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**ASSUMPTION ENGLISH SCHOOL  
PRELIMINARY EXAMINATION 2024**

**BIOLOGY  
6093 / 01**



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LEVEL: Sec 4 Express

DATE: 27 August 2024

CLASS: Sec 4/1

DURATION: 1 hour

Additional Materials provided: 1 sheet of OAS paper

**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 and on the OAS paper.  
**Shade your index number on the OAS paper.**

**PAPER 1 (40 marks)****MULTIPLE CHOICE QUESTIONS**

There are 40 questions in this paper. Answer **all** questions.  
For each question, there are four possible answers **A, B, C**  
and **D**.

At the end of the examination, hand in your OAS paper and question booklet separately.

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**This Question Paper consists of 24 printed pages including this page.**

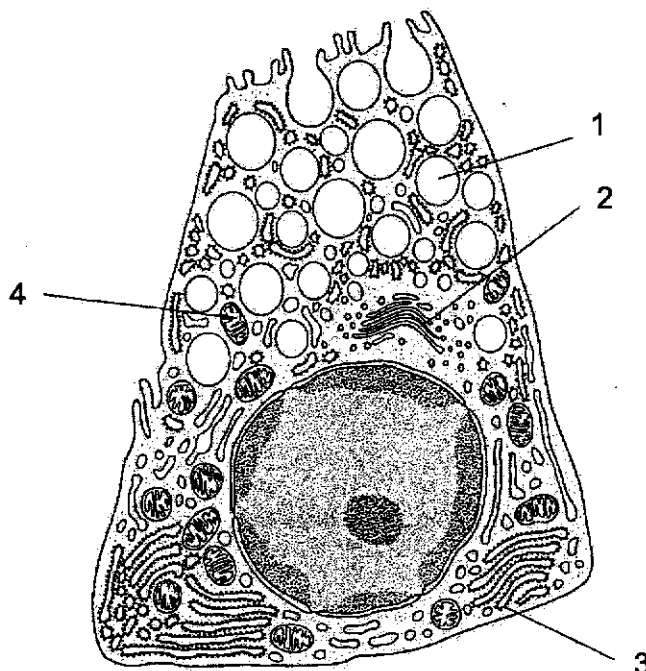
**[Turn over**

**MULTIPLE-CHOICE QUESTIONS [40 marks]**

For each question, there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice in the OAS paper provided.

- 1 The diagram shows an electron micrograph of an animal cell.  
Which row shows the correct identity of 1, 2, 3 and 4?



|          | 1           | 2                            | 3                            | 4             |
|----------|-------------|------------------------------|------------------------------|---------------|
| <b>A</b> | ribosome    | smooth endoplasmic reticulum | rough endoplasmic reticulum  | chloroplast   |
| <b>B</b> | chloroplast | smooth endoplasmic reticulum | Golgi apparatus              | mitochondrion |
| <b>C</b> | vacuole     | Golgi apparatus              | rough endoplasmic reticulum  | mitochondrion |
| <b>D</b> | vacuole     | rough endoplasmic reticulum  | smooth endoplasmic reticulum | chloroplast   |

- 2 Which cells contain DNA?

1 guard cell

3

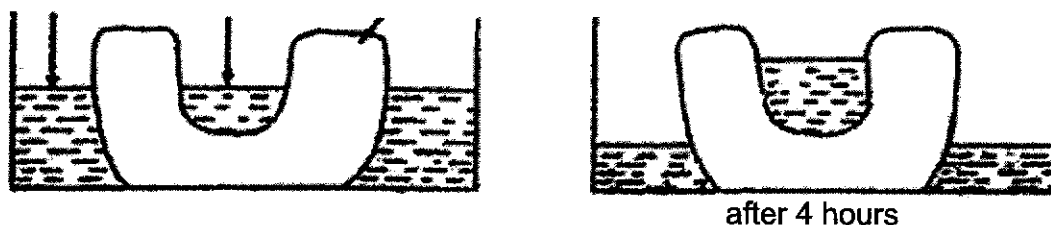
- 2 palisade mesophyll cell
- 3 sieve tube cell
- 4 xylem cell

- A 1 and 2
- B 1 and 3
- C 2 and 4 only
- D 2, 3 and 4

- 3 A peeled potato shaped into a cup was placed in a container. Salt solutions of varying concentrations were poured into the centre of the potato and the rest of the container.

The water potential of the potato flesh was determined to be similar to that of a salt solution with a concentration of  $0.4 \text{ mol/dm}^3$ .

solution P    solution Q    potato

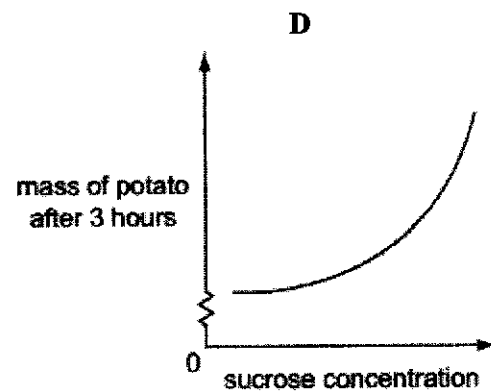
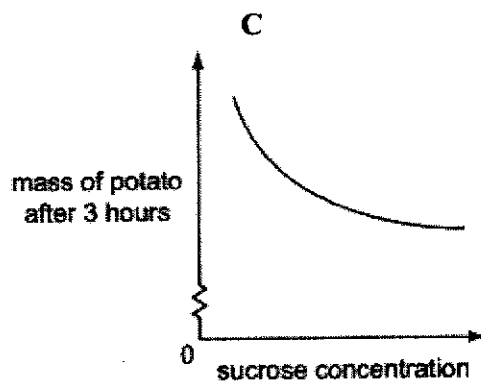
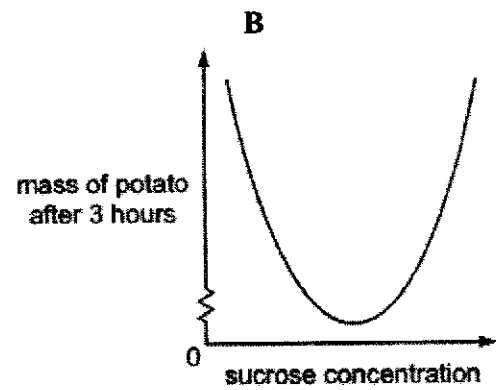
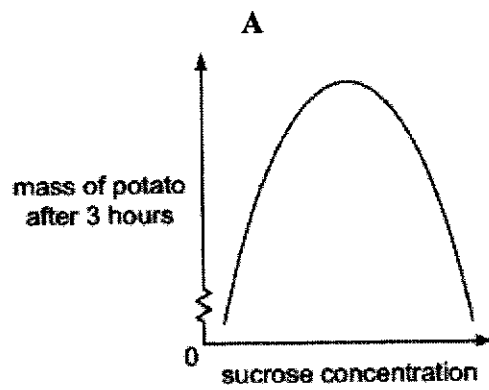


Which row shows the possible concentrations of solutions P and Q?

|   | solution P             | solution Q             |
|---|------------------------|------------------------|
| A | $0.1 \text{ mol/dm}^3$ | $0.3 \text{ mol/dm}^3$ |
| B | $0.2 \text{ mol/dm}^3$ | $0.6 \text{ mol/dm}^3$ |
| C | $0.4 \text{ mol/dm}^3$ | $0.8 \text{ mol/dm}^3$ |
| D | $0.8 \text{ mol/dm}^3$ | $0.2 \text{ mol/dm}^3$ |

- 4 Identical potato strips were placed in sucrose solutions of varying concentrations. After three hours, the mass of each potato strip was measured.

