O

JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
Secondary 4 Express

STUDENT NAME			
CLASS		INDEX NUMBER	

BIOLOGY

6093/02

Paper 2

12 August 2024

1 hour 45 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces on all the work you hand in.
Write in dark blue or black pen.
You may use pencil for drawing diagrams or graphs.
Do not use staples, paper clips, highlighters, 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

DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

For Examiner's Use	
Section A	/70
Section B	/10
Total	/80

Setter: Ms Jo-Ann Lee Hui

This document consists of **19** printed pages.

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Section A: Structured Questions [50 marks]

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

1 A substance called phenol that is found in the flesh of apples turns brown when it is exposed to air for a period of time. This browning involves an enzyme called polyphenol oxidase which catalyses the conversion of phenol found in apples to a brown compound called melanin.

A student carried out an investigation of the action of polyphenol oxidase on phenol. Four test-tubes were set up with different contents as follows:

test tube	test tube contents
1	phenol + polyphenol oxidase solution
2	phenol + boiled polyphenol oxidase solution
3	phenol + polyphenol oxidase solution + dilute hydrochloric acid
4	phenol + polyphenol oxidase solution + aqueous sodium hydroxide
5	phenol + distilled water

Each test-tube was shaken thoroughly and then placed in a water bath that was maintained at 40 °C. After some time, the observations for each test tubes were recorded in Table 1.1.

Table 1.1

test tube	1	2	3	4	5
colour at the start of the experiment	colourless	colourless	colourless	colourless	colourless
colour at the end of the experiment			brown	colourless	colourless

(a) (i) Fill in the blanks in Table 1.1 by stating the colour at the end of the experiment for test-tubes 1 and 2. [2]

(ii) Explain your answer for **(a)(i)**.

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..... [3]

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(b) State the reason for the result in test-tube 4.

.....

..... [1]

(c) Explain the purpose of test-tube 5.

.....

..... [1]

(d) Suggest two factors that must be kept constant during the investigation.

.....

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..... [2]

[Total: 9]

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

After 12 hours, the raisins were blotted dry and the volume of each sample of raisins was measured again. Fig. 2.1 shows the results.

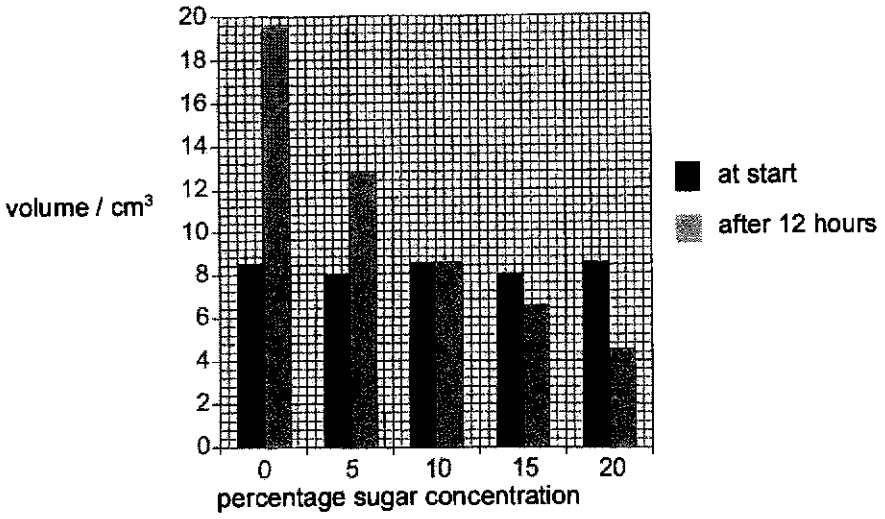


Fig. 2.1

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

.....

..... [1]

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

.....% [2]

(c) Explain the results in the 10% sugar solution.

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..... [2]

[Total: 5]

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3 Fig. 3.1 shows a human heart in which the coronary arteries are partially blocked. A coronary by-pass operation is a remedy for this. It involves grafting sections of vein from the patient's leg to the heart.

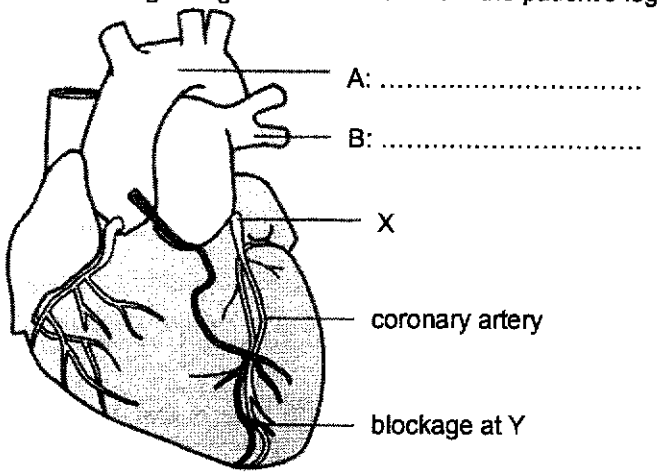


Fig. 3.1

(a) Name A and B on the diagram. [2]

(b) Explain how blockages in coronary arteries affect the heart's ability to work.

