



Geylang Methodist School (Secondary) Preliminary Examination 2020

BIOLOGY

Paper 1

6093/01
4 Express

Additional materials: Optical Answer Sheet

1 hour

Setter : Ms Ng Sio Ying

15 Sep 2020

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, papers clips, highlighters, glue or correction fluid on the Optical Answer Sheet.

Write your name, class and index number on the Optical Answer Sheet provided.

There are **forty** questions in this paper. Answer **all** the 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 separate answer sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. No mark will be deducted for a wrong answer.

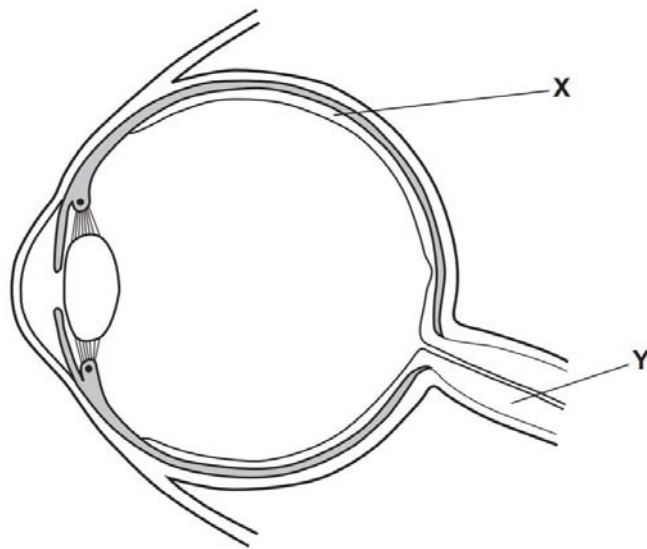
Any rough working should be done in this paper.

- 1** When a red stain is added to a culture containing both living and dead cells, only the dead cells take up the stain.

Which structure prevents the stain from entering the living cells?

- A** cell membrane
- B** cell wall
- C** lysosomes
- D** nucleus

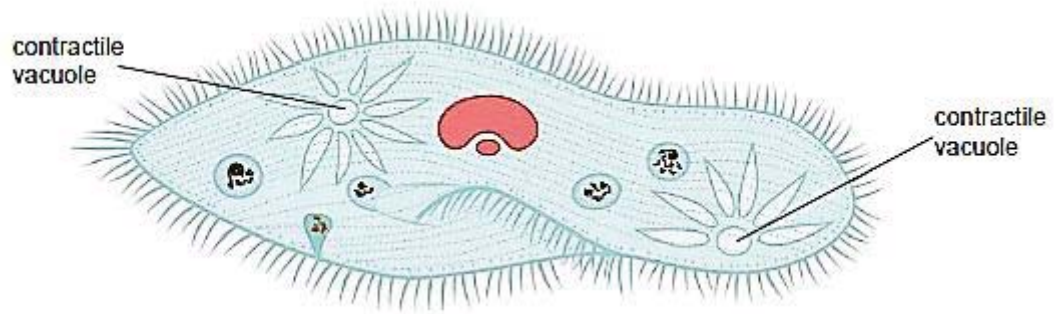
- 2** The diagram shows a section through an eye.



Which of the following best describes structures X and Y?

- A** organs in an organ system
- B** organs in a tissue
- C** organ systems in an organ
- D** tissues in an organ

- 3 The diagram shows *Paramecium*, a single-cell freshwater organism.



Paramecium has two contractile vacuoles for the evacuation of excess water from its body.

The table below records the average time taken by a contractile vacuole to fill up and expel excess water out of the cell by contracting, when the organism is immersed into the three different liquids, X, Y and Z.

liquid that organism is immersed in	average time taken / s
X	189
Y	28
Z	63

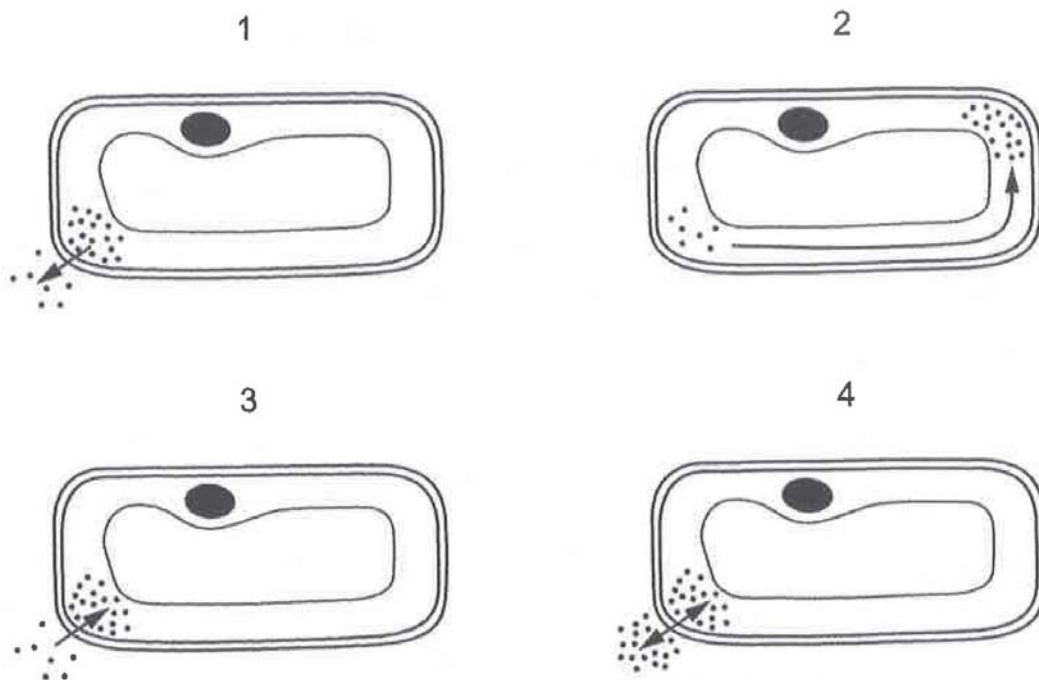
Which row shows the correct identities of liquids X, Y and Z?

	X	Y	Z
A	0.3% salt solution	0.1% salt solution	water
B	0.1% salt solution	water	0.3% salt solution
C	water	0.3% salt solution	0.1% salt solution
D	0.3% salt solution	water	0.1% salt solution

- 4 What property of water makes it suitable as a component of blood plasma?
- A** Water has a high latent heat of vaporisation.
- B** Water is a good solvent.
- C** Water is incompressible.
- D** Water is the raw material for chemical reactions.

- 5 The diagrams show four identical plant cells.

The dots show the concentration of a chemical. The arrows represent the direction of movement of the chemical.



Which diagram or diagrams show a cell where active transport is taking place?

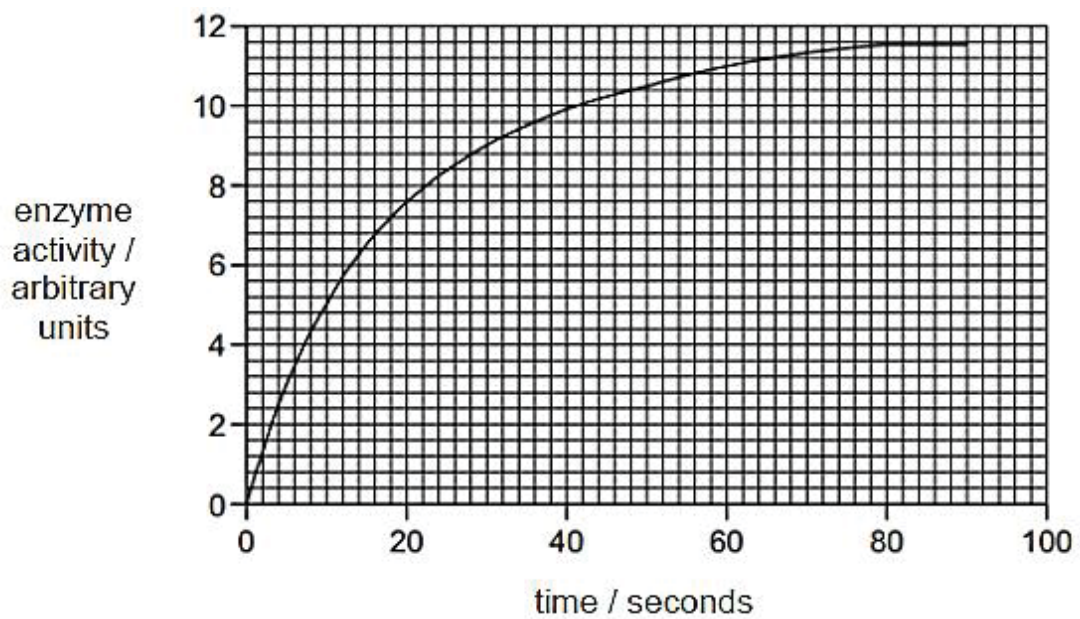
- A** 1 and 2 **B** 2 and 3 **C** 2 and 4 **D** 3 only
- 6 A student conducted a series of food tests to determine which two nutrients were placed in test-tubes X, Y and Z. The table shows the results of the tests.

test-tube	Benedict's test	biuret test	iodine test
X	orange precipitate	violet solution	yellowish-brown solution
Y	blue solution	blue solution	blue-black solution
Z	blue solution	violet solution	blue-black solution

Which conclusion is consistent with the results?

- A** Tube X contained albumin and sucrose.
B Tube Y contained starch and sucrose.
C Tube Z contained albumin and maltose.
D Tube Z contained maltose and starch.

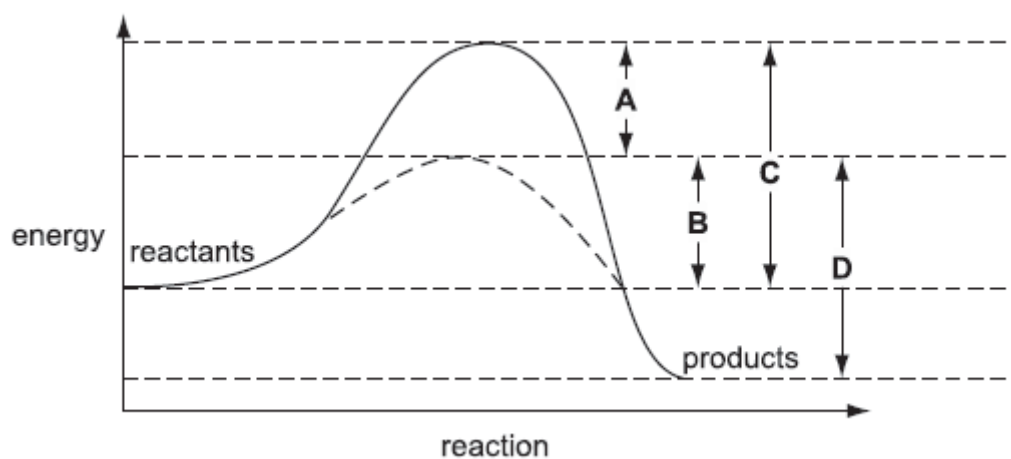
- 7 The graph shows the enzyme activity of sucrase plotted against time.



Why does enzyme activity remain constant from 80 seconds to 90 seconds?

- A All enzymes have denatured.
 - B All substrates have been used up.
 - C Enzyme concentration is the limiting factor.
 - D Substrate concentration is the limiting factor.
- 8 The graph shows the activation energy of an enzyme-catalysed reaction and the same reaction without a catalyst.

Which arrow shows the activation energy of the uncatalysed reaction?



- 9 The small intestines of cows are similar in general structure and function to the small intestines of humans.

A disease in cows reduces the number of villi in their small intestines. The cows lose weight and become weak.

Which of the following explains the weight loss?

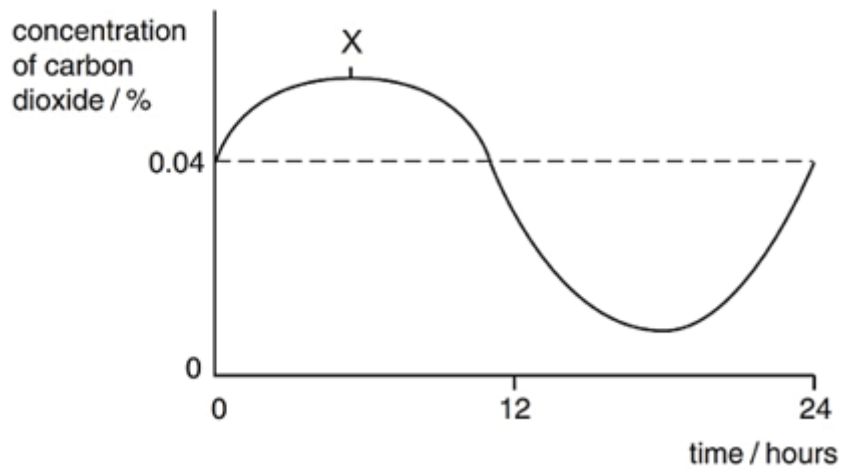
- A lesser amylase produced
 - B lesser peristalsis
 - C lesser absorption of nutrients
 - D slower digestion of proteins
- 10 Which of the following is **not** a function of the liver?
- A production of insulin
 - B detoxification of alcohol
 - C conversion of excess glucose into glycogen
 - D production of plasma proteins involved in clotting
- 11 The table shows the results of an investigation into the absorption of products of digestion in the presence and absence of oxygen.

product of digestion	absorption in the presence of oxygen / arbitrary units	absorption in the absence of oxygen / arbitrary units
amino acids	5.3	1.8
fatty acids	2.0	2.1
glucose	6.2	2.4
glycerol	4.8	4.7

Which conclusion can be drawn from these results?

