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.

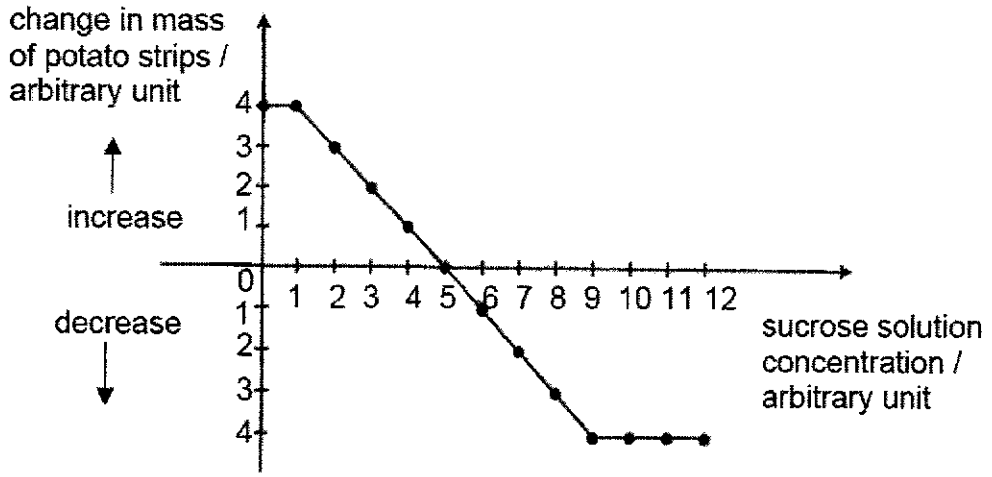

Fig 1.1

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

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.....

.....

..... [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.

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..... [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.

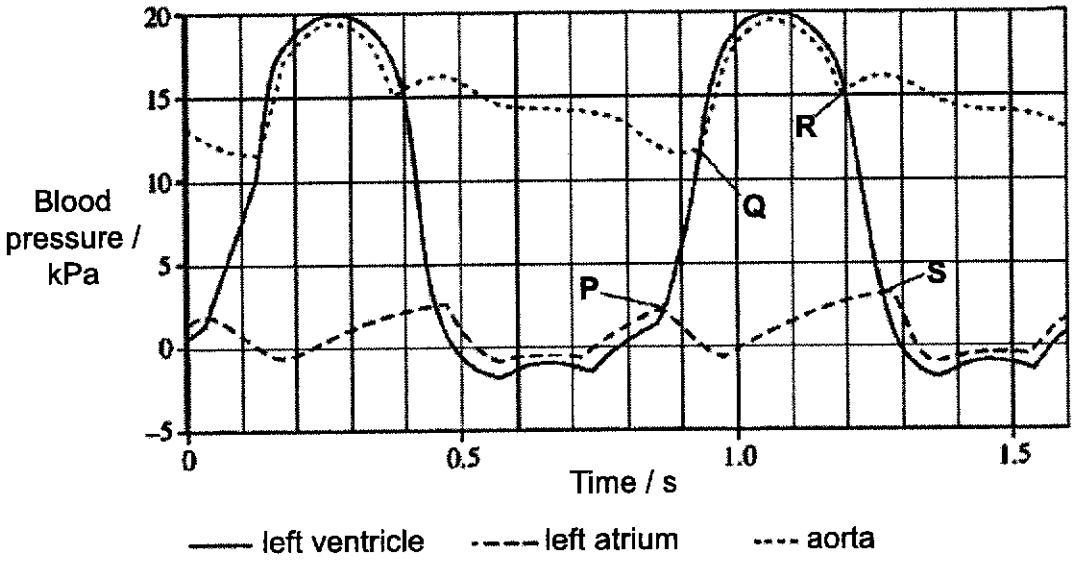

Fig 2.1

(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**.

