



康 柏 中 学

**COMPASSVALE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2017
SCIENCE (BIOLOGY) 5078/04
Paper 4 Theory
Secondary 4 Express / 5 Normal (Academic)**

Name : _____

Duration: 1 h 15 min

Index No : _____

Date: 24 Aug 2017

Class : _____

Marks: _____ / 65

READ THESE INSTRUCTIONS FIRST

Write your full name, class and index number in the spaces provided on the question paper and on all separate answer paper used.

Write in dark blue or black pen on both sides of the paper.

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

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

Answer **all** questions in Section A and any **two** questions in Section B.

Enter the numbers of the Section B questions you have answered on the dotted lines in the grid below.

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	

This paper consists of 15 printed pages including this page.

Section A [45 marks]

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

- 1 An experiment was carried out to investigate the effects of sugar solutions on onions.
- 5 pieces of onion rings of similar sizes were obtained from the outermost layer of an onion bulb.
 - Each onion ring was 2 mm thick.
 - The onion rings were placed in petri dishes containing solutions of different sugar concentration.
 - The vertical internal diameter of the onion rings were measured and recorded at the start of the experiment and after 30 minutes of being immersed in the solutions.

Fig. 1.1 shows one of the onion rings.

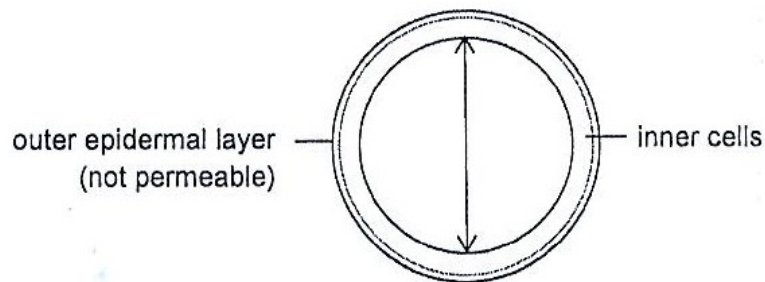


Fig. 1.1

Table 1.2 shows the measurements taken.

Table 1.2

concentration of sugar solution / %	initial diameter / cm	final diameter / cm	change in diameter / cm	percentage change in diameter / %
0	6.3	6.9	+ 0.6	+ 9.52
10	6.1	6.5	+ 0.4	+ 6.56
20	6.0	6.2	+ 0.2	+ 3.33
30	6.0	5.9	- 0.1	- 1.67
40	6.1	5.8	- 0.3	- 4.92

(a) Name the process that resulted in the changes in diameter of the onion rings.
..... [1]

(b) State one condition needed for the process in (a) to occur.
..... [1]

- (c) Explain why some of the onion rings had a positive change while some had a negative change in diameter.

.....

.....

.....

..... [2]

- (d) Another student carried out a similar experiment, but using onion rings that were cut into two. Instead of measuring the diameter, he only observed the change in appearance. Fig. 1.3 shows the cut onion rings before the experiment.

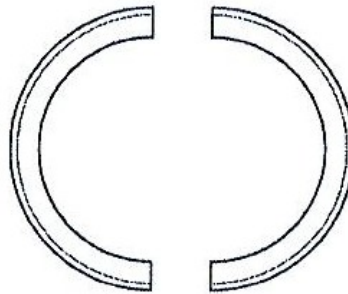


Fig. 1.3

Besides the change in size, suggest and draw how the shape of the cut piece of onion ring had changed after 30 minutes, for the pieces that were placed in 0% and 40% sugar solution.

shape of the cut piece of onion ring placed in 0 % sugar solution	shape of the cut piece of onion ring placed in 40 % sugar solution

[2]

- (e) A small piece of the outer epidermal layer of the onion was peeled off and observed under a light microscope. Fig. 1.4 shows the cells as seen under the microscope.

