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TAMPINES SECONDARY SCHOOL

Secondary Four Express
PRELIMINARY EXAMINATION 2021

CANDIDATE NAME

CLASS

REGISTER NUMBER

BIOLOGY

6093/01

Paper 1 Multiple Choice

14 September 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided unless this has been done for you.

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 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.

This document consists of **24** printed pages.

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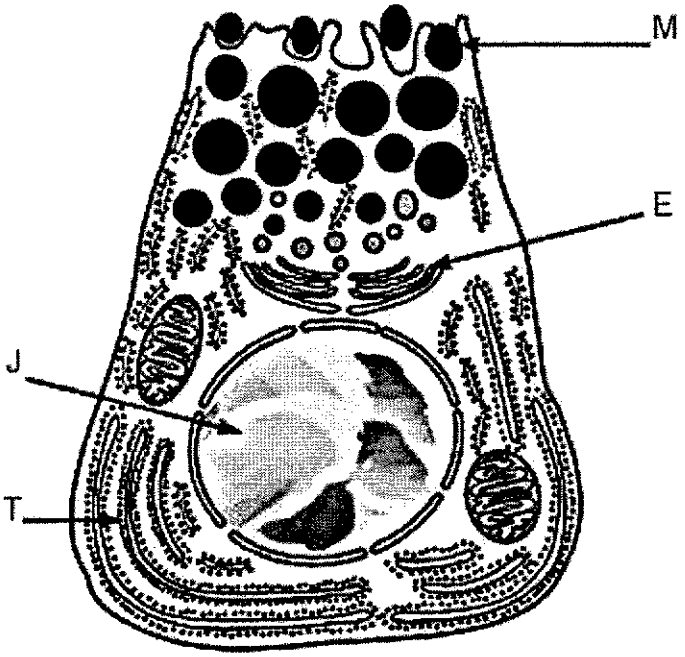
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1 The diagram shows a cell.



Which of the following shows the order of structures involved in the production and secretion of an enzyme?

A M, E, T, J

B T, J, E, M

C J, T, E, M

D T, E, M, J

2 Which of the following is an example of diffusion in a plant?

A carbon dioxide from the air moving into a photosynthesizing leaf

B ions moving into root hair cells against a concentration gradient

C sugars in phloem moving from leaves to roots

D water in xylem moving from roots to leaves

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3 In an experiment, groups of 50 potato discs were blotted dry and weighed. Each group was then immersed in one of a series of sucrose solutions. After 2 hours, each group was blotted dry and weighed again. The table shows the results obtained.

concentration of sucrose solution/ mol/dm^3	initial mass of 50 potato discs/ g	final mass of 50 potato discs/ g	percentage change in mass/ %
0.1	20.0	21.0	+5.00
0.2	20.0	20.4	+2.00
0.3	20.0	19.8	-1.00
0.4	22.0	21.1	-4.09
0.5	21.0	19.5	W

Which value of W and the likely concentration of potato cell sap are correct?

	W	concentration of potato cell sap
A	7.15	between 0.1 to 0.2 mol/dm^3
B	7.15	between 0.2 and 0.3 mol/dm^3
C	-7.15	between 0.1 to 0.2 mol/dm^3
D	-7.15	between 0.2 and 0.3 mol/dm^3

4 Four different sugar solutions were tested with Benedict's solution and the observations of the mixtures after testing are shown in the table.

sugar solution	colour
P	green
Q	yellow
R	brick-red
S	blue

Which of the following correctly identifies the sugar solutions?

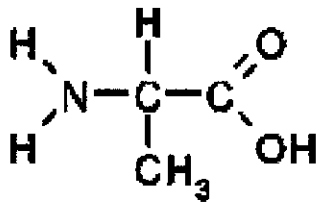
	P	Q	R	S
A	0.1% fructose	0.01% sucrose	1.0% glucose	0.01% galactose

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B	0.01% glucose	0.1% fructose	1.0% maltose	1.0% galactose
C	0.1% glucose	0.01% maltose	1.0% lactose	0.01% fructose
D	0.01% lactose	0.1% fructose	1.0% glucose	1.0% sucrose

5 The diagram shows a molecule.



Which substance might include this molecule?

A galactose

B glucagon

C glucose

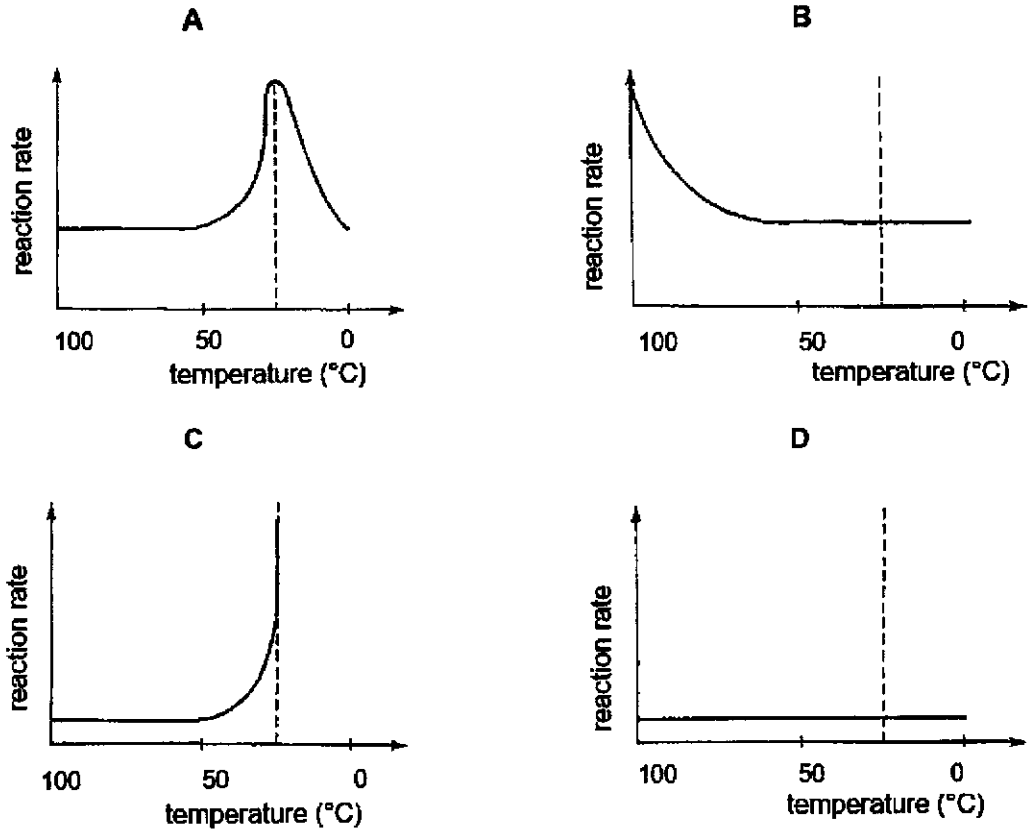
D glycogen

6 Which of the following graphs shows the change in rate of reaction when a hot mixture of starch and amylase is cooled down from 100 °C to 0 °C?

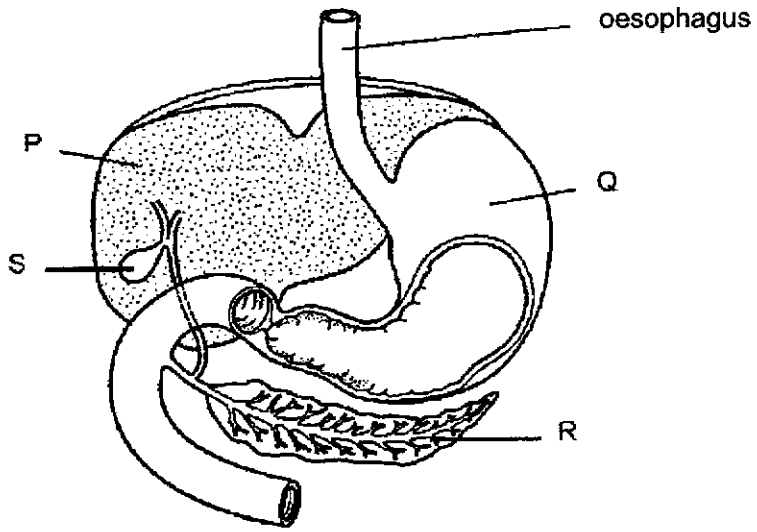
A **B**

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5



7 The diagram shows part of the alimentary canal.



Which structures are involved in fat digestion?

A Q only

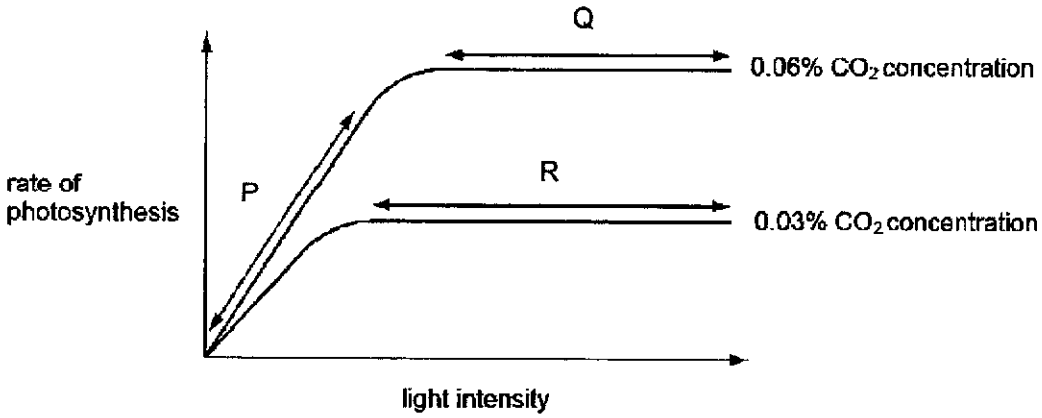
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B P and S only

C R and S only

D P, S and R only

8 The graph shows the rate of photosynthesis of a plant at increasing light intensities at two different carbon dioxide (CO_2) concentrations. The temperature is kept constant.



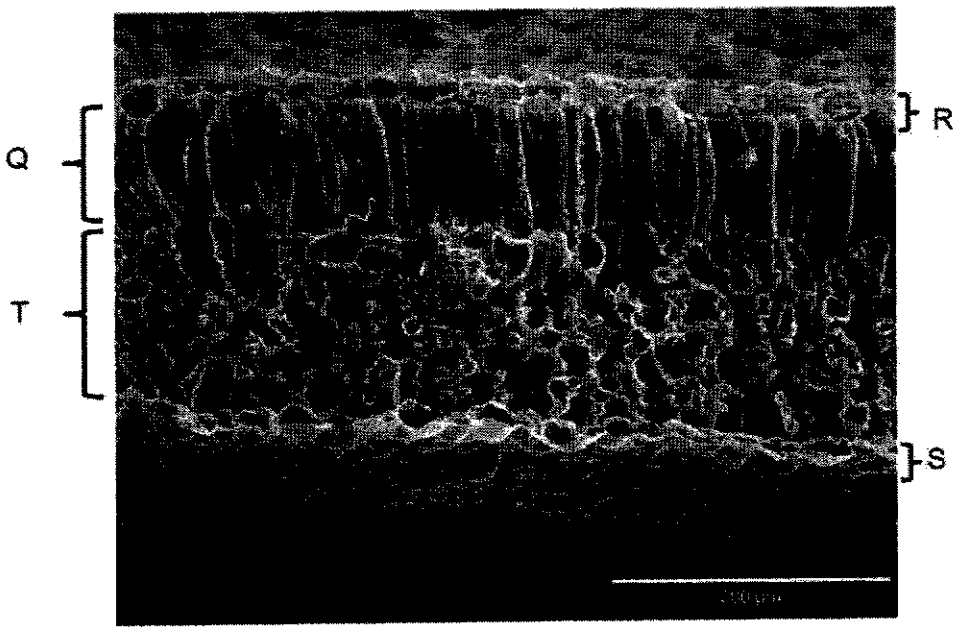
Which of the following accurately identifies the limiting factors at P, Q and R?