- A All products of digestion are absorbed by both active transport and diffusion.
- B All productions of digestion are absorbed by diffusion only.
- C Amino acids and glucose are absorbed by active transport only.
- D Fatty acids and glycerol are absorbed mainly by diffusion.

- 12** The graph shows the concentration of carbon dioxide in the air surrounding a plant measured over 24 hours.



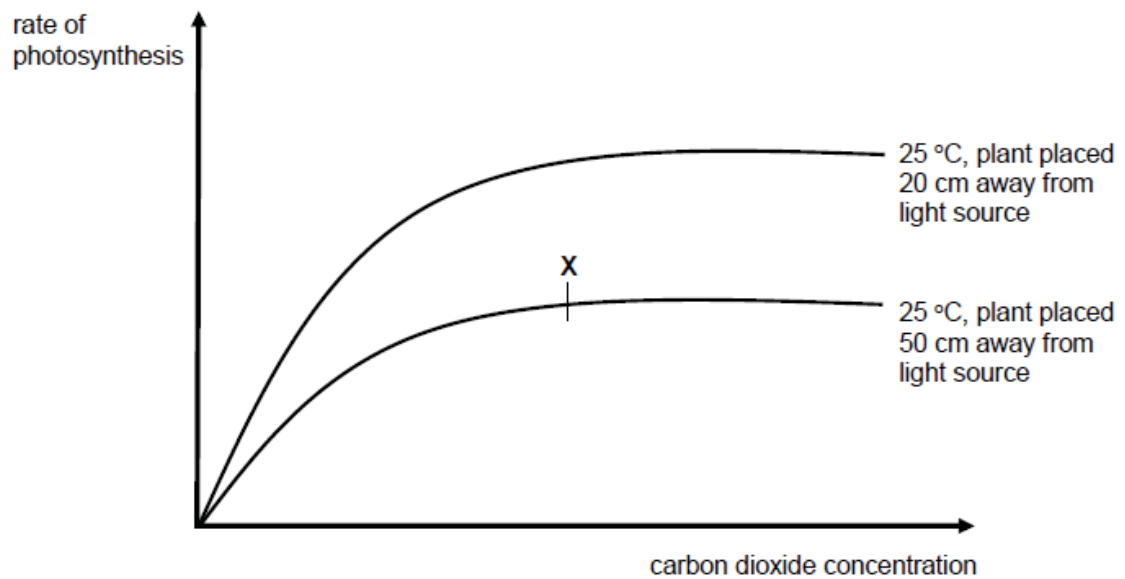
Which of the following explains the carbon dioxide concentration at X?

	light intensity	process
A	darkness	respiration
B	darkness	transpiration
C	daylight	photosynthesis
D	daylight	respiration

- 13** Why is sunlight necessary for photosynthesis?

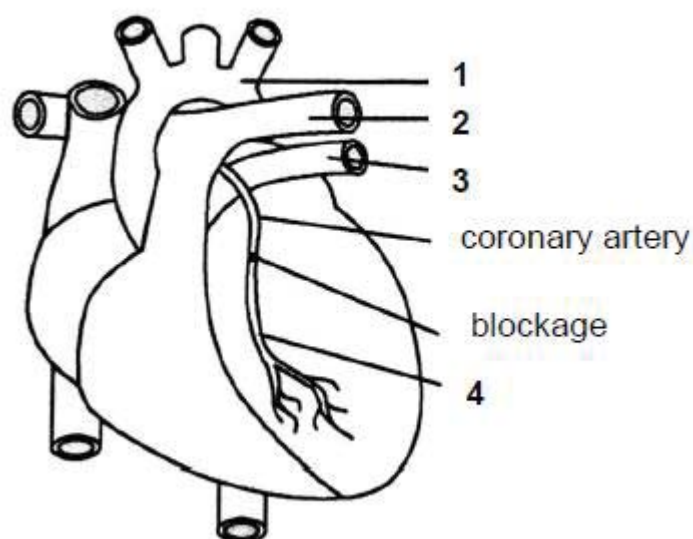
- A** It is a catalyst.
- B** It is required to activate enzymes.
- C** It is required to break down water molecules.
- D** It is required to form chlorophyll.

- 14** The graphs below show the effects of various environmental factors on the rate of photosynthesis of a *Hydrilla* plant submerged in sodium bicarbonate solution.



From the graphs, what is the limiting factor at X?

- A** carbon dioxide concentration
 - B** temperature
 - C** light intensity
 - D** amount of water
- 15** A blockage of the coronary artery can be treated by attaching a blood vessel to the coronary artery to bypass the blockage.



Which two vessels should be joined together?

- A** 1 and 3
- B** 1 and 4
- C** 2 and 4
- D** 3 and 4

- 16** The duration of each sequence of events in the cardiac cycle of an individual is shown below.

event in cardiac cycle	duration / s
atrial systole	0.1
atrial diastole	0.6
ventricular systole	0.2
ventricular diastole	0.5

What is the heart rate of this individual?

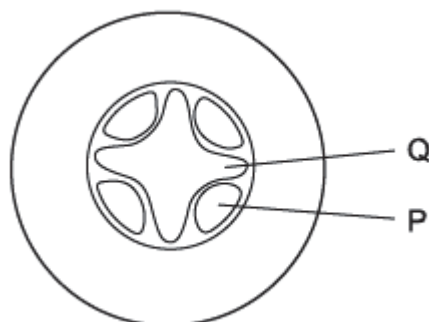
- A** 42 beats per minute
B 75 beats per minute
C 85 beats per minute
D 120 beats per minute
- 17** The table shows the blood groups of four people and the type of blood each received in a transfusion.

person	blood group	blood type received
P	A	O
Q	B	AB
R	AB	O
S	O	AB

Which two people are at risk from agglutination?

- A** P and Q
B P and R
C Q and S
D R and S

- 18** A herbaceous plant growing in a nutrient solution, is placed in a well-lit experimental chamber through which humid air is being passed slowly. The diagram below shows a section through a part of the plant.



The speeds of movement of the fluids in tissues P and Q are measured. The humid air is then replaced by dry air and the speeds of movement of the fluids changed.

What are these changes?

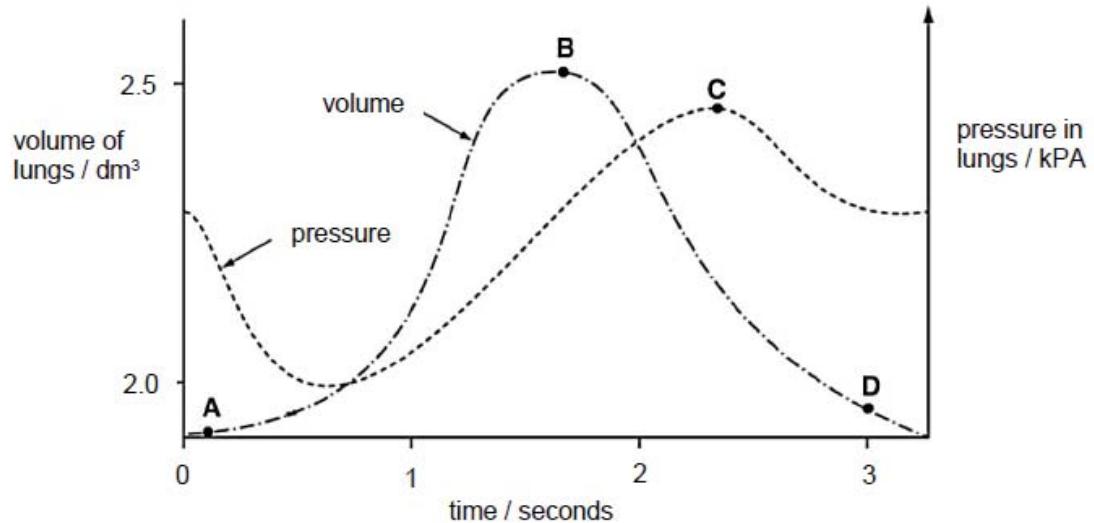
	tissue P	tissue Q
A	greatly increased upward movement	greatly increased downward movement
B	greatly increased downward movement	little change
C	little change	greatly increased downward movement
D	little change	greatly increased upward movement

- 19** Which row correctly identifies xylem vessel and sieve tube element?

	xylem vessel		sieve tube element	
	cytoplasm	nucleus	cytoplasm	nucleus
A	✓	✓	✗	✗
B	✗	✓	✗	✗
C	✗	✗	✓	✓
D	✗	✗	✓	✗

- 20** The graph shows how the pressure and volume inside the lungs change during one complete breath.

At which point are the external intercostal muscles contracted?



- 21** Gas exchange in annelid worms occurs throughout the whole of the skin surface.

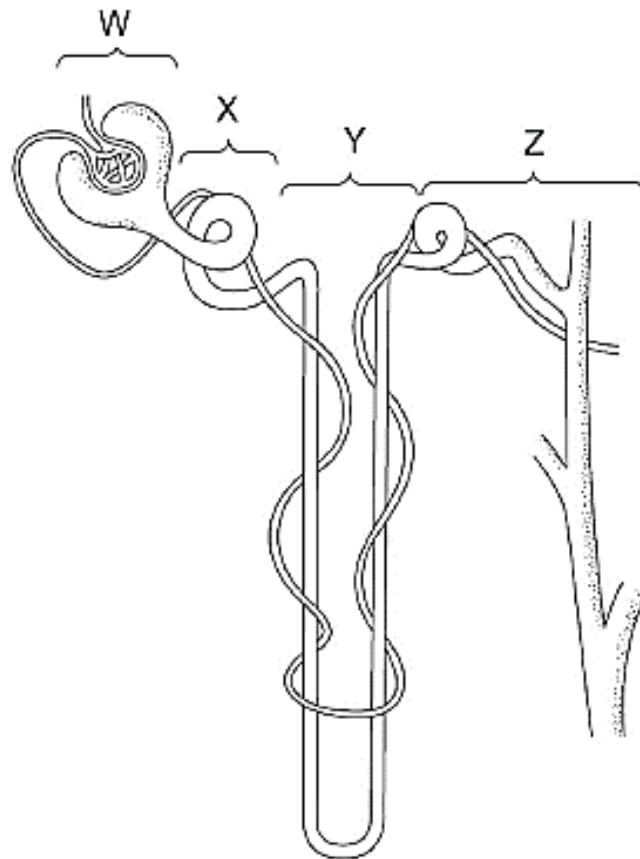
What are the most likely characteristics of the skin surface?

	surface area to volume ratio	condition of surface
A	large	dry
B	large	wet
C	small	dry
D	small	wet

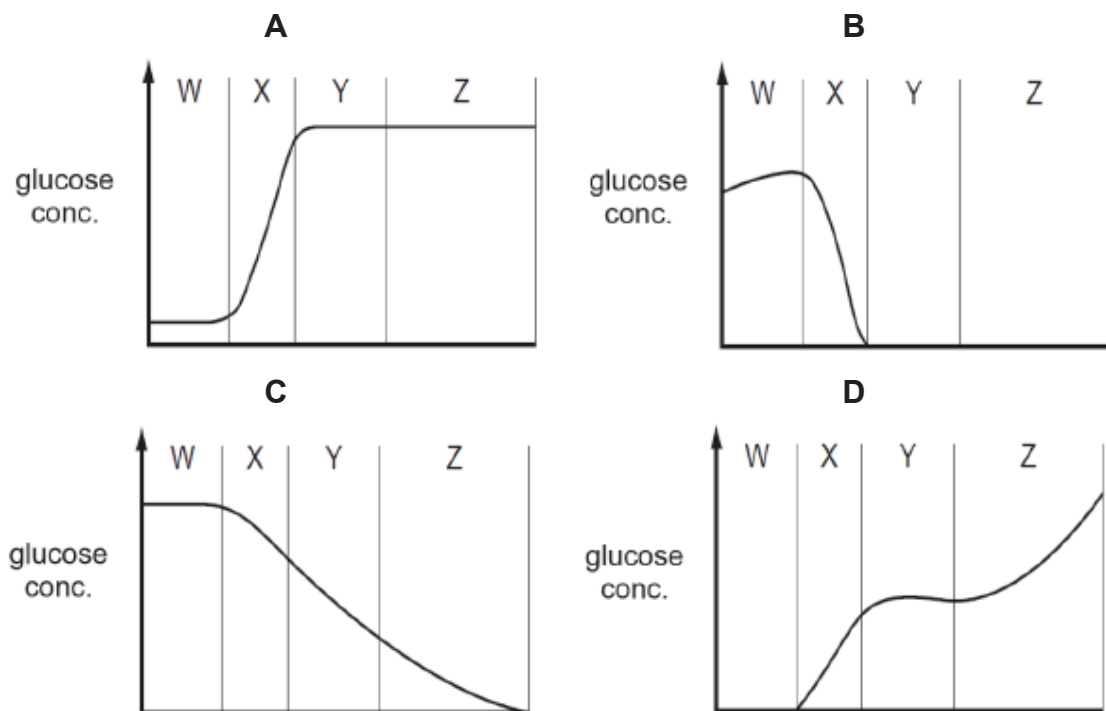
- 22** Which row correctly gives the sequential events involved in the secretion and action of anti-diuretic hormone (ADH)?

	water potential in blood relative to norm	amount of ADH secreted relative to norm	amount of water reabsorbed by the nephrons
A	decreased	decreased	decreased
B	decreased	increased	increased
C	increased	decreased	increased
D	increased	increased	decreased

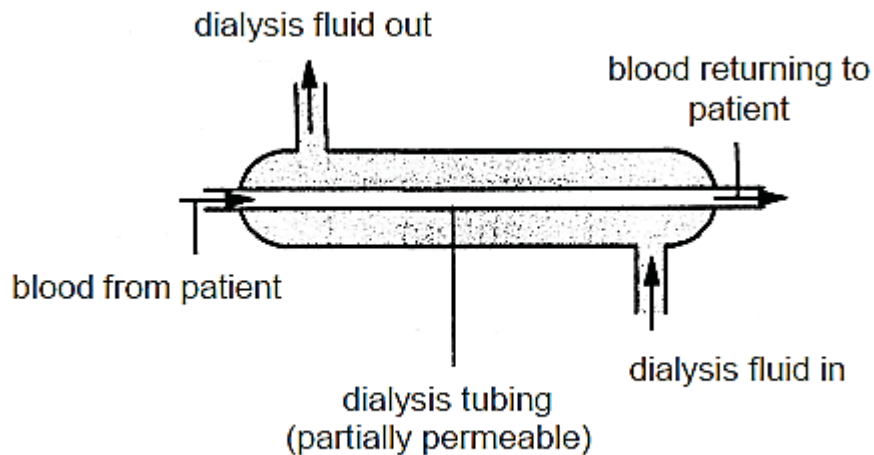
- 23** The diagram shows a nephron and its associated blood vessels of a healthy person.



