TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS 4

INDEX NUMBER

BIOLOGY

Paper 1 Multiple Choice

6093/01
22 August 2024
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, index number on the Answer Sheet.

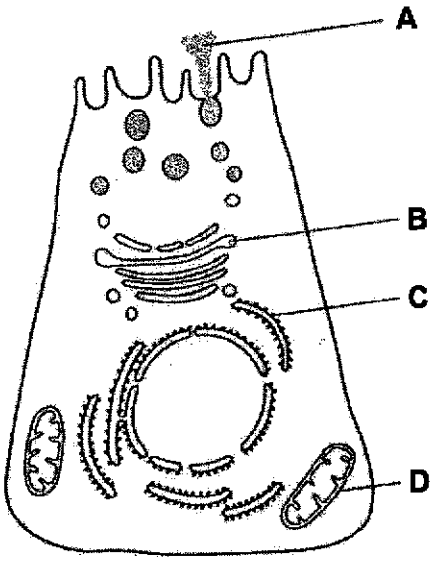
There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice **in soft pencil** on the separate Answer Sheet.

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

1 The diagram shows a cell viewed under an electron microscope.

Which structure is responsible for the modification and packaging of substances for secretion out of the cell?



2 A unicellular organism containing sodium ions at a concentration of 0.1 mM lives in a pond of sodium concentration 0.01mM.

How does the organism absorb sodium ions?

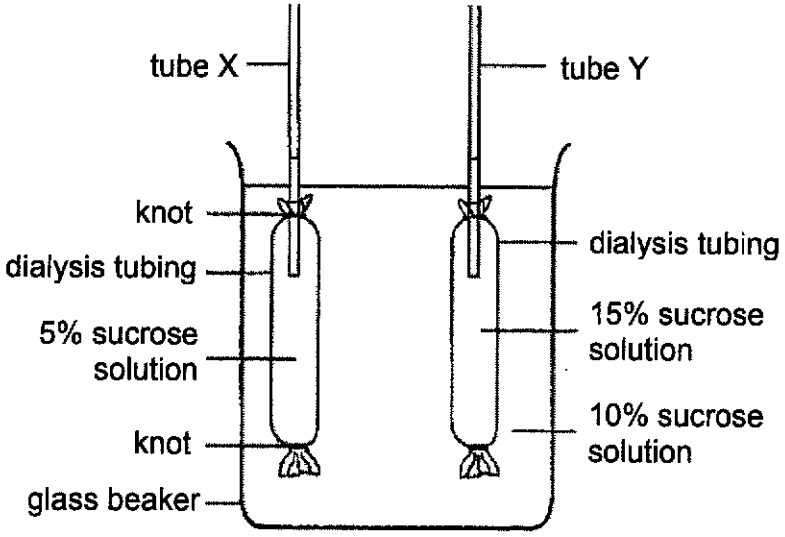
A osmosis

B diffusion

C ingestion

D active transport

3 The diagram shows an experiment setup to investigate osmosis.



What will happen to the liquid levels in tube X and tube Y after 30 minutes?

	tube X	tube Y
A	rise	fall
B	fall	rise
C	rise	rise
D	fall	fall

4 During deamination, which element is **significantly** removed from an amino acid molecule?

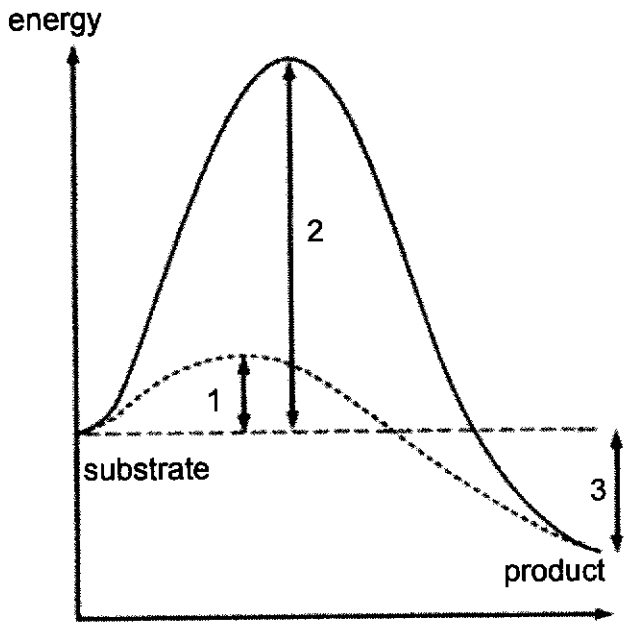
A carbon

B oxygen

C nitrogen

D hydrogen

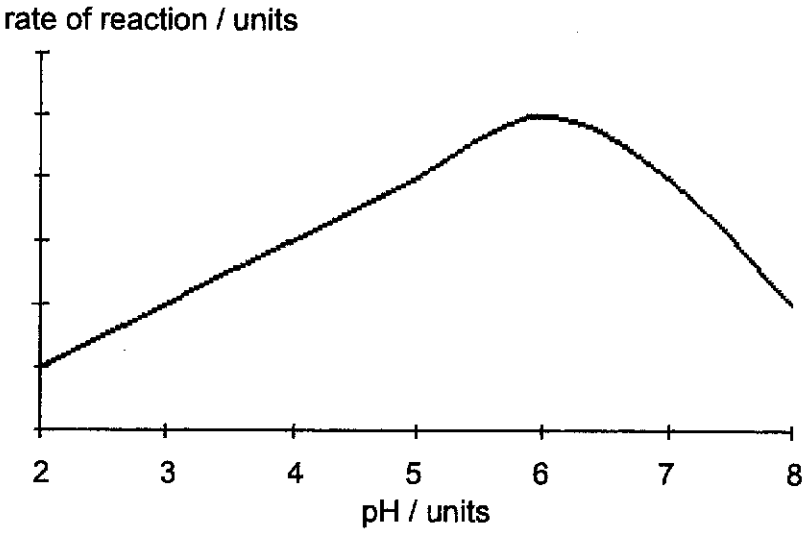
5 The graph shows two possible energy changes of an enzyme-controlled reaction.



Which represents the activation energy of the reaction with and without the enzyme?

	with enzyme	without enzyme
A	1 + 2	1
B	1	2
C	1 + 3	2 + 3
D	1	2 – 1

6 The graph shows the rate of reaction of an enzyme under different pH.



Which statement is correct?

A The enzyme is inactive at pH 2.

B The time taken for the reaction to complete is highest around pH 6.

C The rate of enzyme-substrate complexes formed is highest at pH 6.

D The collision of enzyme and substrate molecules is highest at pH 5.

7 A student mixes 2 cm^3 of starch to 1 cm^3 of salivary amylase in a test tube. He leaves the test tube standing for 30 minutes.

What are the colour observations if the student perform iodine and Biuret tests on the contents in the test tube?

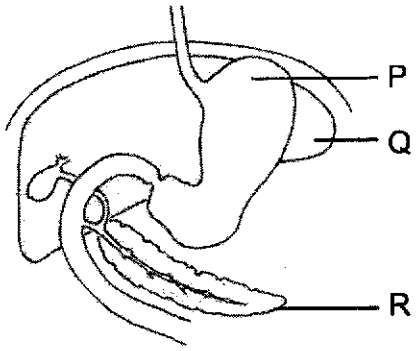
A yellowish brown and blue colourations

B yellowish brown and violet colourations

C blue-black and blue colourations

D blue-black and violet colourations

8 The diagram shows a section of the alimentary canal.



What processes are occurring at P, Q and R?