Which graph shows the result of the experiment?



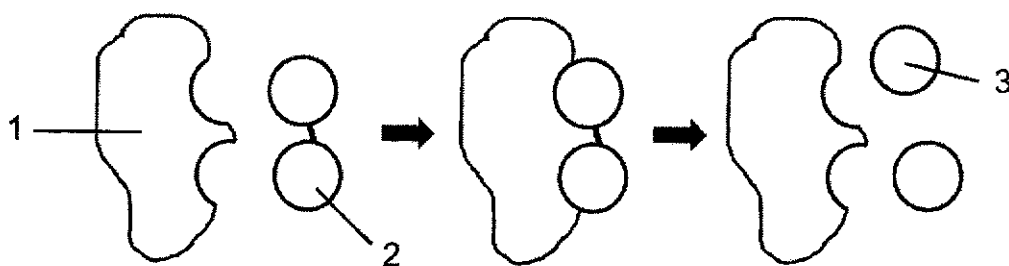
- 5 A student carried out tests on a food sample. The results are shown in the table.

| test                  | observation of sample |
|-----------------------|-----------------------|
| biuret test           | violet                |
| ethanol emulsion test | colourless            |
| Benedict's test       | orange ppt            |

What did the sample contain?

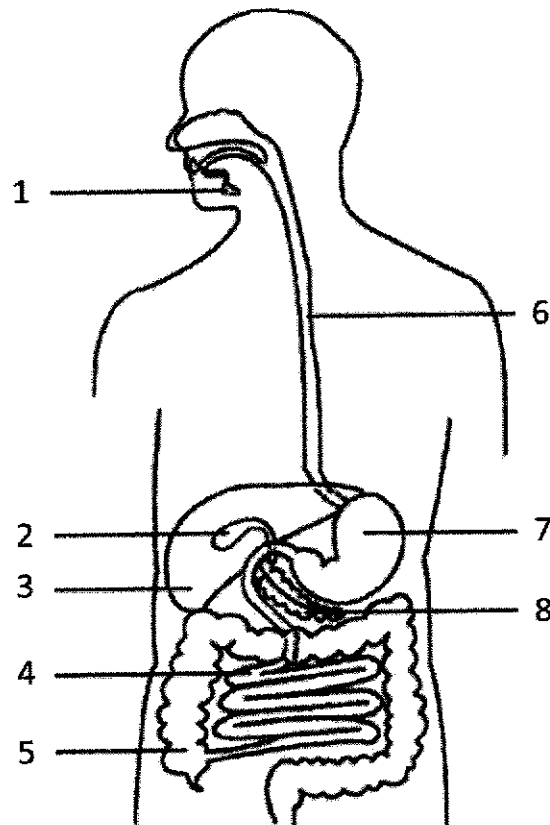
|          | protein | reducing sugar | fat |
|----------|---------|----------------|-----|
| <b>A</b> | ✓       | ✓              | X   |
| <b>B</b> | ✓       | X              | ✓   |
| <b>C</b> | X       | ✓              | ✓   |
| <b>D</b> | X       | X              | X   |

- 6 Using the 'lock-and-key' hypothesis, which row shows the correct identity of the structures in the diagram?



|          | 1      | 2         | 3         |
|----------|--------|-----------|-----------|
| <b>A</b> | enzyme | key       | substrate |
| <b>B</b> | key    | enzyme    | substrate |
| <b>C</b> | lock   | substrate | key       |
| <b>D</b> | lock   | substrate | product   |

Refer to the diagram of the human digestive system for questions 7 and 8.



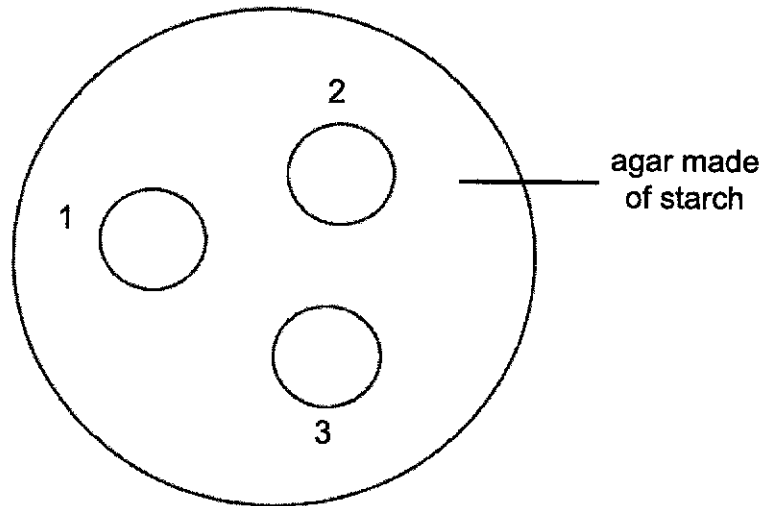
7 Which option shows the organs that produce enzymes involved in the digestion of proteins?

- A 1, 3 and 4
- B 1, 3 and 8
- C 4 and 7 only
- D 4, 7 and 8

8 Which row **does not** correctly show the structure matched to its function?

|   | structure | function                         |
|---|-----------|----------------------------------|
| A | 2         | production of lipase             |
| B | 5         | absorption of water              |
| C | 6         | transport of food to the stomach |
| D | 8         | production of amylase            |

- 9 Digestive juices were collected from three different parts of the human alimentary canal. The samples were each dropped into a well made in an agar plate of starch.



After 24 hours, iodine solution was added to each well.  
The results are as follows:

| well   | 1          | 2     | 3          |
|--------|------------|-------|------------|
| colour | blue-black | brown | blue-black |

Which row shows the possible identities of the digestive juices placed in each well?

|          | 1                | 2                | 3                |
|----------|------------------|------------------|------------------|
| <b>A</b> | pancreatic juice | saliva           | stomach juice    |
| <b>B</b> | saliva           | stomach juice    | pancreatic juice |
| <b>C</b> | stomach juice    | intestinal juice | pancreatic juice |
| <b>D</b> | stomach juice    | pancreatic juice | intestinal juice |

- 10 A patient, with blood group B, required a blood transfusion. His friends offered to donate blood to him.

Donor X and Y's donations were accepted, but donor Z's donation was rejected.

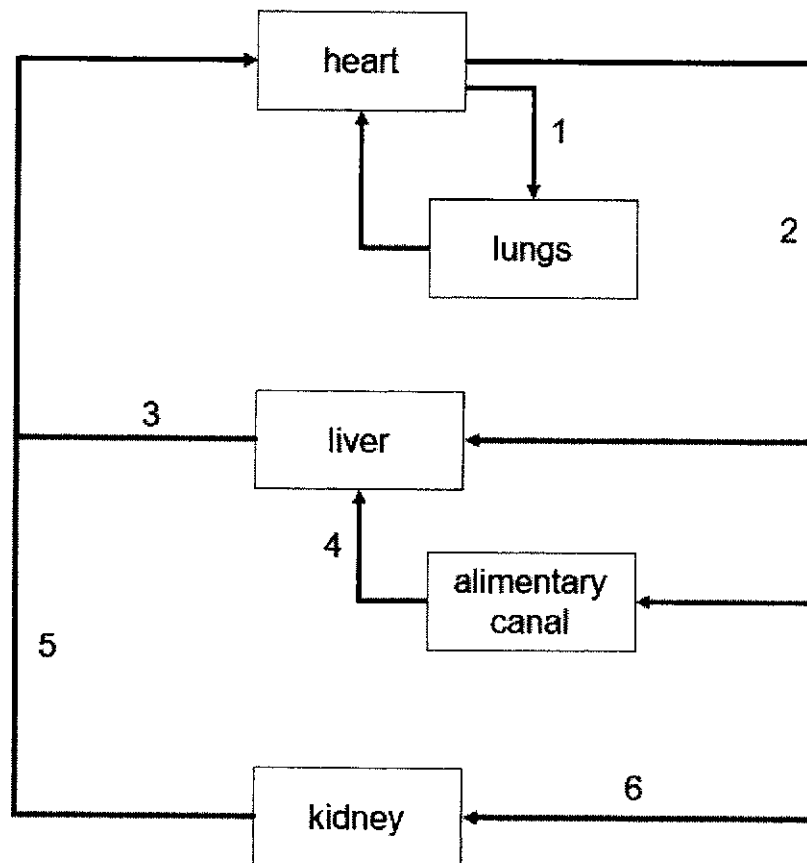
Which option shows the possible blood groups of the three donors?

