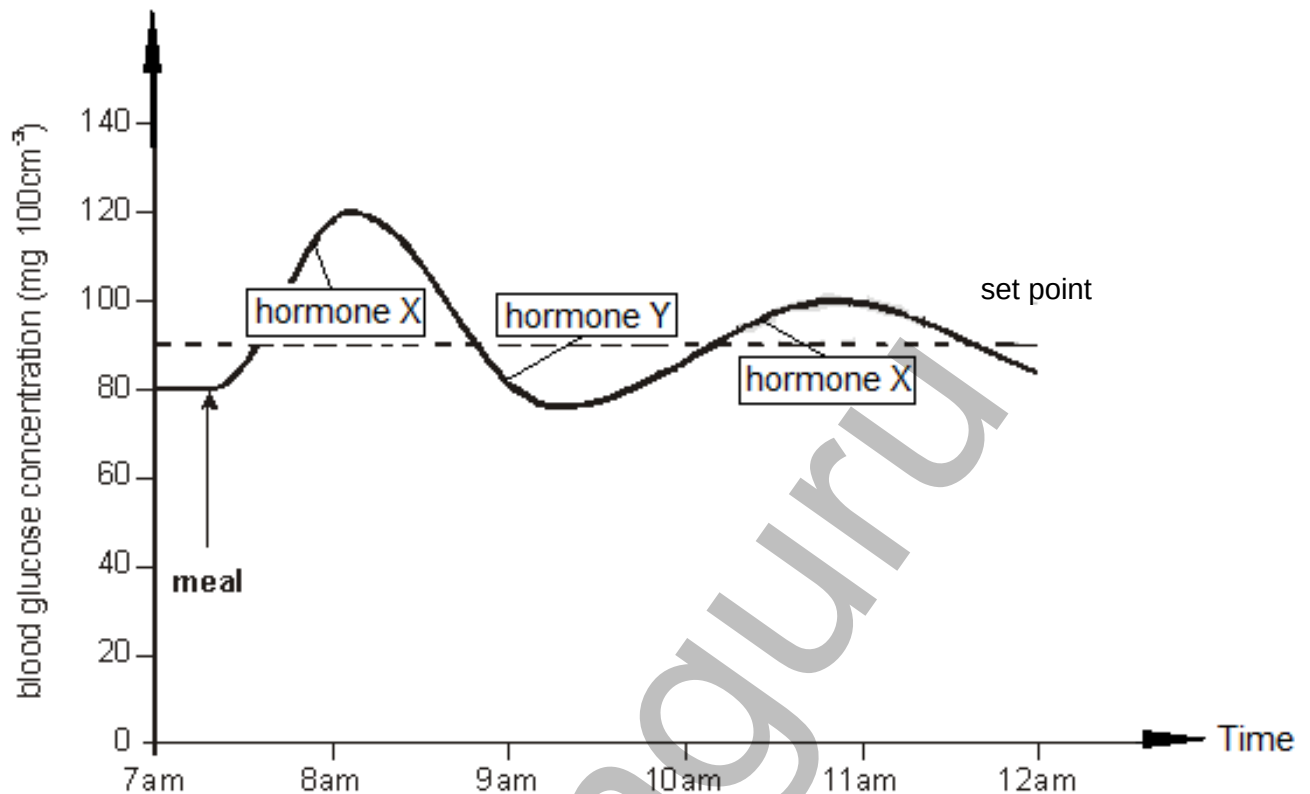
	receptor	sensory neurone	effector
A	1	2	4
B	5	1	3
C	1	6	5
D	5	2	6

26. Colin was reading a book in the garden. He looked up to check on his son swimming in the pool ten metres away.

Which changes occur in his eyes so that his vision is still in focus?

	3	7	5	light rays refracted
A	contract	slacken	thinner	less
B	contract	tighten	thicker	more
C	relax	slacken	thicker	more
D	relax	tighten	thinner	less

27. The graph shows the changes in blood glucose concentration after a meal. Hormones X and Y are produced in response to the changes in blood glucose concentration.



Which of the following statements about hormones X and Y can be concluded from the graph?

- 1) Hormone X is secreted in response to an increase in blood glucose concentration.
- 2) Hormone X is absent in the blood between 9 – 10 am.
- 3) Hormone X increases the permeability of liver cells to absorb more glucose.
- 4) Hormone Y is produced by the liver cells.
- 5) Hormone Y converts glycogen into glucose.

- A** 1 and 2
B 1 and 3
C 2 and 4
D 2 and 5

28. Which statement describes the effects of adrenaline?

- A** Causes pupil to constrict.
B Decreases blood pressure.
C Increases blood flow to muscles.
D Promotes conversion of glucose to glycogen.

29. May decided to grow two closely-related species of plants in her garden. The table shows the time period at which the reproductive parts of plant X and Y mature.

plant X	plant Y
anther matures in April	anther matures in July
stigma matures in April	stigma matures in April

She made the following conclusions:

- 1) It is possible for plant X to be self pollinated.
- 2) It is possible for plant Y to be self pollinated.
- 3) Plant X can cross pollinate with plant Y.
- 4) Plant Y must be pollinated by insects.
- 5) Pollen grains from plant Y can be germinated on plant X.

Which of the statements can be concluded about plant X and Y?

- A** 1 and 2
B 1 and 3
C 3 and 4
D 3 and 5

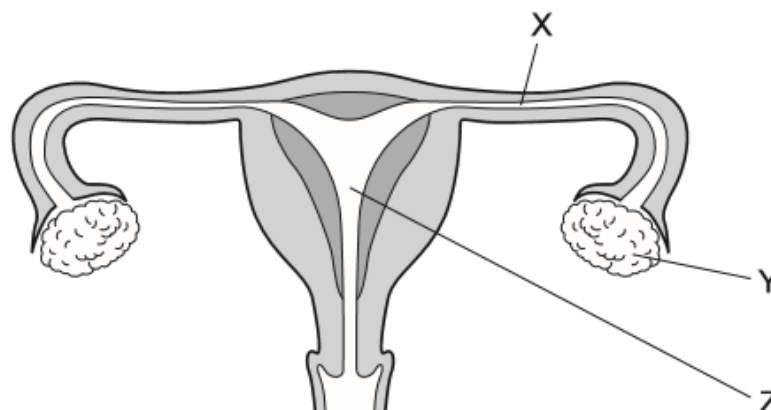
30. Some of the events that occur during sexual reproduction in a flowering plant are listed below:

- 1) Male gamete fuses with the female gamete.
- 2) Growth of pollen tube.
- 3) Pollen grain sticks onto stigma.
- 4) Seed develops inside ovary.
- 5) Generative nucleus divides into two male gametes.

What is the correct order of events?

- first —————> last
- A** 4 2 3 1 5
B 4 3 2 5 1
C 3 2 5 1 4
D 3 1 2 5 4

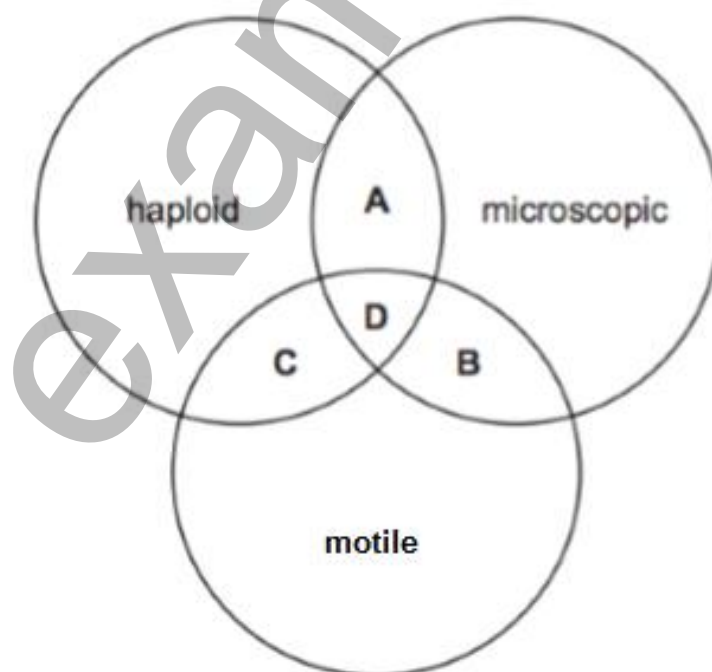
31. The diagram shows a section through the female reproductive system.



Which of the following correctly matches the function of X, Y and Z?

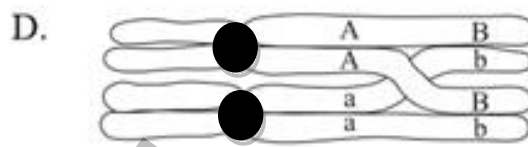
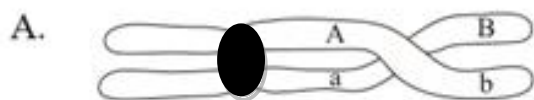
	X	Y	Z
A	cells of embryo undergoes mitosis	haploid gametes can be found	supports the development of embryo
B	supports the development of embryo	cells of embryo undergoes mitosis	diploid zygote formed
C	diploid zygote formed	produce hormones to regulate menstrual cycle	cells of embryo undergoes mitosis
D	haploid gametes can be found	cells of embryo undergoes mitosis	produce hormones to regulate menstrual cycle

32. The diagram represents three properties of male gametes.



Which area describes the male gametes of humans **and** flowering plants?

33. A cell replicates its DNA and then starts to divide by meiosis. What is the expected arrangement of chromosomes if crossing over has taken place between the two genes A and B shown?



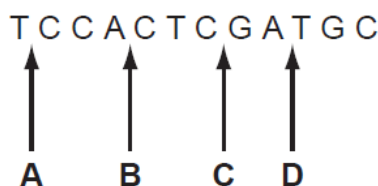
34. A student examined the cells in the growing region of an onion root under the microscope and obtained the data below.

stage	number of cells
interphase	886
prophase	73
metaphase	16
anaphase	14
telophase	11

What is the percentage of cells containing sister chromatids?

- A 7.3%
 B 8.9%
 C 95.9%
 D 97.5%
35. If a polypeptide consists of 240 amino acids, what is the minimum number of nucleotides on the gene to code for it?
- A 80
 B 240
 C 720
 D 1440

36. UAG is a stop codon which terminates the synthesis of a polypeptide. The diagram shows a strand of DNA which codes for four amino acids in a polypeptide.



Where would a mutation that introduces a thymine nucleotide in this DNA template strand result in the termination of transcription?

37. In maize, one allele of a particular gene allows chlorophyll production while the other allele prevents this, giving plants with cream coloured leaves. Chlorophyll production in leaves only starts if seedlings are grown in light.

A batch of seeds were obtained by crossing two heterozygous parents. Half the seeds were sown in trays kept in the dark, while the other half were sown in similar conditions except that they received light.

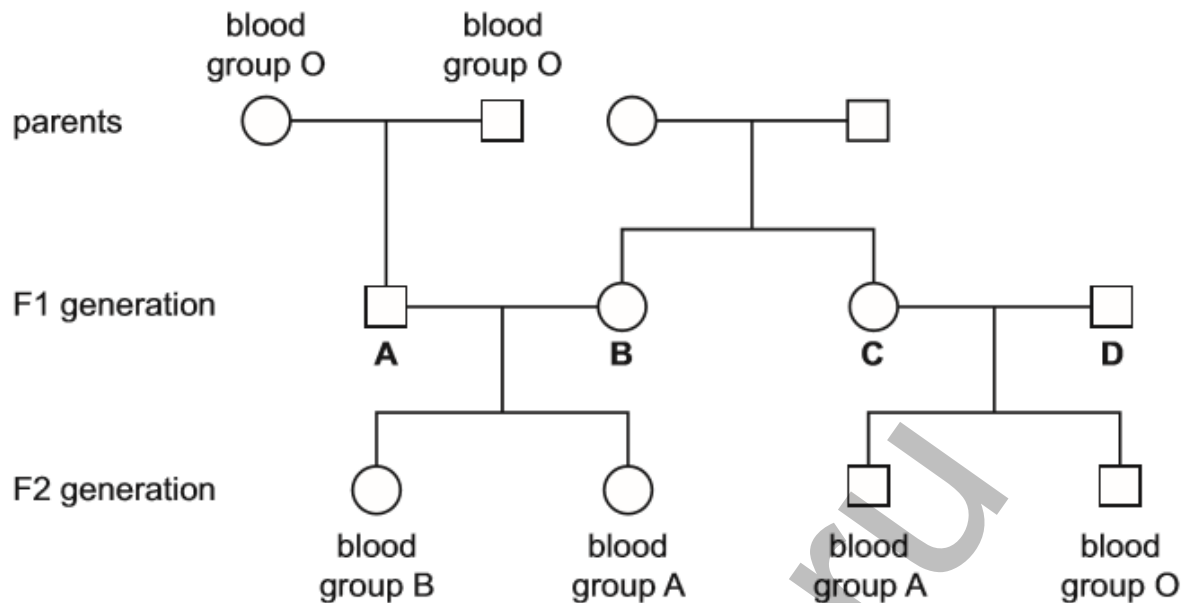
After two weeks, the seedlings were counted and the table gives the results obtained.

number of seedlings			
kept in the dark		kept in the light	
green leaves	cream leaves	green leaves	cream leaves
?	405	320	110

How many of the seedlings that were kept in the dark had green leaves?

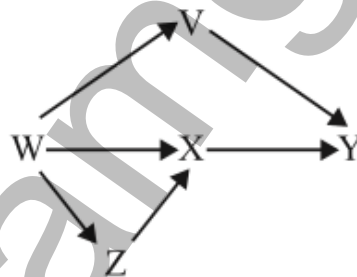
- A 0
- B 320
- C 405
- D 1205

38. The diagram shows the blood group phenotypes of some members of a family.



Which member of the F₁ generation must be heterozygous, containing two codominant alleles?

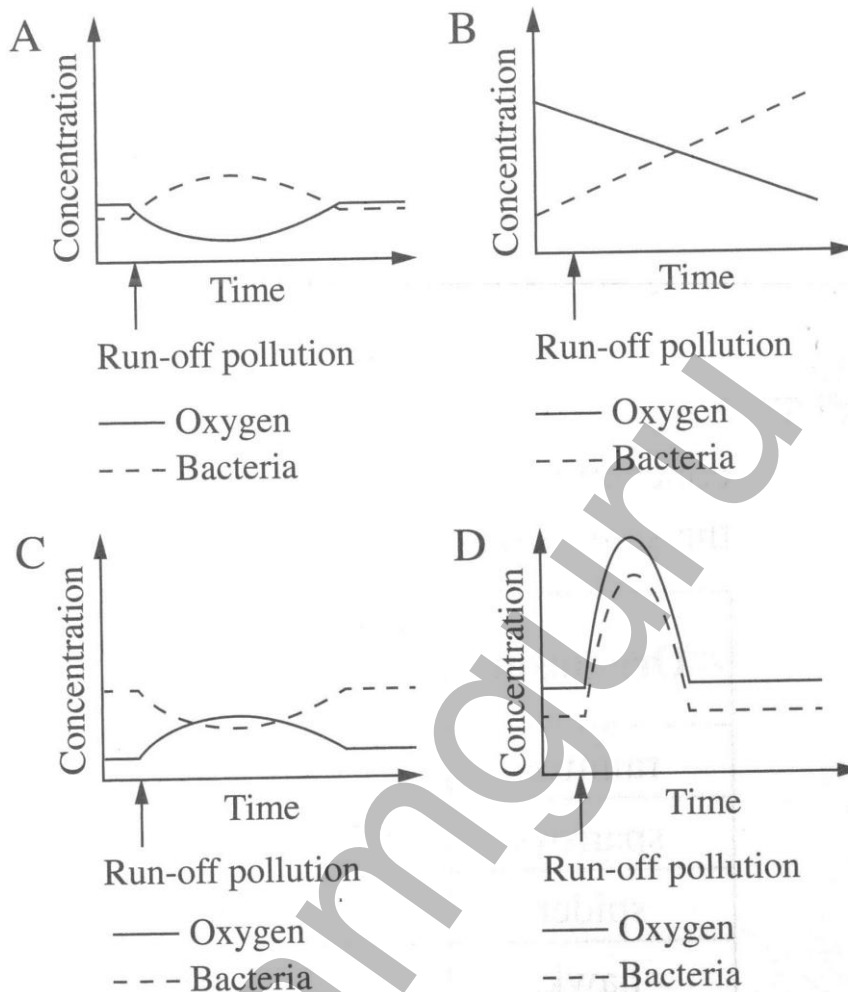
39. The diagram shows food web involving different species of land organisms. Each letter represents a species.