.....

.....

..... [2]

(c) Suggest why a blockage at X will have more serious consequences than a blockage at Y.

.....

..... [1]

(d) Suggest why a coronary by-pass is preferable to a heart transplant operation.

.....

..... [1]

(e) State two precautions that can be taken to reduce the risk of coronary heart disease.

.....

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..... [2]

[Total: 7]

4 A seal is a mammal that spends most of its time in the sea. It breathes and respires in a similar way

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to humans, but when it dives to hunt and catch fish, can stay under water for an extended length of time each dive.

Fig. 4.1 shows the percentage concentrations of oxygen, carbon dioxide and lactic acid in a seal's blood over a 40 minute period during which it dives to hunt for fish at some point.

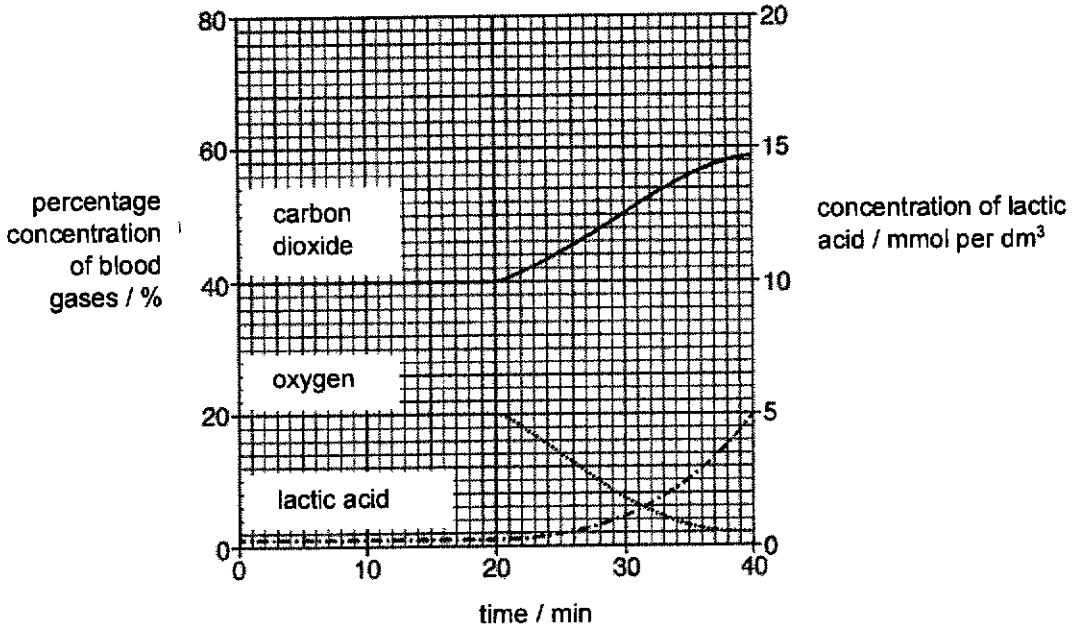


Fig. 4.1

(a) Write a word equation of the process taking place in the seal's muscles before it dives.

..... [1]

(b) State the time the seal starts its dive.

..... min [1]

(c) Describe and explain the relationship between the concentration of oxygen and lactic acid from time 20 min to 40 min.

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..... [2]

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(d) Suggest and explain what would happen to the concentration of lactic acid in the seal's blood when it returns to the surface of the sea after its dive.

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..... [3]

[Total: 7]

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5 An investigation was carried out into the effect of eating two different sources of carbohydrate on the concentration of glucose and the concentration of insulin in the blood plasma. The carbohydrate sources used were glucose and rice. The carbohydrate in rice is mainly in the form of starch.

Volunteers were fed either 50 g of glucose or the quantity of rice known to contain 50 g of carbohydrate. The concentration of glucose and insulin in their blood plasma was then measured at intervals for 3 hours. The results are shown in Fig. 5.1 and 5.2.