	P	Q	R
A	CO_2 concentration	light intensity	CO_2 concentration
B	CO_2 concentration	light intensity	light intensity

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C	light intensity	CO_2 concentration	CO_2 concentration
D	light intensity	CO_2 concentration	light intensity

9 The diagram shows an electron micrograph of a cross-section of a leaf.



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Which row shows the correct order in terms of chloroplast density?

	highest →			lowest
A	Q	R	S	T
B	Q	T	S	R
C	T	Q	R	S
D	S	T	Q	R

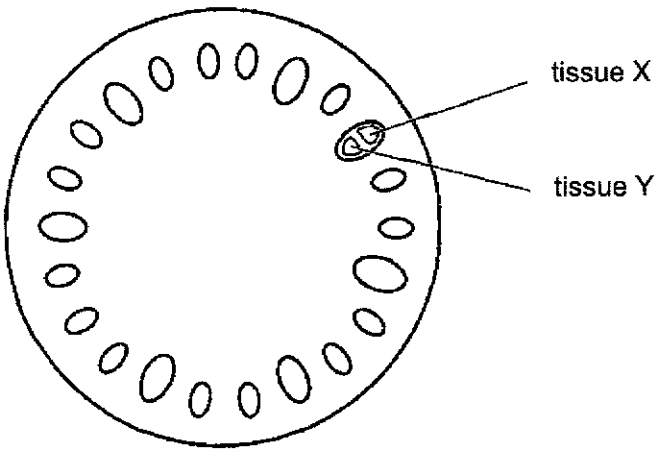
10 The table shows four substances and the parts of the plant to which they are transported.

	substance	part of plant
1	amino acids	flower buds
2	nitrate ions	leaf cells
3	sucrose	root cells
4	water	guard cells

The diagram shows a cross-section through a plant stem.

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9



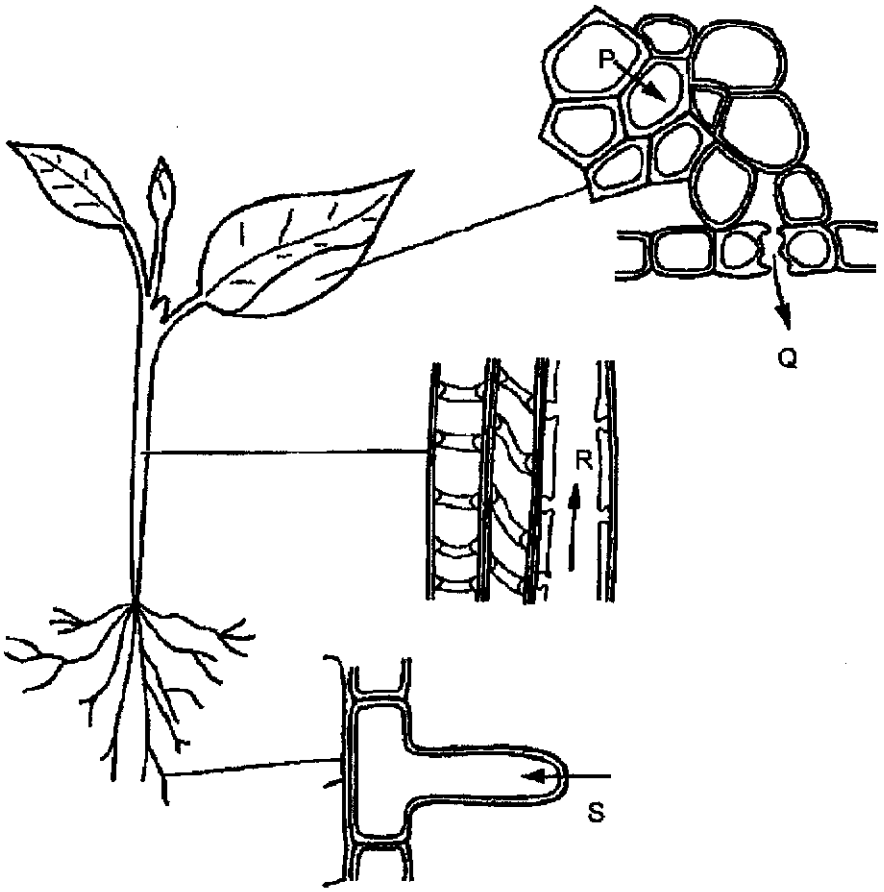
Which row correctly identifies the examples of translocation and the tissue which the substances are transported in?

	examples of translocation	tissue which the substances are transported in
A	1 and 2	Y
B	1 and 3	X
C	2 and 4	Y
D	2 and 3	X

11 The diagram shows the different stages in the movement of water through a plant.

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Which arrow shows the movement of water in the form of water vapour and what is the name of the process responsible for this movement?

	movement of water vapour	name of process
A	arrows P and Q	diffusion
B	arrow Q	diffusion
C	arrow R	transpiration pull
D	arrows P and S	osmosis

12 The table shows the blood groups of four people and the type of blood each received in a transfusion.

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individual	blood group	blood type received in transfusion
W	O	AB
X	B	A
Y	AB	B
Z	A	O

Which individuals are at risk of agglutination?

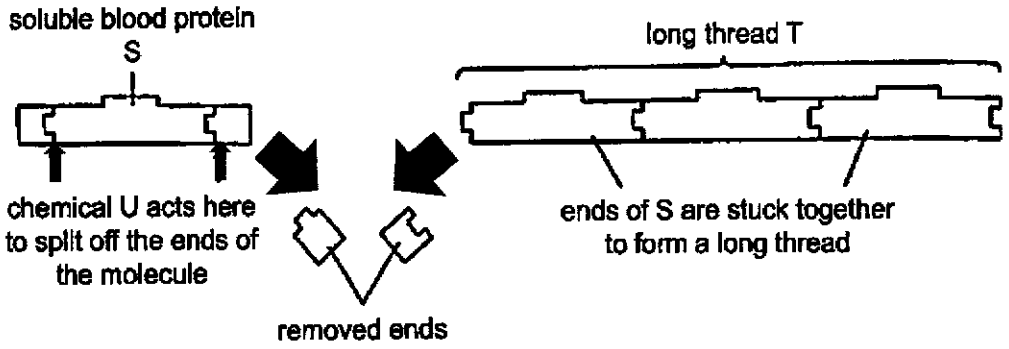
A W and X only

B W and Y only

C X and Z only

D X, Y and Z

13 The diagram describes a process in the clotting of blood.



What are the names of S, T and U?

	S	T	U
A	fibrin	fibrinogen	thrombin
B	fibrinogen	fibrin	thrombin
C	thrombin	prothrombin	fibrin
D	prothrombin	thrombin	fibrin

14 Blood samples from three veins were tested for the concentration of oxygen, carbon dioxide and urea. The results in arbitrary units are shown in the table.

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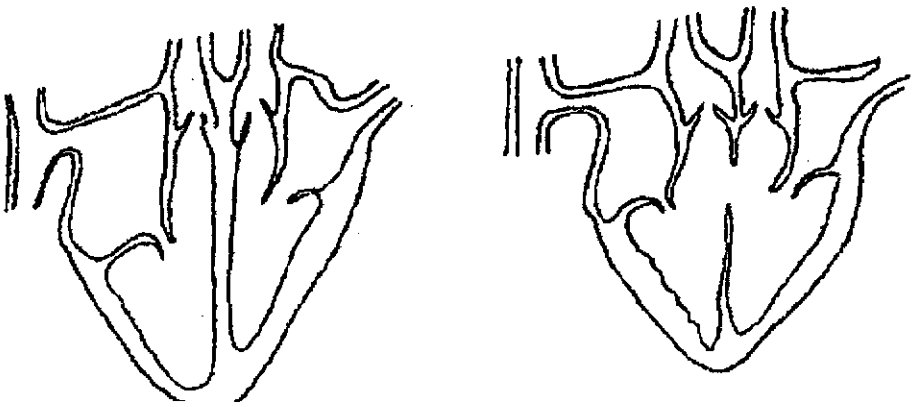
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vein	oxygen concentration	carbon dioxide concentration	urea concentration
1	42	49	1.8
2	41	50	8.6
3	95	37	4.0

Which of the following matches the composition of substances found in the respective veins?

	hepatic vein	pulmonary vein	renal vein
A	1	2	3
B	3	2	1
C	2	3	1
D	3	1	2

15 The diagrams below represent the hearts of a reptile and a bird.



bird reptile

Which of the following conclusions can best be drawn about the animals?

A The aorta of the reptile carries less oxygen than that of the bird.

B The bird's heart has fewer chambers than the reptile's heart.

C The pulmonary vein in the reptile carries less oxygen than that of the bird.

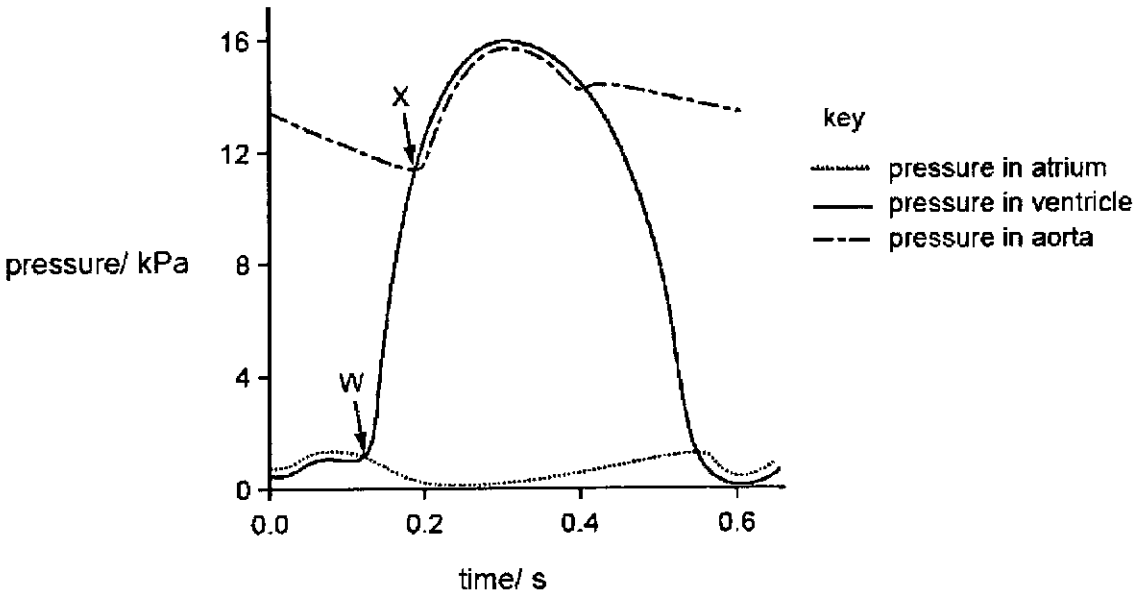
D The reptile's heart is more efficient than the bird's in supplying blood to the animal.

16 The graph shows pressure changes in the left side of the heart, during a single heartbeat.

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13



Between points W and X, are the following valves open or closed?

	bicuspid	semi-lunar
A	closed	closed
B	closed	open
C	open	closed
D	open	open

17 A student breathes in and out for 30 seconds with a paper bag covering her mouth and nose as shown in the diagram.

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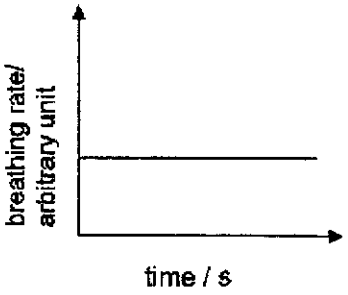
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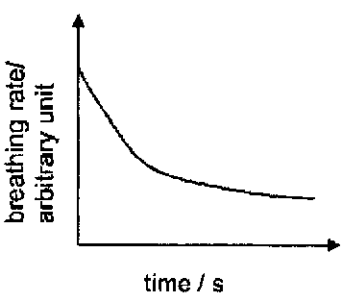
Her rate of breathing over 30 seconds was recorded.

