

Name: ..... ( )

**PRELIMINARY EXAMINATION 2024**

**BIOLOGY**

**6093 / 02**

**LEVEL:** Sec 4 Express

**DATE:** 27 August 2024

**CLASS:** Sec 4/1

**DURATION:** 1 hour 45 minutes

Additional Materials provided: NIL

**INSTRUCTIONS TO CANDIDATES**

**Do not open this booklet until you are told to do so.**

Write your NAME and INDEX NUMBER at the top of this page.

**SECTION A (70 marks)**

**STRUCTURED QUESTIONS**

Answer **all** questions.

Write your answers in the spaces provided.

**SECTION B (10 marks)**

**FREE RESPONSE QUESTIONS**

Answer **one** question.

Write your answers in the spaces provided.

| For Examiner's Use   |      |
|----------------------|------|
| Paper 1              | /40  |
| Paper 2<br>Section A | /70  |
| Paper 2<br>Section B | /10  |
| Paper 3              | /40  |
| Total<br>Marks       | /160 |
| Overall              | /100 |

## SECTION A – STRUCTURED QUESTIONS (70 marks)

Answer **ALL** the questions in the spaces provided.

- 1 Fig 1.1 shows the results of an experiment in which raw potato strips were immersed in sucrose solutions of varying concentrations.

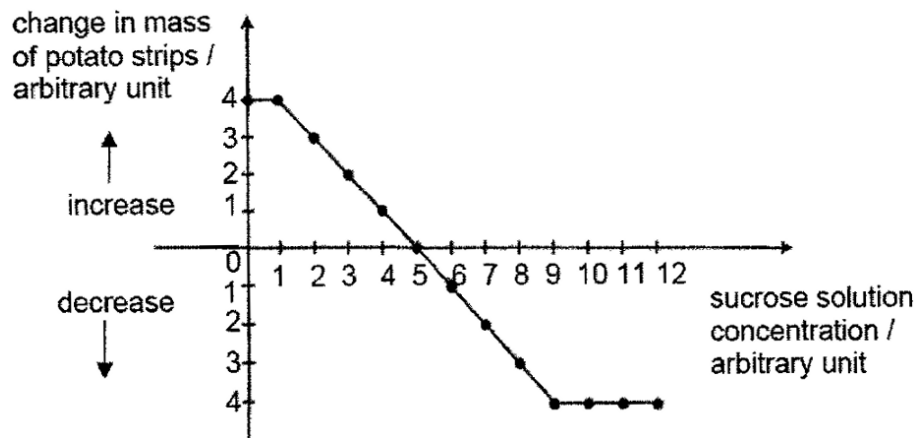


Fig 1.1

- (a) Explain the change in mass of potato strips placed in sucrose solution with a concentration of 8 arbitrary units.

.....

.....

.....

..... [3]

- (b) With reference to Fig 1.1, determine the concentration of sucrose solution which has the same water potential as the potato strips. Explain your answer.

.....

.....

.....

..... [3]

- 2 Fig 2.1 shows the changes in pressure in the left side of the human heart of a patient over 1.6 seconds.

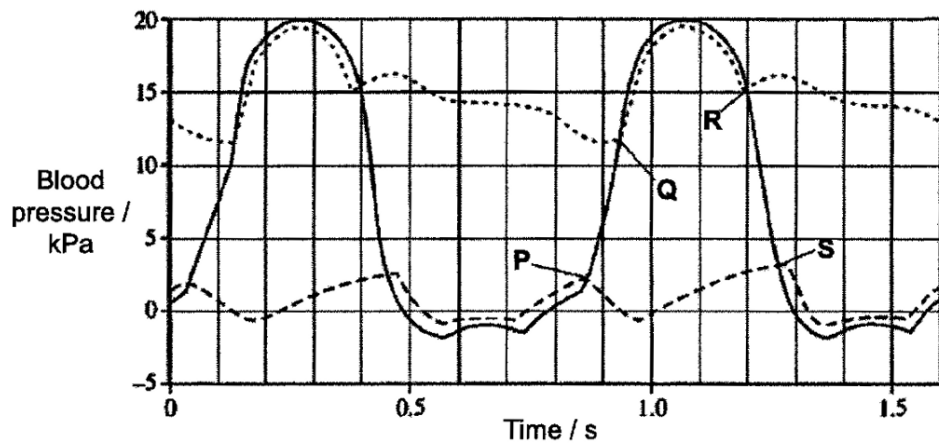


Fig 2.1

- (a) Calculate the number of heartbeats per minute for this patient. Show your working clearly.