Which graph shows the concentration of glucose present in each part of the kidney tubule?



- 24 An engineer has been tasked to improve the efficiency of the dialysis machine shown in the diagram below.



He has made the following recommendations:

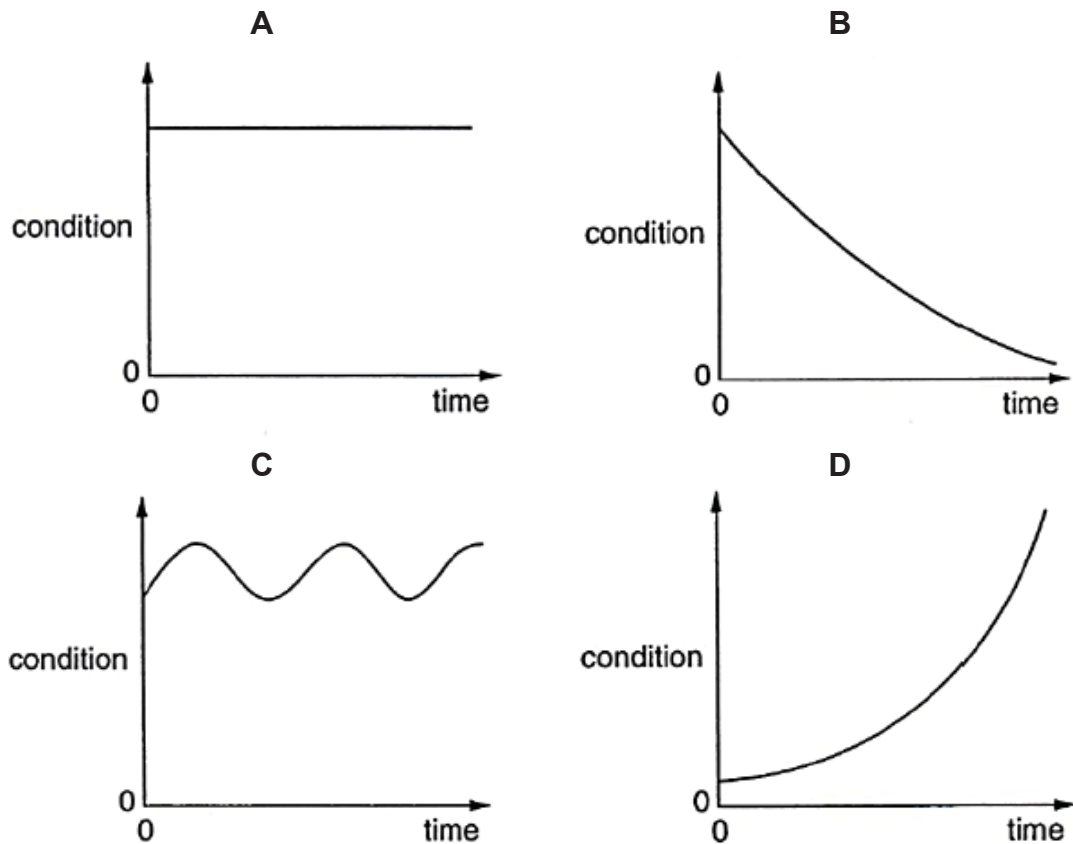
- (i) reverse the direction of blood flow
- (ii) increase the rate at which dialysis fluid is replaced
- (iii) increase the length of the dialysis tubing by coiling it
- (iv) increase the lumen of the dialysis tubing while keeping the thickness of tubing the same.

Which of his recommendations will improve the efficiency of the dialysis process of a patient?

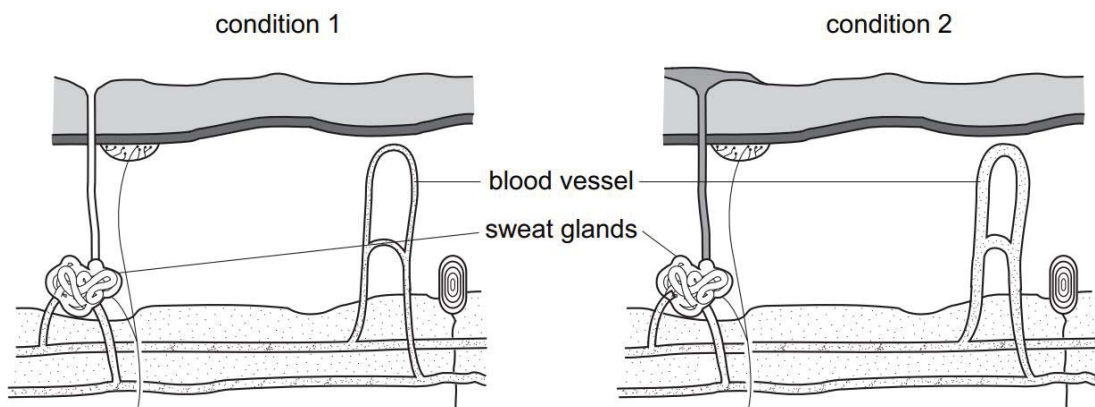
- A (i) and (iii) only
 - B (ii) and (iii) only
 - C (i), (ii) and (iii) only
 - D (ii), (iii) and (iv) only
- 25 Which statement is **not** an example of homeostasis?
- A Increase in the rate of expiration to remove excess carbon dioxide from the body.
 - B Sweating during strenuous physical activity.
 - C The conversion of excess blood glucose into glycogen for storage.
 - D The removal of undigested materials from the body.

- 26** The graphs below show how four different conditions in the body may change with time.

In which graph is the condition being controlled by negative feedback?



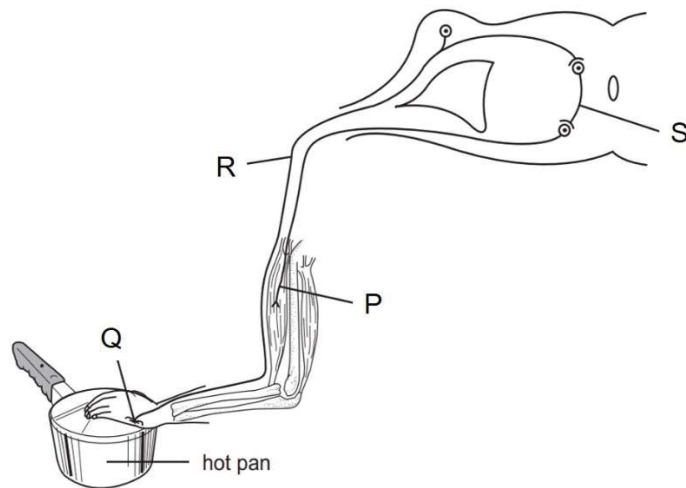
- 27** The diagram shows structures within human skin under two different conditions.



Which statement accounts for the change from condition 1 to 2?

- A** A person enters a cold room to store fresh food products.
- B** A person leaves an air-conditioned room to go to an open field.
- C** A person stands stationary in the field on a sunny day.
- D** A person walks under a sheltered walkway from the office to the canteen.

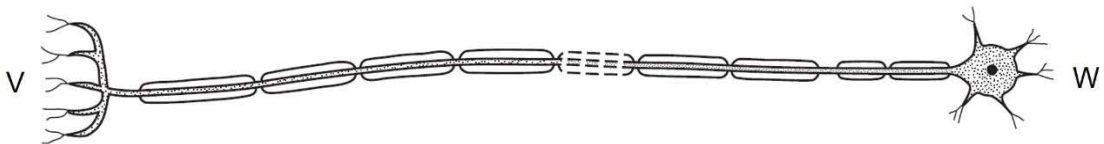
- 28 The diagram shows the structures involved in a reflex action.



Which sequence shows the correct flow of structures involved in the reflex action?

- A** $P \rightarrow Q \rightarrow R \rightarrow S$
B $P \rightarrow S \rightarrow R \rightarrow Q$
C $Q \rightarrow R \rightarrow S \rightarrow P$
D $Q \rightarrow S \rightarrow P \rightarrow R$

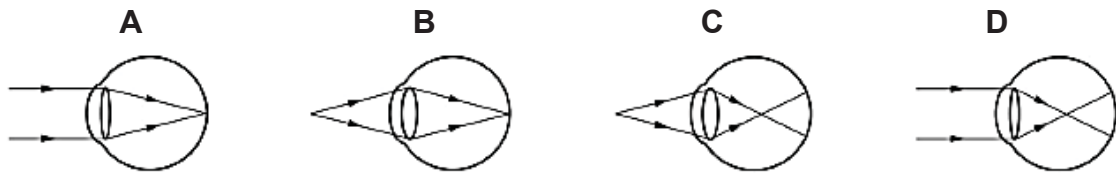
- 29 The diagram shows a neurone.



Which structures could be found at V and W?

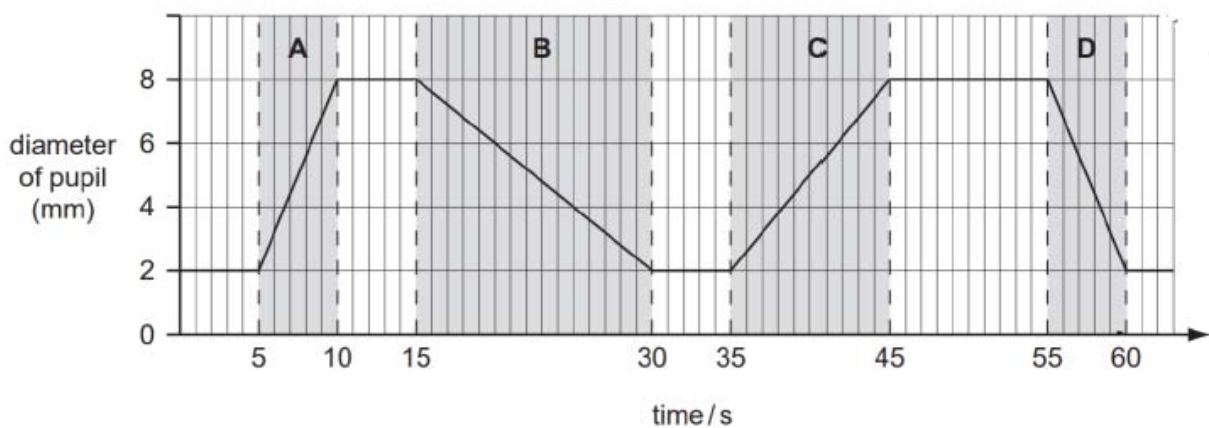
	V	W
A	brain	intestine
B	brain	leg
C	eye	hand
D	ovary	spinal cord

- 30 Which diagram shows how light from a distant object is focused on the retina to form a clear image?



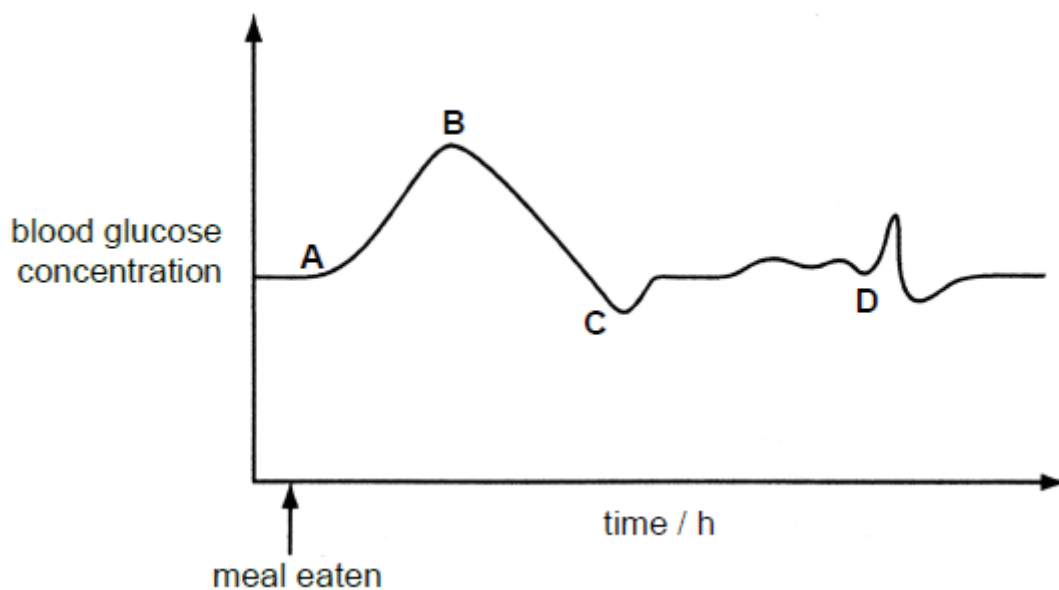
- 31 The diameter of a person's pupil is measured as the light intensity is varied.

