Class/ Index Number /	Centre Number/ 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

BIOLOGY
Paper 1 Multiple Choice

6093/01
28 August 2020
1 hour

Additional Materials:
Optical Test Answer Sheet (OTAS) – 1 sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class, index number, Centre number and 'O' Level index number on the Answer Sheet in the spaces provided.

There are **forty** questions on 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 answer in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

The total number of marks for this paper is 40.

At the end of the examination, hand in the following separately:
(1) Optical Test Answer Sheet (OTAS)
(2) Question Paper

1 The endoplasmic reticulum (ER) comprises of interconnected sacs or tubules suspended in the cytosol, a liquid found inside the cell. It has the following characteristics:

1: comprised of mostly tubules

2: comprised of flattened membranous sacs

3: involved in the synthesis of steroid hormones, e.g. testosterone

4: involved in the transport of polypeptides

Which of the characteristics describe rough ER and smooth ER?

	rough ER	smooth ER
A	1 & 3	2 & 4
B	1 & 4	2 & 3
C	2 & 3	1 & 4
D	2 & 4	1 & 3

2 A mixture of food gives the following results on testing:

A lilac colour in the biuret test;

A blue colour when heated with Benedict's solution;

A yellow colour with iodine;

A white emulsion with ethanol.

What does the mixture contain?

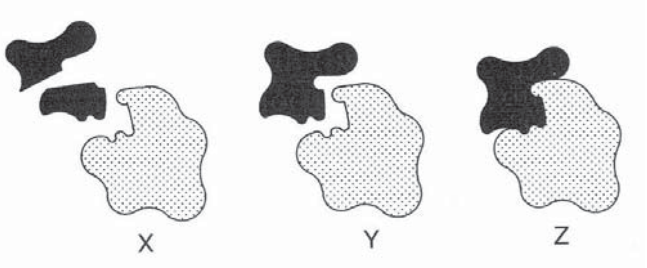
A fat and protein

B protein and reducing sugar

C reducing sugar and starch

D starch and fat

3 The diagram shows three stages that occur during an enzyme-controlled reaction.



Which of the following indicates the correct sequence in which the three stages would occur if the enzyme promotes the building-up of a complex molecule from simpler ones?

A Y → X → Z

B Y → Z → X

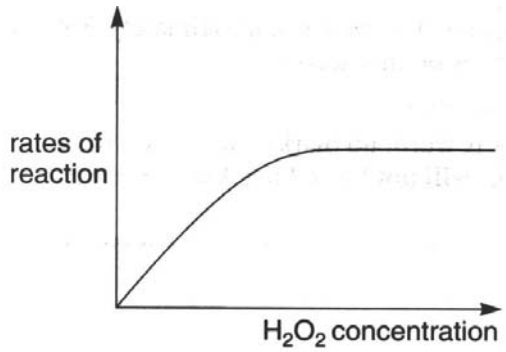
C X → Y → Z

D X → Z → Y

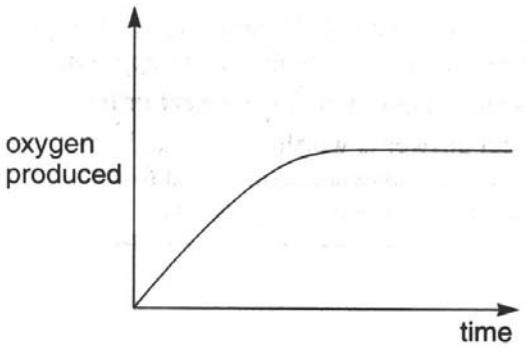
For **Q4-5**, refer to the following information.
An experiment was performed to investigate the effect of the enzyme catalase on hydrogen peroxide. The reaction was as follows:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

From the results of this investigation, the following graphs X and Y were obtained:



graph X



graph Y

4 In graph X, when there is an increase in the catalase concentration,

A the rate will be the same at the start but it will reach a higher plateau.

B there will be an increase in the rate at the start and it will reach a higher plateau.

C there will be an increase in the rate at the start but it will reach the same plateau.

D there will be no change.

5 In graph Y, when there is an increase in the catalase concentration,

A the rate will be the same at the start but it will reach a higher plateau.

B there will be an increase in the rate at the start and it will reach a higher plateau.

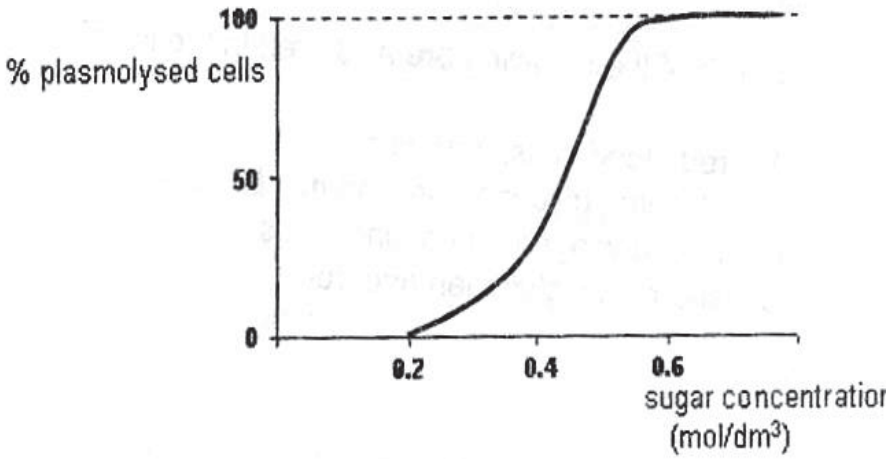
C there will be an increase in the rate at the start but it will reach the same plateau.

D there will be no change.

6 Benedict's Test was performed on a 20 cm^3 sample of four fruit syrups.
A second 20 cm^3 sample of each was then hydrolysed and tested with Benedict's solution.
The table shows the masses of precipitate formed.
Which syrup contains the greatest mass of non-reducing sugar?

syrup	mass of precipitate before hydrolysis/ mg	total mass of precipitate after hydrolysis/ mg
A	25	55
B	75	85
C	55	55
D	50	70

7 The following graph illustrates the percentage of plasmolysed leaf cells at different concentrations of sugar solution.



The above results suggest that the leaf cells

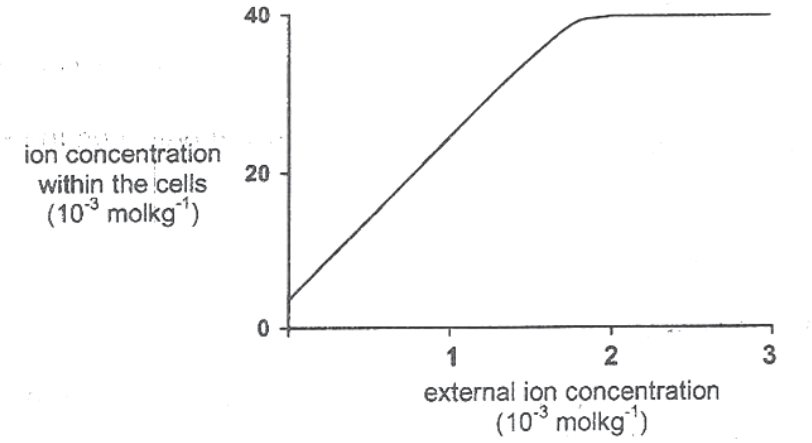
A are resistant to low sugar concentration.

B have cell sap of different concentration.

C are of different shapes.

D are of different sizes.

8 The graph below shows the effect of the change in the external concentration of an ion on the concentration of the same ion within the same plant cells.



Which of the following conclusion(s) can be drawn from the graph?

I The ion is taken up by the cells against a concentration gradient.

II The uptake of the ion occurs only in living cells.

III The cell surface membrane becomes impermeable to the ion when the external ion concentration reaches 2×10^{-3} mol kg^{-1}.

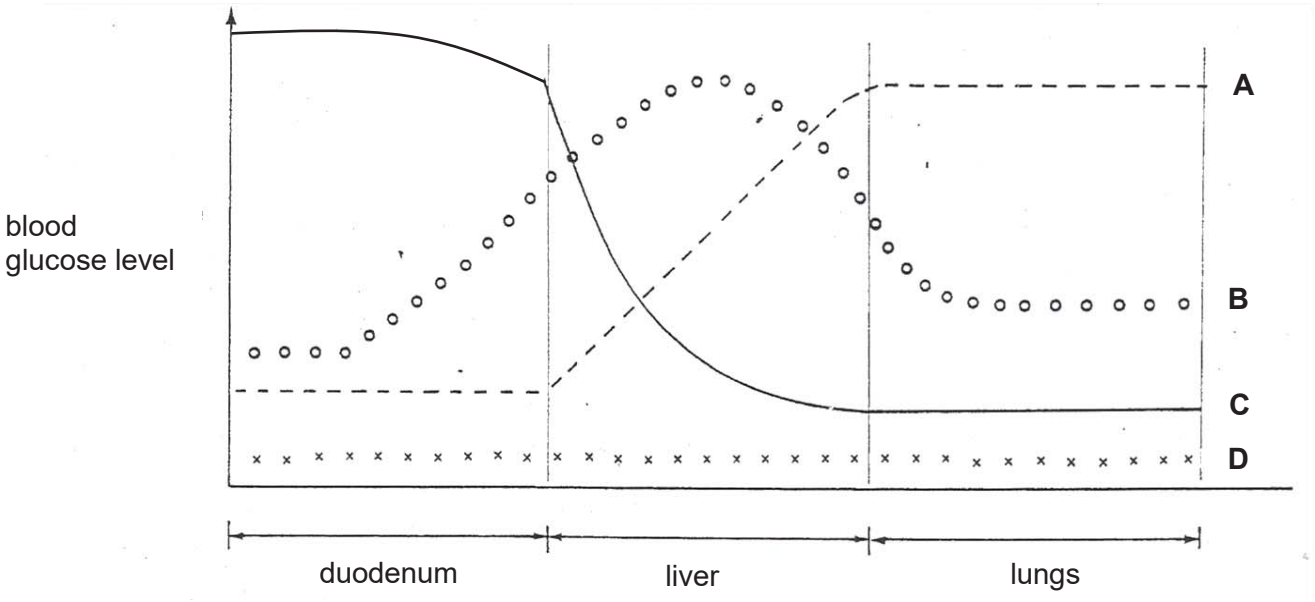
A I only

B III only

C I and II only

D II and III only

9 Which of the following curves best represents the change in the glucose level of blood flowing through the following organs of a man who has starved for eight hours?