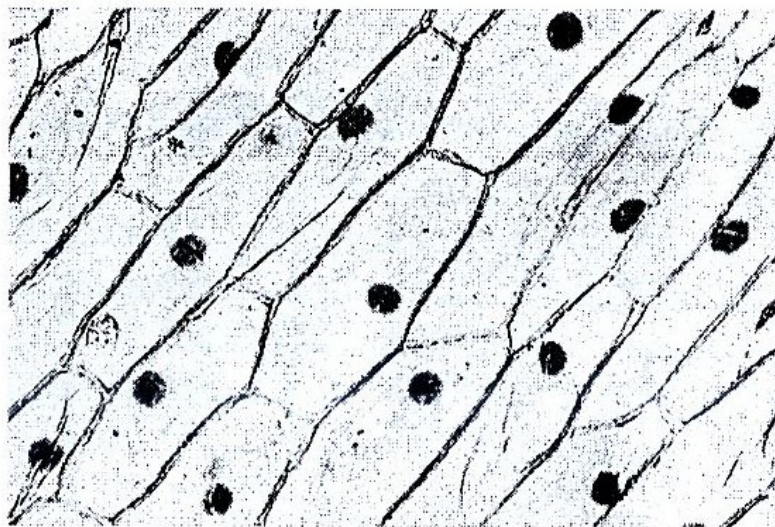


Fig. 1.4

On Fig. 1.4, identify

- (i) a structure in these cells that cannot be found in animal cells.
Label this structure as X and name it. [1]
- (ii) a structure in these cells that can also be found in animal cells.
Label this structure as Y and name it. [1]

[Total: 8]

- 2 Fig. 2.1 is a flow diagram showing the pathways taken by oxygen and carbohydrates from their absorption into a mammal's blood to their use in the liver.