During which time period does the light intensity increase the fastest?

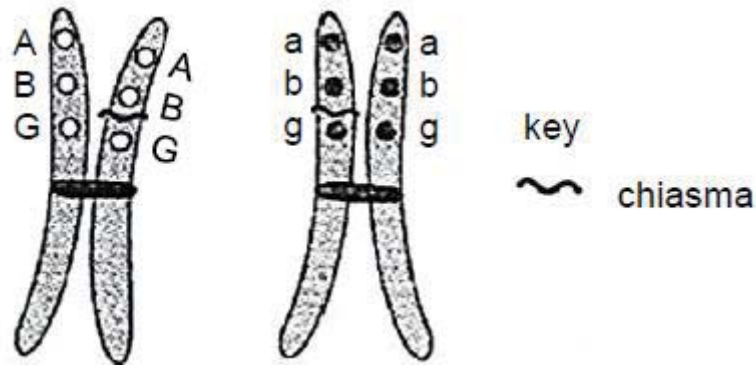


- 32 The graph shows changes in the glucose concentration in the blood of a person over a few hours after a meal has been consumed.

Which point on the graph represents the secretion of adrenaline?

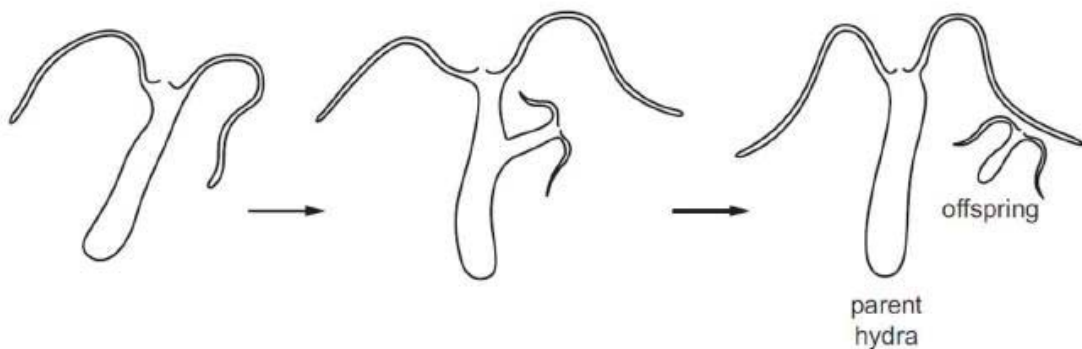


- 33** The diagram below represents a pair of homologous chromosomes during meiosis where crossing over and independent assortment of chromosomes occur.



What are the genotypes of the resulting gametes?

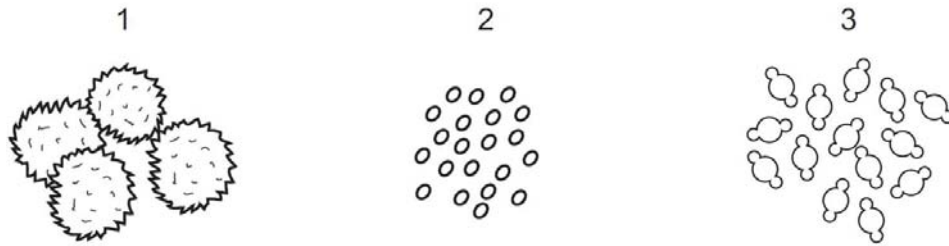
- A** ABG, abG, ABg, abg
B ABG, aBg, AbG, abg
C ABG, ABG, abg, abg
D ABG, aBG, Abg, abg
- 34** A hydra, a small freshwater organism, was kept in an aquarium and its growth was observed. The diagram shows the hydra growing and releasing an offspring from the side of its body.



Which row describes the reproduction of hydra?

	parent and offspring are genetically identical	uses sexual reproduction
A	✓	✓
B	✓	x
C	x	✓
D	x	x

- 35** The diagrams show pollen grains from three different species of plant as they appear under the microscope. The diagrams are all drawn to the same scale.



Which pollen grain(s) is/are involved in insect-pollination?

- A** 1 only **B** 1 and 2 **C** 2 and 3 **D** 3 only
- 36** Which row on the male reproductive system in a human, is correct?

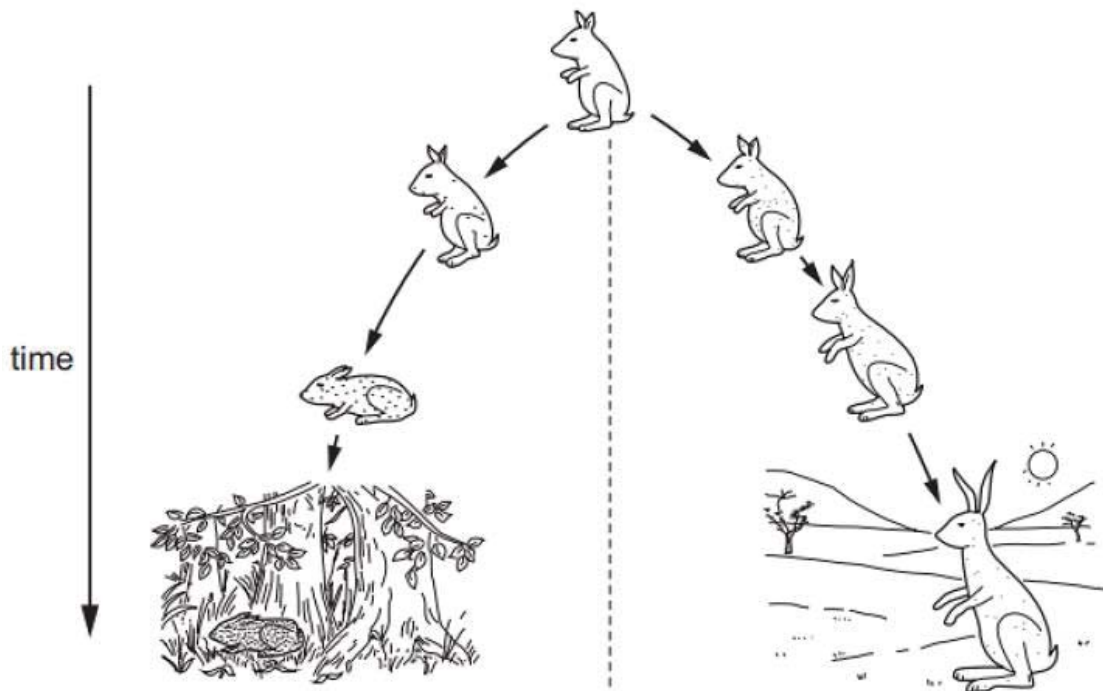
	produces sperm	secretes sex hormones	secretes enzymes to nourish sperm	stores inactive sperm
A	testes	scrotum	ureter	urethra
B	epididymis	testes	prostate gland	ureter
C	testes	testes	prostate gland	epididymis
D	scrotum	prostate gland	epididymis	testes

- 37** Which of the following precautions should be taken to prevent the spread of HIV?

- (i) avoidance of any skin contact with infected person
- (ii) medical staff wearing gloves when treating patients
- (iii) not sharing soap used by another person
- (iv) prevent exchange of body fluids
- (v) treatment of blood products to destroy the virus

- A** (i) and (iii) only
B (ii) and (iv) only
C (i), (ii) and (iii) only
D (ii), (iii) and (iv) only

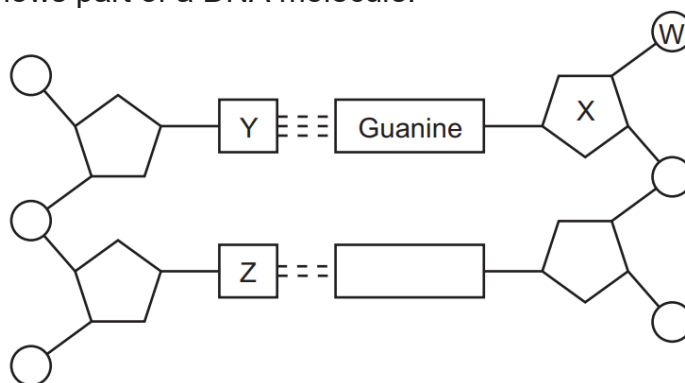
- 38** The diagram shows a species becoming modified to survive in two different habitats.



Which statement best explains this modification?

- A** The species has evolved by adapting quickly to the different habitats.
- B** Individuals that survived in each habitat passed down their survival skills to the next generation.
- C** Desirable genes are inherited by offspring.
- D** Competition among the population forces the species to colonise two distinct habitats.

39 The diagram shows part of a DNA molecule.



Which of the letters represent cytosine, deoxyribose, phosphate and thymine?

	cytosine	deoxyribose	phosphate	thymine
A	W	X	Y	Z
B	Y	X	W	Z
C	Y	Z	X	W
D	Z	W	X	Y

40 Six possible processes in genetic engineering are listed.

1. The bacterium is cloned.
2. The gene is copied.
3. The gene is switched on.
4. The gene is transferred into a bacterium.
5. The human gene is isolated.
6. The protein, insulin is synthesized.

Which four processes, in the correct order, show the production of human insulin by bacteria?

- A** 2 → 3 → 5 → 6
B 3 → 1 → 4 → 6
C 5 → 3 → 2 → 6
D 5 → 4 → 1 → 6

END OF PAPER



Geylang Methodist School (Secondary)

Preliminary Examination 2020

Candidate
Name

Class

Index
Number

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BIOLOGY

Paper 2

6093/02
Sec 4 Express

Additional materials: Nil

1 hour 45 minutes

Setter: Miss Ng Sio Ying

26 Aug 2020

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 on both sides of the paper. 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** 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.

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		
8		11
9		9
10		10
Total		80

This document consists of **19** printed pages and 1 blank page

[Turn over

Section A

Answer **all** questions in the spaces provided.

- 1** In an investigation, the volume of samples of 20 dried raisins was measured. Each sample was then placed in water or sugar solution of different concentrations.

Fig. 1.1 shows the volume of each sample of raisins after 12 hours.

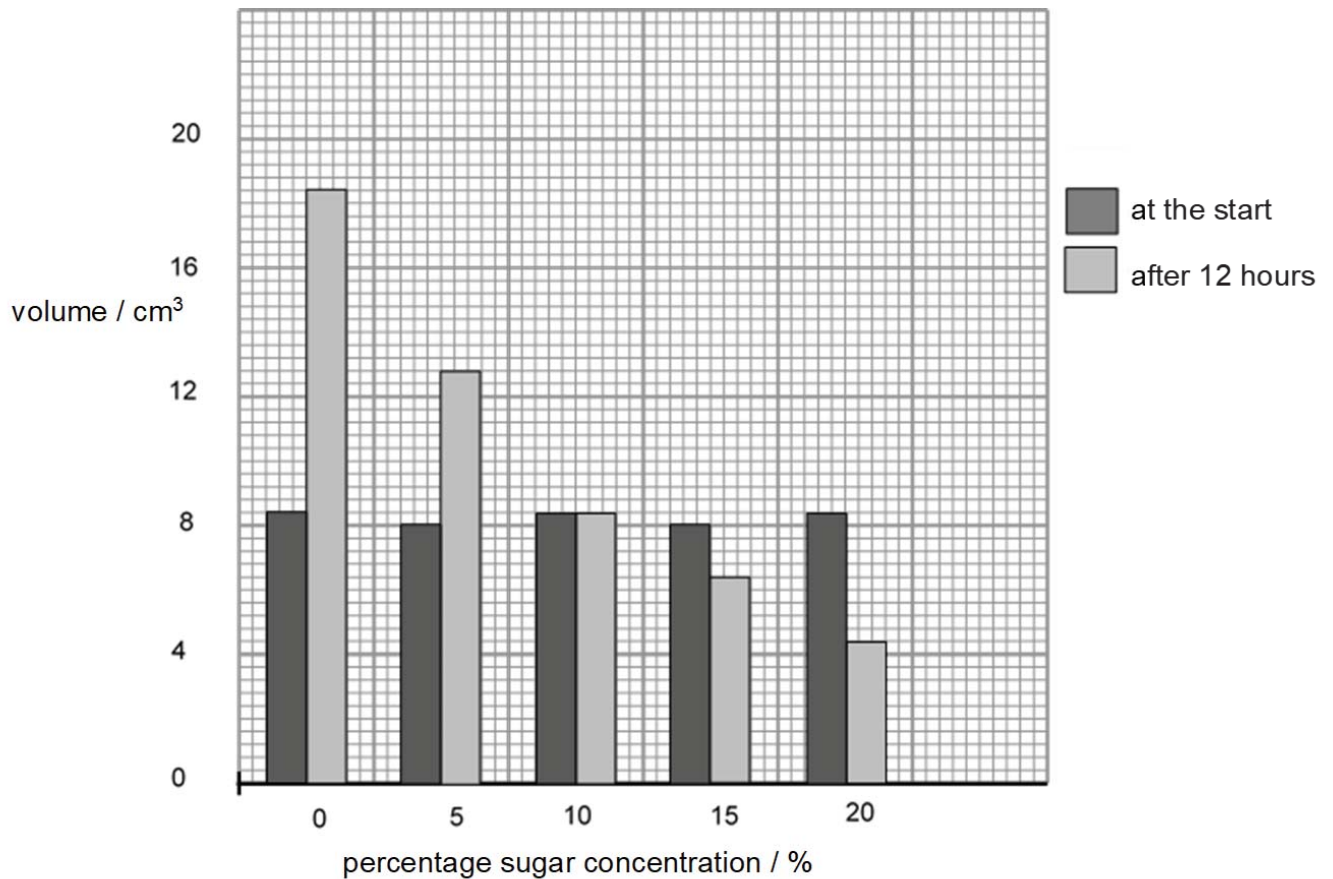


Fig. 1.1

- (a)** Explain why samples of 20 raisins were used rather than a sample of one raisin.