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..... [2]

3 Fig 3.1 shows the cross section of a villus.

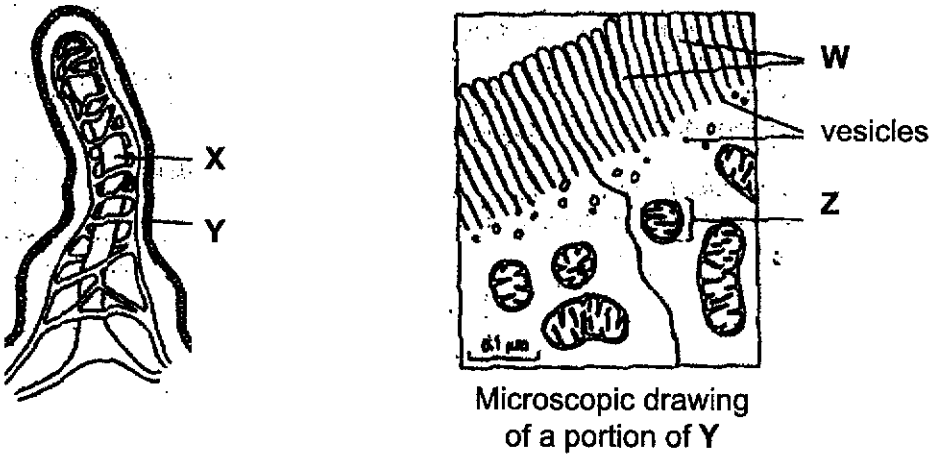

Fig 3.1

(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.

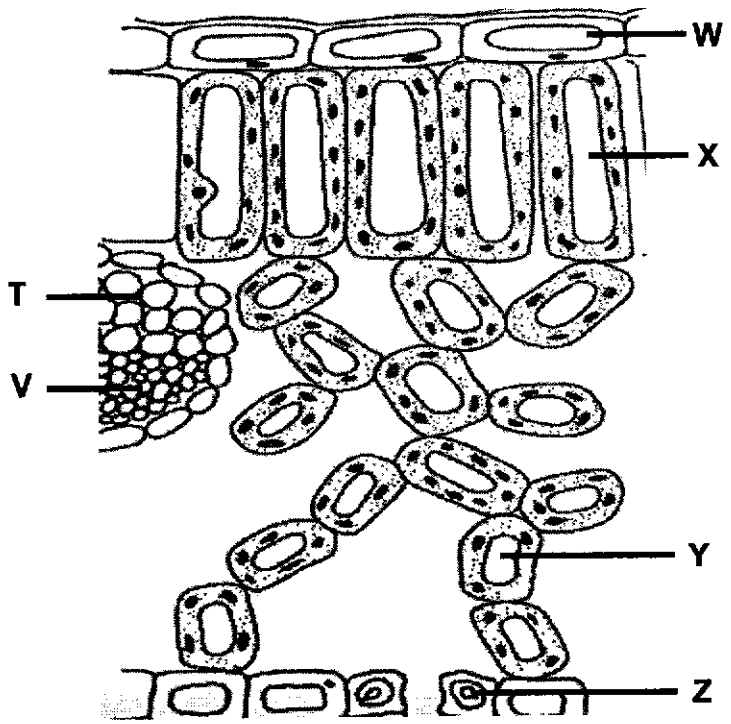

Fig 4.1

(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.

.....

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..... [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.

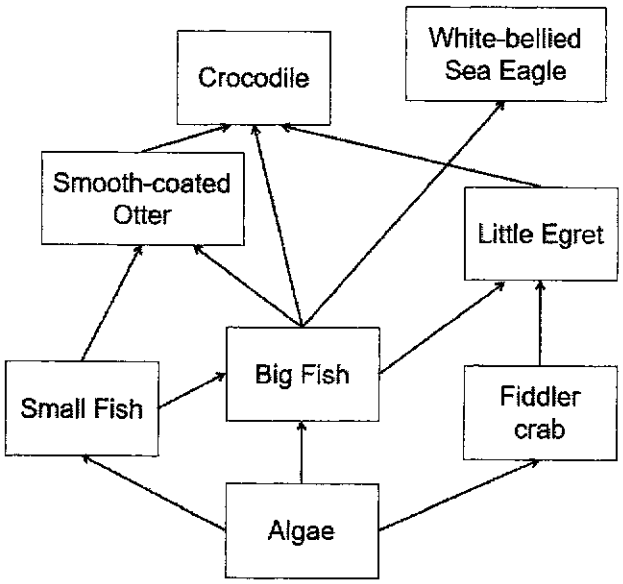

Fig 5.1

(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.