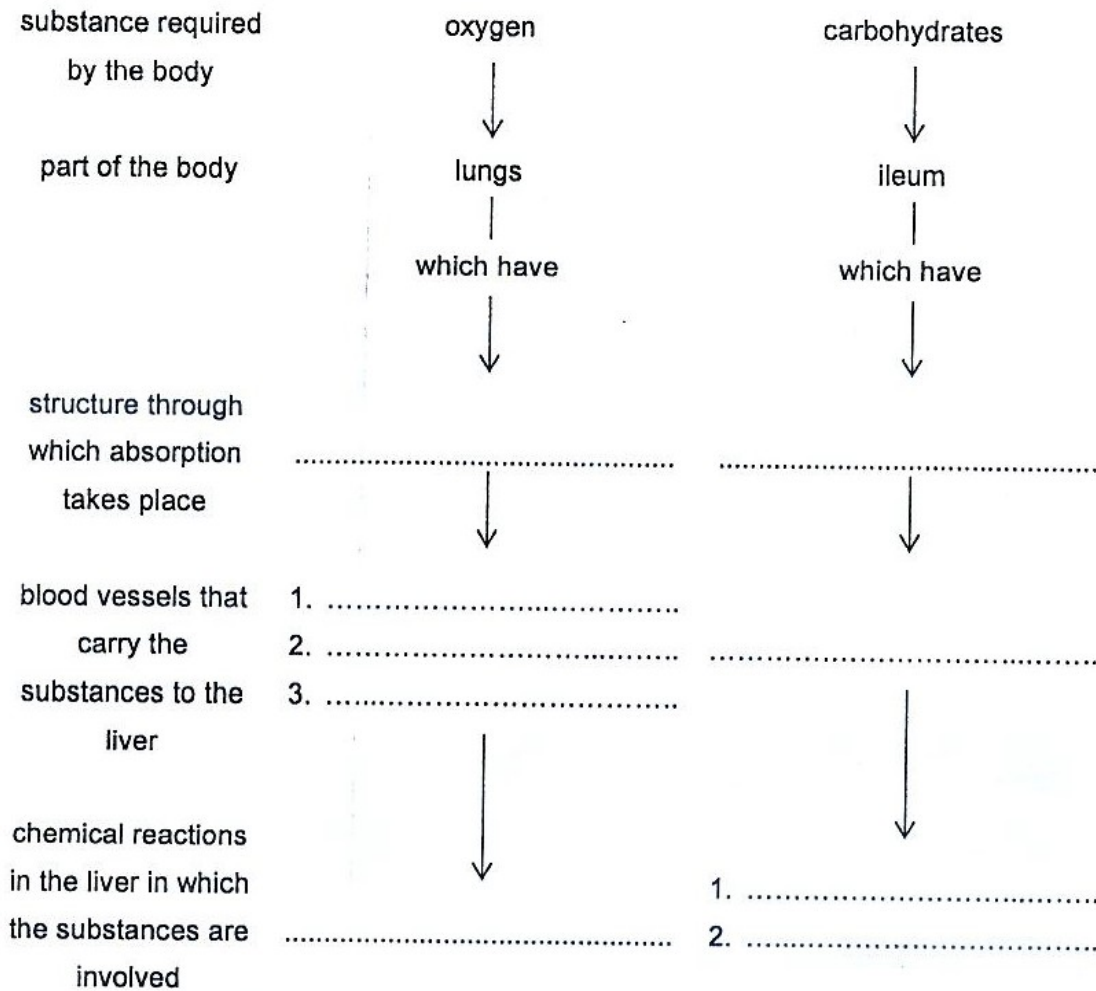


Fig. 2.1

- (a) Fill in the spaces in Fig. 2.1 to state
- the structures involved
 - the blood vessels used
 - what happens in the liver cells

[4]

[Total: 4]

- 3 During heart transplant procedures, it is possible to keep the heart beating while it is being transported many miles from the donor to the patient. Fig. 3.1 shows diagrammatically how the heart is kept beating during transportation.

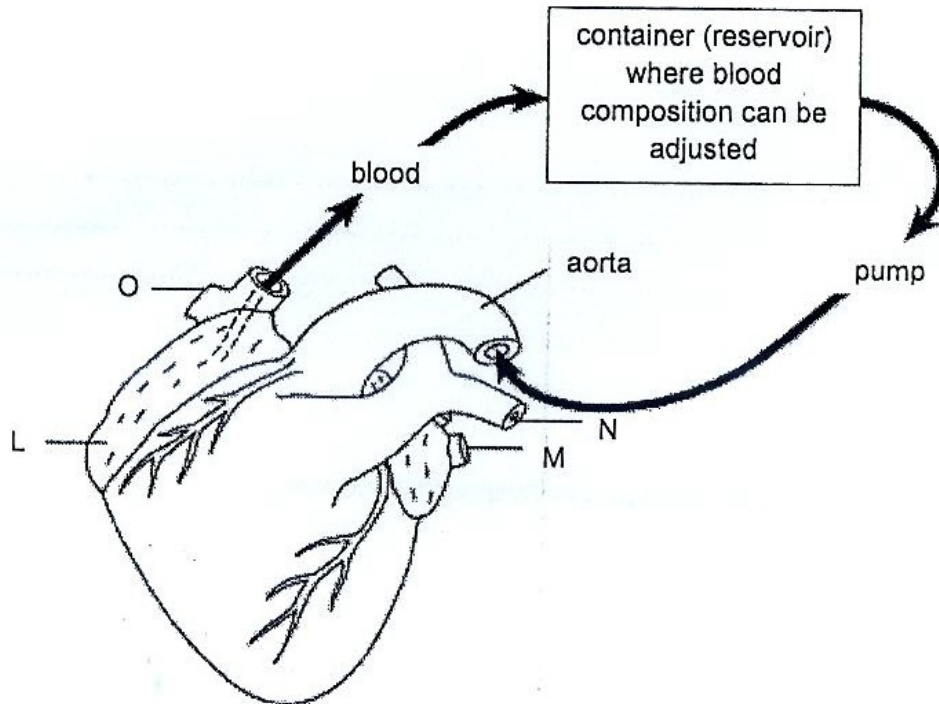


Fig. 3.1

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

chamber L	blood vessel M
blood vessel N	blood vessel O

[2]

- (b) Suggest a substance that must be added to the blood in the reservoir and explain your suggestion.

substance

explanation

.....