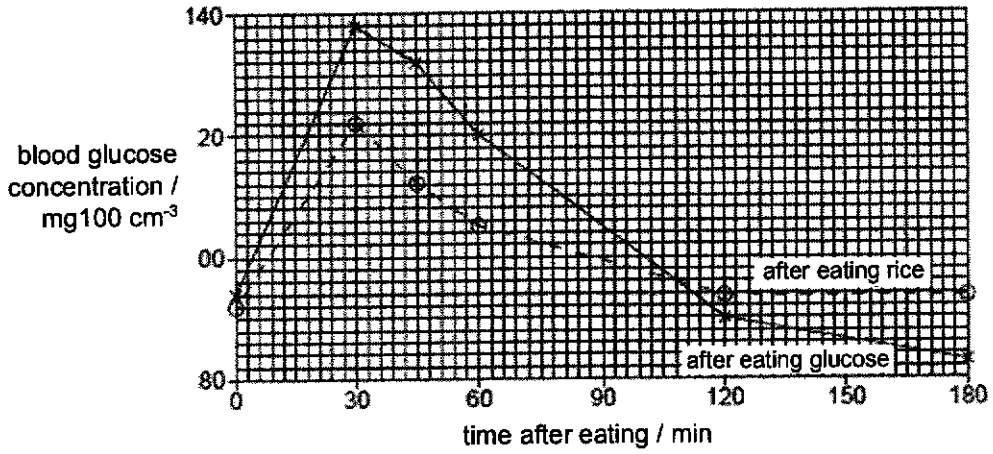


Fig. 5.1

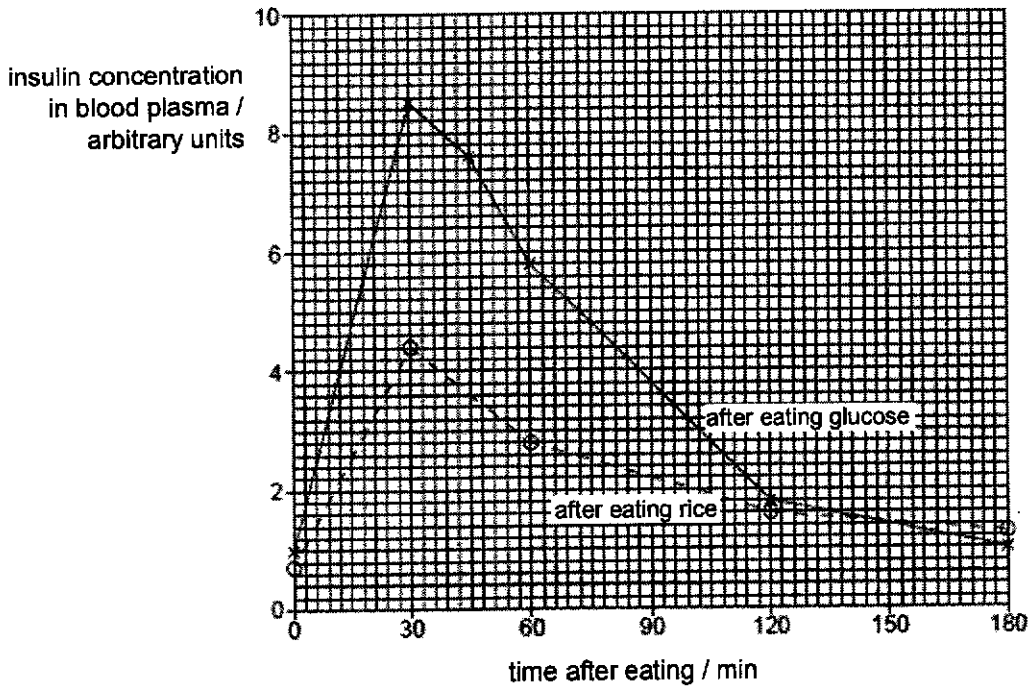


Fig. 5.2

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5 (a) (i) Calculate the percentage difference between the maximum concentrations of glucose in the blood after eating rice and eating glucose.

Show your working in the space provided.

percentage difference: ..... % [2]

(ii) Explain why there is a difference in the maximum concentrations of glucose in the blood after eating rice and eating glucose.

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..... [2]

(b) With reference to Fig. 5.1 and Fig. 5.2, explain the differences between the concentrations of insulin in the blood after eating glucose and eating rice.

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..... [3]

(c) By 180 minutes after eating the glucose or rice, the concentration of glucose in the blood had fallen considerably.

Describe the role insulin and the liver in bringing about the reduction in blood glucose concentration.

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..... [3]

[Total: 10]

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6 Table 6.1 shows the rate of photosynthesis of a plant over a range of light intensities.

Table 6.1

light intensity / lux	rate of photosynthesis / mg carbohydrate produced per unit area per min
5	2
10	5
20	9
30	19
40	23
50	32
60	43
70	55
80	55

(a) State the general relationship between light intensity and the rate of photosynthesis.

.....

..... [1]

(b) Explain why, at a light intensity above 80 lux, the rate of photosynthesis may increase if the plant was supplied with a higher concentration of carbon dioxide.

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..... [2]

(c) Plants wilt when they are not watered for a few days.

Suggest why the rate of photosynthesis would decrease when a plant wilts.

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..... [3]

[Total: 6]

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7 Fig. 7.1 shows a diagram of a kidney nephron.

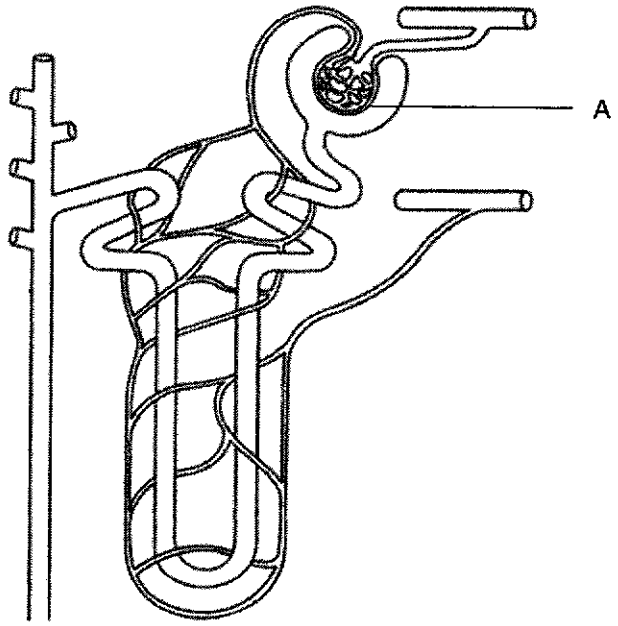


Fig. 7.1

(a) Describe one feature of the structure of A and explain how this feature aids in the formation of urine.