.....

..... [1]

- (b)** Explain why there is an increase in the volume of the sample of raisins in 5% sugar solution.

.....

.....

.....

..... [2]

- (c)** Calculate the percentage increase in the volume of the sample of raisins in 5% sugar solution.
(Show your working)

[2]

- (d)** Suggest the concentration of the cell sap in the raisin.

Explain your answer.

.....

.....

.....

..... [2]

[Total: 7]

- 2 It is reputed that almost 65% of the world's population has lactose intolerance. Consuming cow's milk, which has 5% lactose, will result in diarrhoea, bloating and vomiting.

Cow's milk can be treated with enzyme lactase to hydrolyse lactose. The end result is lactose-free milk. Fig. 2.1 shows how the simplified version of this treatment is carried out. Beads are coated with lactase and placed in a funnel-like apparatus. Cow's milk flows over the beads and the lactose is hydrolysed.

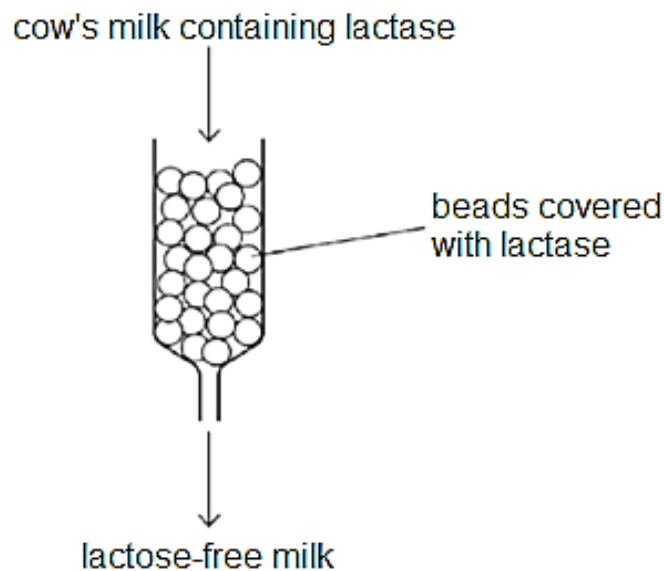


Fig. 2.1

- (a) Using beads coated in lactase is a more efficient use of lactase than adding lactase directly to the cow's milk.

Suggest **two** reasons why this is so.

.....

.....

.....

..... [2]

- (b)** Suggest why the lactose-free milk made after hydrolysis with lactase tastes sweeter than the cow's milk containing lactose.

.....

.....

.....

..... [2]

- (c)** An equipment error during the production of lactose-free milk resulted in boiling water being poured over the beads covered with lactase.

Predict how the milk produced due to this equipment error would differ from the expected product and provide a reason for your answer.

.....

.....

.....

..... [2]

[Total: 6]

3

The name "*diabetes mellitus*" means "sweet urine". It stems from ancient times, when physicians would taste a patient's urine as a part of diagnosis.

Craig Freudenrich, Ph.D. "How Diabetes Works" 22 June 2001. HowStuffWorks.com.
<<https://health.howstuffworks.com/diseases-conditions/diabetes/diabetes.htm>> 11 July 2020

Fig. 3.1

Use the information from the passage in Fig. 3.1 to help you answer these questions.

- (a)** Explain how the blood glucose return to normal levels within two to three hours of the Glucose Tolerance Test for a normal (non-diabetic) person.

..... [5]

- (b) Explain the two ways in which a person suffering from diabetes would respond differently to the Glucose Tolerance Test than a normal person.

.....

 [2]

- (c) Diabetics can control their blood glucose levels artificially by injecting insulin. Insulin is a protein.

Suggest why insulin has to be injected rather than taken orally.

.....
 [1]

[Total: 8]

- 4 Fig. 4.1 is a photomicrograph of a cross-section through the leaf of *Nerium oleander*.

N. oleander is a xerophytic plant. Xerophytic plants have adaptations to survive in an environment with little water, such as a desert or snow-covered region.

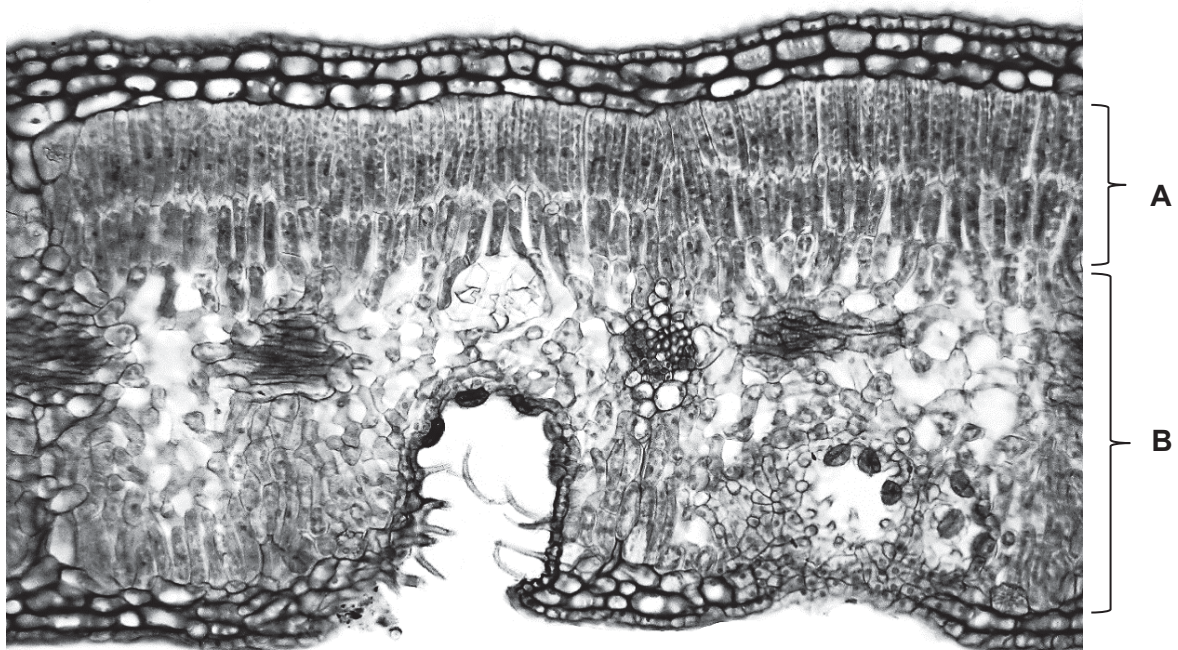


Fig. 4.1

- (a) Identify the tissues labelled A and B.

A

B

[2]

- (b)** The leaf shown in Fig. 4.1 has a number of adaptations to reduce water loss by transpiration.

Two of the adaptations are:

- a multilayered epidermis
- stomata only found in depressions, known as stomatal crypts, on the lower surface of the leaf.

Explain how the two adaptations will help to reduce water loss in *N. oleander*.

multilayered epidermis

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

stomatal crypts

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

[Total: 5]

- 5** Table 5.1 shows the results of a survey on fifty females to investigate the impact of smoking on the live birth weight of babies.

All participants were habitual smokers who continued smoking during pregnancy.

Table 5.1

average number of cigarettes smoked each day	average live birth weight of the baby / kg
0	2.78
2	2.60
4	2.45
6	2.33
8	2.20
10	2.12

- (a)** Describe and explain the results shown in Table 5.1.

.....

.....

.....

.....

.....

..... [3]

- (b)** Name the hormone that is high in concentration throughout pregnancy.
State its source and outline its role in maintaining pregnancy.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

- 6 (a) Fig. 6.1 shows the total mass of DNA in a haploid nucleus of an organism's egg cell and the total mass of DNA in a body cell developed from this egg cell after fertilisation and cell division.

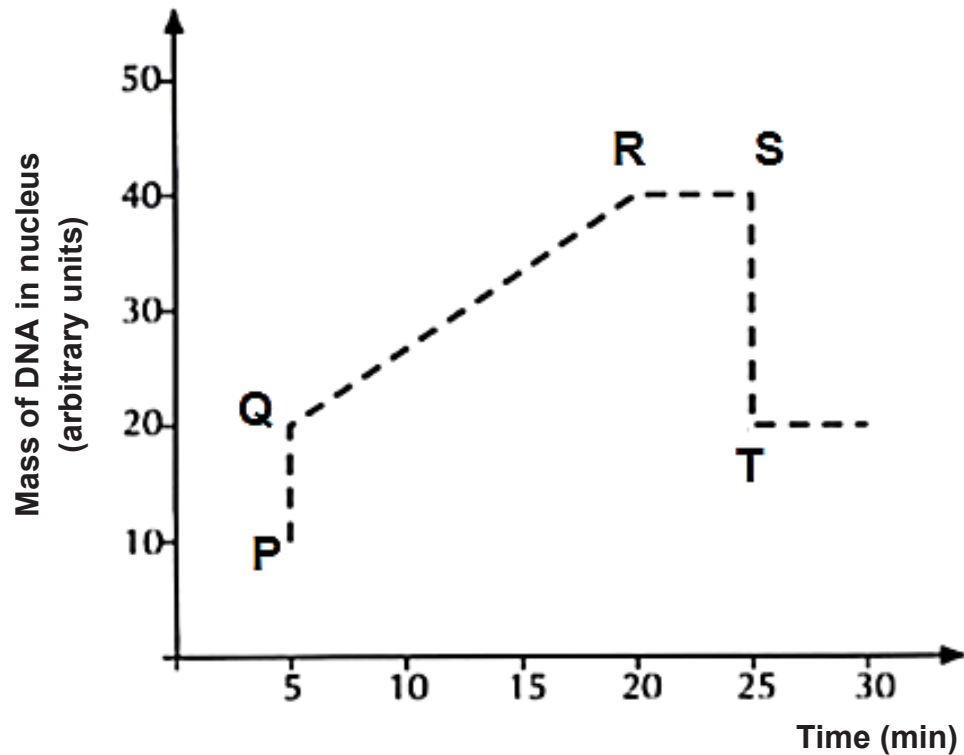


Fig. 6.1

With reference to Fig. 6.1,

- (i) explain what is happening from **Q** to **R**.

.....
 [1]

- (ii) given that the mass of DNA in a chromosome of this organism is 1 arbitrary unit, state the diploid number of this organism.

..... [1]

- (b) Fig. 6.2 is a photomicrograph of a cut section of the root tip of a broad bean plant. The cell labelled **D** is in interphase.

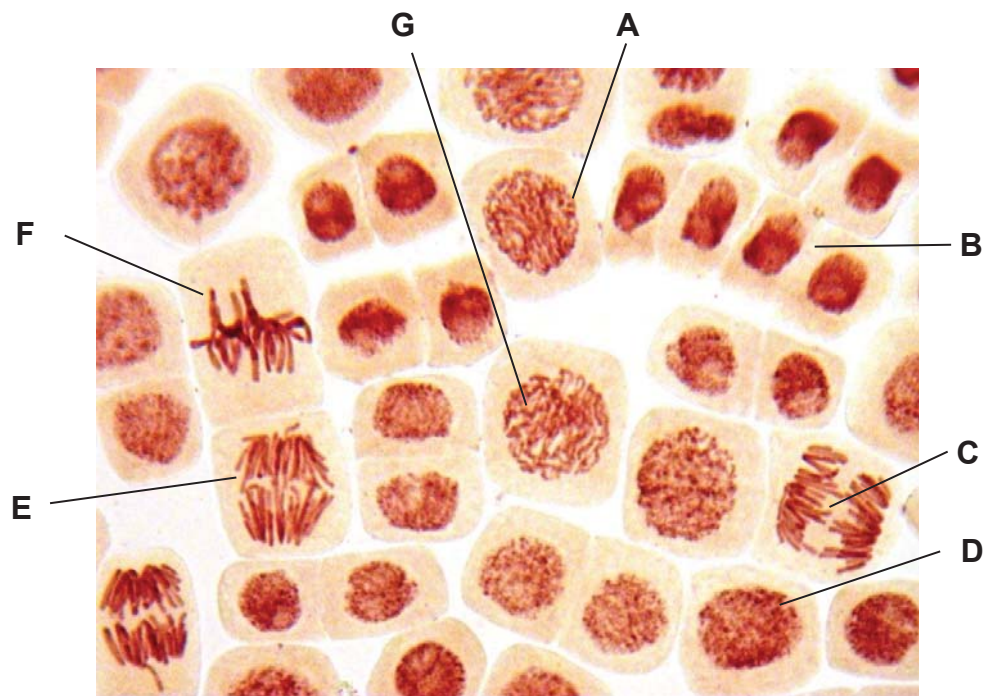


Fig. 6.2

- (i) Complete the table below by:
- naming the stages of mitosis in the correct sequence following interphase.
 - identifying one example from the cells labelled **A** to **G** that is in the stage of mitosis that you have named.

stage of mitosis	label from photomicrograph

[4]

- (ii) Describe how stage **F** is different from a similar stage in meiosis I.