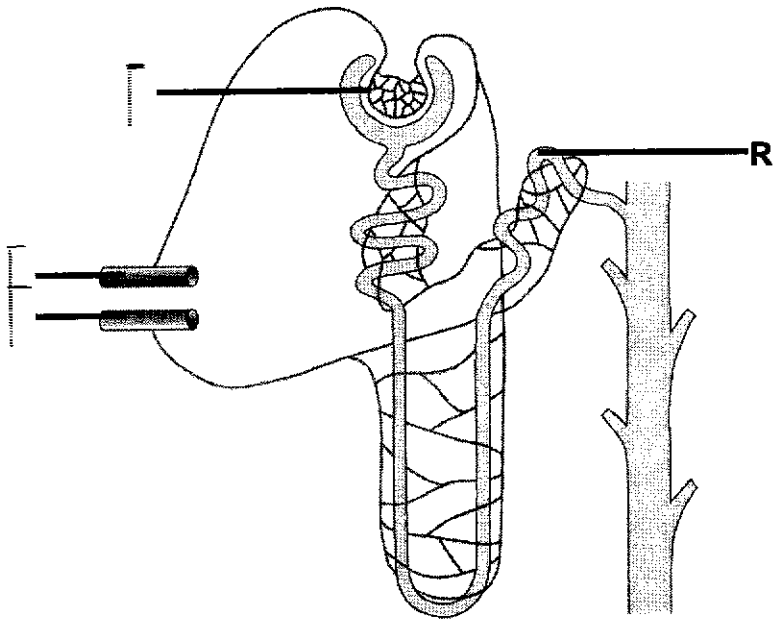

Fig 6.1

(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 / arbitrary units	concentration in dialysis fluid / 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.

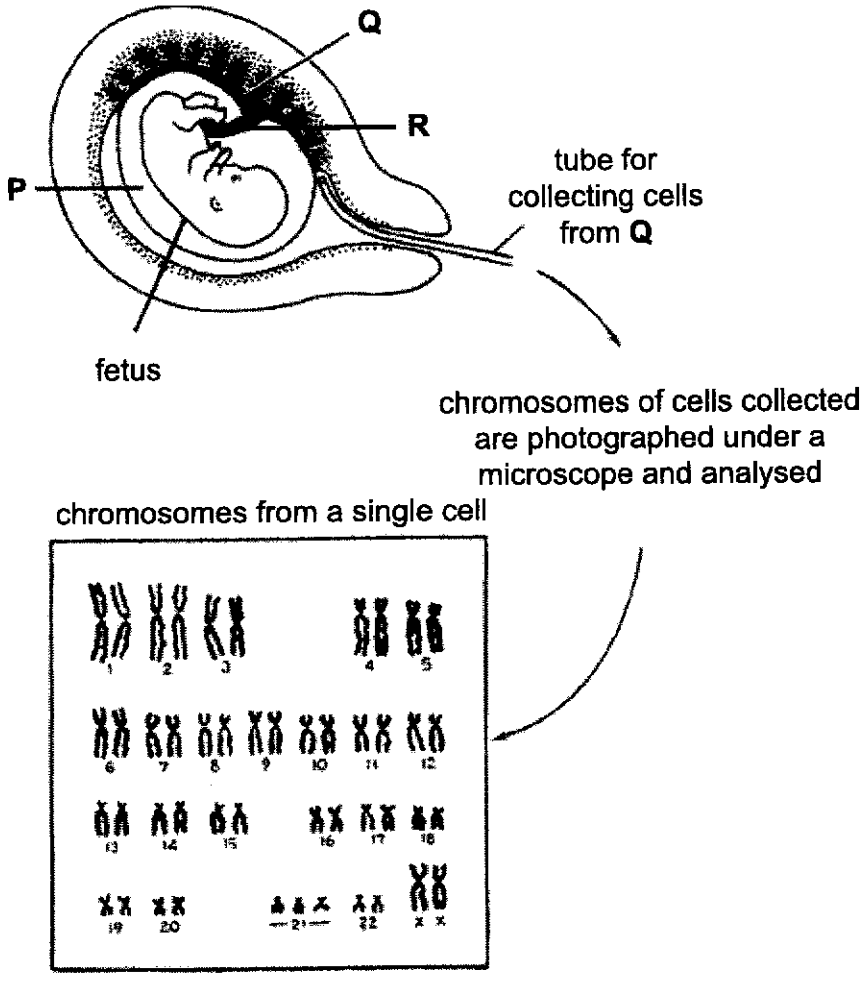

Fig 7.1

(a) Name **P** and **R**.

[2]

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.