Which is the best prediction about the biomasses of these species measured at a particular point in time?

- A The biomass of V + X + Z is equal to the biomass of W.
- B The biomass of X is less than the biomass of Y.
- C The biomass of X is more than the biomass of W.
- D The biomass of Y is less than the biomass of Z.

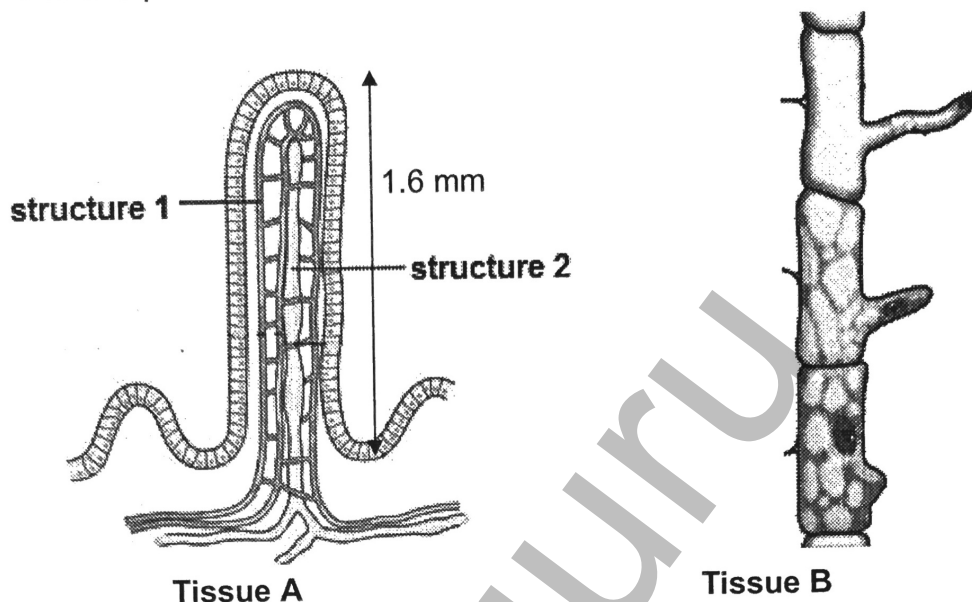
40. Run-off pollution of a particular river resulted from over-use of chemical fertilisers by a nearby farm. Which of the following graphs correctly shows the resulting changes in levels of oxygen and bacteria in this river?



Section A

Answer **all** questions.

- 1 Figure 1 shows two types of tissues that are adapted for their function, one from an animal and the other from a plant.



- a) State one feature that these two tissues have in common and explain how it helps them to carry out their function. [1]

.....

.....

- b) Calculate the magnification of tissue A. Show your working. [1]

X

- c) A student just consumed a serving of fried chicken burger. State the process(es) by which the following substances are transported in structures 1 and 2 in the table below. (Put N.A. if the structure does not transport the substance.) [2]

	structure 1	structure 2
glucose		
amino acids		
fatty acids		

[Total: 4 marks]

- 2 In an experiment to measure the rate of diffusion, a student placed cubes of agar jelly containing an indicator into dilute hydrochloric acid. The indicator changes from pink to colourless in acidic conditions.

The student used cubes of different sizes and recorded the time taken for the pink colour of each cube to disappear completely. The student's results are recorded in Table 2.1.

Table 2.1

length of side of cube (mm)	surface area of cube (mm ²)	volume of cube (mm ³)	surface area to volume ratio	time taken for pink colour to disappear (s)	rate of diffusion (mm/s)
2	24	8	3.0:1	50	0.020
5	150	125	1.2:1	120	0.021
10	600	1 000		300	0.017
20	2 400	8 000	0.3:1	700	0.014
30	5 400	27 000	0.2:1	1 200	0.013

- a) (i) Complete Table 2.1 to show the surface area to volume ratio of the cube with 10 mm sides. [1]

(ii) With reference to Table 2.1, explain the significance of the relationship between the rate of diffusion and the surface area to volume ratio for large plants. [2]

.....

.....

.....

- b) Another student used the same raw data obtained in the experiment but calculated a different rate of diffusion for each cube. This student's results are shown in Table 2.2.

length of side of cube (mm)	time taken for pink colour to disappear (s)	rate of diffusion (mm/s)
2	50	0.040
5	120	0.042
10	300	0.033
20	700	0.029
30	1 200	0.025

Table 2.2

Which method is more accurate? Explain why. [2]

.....

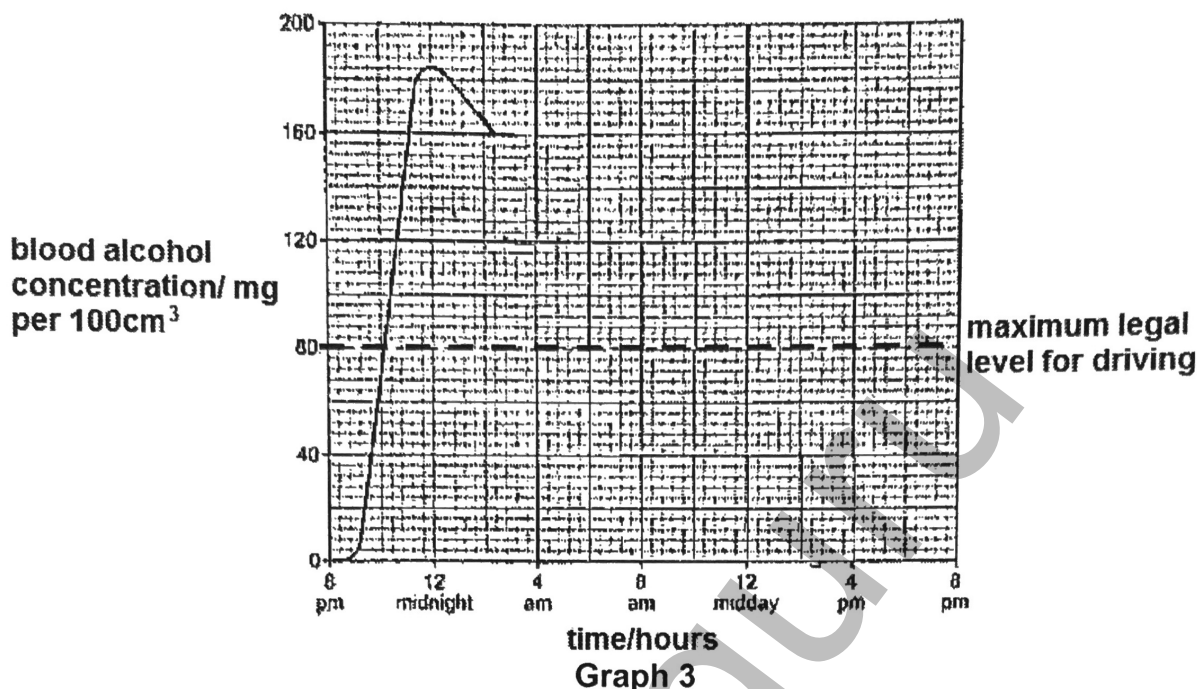
.....

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[Total: 5 marks]

- 3 It is illegal for a person to drive a vehicle with more than 80 mg of alcohol per 100 cm³ of blood.

Graph 3 shows the concentration of alcohol in the blood of a person over a number of hours. During this time, the person had several alcoholic drinks while eating a meal.



- a) Suggest why it is illegal for the person to drive when the person's blood alcohol concentration is above the advisory limit. [1]

.....

.....

- b) Use the graph to determine the highest concentration of alcohol in the person's blood. [1]

..... mg per 100 cm³

- c) Describe the role of liver in the breaking down of alcohol. [2]

.....

.....

.....

- d) Complete Graph 3 by extending the line to predict when the person would be able to legally drive a vehicle again. [1]

.....

[Total: 5 marks]

- 4 Figure 4.1 is a simplified plan of the mammalian circulatory system.

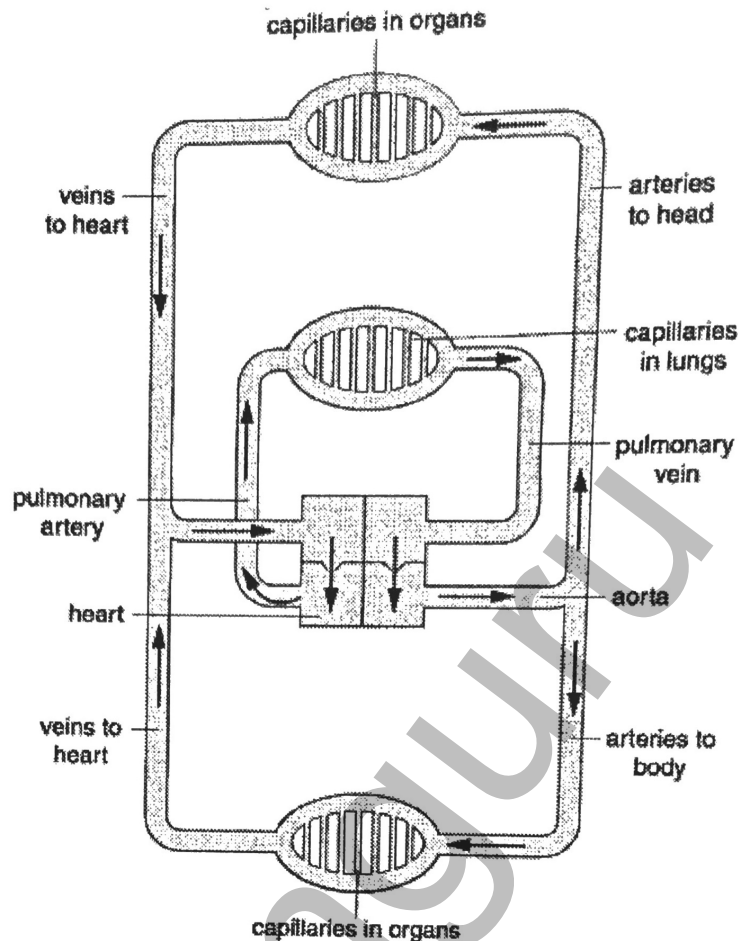


Figure 4.1

- a) With reference to Figure 4.1, describe what is meant by the term *double* [2]
circulation.

.....

.....

.....

- b) Describe and explain how a molecule of oxygen is forced out of the heart and [4]
eventually reaches the liver cells.

.....

.....

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c) Figure 4.2 shows the formation of tissue fluid in a mammal.

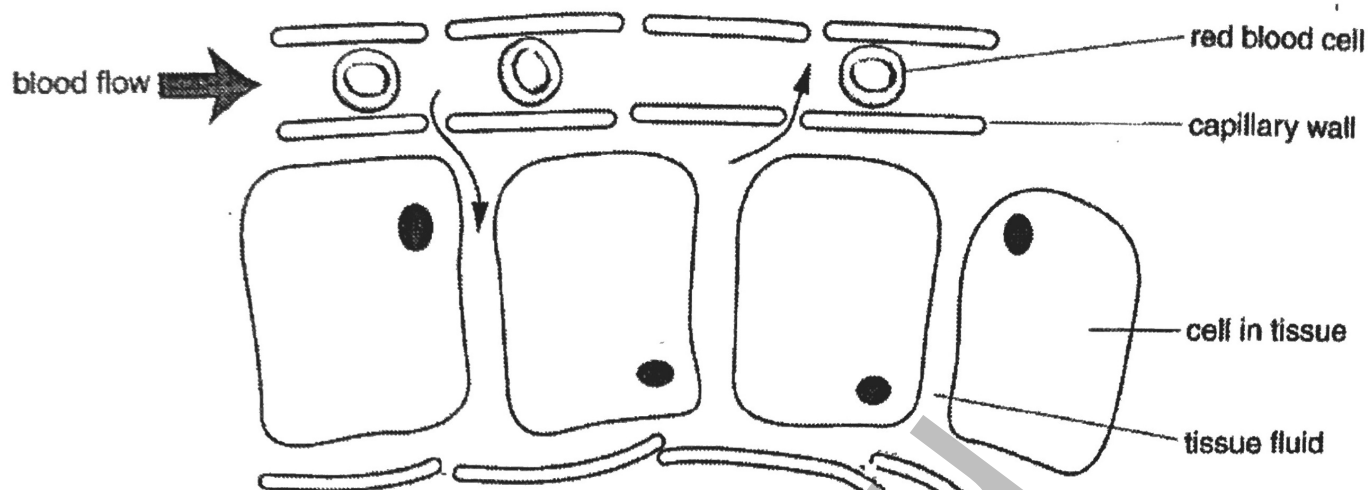


Figure 4.2

(i) State two differences between the composition of tissue fluid and blood. [2]

1.

.....

2.

.....

(ii) Describe the formation of tissue fluid. [1]

.....

.....

[Total: 9 marks]

- 5 Figure 5.1 shows the mammalian respiratory system and Figure 5.2 shows the cross-section taken through line XY.