Which graph shows the change in breathing rate?

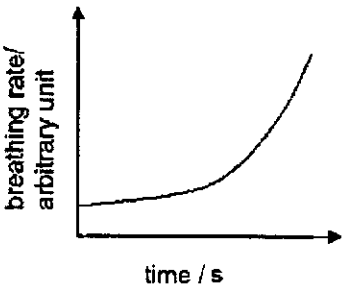
A



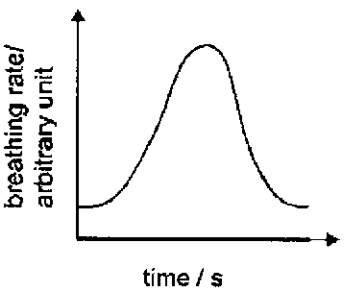
B



C



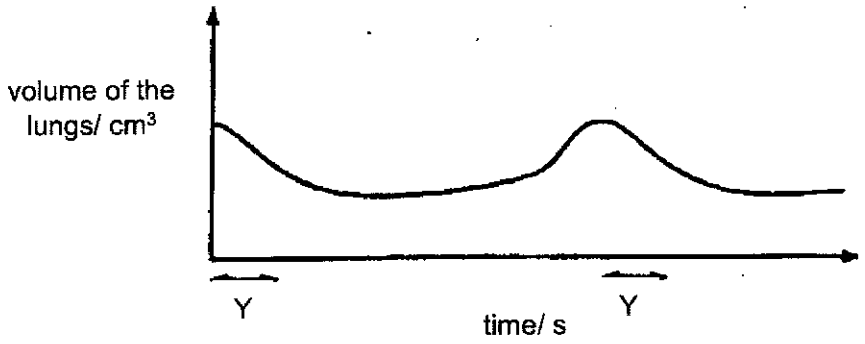
D



18 The graph shows changes in the volume of the lungs during breathing.

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15



What causes the change in volume in the lungs during period Y?

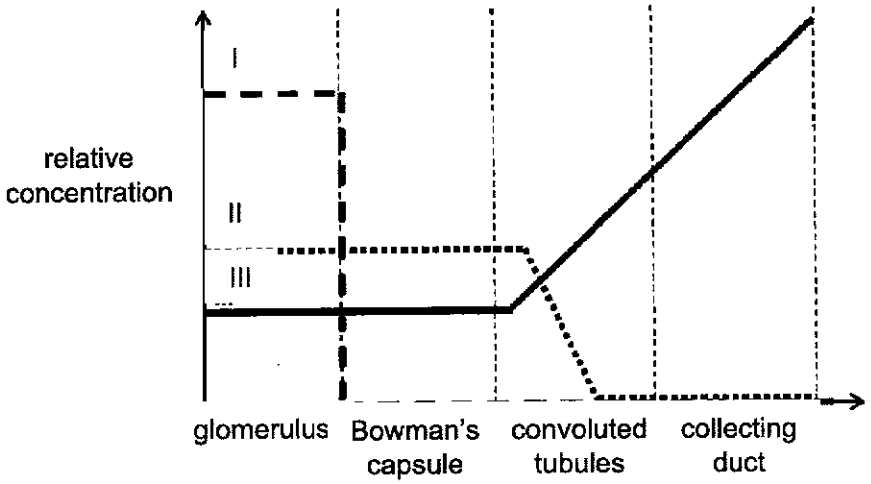
A contraction of the external intercostal muscles

B decrease in the air pressure in the lungs

C movement of the ribs upwards and outwards

D relaxation of the diaphragm muscles

19 The line graphs show the relative concentration of glucose, protein and urea in the fluids obtained from various parts of the healthy mammalian kidney.



Which of the following correctly matches the three graphs?

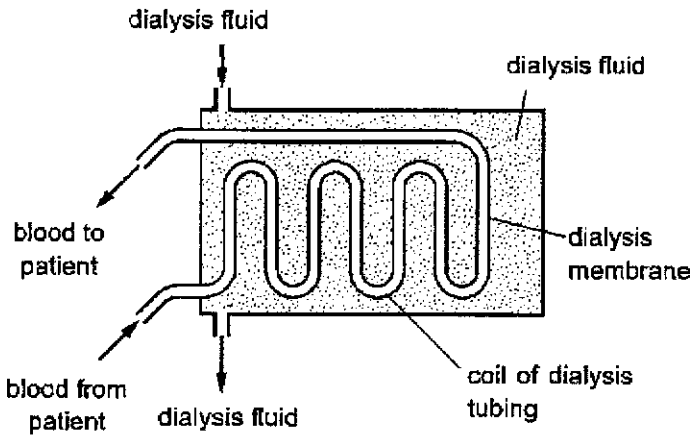
	I	II	III
A	glucose	protein	urea
B	glucose	urea	protein
C	protein	glucose	urea
D	protein	urea	glucose

20 The kidney dialysis machine is used for patients whose kidneys are not functioning well.

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16



Which of the following modifications to the kidney dialysis machine will result in a faster removal rate of the excretory products?

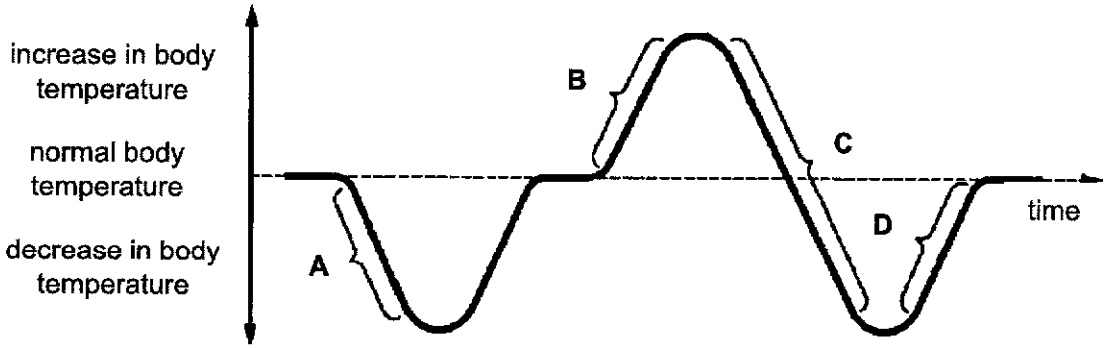
A decreasing the length of the dialysis tubing

B increasing the number of coils of the dialysis tubing

C increasing the diameter of the dialysis tubing

D recycling the dialysis fluid throughout the whole session

21 The graph shows the changes in a person's body temperature over time. Which part of the graph is vasodilation of arterioles taking place after vigorous exercise?

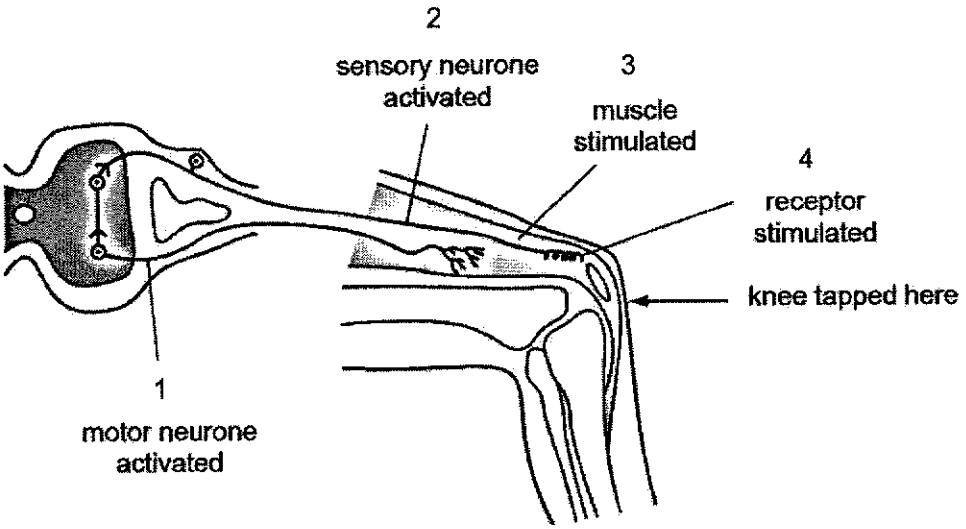


22 Which row correctly gives the sequential events involved in the secretion and action of anti-diuretic hormone (ADH)?

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

23 The diagram shows a simple reflex arc.



What is the correct order of events after the knee is tapped?

A 1 → 2 → 3 → 4

B 1 → 4 → 2 → 3

C 4 → 2 → 1 → 3

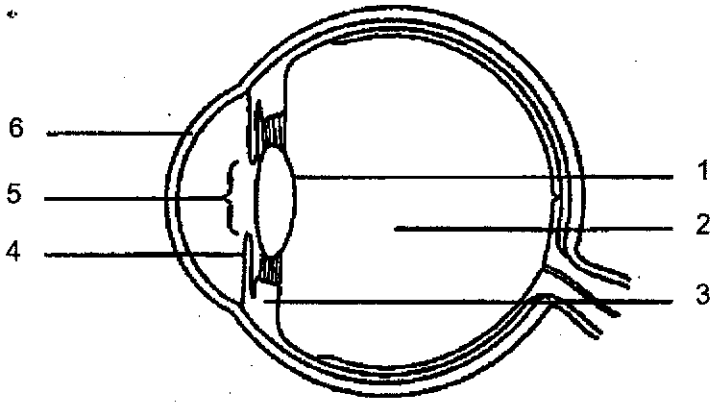
D 4 → 3 → 2 → 1

24 The diagram below shows a horizontal section of a human eye.

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18



Which of the following are effectors involved in forming a clear image when a person changes his/her focus from a distant object in the bright sky to a close object in a dim room?

A 1 and 2
B 2 and 6
C 3 and 4
D 4 and 5

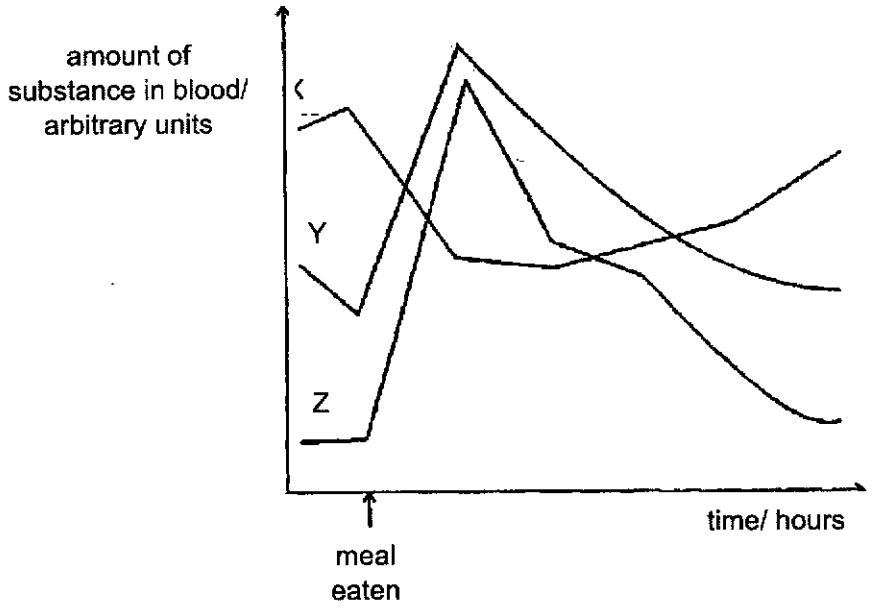
25 Small pieces of shoot tissues, taken from the tips of young leaves of an orchid plant, are placed in a nutrient medium. Each small piece produces a new orchid plant.
Which row about this process is correct?

	type of reproduction	genetics of new orchid plants
A	asexual	genetically dissimilar
B	asexual	genetically identical
C	sexual	genetically dissimilar
D	sexual	genetically identical

26 The graph below shows the amount of insulin, glucagon and glucose before and after a meal.

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19



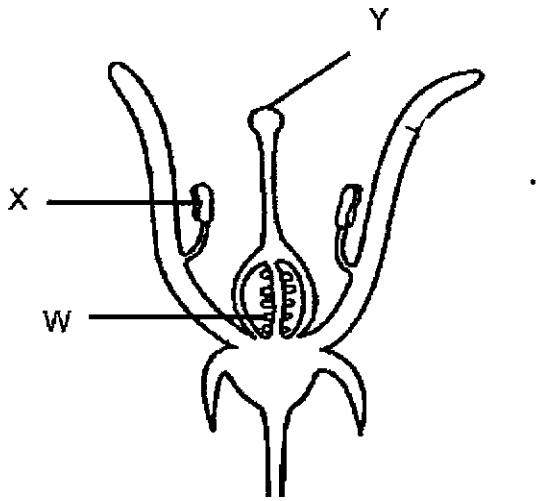
Which of the following shows the correct representation of the graph?

	glucose	insulin	glucagon
A	X	Y	Z
B	Y	Z	X
C	Z	X	Y
D	Y	X	Z

27 The diagram shows a section through a flower.

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20



Which row about the labelled parts is correct?

	contains gametes	receives pollen
A	X only	Y
B	W only	X
C	X and W	Y
D	X and Y	X

28 What would be the result of cutting the sperm ducts in a male animal?

A Male sex hormones would no longer circulate in the blood.