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..... [3]

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

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..... [2]

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

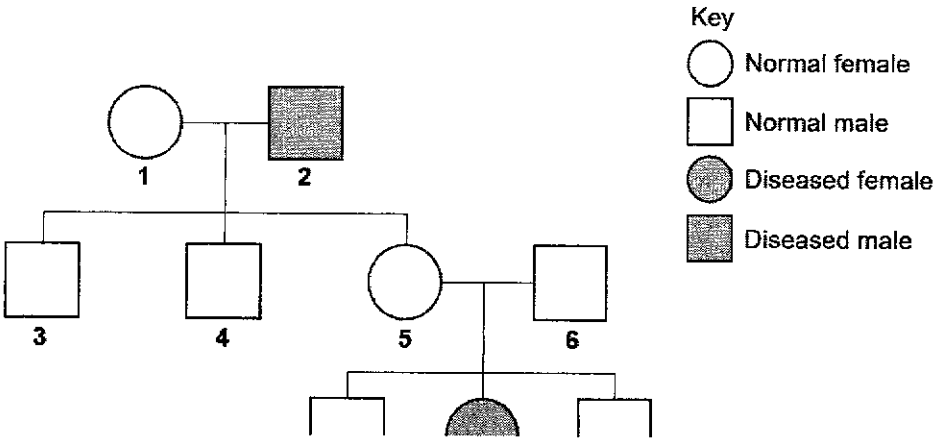


Fig 8.1

(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.

.....

.....

.....

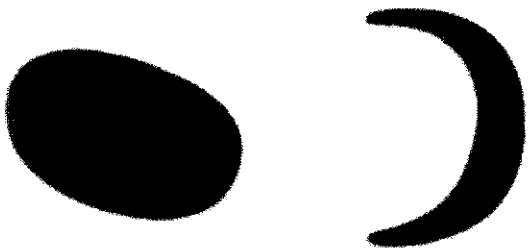
..... [3]

(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.



normal red blood cell diseased red blood cell

Fig 8.2

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

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..... [2]

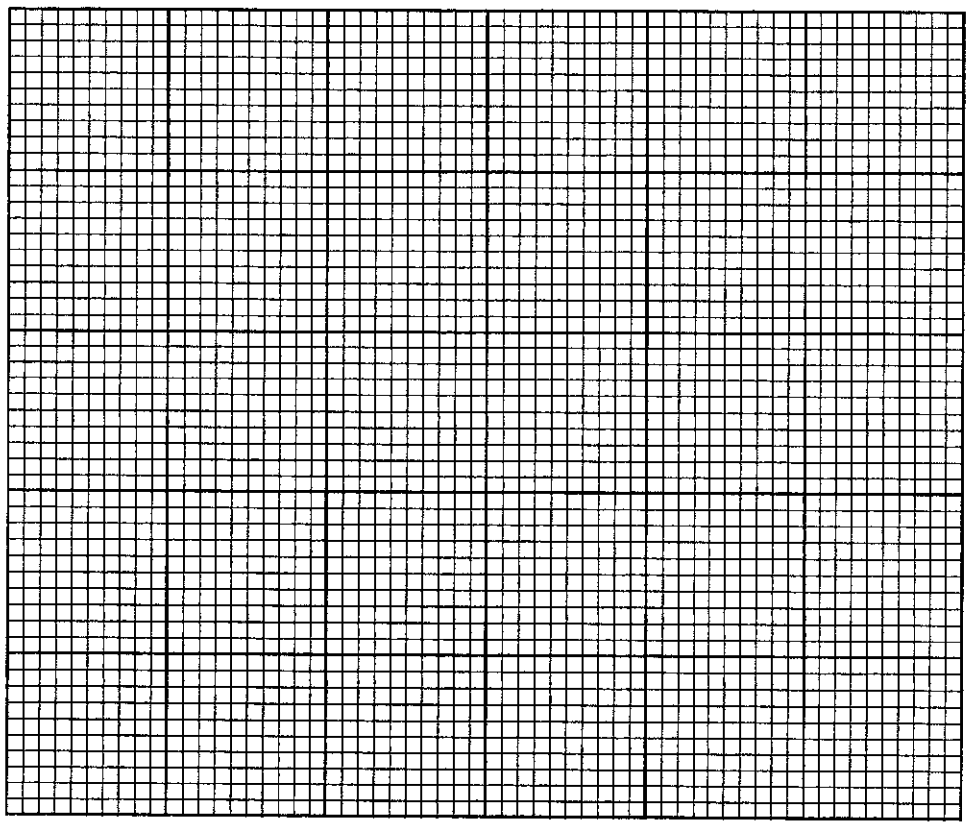
9 An athlete engages in strenuous physical exercise.

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.