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..... [2]

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7 **(b)** Fig. 7.2 shows the proportions of certain components in glomerular filtrate and urine from a healthy person.

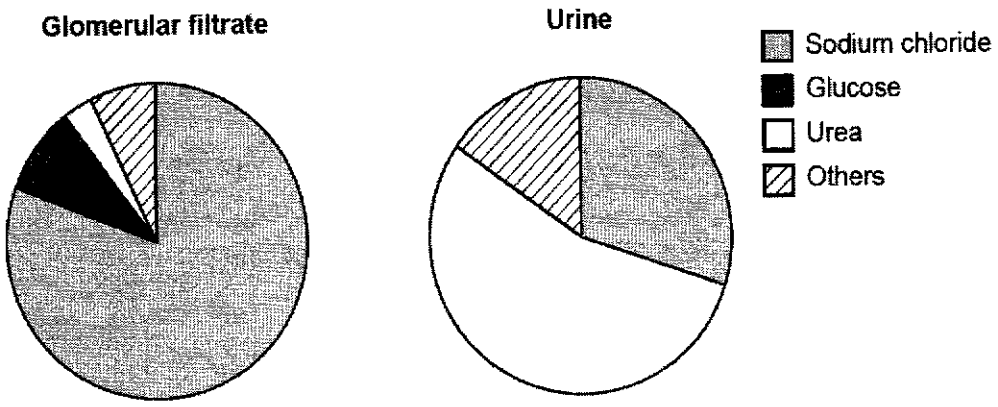


Fig. 7.2

(i) Draw a line labelled G on Fig. 7.1 to show where the glomerular filtrate was obtained. [1]

(ii) Use information from Fig. 7.2 to show that selective reabsorption occurs in the kidney tubule.

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..... [3]

(iii) Explain how the proportion of the components in the glomerular filtrate would change after eating a diet rich in meat.

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..... [3]

[Total: 9]

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8 Fig. 8.1 shows the stages in the process of genetic engineering to produce the hormone insulin.