10 Shutting of the cuspid valves (atrio-ventricular) of the heart is caused by

A blood pressure in the ventricles rising.

B blood pressure in the atria (auricles) rising.

C the muscles attached to the valves contracting.

D the heart strings contracting.

11 Human blood passes from the inferior (posterior) vena cava into the diastolic right atrium of the heart as a result of

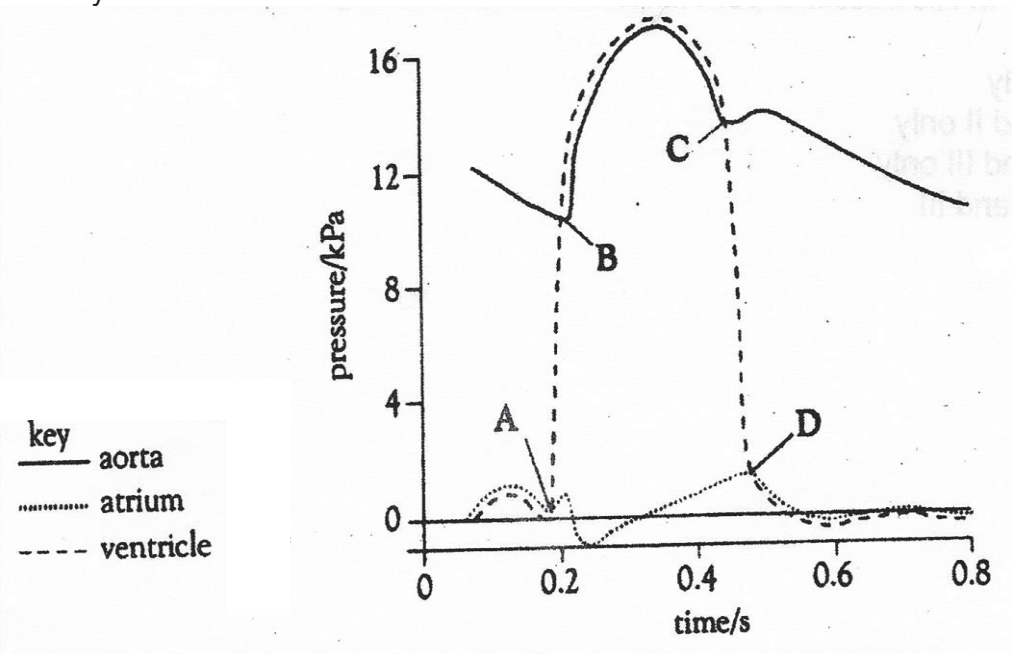
A mass flow of blood.

B the closure of venous valves.

C the closure of tricuspid valve.

D a pressure difference between the atrium and the vena cava.

12 The diagram below shows information on blood pressure in the aorta, left atrium and left ventricle during a cardiac cycle.



At which labelled point does the semi-lunar valve of the aorta close?

13 The cut surface of apples turns brown after exposure to air due to an enzyme present. Dipping the apples in some diluted lemon juice stops the browning. Which of the following offers the best explanation?

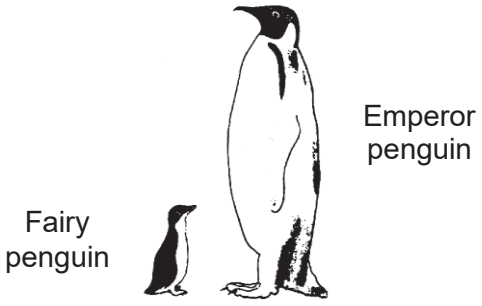
A The lemon juice washed away the enzymes.

B The acidity of the lemon juice denatured the enzymes.

C The lemon juice sealed off exposure to the air.

D Osmosis took place.

14 The diagram shows a Fairy penguin and an Emperor penguin.



Which statement correctly explains why Fairy penguins are found in Australia and Emperor penguins found in Antarctica? Compared to Emperor penguins, Fair penguins have

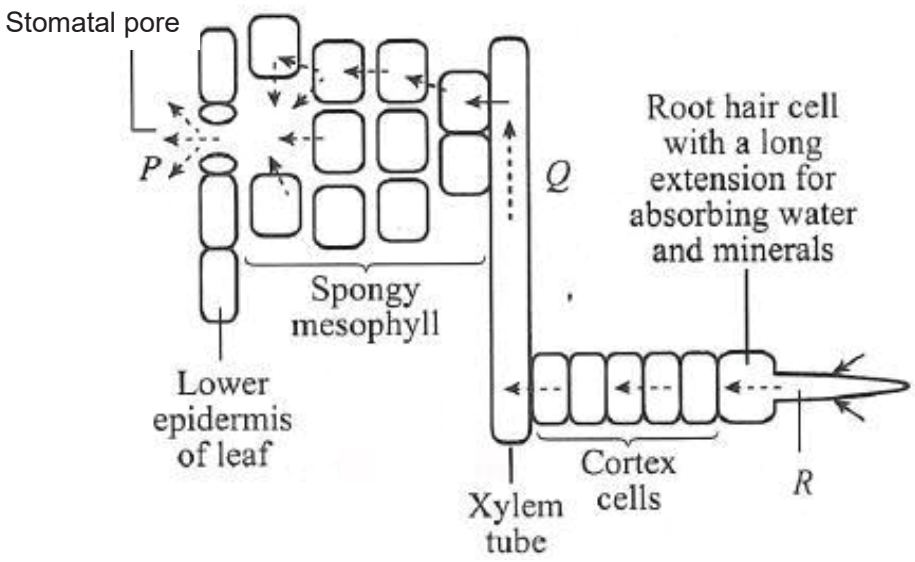
A smaller surface area to volume ratio and lose heat more easily.

B larger surface area to volume ratio and lose heat more easily.

C smaller surface area to volume ratio and lose heat less easily.

D larger surface area to volume ratio and lose heat less easily.

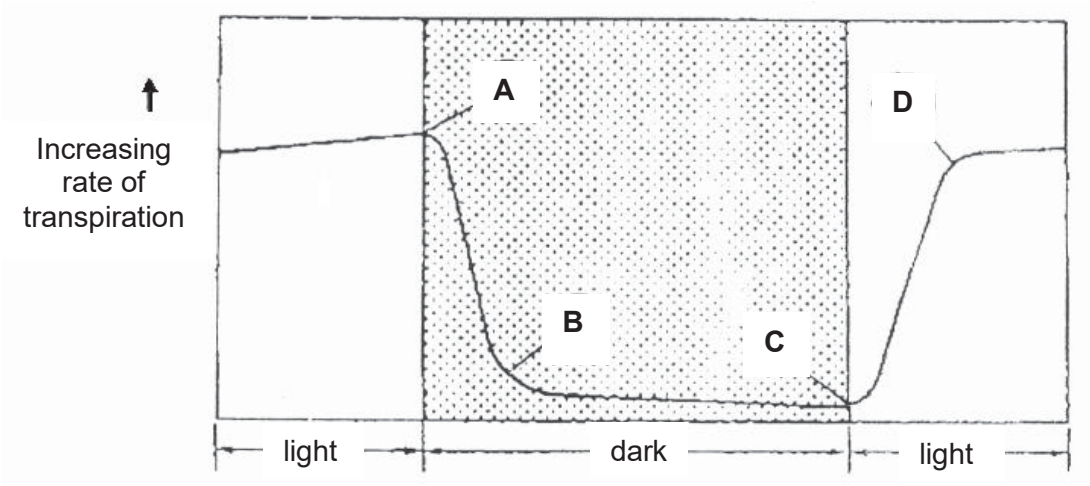
15 The diagram shows the transport of water through a plant.



What causes the movement of water at P, Q and R?

	P	Q	R
A	diffusion	transpiration pull	osmosis
B	transpiration pull	capillary action	osmosis
C	osmosis	capillary action	active transport
D	diffusion	transpiration pull	root pressure

16 The following graph shows the rate of transpiration from the leaves of a plant.



At which point (**A**, **B**, **C**, or **D**) does the stomata begin to open?

17 The table below gives some information about the uptake of oxygen by an athlete at rest and under conditions of strenuous exercise.

	% O_2 in inhaled air	% O_2 in exhaled air	% O_2 uptake	intake of air per breath / dm^3	breaths per minute
at rest	21.0	17.0	4.0	0.5	12
exercise	21.0	15.0	6.0	2.0	30

What volume of oxygen is taken up during one minute of exercise?