number of heartbeats per minute = ..... [2]

- (b) Using the letters **P**, **Q**, **R** or **S** from Fig 2.1, identify the following events. Each letter may be used once, more than once, or not used at all.

| event                         | letter |
|-------------------------------|--------|
| closure of semilunar valve    |        |
| opening of bicuspid valve     |        |
| contraction of left ventricle |        |

[2]

(c) Explain why the pressure of the aorta only starts to increase at Q.

.....

.....

.....

..... [2]

3 Fig 3.1 shows the cross section of a villus.

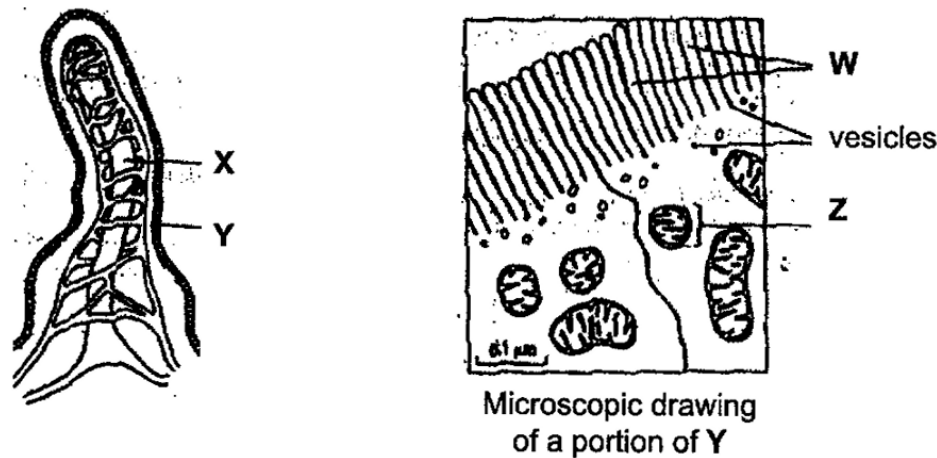


Fig 3.1

- (a) Name W and X.
- W: .....
- X: ..... [2]
- (b) State the function of structure X.
- ..... [1]
- (c) Explain how the following structures enable the ileum to carry out its function of absorption of food molecules.
- (i) W:
- ..... [1]
- (ii) Y:
- ..... [1]

(iii) Z:

.....  
..... [1]