|   | donor X | donor Y | donor Z |
|---|---------|---------|---------|
| A | AB      | B       | A       |
| B | AB      | B       | O       |
| C | B       | O       | AB      |
| D | O       | A       | B       |

- 11 Which row correctly shows the presence of valves in blood vessels?

|   | veins | arteries | capillaries |
|---|-------|----------|-------------|
| A | ✓     | ✓        | ✓           |
| B | ✓     | X        | ✓           |
| C | ✓     | X        | X           |
| D | X     | X        | X           |

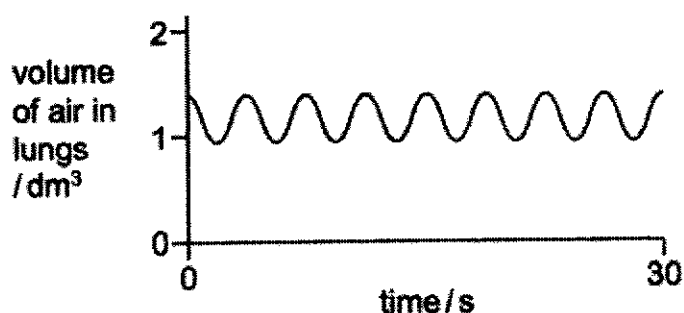
- 12 The diagram represents part of the human circulatory system.



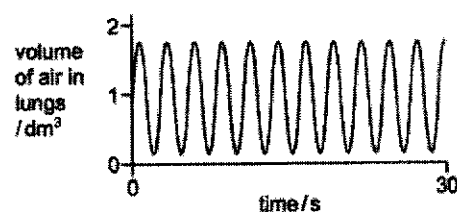
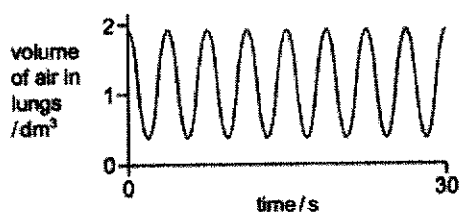
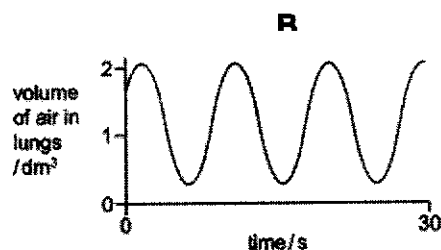
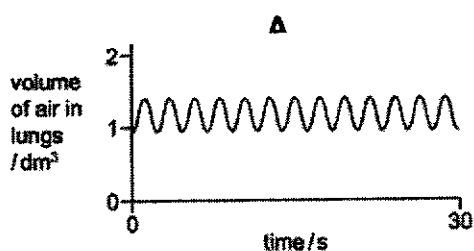
Which statement is true?

- A 2 contains more carbon dioxide than 1.
- B 3 contains more oxygen than 2.
- C 4 contains less glucose than 3.
- D 5 contains less urea than 6.

- 13 The graph shows the changes in volume of air in a person's lungs at rest for a period of 30 s.



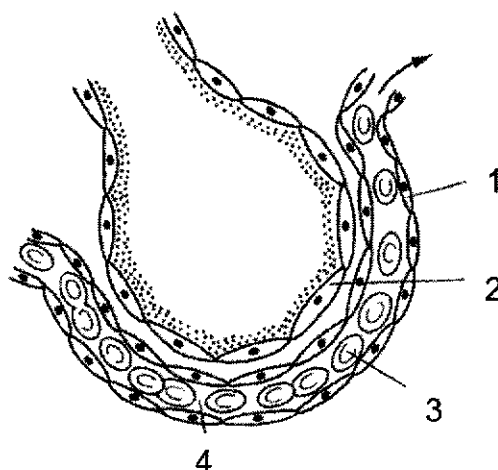
Which option shows the change in volume of air in the person's lungs after he has played an intense game of badminton?



- 14 Which row is true regarding the effects of the components of tobacco smoke?

|          | carbon monoxide                                   | tar                                      |
|----------|---------------------------------------------------|------------------------------------------|
| <b>A</b> | combines permanently with haemoglobin             | paralyses cilia                          |
| <b>B</b> | makes blood clot easily                           | higher risk of emphysema                 |
| <b>C</b> | more fatty deposits on walls of coronary arteries | reduced ability of blood to carry oxygen |
| <b>D</b> | uncontrolled cell division                        | higher risk of lung cancer               |

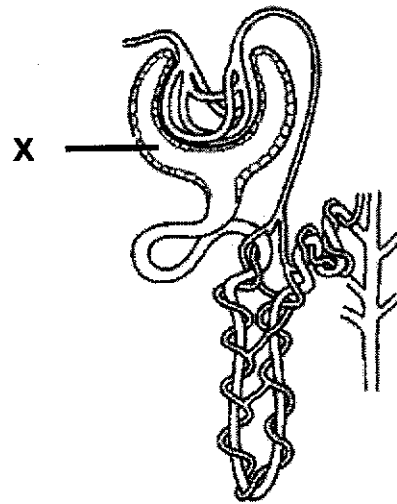
- 15 The diagram shows an alveolus and the adjacent blood vessels.



Which statement is **not** true?

- A 1 and 2 are one-cell thick to reduce distance for diffusion of gases.
  - B 2 is coated with a film of moisture to allow carbon dioxide to diffuse in it before diffusing into the bloodstream.
  - C 3 does not contain a nucleus to transport more oxygen.
  - D 4 contains glucose.
- 16 Which option shows the body's response towards dehydration?
- 1 decreased permeability of collecting duct wall
  - 2 less water excreted
  - 3 more dilute urine
  - 4 more water reabsorbed into bloodstream
- A 1, 2 and 4
  - B 2 and 3 only
  - C 2 and 4 only
  - D 2, 3 and 4

- 17 The diagram shows a kidney tubule.



Which option shows the substances present in X?

- 1 glucose
  - 2 protein
  - 3 salts
  - 4 urea
- A 1 only
  - B 1, 2 and 3
  - C 1, 3 and 4
  - D 3 and 4 only

- 18 Which row shows the body's response to hot weather?

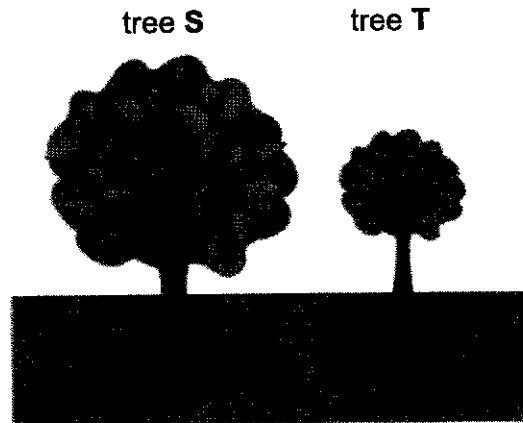
|   | arterioles in skin | sweat glands | metabolic rate |
|---|--------------------|--------------|----------------|
| A | constrict          | less sweat   | increases      |
| B | constrict          | more sweat   | decreases      |
| C | dilate             | less sweat   | increases      |
| D | dilate             | more sweat   | decreases      |

- 19 During dental surgery, the dentist applies local anaesthetic to the patient's mouth. This affects the transmission of nerve impulses through the trigeminal nerve, which causes the patient to not feel any pain and not be able to smile properly. A few hours after the procedure, the patient will be able to regain normal sensation and function of the area.