..... [2]

- (c) Using your knowledge of blood vessels and the structure of the heart, explain why blood entering the aorta from the reservoir flows into the heart muscle and **not** into the left ventricle.

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.....

.....

.....

[3]

[Total: 7]

- 4 The bar chart in Fig. 4.1 shows the percentage of energy released by aerobic and anaerobic respiration during races run by athletes over different distances.

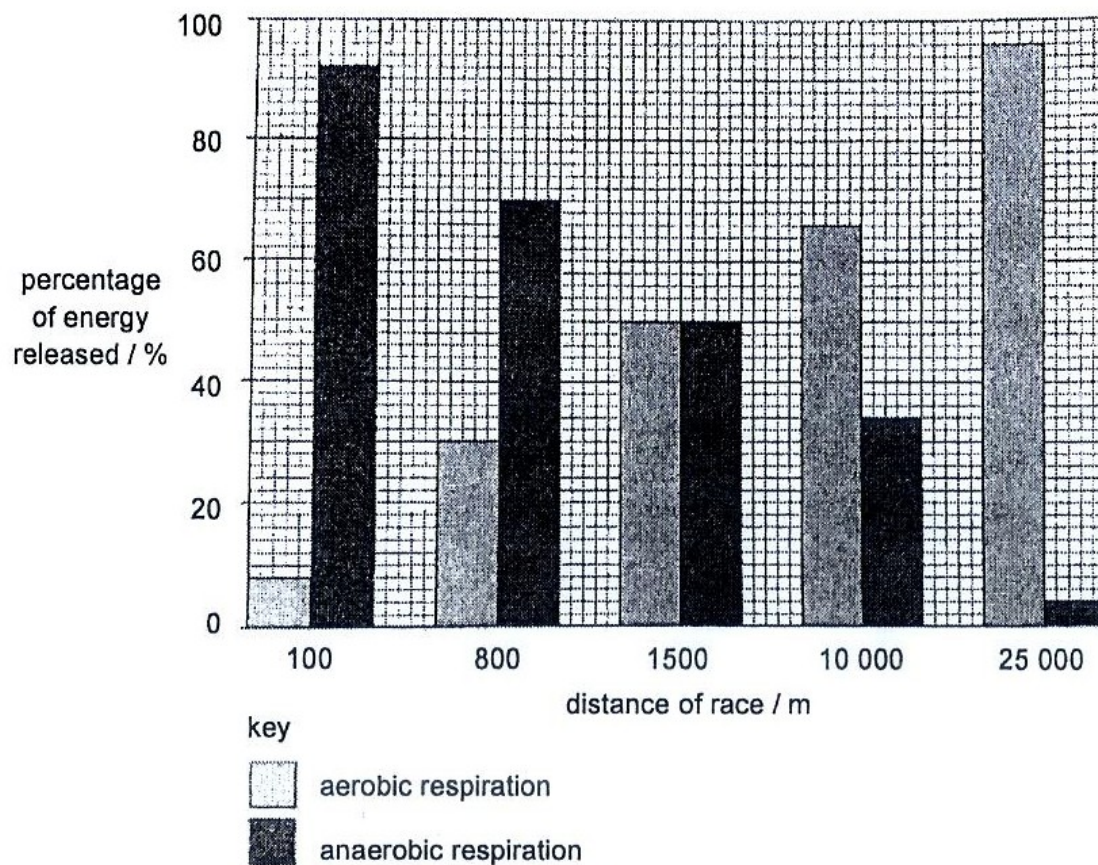


Fig. 4.1

- (a) State the word equation for:
aerobic respiration

.....

anaerobic respiration

.....

[2]

- (b) Compare the effect of distance of race on the percentage of energy released by different types of respiration.

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

- (c) Explain why anaerobic respiration occurs during a race.

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

- (d) With reference to the information given in Fig. 4.1, describe how sprinters and marathon runners obtain most of their energy for their races. Suggest an explanation for your answer.

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

- (e) Suggest and explain one way how smoking can affect an athlete's performance.

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

[Total: 12]

- 5 Fig. 5.1 shows a method used by a student to understand how traits are inherited. Both cubes had three of their faces marked with the letter T and three with the letter t.