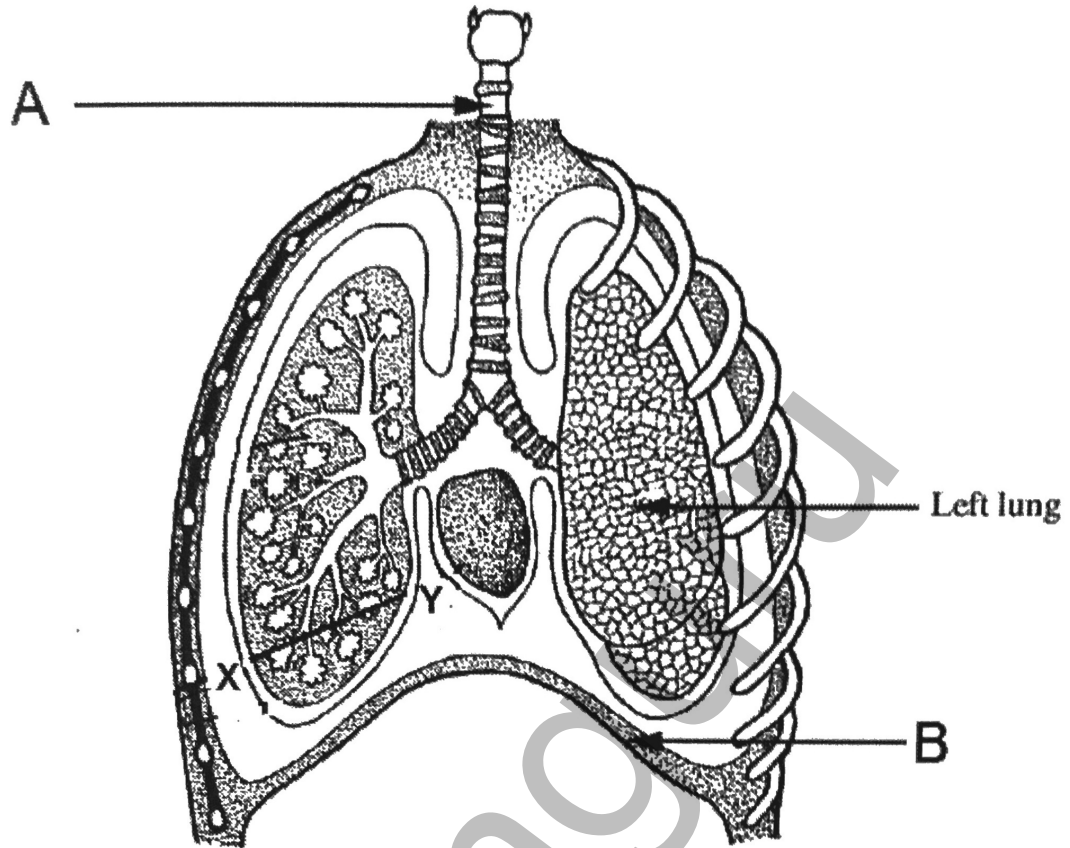


Figure 5.1

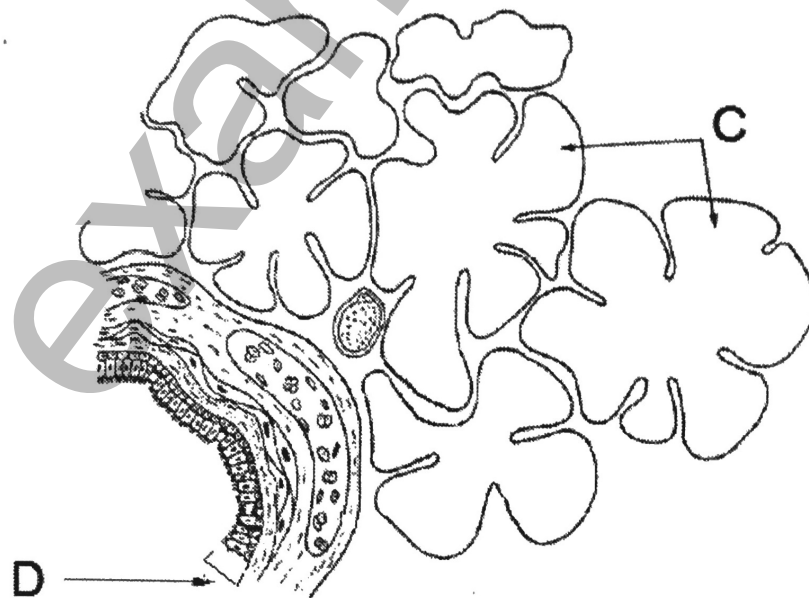


Figure 5.2

- a) Name structures A and B.

[1]

A:

B:

- b) (i) Describe how structure **C** will appear in a person suffering from emphysema [2] and explain how this will affect the breathing of the person.

.....

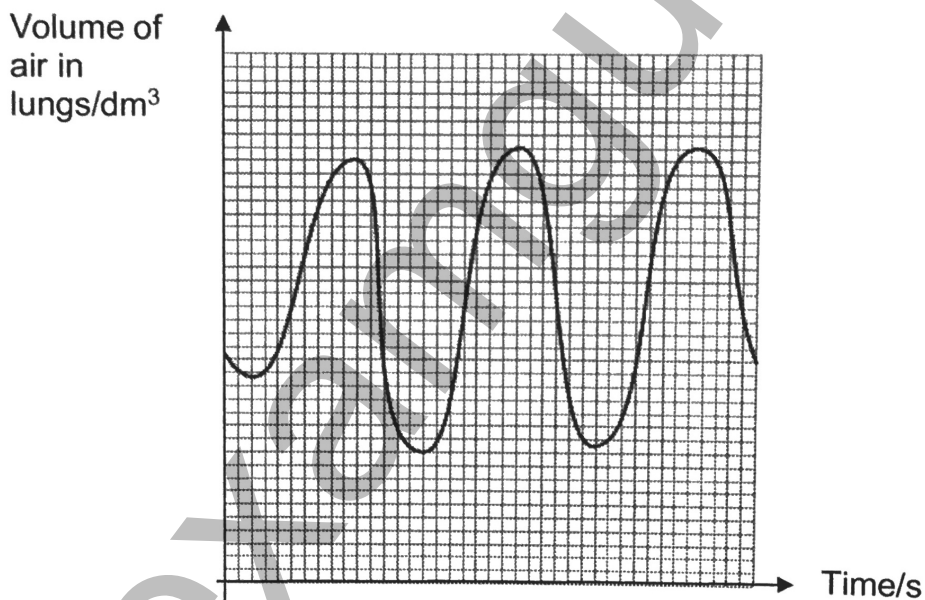
.....

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.....

- (ii) A spirometer can be used to trace the movements of air during breathing. The [1] graph below shows the spirometer trace of a normal person at rest.

Draw the spirometer trace obtained from a person with emphysema in the grid below.



- c) Structure **D** is affected by a major component of tobacco smoke. Identify the [2] component and explain how it affects the normal functioning of **D**.

.....

.....

.....

.....

[Total: 6 marks]

- 6 Figure 6.1 shows the percentage composition of solutes in fluid samples P and Q taken from two sites of the human nephron.

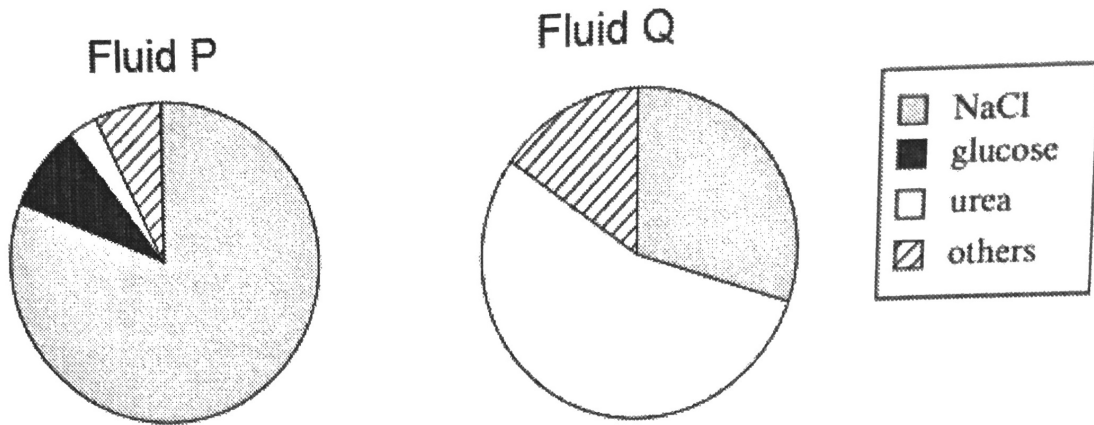


Figure 6.1

- a) (i) Name fluids P and Q.

[1]

Fluid P:

Fluid Q:

- (ii) Explain the difference in percentage of glucose in fluids P and Q as shown in Figure 6.1. [2]

.....

.....

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.....

- b) Patients with kidney failure have to go for weekly dialysis treatment.

Figure 6.2 outlines the procedure of dialysis.

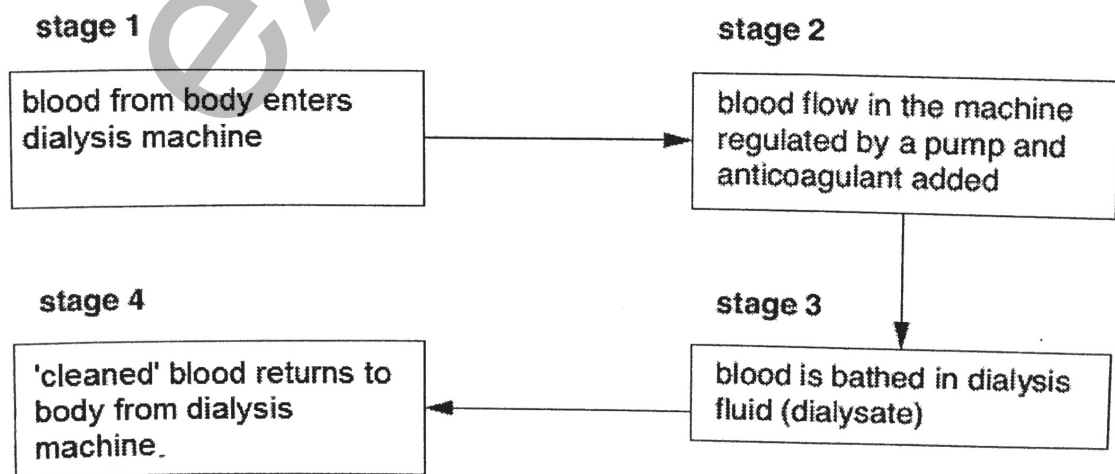


Figure 6.2

Figure 6.3 shows further details of how stage 3 is achieved.

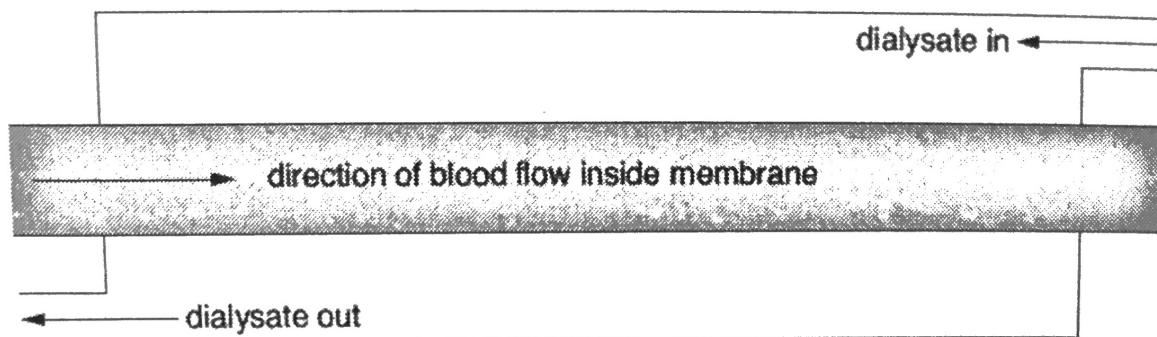


Figure 6.3

(i) Suggest why it is necessary to add an anticoagulant to the blood in stage 2. [1]

.....

(ii) Explain how the dialysis machine ensures that 'cleaned' blood returns to the body. [2]

.....

[Total: 6 marks]

7 In maize, wind pollination occurs. An investigation was carried out to find out how the length of time that maize pollen is in the air affects its ability to bring about fertilisation in a female flower.

1. Pollen grains were removed from maize flowers and left exposed to the air for varying amounts of times.
2. The pollen grains were then placed onto groups of female flowers in another plot of land in the farm.
3. The groups of fertilised flowers developed into 'ears', each containing many seeds. The number of seeds per ear was counted.

a) (i) Identify the type of pollination described. Explain your answer. [1]

.....

(ii) Explain why the type of pollination stated in (i) is more beneficial to maize. [2]

.....

- b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize as shown in Figure 7. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

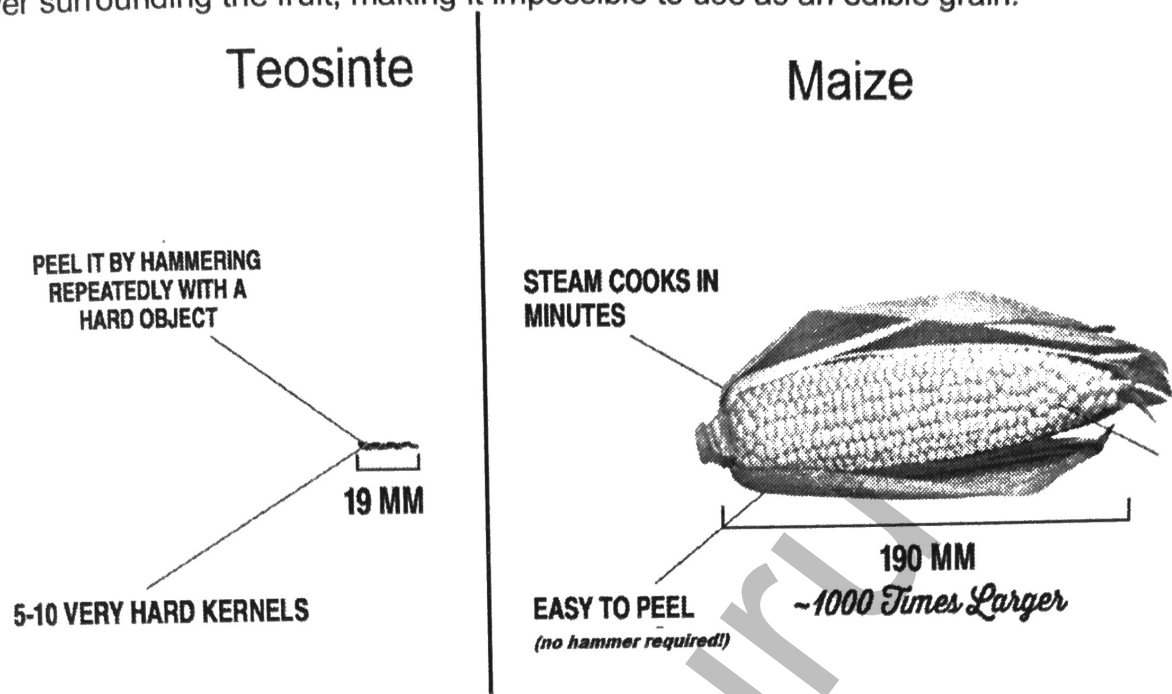


Figure 7

- (i) Describe how farmers can use artificial selection to produce maize from [2] teosinte.

.....

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.....

- (ii) A gene on chromosome 4, *tga 1*, was found to be responsible for all the structural differences between teosinte and maize. The DNA sequence is shown below:

teosinte	GAT	TGG	GAT	CTC	AAG	GCG	GCG	GGC	GCG	TGG
maize	GAT	TGG	GAT	CTC	AAC	GCG	GCG	GGC	GCG	TGG

- Suggest how the difference in the *tga 1* gene could cause large differences in [2] phenotype between teosinte and maize.

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[Total: 7 marks]

- 8 Male and female ants of a species of Australian ant, *Myrmecia pilosula*, have different number of chromosomes in each of their cells. Female ants are diploid, while males are haploid.