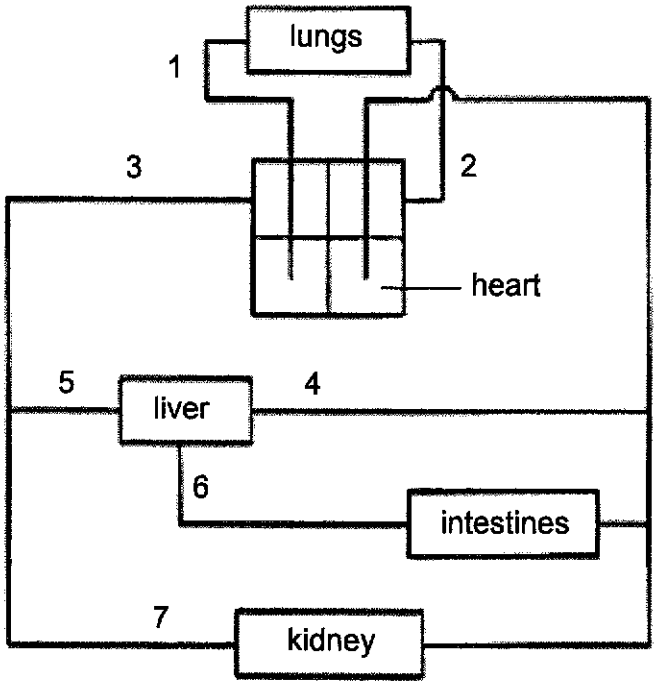
	P	Q	R
A	assimilation	detoxification	storage
B	digestion	storage	absorption
C	digestion	detoxification	secretion
D	egestion	absorption	digestion

9 The diagram shows a tissue found in the small intestine.

Which adaptation is **not** true to the description made of the tissue?

	description	adaptation
A	thin epithelium	absorbs protein more efficiently
B	dense network of blood capillaries	transports glucose
C	presence of microvilli	absorbs nutrients more efficiently
D	highly folded	more surface area to volume ratio for more absorption

10 The diagram shows part of the circulatory system.



Which row shows the correct blood vessels?

	hepatic portal vein	hepatic vein	renal vein
A	2	5	1
B	5	6	7
C	6	4	3
D	6	5	7

11 Which is a correct property of a blood capillary?

A The blood capillary is one-cell thick.

B The wall of the blood capillary is partially permeable.

C The blood capillary can vasodilate due to muscle cells in its walls.

D The blood pressure in the blood capillary is the lowest compared to the artery and the vein.

12 A person who is blood group A can _____.

A donate blood to blood group O

B donate blood to blood group AB

C receive blood from blood group B

D receive blood from blood group AB

13 The Heimlich maneuver is a first-aid method administered to a person who is experiencing choking. It involves thrusting in the abdominal area of the person to force the object that causes the individual to choke out of the body.

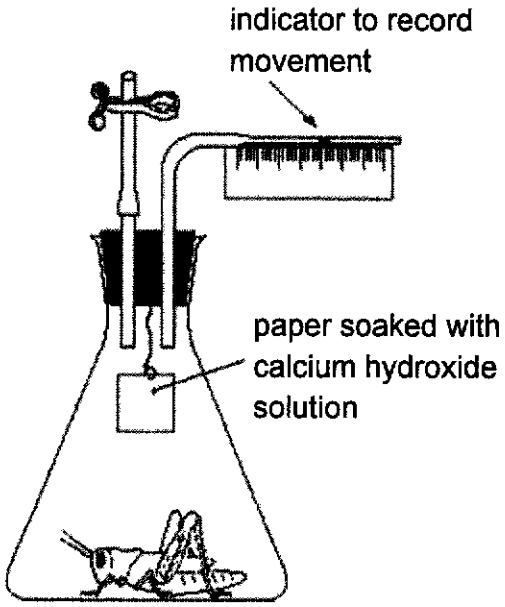
With respect to pressure and volume in the thoracic cavity, what is the best explanation for this?

	thoracic cavity	
	volume	pressure
A	decrease	decrease
B	increase	decrease
C	decrease	increase
D	increase	increase

14 What changes will have occured to cause muscle fatigue?

	glycogen	lactic acid	pH
A	decreased	increased	decreased
B	decreased	decreased	increased
C	increased	increased	decreased
D	increased	decreased	increased

15 The diagram shows an experiment setup to investigate respiration in an insect.



What does the experiment measure and what is the purpose of calcium hydroxide solution?

	experiment measures	calcium hydroxide
A	amount of oxygen absorbed	absorb oxygen
B	amount of oxygen absorbed	absorb carbon dioxide
C	amount of carbon dioxide released	release oxygen
D	amount of carbon dioxide released	release carbon dioxide

16 What is the significance in the directions of flow of the dialysis fluid and blood in kidney dialysis?

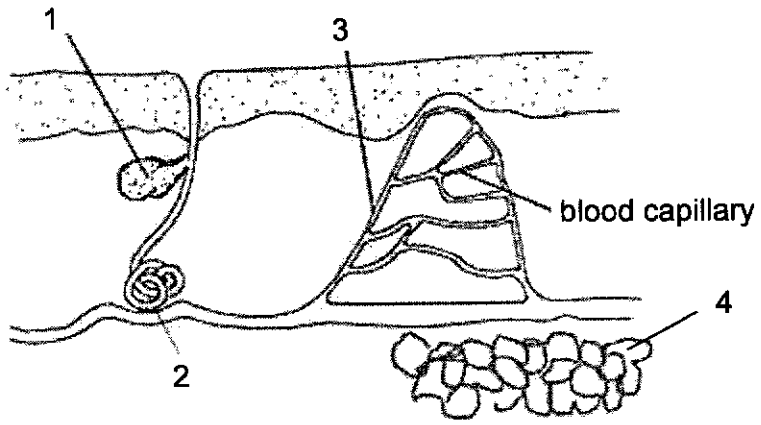
A Speed up the flow of blood in the kidney dialysis machine.

B Slow down the transfer of waste products in the dialysis machine.

C Ensure that waste products will continuously enter the dialysis fluid.

D Ensure that the difference in the concentrations of waste products in blood and dialysis fluid is small.

17 The diagram shows a section through a skin of a man.



Which parts will be activated when the man moves from a hot kitchen into an air-conditioned room?

A 1 and 2 only

B 2 and 3 only

C 3 and 4 only

D 2, 3 and 4 only

18 Which statements on the endocrine gland are correct?

1 secretes substances through ducts

2 substances are produced by the brain

3 production of substances is involuntary

4 substances secreted are transported by blood

A 1 and 2 only

B 3 and 4 only

C 1, 2 and 3 only

D 1, 3 and 4 only

19 How does the injection of insulin into a diabetic patient lead to a lowering of blood glucose concentration?

A increase excretion of glucose

B stimulates the production of glucagon

C decrease permeability of cells to glucose

D increase the formation of polysaccharides

20 What happens when a person is sweating excessively?

	blood water potential	ADH	reabsorption of water
A	increase	increase	increase
B	increase	decrease	decrease
C	decrease	increase	increase
D	decrease	decrease	no change

21 Sometimes a physical injury to the eye may result in a section of the retina being detached from the choroid.

What happens to the individual when such an injury happens?

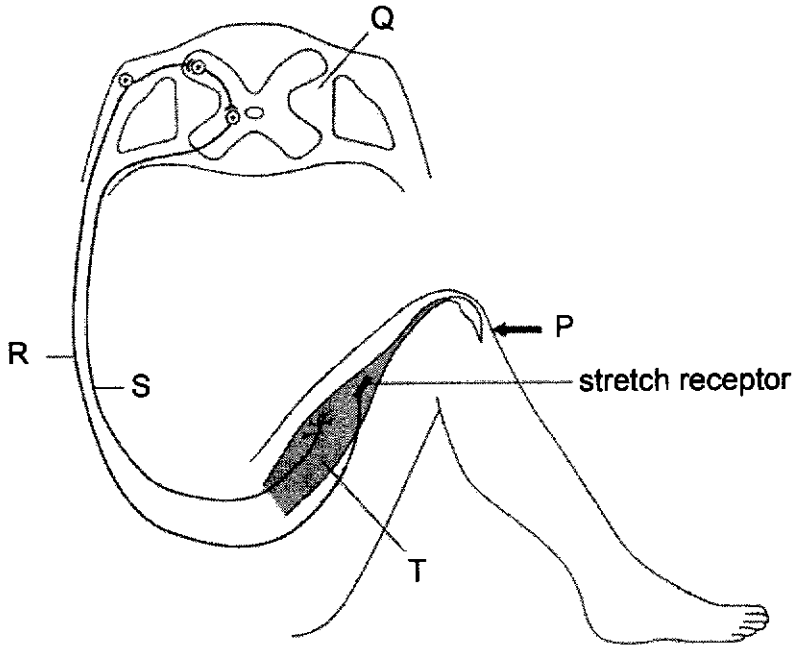
A The person can still see normally as the retina is still in the eye.