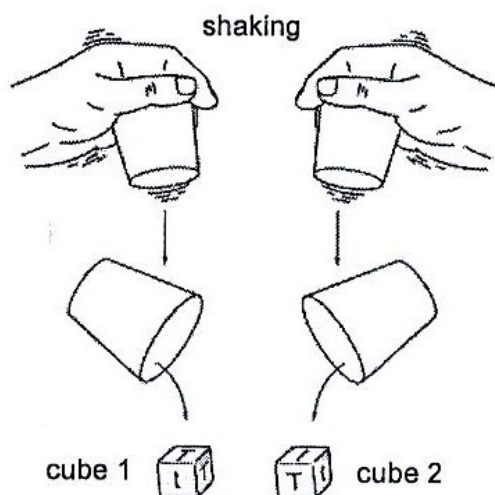


Fig. 5.1

In this example, the letters appearing on the upper faces are Tt.

The student shook each container and then flipped both cubes out at the same time and recorded the letters appearing on the upper faces of the cubes.

The student tipped both cubes out a total of 405 times.

- (a) (i) Complete Table 5.2 to show the results obtained.

Table 5.2

letters appearing on the upper faces of the cubes	tt	TT	Tt
number of times each pair of letters appeared	98	202

[1]

- (ii) State what the letters on the faces of the cubes represent.

.....

[1]

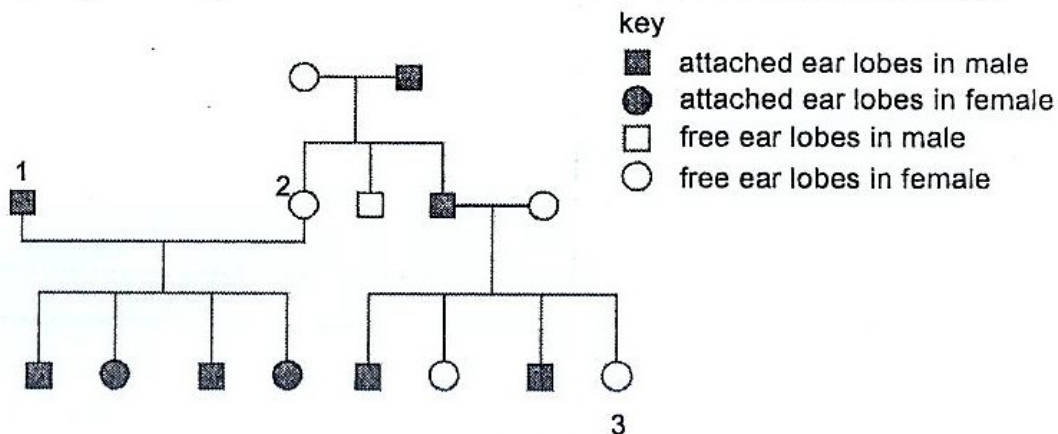
- (ii) Suggest the reason for shaking the containers.

.....

[1]

- (b) In humans, T and t control the type of ear lobes. A person will have attached earlobes only if he is homozygous for this trait.

The pedigree in Fig. 5.3 shows the inheritance of this trait in a particular family.



- (i) State and explain the genotype of individual 3.

.....

.....

.....

..... [2]

- (ii) Complete the Punnett square below to show the probability of individual 1 and 2 having a child with attached ear lobes.

		individual 1 gametes	
individual 2 gametes			

[2]

- (iii) Compare your answer in (ii) to the four children of individual 1 and 2 in Fig. 5.3. Suggest reasons for the difference.

.....

.....

.....

..... [2]

- (iv) State the type of variation shown in ear lobes and draw an appropriate diagram to show its distribution in this particular family.

type of variation [2]

[Total: 11]

- 6 The release of intestinal juice as a result of tasting food in the mouth is a reflex action. This reflex action is similar to that of the pupil of the eye in response to bright light. Use the terms motor neurone, relay neurone and sensory neurone to describe the reflex action occurring in the small intestine as a result of tasting food in the mouth.