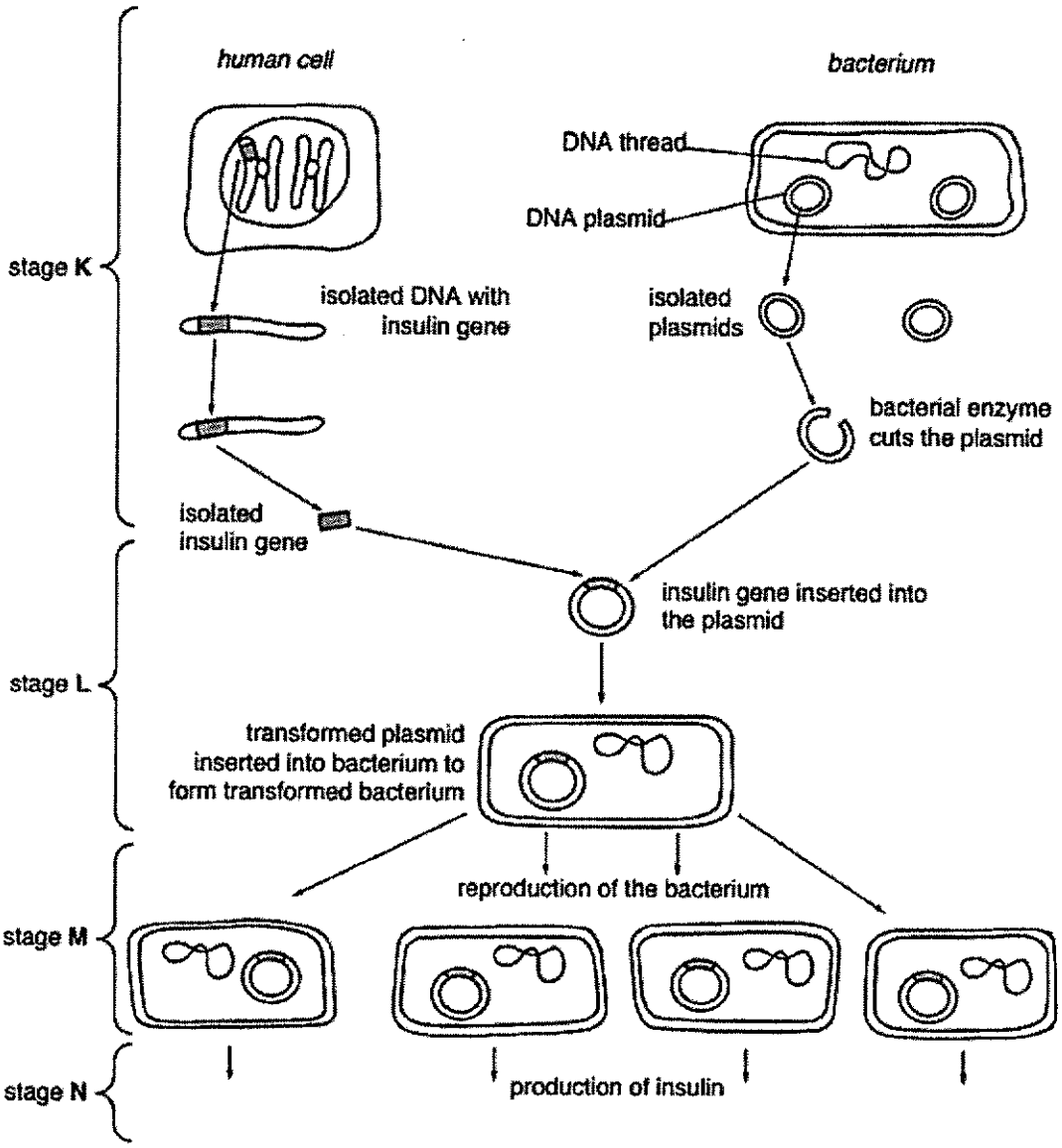


Fig. 8.1

(a) State the type of cell division that takes place in stage M of Fig. 8.1. Use your knowledge of the process of cell division to explain why it is important that this type of cell division occurs.

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..... [3]

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

Discuss the potential advantages and danger of using genetic engineering to produce crop plants for humans to eat.

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..... [4]

[Total: 7]

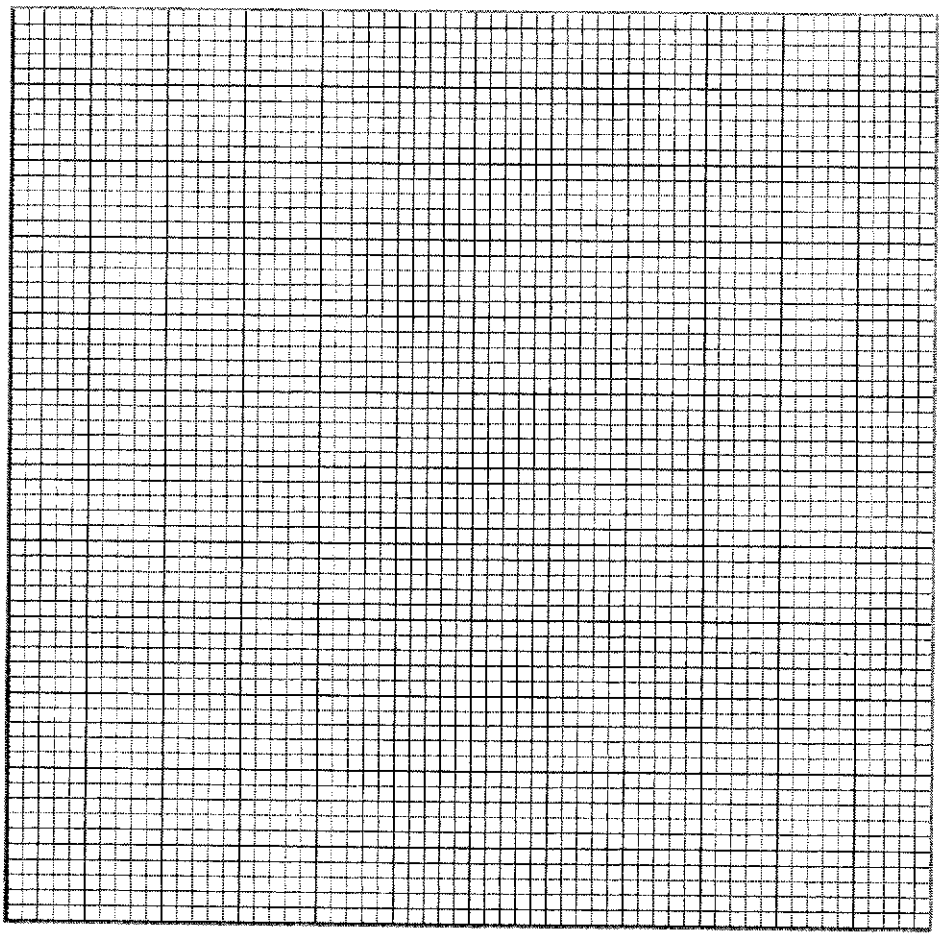
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9 The table below shows the distribution in blood group among a population of 1000 people living in a small town.

Table 9.1

blood group	number of people
A	400
AB	40
B	100
O	460

(a) With reference to the data above, draw a bar graph to represent the data.



[3]

(b) Identify and explain the type of variation that is shown by blood group.

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..... [2]

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(c) Blood groups of individuals are inherited from their family members. Fig 9.1 shows a family tree.