.....

.....

.....

..... [2]

[Total: 8]

- 7 Fig. 7.1 shows flowers from the same species of a plant at different stages, **D** and **E**, in their development.

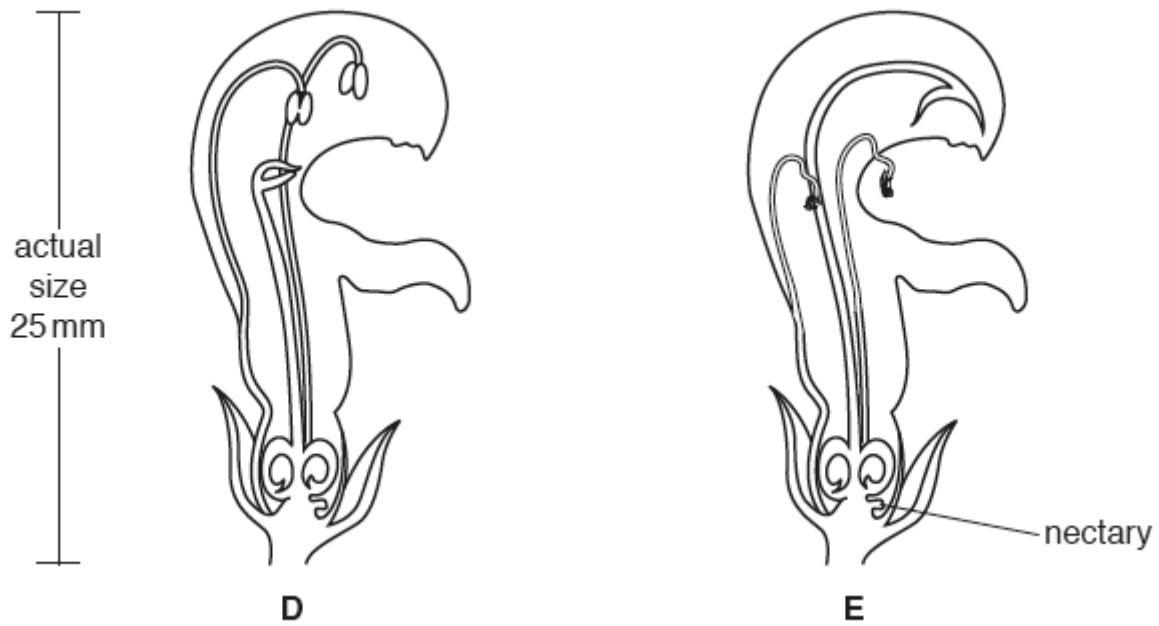


Fig. 7.1

- (a) The flowers are cross-pollinated by an insect.

Explain why the insect must visit flower **D** before visiting flower **E**.

.....

.....

.....

.....

.....

..... [3]

- (b)** Suggest how flowers of this species are adapted to be pollinated by an insect such as a bee.

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.....

..... [3]

- (c)** In some species, some plants have only male flowers while the rest have only female flowers.

Explain the advantages of this to the species..

.....

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.....

.....

..... [3]

[Total: 9]

End of Section A

Section B

Answer all **three** questions in this section in the spaces provided.

- 8** Table 8.1 shows the information about some of the characteristics of 20 students in a class.

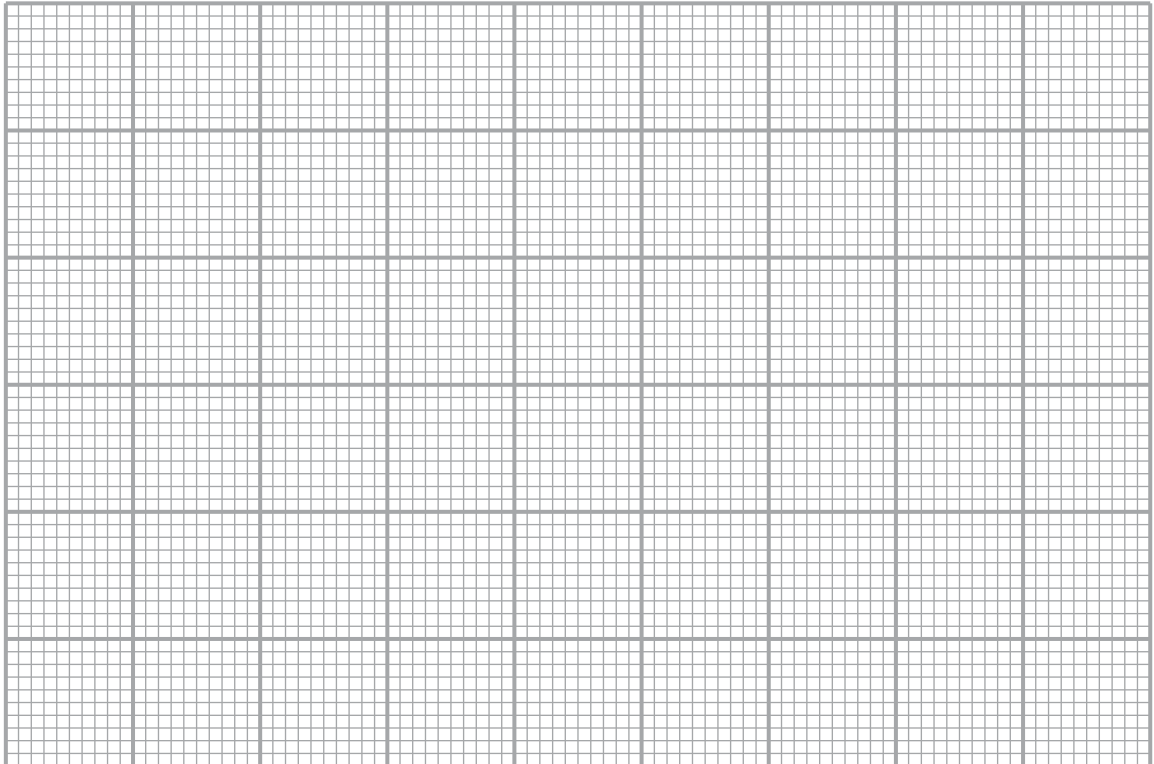
Table 8.1

student	height / cm	blood group	ability to roll tongue
1	136	O	roller
2	165	A	roller
3	159	A	non-roller
4	139	O	roller
5	174	O	non-roller
6	167	AB	non-roller
7	165	O	roller
8	164	A	roller
9	161	B	non-roller
10	169	O	roller
11	179	O	roller
12	170	A	non-roller
13	163	B	roller
14	166	B	roller
15	164	A	roller
16	165	B	roller
17	162	O	roller
18	170	AB	roller
19	168	A	roller
20	168	O	non-roller

- (a) (i)** State and explain the type of variation shown by blood group.

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

- (ii)** On the grid below, plot a bar chart to show the distribution of students with different blood groups. [3]



- (b)** Both parents of student 1 have blood group A.

Use a genetic diagram to explain how two parents with blood group A are able to have a child with blood group O.

[4]

- (c)** The ability to roll tongue is determined by a pair of alleles.

Students 19 and 20 are fraternal twins. Both their parents are tongue rollers.

Deduce, with reasons, whether the allele for tongue rolling is dominant or recessive.

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.....

..... [3]

[Total: 11]

..... [5]

Discuss the potential advantages and dangers of using genetic engineering to produce crop plants for this purpose.

..... [4]

[Total: 9]

10 A small toddler went barefooted into the grass field and stepped on a sharp object.

A series of reactions as shown below occurred:

reaction 1: Leg muscles contract to draw back foot upon stepping on sharp object.

reaction 2: Pain is felt on the foot with blood flowing out from the wound.

reaction 3: The toddler starts to cry.

(a) Explain briefly why reaction 1 is an involuntary reaction.

.....

.....

.....

..... [2]

(b) Describe and explain the action of the body's clotting mechanism on the large wound formed in reaction 2.

.....

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..... [4]

- (c) Describe the route taken by the nerve impulse in reaction 3.

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..... [4]

[Total: 10]

End of Paper

ANSWERS

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



Geylang Methodist School (Secondary)

Preliminary Examination 2020

Candidate
Name

ANSWERS SCHEME

Class

Index
Number

BIOLOGY

Paper 2

6093/02
Sec 4 Express

Additional materials: Nil

1 hour 45 minutes

Setter: Miss Ng Sio Ying

26 Aug 2020

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 on both sides of the paper. 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** questions.

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 12 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 on Section B.

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		
8		11
9		9
10		10
Total		80

Section A

Answer **all** questions in the spaces provided.

- 1 In an investigation, the volume of samples of 20 dried raisins was measured. Each sample was then placed in water or sugar solution of different concentrations.

Fig. 1.1 shows the volume of each sample of raisins after 12 hours.

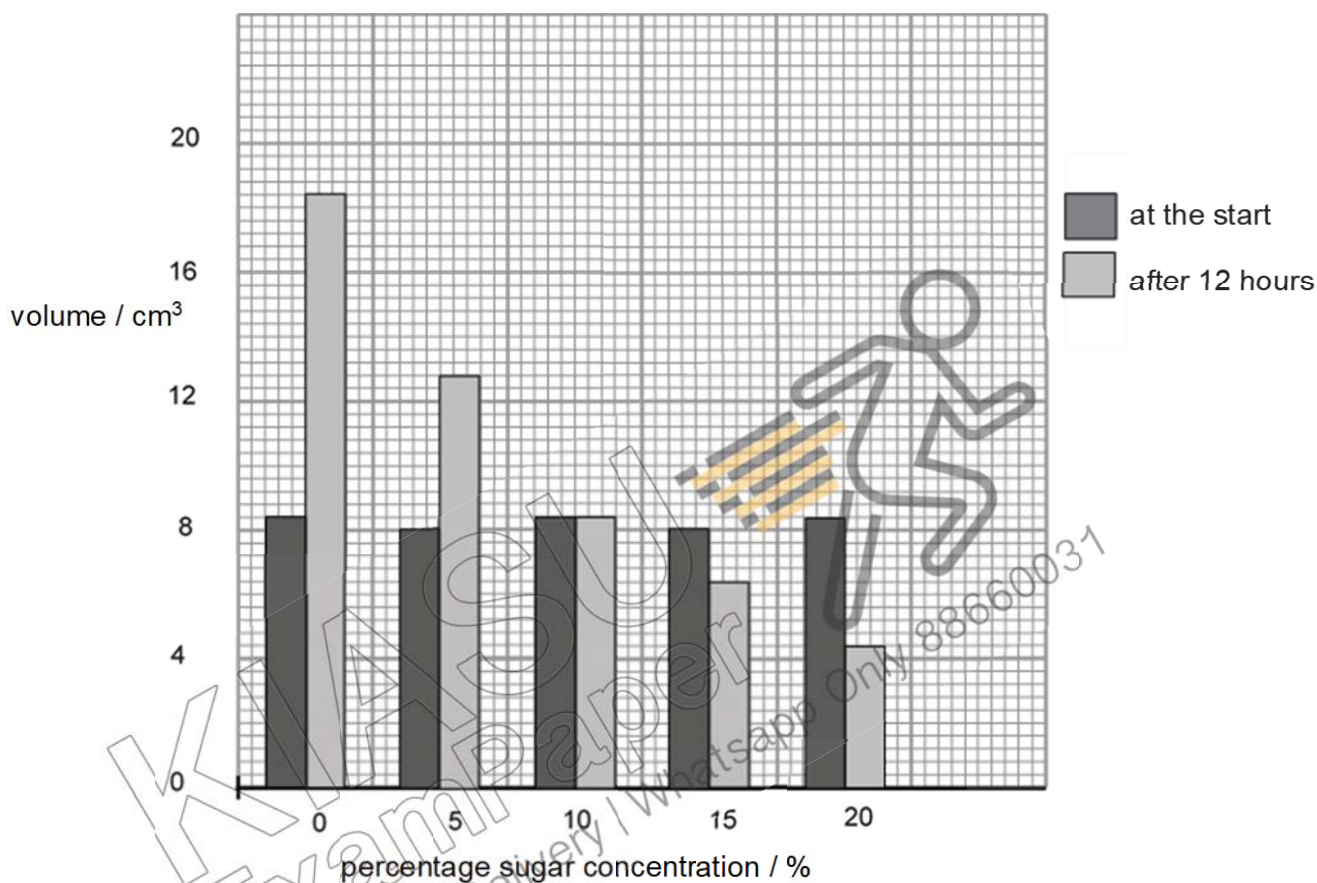


Fig. 1.1

- (a) Explain why samples of 20 raisins were used rather than a sample of one raisin.

To increase the accuracy of the investigation by taking the average results of 20 raisins.

1

[1]

- (b) Explain why there is an increase in the volume of the sample of raisins in 5% sugar solution.

The water potential of the 5% sucrose solution outside the raisin is higher than that of the raisin contents;	1
Water molecules move into the raisins by osmosis down the water potential gradient through the partially permeable membrane causing the raisin to swell and increase in volume;	1

[2]

- (b) Calculate the percentage increase in the volume of the sample of raisins in 5% sugar solution.
(Show your working)

$(12.8 - 8) \text{ cm}^3 / 8 \times 100$	1
= 60%	1

[2]

- (c) Suggest the concentration of the cell sap in the raisin.

Explain your answer.

The concentration of the raisin is 10% sugar solution	1
From the results/ bar chart, it can be seen that there is no net change in volume at 10% sucrose solution / The concentration inside and outside the raisin must be the same / No net movement of water molecules / water potential is the same / no concentration gradient;	1

[2]

[Total: 7]

- 2 It is reputed that almost 65% of the world's population has lactose intolerance. Consuming cow's milk, which has 5% lactose, will result in diarrhoea, bloating and vomiting.