B The person's vision will be sharp as the retina is not obstructing the choroid.

C The person becomes partially blind due to the overstimulation of receptors in the choroid.

D The person becomes partially blind because the cells of the retina are unable to receive nutrients from the choroid.

22 The diagram shows the nervous pathway for a knee-jerk reflex. When the person is hit at P, the lower leg will be raised involuntarily.



Which are the motor neurone and effector?

	motor neurone	effector
A	S	Q
B	S	T
C	R	Q
D	R	T

23 Which muscles in the eye help in accommodation?

1 radial muscles
2 rectus muscles
3 ciliary muscles
4 suspensory ligaments

A 1 only
B 3 only
C 1 and 2 only
D 3 and 4 only

24 Which statement about AIDS is true?

A AIDS can be treated with antibiotics.

B AIDS is caused by the human immunodeficiency bacteria.

C AIDS can be transmitted through exchange of any bodily fluids.

D AIDS is a sexually transmitted infection that affects the immune system.

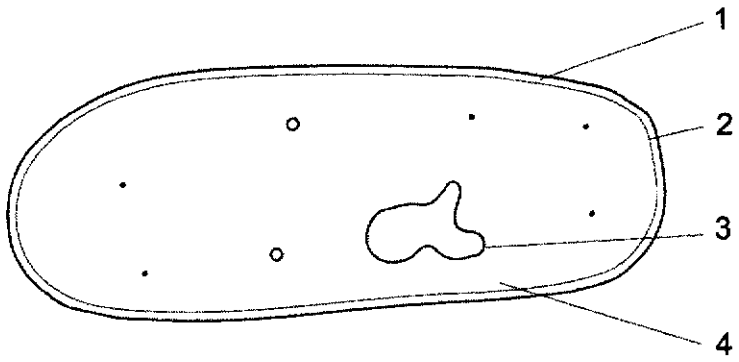
25 The diagram shows a bacterial cell with labelled features, 1 to 4.

1 cell wall

2 cell membrane

3 genetic material

4 cytoplasm



Which feature(s) is/are also found in a virus?

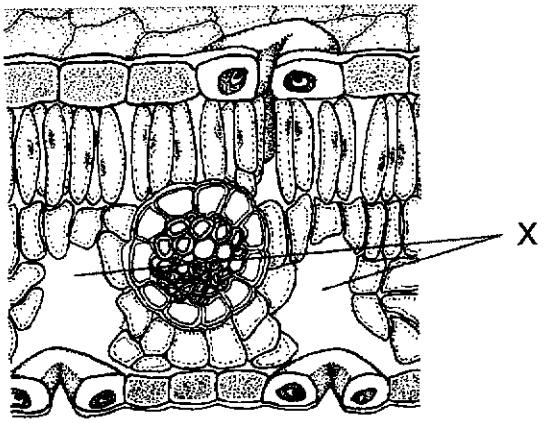
A 2 only

B 3 only

C 1 and 3 only

D 2 and 4 only

26 The diagram shows a section of a leaf.



What is a function of X?

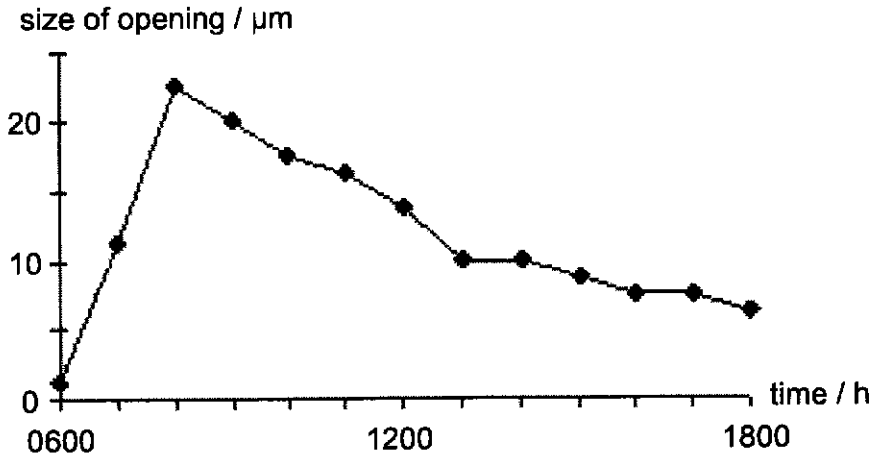
A Enables nutrients to move.

B Enables gases to exchange.

C Enables the leaf to retain water.

D Enables the leaf to lose excess liquids.

27 The graph shows how the size of stomatal openings varies throughout the day.



Which statement is correct?

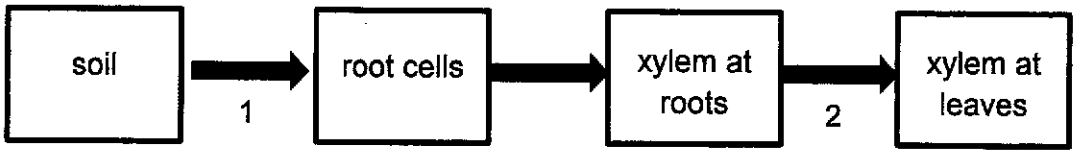
A It is hottest at 0800h than at 1200h.

B More light is available at 0800h than at 1200h.

C Water availability is constant throughout the day.

D The carbon dioxide concentration is highest at 0800h and then decreases until 1800h.

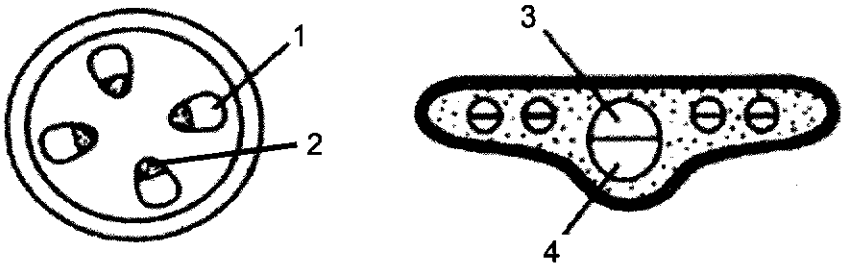
28 The diagram shows how water moves through the roots and stem of a plant.



What are processes 1 and 2?

	process 1	process 2
A	active transport	transpiration pull
B	active transport	osmosis
C	osmosis	transpiration pull
D	osmosis	osmosis

29 In a photosynthesis experiment, a plant was exposed to carbon dioxide containing radioactive carbon for 24 hours.



Which parts of the plant, 1 to 4, will contain the most amount of the radioactive carbon?

A 1 and 3

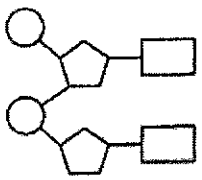
B 1 and 4

C 2 and 3

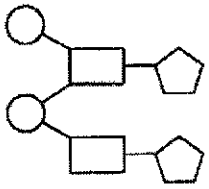
D 2 and 4

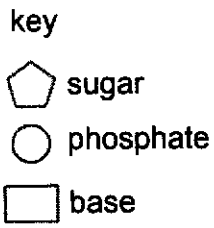
30 Which diagram shows the correct structure consisting of 2 nucleotides in DNA?

A

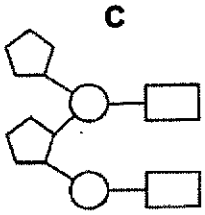


B

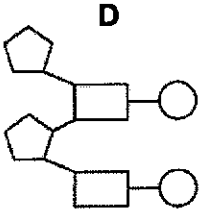




C



D



31 A farmer administers a non-biodegradable insecticide into a lake to kill a type of insect larvae. The larvae will grow into an adult insect which becomes a pest for the farmer's crops. The insecticide is administered once a year in small concentrations that are harmless to the other forms of life in the lake. After several years, it is observed that a large number of water birds that feed only on the fishes in the lake has died.

Which is the most **unlikely** explanation for the death of the water birds?

A The insecticide kills the fishes in the lake.

B The birds have died due to the eutrophication of the lake.

C The birds are at the top of the food chain involving the insect larvae.

D The concentration of insecticide in the water has increased over the years.