Which statements are true?

- 1 Motor neurones are connected to the trigeminal nerve.
  - 2 Sensory neurones are not connected to the trigeminal nerve.
  - 3 The anaesthetic affects transmission of impulses to the effectors.
  - 4 The anaesthetic destroys the receptors in the mouth.
- A 1 and 3  
B 1, 2 and 4  
C 2 and 3 only  
D 2 and 4
- 20 Which statement is true regarding voluntary and reflex actions?
- A Both actions involve transmission of nerve impulses to the brain.
  - B Reflex actions are usually quicker than voluntary actions.
  - C Reflex actions may or may not be consciously controlled.
  - D Voluntary actions are initiated by stimulation of receptors.

- 21 Which row shows the changes in the eye as a person shifts their focus from tree S to tree T?



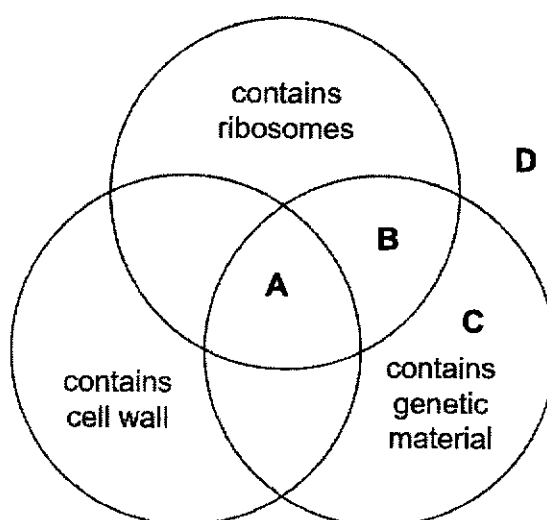
|   | ciliary muscles | suspensory ligaments | lens    |
|---|-----------------|----------------------|---------|
| A | contract        | slacken              | thinner |
| B | contract        | tighten              | thicker |
| C | relax           | slacken              | thicker |
| D | relax           | tighten              | thinner |

- 22 Which row shows the changes in the eye when a person switches on a light in a dark room?

|   | pupil     | iris             |                |
|---|-----------|------------------|----------------|
|   |           | circular muscles | radial muscles |
| A | constrict | contract         | relax          |
| B | constrict | relax            | contract       |
| C | dilate    | contract         | relax          |
| D | dilate    | relax            | contract       |

- 23 The venn diagram shows the presence of various structures in bacteria and viruses.

Which option shows where viruses will be placed?

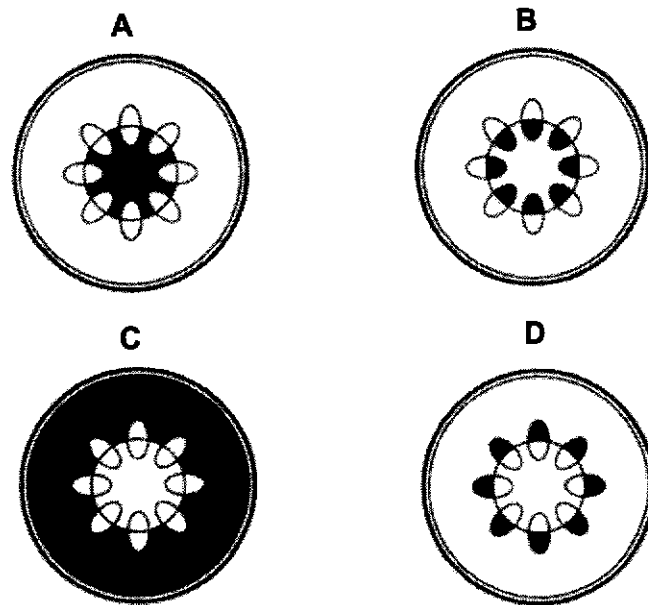


- 24 Which row correctly identifies an infectious and a non-infectious disease?

|   | infectious disease     | non-infectious disease |
|---|------------------------|------------------------|
| A | coronary heart disease | influenza              |
| B | COVID-19               | pneumococcal disease   |
| C | diabetes               | sickle-cell anaemia    |
| D | HIV                    | cancer                 |

- 25 A plant has its roots chopped off, and is placed in a vase containing black food dye. After 2 hours, the stem of the plant is cut and observed under a microscope?

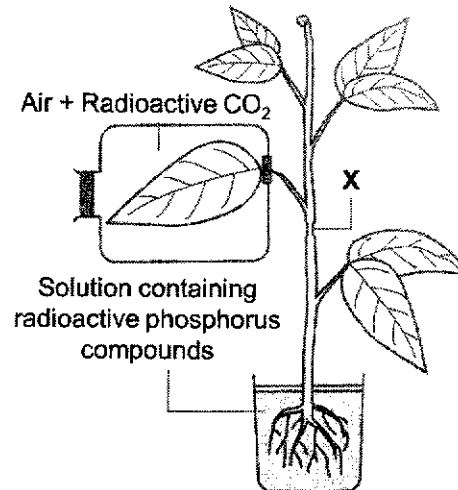
Which option shows the cross section of the stem?



- 26 Which row shows the changes in the guard cells and stomata of a typical plant under various lighting conditions?

|          | guard cells | stomata | lighting conditions |
|----------|-------------|---------|---------------------|
| <b>A</b> | flaccid     | close   | dark                |
| <b>B</b> | flaccid     | open    | light               |
| <b>C</b> | turgid      | close   | light               |
| <b>D</b> | turgid      | open    | dark                |

- 27 The diagram below shows a plant with the section **X** removed from the stem. After a few hours, the amounts of radioactive carbon and phosphorus in various parts of the plant were determined.

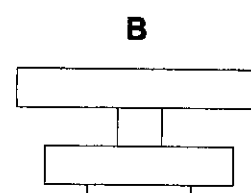
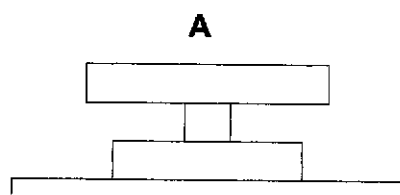


Which row shows the possible locations where radioactive carbon and phosphorus will be detected?