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..... [2]

(ii) Explain the change in lactic acid concentration from the 3rd to 6th minute.

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..... [2]

(iii) Suggest what would happen to the lactic acid concentration in the blood after the 6th 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.

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..... [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.

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..... [6]

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

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[4]

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11 **(a)** A football player sees the ball rolling towards him. He kicks the ball and scores a goal.

Outline the nervous pathway involved.

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..... [6]

(b) Compare and contrast between voluntary and reflex actions.

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..... [4]

- End of Paper -

<table>
<tr><td></td><td>cii</td><td>Platelets, Red blood cells, White blood cells, hormones (any two)</td><td>2</td></tr>
<tr><td></td><td>ciii</td><td>
<table>
<tr><th>substance</th><th>concentration in blood / arbitrary units</th><th>concentration in dialysis fluid / arbitrary units</th></tr>
<tr><td>glucose</td><td>5.5</td><td>5.5</td></tr>
<tr><td>urea</td><td>4.2</td><td>0</td></tr>
<tr><td>mineral salts</td><td>35.6</td><td>35.6</td></tr>
</table>
3 pts – 2m, 2 pts – 1m, 1 pt – 0m
</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>a</td><td>P: Amniotic fluid
R: Umbilical cord

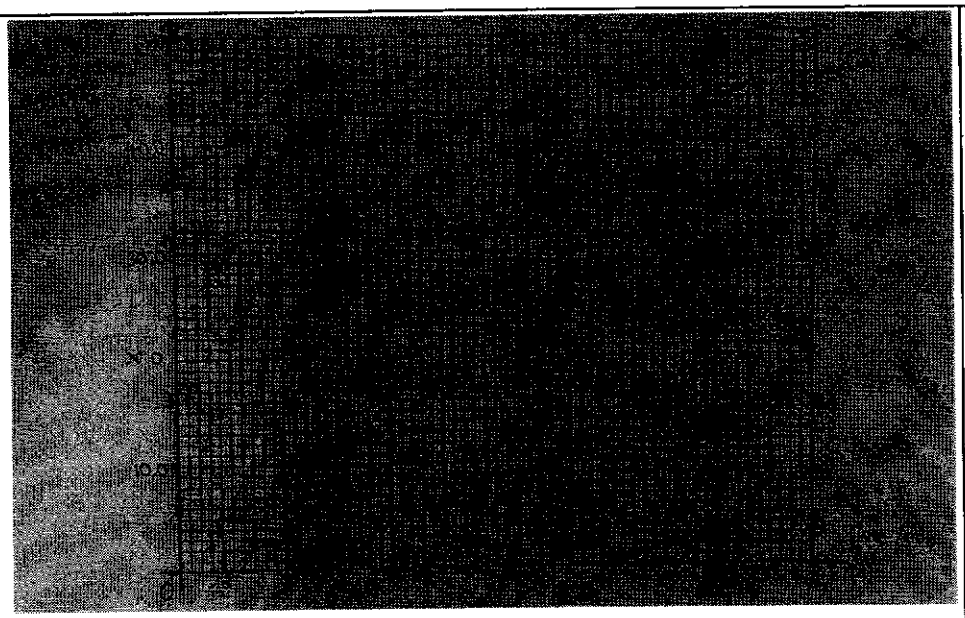
Umbilical artery/vein accepted.</td><td>2</td></tr>
<tr><td></td><td>bi</td><td>Cushions and protects fetus from physical injury</td><td>1</td></tr>
<tr><td></td><td>bii</td><td>The fetus will die
Carbon dioxide and waste products cannot be transferred from fetus to placenta.
Oxygen and food substances cannot be transferred from placenta to fetus.</td><td>3</td></tr>
<tr><td></td><td>c</td><td>Down syndrome
Fetus has an extra copy of chromosome 21</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>a</td><td>5 and 6 are Aa.
8 is aa, so it must inherit 1 copy of sickle cell allele from each parent.
5 and 6 are normal/not diseased, so they must be heterozygous.