Cow's milk can be treated with enzyme lactase to hydrolyse lactose. The end result is lactose-free milk. Fig. 2.1 shows how the simplified version of this treatment is carried out. Beads are coated with lactase and placed in a funnel-like apparatus. Cow's milk flows over the beads and the lactose is hydrolysed.

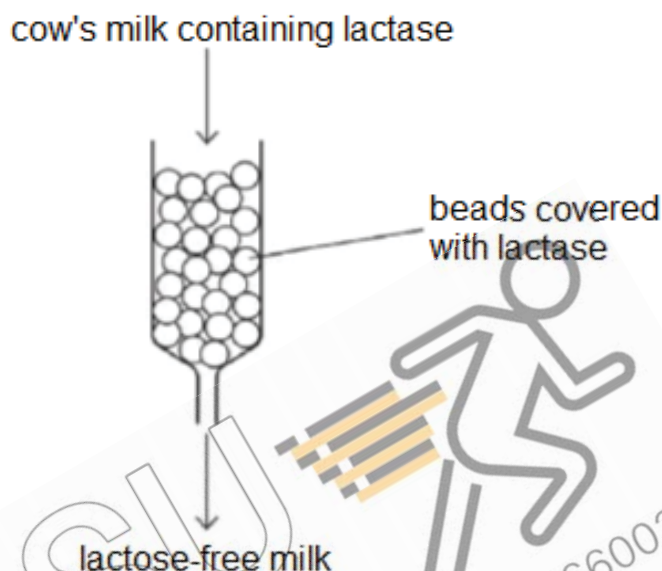


Fig. 2.1

- (a) Using beads coated in lactase is a more efficient use of lactase than adding lactase directly to the cow's milk.

Suggest **two** reasons why this is so.

- | | |
|--|----------|
| <ul style="list-style-type: none">• Lactase beads can be reused as they are not washed away• There is no need to add more lactase as they are not washed away• No need to remove lactase from milk after hydrolysis/efficient reuse of enzymes;• Avoid contamination of product;• Enzymes are spread out/larger surface area to volume ratio/easier contact with substrate for faster reaction;• Longer time for reaction because beads will slow down milk flow; | Any
2 |
|--|----------|

- (b) Suggest why the lactose-free milk made after hydrolysis with lactase tastes sweeter than the cow's milk containing lactose.

Lactose is hydrolysed/broken down/ digested to galactose and glucose	1
Monosaccharide molecules are sweeter in taste;	1

[2]

- (c) An equipment error during the production of lactose-free milk resulted in boiling water being poured over the beads covered with lactase.

Predict how the milk produced due to this equipment error would differ from the expected product and provide a reason for your answer.

The milk produced will contain lactose / will not be lactose-free	1
Lactase has denatured due to high temperatures	1

[2]

[Total: 6]

- 3 Read this passage taken from a website.

Diabetes Mellitus and Glucose Tolerance Test

The name "diabetes mellitus" means "sweet urine." It stems from ancient times, when physicians would taste a patient's urine as a part of diagnosis.

A Glucose Tolerance Test is a diagnostic test for diabetes. After fasting overnight, you are given a concentrated sugar solution (50 to 100 grams of glucose) to drink, and your blood is sampled periodically over the next several hours to test its glucose levels.

Normally, blood glucose does not rise very much and returns to normal within two to three hours. In a diabetic, the blood glucose is usually higher after fasting, rises more after the glucose solution and takes from four to six hours to come down.

*Craig Freudenrich, Ph.D. "How Diabetes Works" 22 June 2001. HowStuffWorks.com.
<<https://health.howstuffworks.com/diseases-conditions/diabetes/diabetes.htm>> 11 July 2020*

Fig. 3.1

Use the information from the passage in Fig. 3.1 to help you answer these questions.

- (a) Explain what causes the blood glucose to return to normal levels within two to three hours of the Glucose Tolerance Test for a normal (non-diabetic) person.

islets of Langerhans cells in the pancreas produces insulin in response to the increase in blood glucose concentration;	1
insulin increases the permeability of cell membranes to glucose;	1
Thus, increases the rate of glucose uptake by cells;	1
insulin increases oxidation of glucose during tissue respiration;	1
insulin stimulates liver and muscles cells to convert glucose to glycogen to be stored in the liver and muscles;	1
all these actions reduce the blood glucose concentration to return to normal	

- (b) Explain the two ways in which a person suffering from diabetes would respond differently to the Glucose Tolerance Test than a normal person.

His pancreas is not able to produce insulin to stimulate the conversion of excess glucose to glycogen / His cells are not responsive to the insulin produced	1
glucose remains in the blood until it is removed through the urine	1

[2]

- (c) Diabetics can control their blood glucose levels artificially by injecting insulin. Insulin is a protein.

Suggest why insulin has to be injected rather than taken orally.

Insulin is a protein and would be digested by protease in the alimentary canal before it can be absorbed.	1
---	---

[1]

[Total: 8]

- 4 Fig. 4.1 is a photomicrograph of a cross-section through the leaf of *N. oleander*.

Nerium oleander is a xerophytic plant. Xerophytic plants have adaptations to survive in an environment with little water, such as a desert or snow-covered region.

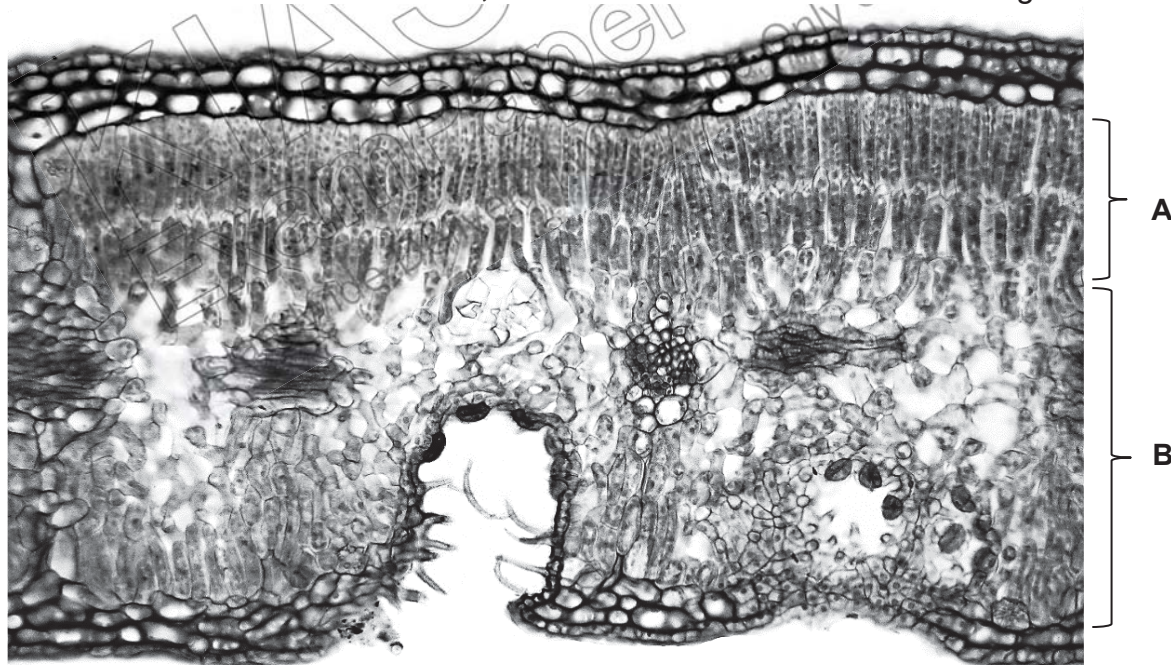


Fig. 4.1

- (a) Identify the tissues labelled A and B.

A palisade mesophyll

B spongy mesophyll

[2]

(b) The leaf shown in Fig. 4.1 has a number of adaptations to reduce water loss by transpiration. Two of the adaptations are:

- a multilayered epidermis
- stomata only found in depressions, known as stomatal crypts, on the lower surface of the leaf.

Explain how the two adaptations will help to reduce water loss in *N. oleander*.

multilayered epidermis

Thick layer of epidermis increases diffusion distance hence slows down water loss by evaporation from the surface
--

1

[1]

stomatal crypts

The leaf has sunken stomata/ stomata that lie in the grooves of the leaf on the lower surface of the leaf OR has hairs that trap water vapour diffusing out of the stomata.
--

1

This increases the humidity around the stomata and so reduces the rate of transpiration.

1

[2]

[Total: 5]

- 5 Table 5.1 shows the results of a survey on fifty females to investigate the impact of smoking on the live birth weight of babies.

All participants were habitual smokers who continued smoking during pregnancy.

Table 5.1

average number of cigarettes smoked each day	average live birth weight of the baby / kg
0	2.78
2	2.60
4	2.45
6	2.33
8	2.20
10	2.12

- (a) Describe and explain the results shown in Table 5.1.

[describe the trend] As the number of cigarettes smoked increases from 0 to 10 sticks, the average live birth weights of a baby decrease from 2.78 to 2.12 kg. (no marks if no reference is made to values in table)	1
[content of cigarette smoke] cigarette smoke contains nicotine.	EITHER explanation 1 – 2 m
[effects of cigarette smoke] nicotine constricts blood vessels including the umbilical blood vessels, hence less oxygenated blood are transported to the developing fetus leading to reduced average live birth weights	
[content of cigarette smoke] cigarette smoke contains carbon monoxide	OR explanation 2 – 2 m
[effects of cigarette smoke] carbon monoxide binds irreversibly to the mother's haemoglobin which result is less oxygenated blood being transported and less oxygenated blood transported to the developing fetus leading to reduced average live birth weights	

[3]

- (b) Name the hormone that is high in concentration throughout pregnancy.

State its source and outline its role in maintaining pregnancy.

[name of hormone] Progesterone	1
[source] Corpus luteum releases progesterone (accept: ovary)	1
[function] to maintain the thickness of the uterine lining	1
[during pregnancy] when the placenta develops, more progesterone is released causing further thickening of uterine lining to ensure sufficient nutrient exchange between mother and fetus	1

[4]

[Total: 7]

- 6 (a) Fig. 6.1 shows the total mass of DNA in a haploid nucleus of an organism's egg cell and the total mass of DNA in a body cell developed from this egg cell after fertilisation and cell division.

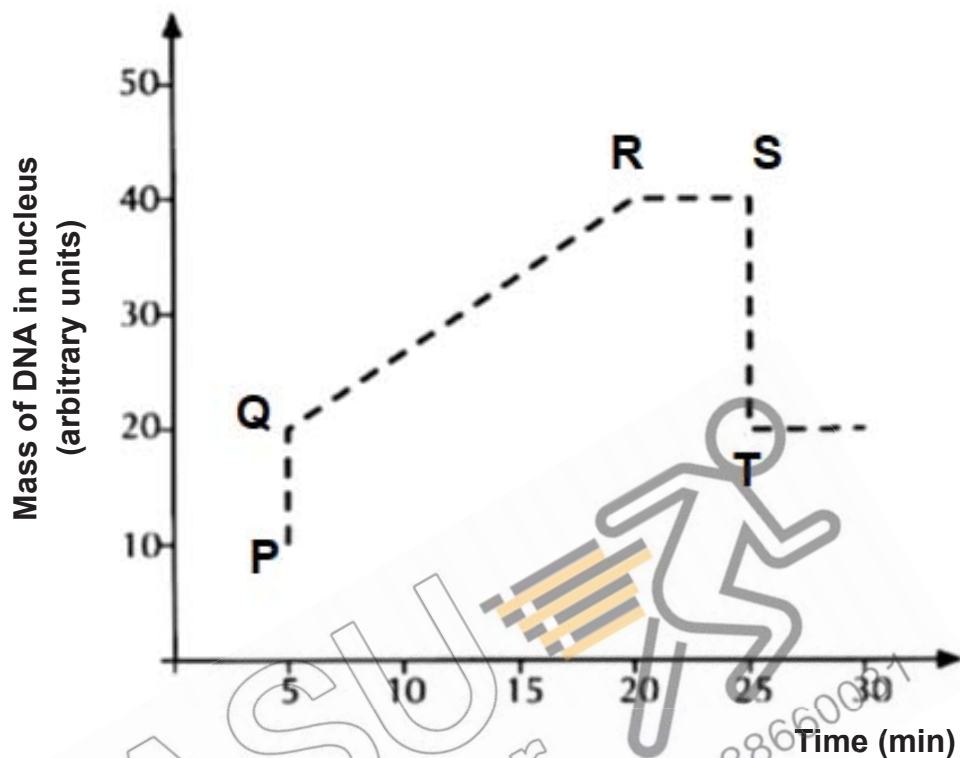


Fig. 6.1

With reference to Fig. 6.1,

- (i) explain what is happening from Q to R.

DNA replication during interphase	1
-----------------------------------	---

1

[1]

- (ii) given that the mass of DNA in a chromosome of this organism is 1 arbitrary unit, state the diploid number of this organism.

20	1
----	---

1

[1]

- (b) Fig. 6.2 is a photomicrograph of a cut section of the root tip of a broad bean plant. The cell labelled **D** is in interphase.