A 0.36 dm^3 **B** 1.5 dm^3

C 2.4 dm^3 **D** 3.6 dm^3

18 The rate of breathing movements in a human responds very sensitively and immediately to

A the percentage of oxygen in the air.

B the rate of heart beat.

C the percentage of carbon dioxide in the blood.

D the number of red blood cells in the blood.

For **Q19-20**, refer to the following information.
The table below shows the relative amounts of substances found in the glomerular filtrate and urine of a human in one day.

substance	glomerular filtrate (g)	urine (g)
amino acids	10	0.5
protein	0	0
salt	10 000	9750
glucose	200	0
urea	65	50
water	200 000	2000

19 Using the above information and your knowledge, it would be expected that

A the salt concentration in the filtrate and urine are in equilibrium.

B glucose is absorbed by diffusion.

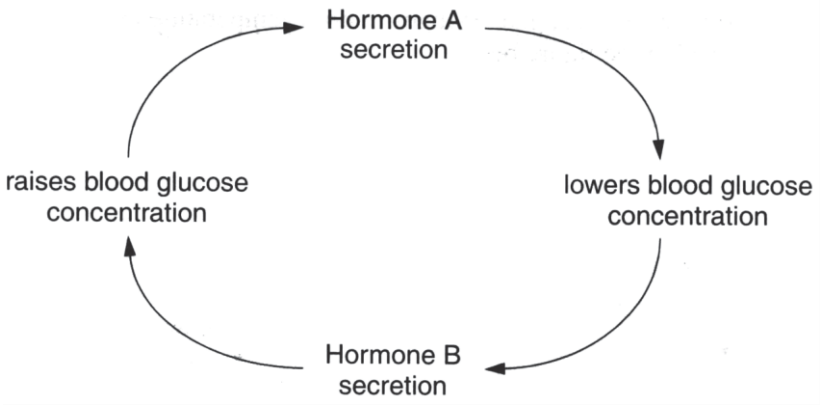
C urea is excreted by active transport.

D water is absorbed by osmosis from the filtrate.

20 Energy would be required for the absorption of _____.

A amino acids **B** water
C urea **D** salt

For **Q21-24**, refer to the following information.



21 Hormone A would be secreted _____.

A before a meal **B** after a meal
C before exercise **D** during exercise

22 Hormone B would be secreted _____.

A before a meal **B** after a meal
C before exercise **D** during exercise

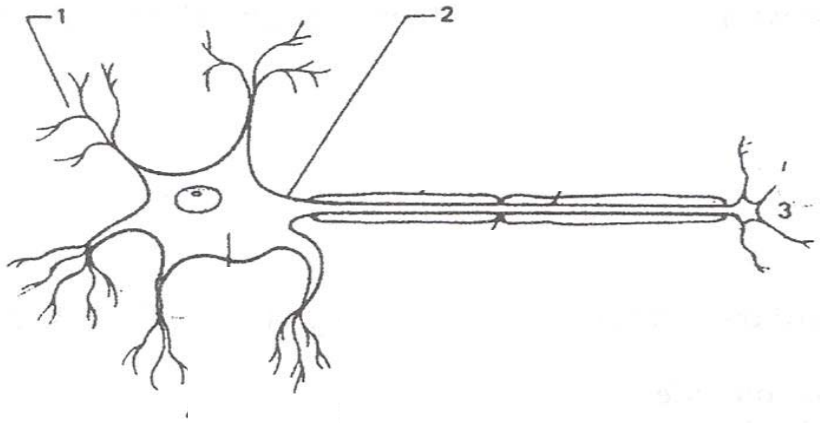
23 The above pathway is an example of _____.

A negative feedback **B** stimulus response
C homeostasis **D** reflex action

24 Hormone B is _____.

A antidiuretic hormone (ADH) **B** insulin
C glucagon **D** pancreatase

25 Refer to the diagram of a motor (effector) neurone below:



Which of the following shows the correct path of nervous impulse flow through the motor neurone?

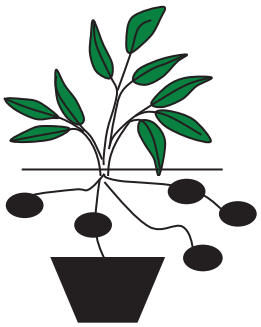
A 1 → 2 ← 3 **B** 1 ← 2 ← 3

C 1 → 2 → 3 **D** 1 ← 2 → 3

26 When the eye is focused on far objects, which of the following sequences gives the correct state of the lens, the ciliary muscles and the suspensory ligaments?

	lens	muscle	ligament
A	most convex	relaxed	slackened
B	least convex	contracted	slackened
C	least convex	relaxed	taut
D	most convex	contracted	taut

27 The diagram shows a potato plant that can reproduce asexually by tubers.



Four observations were made about the potato plant.

1. There is one parent plant.
2. The tubers are attached to the parent.
3. The tubers are genetically identical to the plant.
4. The tubers store food.

Which of these observations describe asexual reproduction?

A 1 and 3 **B** 2 and 3

C 1 and 4 **D** 2 and 4

28 A woman's menstrual period started on 23rd March. In which week was an egg most likely to have been released?

	March						
Week	Sun	Mon	Tue	Wed	Thurs	Fri	Sat
A	-	-	-	1	2	3	4
B	5	6	7	8	9	10	11
C	12	13	14	15	16	17	18
D	19	20	21	22	23	24	25
	26	27	28	29	30	31	

29 Which of the following correctly indicates the stages of mitosis at which particular events occur?

	DNA replication	breakdown of nuclear membrane	division of centromere
A	interphase	metaphase	metaphase
B	interphase	prophase	anaphase
C	interphase	interphase	anaphase
D	prophase	interphase	metaphase

30 Independent assortment of chromosomes is one of the most important events in meiosis because

A it produces new combinations of the genetic information in gametes.

B it limits variation in genetic information.

C it halves the number of chromosomes in each cell during segregation.

D it allows for exchange of genetic information between chromosomes.

31 The table shows the percentages of bases in DNA from various types of cell.

source of DNA	adenine	guanine	thymine	cytosine
ox thymus	28.2	21.5	27.8	22.5
ox spleen	27.9	22.7	27.3	22.1
ox sperm	28.7	22.2	27.2	22.0
rat bone marrow	28.6	21.4	28.4	21.5
yeast	31.3	18.7	32.9	17.1

Which of the following is a valid deduction from these data?

A DNA is composed of two strands twisted around each other.

B DNA occurs in about the same amounts in all cells from the same species.

C The four bases show complementary base pairing.

D The structure of DNA is the same in both yeast and animal cells.

32 Two organisms with the same genotype

A must have the same phenotype.

B would have the same appearance regardless of the environment.

C could have the same phenotype.

D must be related.

33 If a man who belongs to blood Group A marries a woman of blood Group B, what will be the possible blood groups of their children if both parents are heterozygous for this character?

A all Group A

B all Group B

C 1 Group A : 1 Group B : 1 Group AB : 1 Group O

D 1 Group A : 1 Group B : 1 Group AB

For **Q34-36**, refer to the following information.
With extensive and continued use of antibiotics such as tetracycline, many strains of bacteria have become resistant to antibiotics. Resistance to antibiotics is found in plasmids with the bacterium. Plasmids can be transferred from one bacterium to another, when in close association. For certain diseases, tetracycline is not prescribed.

34 Plasmids are _____ .

A mRNA **B** protein
C DNA **D** antibodies

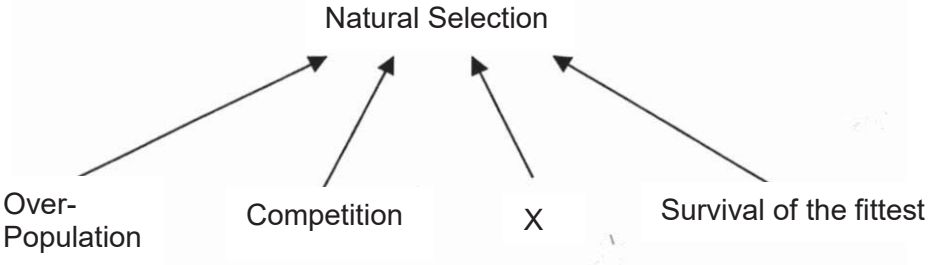
35 Which of the following processes is responsible for the bacteria to develop resistance to an antibiotic?

A mutation **B** evolution
C natural selection **D** variation

36 The initial source of the original variation is due to _____ .

A sexual reproduction **B** asexual reproduction
C crossing over **D** mutation

37 Some of the concepts included in Darwin's Theory of Natural Selection is represented in the diagram below:



Which concept could be correctly represented by X?

A meiosis **B** mutation
C transmission of acquired traits **D** variation

38 The production of a molecule of protein involves the stages in the following list.

1. messenger RNA passes out of nucleus into cytoplasm
2. region of DNA in nucleus opens up
3. protein is made according to the order of codewords on mRNA
4. mRNA is made against a DNA strand

The correct order of these stages is
A 2, 4, 3, 1 **B** 2, 4, 1, 3 **C** 4, 2, 1, 3 **D** 4, 2, 3, 1

39 The diagram shows the nucleotide sequence of a gene on a DNA template:

CGCCGCACGCGC

The table shows the amino acids coded for by 10 mRNA codons.

mRNA codon	amino acid
AAG	Lys
ACG	Thr
CGG CGC CGU	Arg
CCG	Pro
GCC GCG	Ala
GGC	Gly
UGC	Cys

What is the order of the four amino acids in the polypeptide translated from this small section of a gene?