32 Which statement does **not** explain the need for conservation of mangrove?

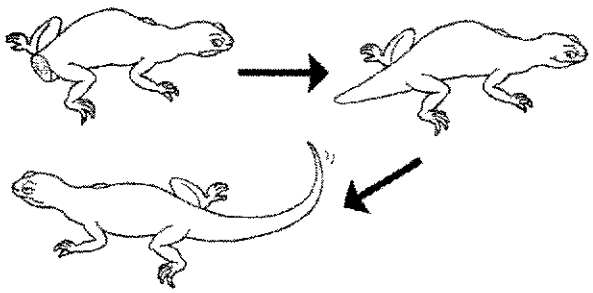
A Mangrove ecosystems are good carbon sinks.

B Mangrove ecosystems provides a rich biodiversity.

C Conservation of mangrove ecosystems reduces soil erosion.

D Conservation of mangrove ecosystems reduces strong winds and waves.

33 When lizards are faced with danger, they are able to remove their tail and escape. The tail will gradually grow back. The diagram shows the gradual growth of a tail of a lizard after it has been removed.



What process is responsible for the growth of their tail?

A mitosis

B meiosis

C fertilisation

D reproduction

34 A student cut open a fruit and observed that it contains many seeds.

Which statement best explains the observation?

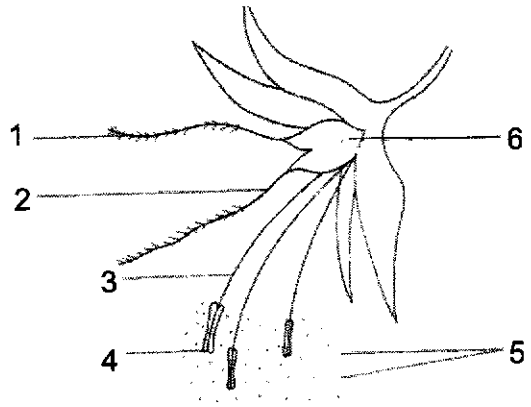
A The flower contains many ovules.

B The flower contains many ovaries.

C The ovum in the flower is fertilised by only one pollen grain.

D The stigma of the flower is feathery to trap a large number of pollen grains.

35 The diagram shows a wind-pollinated flower.



Which features of the flower help to make wind pollination successful?

A 1, 2, 3 and 4 only

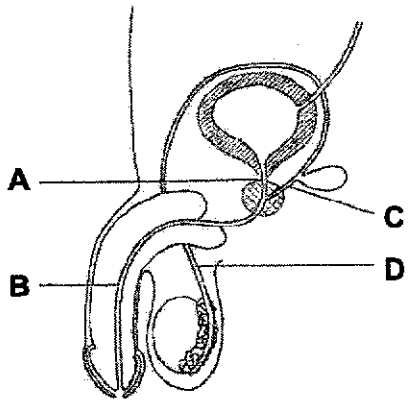
B 1, 2, 3 and 5 only

C 3, 4, 5 and 6 only

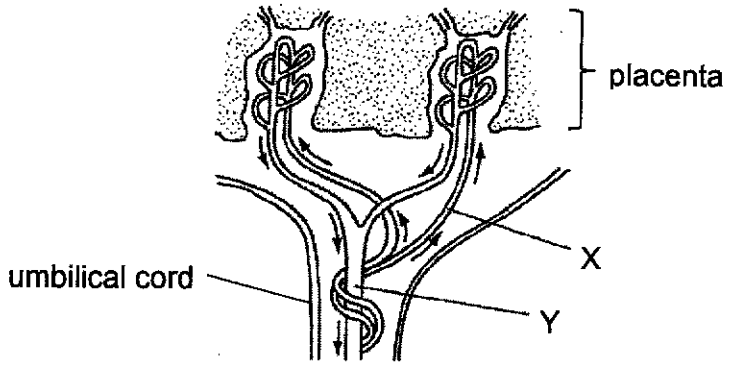
D 2, 3, 4, 5 and 6 only

36 The diagram shows a section of the male reproductive system.

Which duct does **not** contain haploid cells?



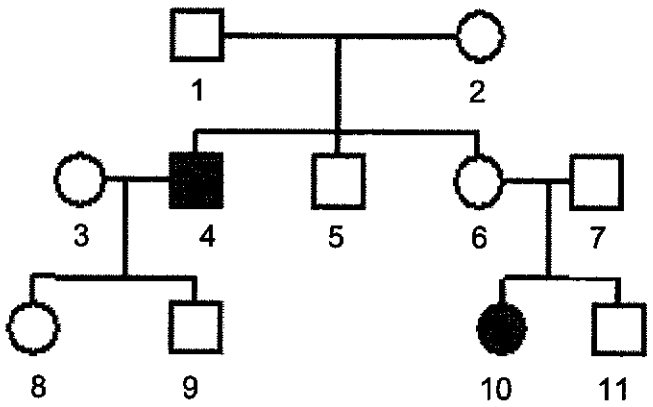
37 The diagram shows the blood vessels in human umbilical cord and placenta.



Which row is correct?

	vessel X	vessel Y	substances in X higher than Y
A	artery	vein	oxygen and glucose
B	artery	vein	urea and carbon dioxide
C	vein	artery	oxygen and glucose
D	vein	artery	urea and carbon dioxide

38 The diagram shows a family tree of individuals infected with a condition.



If Q represents the dominant allele for normal and q represents the recessive allele for the condition, what are the genotypes of individuals 4 and 6?

	individual 4	individual 6
A	QQ	QQ
B	Qq	Qq
C	qq	QQ
D	qq	Qq

39 In codominance, when two heterozygotes are crossed with each other, what is the expected phenotypic ratio and genotypic ratio?

	phenotypic ratio	genotypic ratio
A	1:1	1:1
B	3:1	1:2:1
C	1:2:1	3:1
D	1:2:1	1:2:1

40 A DNA test on the amniotic fluid of a 16-week pregnant woman revealed the following observations:

1 21st pair of chromosomes has an extra chromosome

2 23rd pair of chromosome is non-homologous

What is the condition and the sex of the unborn fetus?

	condition	sex
A	Down's syndrome	male
B	sickle-cell anaemia	male
C	Down's syndrome	female
D	sickle-cell anaemia	female

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME					
CLASS	4			INDEX NUMBER	

BIOLOGY
Paper 2

6093/02
13 August 2024
1 hour 45 minutes

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

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.
You may use a HB pencil for any diagrams, graphs 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.

Section B
Answer **one** question.
Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.
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	
Total	**/ 80**

Section A

Answer **all** questions.

1 Fig. 1.1 and Fig. 1.2 show the sections of alveoli and a villus respectively.

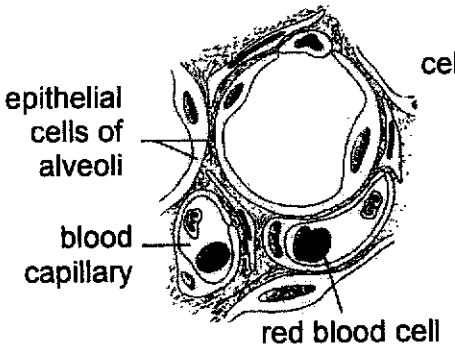


Fig. 1.1

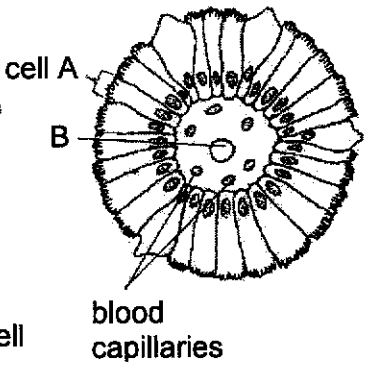


Fig. 1.2

(a) With reference to Fig. 1.1, describe one adaptation of an alveolus with respect to its function.

.....

.....[1]

(b) Cell A contains numerous small finger-like projections from the cell membrane.

Name these projections.

.....[1]

(c) Structure B absorbs nutrients from the lumen of the small intestine.

Name structure B.