B The animal would be sterile.

C The animal would be unable to develop sperms.

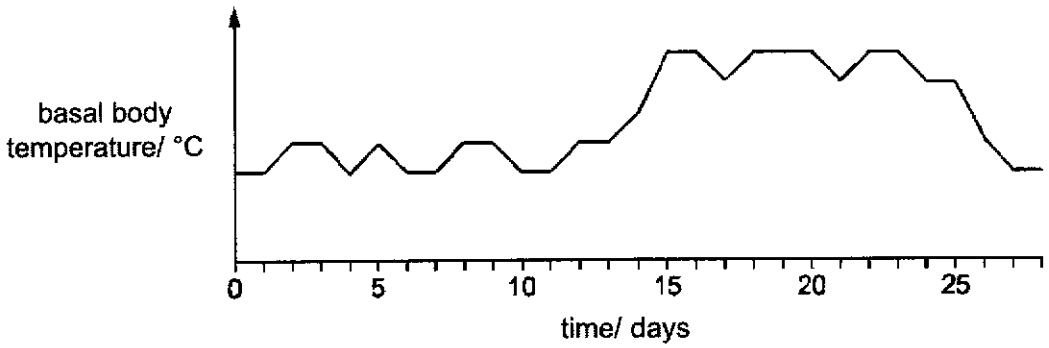
D The animal would not be able to ejaculate.

29 A person's basal body temperature is their temperature when they first wake up in the morning.

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21

In women, an increase in blood progesterone concentration causes a small rise in basal body temperature. The graph shows one woman's basal body temperature over a period of 28 days.



On which day did ovulation occur?

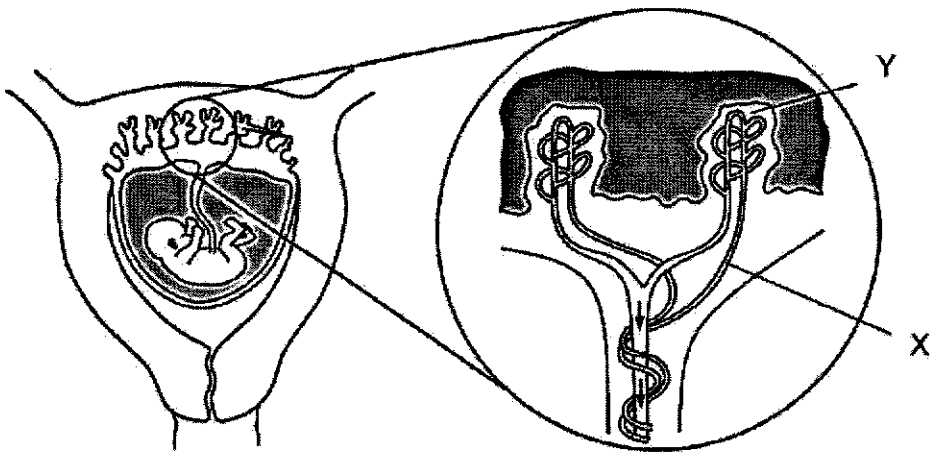
A day 1

B day 5

C day 11

D day 27

30 The diagram shows a developing foetus in the uterus.



Which substances will be at a lower concentration at X than at Y?

A carbon dioxide and glucose

B carbon dioxide and urea

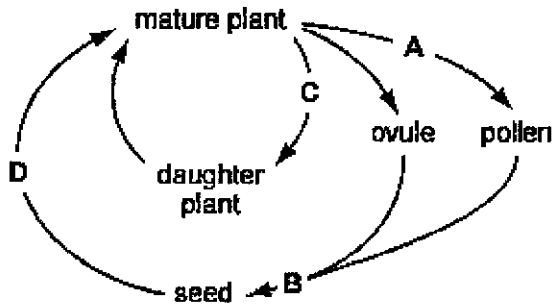
C glucose and oxygen

D oxygen and urea

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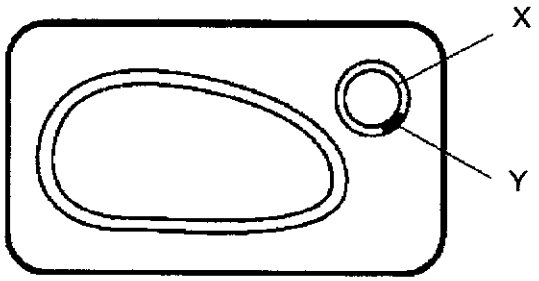
31 The diagram shows the life cycle of a species of plant. During which of the stages does meiosis occur?



32 The template strand of a particular gene contains the following sequence: GTCAGTCAA. What is the sequence of the corresponding mRNA segment resulting from the transcription of this gene?

A CAGTCAGTT
B CAGUCAGUU
C GTCAGTCAA
D GUCAGUCAA

33 The most common treatment for diabetes mellitus is the use of insulin. To create a large supply, transgenic bacterial cells grown in large fermenters are used for insulin production.
The diagram represents a transgenic bacterial cell used to produce insulin.

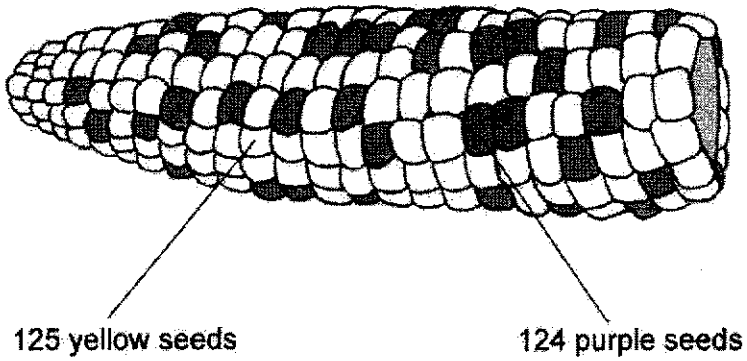


Which of the following correctly identifies structures X and Y, and the enzyme which joins them together?

	X	Y	enzyme
A	chromosome	human insulin gene	DNA ligase
B	chromosome	bacterial insulin gene	restriction enzyme
C	plasmid	human insulin gene	DNA ligase
D	plasmid	bacterial insulin gene	restriction enzyme

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34 In corn, yellow seed (G) is dominant to purple seed (g). The cob below shows some yellow and purple seeds. The seeds have been counted.



The genotypes of the parents that produced this cob were

A GG x gg

B Gg x gg

C gg x gg

D Gg x Gg

35 In goats, the allele for black hair is dominant to the allele for red hair. Two black-haired goats mated and produced twelve offspring. Of the first eleven, eight had black hair and three had red hair.

What is the probability of the twelfth offspring having red hair?

A 25%

B 50%

C 75%

D 100%

36 Which of the following statements about mutations are true?

1 Mutations are only caused by mutagens.

2 Mutations may be harmful or beneficial to an organism.

3 Mutations provide variations for natural selection to operate on.

4 Mutations may result in changes in gene structure or chromosome number.

A 1 and 2 only

B 3 and 4 only

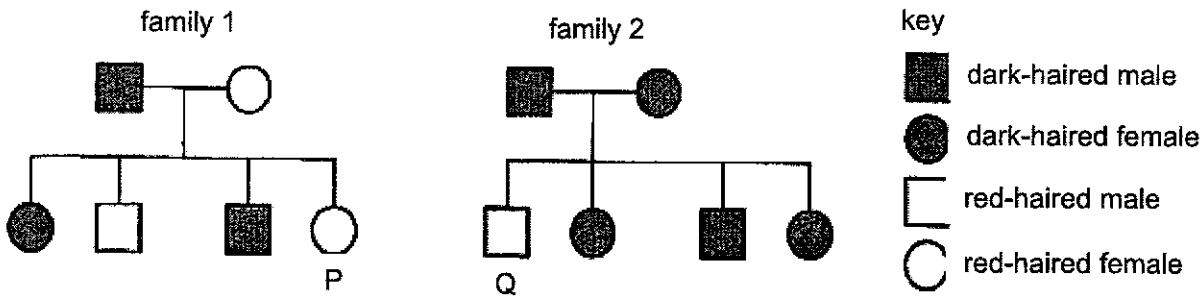
C 2, 3 and 4 only

D 1, 2, 3 and 4

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37 The diagram shows the pattern of inheritance of dark hair and red hair in two families.



If individuals P and Q marry and have children, which prediction can be made about the hair colour of their children?

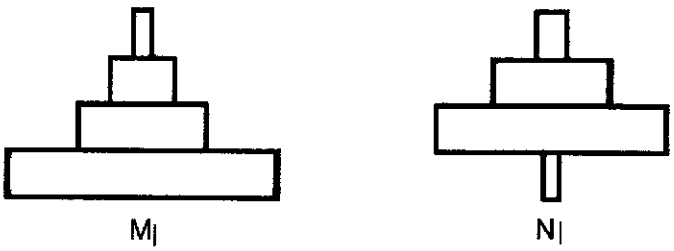
A All the children will have dark hair.

B All the children will have red hair.

C Half of the children will have dark hair.

D Three quarters of the children will have dark hair.

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



What do the two pyramids represent?

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

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39 The rate of absorption of light energy measured in a field is 6300 kJ / m^2 / day. Only 1% of this energy is converted into new plant production. 10% of the net plant production at one trophic level is transferred to the next trophic level.

How much energy is emerging from the primary consumers?

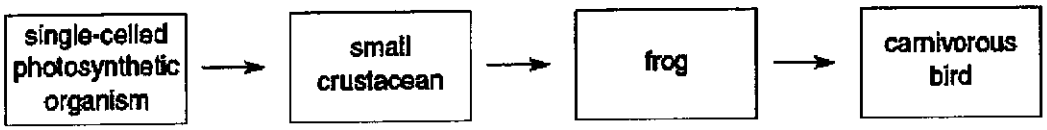
A 0.063 kJ / m^2 / day

B 0.63 kJ / m^2 / day

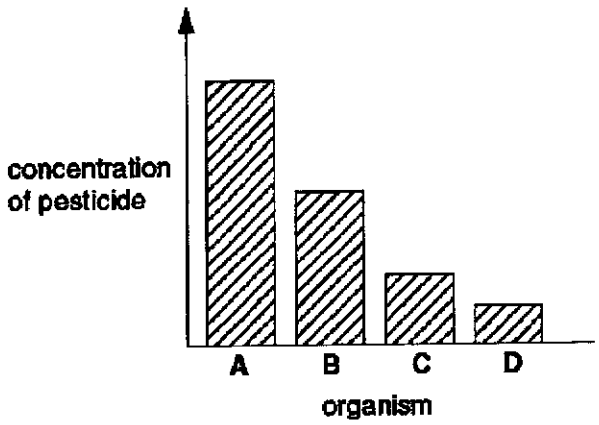
C 6.3 kJ / m^2 / day

D 63 kJ / m^2 / day

40 The following diagram shows part of a food chain in a lake.



The bar chart below shows the concentration of a pesticide in the bodies of each organism in the chain.