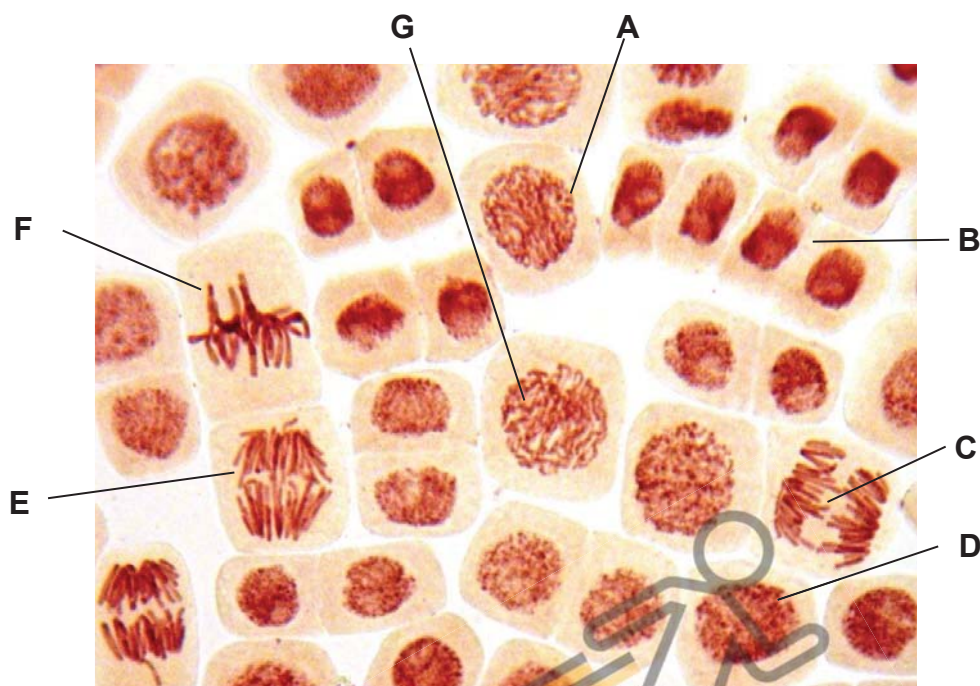


Fig. 6.2

- (i) Complete the table below by:
- naming the stages of mitosis in the correct sequence following interphase.
 - Identifying one example from the cells labelled **A** to **G** that is in the stage of mitosis that you have named.

stage of mitosis	label from photomicrograph
Prophase	A or G
Metaphase	F
Anaphase	C or E
Telophase	B

1 row 1 mark [4]

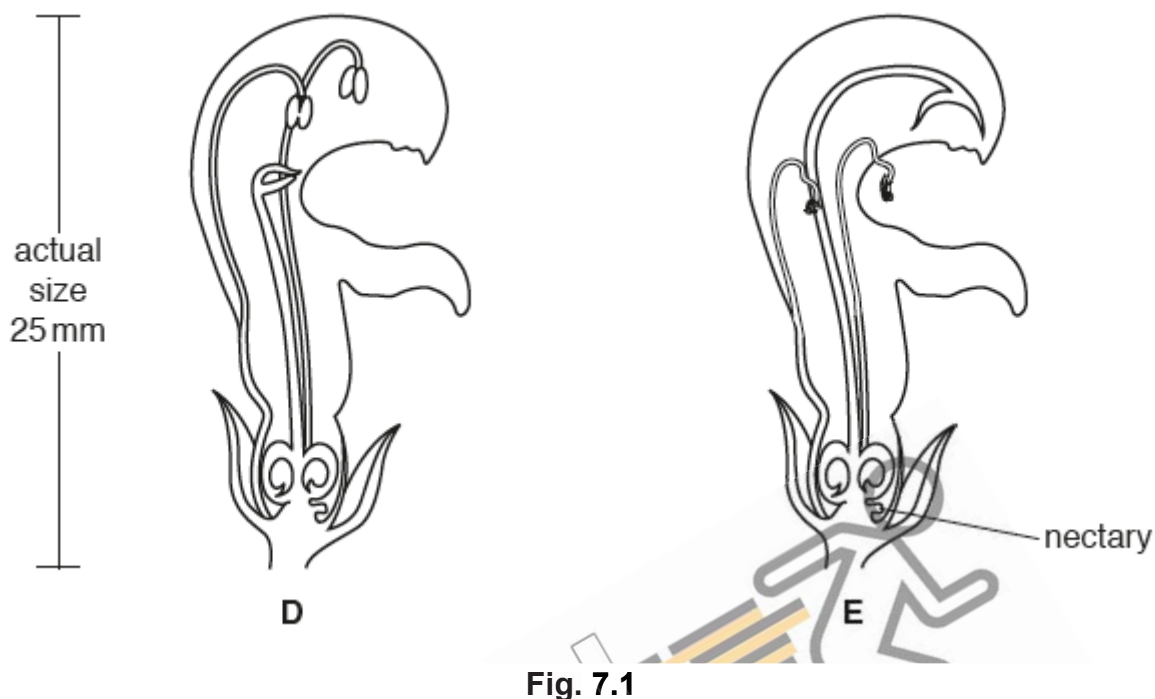
- (ii) Describe how stage **F** is different from a similar stage in meiosis I.

Metaphase 1 in meiosis 1 involves the lining of homologous chromosomes at the equatorial plane but	1
metaphase in mitosis involves lining of chromosomes/sister chromatids only.	1

[2]

[Total: 8]

- 7 Fig. 7.1 shows flowers from the same species of a plant at different stages, **D** and **E**, in their development.



- (a) The flowers are cross-pollinated by an insect.

Explain why the insect must visit flower **D** before visiting flower **E**.

The anthers on flower D are mature and can produce/release pollen while the stigma is closed and cannot receive pollen	1
The anthers on flower E are withered hence no longer produce pollen while the stigma is mature/open .	1
Insect must visit flower D to pick up pollen and then transfer to stigma of flower E .	1

- (b) Suggest how flowers of this species are adapted to be pollinated by an insect such as a bee.

- Large colourful petals to attract insects/for insects to land on; - Nectaries/sweet smell to attract insects; - Nectar guides to guide insects to the nectaries; - Pollen has rough edges/sticky to stick to insects' hairy body; - Compact/not feathery stigma; - Stigma/stamen does not protrude out of flower/non-pendulous;	Any 3
--	----------

[3]

- (c) In some species, some plants have only male flowers while the rest have only female flowers.

Explain the advantages of this to the species.

Ensures cross pollination as 2 parents are involved	1
Offspring can inherit beneficial qualities from both parents	1
Greater genetic variation in offspring hence more adaptive to changing environmental conditions	1

[3]

[Total: 7]

Section B

Answer all **three** questions in this section in the spaces provided.

The last question is in the form of an Either / Or and only one of the alternatives should be attempted.

- 8 Table 8.1 shows the information about some of the characteristics of 20 students in a class.

Table 8.1

student	height / cm	blood group	ability to roll tongue
1	136	O	roller
2	165	A	roller
3	159	A	non-roller
4	139	O	roller
5	174	O	non-roller
6	167	AB	non-roller
7	165	O	roller
8	164	A	roller
9	161	B	non-roller
10	169	O	roller
11	179	O	roller
12	170	A	non-roller
13	163	B	roller
14	166	B	roller
15	164	A	roller
16	165	B	roller
17	162	O	roller
18	170	AB	roller
19	168	A	roller
20	168	O	non-roller

- (a) (i) State and explain the type of variation shown by blood group.

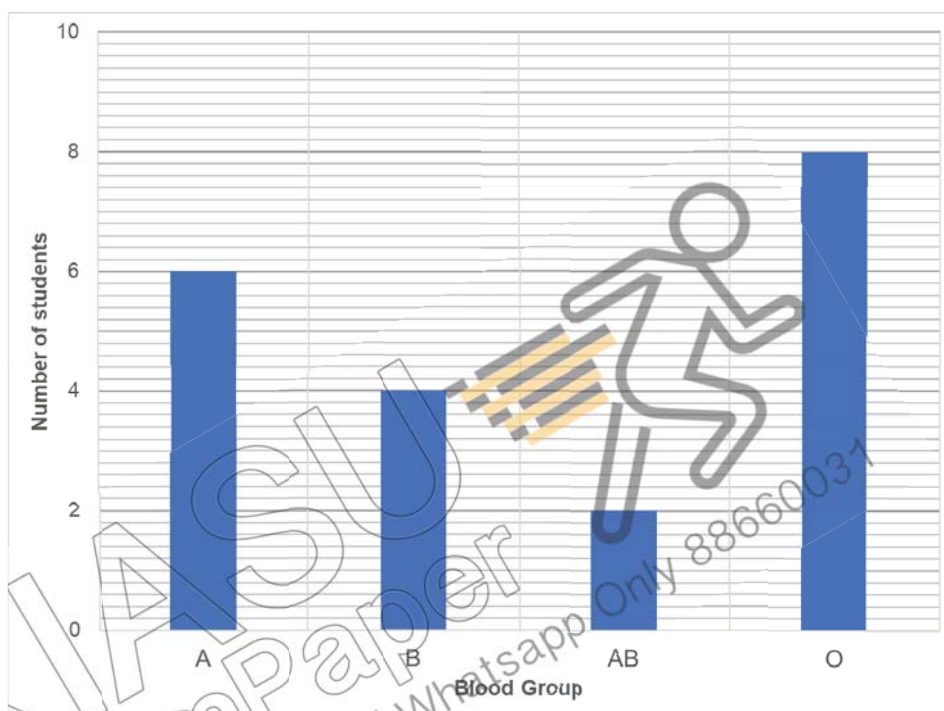
Discontinuous variation.

Blood group occurs in **discrete/ distinct/ clear cut** groups.

1

[1]

- (ii) On the grid below, plot a bar chart to show the distribution of students with different blood groups. [3]



Scale

1

Discrete grouping (equal gaps between bars, bars of equal width, drawn with clear lines)

1

Axes labeled

1

- (b) Both parents of student 1 have blood group A.

Use a genetic diagram to explain how two parents with blood group A are able to have a child with blood group O.

Phenotype of parents	Father Blood group A		Mother Blood group A		1									
Genotype of parents	$I^A I^O$		$I^A I^O$											
Gametes	I^A I^O		I^A I^O		1									
Genotypes of offspring (accept Punnett square or arrows)	<table><tr><td></td><td>I^A</td><td>I^O</td></tr><tr><td>I^A</td><td>$I^A I^A$</td><td>$I^A I^O$</td></tr><tr><td>I^O</td><td>$I^A I^O$</td><td>$I^O I^O$</td></tr></table>					I^A	I^O	I^A	$I^A I^A$	$I^A I^O$	I^O	$I^A I^O$	$I^O I^O$	1
		I^A	I^O											
	I^A	$I^A I^A$	$I^A I^O$											
I^O	$I^A I^O$	$I^O I^O$												
Genotype of offspring	$I^A I^A$	$I^A I^O$	$I^O I^O$											
Phenotype of offspring	Blood group A	Blood group A	Blood group O		1									

[4]

- (c) The ability to roll tongue is determined by a pair of alleles.

Students 19 and 20 are sisters. Both their parents are tongue rollers.

Deduce, with reasons, whether the allele for tongue rolling is dominant or recessive.

ability to roll tongue is a dominant trait	1
both parents are heterozygous for the trait	1
each contribute one recessive allele to student 20 who is a non roller	1

Reverse is true

ability to roll tongue is a dominant trait	1
it cannot be recessive as both parents being tongue rollers, they will be homozygous recessive	1
they will not be able to produce child 20 who is a non-tongue roller as they do not have the dominant allele to pass down.	1

[3]

[Total: 11]

- 9 (a) Describe the structure of DNA.

DNA is a double helix made up of two anti-parallel strands.	1
Each strand consists of repeating units of nucleotides . Each nucleotide comprises of a deoxyribose sugar, a phosphate group and a nitrogenous base .	1
There are four types of nitrogenous bases, adenine, guanine, thymine and cytosine .	1
Adenine binds to thymine while guanine binds to cytosine , also known as complementary base pairing.	1
Hydrogen bonds hold the two strands of polynucleotides together to form a DNA molecule.	1

[5]

- (b) Genetic engineering can also be used to produce crop plants for consumption by humans.

Discuss the potential advantages and dangers of using genetic engineering to produce crop plants for this purpose.

Potential advantages: • increase yield of genetically modified crop grown / able to grow quickly • Able to grow in harsh environment conditions, grow in new areas • able to transfer beneficial genes / characteristics between species. • Can be resistant to diseases or pests.	Any 2
Potential dangers • risk of diseases spread to other species • Expensive / costly to implement genetic engineering • Possible health risks to people / organisms when consuming genetically modified crops / possible food allergies	Any 2

[4]

[Total: 9]

- 10** A small toddler went barefooted into the grass field and stepped on a sharp object.

A series of reactions as shown below occurred:

Reaction 1: Leg muscles contract to draw back foot upon stepping on sharp object.

Reaction 2: Pain is felt on the foot with blood flowing out from the wound.

Reaction 3: The toddler starts to cry.

- (a)** Explain briefly why reaction 1 is an involuntary reaction.

Response is immediate/ without requiring conscious thought;	1
impulses travel through reflex arc involving the spinal cord only and bypassing the brain;	1

[2]

- (b)** Describe and explain the action of the body's clotting mechanism on the large wound formed in reaction 2.

Damaged cells and platelets release thrombokinase;	1
Thrombokinase activates prothrombin to thrombin with the help of calcium ions;	1
Thrombin converts soluble fibrinogen into insoluble fibrin threads;	1
Mesh-like structure formed which traps blood cells to prevent the further loss of blood;	1

[4]

- (c)** Describe the route taken by the nerve impulse in reaction 3.

Pain receptors in skin stimulated and electrical impulse generated	1
Sensory neurone transmit impulses to relay neurone in spinal cord;	1
Relay neurones transmit impulses within the spinal cord up to the brain;	1
Brain interprets impulses as pain / initiates crying response – as a result of awareness of pain;	1

[4]

[Total: 10]