.....

 [3]

[Total: 3]

Section B [20 marks]

Answer any **two** questions. Write your answer in the spaces provided on the question paper.

- 7 Fig. 7.1 shows the changes in size of three populations over a period of time, before and after untreated sewage from a nearby agricultural land was discharged into the lake.

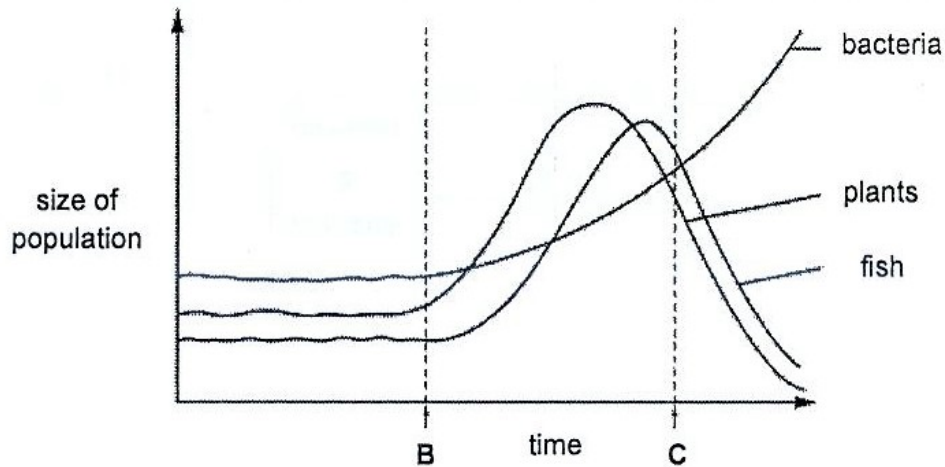


Fig. 7.1

- (a) Describe and explain the changes in the size of populations of bacteria, plants and fish after time C.

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[5]

- (b) Fig. 7.2 shows the amount of oxygen in the same lake before time B. Complete the graph to show how the oxygen concentration will change over the same time period shown in Fig. 7.1.

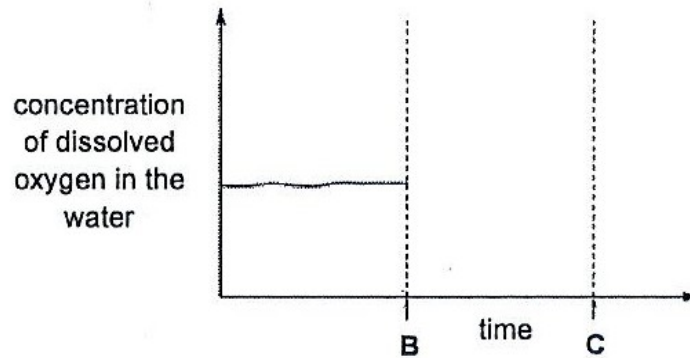


Fig. 7.2

[1]

- (c) Describe the role of:
- (i) bacteria in sewage treatment

.....

.....

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.....

- (ii) oceans as carbon sink

.....

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.....

.....

[4]

[Total: 10]

- 8 (a) With reference to the organelles in plant cells, describe how plants use light energy from the sun and release the energy back into the atmosphere.

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..... [4]

- (b) Fig. 8.1 shows the Flower Dome at Singapore Gardens by the Bay. It is a large glass greenhouse that displays various plants from different countries.