.....[1]

(d) Name the substances that are absorbed into the blood capillaries of the alveoli and the villi.

blood capillaries of the alveoli: .....

blood capillaries of the villi: .....[2]

[Total: 5]

2 Fig. 2.1 shows a section of a mammalian heart.

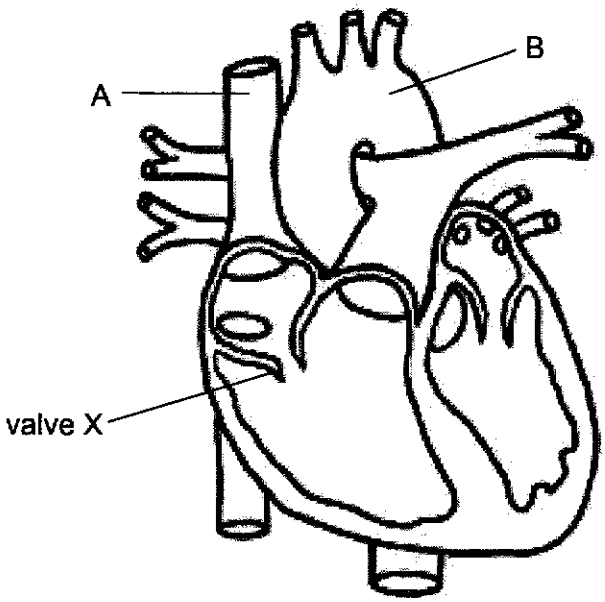


Fig. 2.1

(a) Describe one structural difference in the walls of vessels A and B.

.....

.....[1]

(b) On Fig. 2.1, draw arrows to show the flow of blood inside the heart. [1]

(c) Name valve X and explain its significance during ventricular systole.

.....

.....

.....[2]

(d) Table 2.1 shows the cardiac cycle of a healthy man at rest.

Table 2.1

time / s	at rest		during exercise	
	atrium	ventricle	atrium	ventricle
0.0 – 0.1	■			
0.1 – 0.2		■		
0.2 – 0.3		■		
0.3 – 0.4		■		
0.4 – 0.5				
0.5 – 0.6				
0.6 – 0.7				
0.7 – 0.8				
0.8 – 0.9	■			
0.9 – 1.0		■		
1.0 – 1.1		■		
1.1 – 1.2		■		

legend:
■ contraction
□ relaxation

(i) Calculate the heart rate of the man at rest. Show your workings clearly.

heart rate: ..... beats / minute [1]

(ii) In Table 2.1, shade the relevant boxes to suggest how the cardiac cycle of the man will be like during vigorous exercise. [1]

[Total: 6]

3 **(a)** Fig. 3.1 shows a nephron and the blood capillary surrounding it.

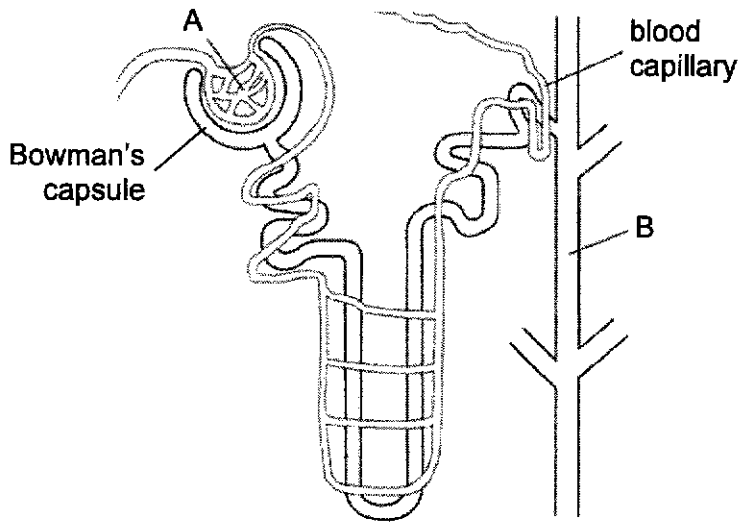


Fig. 3.1

(i) Name structures A and B.

A: .....

B: ..... [2]

(ii) Some substances in A are forced out into the Bowman's capsule of the nephron.

Explain how these substances are forced into the Bowman's capsule.

.....

.....

.....[2]

(b) Fig. 3.2 shows a type of dialysis where the dialysis fluid enters the abdominal cavity. Exchange of materials will take place across the membrane that surrounds the abdominal cavity. This removes the waste products from the blood. After a few hours, the used fluid is drained out of the cavity, and fresh fluid will re-enter the abdominal cavity.

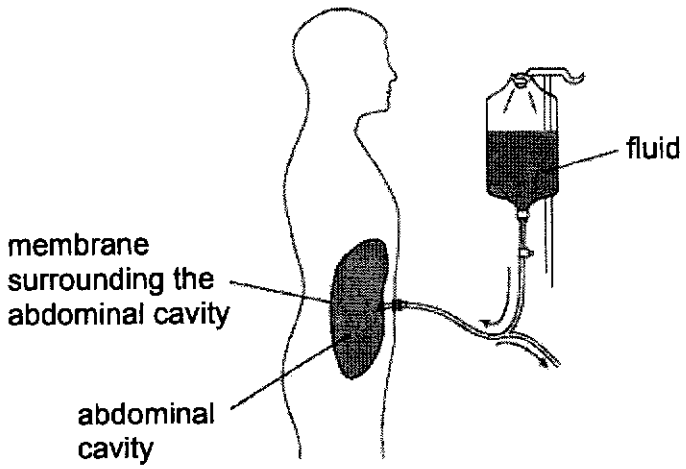


Fig. 3.2

Suggest why the fluid must be changed after a few hours.

.....

.....

.....[2]

[Total: 6]

4 Fig. 4.1 shows a submerged aquatic plant known as bladderwort. Bladderworts thrive in aquatic environments that are poor in nutrients. To ensure their optimal development, they have evolved to be carnivorous in nature. The outer cells around the entrances of the bladders of the plant secrete a sticky mucus, which traps and then digests small water animals such as water fleas.

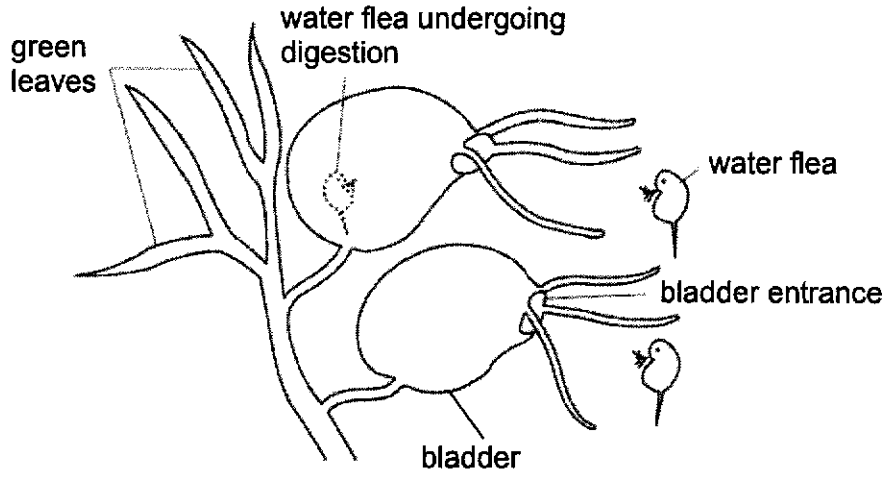


Fig. 4.1

(a) Write the chemical equation of the process that allows bladderworts to obtain carbohydrates.

[2]

(b) Name the elements of the carbohydrates formed in **(a)**.

.....[1]

(c) The nutrients obtain from the digestion of the water fleas enable bladderworts to develop optimally in the aquatic environment.

Suggest how the digestion of water fleas ensures the optimal development of bladderworts.

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.....[2]

[Total: 5]

5 Fig. 5.1 shows a setup to investigate transpiration of a plant.

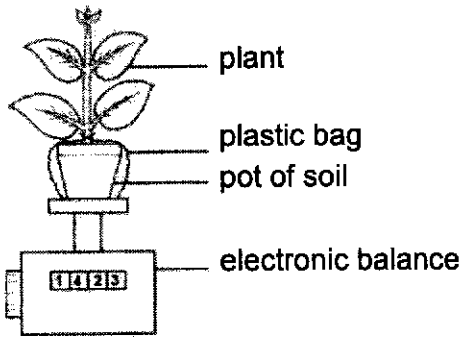

Fig. 5.1

The setup was placed under different environmental conditions. Table 5.1 shows the data collected.