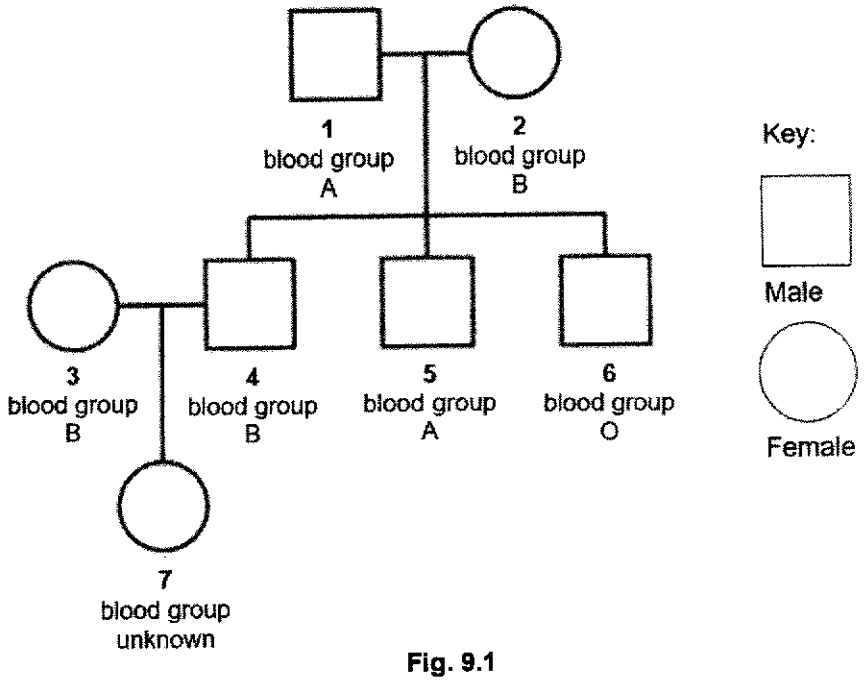


Fig. 9.1

(i) Using a genetic diagram, determine the probability that individuals 1 and 2 can have a child with blood group AB.

probability = ... [4]

(ii) Deduce using Fig. 9.1 the possible blood group(s) that individual 7 could have.

..... [1]

[Total: 10]

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Section B (10 marks)

Answer **one** question.

10 Tuberculosis is caused by bacteria called *mycobacterium tuberculosis*.

(a) Describe two features of a bacterial cell that are different from an animal cell.

1 .....

2 ..... [2]

(b) Fig. 10.1 shows the annual hospitalisation rate for tuberculosis by age group in Singapore between 1998 and 2004.

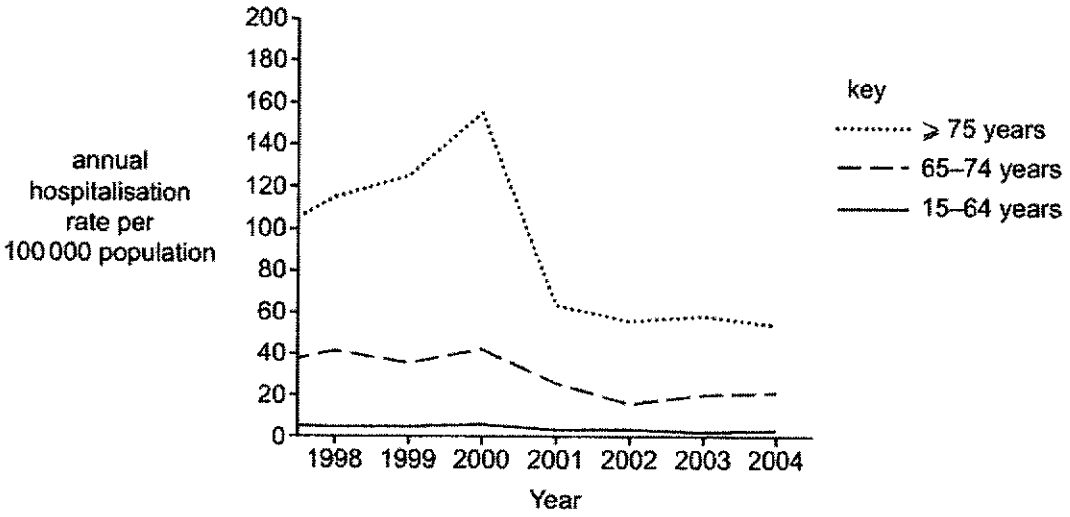


Fig. 10.1

Using Fig. 10.1, describe the differences in the hospitalisation rate for people aged 75 and above with people aged 15 to 74.

Suggest a reason for the differences.

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..... [3]

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(c) National Childhood Immunisation Programme (NCIP) in Singapore started to cover vaccination against tuberculosis in the 1950s.

Explain the different ways in which vaccines and antibiotics are used to reduce the number of deaths by tuberculosis.

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..... [5]

[Total: 10]

11 A team of scientists wanted to compare the efficiency of raising chickens in a farm. This farm grows maize to feed the chickens, which are kept in cages when they are not allowed to move much.

Fig. 11.1 shows a chicken mite (not drawn to scale) which is a parasite feeding on the blood of the chicken. It leads to lower weight and egg production in the chicken. There can be up to 1000 chicken mites living in some chickens.