Which organism on the bar chart is the crustacean?

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O

TAMPINES SECONDARY SCHOOL

Secondary Four Express
PRELIMINARY EXAMINATION 2021

CANDIDATE NAME

CLASS

REGISTER NUMBER

BIOLOGY **6093/02**

Paper 2 **31 August 2021**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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

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

Section B
Answer **all** the questions, the last question is in the form either/or.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

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

Sect. A	/50
Sect. B	/30
Total	/80

This document consists of **21** printed pages and **1** blank page.

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Section A

Answer **all** questions.

Write your answers in the spaces provided.

1 Lactic acid produced by the anaerobic respiration of skeletal muscles will accumulate in blood in the form of lactate.

Fig. 1.1 shows the blood lactate concentration at different levels of exercise intensity of an athlete before training and after training.

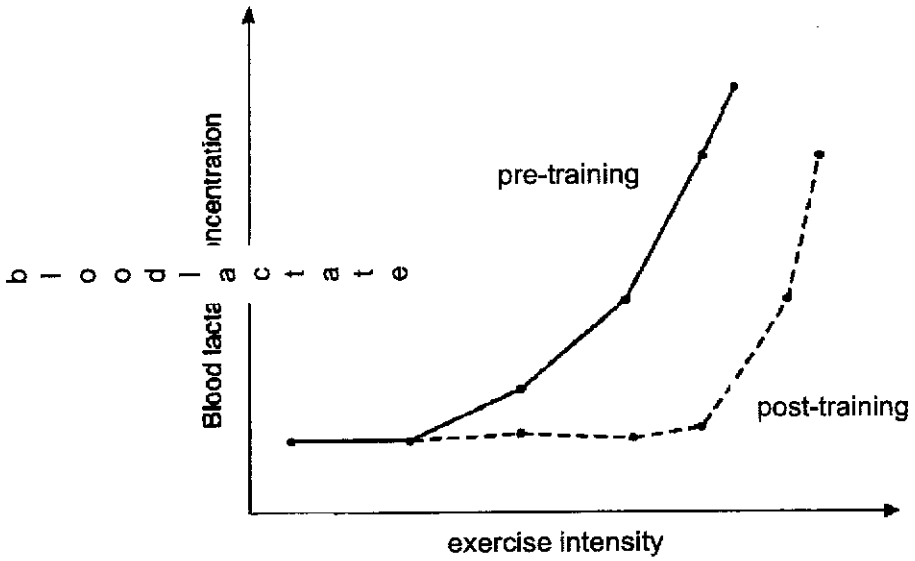


Fig. 1.1

(a) With reference to Fig 1.1, describe how training affects the accumulation of lactic acid in the body of the athlete.

.....

..... [1]

(b) Suggest **one** reason for the change in blood lactate concentration after the athlete has received training.

.....

.....

..... [2]

[Total: 3]

2 Fig. 2.1 shows the changes in the relative size of the stomatal openings in the leaves of an Angsana tree during a 24-hour period. This is an example of a physiological adaptation.

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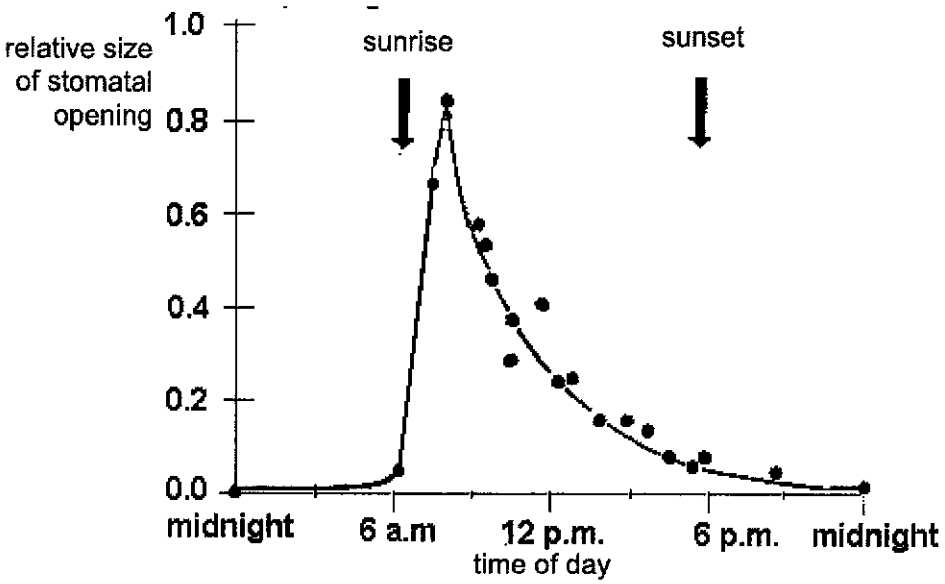


Fig. 2.1

(a) Describe the changes occurring to the stomata during the period from sunrise to sunset.

.....

.....

.....

..... [2]

(b) In the space below, draw a simple outline of a pair of guard cells seen on the surface view of the lower epidermis of the Angsana leaf as they would appear at 9 a.m. Labels are **not** needed.

[1]

(c) Explain the significance of the changes in relative size of stomatal opening between sunrise and sunset to the survival of the Angsana tree.

.....

.....

.....

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.....

..... [2]

[Total: 5]

3 Fig. 3.1 shows three white table cloths with identical fat stains. The table cloths were washed in an enzyme-containing washing powder at three different temperatures, 10 °C, 40 °C, and 70 °C.

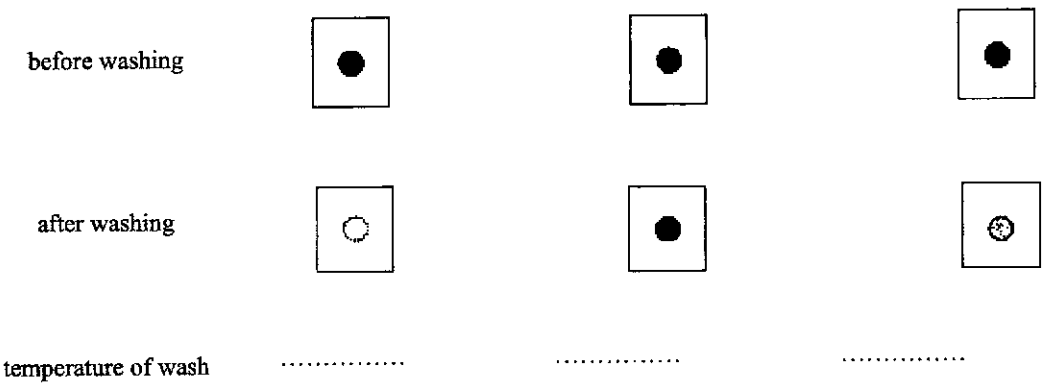


Fig. 3.1

(a) On Fig 3.1, identify the temperature at which each table cloth was washed. [1]

(b) Explain your answer to **(a)**.

.....

.....

.....

.....

..... [3]

[Total: 4]

4 Fig. 4.1 shows some events of a cell cycle taking place in an animal cell. The events are not arranged in the correct sequence.

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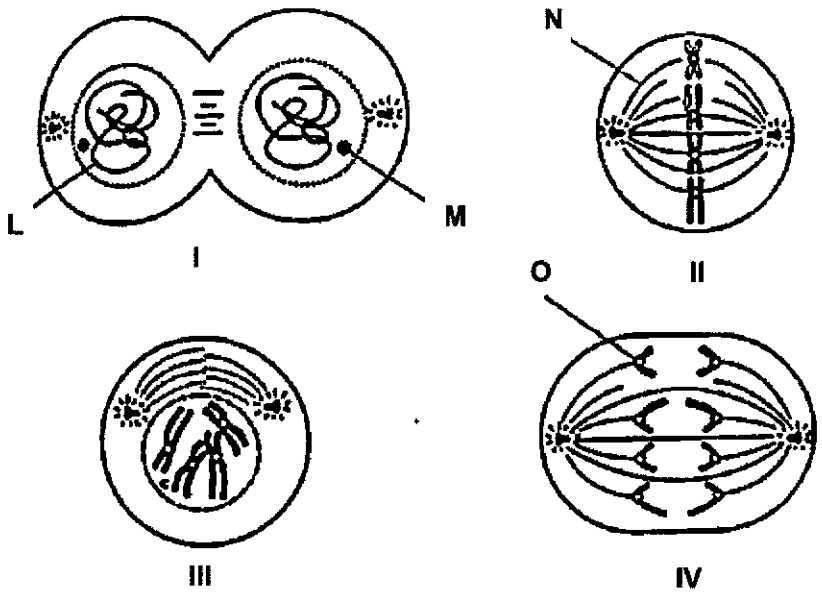


Fig. 4.1

(a) Name the structures **L**, **M**, **N** and **O**.

L ..... **M** .....

N ..... **O** ..... [2]

(b) Name the stages **I**, **II**, **III** and **IV**.

I ..... **II** .....

III ..... **IV** ..... [2]

(c) State **two** differences between the daughter cells produced during mitosis and meiosis.

.....

.....

.....

..... [2]

[Total: 6]

5 Fig. 5.1 shows a section of a pancreas, as seen using a light microscope. **[Turn over**

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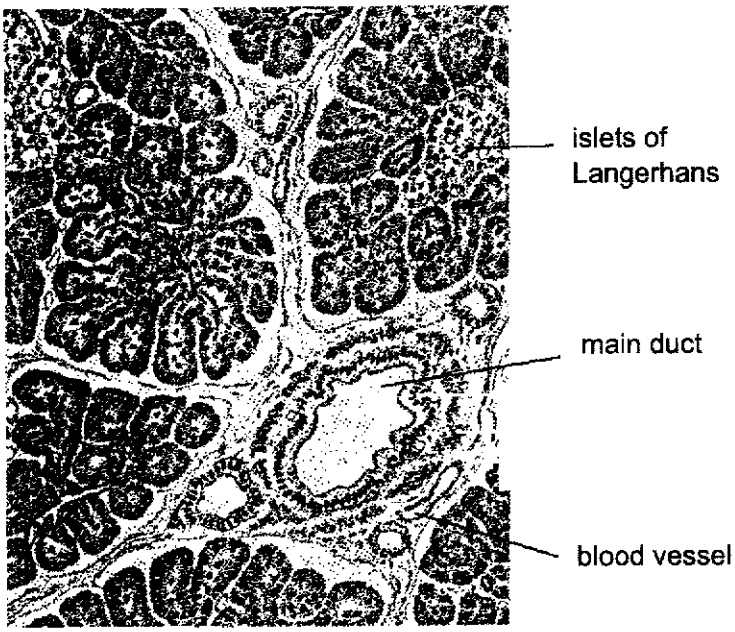


Fig. 5.1

(a) **(i)** Name one protein which can be found in the main duct after a meal.

..... [1]

(ii) State the organ which the main duct empties its contents into.

..... [1]

(b) **(i)** Name the substance that will be released by the islets of Langerhans into the blood vessel after a meal.

..... [1]

(ii) Describe the effects of the substance identified in **(b)(i)**.

.....

.....

.....

.....

..... [3]

(c) The graph shows the blood sugar concentration of a person just before he has taken a meal.