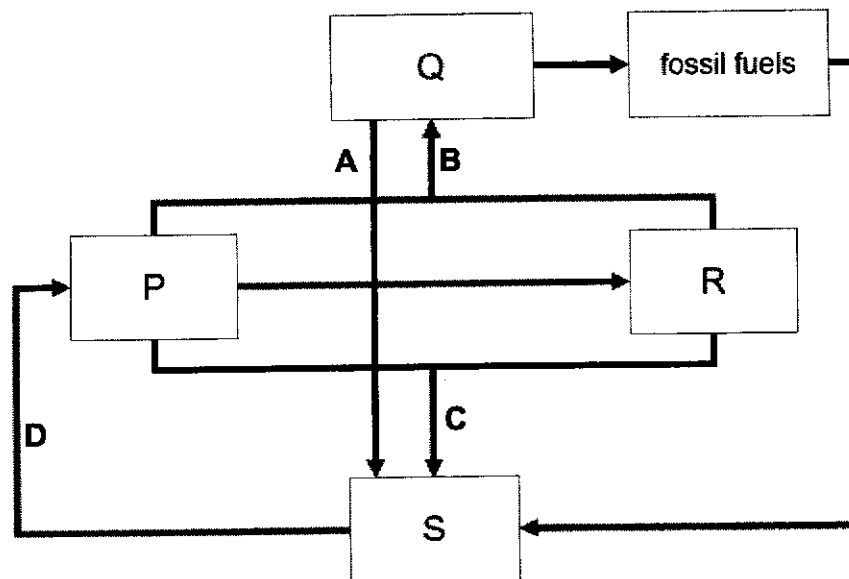
|          | radioactive carbon | radioactive phosphorus |
|----------|--------------------|------------------------|
| <b>A</b> | leaves above X     | leaves above X         |
| <b>B</b> | leaves below X     | leaves above X         |
| <b>C</b> | roots              | stem below X           |
| <b>D</b> | stem below X       | stem above X           |

- 28 Which diagram best represents the pyramid of biomass for this food chain?

grass → rabbit → wolf → flea



- 29 The diagram shows the carbon cycle.  
Which arrow represents respiration?



- 30 A scientist found that 35% of the nucleotide bases in a cell are guanine.  
What would be the expected percentage of bases which are thymine?

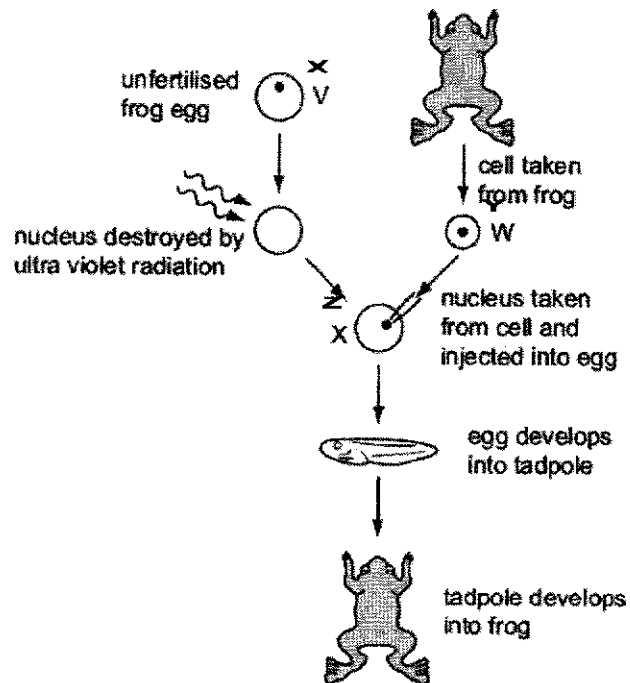
A 15%  
B 35%  
C 65%  
D 70%

- 31 What is the purpose of heat shock in genetic engineering?

A to activate the gene of interest  
B to break bonds between DNA strands

- C** to destroy the bacteria cell wall  
**D** to open up pores in the bacteria cell membrane

- 32** The diagram shows how a genetically identical frog can be developed from an unfertilised egg. The diploid number ( $2n$ ) of a frog is 26.



Which row shows the number of chromosomes at X, Y, and Z?

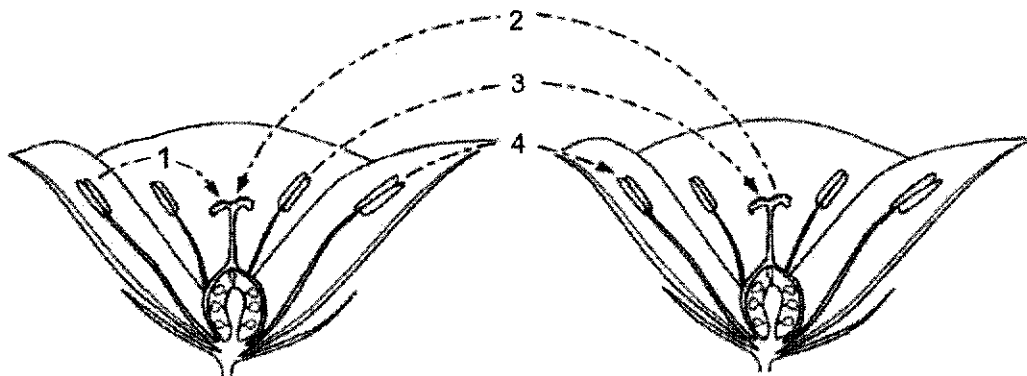
|          | X  | Y  | Z  |
|----------|----|----|----|
| <b>A</b> | 13 | 13 | 26 |
| <b>B</b> | 13 | 26 | 13 |
| <b>C</b> | 13 | 26 | 26 |
| <b>D</b> | 26 | 13 | 13 |

33 Which processes involve meiosis?

- 1 formation of zygote
- 2 production of pollen grains
- 3 production of red blood cells
- 4 production of sperm

- A 1 and 3
- B 1, 2 and 4
- C 2 and 4 only
- D 2, 3 and 4

34 The diagram shows two flowers from two different plants of the same species. Which arrow(s) show cross pollination?



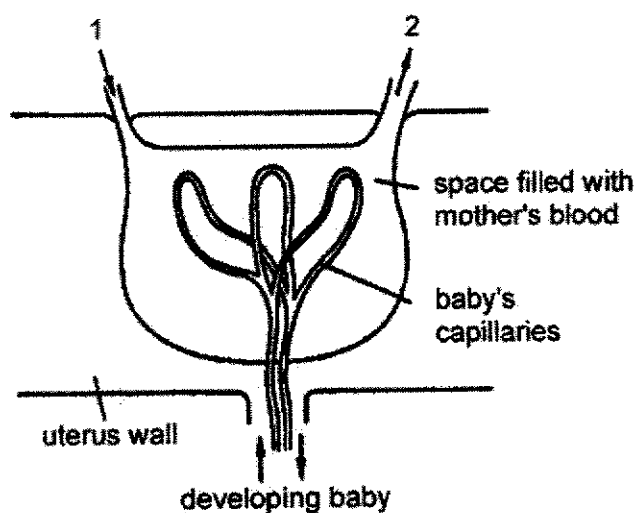
- A 1 and 2
- B 2 and 3 only
- C 2, 3 and 4
- D 3 only



35 Which row shows the characteristics of a typical insect-pollinated flower?

|          | colour | size of stigma | smell     |
|----------|--------|----------------|-----------|
| <b>A</b> | bright | large          | odourless |
| <b>B</b> | bright | small          | strong    |
| <b>C</b> | dull   | small          | odourless |
| <b>D</b> | dull   | large          | strong    |

36 The graph shows the structure of the placenta in the body of a pregnant woman.



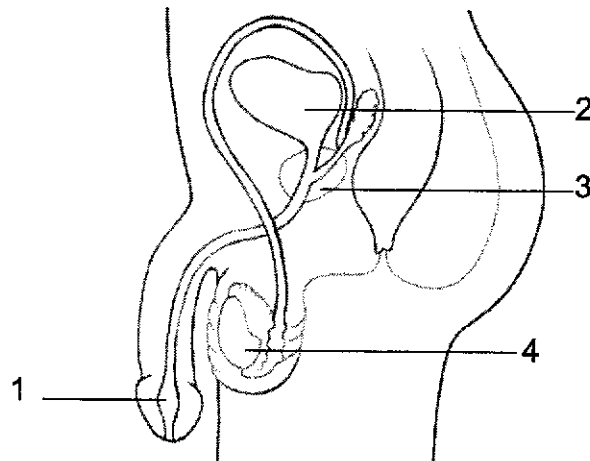
Which  
are true?

statements

- 1 The glucose concentration in 1 is higher than 2.
- 2 The mother's and baby's blood groups are always identical.
- 3 1 has a higher concentration of carbon dioxide than 2.
- 4 2 contains more urea than 1.