Table 5.1

environment condition	air movement	temperature / °C	humidity / %	rate of transpiration / gh^{-1}
A	still air	30.0	65.0	9.8
B	still air	30.0	80.0	4.7

(a) Account for the difference in transpiration rates between environment conditions A and B.

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.....[3]

(b) Suggest a limitation to the setup in measuring the rate of transpiration.

.....[1]

(c) Suggest the significance of the plastic bag in the setup.

.....[1]

[Total: 5]

6 Fig. 6.1 shows how a molecule of mRNA is formed from a molecule of DNA.

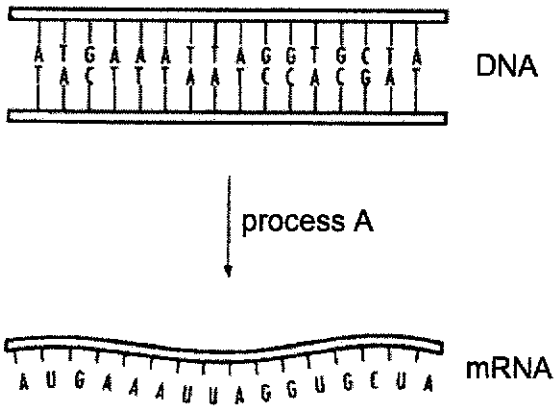

Fig. 6.1

(a) Describe the structure of a DNA molecule.

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.....[3]

(b) On Fig. 6.1, circle the DNA template. [1]

(c) Name process A and state the location of the cell that process A is occurring in.

Process A: .....

Cell location: .....[2]

[Total: 6]

7 Fig. 7.1 shows the interactions of organisms in a pond habitat.

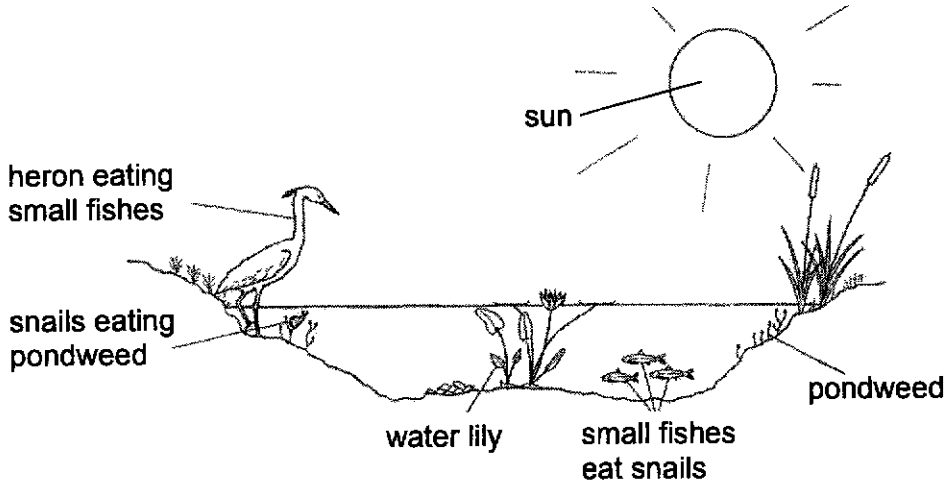

Fig. 7.1

(a) Using information from Fig. 7.1, construct a pyramid of biomass comprising of three trophic levels.

[2]

(b) Explain why food chains rarely go beyond 5 trophic levels.

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.....[3]

(c) Due to excessive leaching of fertilisers into the pond from a farm nearby, a thick layer of algae was formed on the surface of the pond. Within days, after the formation of the algal layer, dead fishes were seen floating on the surface of the pond.

(i) State the process that results in the condition of the pond.

.....[1]

(ii) Explain how the appearance of the layer of algae results in the death of the fishes.

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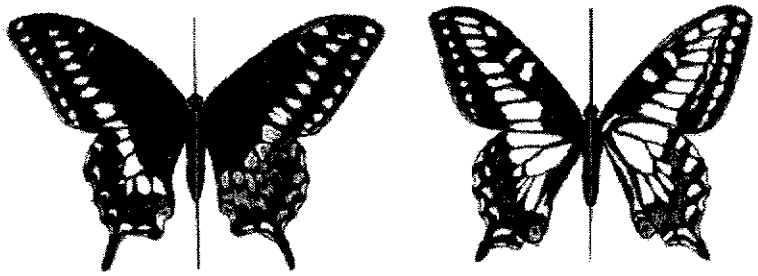
.....[2]

[Total: 8]

8 A species of butterfly displays two variations of wing pattern phenotypes. Fig. 8.1 shows the two different phenotypes displayed by this species.



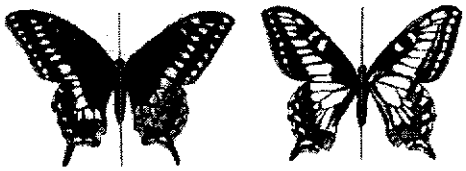
type A type B

Fig. 8.1

When the two types of butterflies are crossed, they produced different outcomes of offspring.

Table 8.1 shows the different outcomes of offspring from two types of crosses, C1 and C2.

Table 8.1

cross	parent butterflies	offspring number	
		type A	type B
C1	 type A type B	68	82
C2	 type A type B	0	150

(a) With reference to Table 8.1, determine which type, A or B, is the dominant phenotype. Explain your answer.

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.....[2]

(b) Explain how cross C1 can produce the results shown in Table 8.1.

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.....[3]

(c) State the type of variation shown in this species of butterfly.

.....[1]

(d) Suggest how the variation in wing pattern phenotype might have been developed in this species of butterfly.

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.....[3]

[Total: 9]

9 **(a)** Fig. 9.1 shows the emissions of carbon dioxide worldwide from 2005 to 2023.

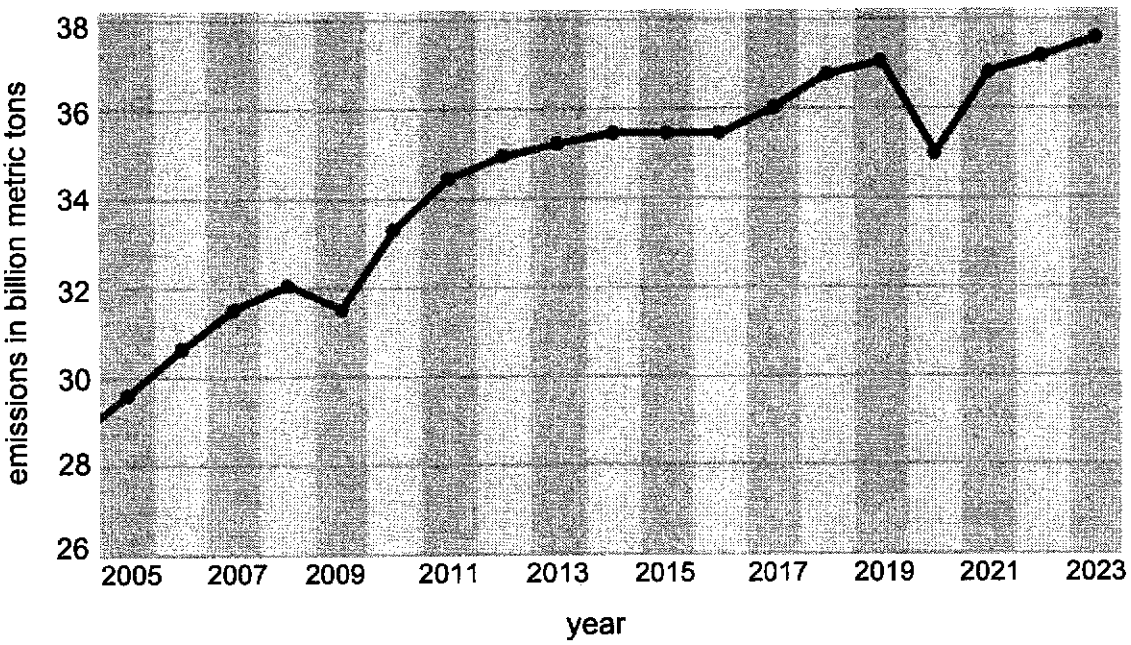

Fig. 9.1

(i) Describe the change in carbon dioxide emission from 2005 to 2023.