Sketch and complete the graph to show the changes in the blood sugar concentration of:

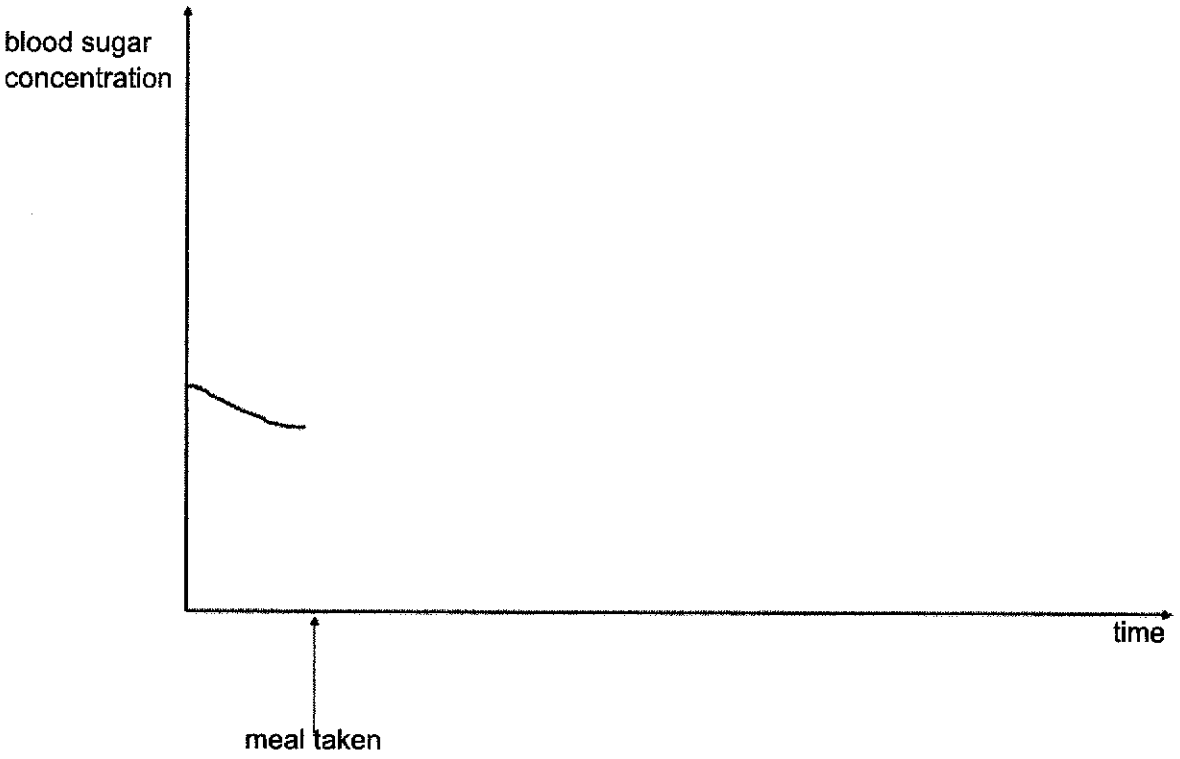
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(i) a healthy person

(ii) a person suffering from diabetes mellitus

Label your graphs clearly.



[2]

[Total: 8]

6 Cystic fibrosis is a genetic condition in humans that results from a failure to inherit a particular dominant allele of a gene.

[Turn over

(a) (i) In the space below, draw a fully labelled genetic diagram to show how cystic fibrosis is inherited by the children of two heterozygous parents. Use the letter **D** to represent the dominant allele and **d** to represent the recessive allele.

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[3]

(ii) State the expected phenotype ratio of the children.

..... [1]

(b) One effect of cystic fibrosis is that the bile and pancreatic duct becomes blocked with mucus.

Suggest why a person whose bile and pancreatic duct is blocked may find it difficult to gain weight despite eating a balanced diet.

.....

.....

.....

.....

..... [3]

[Total: 7]

7 Two plants were crossed and 70 seeds from the cross were planted. The height of the seedlings after 10 days of growth are recorded in Table 7.1.

Table 7.1

height of seedlings / cm	number of seedlings
0	20
10	25
20	29

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30	32
40	33

(a) Calculate the percentage of seeds that grew into seedlings. Show your workings.

..... % [1]

(b) State the type of variation shown by the seedlings.

..... [1]

(c) A farmer wants to produce future generations of plants that grow the tallest as they fetch higher prices than short plants. Suggest how he may do so with the seedlings in Table 7.1.

.....

.....

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..... [2]

(d) Describe two difference between natural selection and artificial selection.

[Turn over

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..... [2]

[Total: 6]

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8 Table 8.1 shows the percentage of different bases in DNA from different organisms.

Table 8.1

source of DNA	percentage of			
	cytosine	adenine	guanine	thymine
human	20	30	20	30
salmon	21	29	21	29
turtle		28		
yeast	19	31	19	31
virus **Z**	18	23	34	25

(a) Complete Table 8.1 by calculating the percentage of cytosine, guanine and thymine of turtle DNA. Show your working clearly in the space below.

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[2]

(b) It was found that turtles and rats have the same percentage of each nucleotide.

Explain briefly why they exist as different species.

.....

.....

.....

..... [2]

(c) Suggest and explain why the ratios of bases in virus **Z** are different from the other organisms listed in Table 8.1.

.....

.....

..... [2]

[Total: 6]

9 Fig. 9.1 shows the numbers and biomass of organisms in a lake. **[Turn over**

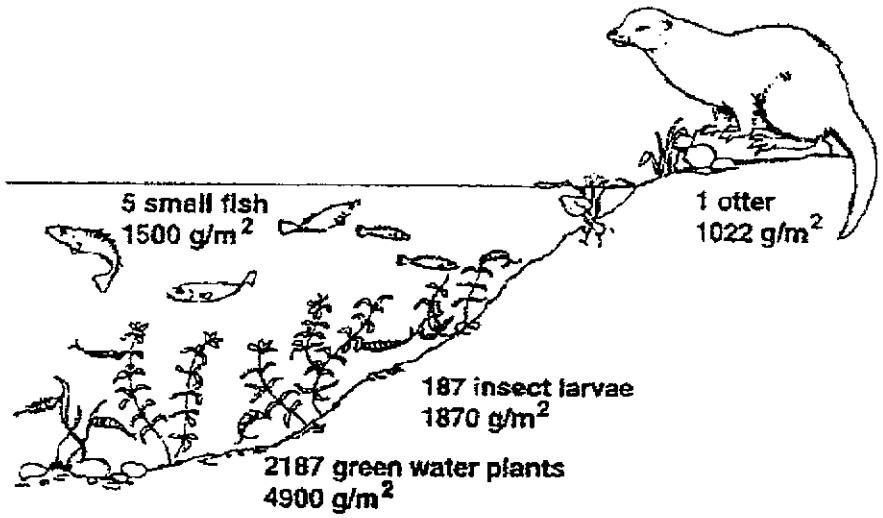


Fig. 9.1

(a) Based on the information shown in the diagram,

(i) construct a food chain using the organisms present.

..... [1]

(ii) draw a labelled pyramid of biomass.

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[2]

(b) Explain what would happen to the other organisms in the lake if all the fishes were removed by a fisherman.

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..... [2]

[Total: 5]

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Section B

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

10 Fig 10.1 shows the transverse sections of two blood vessels, **M** and **N**.

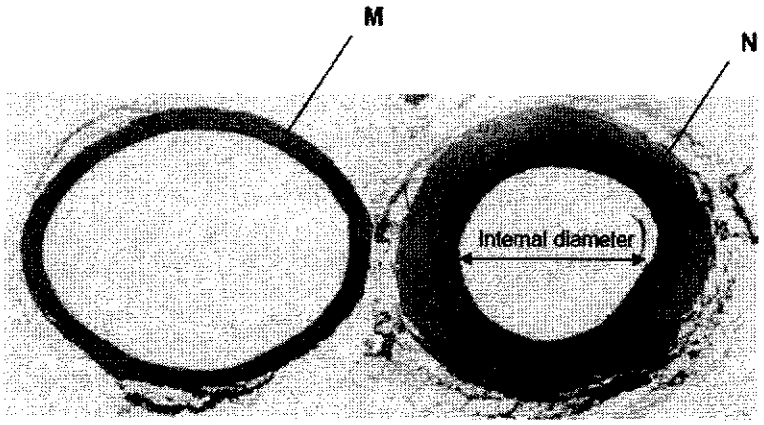


Fig. 10.1

A transverse section of blood vessel **N** was used to investigate how far the internal diameter could be stretched using a number of 10 g weights.
The apparatus used is shown in Fig. 10.2.

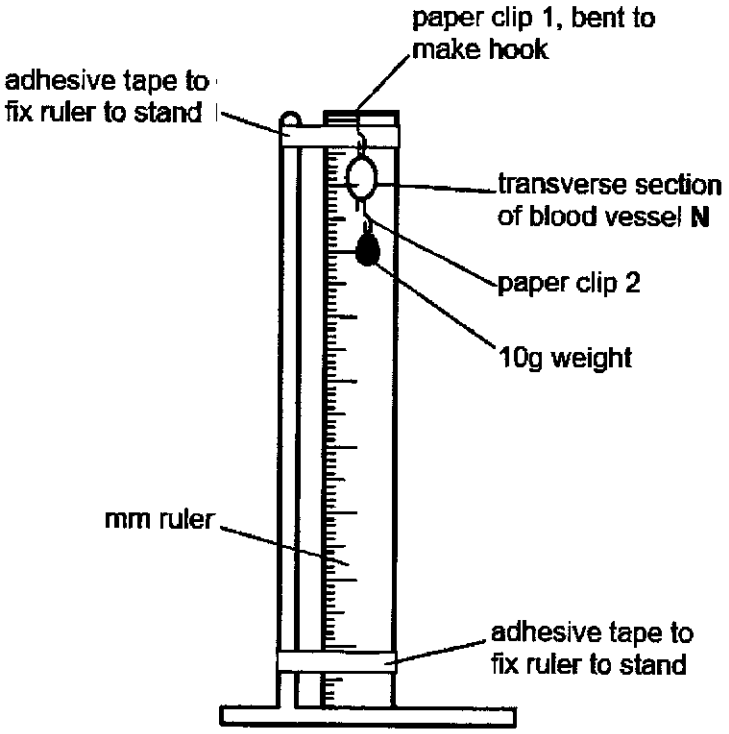


Fig. 10.2

[Turn over

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As weights were added, the internal diameter of the blood vessel increased as shown in Table 10.1.

Table 10.1

mass of weights / g	internal diameter / mm	increase in internal diameter / mm
0	20	0
10	25	5
20	29	9
30	32	12
40	33	13
50	34	
60	35	
70	36	
80	37	
90	37	
100	38	