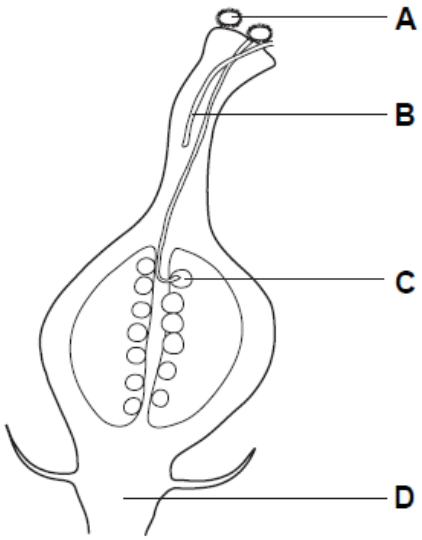
A Ala-Ala-Cys-Ala

B Ala-Arg-Gly-Ala

C Arg-Ala-Pro-Arg

D Arg-Arg-Thr-Arg

40 New plants may be grown from groups of cells that are taken from other plants.
The diagram shows part of plant **X**.
From which structure will cell samples grow into new plants that are genetically identical to plant **X**?



Plant **X**

End of Paper

Class/ Index Number /	Centre Number/ 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

BIOLOGY **6093/02**
Paper 2 **25 August 2020**
1 hour 45 minutes

Candidates to answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number, Centre number, O level index number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section A of the paper.
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.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

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

Section A

Answer **all** questions. Write your answer in the spaces provided.

1 **(a)** Explain the differences between the terms “agglutination” and “clotting”.

[4]

(b) Explain why people with blood group O are universal donors, while people with blood group AB are universal recipients.

[4]

[Total:8]

2 Describe the path taken by a molecule of carbon dioxide as it passes from air outside a leaf to a fruit in the plant.

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[5]

[Total: 5]

3 **(a)** A student completed his 2.4km NAPFA test in 10 minutes and rested for 10 minutes.

Fig. 3.1 shows the lactic acid and muscle glycogen concentration in blood samples taken from the student at different time intervals.

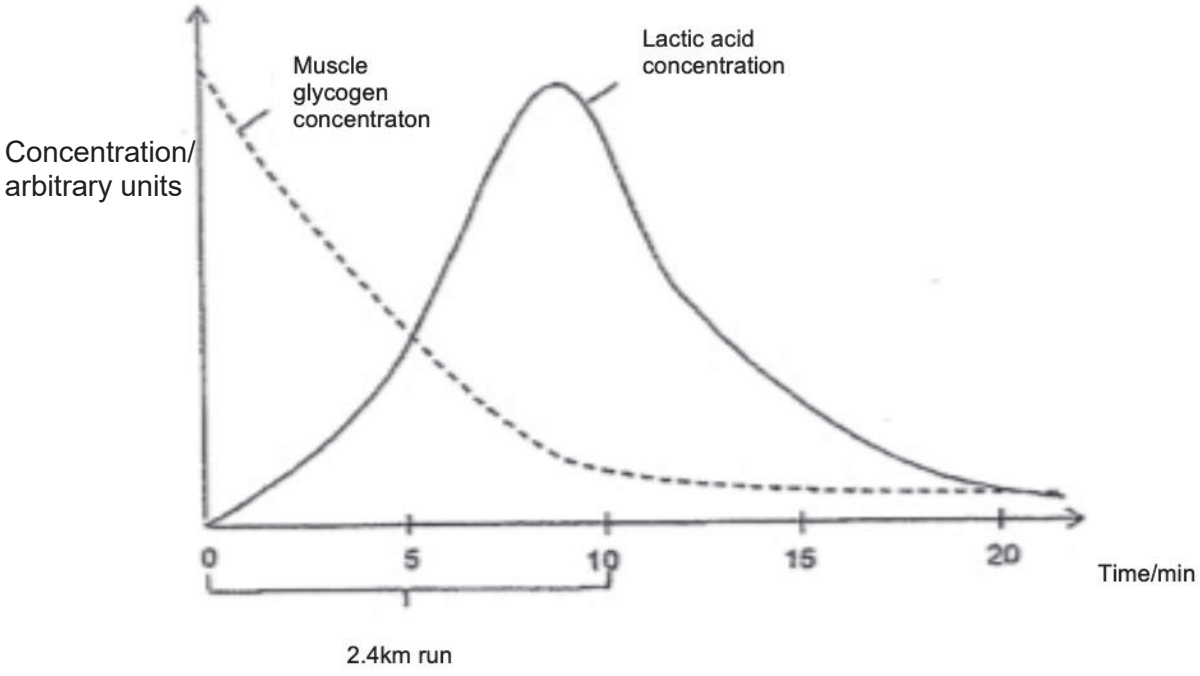

Fig. 3.1

(i) On **Fig. 3.1**, draw a line representing the oxygen intake of the student. [1]

(ii) Explain the decrease in muscle glycogen concentration during the run.

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..... [2]

(iii) Describe and explain the changes in lactic acid concentration during rest.

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..... [3]

(b) **Fig. 3.2** below shows the relationship between an alveolus and a blood capillary in the lung of a mammal. The arrows show the path taken by oxygen from inhaled air entering the blood during gas exchange.

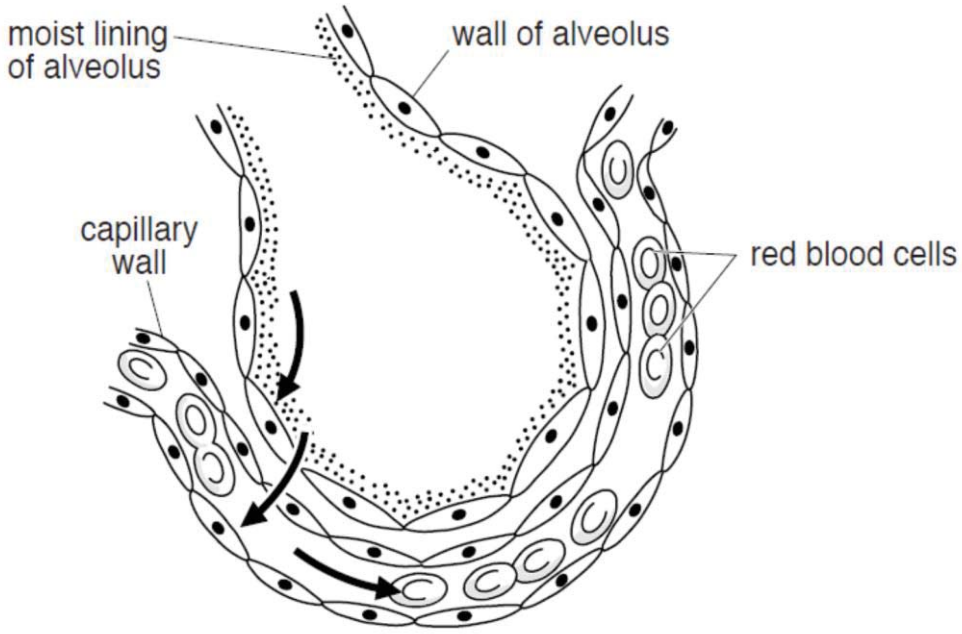

Fig. 3.2

(i) Draw two arrows on **Fig. 3.2** to show the path taken by most carbon dioxide leaving the blood. [1]

(ii) Explain why this movement of carbon dioxide is considered a form of excretion.

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..... [1]

[Total: 8]

4 **Fig. 4.1(a)** and **Fig. 4.1(b**) show a section through the skin of a person at two different temperatures.

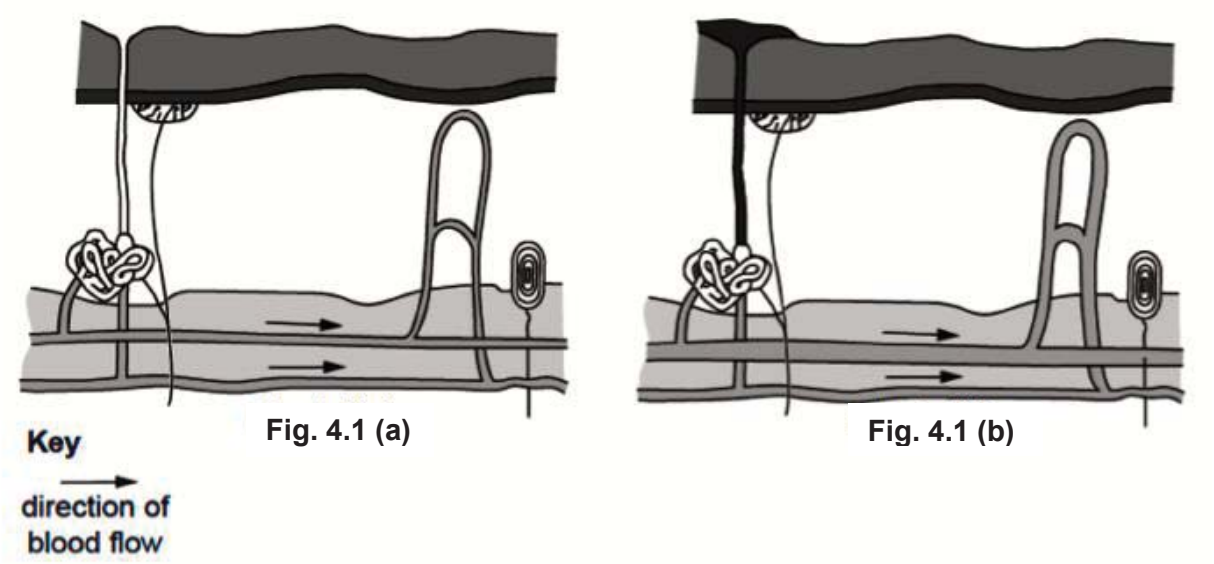

Fig. 4.1 (a)

Fig. 4.1 (b)

(a) On **Fig 4.1(a)**, identify and label the sweat gland and temperature receptor. [1]

(b) State what happened to the body temperature to cause the changes shown in **Fig. 4.1(b)** compared with **Fig. 4.1(a)**. Explain your answer.