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.....[2]

(ii) State two human practices that contribute to the change in carbon dioxide emission shown in Fig. 9.1.

1. .....

2. .....[2]

(iii) Using your knowledge of recent world events, suggest what would have caused the change in the carbon dioxide emission from 2019 to 2020.

.....

.....[1]

(b) Pollution is the process by which harmful substances, or pollutants, are added into the environment, making it undesirable or unfit for life.

Although carbon dioxide is not considered as an air pollutant, the concentration of carbon dioxide in the atmosphere has significantly increased due to human activity.

Explain the effects of carbon dioxide pollution on the environment.

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[Total: 10]

10 In commercial production of apple juice, after the apples are chopped and grinded to a pulp, the enzyme pectinase is added to speed up the process of extracting the juice. Pectinase breaks down pectin, a polysaccharide component found in the cell walls of plant cells, to result in a higher yield of apple juice.

Fig. 10.1 shows how the final product is obtained. The apple pulp is added to a gel containing pectinase. The extracted apple juice will flow through the gel and is collected at the bottom.

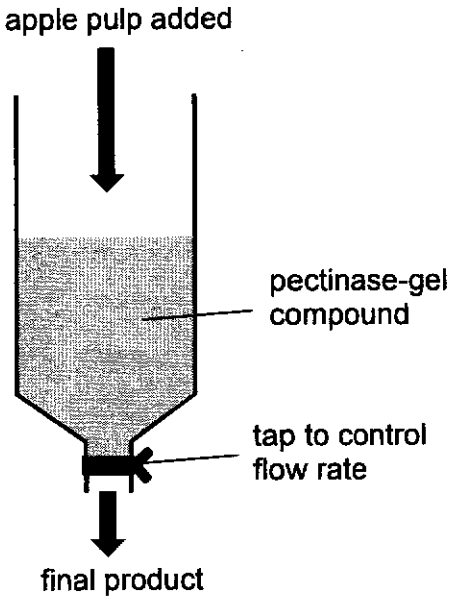

Fig. 10.1

(a) Suggest why reducing the flow rate of apple pulp through the tap would result in an increase in the yield of the final product.

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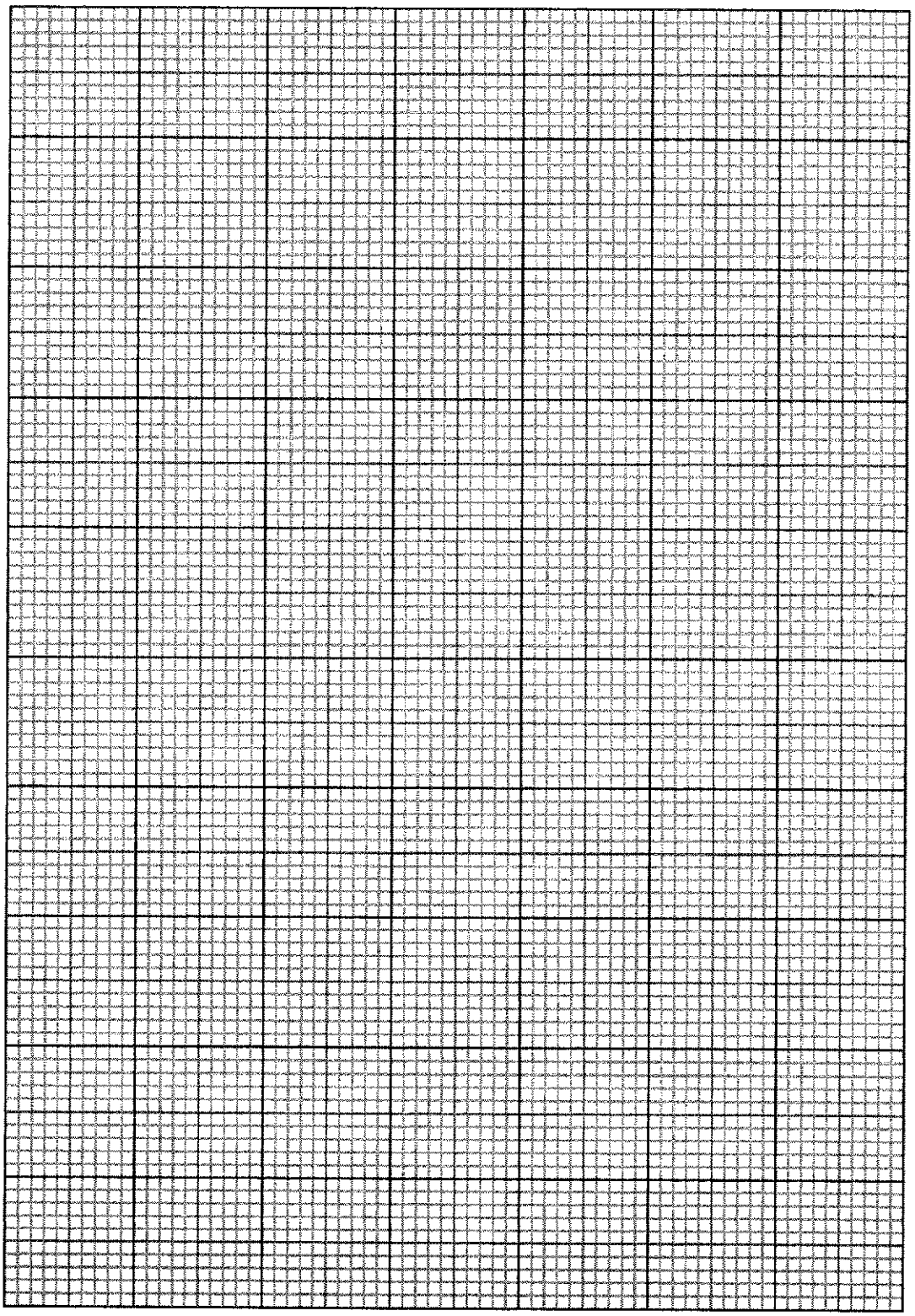
.....[1]

Table 10.1 shows the yield of apple juice over a range of reaction temperatures for pectinase.

Table 10.1

temperature / °C	apple juice yield / cm^3
20	28
30	50
40	64
50	88
60	22

(b) Draw a graph to show the relationship between temperature and apple juice yield. [4]



(c) Explain the change in apple juice yield between 20 °C and 50 °C.

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.....[3]

(d) Define *enzyme*.

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.....[2]

[Total: 10]

Section B

Answer **one** question from this section.

11 Infectious diseases can be caused by organisms such as bacteria, viruses, fungi or parasites.

(a) Discuss on how infectious diseases can be transmitted.

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.....[4]

(b) The World Health Organisation reported that in 2022, the global number of people living with HIV was 39.0 million, compared to 26.6 million in 2000.

Explain the effect of HIV on human body and suggest why it is difficult to control the spread of HIV.

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[Total: 10]

12 Flowering plants reproduce sexually through a process called pollination.

(a) Discuss on the advantages and disadvantages of self-pollination over cross-pollination.

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(b) Successful pollination will often lead to fertilisation.

Outline the events that occur after pollination that will lead to fertilisation.