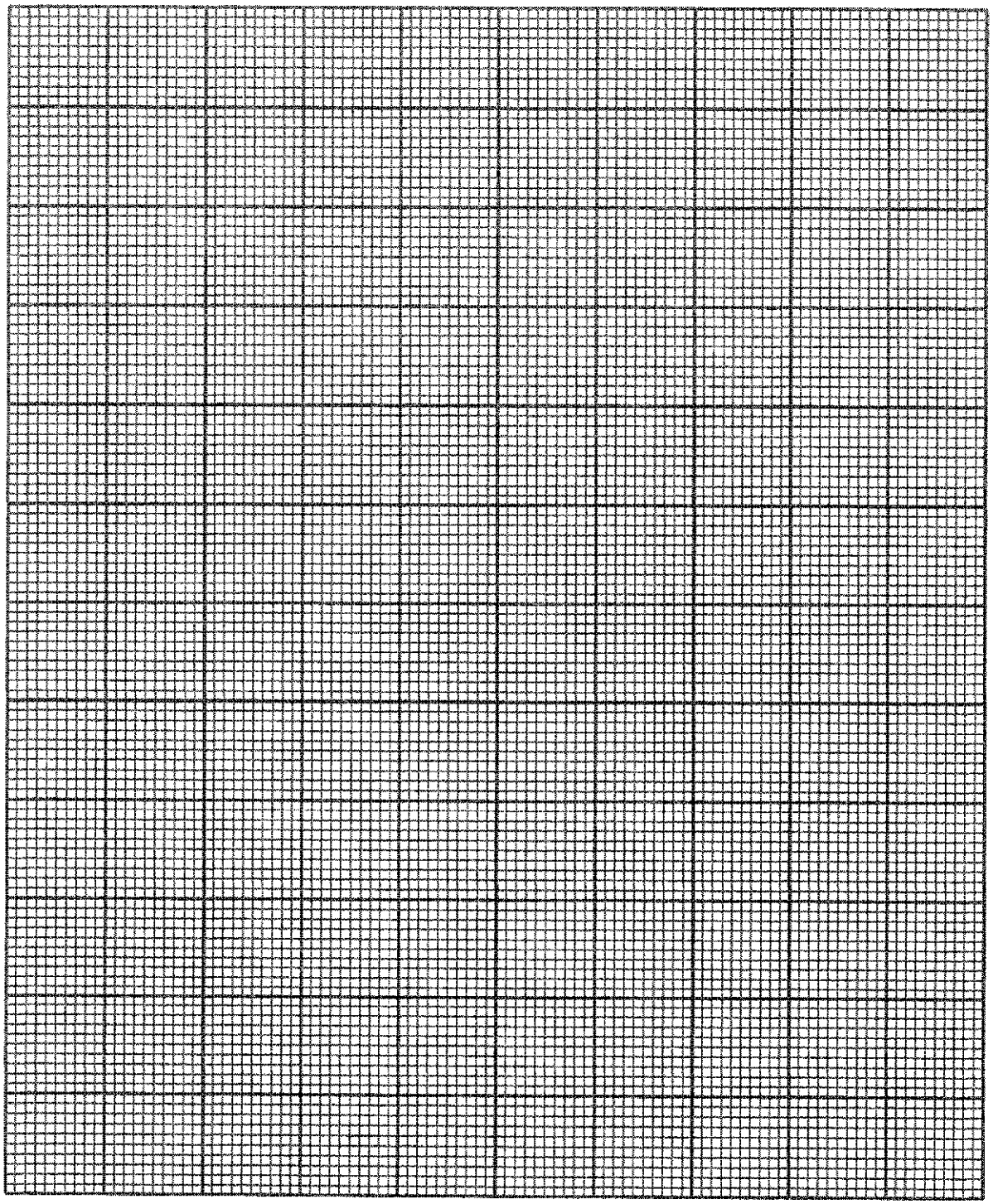
(a) Complete Table 10.1 by calculating the increase in diameter of the blood vessel. [1]

(b) Plot a line graph of the data in Table 10.1 on the grid on the next page.

[4]

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(c) Predict and explain what will happen to the internal diameter of the blood vessel after the weights are removed.

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.....

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[2]

(d) Sketch another curve on the grid to show the effect of increasing mass of weights on vessel **M**.

[1]

(e) State a key physical feature of vessel **M** not found in vessel **N**. Describe the importance of that mentioned feature.

.....

.....

.....

[2]

[Total: 10]

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11 The production of pathogen-resistant transgenic plants has been achieved by genetic engineering. For example, the production of a beetle-resistant tomato plant relies on a gene from a bacterium (*Bacillus thuringiensis*), which scientists inserted into the tomato plant's genome. This gene encodes a protein that is poisonous to certain types of insects, including the beetle.

(a) Explain the term 'transgenic organism'.

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[2]

(b) Describe and explain how a gene that controls the production of human insulin can be inserted into bacterial DNA to produce human insulin for medical use.

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[6]

(c) Describe **two** disadvantages of genetic engineering. **[Turn over**

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[2]

[Total: 10]

Either

12 **(a)** Describe **two** ways genetic variation is increased in an offspring.

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[2]

(b) The sperm and the pollen grain are reproductive structures in humans and plants respectively.

State **one** similarity and **one** difference in the structure of the sperm and pollen grain.

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[2]

(c) Fig. 12.1 shows the carpel (pistil) of a flower after pollination.

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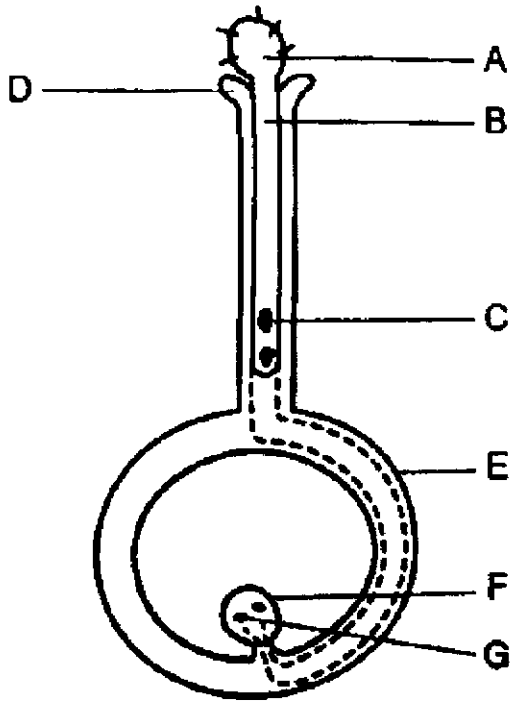


Fig. 12.1

Describe in details, the events that occur after pollination and leading to fertilization.
Your answer should identify and refer to structures **A** to **G** in the diagram.

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[6]

[Total: 10]

Or **[Turn over**

12 (a) Outline the nervous pathway that leads to the secretion of a named hormone when a hiker suddenly encounters a swarm of angry bees in a forest. List the responses arising from this hormonal secretion that allow him to survive this unexpected encounter.

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[6]

(b) In a series of observations, Jovan, with one eye covered, looked at a moving object while the degree of curvature (convexity) of the lens of the uncovered eye was continuously recorded. Table 12.1 shows the results.

Table 12.1

time/ s	0	1	2	3	4	5	6	7	8
degree of curvature of lens/ arbitrary units	1.00	2.40	3.80	3.80	3.80	1.00	2.75	1.90	1.05

Describe and explain the changes in the curvature of Jovan's lens in relation to the movement of the object, from 0 seconds to 4 seconds.

.....

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[4]

[Total: 10]

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4E Pure Bio Prelim 2021 Mark Scheme

Paper 1 (40 marks)

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

Paper 2 Section A (50 marks)

1(a)	In the body of trained athlete, lactic acid starts to **accumulate at a higher level of exercise intensity.**	[1]
(b)	The functions of the athlete's heart and lungs improved after training. Therefore, the oxygen supply to the muscles was enhanced; As a result, the muscles relied less on anaerobic respiration for energy at the level of exercise intensity;	[1] [1]

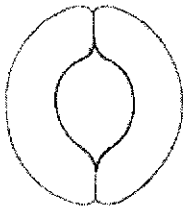
Comments:

- Many students misread / misinterpreted the question;
- Pre-training refers to a period before the athlete has undertaken training / conditioning and does not refer to "warming up before an exercise session"
- Post training refers to a period after the atlete has undertaken a period of training / conditioning and does not refer to "cooling down after a single exercise session"
- Therefore, students are supposed to compare the bold graph (pre-training) with the dashed graph (post-training)

3 marks

2(a)	• Between **6am to 9am**, stomatal opening increased sharply in in size from **0.05 to 0.82**. • Between **9am and 6pm**, opening reduced in size from **0.82 to 0.1** Comments: students are reminded to quote values from both the X and Y axis.	[1] [1]

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(b)	 Open stoma	Comments: Generally well done. However, students need to be careful to not have a gap between the guard cells at the top and at the bottom. (i.e. the guard cells do not fully separate from each other when they open up.)	[1]
(c)	• Opened when there is sunlight to allow **carbon dioxide** to enter for **photosynthesis**; • Stomata closed in the dark / at hight to **reduce excessive water loss** via **transpiration**. Comments: Some students were describing how the guard cell opens and closes (e.g. uptake of potassium ions via active transport etc.). However, that is NOT what the question is asking for. The question asks students to "explain the significance". In other words, why is the opening and closing of stomata so important to the plant? READ THE QUESTION!		[1] [1]

5 marks

3(a)	40 / 70 / 10 °C	[1]
(b)	At 10 °C, enzymes are **inactive** and only a **small amount of fat stains** are removed; At 70 °C, the enzymes are **denatured**; The active site has been altered and **no fat stains** can be removed. At 40 °C, the enzymes are at an **optimal temperature** to digest the fat stains;	[1] [1] [1]
Comments: This question was generally well done.		

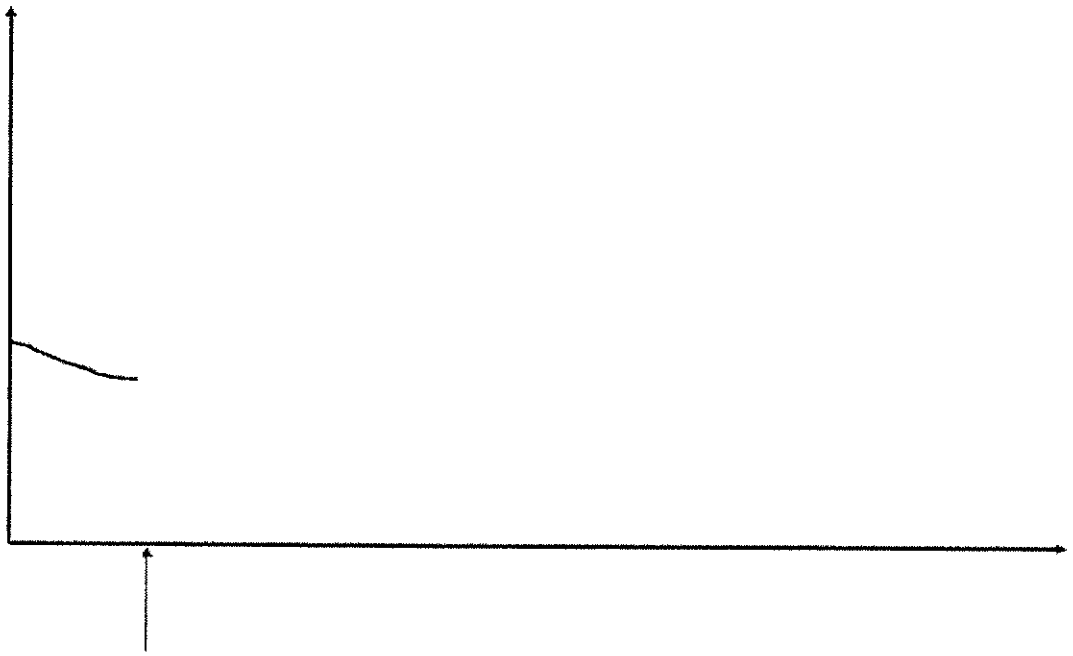
4 marks

4(a)	**L:** chromatin thread **M:** nucleolus; **N:** spindle fibre, **O:** centromere *Every two correct one mark. Comments: some students mistook the nucleolus as the nucleus; remind students to be careful of spelling as well as singular vs plural	[2]
(b)	**I:** cytokinesis **II:** metaphase **III:** prophase **IV:** anaphase *Every two correct one mark. Comments: Many students answer "I" as "telophase". However, the presence of the cleavage furrow indicates that the cell is in cytokinesis already ("cyto" = cell ; "kinesis" = movement)	[2]
(c)	• Mitosis produces diploid cells, whereas meiosis produces haploid cells • Mitosis produces cells that are identical to the parent cell, whereas meiosis does not. Comments: Several students stated that daughter cells produced by mitosis have 46 chromosomes whereas those produced by meiosis have 23 chromosomes. Take note that this only applies to humans. Other organisms have different diploid / haploid numbers.	[1] [1]