4 Fig 4.1 shows the cross section of part of a leaf.

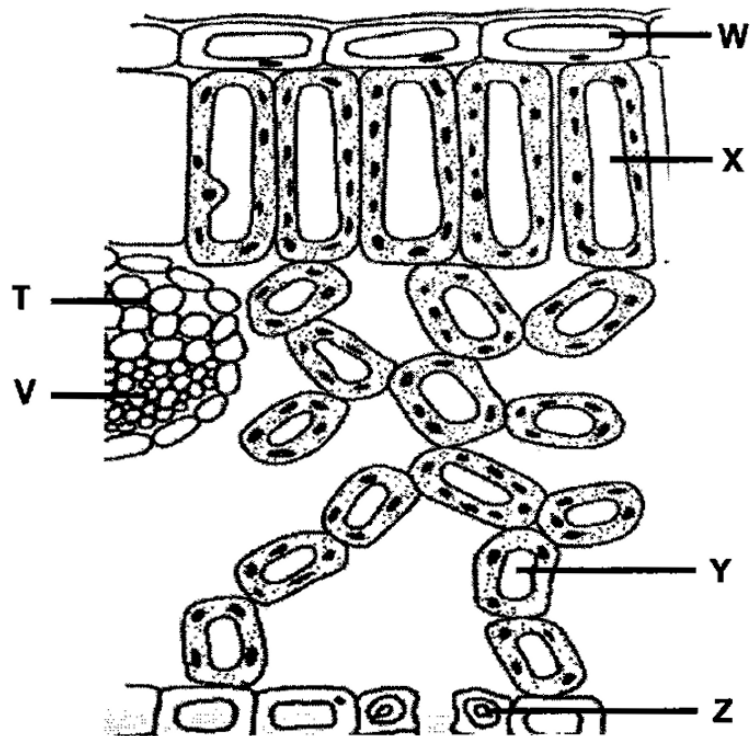


Fig 4.1

(a) Using the letters in Fig 4.1, identify the structures responsible for

(i) the highest rate of photosynthesis in the leaf: ..... [1]

(ii) the transport of water and mineral salts: ..... [1]

(b) Describe and explain how carbon dioxide enters cell Y.

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

.....

.....

(c) Compare and contrast between cell X and a root hair cell.

.....

.....

.....

..... [2]

5 Sungei Buloh Wetland Reserve is a nature reserve in Singapore which is rich in biodiversity and serves as an important site for migratory birds and other wildlife.

Fig 5.1 shows the transfer of energy among some organisms in Sungei Buloh Wetland Reserve.

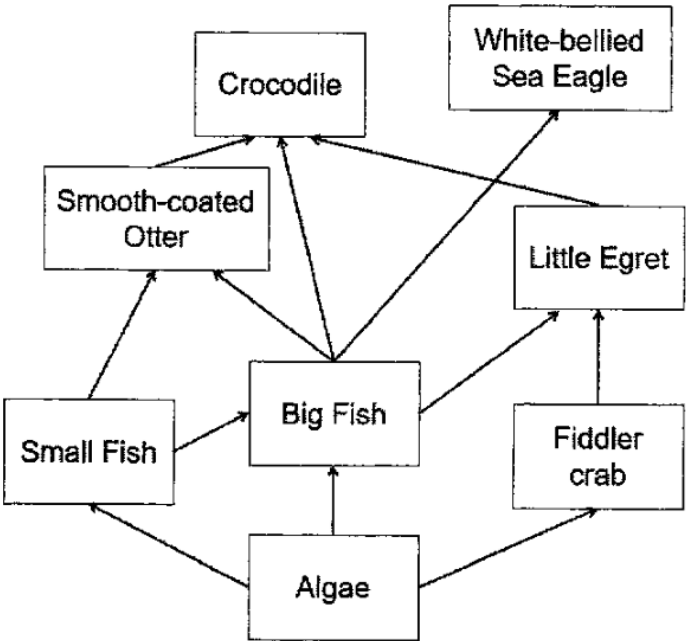


Fig 5.1

(a) With reference to Fig 5.1, identify two organisms which are part of two trophic levels. Name the trophic levels.

| organism | trophic levels |  |
|----------|----------------|--|
|          |                |  |
|          |                |  |

[2]

(b) Explain why food chains rarely exceed 4 trophic levels.

.....

.....

.....

..... [3]

(c) Besides feeding on algae, fiddler crabs also pass sand through their mouthparts, scraping off pieces of dead organic matter to consume.

Suggest why Fig 5.1 does not give the most complete representation of the transfer of energy between organisms in the ecosystem.

.....

.....

..... [2]

6 Fig 6.1 shows the structure of a kidney tubule.

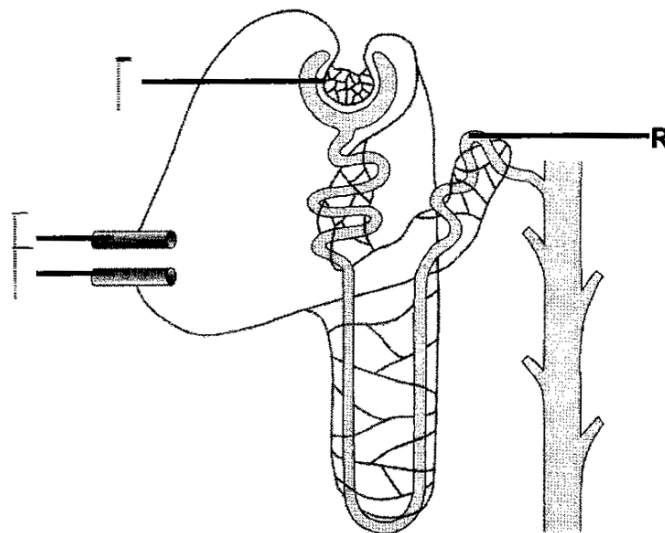


Fig 6.1

(a) Identify structures **P** and **R**.