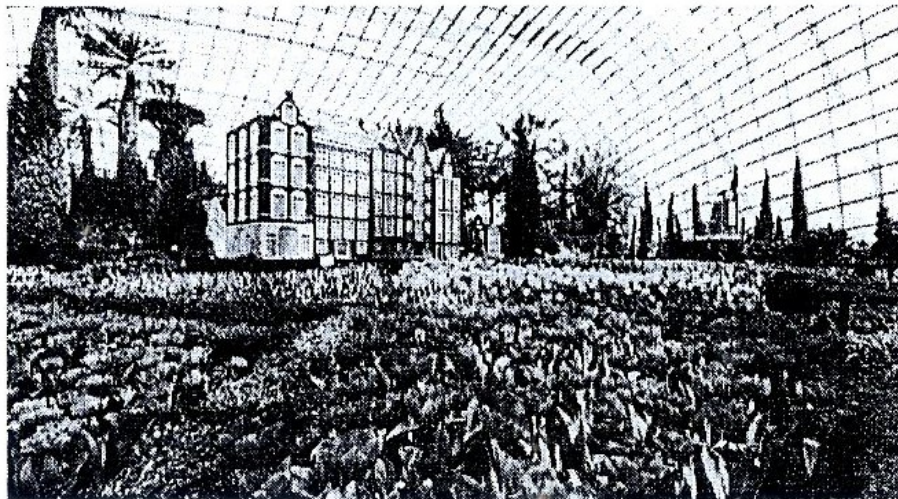


Fig. 8.1

State the conditions in the glasshouse that must be controlled to ensure maximum growth of the plants. Suggest how these conditions can be controlled.

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..... [6]

[Total: 10]

- 9 (a) Define *hormones*.

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

- (b) Describe how insulin is transported from the site of production to its target organ.

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.....
.....
.....
.....
.....
.....
.....
..... [5]

- (c) Suggest an explanation why hormones are usually produced in the form of small molecules.

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

[Total: 10]

End of Paper

Answer Scheme

Paper 4

1a osmosis

B partially permeable membrane/difference in water potential between two regions/water potential gradient

C the onion cells in 0, 10 and 20 % sugar solution had a lower water potential than the sugar solution (0.5). thus, water molecules moved into the onion cells (0.5) resulting in positive change in diameter.

the onion cells in 30 and 40 % sugar solution had a higher water potential than the sugar solution (0.5). thus, water molecules moved out of the onion cells (0.5) resulting in negative change in diameter.

D

shape of the cut piece of onion ring placed in 0 % sugar solution	shape of the cut piece of onion ring placed in 40 % sugar solution
Become less curved/ or curved outwards	Become more curved

Ei cell wall ;

ii nucleus/cytoplasm/cell membrane (if its clearly different from cell wall labelled in ei) ;

2a structure through which absorption takes place : alveolus / villus

Blood vessels: pulmonary vein, aorta, hepatic artery/hepatic portal vein

Chemical reactions: aerobic respiration/respiration, conversion to glycogen

All correct : 4m

6 to 8 correct : 3m

4 to 5 correct : 2 m

2 to 3 correct : 1m

1 correct: 0m

3a L: right atrium M: pulmonary vein M: pulmonary artery O: vena cava (0.5 each)

B glucose/oxygen (0.5)

It is needed for heart muscles cells to respire (0.5) to release energy (0.5) for muscle contraction (0.5)

C there are valves in the aorta that prevents the backflow of blood back into the ventricles (1). Thus, blood in the aorta enters the coronary artery that branches from the aorta (1). coronary artery transports blood to the heart muscle cells (1).

4a aerobic: glucose + oxygen → carbon dioxide + water + energy ;

anaerobic: glucose → lactic acid + small amount of energy ;

- b as the distance of race increases, the percentage energy released by aerobic respiration increases (1) but the percentage energy released by anaerobic respiration decreases (1)
- c during a race, insufficient oxygen (0.5) is supplied to the muscle cells (0.5) to meet the energy demand/for aerobic respiration to release enough energy (0.5) thus, anaerobic respiration occurs to release extra energy (0.5)
- d sprinters obtain most of their energy from anaerobic respiration (0.5) and marathon runners obtain most of their energy from aerobic respiration (0.5). this is because, during a sprint, the energy demand increases rapidly over a short time (0.5). the athlete cannot breathe faster/deeper to take in more oxygen (0.5). however, during a marathon, energy demand increases more gradually over a longer period of time (0.5). thus, the athlete can breathe faster/deeper to take in more oxygen (0.5),
- e carbon monoxide in cigarette smoke binds irreversibly to haemoglobin (0.5). less oxygen can bind to haemoglobin (0.5) and transported to muscle cells . muscle cells respire less, releasing less energy (0.5), decreasing athlete's performance (0.5)