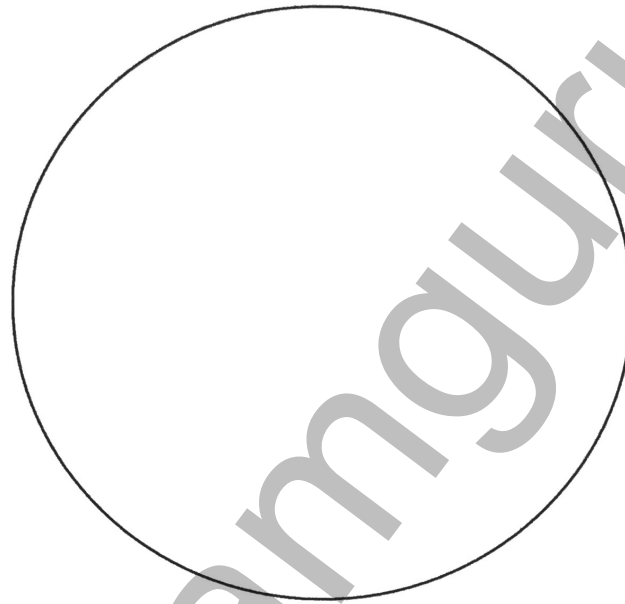
a) Define the term *diploid*.

[1]

.....

.....

- b) In the cell outline provided below, make a labelled drawing to show the appearance of a female ant cell at anaphase I of meiosis (Assume there are two chromosomes in the sperm cell of the male ant). [2]



- c) Figure 8.1 shows the events that take place in a body cell of a female ant.

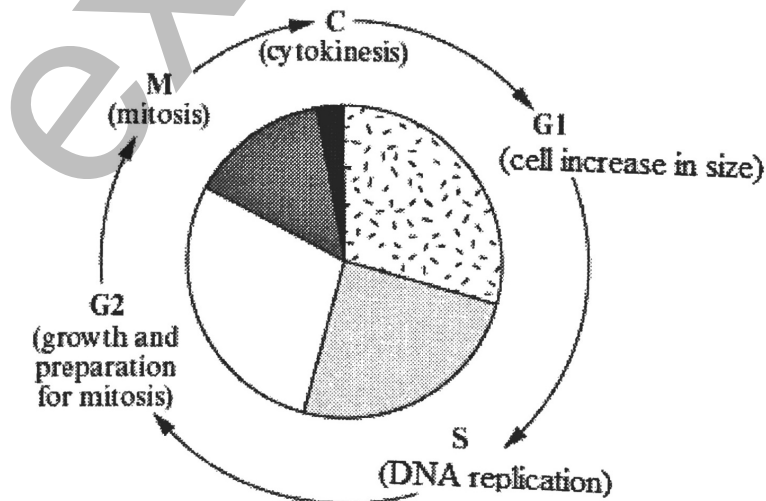


Figure 8.1

Table 8.2 shows the DNA content of a cell measured during one cell cycle.

Table 8.2	
stage	DNA content of cell/arbitrary units
	2x
G1	
S	
G2	
M	
C	

Complete Table 8.2 to determine the DNA content at different stages of the cell cycle. [2]

- d) During mating, the queen ant collects sperm cells from male ants, which she stores in an organ. The haploid egg cells from the queen's ovaries pass by the organ as they are laid. Some eggs are fertilised as they pass out, while others pass out unfertilised.

- (i) Suggest how ants that develop from fertilised egg cells differ from the ants that develop from unfertilised egg cells. [1]

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- (ii) Explain the significance of the queen ant producing haploid egg cells. [2]

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[Total: 8 marks]

Section B

Answer **three** questions. Question **11** is in the form of an **Either/Or** question. Only one part should be answered.

- 9 An investigation into feeding relationships in a forest community was carried out using radioactively labelled phosphorus (^{32}P). A solution containing ^{32}P phosphate ions was supplied to a plant using a stem well.

Figure 9.1 shows a vertical section through a stem well.

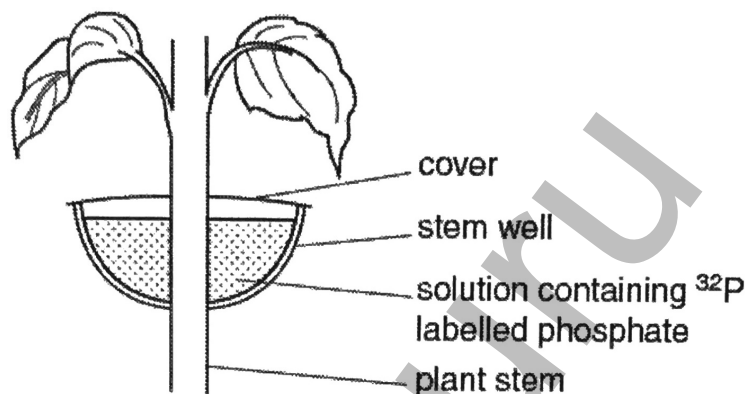
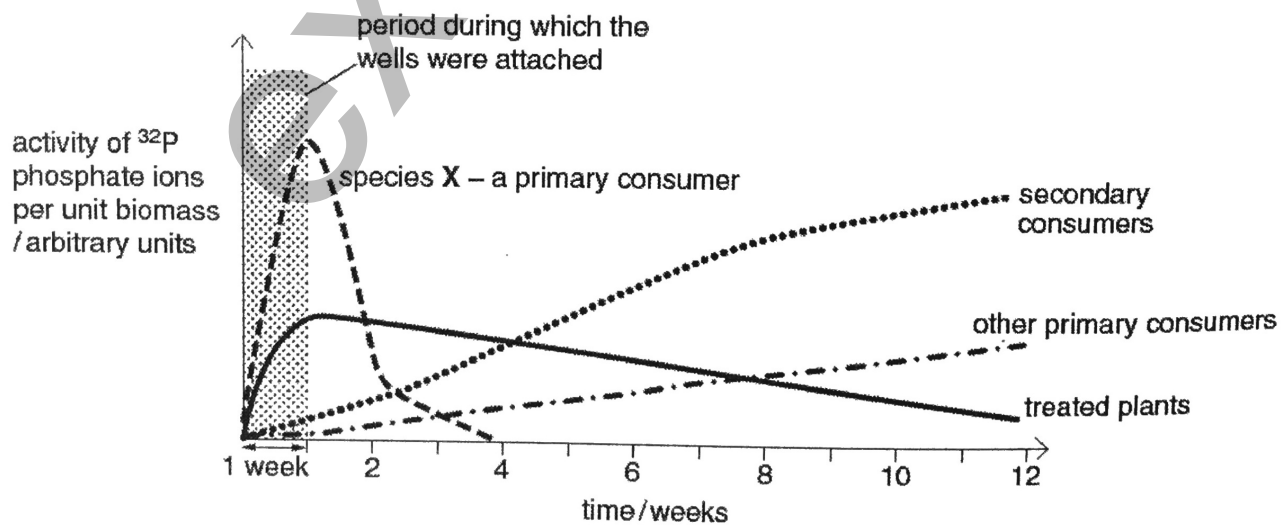


Figure 9.1

- Stem wells were used to supply 200 individual plants in the community with a solution containing ^{32}P phosphate ions.
- The stem wells were left at the same place for one week and then removed.
- At intervals during the first week and for a further 11 weeks after the wells were removed, tissue samples were taken from the plants and from other members of the community.
- The activity of ^{32}P phosphate ions per unit biomass was measured in each sample.

Graph 9.2 shows the results of this investigation.



Graph 9.2

a) Identify two variables that should be kept constant in this investigation. [1]

1.

2.

b) Define the term *consumer*. [1]

.....

.....

c) With reference to Graph 9.2, describe and explain the level of activity of ^{32}P phosphate ions observed in the four populations of organisms. [6]

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d) Describe how processes that occur in a green leaf play a part in the carbon cycle. [3]

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[Total:11 marks]

- 10 The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK. This is shown in Figure 10.1.

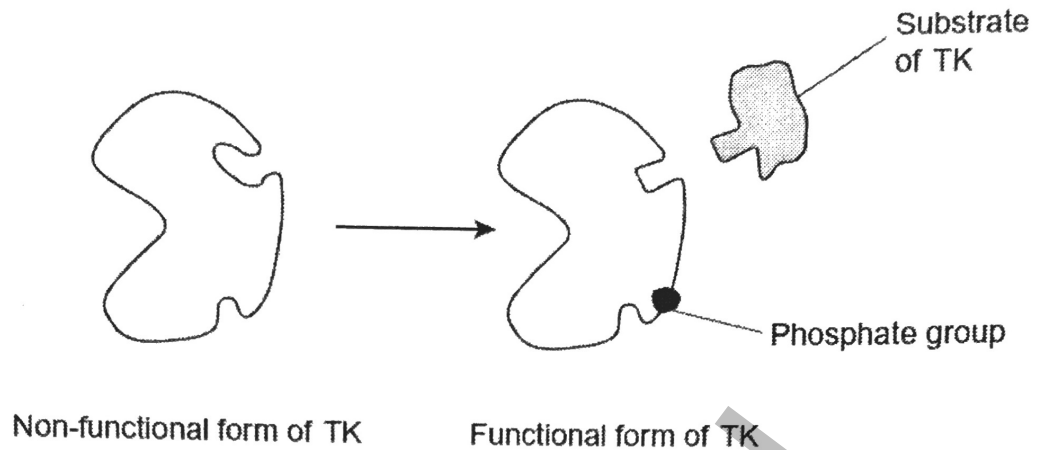


Figure 10.1

- a) Based on Figure 10.1, explain how the activation of TK is regulated in human cells. [3]

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- b) The binding of the functional form of TK to its substrate leads to cell division. In chronic myeloid leukaemia, a faulty form of TK is produced. Figure 10.2 shows the faulty form of TK.



Faulty form of TK

Figure 10.2

Suggest how faulty TK leads to chronic myeloid leukemia.

[2]

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- c) Imatinib is a drug used to treat chronic myeloid leukemia. Figure 10.3 shows how Imatinib inhibits faulty TK. [4]

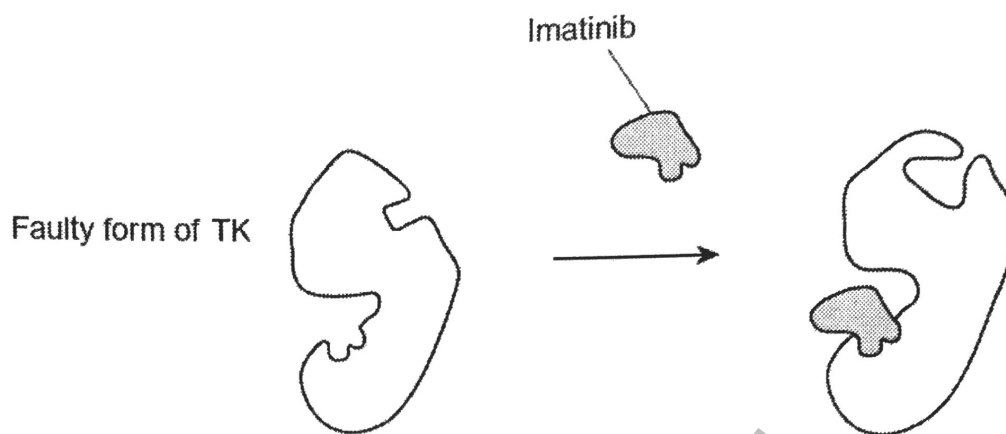
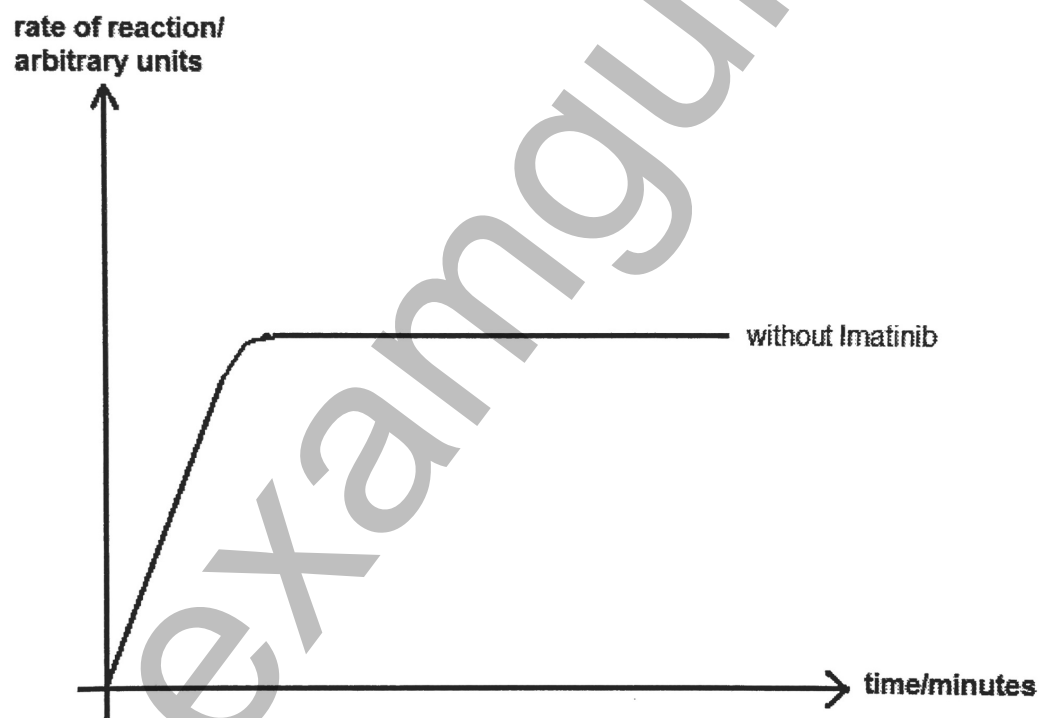


Figure 10.3

Sketch on the axes below a labelled graph how the rate of reaction will be with Imatinib added.



Explain how Imatinib can be used to treat chronic myeloid leukemia.

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[Total: 9 marks]

Either

11 a) A student used the set-up shown in Figure 11 to estimate the rate of transpiration in a leafy shoot.

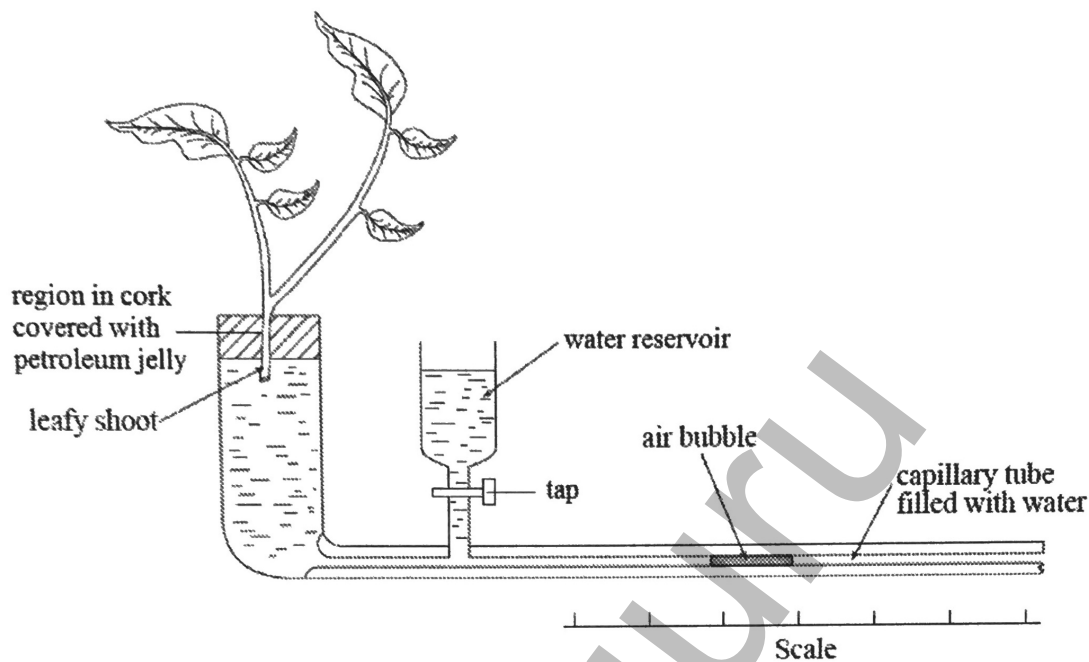


Figure 11

Describe and explain how you would use the experimental set-up to measure the [5]
effect of air movement on transpiration rate of the plant.