Fig. 11.1

(a) With reference to the information above, construct a food chain consisting of the organisms in the farm in the space below.

[1]

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(b) Draw a pyramid of numbers and a pyramid of biomass of the food chain in **(a)**.

pyramid of numbers	pyramid of biomass

[2]

(c) Explain how energy losses occur along food chains.

.....

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..... [3]

(d) For the past few weeks, the farm has attempted to increase its output of crops by spraying the crops with more pesticides and fertilisers.

Predict and explain what might happen to the organisms in a river located near the farm in the next few months.

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..... [4]

[Total: 10]

End of paper

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Marking Scheme

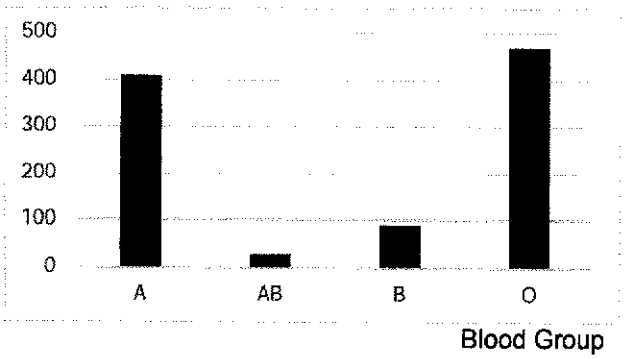
Assessment: **Preliminary Examination** **Level:** **4 Express**
Biology P2 (6093)

Qn	Marking Scheme	Remarks	Marks
1ai	1: brown 2: colourless	Accept 1: colourless if explained in 1aii about optimum pH of enzyme being acidic	[1] [1]
1aii	1. In test-tube 1, phenol can bind with active site of polyphenol oxidase to form enzyme-substrate complex and hence break down to form melanin, which is brown; 2. In test-tube 2, polyphenol oxidase is denatured; 3. The 3D shape of the active site will be altered and will no longer be able to fit the substrate of phenol;	Also accept if 1 colourless, but explains that from 3, optimum pH for enzyme seems acidic. (however at normal conditions, the break down is still catalysed, so original marking scheme still valid)	[1] [1] [1]
1b	Polyphenol oxidase is denatured by alkaline condition/ high pH;		[1]
1c	It acts as a control to show that the colour change is due to the presence of polyphenol oxidase;		[1]
1d	Any 2 of Temperature, concentration of phenol/polyphenol oxidase solutions, volume of solutions, duration of experiment		[2]
2a	More than one raisin was used to find average results to ensure reliability/ consistency of results;		[1]
2b	12.8-8.0= 4.8 cm^3 Percentage increase = 4.8/ 8 x 100% = 60%		[1] [1]
2c	The concentration of cell sap in cells of the raisin was the same as in 10% sugar solution/ the water potential of cell sap in cells was the same as in the 10% sugar solution; There was no net movement of water molecules in or out of the raisin;		[1] [1]
3a	A: aorta; B: pulmonary artery;		[1] [1]
3b	Blockage of coronary arteries reduces the supply of oxygen and glucose to the heart muscles for respiration; The heart muscles would contract with lesser force/ heart pumps blood less powerfully around the body/ heart muscles die, leading to heart attack;		[1] [1]
3c	If X was blocked, more parts of the heart muscles would have less oxygen and glucose than if Y was blocked;		[1]
3d	There would not be issues with tissue rejection/ it is a less risky operation than removing the heart and replacing it with a new heart;		[1]
3e	Any 2		[2]

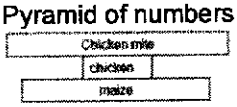
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Qn	Marking Scheme	Remarks	Marks
	Have a diet low in cholesterol and saturated fats, exercise regularly, manage low stress levels, do not smoke;		
4a	Glucose + oxygen → carbon dioxide + water		[1]
4b	20		[1]
4c	From 20 min to 40 min, the oxygen concentration decreased, causing an increase in anaerobic respiration; Lactic acid is a product of anaerobic respiration and the lactic acid concentration increases more the lower the oxygen concentration; OR Increased lactic acid concentration means more anaerobic respiration has taken place; Increased anaerobic respiration is a result of a decreased concentration of oxygen to carry out aerobic respiration;		[1] [1]
4d	1. Lactic acid concentration will decrease; 2. The rate of breathing will be high so that more oxygen can be taken in/ increase heart rate/ blood flow to muscles; 3. Oxygen is used to break down lactic acid into carbon dioxide and water;	Cannot just mention pay off oxygen debt	[1] [1] [1]
5ai	Difference= 138-122 = 16 Percentage difference = 16/138 x 100 = 11.6%		 [2]
5aii	Any 2 Glucose does not need to be digested, but starch needs to be digested; Glucose is absorbed into the bloodstream faster/ immediately; Glucose absorption from starch continues for a longer time as it takes time for digestion before absorption can take place;		[2]
5b	Insulin is released in response to increased blood glucose concentrations; As such, after eating glucose, there will be a greater increase in insulin concentration at 30 min (8.7) than after eating rice (4.4); Insulin increased faster when glucose was consumed as blood glucose concentration increased faster than when starch was consumed	Must quote some data from graph for full award of 3 marks	[1] [1] [1]
5c	1. Insulin stimulates liver to convert excess glucose to glycogen; 2. Glycogen is stored in liver cells; 3. Insulin also increases uptake of glucose by cells and increases tissue respiration;		[1] [1] [1]
6a	Increasing light intensity increases the rate of photosynthesis;	R: reverse argument	[1]
6b	Carbon dioxide concentration a limiting factor; Carbon dioxide is a raw material needed for photosynthesis;		[1] [1]
6c	1. Due to insufficient water in leaves as water is a raw material needed for photosynthesis; 2. stomata close and less carbon dioxide would be taken into the leaves to be used for photosynthesis; 3. drooping leaf position decreases the amount of light energy absorbed for photosynthesis;		[1] [1] [1]
7a	Any set of The blood capillaries have one-cell thick walls/ tiny pores in the membranes; to speed up the process of ultrafiltration; OR The blood capillaries have a thin partially permeable membrane;		[2]