5 is Aa because mother is either Aa or AA, and father is aa (does not explain why 6 is Aa) – 1m

Usage of wrong symbols (Not A and a) – 1m deducted</td><td>3</td></tr>
<tr><td></td><td>b</td><td>50%

Answer – 1
Labels – 1
Content of diagram – 1</td><td>3</td></tr>
<tr><td></td><td>c</td><td>Carry less haemoglobin and transport less oxygen OR
Can get stuck in blood vessels and block bloodflow

Less oxygen available for aerobic respiration for release of energy for muscle contractions. OR
Fainting/sudden pains/death</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

9	a	 S – Scale L – Line A – Axes P – Points	4
	bi	From 0 to 1 min. lactic acid concentration remained constant at 6.0 arbitrary units. From 1 to 3 min, it increased from 6.0 arbitrary units to 38.0 arbitrary units. From 3 to 6 min, it decreased from 38.0 to 20.0 min. 3 pts for 2m, 2 pts – 1m, 1 pt – 0m No data quoted – 1m (if all points are correct)	2
	bii	Exercise has stopped Lactic acid is gradually transported to the liver where oxygen is used to remove it from the bloodstream/broken down in the liver	2
	biii	It will gradually decrease and remain constant at 6.0 arbitrary units.	1
	c	Diaphragm is unable to relax and curve upwards; Volume of lungs does not decrease/remains constant Pressure in lungs does not increase/is similar to atmospheric pressure; Lower volume of air exhaled. 4 pts – 3m, 3 pts – 2m, 2 pts – 1m, 1 pt – 0m	2

Paper 2 Section B (10 m)

10 EITHER	a	1 When there is wind, pollen is shaken from anthers and carried away; 2 Pollen is captured in the air by large, feathery stigma; 3 Sugary fluid on stigma causes pollen grain to germinate; 4 Pollen tube grows from pollen grain; 5 Pollen tube secretes enzymes to digest stigma and style; 6 Pollen tube grows into ovary, through micropyle, into ovule; 7 Tip of pollen tube absorbs sap and bursts, releasing male gamete; 8 Male gamete fuses with female gamete. 8 pts – 6m, 6-7 pts – 5m, 4-5 pts – 4m, 3 pts – 2m, 2 pts – 1m, 1 pt – 0m	6
	b	<u>Advantages</u> 1 Self pollination only requires one parent, while cross pollination requires two parents; 2 Self pollination requires less pollen to be produced, conserving energy, while cross pollination wastes more pollen and energy; 3 Self pollination is not dependent on external factors such as wind/insects for pollination, while cross pollination is dependent on them; 4 In self-pollination, beneficial qualities can be passed directly down from parent plant to offspring, while it is not possible in cross pollination; 5 Higher probability of self-pollination occurring due to close proximity of anthers to stigma, but lower probability of cross pollination due to larger distance between flowers; <u>Disadvantages</u> 6 Less genetic variation in self-pollination but cross pollination allows for more genetic variation; 7 Less viable seeds produced by self-pollination, but more viable seeds are produced in cross-pollination which can survive longer before germination; 8 Offspring may inherit beneficial qualities from both parents in cross pollination, while they can only inherit qualities from one parent in self-pollination 9 Offspring may inherit unfavourable traits directly from parents in self pollination, while they may be able to lose these traits during cross-pollination Max 4m - min 2 advantages/disadvantages. Max 3m – min 1 advantage/disadvantage Max 2m – Only advantage or disadvantage stated. 5 pts – 4m, 4 pts – 3m, 3 pts – 2m, 2 pts – 1m, 1 pt – 0m	4
11	a	1 Receptors in his eye detect the ball rolling towards him and produce nerve impulses; 2 Nerve impulses are sent by sensory neurones; 3 To relay neurones; 4 To brain; 5 Brain generates another set of nerve impulses; 6 Nerve impulses are sent by relay neurones in spinal cord;	6

		7 To motor neurones in leg; 8 To leg muscles to kick the ball 8 pts – 6m, 6-7 pts – 5m, 5 pts – 4m, 4 pts – 3m, 3 pts – 2m, 2 pts – 1m, 1 pt – 0m	
	b	<u>Differences</u> 1 Voluntary actions are consciously controlled, while reflex actions are not consciously controlled; 2 Voluntary actions are initiated in the brain, while reflex actions are initiated by stimulation of receptors; 3 Voluntary actions take a longer time to execute than reflex actions; 4 Nervous pathway is longer in voluntary actions than reflex actions; 5 In voluntary actions, the brain is involved, while in reflex actions, impulses do not need to travel to the brain. <u>Similarities</u> 6 Nerve impulses are generated; 7 Motor neurones carry the impulses to the effectors; 8 Responses are carried out by the effectors 9 Synapses are involved in transmission of nerve impulses 10 Both require use of sensory/motor/relay neurones Any 4 pts. Minimum 1 similarity and 1 difference. <u>Max 3m – Only similarities or differences</u>	4