- A** 1 and 4 only  
**B** 1, 3 and 4  
**C** 2 and 3  
**D** 2 and 4

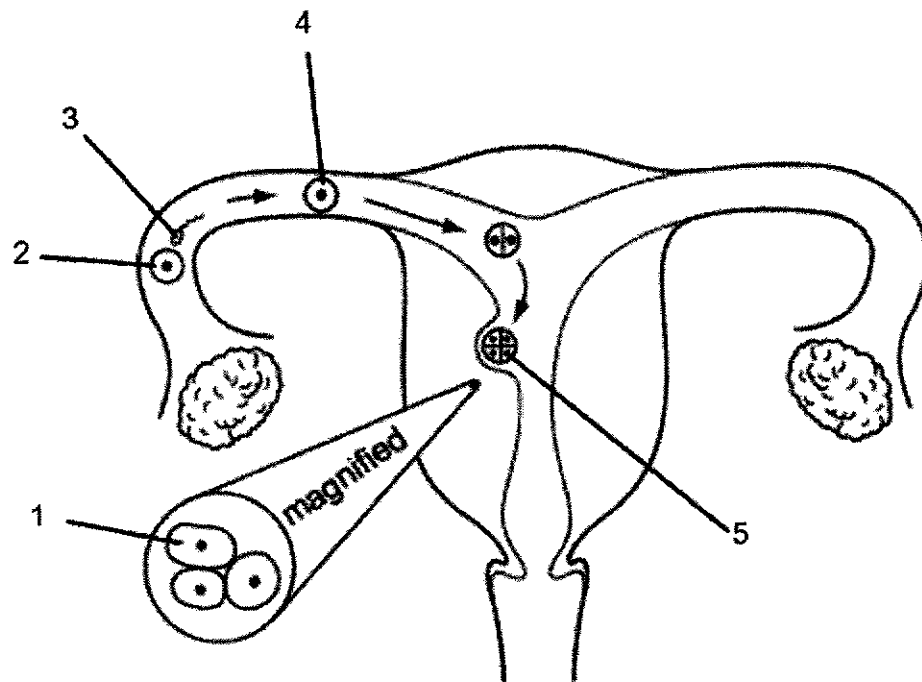
- 37 The diagram shows the male reproductive system.



Which structures are involved in semen production?

- A 1 and 3 only
- B 1, 2 and 3
- C 1, 3 and 4
- D 3 and 4 only

- 38 The diagram shows the process of fertilisation and implantation in the female reproductive system.

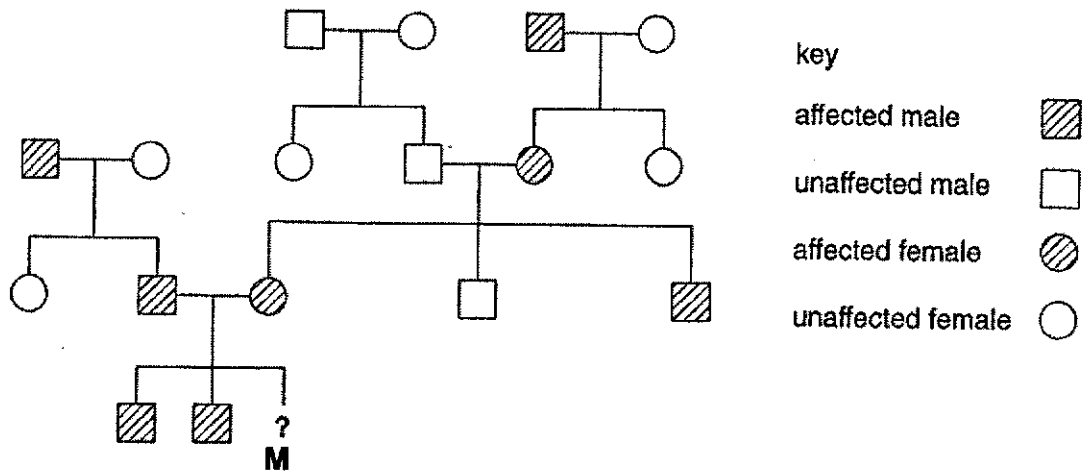


Which cells are genetically identical?

- A 1 and 2  
 B 1 and 5  
 C 2 and 3  
 D 4 and 5
- 39 Which row correctly shows examples of continuous and discontinuous variation?

|   | continuous       | discontinuous          |
|---|------------------|------------------------|
| A | blood groups     | type of earlobes       |
| B | height           | ability to roll tongue |
| C | skin colour      | foot size              |
| D | type of earlobes | sickle-cell anaemia    |

- 40 The family tree shows the individuals affected with a disease, which is a dominant condition.



What is the probability of individual **M** being an unaffected female?

- A 12.5%
- B 25%
- C 50%
- D 75%

- End of Paper -

Name: ..... ( )

**ASSUMPTION ENGLISH SCHOOL  
PRELIMINARY EXAMINATION 2024**

**BIOLOGY**

**6093 / 02**



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**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 |

**This Question Paper consists of 15 printed pages including this page.**

**[Turn over**

**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.

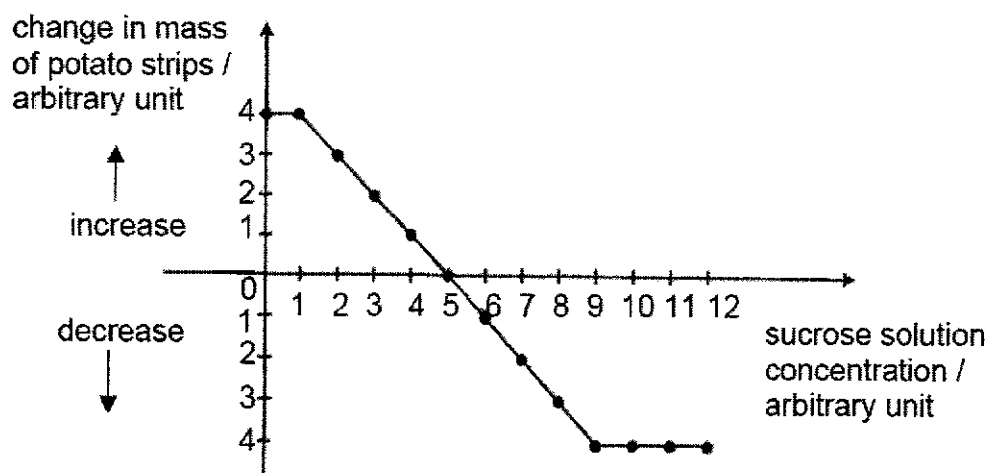


**Fig 1.1**

- (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.