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..... [4]

[Total: 5]

5 **(a)** Define the term *limiting factor.*

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[1]

(b) A researcher carried out four experiments, **A** to **D**, to investigate the effect of light intensity on the rate of photosynthesis of cucumber plants. The experiments were carried out at two concentrations of carbon dioxide and at two temperatures.

The results are shown in **Fig. 5.1**

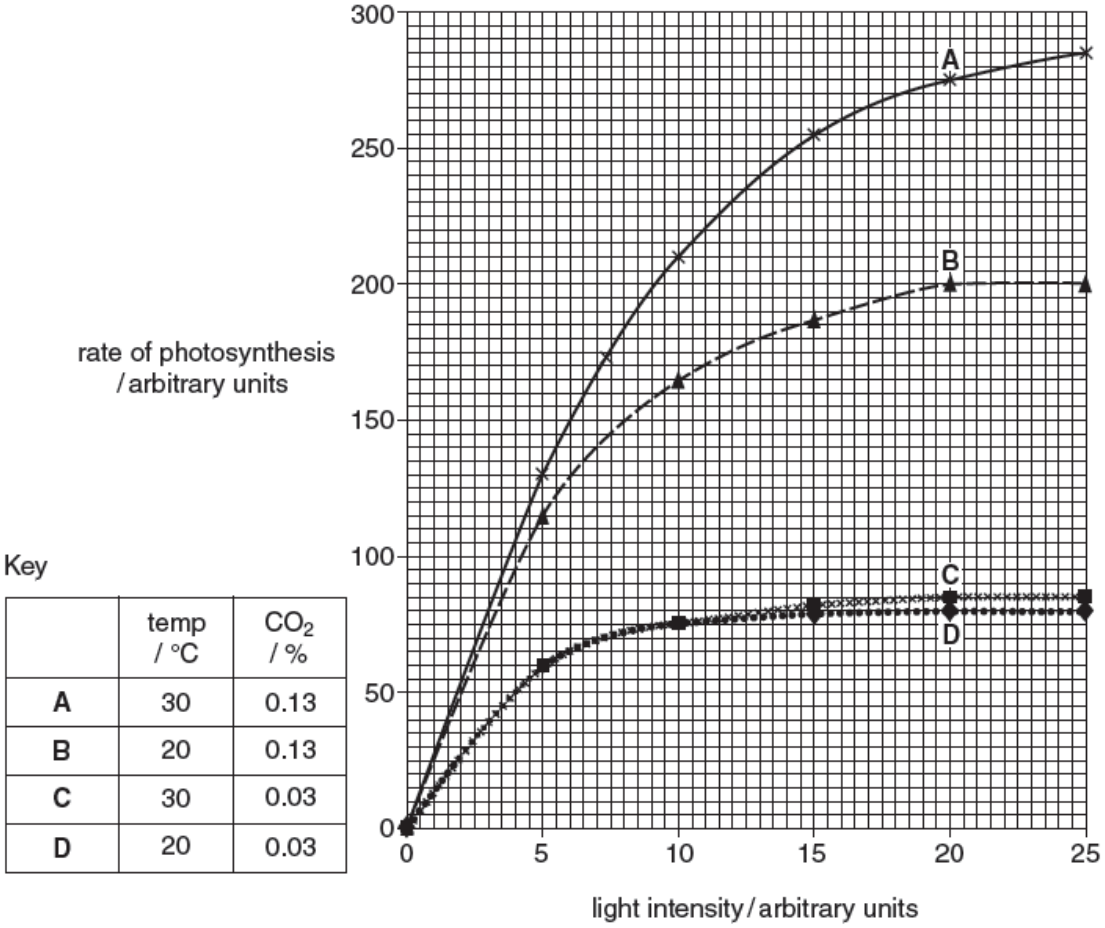

Fig. 5.1

Use the results in **Fig. 5.1** to identify the limiting factor for the rate of photosynthesis at the light intensities given in **Table 5.1**. Write your answers in **Table 5.1**.

Table 5.1

experiment	light intensity/arbitrary units	limiting factor
A	20	
B	20	
C	20	
D	5	light intensity

[3]

[Total: 4]

6 An investigation was carried out in China using crop residues and animal manure mixed together in composting units that were placed into a glasshouse containing crop plants.

Fig. 6.1 shows a composting unit in which decomposition takes place.

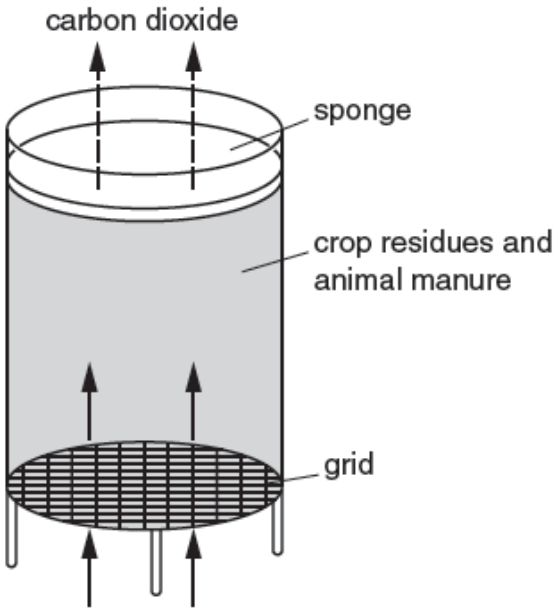

Fig. 6.1

Two glasshouses were used in this investigation. One glasshouse contained composting units and the other did not. Each glasshouse contained the same number and type of crop plants.

The concentration of carbon dioxide in both glasshouses was measured at midday.
The results are shown in **Fig. 6.2**.

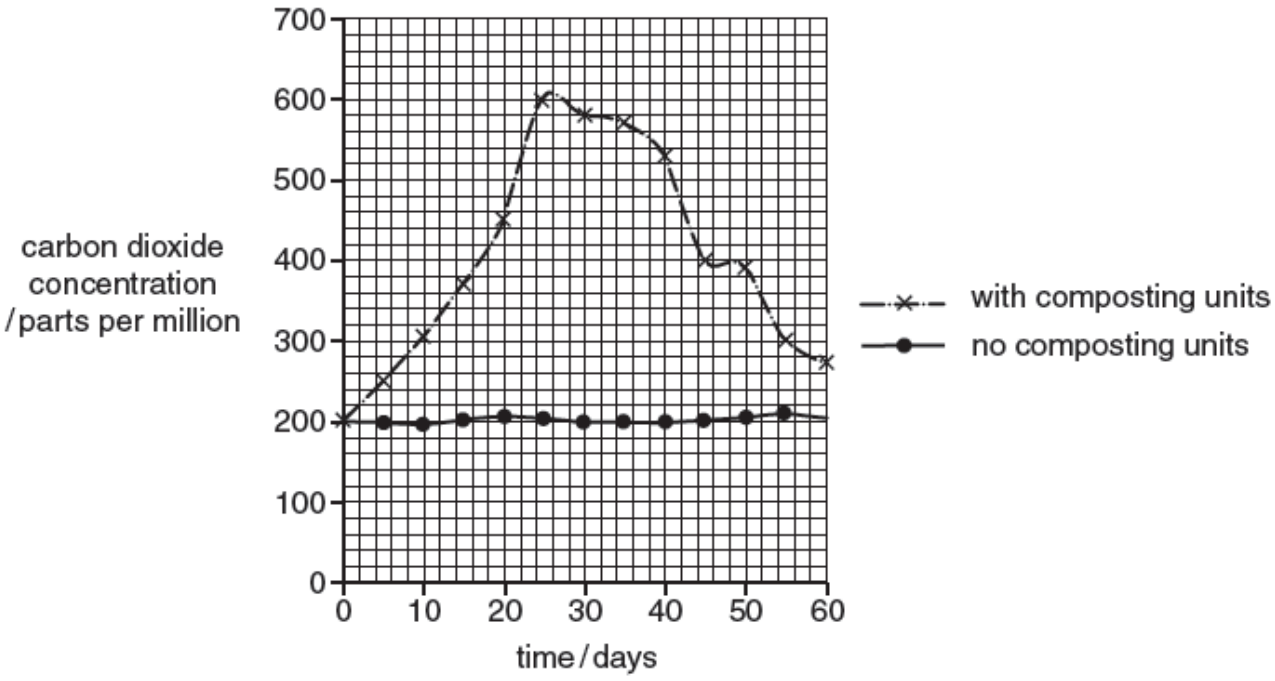

Fig. 6.2

Describe the results shown in **Fig. 6.2** and suggest two reasons why the two graphs show very different trends.