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- b) Describe how the structures within a leaf are adapted for photosynthesis. [5]

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[Total:10 marks]

Or

- 11 a) *David enters the forest wearing only shorts and a sleeveless shirt when the air temperature is below 10 °C.* [4]

Explain, with reference to the principles of homeostasis, how his body will respond.

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- b) *David spots a hungry bear standing five meters in front of him and his heart beats faster.* [6]

Describe the nervous pathway that resulted in his response.

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[Total:10 marks]

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**G CHIJ St. Nicholas Girls' School
2016 Secondary 4 (O Level) Biology Prelim
Marking Scheme and Markers' Report**

General Comments

Generally, candidates who attempted the Either question performed better with a handful of candidates scoring close to full marks. Most students did not perform well for this exams. Answers generally lacked details and precision.

Paper 1 (40 marks)

Question	1	2	3	4	5	6	7	8	9	10
Answer	D	A	B	D	C	C	B	A	B	B

Question	11	12	13	14	15	16	17	18	19	20
Answer	B	A	A	A	D	D	C	B	B	A

Question	21	22	23	24	25	26	27	28	29	30
Answer	B	D	A	C	A	D	B	C	B	C

Question	31	32	33	34	35	36	37	38	39	40
Answer	A / C	A	D	B	D	B	A	B	D	A

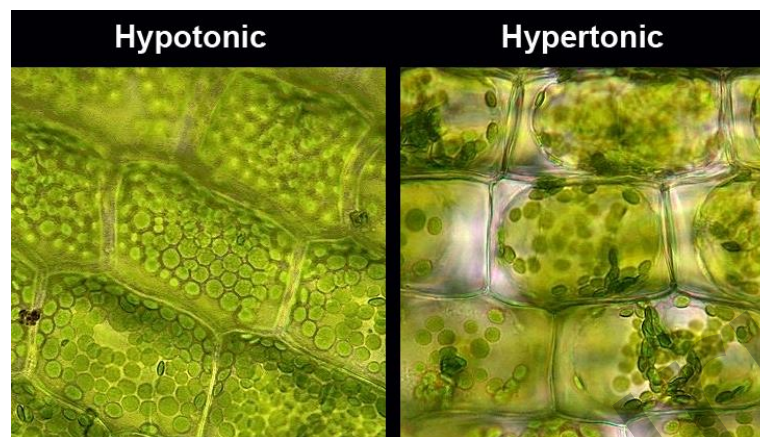
Comments on MCQ

Question 4

77% of candidates got this question incorrect. Most candidates chose distractor A instead of answer D.

Candidates showed understanding that the vacuole will decrease in size due to the movement of water out of the cell by osmosis.

However, they were careless and failed to identify the slight change in shape in the cell wall due to the shrinkage of the cytoplasm.



Question 5

57% of candidates got this question incorrect. Most candidates chose distractor A instead of answer C. Candidates failed to recognise water as the main constituent of the amniotic fluid, which provides protection to a growing foetus.

Question 11

Many candidates chose options A and C instead of answer B.

From the graph, the % of stomata that are open varies with changes in light intensity throughout 24 hours in a day. No information on temperature is given. With the graph being higher during daytime and higher % of stomata are open, it can be deduced that transpiration occurs at a higher rate. It also cannot be deduced from the graph that photosynthesis only occurs in light because in darkness, there are still gases present within the intercellular air spaces.

Question 12

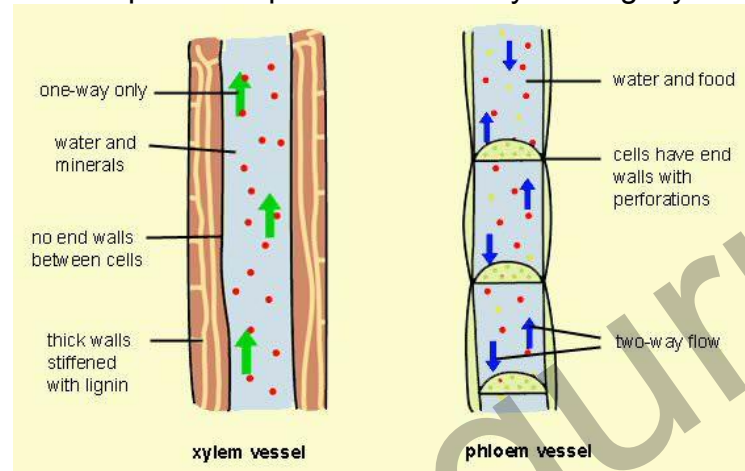
44% of candidates chose distractor D instead of answer A.

While candidates understand that light intensity was the limiting factor at the start of the graph, they failed to understand that for graph of Y, they will have to compare it with the graph below and the difference in carbon dioxide concentration indicates that it is the change in that condition that results in a higher rate in graph of Y.

Question 14

55% of candidates chose distractor C instead of answer A.

Candidates wrongly identified the cells as the sides as sieve tube cells and wrongly deduced the vessel to be the phloem. Candidates should be able to recognise the shape of companion cells. They are slightly flattened and tapered at ends.

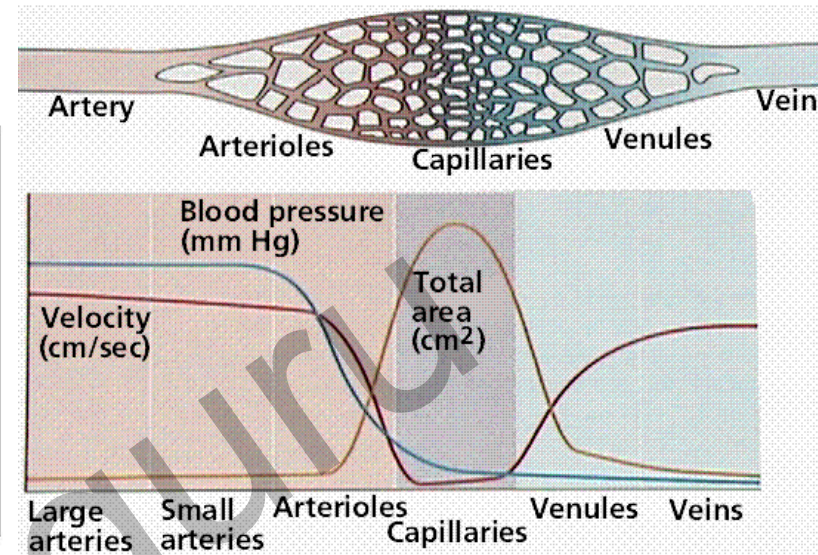
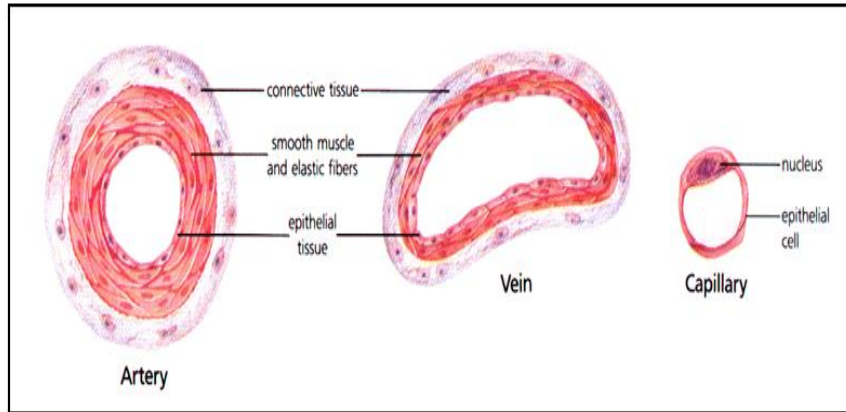


Question 15

65% of candidates got this question incorrect. Most candidates chose distractor C instead of answer D.

Candidates failed to recognise that the layer of smooth muscles is much thinner in vein, resulting in a thin wall in veins. Velocity of blood in the vein is also quite high.

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Question 16

25% of the candidates chose distractor C instead of answer D.

Candidates did not recognise that the pulmonary artery, which usually transports deoxygenated blood from right of heart to lung, will receive oxygenated from the left atrium due to ASD.

Question 17

40% of the candidates chose distractor A instead of answer C.

Student did not remember that the stimulus for breathing is the need to remove carbon dioxide, a byproduct of cellular respiration. Thus, a rise in carbon dioxide concentration in the blood leads to an increase in breathing rate.

Question 20

33% of the candidates chose distractor C instead of answer A.

Candidates did not recognise that ADH is secreted by the hypothalamus, which is also the receptor for the stimulus (change in blood water potential).

Question 27

35% of candidates chose distractor A instead of answer B.

Candidates know that Hormone X is insulin. But between 9-10am when blood glucose concentration is low and insulin is not needed, it cannot be assumed that the concentration of insulin is absolute zero in the blood.

Question 34

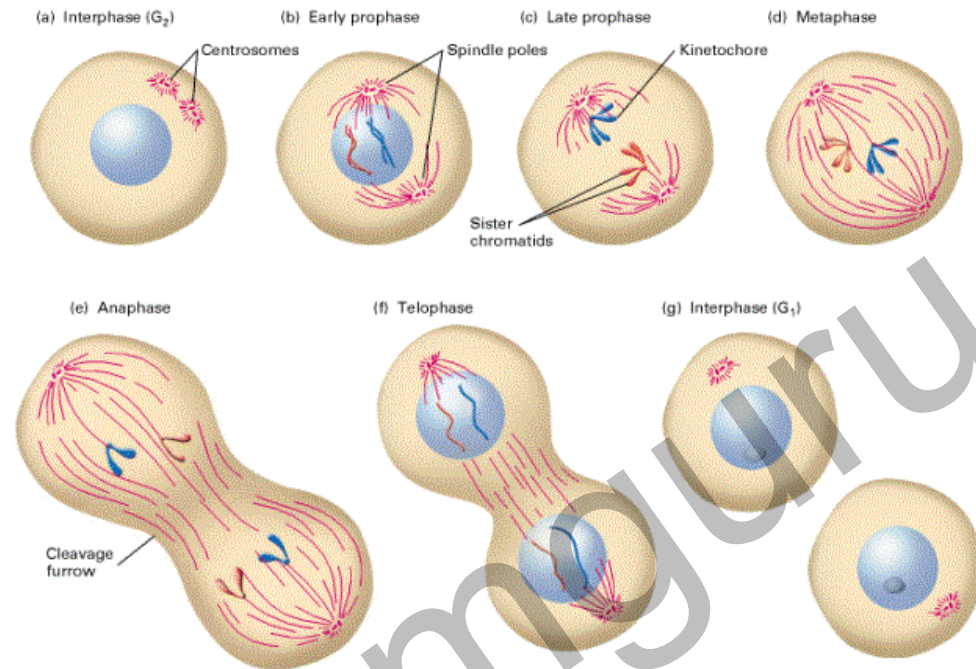
46% of the candidates got this incorrect. Many candidates chose distractor D instead of answer B.

Cells which are not dividing (highest number in root) are in interphase, the resting phase. Only when cells are ready to undergo nuclear division, DNA replication occurs, forming sister chromatids. Hence, sister chromatids, which are 2 identical DNA strands joined at the centromere, are only present during Prophase and Metaphase, before they are separated to form individual daughter chromosomes when the centromere separates in anaphase.

$$73 + 16 = 89$$

$$89/1000 \times 100\% = 8.9\%$$

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Question 35

Most candidates chose distractor C instead of answer D.

Candidates did not remember that a gene is a **double-stranded segment of DNA**.

240 amino acids x 3 nucleotides in a codon = 720 nucleotides in mRNA strand = 720 nucleotides in DNA template strand
 720 x 2 = 1440 nucleotides (or 720 base-pairs) in gene

Paper 2
Section A (80 marks)

Qn	Answer	Marks	Markers' Report												
1(a)	Long and narrow protrusion/extension; To increase <u>surface area to volume ratio</u> for <u>absorption/diffusion</u> ;	[1] 0.5m each	Function is not for exchange of substances												
1(b)	51/1.6= x31.9	[1]	Many candidates do not know that 1cm = 10mm												
1(c)	<table><tr><td></td><td>Structure 1</td><td>Structure 2</td></tr><tr><td>glucose</td><td>Diffusion and active transport</td><td>NA</td></tr><tr><td>Amino acids</td><td>Diffusion and active transport</td><td>NA</td></tr><tr><td>Fatty acids</td><td>NA</td><td>diffusion</td></tr></table>		Structure 1	Structure 2	glucose	Diffusion and active transport	NA	Amino acids	Diffusion and active transport	NA	Fatty acids	NA	diffusion	[2]	Any mistakes minus 0.5m
	Structure 1	Structure 2													
glucose	Diffusion and active transport	NA													
Amino acids	Diffusion and active transport	NA													
Fatty acids	NA	diffusion													
2(ai)	0.6:1	[1]													
2(aii)	As SA:VOL ratio decreases rate of diffusion decreases (or vice versa); Use figures with correct units (mms-1 for rate) to illustrate trend; The larger the plant, the lower the SA:V ratio; Plants cannot rely on diffusion to absorb nutrients (will require to carry out active transport)	[2] 0.5m each													
2(b)	First student's answer; The student considered the SA:V ratio than the length of the cube only.	[2] 1m each	Also accepted: The first student divided the answer by 2 as distance has to be to centre of cube rather than whole length of side/ Student assumed diffusion occurs (across whole cube) from whole length of one side;												

Qn	Answer	Marks	Markers' Report
3(a)	Blurred vision/delayed speed of reaction/increased reaction time/impaired judgement/slower reflex actions	[1]	Any one
3(b)	184mg per 100cm ³	[1]	
3(c)	Alcohol dehydrogenase produced by the liver; Will catalyse; the breakdown of alcohol into acetaldehyde; then further into compounds used for respiration	[2] 0.5m each	
3(d)	Extend line using ruler until it reaches the dotted line; Read off time on dotted line	[1] 0.5m each	Ideal answer: 9.12am Each small box is 24 minutes
4(a)	Double circulation means blood passes through the heart <u>twice in one circulation</u> ; Pulmonary circulation and systemic circulation; blood flows out through pulmonary artery to capillaries in lungs; blood flows out through aorta to arteries to body and returns to heart through veins;	[2] 0.5m each	In description, reference must be made to Figure 4.1 – at least 1 part of circulatory system from the figure must be explicitly named Need to mention that blood from capillaries flows <u>back to the heart</u>
4(b)	Oxygen molecules combine with haemoglobin in <u>red blood cells</u> ; To form <u>oxyhaemoglobin</u> ; When <u>muscles</u> in wall of left ventricle; <u>contract</u> / undergo <u>ventricular systole</u> ; The pressure in the left ventricle <u>increases</u> ; and becomes <u>higher than aorta</u> ; <u>aortic valve opens</u> ; (semilunar valve – 0m) blood flows through <u>hepatic artery</u> to liver; oxygen in blood <u>diffuses</u> ; from red blood cell into plasma into tissue fluid and into liver cells;	[Max 4] 0.5m each	Description should only start from point at which oxygen is forced out of left ventricle of the heart, and not from left atrium / lungs.