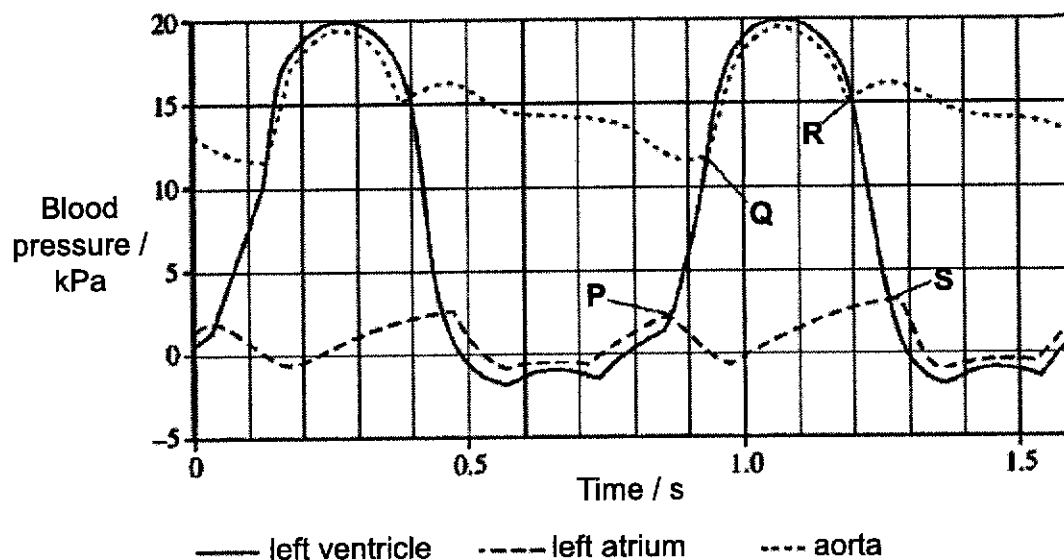


**Fig 2.1**

- (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.

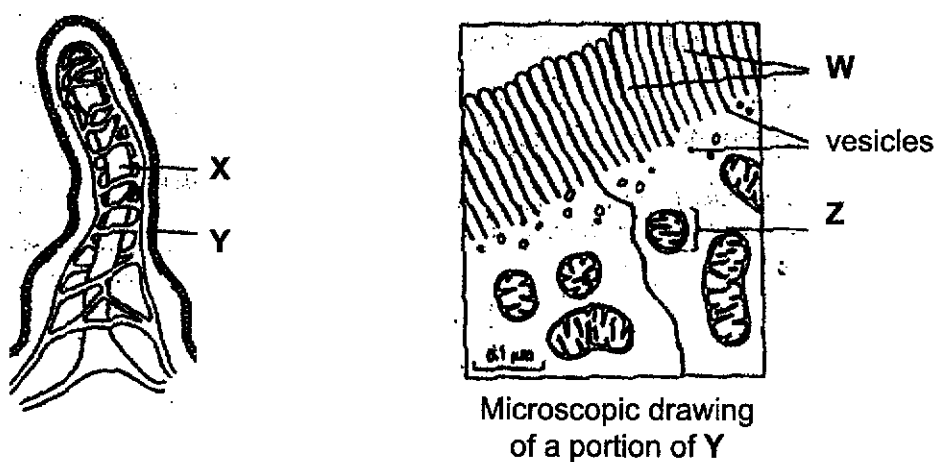


Fig 3.1

- (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.

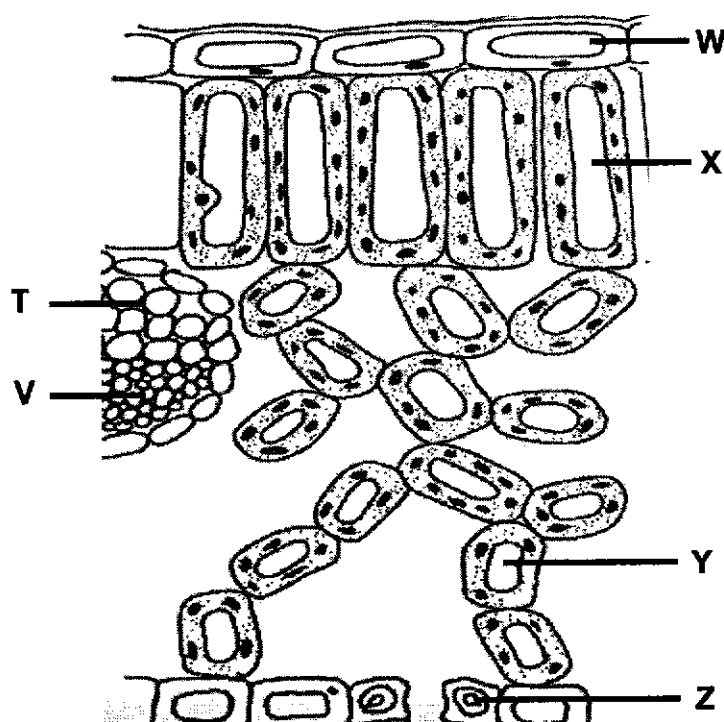


Fig 4.1

(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.

- 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.

[2]

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

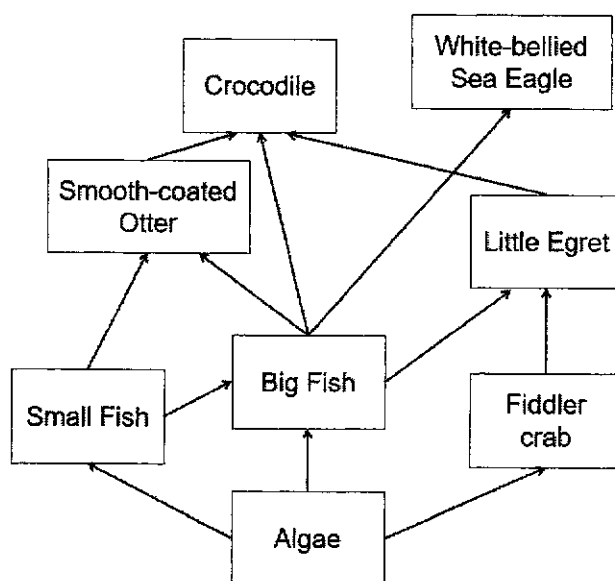


Fig 5.1

- (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.

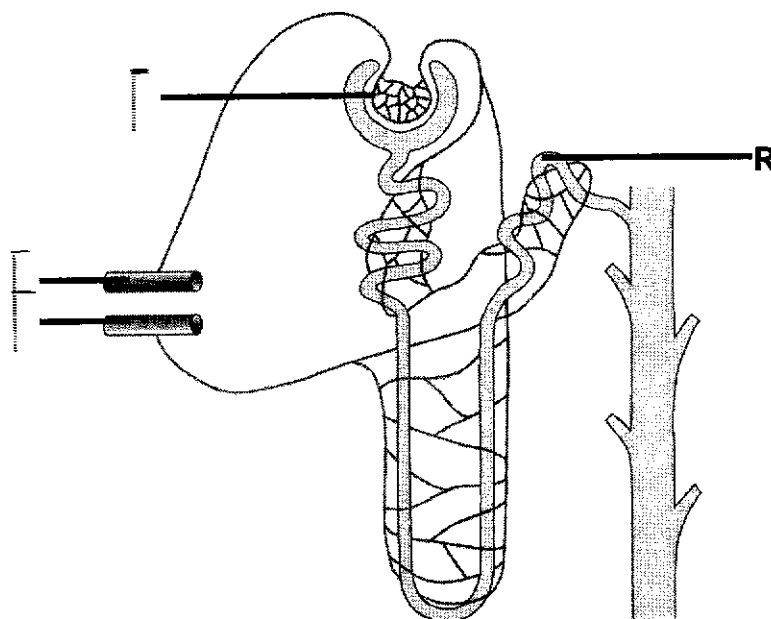


**Fig 6.1**

- (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<br>fluid / arbitrary units |
|------------------|---------------------------------------------|------------------------------------------------------|
| glucose          | 5.5                                         |                                                      |
| urea             | 4.2                                         |                                                      |
| mineral<br>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.