**P:** .....

**R:** ..... [2]

**(b)** State two differences in the structure of **P** and **Q**.

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

**(c) (i)** Glomerular disease is a condition which affects structure **S**. Proteins are found in the urine of patients with this condition.

Suggest how this may happen.

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

**(ii)** Suggest two other substances which may be found in a patient's urine which are **not usually found** in the glomerular filtrate.

substance 1: .....

substance 2: ..... [2]

**(iii)** For patients who have serious cases of glomerular disease, they may need to receive treatment using dialysis. Table 6.1 shows the concentration of various substances in the blood of a patient with serious glomerular disease.

**Table 6.1**

| substance     | concentration in blood /<br>arbitrary units | concentration in dialysis fluid /<br>arbitrary units |
|---------------|---------------------------------------------|------------------------------------------------------|
| glucose       | 5.5                                         |                                                      |
| urea          | 4.2                                         |                                                      |
| mineral salts |                                             | 35.6                                                 |

[2]

Complete Table 6.1 to suggest the concentration of the various substances in the blood and dialysis fluid of the patient.

7 Fig 7.1 shows the procedure and results of a clinical test to examine the fetus during pregnancy.

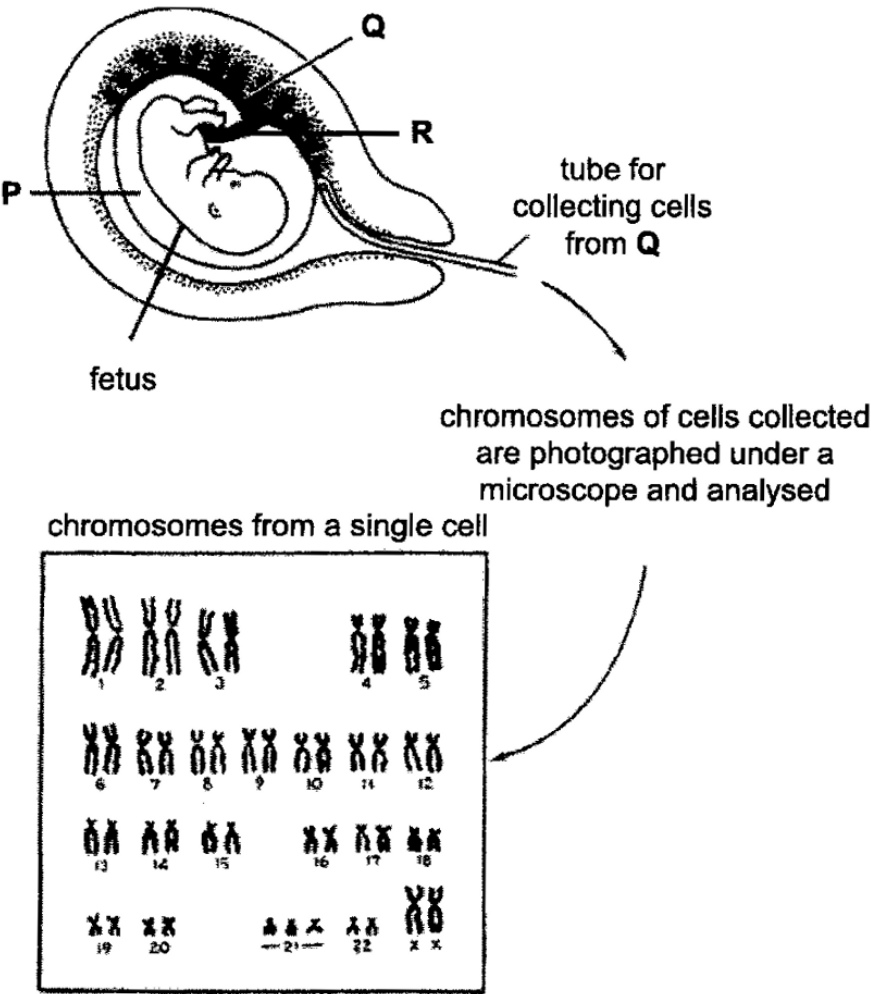


Fig 7.1

(a) Name P and R.