Qn	Answer		Marks	Markers' Report
4(ci)	tissue fluid	blood	[2] 1m each	complete point to point comparison: 1m *Note: tissue fluid is not plasma; plasma relates to the liquid component of blood, while tissue fluid refers to that outside the blood vessels and surrounding tissue cells.
	only phagocytes present	presence of blood cells e.g. RBC and WBC (lymphocytes)		
	absence of plasma proteins	presence of plasma proteins		
4(cii)	Higher pressure at arterial end; forces blood plasma out through capillary wall;		[1] 0.5m each	
5(a)	A: trachea/windpipe B: diaphragm		[1] 0.5m each	wrong spelling 0m
5(bi)	partition walls between alveoli (C) will break down; decreased surface area for gaseous exchange; lungs lose elasticity and becomes inflated with air; person will suffer from wheezing and breathlessness/ have difficulty breathing		[2] 0.5m each	
5(bii)	- more than 3 breaths taken; - each breath is shallower		[1]	Since lungs are inflated with air, the starting volume of air in the lungs should be higher than normal.
5(c)	Tar/Irritants; paralyse cilia found on D (epithelium); dust particles trapped in the mucus cannot be removed; block airways		[2] 0.5m each	D is not the cilia.
6(ai)	Fluid P: glomerular filtrate Fluid Q: urine		[1] 0.5m each	Many candidates fail to understand requirement of question and name the part of nephron or sweat.

Qn	Answer	Marks	Markers' Report
6(aii)	glucose present in fluid P because it is a small; <u>molecule</u> ; will be <u>forced</u> out during ultra filtration; no glucose in fluid Q because they have been selectively reabsorbed ;	[2] 0.5m each	Many candidates gave long-winded answers about the other components in the filtrate while missing out on GLUCOSE.
6(bi)	to prevent blood from clotting/coagulating Any reference to agglutination/ RBC clumping – 0m	[1]	Agglutination occurs in presence of antibodies; not applicable in this situation
6(biii)	dialysate <u>does not contain</u> any metabolic waste products; dialysate flow is opposite direction of blood flow; to generate a steep concentration gradient; ensure <u>faster diffusion</u> of waste products; tubing is long and coiled; increase SA:V ratio for the fast diffusion of waste products; tubing is partially-permeable; to retain large molecules, only allowing small waste products to diffuse out	[2] 0.5m each	Function of dialysis is to remove urea from the blood, not to replenish lost mineral salts, hence focus should not be on salt concentration. If partially-permeable property mentioned then focus should be on the fact that it retains large molecules and allows only small molecules to diffuse out
7(ai)	Cross pollination; because from different plant/ different plot of land	[1]	Some candidates were careless and stated wind/insect pollination, which is the MODE of pollination.
7(aii)	offspring produced may have inherited beneficial qualities from <u>both</u> parents [1] more varieties of offspring can be produced/more genetic variation; hence greater chance of survival in the event of changes in environment/ better adapted in changing environment;	[2] 0.5m each	

Qn	Answer	Marks	Markers' Report
7(bi)	Selective breeding/pollinate/cross breed/hybridise; Select teosinte plants <u>with softer and more kernels/larger fruits</u> ; Select plants with more and softer kernels and larger fruits; <u>Repeat breeding and selection process many times</u> to cross pollinate to produce maize;	[2] 0.5m each	Many candidates still unsure how to carry out selective breeding; teosinte is the ANCESTOR of maize, it is impossible to cross-breed maize with teosinte. Also there is no genetic engineering involved.
7(bii)	difference in sequence of 5 th codon (AAG → AAC); different mRNA sequence produced/state mRNA sequence; which will code for a different polypeptide/ different amino acid added; and hence different function of protein	[2] 0.5m each	Many candidates still make the mistake of saying that amino acids are made in the cell instead of being added to the growing polypeptide. Also they failed to link the structure of protein produced to their function.
8(a)	Having 2 sets of chromosomes; each set inherited from one parent;	[1] 0.5m each	
8(b)	- 4 chromosomes - colour one set of chromosomes to denote paternal/maternal - chromosome made up of 2 sister chromatids - spindle fibre attached to centromere - daughter chromosomes moving to opposite poles (anaphase) - show at least one event of crossing over	[2]	any mistakes -0.5m

Qn	Answer		Marks	Markers' Report
8(c)	Stage	DNA content of cell/arbitrary units	[2] 0.5m each	
	G1			
	S	4x		
	G2	4x		
	M	4x		
	C	2x		
8(di)	Fertilised eggs (diploid) will develop into females, unfertilised eggs (haploid) into males;		[1] 0.5m each	Many candidates did not read the question and context. The male ants will not be genetically identical to the Queen ant because it is haploid.
8(dii)	<u>reduction</u> division/halving number of chromosomes prior to fertilisation; ensure that zygote formed is diploid; prevent doubling of number of chromosomes with each successive generation; genetic variation		[2] 0.5m each	

Section B (30 marks)

Qn	Answer	Marks	Markers' Report
9(a)	Time for which ^{32}P is supplied; Total time of experiment; Duration of sampling intervals; Type / species / similar plant; Concentration of ^{32}P ; All organisms sampled at the same time / same mass; Position/size of stem wells; Volume/concentration of solution; Location / temperature / light / CO_2 / other viable answers	[1] 0.5m each	Mass of soil given to plant – 0m as plants were already growing in forest
9(b)	organisms that <u>feed on other organisms</u> to obtain energy	[1]	Feed on producers/plants – 0m
9(c)	<u>Plants</u> Radioactivity in treated plants <u>increased in week 1 then decreases gradually</u> ; plants <u>make use of ^{32}P to make amino acids/proteins</u> , causing the increase; after week 1, <u>new proteins made by plants no longer contain ^{32}P</u> , which causes the decrease; <u>Species X</u> level of radioactivity <u>increased during week 1, then steeply decreases until 0 at week 4</u> ; As <u>Species X mainly feeds on the species of plant in the experiment</u> ; hence ^{32}P <u>bioaccumulates</u> within Species X to cause the increase; <u>Species X may be eaten by secondary consumers</u> , while <u>new offspring of Species X do not contain ^{32}P</u> , causing the	[6] 0.5m each	All 4 populations of organisms should be mentioned in answer: 2m – description of graph for each organism 4m – explanation of what causes the changes

Qn	Answer	Marks	Markers' Report
	decrease; <u>Other primary consumers</u> ³²P in other primary consumers <u>increases more slowly/gradually</u> than Species X; Because <u>they have food sources other than the plant species in the experiment</u>; <u>Secondary consumers</u> Shows a <u>gradual increase</u> in ³²P as compared to the primary consumers; Due to <u>bioamplification</u>; <u>as they feed on the primary consumers</u>, their level of ³²P increases;		
9(d)	During <u>photosynthesis</u>; The leaf uses the carbon atoms from <u>carbon dioxide</u>; To <u>produce glucose</u>; Which is then used in <u>respiration</u>; Which <u>releases carbon dioxide</u> into the <u>atmosphere</u>; Glucose is also <u>passed on to consumers which feed on the plant</u>; Carbon in the plant is also <u>turned into fossil fuels (coal)</u>; during the process of <u>fossilisation</u>;	[Max 3] 0.5m each	Processes should be named, i.e. photosynthesis, respiration, feeding/consumption, fossilisation.
10(a)	When body needs the functional TK; Phosphate binds to a site away from the active site; Changes the shape of active site; Causes the non-functional TK to become functional/activated; Causes the active site to be <u>complementary</u> to the substrate; Substrate can bind to active site/enzyme-substrate complex formed.	[3] 0.5m each	

Qn	Answer	Marks	Markers' Report
10(b)	Faulty TK's active has the same shape as the functional form of TK; It is always/constantly active [1] ; Cell division occurs uncontrollably. (leading to leukemia, which is a type of cancer)	[2]	
10(c)	Graph should be slower and max lower than without imatinib [1] Imatinib binds to a site away from the active site; Changes the shape of active site; Active site no longer complementary to substrate; Substrate cannot bind to active site; Less TK/active site available/enzyme-substrate complexes formed decreases; Less products formed/rate of reaction decreases.	[4] 0.5m each	Imatinib inhibits faulty TK [0.5]
E11(a)	insert a leafy shoot through the hole in the cork of the potometer; petroleum jelly around the region of shoot that passes through the cork makes the apparatus airtight and waterproof; have two setups, one with fan (air movement), one without fan (no air movement); record the distance that the air bubble has moved using the <u>scale</u> ; (record distance – 0.5m) As the shoot transpires, it absorbs water from the potometer to replace what was lost during transpiration, bubble moves to the left; Water reservoir provides supply of water to ensure that air bubble does not reach too close to the plant;	[5] 1m each	Many candidates did not read the questions carefully and focused their answer on explaining how air movement affects rate of transpiration.

Qn	Answer	Marks	Markers' Report
	The further the air bubble moved, the faster the rate of transpiration; Purpose of the tap is to reset the apparatus;		
E11(b)	presence of <u>chloroplast</u> ; in the <u>mesophyll</u> (spongy and palisade) cells; to <u>trap light energy</u> and convert light into chemical energy stored in glucose; <u>xylem vessels</u> within vascular bundle; helps to <u>transport water</u> for photosynthesis; <u>intercellular air spaces</u> ; facilitate <u>diffusion of gases</u> ; <u>Guard cells</u> become turgid/flaccid; to close/open <u>stomata</u> ; allow <u>carbon dioxide to diffuse</u> into the leaf and used for photosynthesis;	[5] 0.5m each	Max 5m
O11(a)	Decrease in skin temperature (stimulus) is <u>detected</u> by <u>thermoreceptors</u> in skin; Send nerve impulses to <u>hypothalamus</u> (regulatory center); Corrective mechanism: 1. sweat glands less active; less sweat produced, less water in sweat evaporate, less heat is lost. 2. vasodilation of <u>arterioles</u> ; less blood sent to surface of skin, less heat loss 3. metabolic rate increases; less heat generated 4. Contraction of skeletal muscles/shivering; generate more heat. (2 complete explanations) Body temperature increases and goes back to norm;	[4] 0.5m each	Hair stands to trap layer of air for insulation is not a significant corrective mechanism for humans because our hair is not long enough to trap such a thick layer of air.

Qn	Answer	Marks	Markers' Report
	Feedback sent to hypothalamus to stop corrective mechanism;		
O11(b)	<u>Diverging light rays</u> are reflected off bear; Ciliary muscles <u>contract</u> and suspensory ligaments <u>slacken</u> ; Suspensory ligaments <u>relax pull on lens</u> ; Lens becomes <u>thicker and more convex</u> ; Light rays sharply focused on retina; <u>Photoreceptors</u> stimulated; Nerve impulses produced transmitted to <u>brain</u> ; Via <u>sensory neurone</u> ; in <u>optic nerve</u> ; Brain interprets impulses and <u>bear/image is seen</u> ; Nerve impulses transmitted down the <u>relay neurone</u> in the <u>spinal cord</u> ; Across a synapse; from <u>motor neurone</u> ; to the <u>adrenal glands</u> above the kidneys; <u>Adrenaline</u> is secreted such that his heart beat increased;	[6] 0.5m each	Max 6m Bear standing 5m from David is considered a near object.

**BUKIT PANJANG GOVERNMENT HIGH SCHOOL****Preliminary Examination 2016****SECONDARY FOUR EXPRESS****BIOLOGY****5158/02****Paper 2**

Date: 11 August, 2016

Duration: 1h 45min

Time: **1045 – 1230h****READ THESE INSTRUCTIONS FIRST**

Write your name, class and register number on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A [50 marks]

Answer all questions.

Write your answers in the spaces provided on the question paper.

Section B [30 marks]

Write your answers in the spaces provided on the question paper.

Write an **E** (for Either) or an **O** (for Or) next to the number 11 in the grid on the right hand side of this cover page to indicate which question you have answered.

You are advised to spend no longer than an hour on Section A and no longer than 45 minutes on Section B.

The number of marks is provided in brackets [] at the end of each question or part question.

For Examiner's Use		
Section A		/50
Q9		/10
Q10		/10
Q11		/10
Section B		/30
Paper 2		/80

Setter: Ms Jessie Lee

[Turn over*This paper consists of 17 printed pages.*

Section A [50 marks]

Answer **all** questions.

Write your answers in the spaces provided.

- 1** The fur colour of mice is observed to be either yellow or grey. A heterozygous male mouse with grey fur was mated with a female mouse with yellow fur. They had a litter of 8 mice; 5 with grey fur and 3 with yellow fur.

- (a)** By using suitable symbols and a genetic diagram, show the results of the cross between the grey and yellow mice. [2]

- (b)** State the reason why the actual percentage of the offspring with different fur colour does not match that predicted in **(a)**. [1]

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- (c)** A group of equal numbers of yellow and grey mice was released into a field where yellow grains were grown. After a few years, the number of mice in the field had increased. However, the percentage of yellow furred mice was now more than double the percentage of the grey furred mice.

Explain the changes that occurred in the population of mice. [3]

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[Total: 6]

2 **Fig. 2.1** shows a longitudinal section through a mammalian heart.

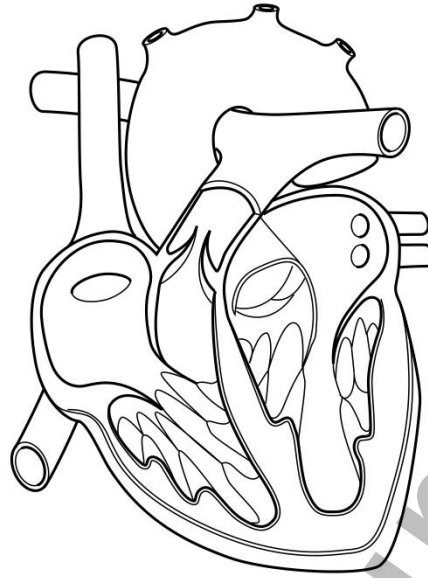


Fig. 2.1

(a) Use label lines and the letters **P**, **Q**, **R** and **S** to label the following on **Fig. 2.1**.

- P** – the left ventricle
- Q** – a semi-lunar valve
- R** – the aorta
- S** – the bicuspid valve

[2]

(b) A device measuring blood pressure was contained in a catheter (a small tube). During a diagnostic investigation, this catheter was inserted into an artery in the arm, moved to the aorta and finally the left ventricle. The result of the investigation is shown in **Fig. 2.2**.