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[4]

[Total: 4]

7 **Fig. 7** shows an actively dividing cell taken from the testes of a male fruit-fly.

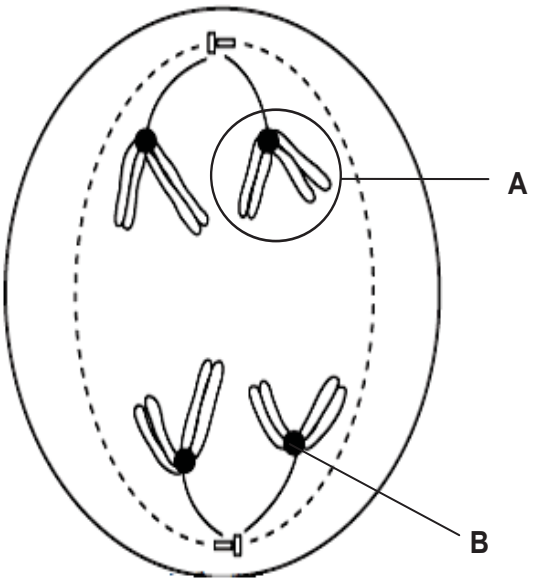


Fig. 7

(a) Label the following structures:

A: .....

B: ..... [2]

(b) Name the stage of cell division shown in **Fig. 7**.

..... [1]

(c) Describe the events taking place in the stage stated in **(b)**.

[2]

(d) Explain how meiosis results in offspring that do not look like the parents.

[4]

[Total: 9]

8 **Fig. 8.1** shows two processes taking place in a cell.

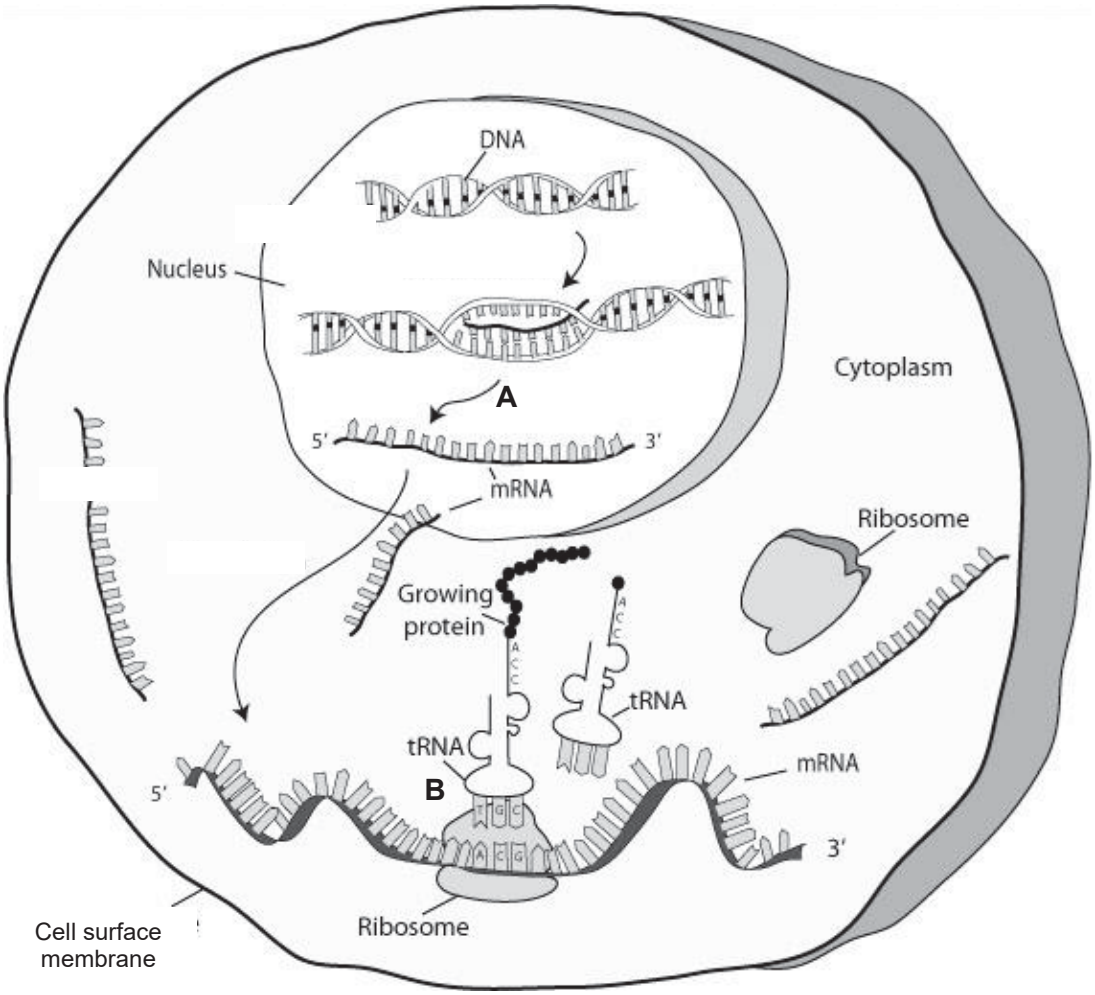


Fig. 8.1

(a) Name the processes **A** and **B**.

A: ..... **B:** ..... [2]

(b) Suggest why process A does not take place in the cytoplasm.

.....

..... [1]

(c) **Fig. 8.2** shows a nucleotide sequence in part of the unwound DNA:

TGAGGACTCCTC

Fig. 8.2

(i) Write the resulting sequence of the messenger RNA produced by process **A**.

..... [1]

(ii) A mutation has occurred in the DNA in **Fig. 8.2**. The mutated DNA sequence is shown in **Fig. 8.3**.

TGAGGACACCTC

Fig. 8.3

State the type of mutation shown in **Fig. 8.3**.

.....[1]

(iii) Explain how a change in the bases leads to a different protein being formed.

.....

.....

.....

.....[2]

[Total: 7]

END OF SECTION A

Class/ Index Number /	Centre Number/ 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

BIOLOGY **6093/02**

Paper 2 **25 August 2020**

1 hour 45 minutes

Candidates to answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number, Centre number, O level index number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section B of the paper.
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.
The total number of marks for this paper (sections A and B) is 80.

At the end of the examination, hand in the following separately:
(1) Section A
(2) Section B

For Examiner's Use	
Question 9	/10
Question 10	/10
Question 11	/10
Total	/30

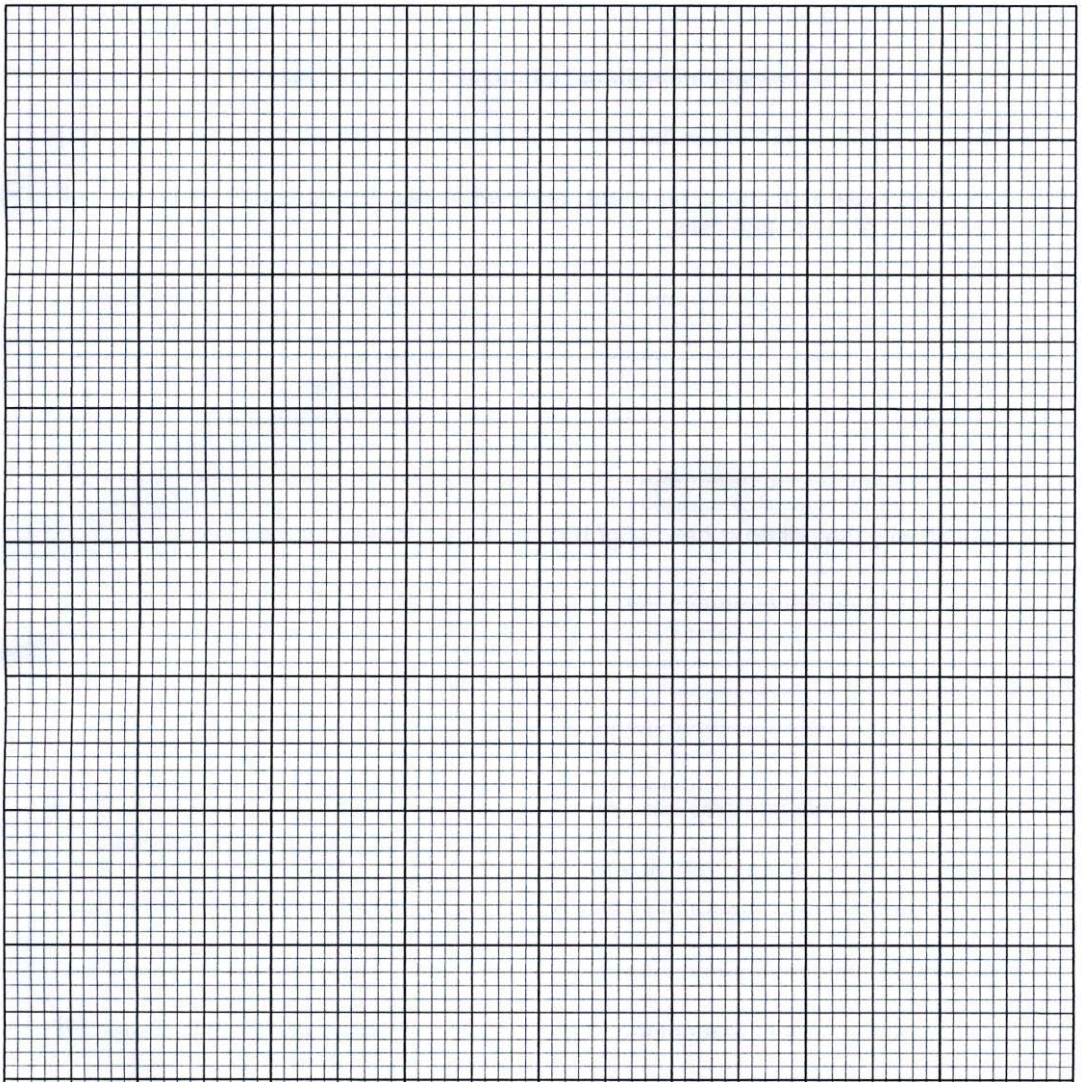
Section B

Answer **three** questions.