**P** .....

**R** .....

**(b) (i)** A pregnant runner participates in a 400 m race.

Describe how the presence of **P** allows her to compete without having a miscarriage.

..... [1]

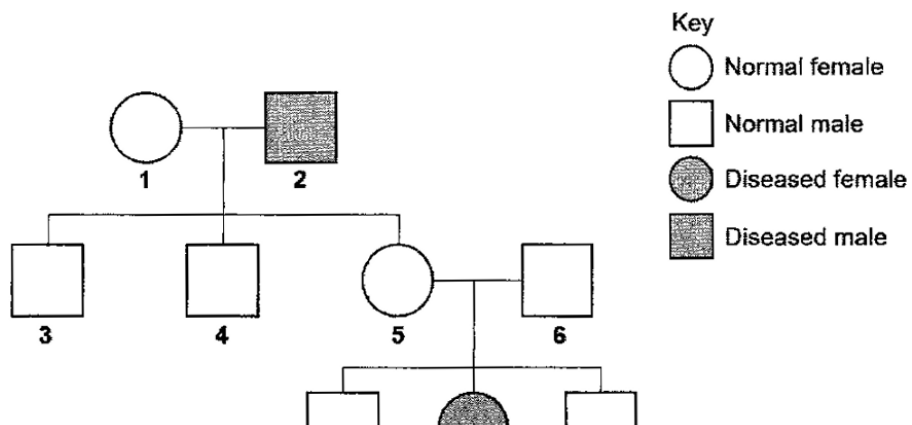
**(ii)** Describe and explain what would happen if **R** is cut halfway during the pregnancy.

..... [3]

**(c)** Name the genetic condition that the fetus suffers from and suggest the cause of the condition.

..... [2]

**8** Fig 8.1 shows a family tree. One member of the family is affected by sickle cell anaemia.



**Fig 8.1**

- (a) Let **A** and **a** represent the normal allele and sickle cell allele respectively. State the genotype(s) of individuals 5 and 6. Explain your answer.

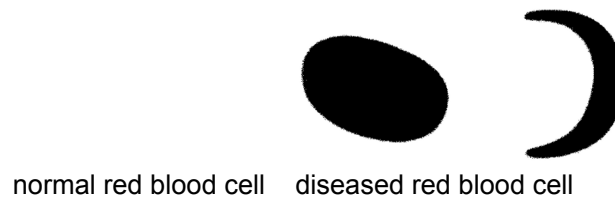
.....  
.....  
..... [3]

- (b) Individual 3 marries an individual who has sickle-cell anaemia.

Using a genetic diagram, calculate the probability of their children **not** having the disease.

[3]

- (c) Sickle cell anaemia causes red blood cells to become sickle-shaped, inflexible, and break apart easily. Fig 8.2 shows the shapes of a normal and diseased red blood cell.



**Fig 8.2**

Suggest why people with sickle-cell anaemia cannot participate in intense sports.

.....

.....