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.....[4]

[Total: 10]

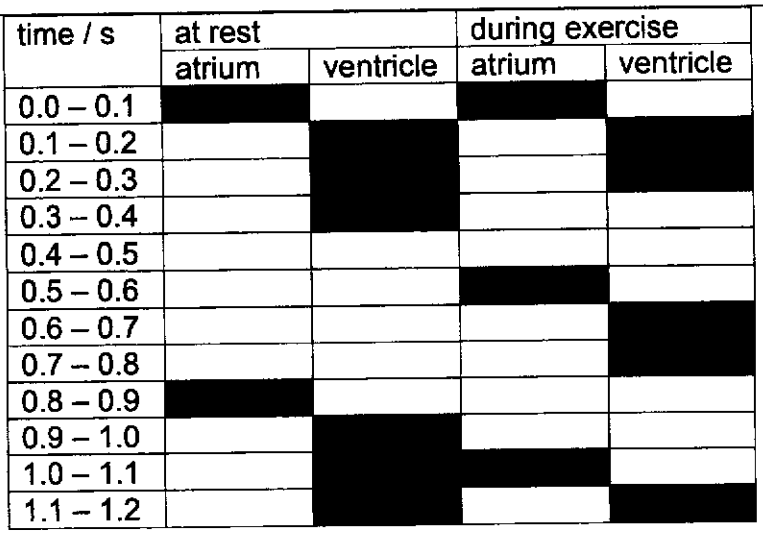
Tanjong Katong Girls' School
Secondary 4 Preliminary Examinations 2024
Answer Key

Biology 6093/01

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

Biology 6093/02

Question		Answer	Marks
1	**(a)**	One-cell thick wall + decrease diffusion distance, increase rate of diffusion of gases; Close proximity to a blood capillary + decrease diffusion distance, increase rate of diffusion of gases;	Max 1m
	(b)	Microvilli;	1m
	(c)	Lacteal;	1m
	(d)	Oxygen; Glucose / amino acids / water / vitamins / minerals;	2m
2	**(a)**	B is thicker, more elastic, more muscular than A; (*vice versa*)	1m
	(b)	*Arrows must show the following to get 1m:* *1. right atrium to right ventricle* *2. right ventricle to pulmonary artery* *3. left atrium to left ventricle* *4. left ventricle to aorta*	1m
	(c)	Tricuspid valve; Closes during ventricular systole + prevent blood from entering right atrium;	2m
	(d)(i)	(60 / 0.8) = 75;	1m

	(d)(ii)	 *Ventricle contraction – 1 or 2 rectangles, as long as lesser than 3* *All chambers relaxation – 1 or 2 or 3 rectangles, as long as lesser than 4* *Must shade until the end*	1m
3	**(a)(i)**	A – glomerulus; B – collecting duct;	2m
	(a)(ii)	Afferent arteriole's lumen is bigger than efferent arteriole's; Creates a high hydrostatic/blood pressure in the glomerulus to force small substances out;	2m
	(b)	Maintain a steep concentration gradient between fluid and blood; (*must write properly*) Allows waste products to diffuse out of blood into fluid; (*reject: "if" answers e.g. if the fluid is not changed…*)	2m
4	**(a)**	$6CO_2 + 6O_2 \rightarrow C_6H_{12}O_6 + 6O_2$; (*light energy and chlorophyll written on the arrow*);	2m
	(b)	Carbon, hydrogen, oxygen;	1m
	(c)	Proteins in water flea is digested into amino acids; Amino acids is used for growth and repair of cells;	2m
5	**(a)**	Rate of transpiration is higher in environment A than B + 9.8 gh^{-1} vs 4.7 gh^{-1}; Or Rate of transpiration in environment A is higher than B by 5.1 gh^{-1}; Increase in humidity lowers rate of transpiration; Gentler / lower concentration gradient between water vapour of air spaces of leaves and environment; (*must write properly*)	3m
	(b)	Did not take into account light intensity;	1m

	(c)	Prevent evaporation of water from the soil;	1m
6	**(a)**	Double helix structure; 2 strands of polynucleotides that are anti-parallel; 2 strands / each base pair held together by hydrogen bonds; Sugar-phosphate backbone of each strand; Each nucleotide consists of sugar, phosphate group and nitrogen-containing base; 4 types of bases adenine, thymine, cytosine, guanine; Each base pair is either adenine to thymine, or cytosine to guanine;	Max 3m
	(b)	(*circle correctly the lower strand including the bases*);	1m
	(c)	A – transcription; Nucleus;	2m
7	**(a)**	(*pondweed → snails → small fishes + "stable shape"*); (*labels + same width*);	2m
	(b)	90% of energy is lost from one trophic level to the next; (*must write properly*) Only 10% is successfully transferred into the organism; Energy is lost by heat energy from respiration / uneaten body parts e.g. _____ / undigested body parts e.g _____; Energy availability at the 5th trophic level is too small to ensure organism to survive;	Max 3m
	(c)(i)	Eutrophication;	1m
	(c)(ii)	Algae blocks sunlight from penetrating into the depths of the pond; Producers deeper in pond unable to photosynthesise; No photosynthesis + no oxygen production; OR Respiration of all organisms depletes oxygen concentration;	Max 2m
8	**(a)**	Type B; Cross C2 creates only offspring of type B + allele of type A is recessive / allele of type B is dominant;	2m
	(b)	Type A parent is homozygous recessive; Type B parent is heterozygous; Offspring inherit 1 allele from type A and 1 allele from type B; 50% chance to create a heterozygous offspring OR ratio of getting type A to type B is 1:1;	Max 3m
	(c)	Discontinuous variation;	1m
	(d)	Mutation creates variation in wing patterns; Variations enables the butterfly to adapt to environment + escape from predators / camouflage into the surroundings; Grow to maturity + reproduce successfully; Pass the genes in wing pattern to the next generation;	Max 3m

9	**(a)(i)**	Increase from 29 billion metric tons to (approx.) 35 billion metric tons; OR Increase in 6 billion metric tons; From 2008 to 2009 + decrease by 1 billion metric tons; From 2019 to 2020 + decrease by 2 billion metric tons; (capped at 2m)	2m
	(a)(ii)	Deforestation; Burning of fossil fuels;	2m
	(a)(iii)	COVID pandemic + less human activity e.g. public transport;	1m
	(b)	Carbon dioxide is a greenhouse gas + traps heat; Higher temperature, melting of ice in polar regions + raise sea levels / release trapped pathogens; Higher temperature, bleaching of corals + decrease biodiversity; Higher concentration of carbon dioxide in water + decrease pH; Dissolves calcium compounds of shell fishes; Climate change + erratic weather conditions; Climate change + vulnerabilities in some animals e.g. polar bears (temperature) and bees (reproduction cycles of plants);	Max 5m
10	**(a)**	Allows more time for pectinase to break down pectin and release the apple juice;	1m
	(b)	*Axes + units;* *Appropriate scale + origin;* *Plots;* *Best-fit line;*	4m
	(c)	Increase temperature + increase kinetic energy of enzyme and substrate molecules; Increase collision rate of enzyme and substrate molecules; Increase formation of enzyme-substrate complex; Increase formation of product molecules;	Max 3m
	(d)	Biological/organic catalyst + protein; Speed up chemical reactions without itself chemically altered after the reaction;	2m
11	**(a)**	Through droplets in the air / airborne transmission + when individual talks / sneezes / coughs; The droplets inhaled by another individual; Exchange of body fluids during sexual intercourse; Baby receiving milk from mother through breastfeeding; Direct contact through mucous membranes e.g. conjunctivitis / HFMD / chicken pox; Transmitted through ingestion of contaminated food / water e.g. cholera, typhoid;	Max 4m

	(b)	HIV destroys/lowers a person's immune system by destroying white blood cells; Hence the body is unable to produce antibodies to protect the person from foreign pathogens; Person infected might not display signs and symptoms for a long time and may unknowingly transmit the virus during this period of time; Social stigma and discrimination against people who are affected will deter affected individuals from seeking medical treatment; Lack of awareness and education about HIV transmission / HIV prevention / misconceptions about viral infections; High-risk behaviours from affected individuals through sharing of unsterilised needles / sharp instruments due to lack of resources, education, awareness, etc; Limited access to healthcare in low-income / remote areas; Virus is able to mutate rapidly which slows down the research on a vaccine against HIV infection; Hard to track movement of people on a global scale, which can spread the infection; (any four)	Max 6m
12	**(a)**	<u>Advantage</u> Only 1 parent is required; High chance that beneficial qualities is passed down to offspring; Does not require external pollinators e.g. wind / insect; High chance of pollination due to close proximity of male and female parts; Less energy is used to produce lesser pollen grains; (any three) <u>Disadvantage</u> Less genetic variation due to only 1 parent; Less adapted to changes in environment; Long-term, offspring becomes weaker and more susceptible to diseases; (any three)	Max 6m
	(b)	Germination of pollen grain + growth of pollen tube containing male gamete; Pollen tube penetrates through the style by secreting digestive enzyme; Pollen tube enters micropyle of ovule; Pollen tube absorbs sap in ovule and burst + release male gamete into the ovule; Male gamete fuses with female gamete to form zygote; (capped at 4m)	Max 4m