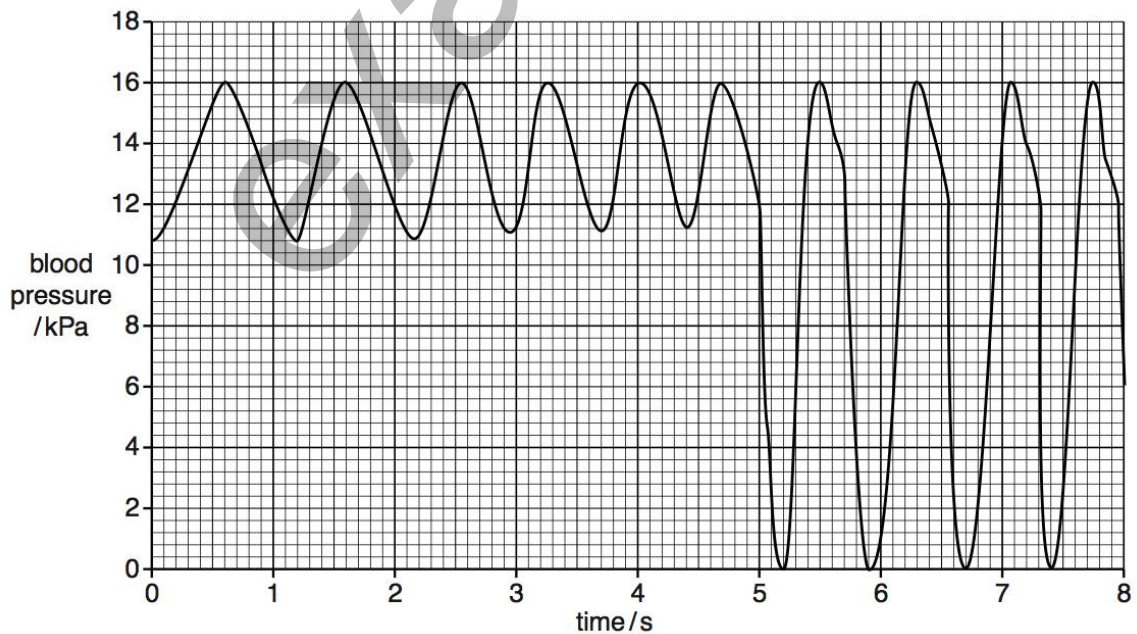


Fig. 2.2

- (i) Calculate the heart rate (in heartbeats per minute) during the period of the investigation. Show your working clearly. [2]

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Heart rate

- (ii) Explain the differences in pressure as the catheter moves from the aorta to the left ventricle. [2]

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- (c) Fig. 2.3 shows an X-ray showing the narrowing of a blood vessel supplying blood to muscles in the heart. The arrows indicate the position of the narrowing of the blood vessels.

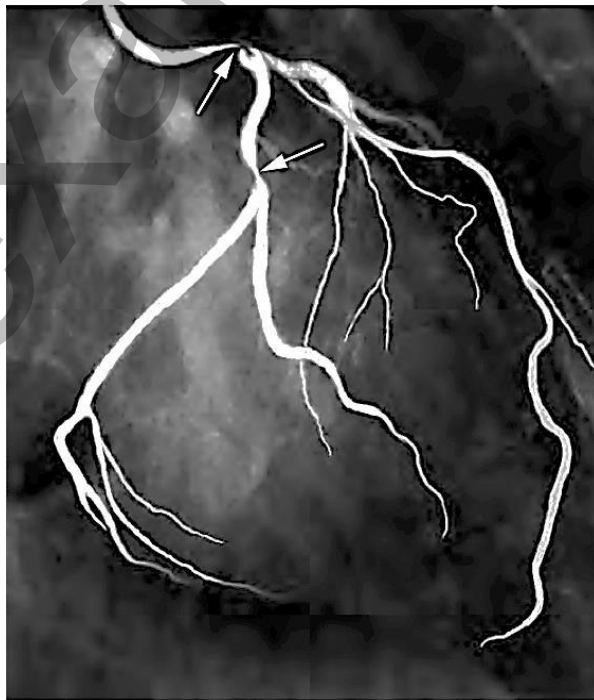


Fig. 2.3

(i) Name the blood vessels shown in **Fig. 2.3**.

[1]

(ii) **State** and **explain** one likely effect of the narrowing of these blood vessels on the person whose heart it belongs to.

[2]

[Total: 9]

3 **Fig. 3.1** shows changes in blood concentration of hormones involved in the regulation of the human menstrual cycle. β -oestradiol is a natural oestrogen.

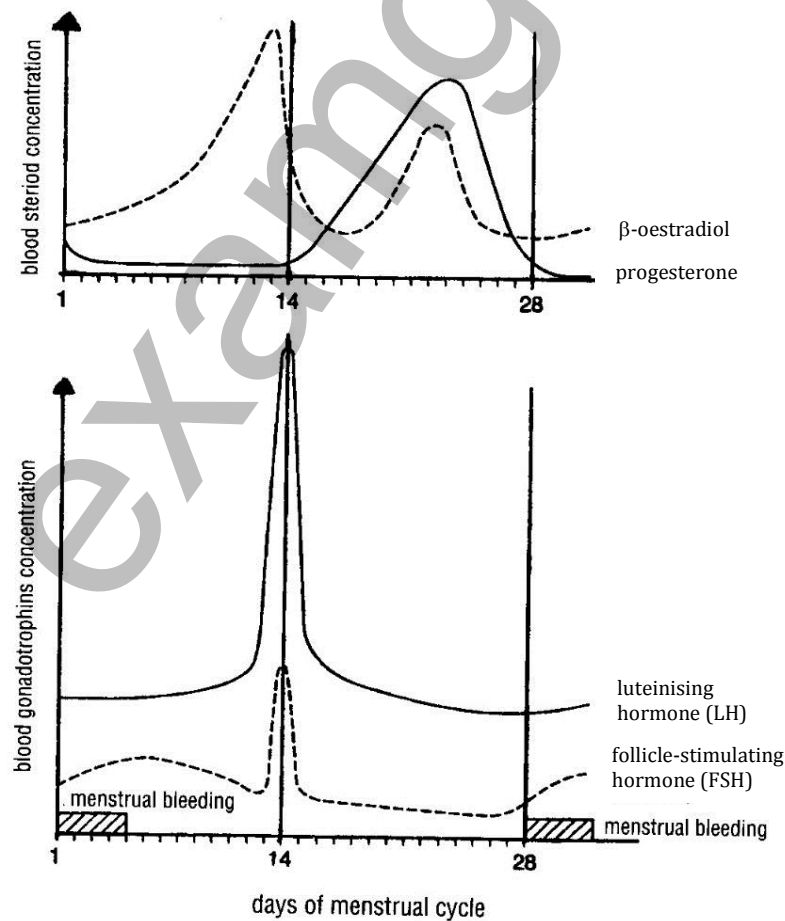


Fig. 3.1

- (a)** Based on your understanding of the menstrual cycle, explain why the two β -oestradiol peaks in a menstrual cycle are due to two different sources of production. [2]

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- (b) (i)** Where is progesterone produced in a non-pregnant female? [1]

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- (ii)** With reference to the graph for progesterone from day 14 until the next menstrual bleeding, account for the function of progesterone in the regulation of the menstruation in humans. [2]

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- (iii)** From your answer in **(b)(ii)**, explain why progesterone injections are used as a means to “stabilize” pregnancy, especially in the first trimester and not at the later stage of pregnancy. [3]

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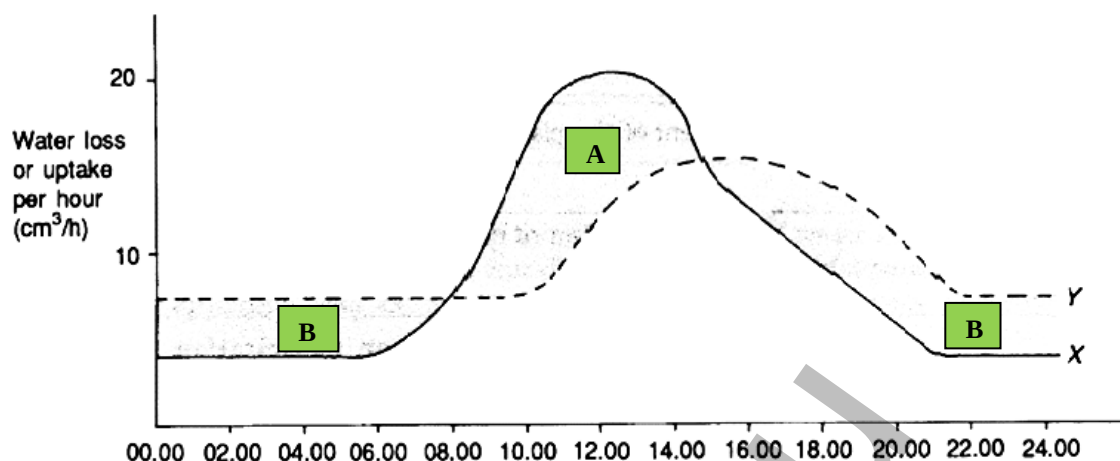
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[Total: 8]

- 4 Fig. 4.1 shows the rates of water absorption and transpiration of a plant during a 24-hour period.



curve X: transpiration rate

curve Y: water absorption rate

Fig. 4.1

- (a) At what times were the rates of water absorption equal to that of transpiration? [1]

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- (b) Complete the following table: [1]

Time (hours)	Stomatal aperture (opening/closing)	Effect of transpiration (increases/decreases)
0800		
2000		

- (c) What do the areas under the curve X and Y respectively represent? [2]

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- (d) What do the shaded areas A and B respectively represent? [2]

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[Total:6]

- 5 *Dicerorhinus sumatrensis*, or the Sumatran rhinoceros, is the only rhino species that has two horns. **Fig. 5.1** below shows the chromosomes from the epidermal horn cell of a female rhinoceros.

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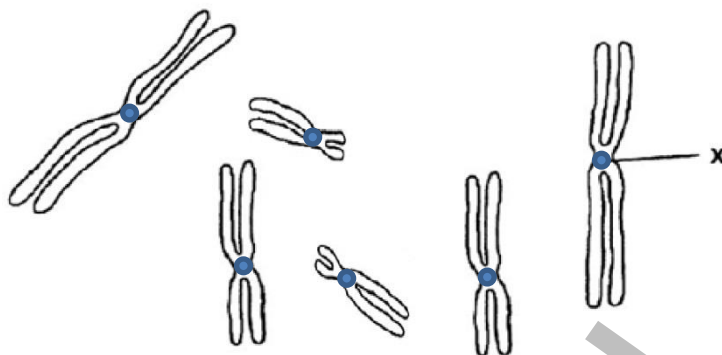


Fig. 5.1

- (a) State the diploid chromosome number of the female Sumatran rhinoceros. [1]

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- (b) State the role of X in cell division. [1]

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- (c) On **Fig. 5.1** above, shade in a pair of homologous chromosomes. [1]

- (d) In the spaces below, draw one of the chromosomes as it would appear during anaphase of mitosis. [1]

- (e) In the spaces below, draw all the chromosomes as it would appear during metaphase I of meiosis. [1]

- (f) In the spaces below, draw **all** the chromosomes found in a **gamete** of the Sumatran rhinoceros.

[1]

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[Total: 6]

- 6 **Table 6.1** shows a comparison of the compositions of blood plasma and glomerular filtrate.

	Composition			
	Glucose	Protein	Urea	Salts
Blood plasma	0.15	8.0	0.04	0.5
Glomerular filtrate	0.15	0.0	0.04	0.5

Table 6.1

- (a) Explain why the concentration of glucose, urea and salts in glomerular filtrate is the same as the blood plasma. [2]

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- (b) In man, the average amount of glomerular filtrate formed in an hour is about 28 litres, whereas the average amount of urine produced in an hour is only about 0.05 litres. Name the process which brings about this difference and explain the importance of this process. [2]

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- (c) Name the hormone involved in the control of blood plasma concentration. [1]

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[Total: 5]

- 7 **Figure 7.1** shows how the rate of heat loss from the ear varies with blood flow to the ear of a small mammal (shown as **Fig. 7.2**) at two different air temperatures.

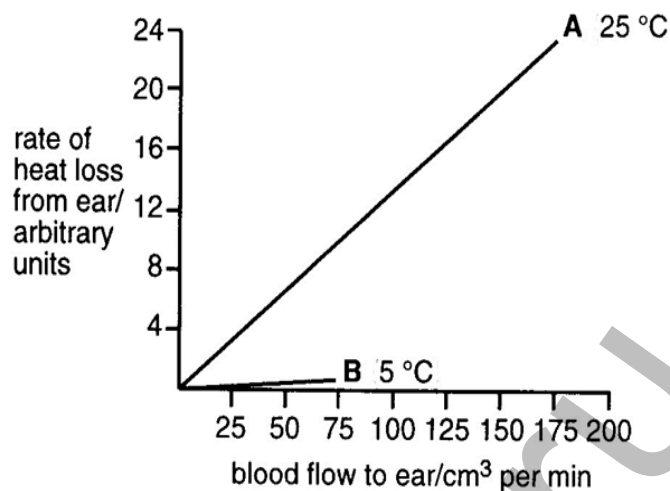


Fig. 7.1



Fig. 7.2

- (a) It is observed that the ears of the small mammal are bright red when placed in a room at 25°C and pale pink when placed in a room at 5°C. Use information from the graph from **Fig. 7.1** and account for this observation. [1]

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- (b) Describe two features of the ear which make them especially suited to the process of heat loss. [2]

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- (c) When placed in a room at 5°C and injected with a chemical that cause prolonged vasodilation to the ears, the rabbit eventually dies. Explain why. [2]

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[Total: 5]

- 8 Fig. 8.1 shows an experiment that is carried out to examine the effect of yeast respiration.

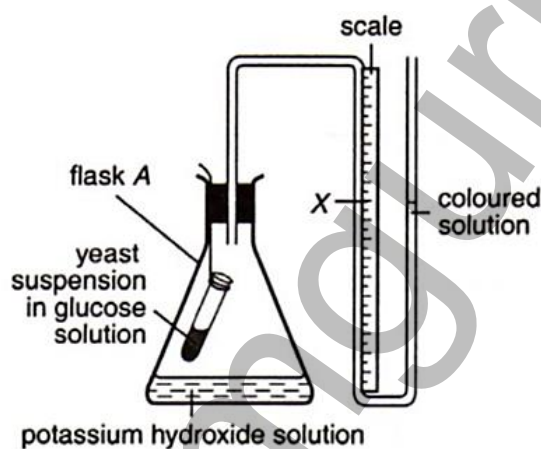


Fig. 8.1

The temperature for both sets is maintained at 37°C. The following table shows the results of the experiment.