..... [2]

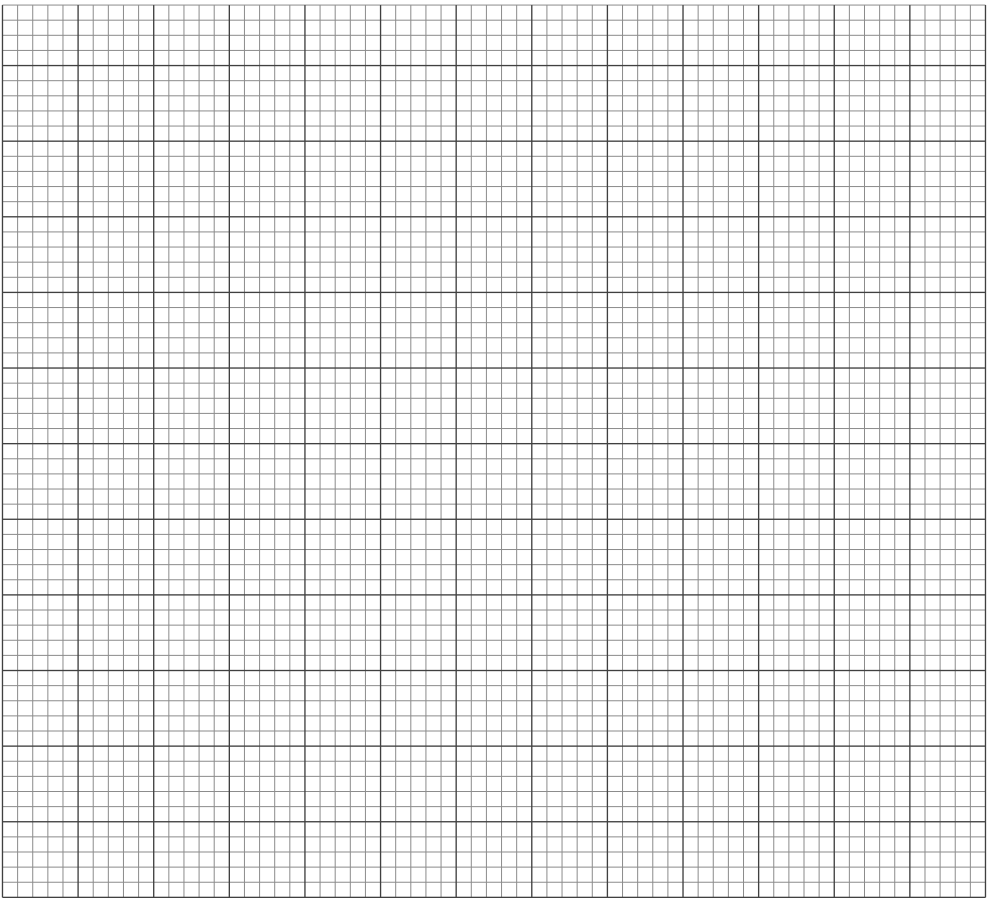
9 An athlete engages in strenuous physical exercise.

Table 9.1 shows the concentration of lactic acid in the athlete’s blood over a period of 6 minutes.

**Table 9.1**

|                                             |     |     |      |      |      |      |      |
|---------------------------------------------|-----|-----|------|------|------|------|------|
| time / min                                  | 0   | 1   | 2    | 3    | 4    | 5    | 6    |
| lactic acid concentration / arbitrary units | 6.0 | 6.0 | 17.0 | 38.0 | 35.0 | 26.0 | 20.0 |

(a) Plot a graph of the data in Table 9.1.



[4]

**(b) (i)** With reference to the graph in **(a)**, describe the change in lactic acid concentration in the blood over the 6 minutes.

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

**(ii)** Explain the change in lactic acid concentration from the 3<sup>rd</sup> to 6<sup>th</sup> minute.

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

**(iii)** Suggest what would happen to the lactic acid concentration in the blood after the 6<sup>th</sup> minute.

..... [1]

**(c)** Diaphragm muscle spasms occur when the diaphragm is unable to relax and remains in a contracted position. The athlete experiences diaphragm muscle spasms during an exercise session.

Describe and explain how this condition affects the volume of air exhaled by the athlete.

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

**SECTION B – FREE-RESPONSE QUESTIONS (10 marks)**

Answer **one** question.

- 10 (a)** Describe the processes starting with pollination and ending with fertilisation in a flower which is wind-pollinated.

- (b)** Discuss the advantages and disadvantages of self-pollination as compared to cross-pollination.

.....  
.....  
.....  
.....  
.....

Outline the nervous pathway involved.

**- End of Paper -**