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Qn	Marking Scheme	Remarks	Marks
	that allows only small soluble molecules or ions to pass through;		
7bi	Label Bowman's capsule G;		[1]
7bii	There is a decrease in the concentration of glucose as all the glucose is reabsorbed back into the blood stream; There is a decrease in the concentration of sodium chloride as some mineral salts are reabsorbed back into the blood stream; Urea concentration increases in urine as it is not reabsorbed back into the blood stream;		[1] [1] [1]
7biii	After consuming a meal rich in meat, there would be increased amino acids in the bloodstream; Excess amino acids would be deaminated in the liver to form more urea; In glomerular filtrate, there would be a higher level of urea;		[1] [1] [1]
8a	Mitosis; Identical copies of original bacterium are produced at the end of stage M/ All copes have the same identical genetic material; All cells will have the ability to be able to produce the same insulin;		[1] [1] [1]
8b	Any 2 Advantages Yield of genetically modified crops is good/ plants can grow quickly; Able to grow in environmental extreme conditions/ new areas; Able to transfer beneficial genes or characteristics between species; Can be resistant to diseases or pests; Any 2 Dangers Risk of genetic spread to other species; Expensive and costly to do genetic engineering; Possible health risks to humans or other organisms when consuming genetically modified crops;		[2] [2]
9a	Number of people  - Clean, clear bars drawn/point plotted correctly; - Correct axis labels; - Appropriate scale with regular intervals;		[1] [1] [1]
9b	Discontinuous variation; There are a few clear-cut phenotypes/ genes do not show additive effect;		[1] [1]

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Qn	Marking Scheme	Remarks	Marks
9ci	Parent Phenotype: blood group A x blood group B Parent Genotype: I^AI^O x I^BI^O Gamete: I^A I^O I^B I^O Offspring Genotype: I^AI^B I^AI^O I^BI^O I^OI^O Offspring Phenotype: AB A B O Probability of child with blood type AB: 25%/ 1/4		[1] [1] [1] [1]
9cii	B or O		[1]
10a	Bacterial cell as a cell wall, but an animal cell does not; Bacterial cell does not have the DNA or genetic material enclosed within a membrane, but an animal cell has a nucleus containing genetic material;		[1] [1]
10b	Any 3 Age group trend: more hospitalisations for group aged 75 (in 1998, around 110) and above/ 15-74 year olds (in 1998, less than 45), fewer hospitalisations; Those above 75 may have weaker immune system/ more prone to tuberculosis; There is a larger difference in hospitalisations between those aged 75 (and above from 1998 to 2000 (60 to 105 a year) as compared to 2001 to 2004 (around 40 a year); Vaccines could have been administered in 2020 to those aged 75 and above;		[3]
10c	1. Antibiotics given during infection/ to help treat the disease/ destroy pathogen; 2. It acts on pathogen directly to prevent synthesis of cellular structures; 3. Vaccines are given before infection/ to prevent disease/ increase immunity; 4. Vaccines contain an agent that resemble pathogen; 5. Vaccines stimulate white blood cells to produce antibodies quickly when pathogen is present;		[1] [1] [1] [1] [1]
11a	Maize → Chicken → Chicken mite		[1]
11b	Pyramid of numbers  Pyramid of biomass		[1] [1]

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Qn	Marking Scheme	Remarks	Marks
			
11c	Uneaten parts of organisms are not eaten by consumers; Egestion of faeces which contains undigested food substances; Energy is lost as heat (via respiration);		[1] [1] [1]
11d	- Pesticides can be consumed by organisms and not be excreted out of the organism, leading to bioaccumulation in organisms; - This can lead to bioamplification/ biomagnification where the toxins in one organism accumulate in organisms further up the food chain; All 3 for 2 marks, 2 for 1 mark - Fertilisers can cause algae growth in rivers resulting in eutrophication - There will be a lack of sunlight for submerged plants, causing them to die - Increase bacteria and decomposition cause dissolved oxygen levels to decrease, causing death of other aquatic life such as fish		[1] [1] [2]

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