9 Tom was curious about the inheritance of traits in the garden pea plant. He decided to collect 100 seeds from each of the three pea plants in his mother's garden. He noticed that the pea seeds are either smooth or wrinkled. He counted the number of smooth and wrinkled seeds from each plant and recorded them in a table. His results are shown in the table below.

Plant	Number of smooth seeds	Number of wrinkled seeds
1	78	22
2	74	26
3	47	53

(a) On the graph paper below, draw a bar chart to show the number of each seed type produced by each pea plant.



[2]

(b) Tom remembered from his Biology lessons in school that the allele for smooth seeds is dominant to the allele for wrinkled seeds. Based on the results above, he hypothesized that plants 1 and 2 are heterozygous for this trait while plant 3 was homozygous recessive.
Explain how Tom arrived at this hypothesis.

[4]

(c) Suggest the experiments that Tom should do to test his hypothesis and the results he should expect if his hypothesis were correct.

[4]

[Total: 10]

10 **(a)** Bile and lipase are involved in the digestion of fats. Describe the role of these substances in fat digestion.

[5]

(b) Explain the roles of the liver in carbohydrates and proteins metabolism.

[5]

[Total: 10]

11 **Fig. 11.1** below shows the structure of a part of the human placenta.

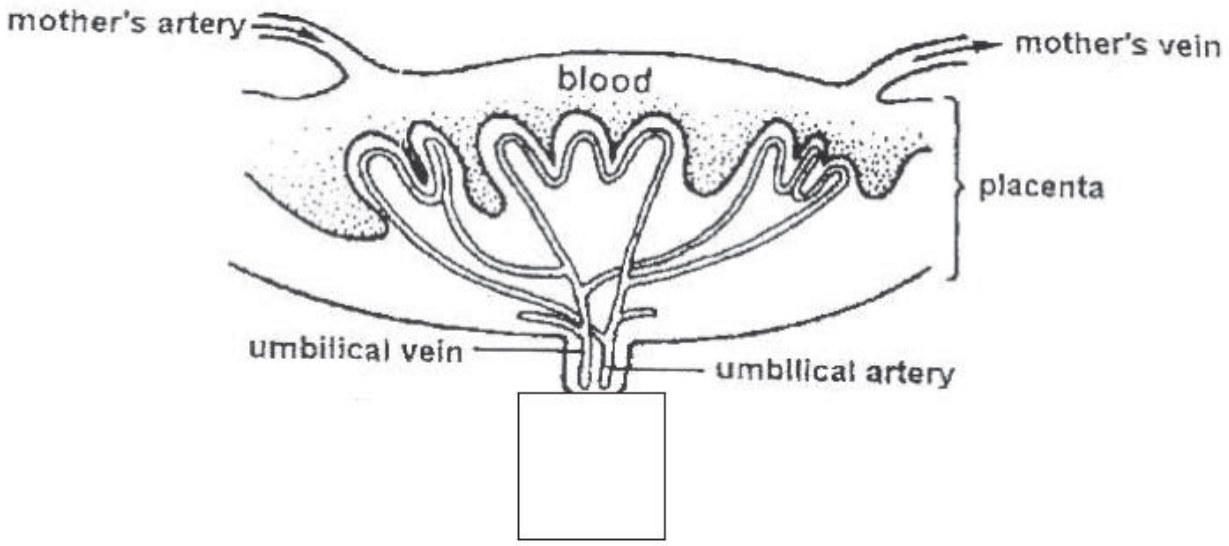


Fig. 11.1

(a) In the box above, draw **two** arrows to show the direction of blood flow in the umbilical artery and vein respectively. [1]

(b) Outline the production, changes in estrogen and progesterone levels after fertilization had taken place, and their effect on the pregnancy.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

(c) **Fig. 11.2** below shows the cross section of the **pistil and stamens** in a flower.

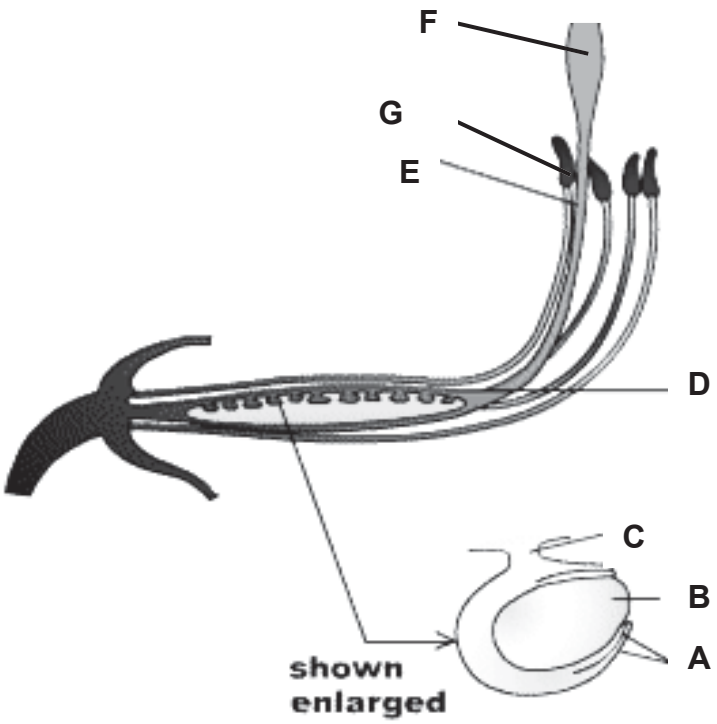


Fig. 11.2

With reference to the labelled parts (except **A & C**) shown in the diagram, describe the events to the point of **fruit formation** if **self-fertilisation** was to occur.

[4]

[Total: 10]

END OF SECTION B

Maris Stella High School
2020 Sec 4 Pure Biology

Name: _____
Class (Index No.): Sec 4____ ( )

Prelim Mark Scheme

Paper 1: MCQ [40m]

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

Questions with most mistakes: Q1, 8, 9, 23, 35 and 40.

Paper 2 Section A: Structured Questions [50m]

1 (a) **Agglutination** is the forming of a complex between **antigen** (found on red blood cells) and **antibody** (in plasma) produced by white blood cells; [1]
Whereas **clotting** is the formation of a **mesh of insoluble fibrin thread (protein)** trapping **red blood cells and some white blood cells;** [1]

Agglutination happens during blood transfusion when the donated blood is **incompatible** with the recipient blood; (**R:** different – Blood group O can donate to Blood group AB) [1]
Whereas **clotting** happens when one has a cut / wound; [1]

@: Agglutination is a **physical** reaction but clotting is a **chemical** action;

@: Agglutination requires **no enzyme** action so is not **temperature affected**, but clotting is a series of **enzyme-based** reactions, hence affected by **temperature**.

(b) People with blood group O has **no antigens A and B types** on their red blood cells; [1]
The **antibodies a and b types, (**if present in the recipients' blood plasma) **will not be able to attack/ bind to the red blood cells in the donated blood.** Hence no agglutination will be formed. Therefore, they are universal donors – can give / donate blood to other people of blood groups A, B and AB; [1]

In comparison, people with AB blood group **have no antibodies a and b types** (in the plasma) **to bind/ clump with any antigens A and B (**if present on the red blood cells) **of the donated blood**. Therefore, they are universal recipients – can accept blood of any types; [1] [1]

@: There could be little amount of antibodies a and b types in a packet of donated blood group O. There will be some agglutination if it is given to people of blood groups A and B. The amount of agglutination will not cause death to the recipients

2 Enters the intercellular air spaces within the leaf through the stomatal pores; [0.5]
By diffusion (from the atmosphere into the intercellular air spaces); [0.5]
Dissolves in film of water/ moisture around spongy mesophyll cell; [0.5]
Diffuses into mesophyll cells (@ chloroplasts); [0.5]
Presence of sunlight; [0.5]
Carbon dioxide is incorporated into glucose molecule; [0.5]
Through photosynthesis; [0.5]
Glucose diffuses out of chloroplast and mesophyll cell; [0.5]
Moves into phloem & out of leaf; [0.5]
Transported as dissolved sucrose till it reaches fruit; [0.5]

3 **(a)** **(i)**
Graph increases but should not start from zero; [0.5]
plateaus well before 10 min is up and decreases back to normal a few minutes after resting; [0.5]

(ii)
Glycogen broken down **to glucose** /increasing glucose concentration; [1]
To ***increase***[1] rate of **respiration** to meet ***increased***[1] energy demand; [1]

(iii)
From 10-20min (during rest), oxygen supply **exceeds oxygen demands** / excess oxygen intake is used to **pay back oxygen debt**; [1]