6 marks

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5(a)(i)	Pancreatic amylase **OR** pancreatic lipase **OR** trypsin Comment: Note that the main duct in Fig. 5.1 is the main duct of the Pancreas. Several students wrote "insulin" as their answer. However, it is important to remember that endocrine glands are DUCTLESS glands. The pancreas is unique in that it is both an endocrine gland (hormones) and exocrine gland (pancreatic juice) at the same time.	[1]
(ii)	Small intestine **OR** duodenum	[1]
(b)(i)	Insulin	[1]
(ii)	• Insulin increases the permeability of cell membranes to glucose, increasing the rate of glucose uptake by cells. • Insulin stimulates the liver and muscle cells the convert **excess glucose** into **glycogen** • Insulin increases the rate of respiration is cell, thus causing a greater amount of glucose to be oxidized / broken down. • These changes cause the blood glucose concentration of the individual to decrease. Comment: most students did not discuss the increased rate of respiration as a means to lower blood glucose concentration	[1] [1] [1]
(c)(i)	Healthy person: blood glucose concentration spikes shortly after meal taken but starts to decrease back to normal levels after a while due to the action of insulin	[1]
(ii)	Person suffering from diabetes mellitus: blood glucose concentration spikes shortly after meal taken but the decrease back to normal is much more gradual  Comment: For the person suffering from diabetes, many students showed a constant level after the spike in blood glucose. Note that blood glucose will still decrease (since body cells are still respiring) albeit more slowly.	[1]

8 marks

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6(a)(i)	• Dd x Dd ; • correctly shown gametes ; • correctly drawn and completed genetic diagram ; [-1m for no proper labels – e.g. parent's phenotype] Comments: Some students drew the arrows representing fertilization wrongly; kindly revise on how to draw a proper genetic diagram. Some students also did not include the labels.	[1] [1] [1]
(ii)	3 non CF : 1 CF Comments: Majority of the students simple wrote "3:1". However this ratio is meaningless without the appropriate indication of what the "3" and "1" is referring to.	[1]
(b)	• **reduction** in enzymes / pancreatic juice / bile entering duodenum ; • correct ref. to reduced **bile** action / action of pancreatic **enzymes** • **less digestion** by enzymes secreted by the pancreas / emulsification; • fewer molecules to absorb / **less absorption** qualified ; • and use for assimilation into larger molecules ; • used in growth ; Comments: Most students could mention the first two points on reduced secretion and digestion / absorption. However, since the question is about "weight gain", a link must be made to assimilation.	[1] [1]

7 marks

7(a)	[55/70] x 100% = 78.6 %	[1]
(b)	Continuous variation Comments: Generally well done.	[1]
(c)	• select the tallest seedlings and carry out self-pollination to produce offspring • repeat the process for future generations to ensure that they inherit the tall allele Comments: Most students stated the first point but did not follow up and talk about repeating the process for multiple generations. Although artificial selection does indeed occur faster than natural selection, it still requires multiple generations for its effect to take place.	[1] [1]
(d)	<table><tr><th>Natural Selection</th><th>Artificial Selection</th></tr><tr><td>Results from random mutation in genes</td><td>Results from manipulation by humans</td></tr><tr><td>Brought about by changes in environmental conditions</td><td>Human select organisms with desired traits to reproduce</td></tr><tr><td>Very slow process</td><td>Relatively faster process</td></tr><tr><td>May be advantageous or harmful to man</td><td>Advantageous to man</td></tr></table> Any two differences	[2]

6 marks

8(a)	C: 22 %, G: 22 %, T: 28%	[1]

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	Clear working showing understanding of base pairing rules	[1]
(b)	Different sequence of nucleotides Resulting in different polypeptides, proteins, hence leading to different traits / characteristics Comments: Students did not appreciate that attention should be placed on 'sequence'. 'Different types of nucleotides/bases' is not accepted as the 4 main types are standard and do not change. Many failed to make the link to the sequence of amino acids being altered and hence the structures of the polypeptides/proteins being changed.	[1] [1]
(c)	DNA may not be double stranded No pairing of complementary bases Comments: Question is poorly attempted. Some attributed it to mutation. Some simply said virus contains RNA without elaborating.	[1] [1]

6 marks

Paper 2 Section B (30 marks)

10(a)	14, 15, 16, 17, 17, and 18 in table (all correct for [1])	[1]
(b)	Scales – linear scale, to fill more than ¾ of the printed grid Plot – all correct Line – best-fit curve Axes – x axis: mass of weights/g, y axis: increase in diameter of blood vessel/mm (R: if no units) Comments: A few used 'total internal diameter' as the y-axis (need to understand that when questions ask to calculate something, means that data should be used in the formation of trends/relationships). If that occurs, plotted points will be awarded credit based on 'error carried forward'. Not all were able to plot a smooth best-fit curve. Note: 'line' does not necessarily mean 'straight'; a line can also be a curve.	[1] [1] [1] [1]
(c)	The blood vessel will <u>return to the original size</u>/shape/diameter; (quote values if possible) Blood vessel wall is <u>elastic</u> and able to stretch and recoil back to original size Comments: Some simply mentioned thick and muscular without mentioning elastic.	[1] [1]
(d)	Sketch a curve <u>lower</u> than the curve for vessel N (because veins are less elastic) Comments: Very poorly attempted. Many students missed out this question. Straight line sketch will not be accepted because question stated 'curve'.	[1]
(e)	Presence of <u>valves</u> To <u>prevent the backflow of blood</u> travelling against gravity Comments: Many mistook the vein as a capillary, and as a result mentioned 'one-cell thick wall' with reference to facilitating diffusion. It cannot be a capillary as the diameter of a capillary would be much smaller. Some mentioned about lumen diameter/thickness when earlier parts already addressed this. Students have to realize that question requirements do not repeat. They have to identify another key feature not already mentioned in earlier parts.	[1] [1]

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11(a)	Transgenic organisms are organisms that have had foreign gene transferred from another organism of the same or different species; Artificially/human inserted into their genome/DNA. Comments: Some students only mentioned 'genetically modified/engineered' without saying how. Many did not recognize that after the transfer, the foreign gene has to be 'inserted' into the genome of the organism. Merely mentioning 'change in DNA/nucleotides' is insufficient as this could also sound like mutation.	[1] [1]
(b)	• insulin gene is located and obtained by cutting it with a restriction enzyme, this produces 'sticky ends' • a plasmid from a bacterium is obtained and cut with the same RE to produce complementary sticky ends • mix plasmid and insulin gene together due to complementary sticky ends, base pairing between plasmid and insulin would occur • add DNA ligase to join plasmid and insulin gene together • mix plasmid with bacteria and apply heat or electric shock which opens up the pores of the bacteria cell membrane to allow plasmid to enter • allow bacteria to grow/multiply under optimal conditions in a fermenter and produce insulin gene, extract and purify Comments: Some confused between 'gene' and 'codon'. Codon only consists of three nucleotides, which is a smaller unit than a gene. Some spelt the enzyme as 'restrictive'. Some simply mentioned 'bacterial DNA' but fell short of stating 'plasmid'. Some mistakenly wrote 'incubator' instead of fermenter; they are not the same as 'incubator' does not reflect the presence of the nutrient broth which plays an important role. Students should avoid using non-technical words like 'paste' or 'glue' when referring to DNA ligase. Some failed to consider that the recombinant plasmid has to be first re-introduced back to the bacteria; they mistook that the plasmid is the one that multiplies when in fact, it is the bacteria that does so. Do note that the same restriction enzyme must be used to generate sticky ends that are complementary.	[1] [1] [1] [1] [1] [1]
(c)	1) Environmental hazards: Genetically-modified (GM) crop plants that produce insect toxins may result in the deaths of insects that feed on them and may result in loss of biodiversity. 2) Economic hazards: If the prices of the seeds of modified crop plants are not regulated, poorer farmers may not have the financial capacity to benefit from this technology while richer farmers continue to get richer through the technology. 3) Health hazards: Genes that code for antibiotic resistance may be accidentally incorporated into bacteria that cause human diseases. 4) Social and ethical hazards: Genetic engineering may lead to class distinctions. Some religions do not approve of genetic engineering as it may not be appropriate to alter the natural genetic make-up of organisms. (any two for [2])	[1] [1]

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	Comments: Most answers are vague and lack elaboration. It is insufficient to merely mention that genetic engineering is expensive/costly without examining the class differences/ social inequality. It is inadequate to mention 'loss of biodiversity' without elaborating with examples. Other answers such as 'introduction of allergens' with elaboration are also accepted.	

12(a) **EITHER**	Crossing over of homologous chromosomes at prophase I of meiosis I; Independent assortment of homologous chromosomes at metaphase I of meiosis I; Random fertilization of any sperm with egg; Gene or chromosomal mutation; Cross-pollination in flowering plants (any two for [2]) Comments: Some did not state the stages of meiosis which crossing over and independent assortment occurs. Independent assortment at metaphase II only increases genetic variation if crossing over has taken place in prophase I to make the sister chromatids genetically different.	[1] [1]
(b)	Similarity (any one for [1]): Sperm and pollen grain contain haploid (R: 23) number of chromosomes from male parent. Both contain/secrete enzymes to break down egg follicle cells and tissues of style respectively. Difference (any one for [1]): Sperm cell has one nucleus but the pollen grain has two nuclei. Sperm uses a tail/flagellum to reach the female gamete while a pollen grain uses a pollen tube. Sperm cell contains numerous mitochondria in its middle piece but a pollen grain does not. Comments: Some wrote incorrectly that a sperm 'contains' the male gamete; a sperm 'is' the male gamete, it does not contain a gamete. No credit was awarded for saying both sperm and pollen grain are small, because this feature is not something specific to these two things only. Students are to take note that the plural of 'nucleus' is 'nuclei'.	[1] [1]
(c)	1) A (pollen grain) germinates/grows in response to the sugary fluid released by D (stigma) 2) B (pollen tube) grows from A (pollen grain) 3) As B grows, it secretes enzymes to digest tissue of stigma and style in order to penetrate into the style as it grows 4) B grows down the style into E (ovary) and enters F (ovule) through the micropyle 5) Tip of pollen tube, once inside the ovule, absorbs sap and burst to release both C (male gametes) 6) One male gamete, C fuses with G (ovum) to form zygote (fertilization) Comments: Quite a number did not make reference to A-G; some identified each alphabet incorrectly. Many missed out the first step of germination. Some were confused between pollen tube nucleus and male gametes. Some were confused between the similar terms 'ovary', 'ovule' and 'ovum'.	[1] [1] [1] [1] [1] [1]

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12(a) OR	Stimulus generate impulses in sensory neurons of brain / hypothalamus, which are then transmitted along relay neurone Nerve impulses travel across synapse to motor neurone to adrenal gland (effector) to secrete adrenaline • Speeds up conversion of glycogen to glucose • Increase metabolic rate • Increase heart rate and blood pressure • Increate in rate and depth of breathing/ventilation • Increase in rate of blood clotting/coagulation • Constricts arterioles in the gut and skin • Cause pupils to dilate • Contracts hair erector muscles to contract (list any 3 effects for [3]) Extra info: • In a fight or flight situation such as being confronted by an armed robber/ just before the start of a race, level of adrenaline would increase. • Adrenaline stimulates the liver to convert glycogen to glucose to raise the blood glucose level so as to increase the supply of glucose for the muscles cells to carry out an increased rate of cellular respiration to release more energy to perform "fight" or "flight" actions. Comments: Many students mistook the 'response' for leg muscles contracting to run away, and as such identified the incorrect effector. Some did not address the first part of the 'nervous pathway'. Some went on to unnecessarily explain the responses when the question only requires them to 'list'. Some mentioned 'body increases the glucose concentration' without mentioning how.	[1] [1] [1] [1] [1] [1]
(b)	• From 1 to 2s, curvature of lens is increasing from 1.00 arbitrary units to 3.80 arbitrary units as object is moving towards/ nearer to Jovan. • The ciliary muscles contract. • Suspensory ligaments slacken. • From 2 to 4s, the curvature of lens remain constant at 3.8 arbitrary units as object remains stationary/ is not moving. Comments: Suspensory ligament 'relaxing' is incorrect because they are not muscles. But can accept 'relaxing their pull on the lens'. Many did not consider the part from 2-4 seconds when the curvature remained constant. Some are still confused between 'ciliary' and 'circular' muscles; should avoid confusion between accommodation and pupil reflex. If candidate writes 'ciliary muscle of the iris', no credit is awarded as it indicates a conceptual error. Students also need to practice quoting data when available. Some went on to talk about the nervous transmission/ pathway which was not necessary for this question. A few also went on to discuss beyond 4 seconds which was not the requirement of the question.	[1] [1] [1] [1]

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