OR

Tar paralyses cilia (0.5). mucus/dirt not able to be swept up, blocking airways (0.5). this results in breathlessness/difficulty in breathing (0.5). less oxygen for muscle cells to respire and release energy (0.5), decreasing athlete's performance (0.5) max 2m

5ai 105

aii alleles

aiii to ensure that the result is random

bi heterozygous/Tt (0.5). His father is homozygous recessive (0.5) and his mother is heterozygous (0.5). thus she inherited a recessive allele from the father and the dominant allele from the mother. (0.5)

ii

		individual 1	
		t	t
individual 2	T	Tt	Tt
	t	tt	tt

iii even though there is a 50% chance (0.5) for each of their child to have attached/free earlobes, all four children have attached earlobes (0.5) due to random fusion of gametes (0.5) and small sample size (0.5)

v bar chart (axis – 0.5, labelled bars + correct trend 0.5)

discontinuous variation (1)

- 6 tasting of food in the mouth will stimulate the receptors on the tongue/mouth (0.5) and produce nerve impulses which is sent to the brain (0.5) via the sensory neurone (0.5). the nerve impulses is then transmitted across a synapse to the relay neurone (0.5) and across another synapse to the motor neurone (0.5). The motor neurone will then transmit the nerve impulses to the effector which is the intestinal glands (0.5) to secrete the intestinal juice.
- 7a eutrophication occurs (0.5). excess nitrates and phosphates causes rapid algae growth (0.5) on the surface of the lake. submerged plants cannot get sunlight to photosynthesize (0.5). plants population decreases (0.5) as they die and decomposed by bacteria (0.5). bacteria multiplies rapidly (0.5) and increases in population (0.5). bacteria use up more oxygen for respiration (0.5). lack of oxygen causes fishes to die (0.5) and decrease in population (0.5).
- B oxygen concentrations will change in a similar way to graph for plants. (1)
- C bacteria is used in aeration tanks (0.5) where they respire aerobically (0.5) and release enzymes (0.5) to break down harmful substances to harmless substances (0.5).
- D when organisms in the oceans die, they are buried in the seabed (0.5) and form fossil fuels (0.5). These fossil fuels contain carbon (0.5). Thus the ocean will store carbon more than it releases / stores carbon for an infinite period of time (0.5)
- 8a the chloroplasts (0.5) contain chlorophyll (0.5) which will trap light energy from the sun (0.5) and converts it to chemical energy (0.5) which is stored in glucose during photosynthesis (0.5). the mitochondria (0.5) then break down the glucose produced (0.5) during respiration (0.5) to release energy back into the atmosphere.
- B carbon dioxide concentration (1) – air pump (0.5) to ensure that carbon dioxide concentration remains high (0.5) OR carbon monoxide sensor (0.5) to monitor carbon dioxide concentration (0.5)
- Light intensity (1) – glass panels (0.5) that can regulate the amount of light passing through (0.5)
- Temperature (1) – temperature sensors (0.5) to monitor temperature (0.5) / thermoregulators (0.5) to maintain optimum temperature (0.5) / insulating material (0.5) to prevent too much heat loss or gained (0.5)
- Relating suggestions to allow for maximum rate of photosynthesis (0.5m)
- Max 6 m
- 9a hormones are chemical substances (0.5) produced by endocrine glands (0.5), secreted directly into bloodstream (0.5) and affects one or more target organs (0.5). it is destroyed by the liver (1).
- B insulin is produced by the islets of Langerhans/pancreas (0.5) and released directly into the bloodstream/capillaries (0.5). it is dissolved (0.5) and transported by the plasma (0.5). it is transported back to the heart (0.5) via the vena cava (0.5) and out of the heart (0.5) via the aorta (0.5). it is then transported to the liver, its target organ (0.5) via hepatic artery (0.5) .

- C to pass through the partially permeable (1) membrane of the capillaries (0.5) and the cells of their target organs (0..5)