Time / day	0	1	2	3	4	5	6
Level of coloured solution for X / mm	0	+2	+10	+22	+22	+22	+22

- (a) Explain the purpose of the potassium hydroxide solution in this experiment. [1]

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- (b) Explain why the level of coloured solution for **X** increases during the first three days and then remains constant after the three days. [4]

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[Total: 5]

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~End of Section A~

Section B [30 marks]

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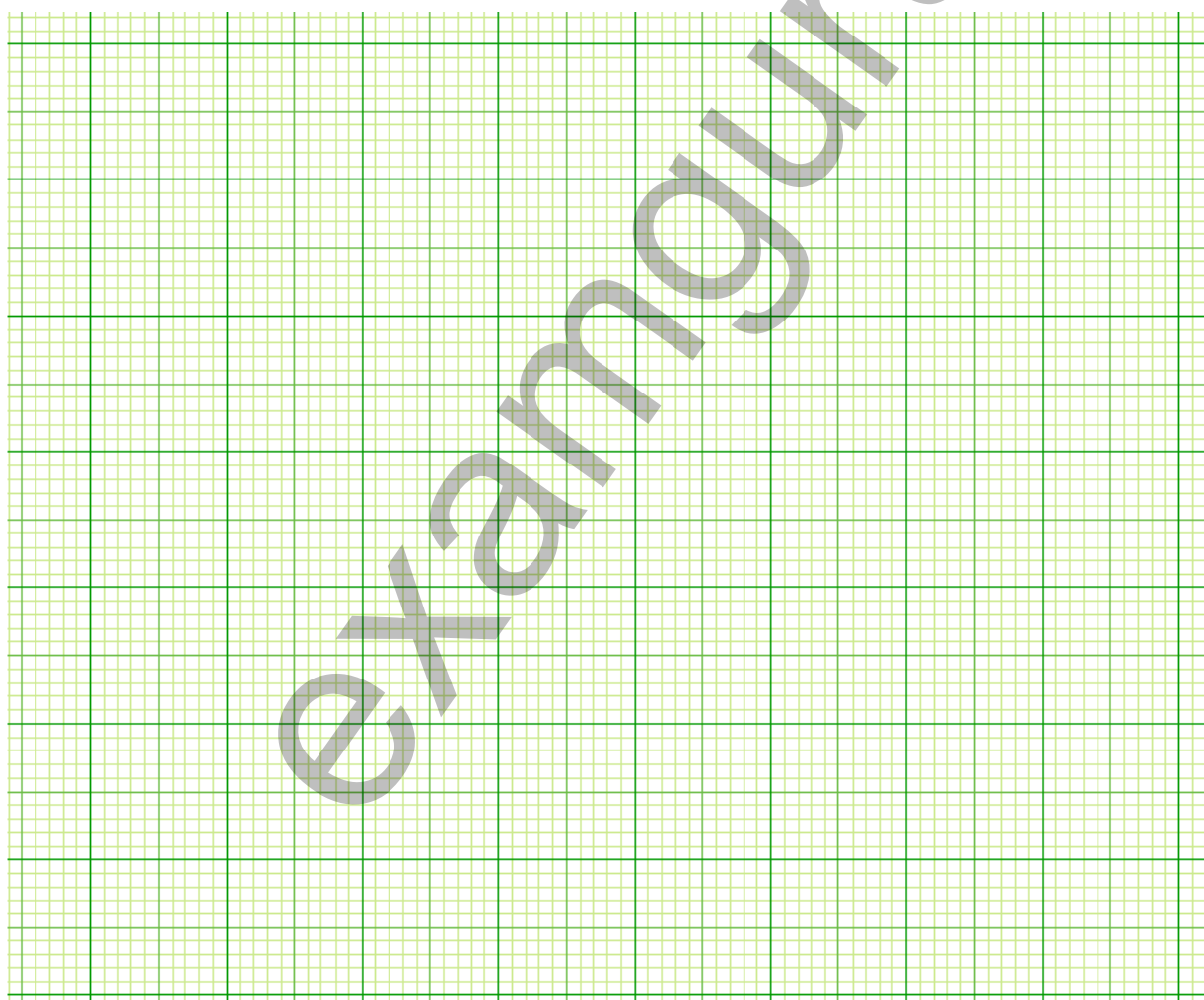
Answer **three** questions only.

Question **11** is in the form of an Either/Or question. Only one part should be answered.

- 9** In an experimental setup, a plant is watered with radioactively labeled water (H_2^{18}O). The plant is then placed in a sealed chamber and the radioactivity of the air in the chamber is measured over time. The table below shows the data that was obtained from the experiment.

Time/h	0	1	2	3	4	5	6	7
Radioactivity/Bq	0.0	10.0	20.0	35.0	48.0	55.0	58.0	60.0

- (a)** Using the data, draw the graph to show how radioactivity of the air changes with time. [4]



- (b)** For this experiment, describe the passage of a radioactively labeled oxygen atom in water that is used in photosynthesis. Your answer should begin from the point the atom is taken up at the roots to the point which it is released into the atmosphere. [6]

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[Total: 10]

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10 In a normal person, the air sacs within the lungs are open which allows air to enter when we breathe. However, when a person suffers from Atelectasis, parts of even all of a lung may collapse. It is caused by a blockage of the air passages (bronchus or bronchioles) or by pressure on the lung. As a result, the air sac collapses as well.

(i) a person taking a leisure stroll for 30 minutes, and [3]
(ii) an athlete running a 400m race. [5]

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[4]

[Total:10]

This is the end of the paper. 😊~

Answers

	Answers	Mark
1a	Parental genotypes : Gg X gg Gametes: G, g X g, g (each gamete to be circled) Correct crosses (with lines correctly drawn) Correct genotypes and phenotypes of F1 generation Some students unaware of what a genetic diagram is. All labels must be present; they were disregarded for this question. Note that dominant alleles must be in CAPITAL letters and recessive alleles in small letters.	½ ½ ½ ½
b	The number of offspring/progeny is too small, OR Sample size of offspring/progeny is too small	1
c	Yellow furred mice better adapted to survive in environment (or any reasonable explanation eg. camouflage); Survive longer thus more likely to mate and pass on their allele for yellow fur to their offspring; Over many generations, greater percentage of population has the advantageous allele for them to survive Some students misunderstood this as the yellow mice growing in numbers due to the fact that they eat yellow grains.	1 1 1
2a	Correct labels Labels for valves must point to the valve and not the empty space in between the valves.	½ each [max 2]
bi	10/8 X 60 (Correct working) 75 beats/minute or bpm (Correct answer with units)	1 1
bii	- Large pressure differences in left ventricle - As a direct result of ventricular diastole (low) and systole (high) - Aorta generally a constant high pressure - Due to its function of carrying blood from heart to rest of the body	½ ½ ½ ½
ci	Coronary arteries (R: artery) (R: spelling errors eg. Conorary)	1
cii	Insufficient glucose and oxygen to cardiac muscle cells Cells unable to respire and die Angina/heart pains/heart attack/cardiac arrest	½ ½ 1
3a	First peak due to production by the follicles in the ovary upon stimulation by follicle-stimulating hormone (FSH) Second peak due to production by corpus luteum, remains of the Graafian follicle after ovulation	1 1
bi	corpus luteum (A: ovary)	
bii	- Level of progesterone increased steadily from day 14 - Before it falls to a low point on day 28 - Followed immediately by menstruation which contains blood and endometrium tissue - Conclude that progesterone is important in the maintenance of the endometrium	½ ½ ½ ½

biii	- Progesterone source in a pregnant woman comes from the corpus luteum and placenta	1									
	- Placenta fully formed only 8 weeks after fertilisation; additional sources of progesterone must be from injections	1									
	- by end of first trimester, placenta fully formed and will take over progesterone production; corpus luteum breaks down	1									
4a	0800 and 1500 hours [A: Range of 745-0800 and 1430 – 1500]	1									
b	<table border="1"> <thead> <tr> <th>Time (hours)</th><th>Stomatal aperture (opening/closing)</th><th>Effect of transpiration (increases/decreases)</th></tr> </thead> <tbody> <tr> <td>0800</td><td>opening</td><td>increases</td></tr> <tr> <td>2000</td><td>closing</td><td>decreases</td></tr> </tbody> </table>	Time (hours)	Stomatal aperture (opening/closing)	Effect of transpiration (increases/decreases)	0800	opening	increases	2000	closing	decreases	1
Time (hours)	Stomatal aperture (opening/closing)	Effect of transpiration (increases/decreases)									
0800	opening	increases									
2000	closing	decreases									
c	The area under curve X represents the total amount of water lost by transpiration during the 24-hour period.	1									
	The area under curve Y represents the total amount of water absorbed during the 24-hour period.	1									
eii	Area A represents the <u>net/overall</u> amount of water lost during the 24-hour period.	1									
	Area B represents the <u>net/overall</u> amount of water gained during the 24-hour period.	1									
5a	6	1									
b	X attaches to the <u>spindle fibre</u> for sister chromatids to be pulled to respective poles / to separate the sister chromatids during anaphase.	1									
c	Any pair of the same size (Students often forget to do this question or shaded just one chromosome)	1									
d	One chromosome separated at the centromere and the sister chromatids pulled to opposite poles. (Show the pair aligned along the equator. Students sometimes only drew one of the chromatids.)	1									
e	Chromosomes at synapsis; homologous chromosomes lining up in a pair at the equator (Show all 3 pairs with different lengths) Spindle fibres, if drawn, should attach to the centromeres)	1									
f	A gamete with half the number of chromosomes (show 3 chromosomes after separation with different lengths, R: pairs of sister chromatids / pairs of homologous chromosomes)	1									
6a	<u>Ultrafiltration</u> (Note: Ultrafiltration is not the same as diffusion)	1									

	Forces <u>small molecules / particles</u> (eg. Glucose, amino acids, mineral salts) (R: substances) to pass through the partially permeable basement membrane of the glomerulus (Not just basement membrane / R: basement membrane of the Bowman's capsule) Under high hydrostatic pressure (Students might be penalized for incoherent, contradictory answers)	$\frac{1}{2}$ $\frac{1}{2}$
b	<u>Selective reabsorption</u> To allow useful substances (R: nutrients / food substances) such as glucose, amino acids, mineral salts and water to be reabsorbed back (R: diffuse back) into the blood stream keep the <u>water potential of blood</u> constant / osmoregulation	1 $\frac{1}{2}$ $\frac{1}{2}$
c	Antidiuretic hormone	1
7a	25°C → increased blood flow to increase heat loss (red ears) 5°C → decreased blood flow to decrease heat loss (pink ears) (Note the link – not increase/decrease heat loss hence blood flow increase/decrease) Students should be careful to <u>relate the data in the graph</u> – no marks are awarded if there is no linkage from blood flow to heat loss.	$\frac{1}{2}$ $\frac{1}{2}$
b	Long, flat/thin: increases surface area to volume ratio for heat loss (via conduction, convection, radiation) Hairless inner surface: does not trap a layer of air as insulation, facilitates heat loss Thin layer of subcutaneous fat: little insulation, facilitates heat loss More blood vessels: Increase blood flow to the surface of the ears for heat loss (R: merely presence of arterioles, shunt vessels etc) R: ears are wide / furry / have sweat glands / hair erector muscles / ears move around / protruding / stick out / have a layer of hair	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ Any 2
c	Increased blood flow to skin surface Increased heat loss through ears by via conduction, convection and radiation Prolonged heat loss will inactivate enzymes (R: denature enzymes) Causing a loss of metabolic activity to sustain life	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

8a	To remove carbon dioxide in the set-up	1
8b	In the first three days, yeast carries out aerobic respiration Oxygen is used up and decreases Carbon dioxide given out / released but absorbed by the KOH Causing the flask pressure to decrease, lower than the atmospheric pressure After three days, yeast carries out anaerobic respiration as oxygen levels reach zero (R: glucose is used up) Only carbon dioxide release will affect the internal pressure of the flask Carbon dioxide absorbed by the KOH Pressure in flask remains constant	½ ½ ½ ½ ½ ½ ½ ½
9a	Correctly plotted points Both axes drawn and correctly labelled (time/h on x-axis, radioactivity/Bq on y-axis) Best fit curve Appropriate scale (Minus 1/2m for wrong/missing points)	1 1 1 1
b	Oxygen atoms enter the plant through <u>root hair cells</u> in the process of <u>osmosis</u> Travels up the <u>xylem</u> Drawn up by capillary action, root pressure and transpiration pull Enters the <u>mesophyll cells</u> from xylem by <u>osmosis</u> Photosynthesis in mesophyll cells produces oxygen gas Oxygen molecules <u>diffuse</u> out of the mesophyll cells and <u>dissolves</u> in the thin film of moisture lining cells <u>Diffuses</u> through <u>stomata</u> into the external environment (as oxygen gas, not water vapour)	1 1 1 1 1 1 1 [max 6]
10a	Collapse of the air sac results in reduction of <u>surface area to volume ratio</u>; Reduced diffusion rate, less air per unit time enters the air sacs/alveoli for gaseous exchange Some students only stated a decrease in surface area without any mention about the volume ratio. Some also were unable to mention what structure exactly had a decrease in surface area to volume ratio: it is the entire air sac and not the air. Some students mentioned a reduction in efficiency, but it is necessary to state the reduction in diffusion rate or a decrease in air entering per unit time.	1 1
bi	No demand for maximum amount of energy body can provide as it is a leisurely jog (or any mention of a low energy demand) Only <u>aerobic respiration</u> occurs Glucose + oxygen → large amount of energy + carbon dioxide + water (½m for any mention of large amount of energy) The focus of the question is about respiration, and not breathing.	1 1 1

	Many students are still mentioning respiration as the production of energy instead of the <u>release</u> of energy! This was only penalized once in parts bi and bii.	
bii	Huge demand of energy by muscle cells; Energy released during aerobic respiration insufficient to meet the high demands of energy Thus <u>anaerobic respiration</u> in muscle cells occur; Combined with the large amount of energy released during aerobic respiration; Provides sufficient energy/to meet the <u>energy</u> demands for the athlete for the race; Glucose → small amount of energy + lactic acid (½m for any mention of either small amount of energy or lactic acid only) Badly answered. R: oxygen insufficient to meet demands of body R: anaerobic respiration takes place in place of aerobic respiration (It is not the insufficient oxygen that causes anaerobic respiration, but the fact that the energy released during aerobic respiration is insufficient, that leads to anaerobic respiration occurring. Anaerobic respiration does not occur in place of aerobic respiration, but it occurs on top of it... therefore the energy released during anaerobic respiration will add on to the energy released during aerobic respiration to meet the huge demands of energy during an exercise.)	1 1 1 1 1 1 [max 5]
Either a	Recessive → I ⁰ Dominance → I ^A and I ^B to I ⁰ Co-dominance → both alleles in a heterozygous equally expressed (I ^A I ^B) and a new phenotype formed *Examples MUST BE SHOWN if not no marks are awarded.	1 1 1 1
b	Mutation occurs when a <u>gene</u> is modified or a <u>chromosome</u> is altered (or spontaneous change in gene structure or chromosome); Down's syndrome occurs when a mutation causes a <u>change in the chromosome number / chromosomal mutation</u> ; Extra copy of chromosome pair 21, has 47 chromosomes rather than normal 46; Due to unequal separation of chromosomes during meiosis; Sickle-cell anaemia occurs when gene mutation occurs; Codes for abnormal haemoglobin (haemoglobin S) that causes red blood cells to become sickle-shaped.	1 1 1 1 1 1 1
Or a	Two anti-parallel strands twisted around each other forming a double helix; Basic unit of a nucleotide; Sugar-phosphate backbone of deoxyribose sugar and phosphate group; 4 nitrogen-containing bases, adenine, thymine, guanine and cytosine; Bases on one chain bonded with bases on the other chain where A-T and G-C; Complementary base pairing	1 1 1 1 1 1
b	Low cost production of medicines [1/2] (e.g. insulin) [1/2] Production of crops that grow in extreme conditions [1/2]	1 1

	(e.g. high salt environments, drought resistant crops, crops that make efficient use of nitrogen and other nutrients) [1/2] to allow farmers to grow crops in unsuitable soils. Development of crops that produce toxins that kill insect pests/ pesticide-resistant/ reduced use of costly pesticides that may damage the environment [1/2] (Bt gene from bacteria inserted into plants to kill pests) and crops. [1/2] Development of foods designed to meet specific nutritional goals [1/2] (golden rice with high vitamin A content). [1/2] [R: Increased crop yield (secondary benefit of the primary benefit, the ones listed above. Hence, this is rejected.)]	1 1
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