Lactic acid is removed from cells and transported **to liver**; [1]

Part of the lactic acid is **broken down**. The **energy released** is used to **convert the rest of lactic acid into glucose**; [1]

(b) **(i)**
Arrow showing leaving plasma (as hydrogen carbonic ions) to RBC; [0.5]
Arrow showing leaving RBC (as carbon dioxide gas) to alveolar air; [0.5]

(ii)
Removal + from body / organism. Waste + of respiration / metabolism. Or /AW [1]
**{Removal of metabolic waste (from the body/organism) is excretion.}*

4 **(a)** Label line must touch the sweat gland; [0.5]
Label line must touch some part of receptor under Malpighian layer; [0.5]

(b) Body temperature increases / rises; [1]
Activation of sweat glands to produce **MORE** sweat; [1]
Vasodilation of **arterioles** in the dermis of skin; [1]
increase blood flow to **capillaries** near the surface of the skin; [1]
to radiate more heat away from the body by radiation …; [1]
[max: 4 marks]

5 **(a)** Any factor that directly affects the rate at which a process (e.g. a chemical reaction) occurs if its quantity is changed; [1]

(b)

experiment	light intensity/arbitrary	limiting factor
A	20	light intensity
B	20	temperature
C	20	carbon dioxide concentration **A**: % carbon dioxide
D	5	light intensity

[1]
[1]
[1]

6 - with compost, CO_2 (concentration) reaches a peak; [0.5]
A: increases and decreases
- at 24–26 days/600 – 610 ppm; [0.5]
units must be given at least once

- without compost, CO_2 (concentration) remains constant; [0.5]
A: very slight fluctuations
- at about 200 ppm; [0.5]

Reasons why the two graphs show very different trends
For the one with composting units:

1) Composting requires / is a decomposition process which involves microorganisms / enzymes
Initially **concentration of "substrate" (crop residue and animal manure) is high**, thus **rate of decomposition is high** and **carbon dioxide is produced in addition** to the atmospheric carbon dioxide; [0.5]
Therefore, total concentration of carbon dioxide produced and atmospheric carbon dioxide is **more than the concentration of carbon dioxide absorbed by plants for photosynthesis**; [0.5]
Thus, there is a **net increase of concentration of carbon dioxide**;

2) As concentration of carbon dioxide produced increases, **concentration of "substrate" decreases (as the crop residue and animal manure are used up);** [0.5]
Rate of reaction decreases and concentration of carbon dioxide produced decreases, resulting in **net decrease of concentration of carbon dioxide**; [0.5]

For the one without composting units:

3) There is no composting units and thus, there are no other factors that contribute to the carbon dioxide concentration other than the surrounding atmospheric carbon dioxide present in both glasshouses; [1]

[max: 4 marks]

7 **(a)** **A**: a double-stranded **chromosome**; **R**: chromatin. [1]
B: centromere; [1]

(b) Anaphase I; **R**: Anaphase. [1]

(c) Spindle fibres contract and **homologous chromosomes** separate and move to opposite poles of the cell; [2]
{1 mark only if the word 'homologous' is not used.}

(d) **Crossing over** between homologous chromosomes in **Prophase I**; [1]
Description of crossing over: (e.g.) equivalent portions of the two non-sister chromatids are broken and rejoined to the other chromatid; [1]

Independent assortment of homologous chromosomes at **metaphase I**; [1]
Description of independent assortment: the homologous chromosomes line up along the equatorial plane RANDOMLY. How one chromosome pair lines up at the plate does not affect how another pair lines up. Each member of a pair of homologous chromosomes then separates independently of the members of other pairs (into different daughter cells). This random arrangement and separation of chromosomes during meiosis give rise to all possible combinations of genes in the gametes formed. Along with chromosomal crossing over, these processes aid in increasing genetic diversity; [1]

*In short, ***independent assortment: aligned randomly; separate independently.***
Reject: pairing up of the homologous chromosomes is random. (Wrong concept)

8 **(a)** **A**: Transcription; [1]
B: Translation; ***R**: translocation* [1]

(b) DNA does not exit nucleus / too large to exit the nucleus; [1]
A: cannot pass through the nuclear pores.

(c) **(i)**
ACUCCUGAGGAG; [1]

(ii)
Gene mutation; [1]
@: Substitution

(iii)
Sequence of bases determines amino acid sequence in protein; [1]
Wrong amino acid in the sequence will lead to a different protein being formed; [1]
Results in different 3D/ physical structure/ protein folds differently; [1]
A: change in bases – call for a different amino acid – different protein formed…
[Any 2]

Paper 2 Section B: Free Response Questions [30m]

9 **(a)** **A**xes labeled; [0.5]
accurate **P**lotting of both datasets; [1]
key/legend; (distinguish the 2 sets of data) [0.5]

(b) The phenotypic ratio of the seeds from **plants 1 and 2** is **3 smooth : 1 wrinkled**; [1]
R: majority / more smooth than wrinkled seeds…

This can only happen if the parental plants are both heterozygotes; [1]
by either self-pollination or cross-pollination between plants 1 and 2;

The phenotypic ratio of the seeds from **plant 3** is **1 smooth : 1 wrinkled**; [1]
R: more wrinkled seeds than smooth seeds…
This **can only happen from cross-pollination between a homozygous recessive and a heterozygous plant**; [1]
Since plants 1 and 2 are heterozygous, plant 3 has to be the homozygous recessive individual;

(c) Tom should **self-pollinate** all 3 plants, taking precaution to prevent cross-pollination by covering the flowers of the plants; [1]

If his hypothesis is correct, the expected results should be

Plant 1 and Plant 2 self-cross: *{Show genetic diagram once}*

Parents' genotypes:	Ss	x	Ss		[0.5]
Gametes:	S	s	S	s	[0.5]
Offspring genotypes:	SS	Ss	Ss	ss	[0.5]
Offspring phenotypes:	Smooth	Smooth	Smooth	Wrinkled	[0.5]

Result: 3 smooth: 1 wrinkled; [0.5]

Plant 3 self-cross: ss x ss
Result: All wrinkled (ss); [0.5]

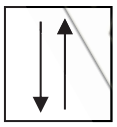
Note:
Accept answer for doing a test cross with homozygous recessive plant and explain the expected result clearly).

10 (a) For bile:
bile emulsifies **fats** to fat droplets; [1]
R: *breaks down fats*
R: *emulsifies **fat molecules***
increases surface area (to volume ratio) for enzyme / lipase action; [1]
neutralizes stomach acid / hydrochloric acid / raises pH / provides optimum pH for enzymes in small intestine; [1]

For lipase:
lipase **hydrolyses** / **chemically digests** fats; [1]
to **fatty acids and glycerol**; [1]

(b) The roles of the liver:
liver cells **break down glucose to release energy** in **tissue respiration**; [1]
liver cells **convert excess glucose to glycogen** + for storage; [1]
***R:** if the named hormones facilitating the conversion is wrongly stated.*
liver carries out **deamination** of excess **amino acids**; [1]
removes amino groups to form **urea**; [1]
carbon residue to glucose; [1]

NB: students must explicitly identify the products of carbohydrate and protein digestion.

11 (a)  [1]

(b) Production & changes in hormonal level after fertilisation:
- The zygote develops into an embryo which implants itself in the uterine lining.
- The embryo secretes a hormone [not in syllabus: HCG[5]] which prevents the corpus luteum from degenerating. {Not necessary}

- The **corpus luteum continues to secrete oestrogen, and later progesterone** until the placenta is formed; [1]
- About **after 6 weeks** of pregnancy, the **placenta takes over** the production of these two female hormones; [1]
-The rise in progesterone level **stimulates further development** of the uterus lining, causes it to **grow thicker and spongier** / vascularised; [1]
- ready **for implantation** / to nourish the embryo; [1]
- The combined high levels of oestrogen and progesterone also trigger an **inhibitory effect on the pituitary, preventing the ripening and growth of more follicles**; [1]

The combined high levels of oestrogen and progesterone inhibits FSH and LH production. {Not necessary.}

(c) *Occur when pollen grains from the anthers (G); [0.5]
are transferred to the stigma (F) of the same flower, or a flower in the same plant. [0.5]

Pre-fertilisation:
The mature stigma produces a **sugary substance** to stimulates the germination of the pollen grains to pollen tubes; [0.5]
The pollen tube secretes enzymes; [0.5]
grows down the style (E); [0.5]
towards the ovary (D); [0.5]
Along the way, the generative nucleus divides to form 2 male gametes; [0.5]
2 male gametes enters the embryo sac; usually through the micropyle; [0.5]
The vegetative nucleus disintegrates; [0.5]
after the pollen tube has grown to reach the **ovule** (B); R: ovum [0.5]

Fertilisation
1 male gamete fertilizes the ovum (R: ovule), forming the zygote, which divides to form the embryo of the seed; R: forming fruit [0.5]
The 2nd male gamete fertilizes the definitive nucleus, forming the endosperm nucleus that divides to form the endosperm; [0.5]
*Disintegrates in non-endospermic seeds. {Not necessary}

Post-fertilization: Fruit formation
The ovary develops into fruit / ovules into seeds; [0.5]
The stamens (G and E) wither and fall off and the stigma (F) and style (E) wither and fall off, or may persist; [0.5]

[Max: 4 marks]

Note: Candidates who did not identify structures B,D,E,F,G will still be able to get full 4 marks.