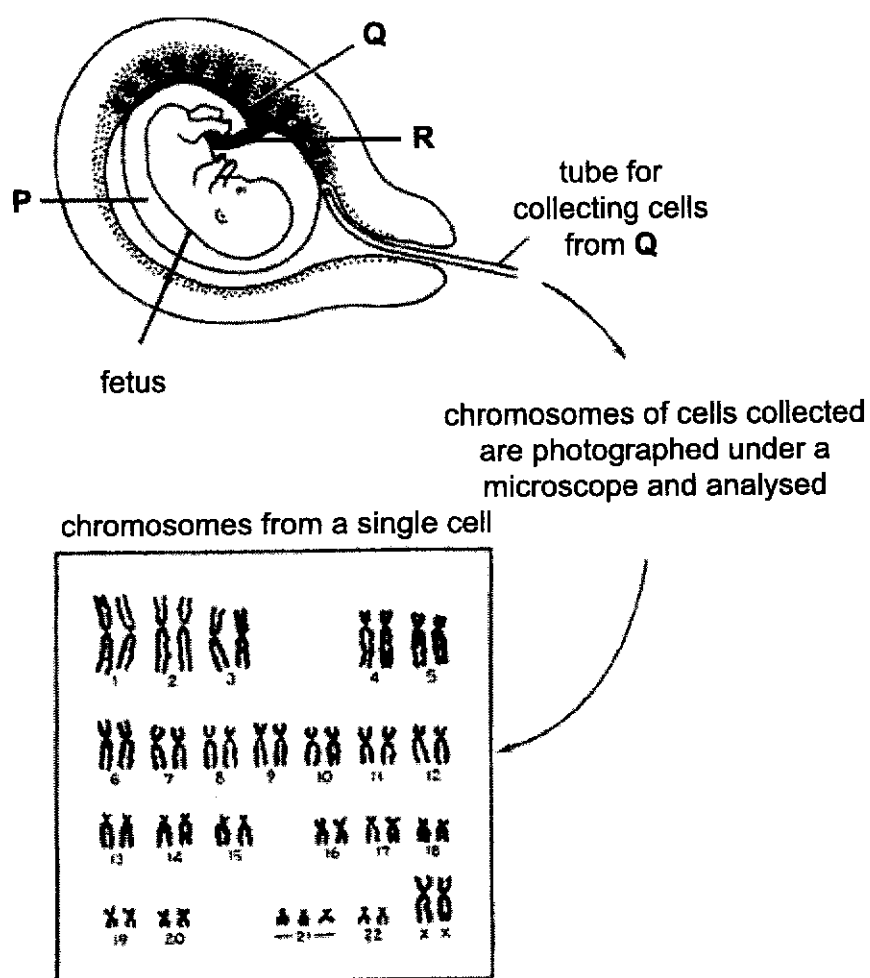


Fig 7.1

- (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.

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

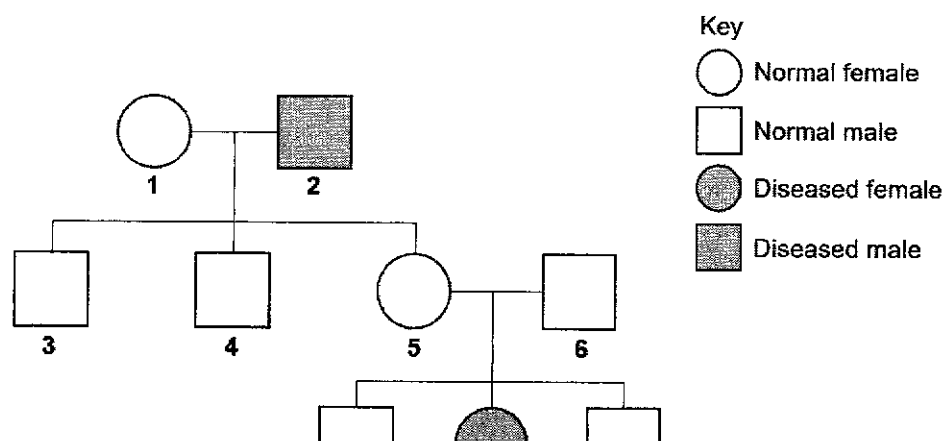
[3]

- (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.



6093/02/4E/PRELIM/24

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.

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

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

[3]

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.

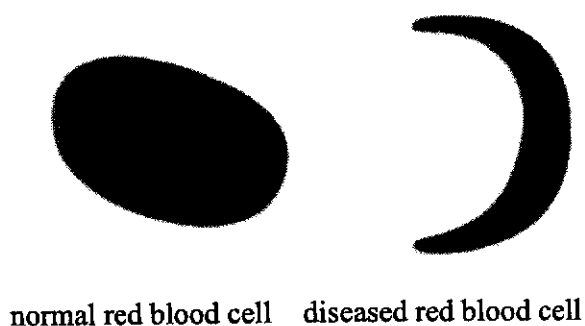


Fig 8.2

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

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.....

.....

[2]

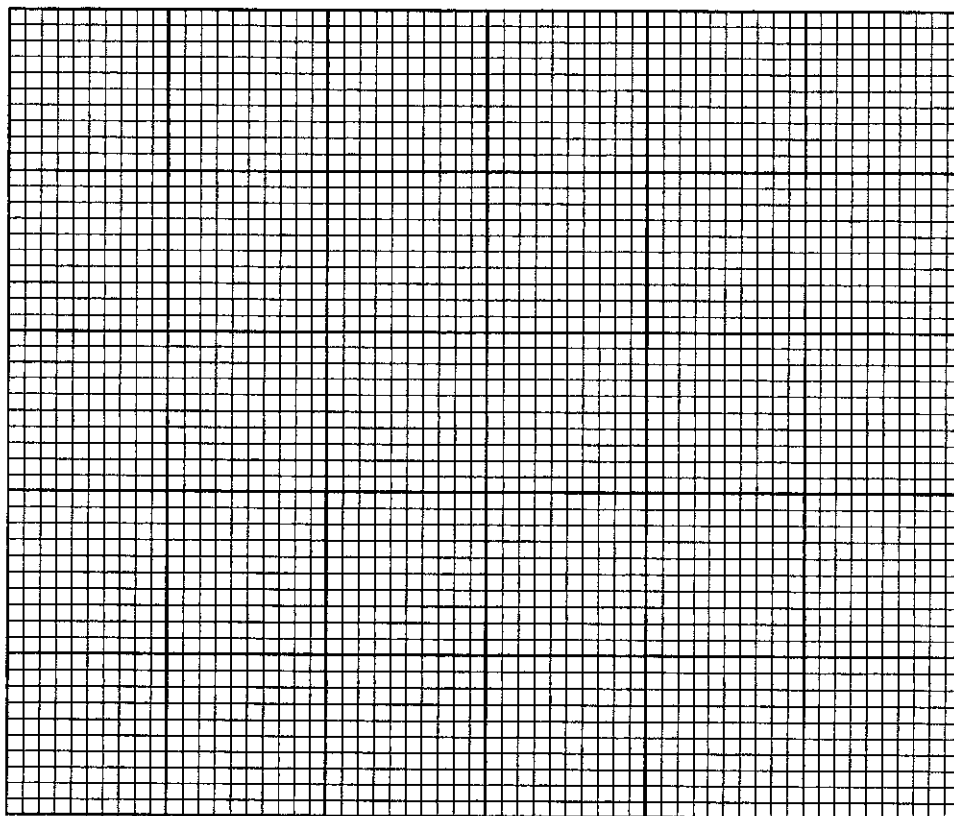
- 9 An athlete engages in strenuous physical exercise.

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.

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

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

[2]

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

[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.

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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 -

**ASSUMPTION ENGLISH SCHOOL**  
**Sec 4 Biology 6093 Marking Scheme**  
**Preliminary Examination 2024**

**Paper 1 (40 m)**

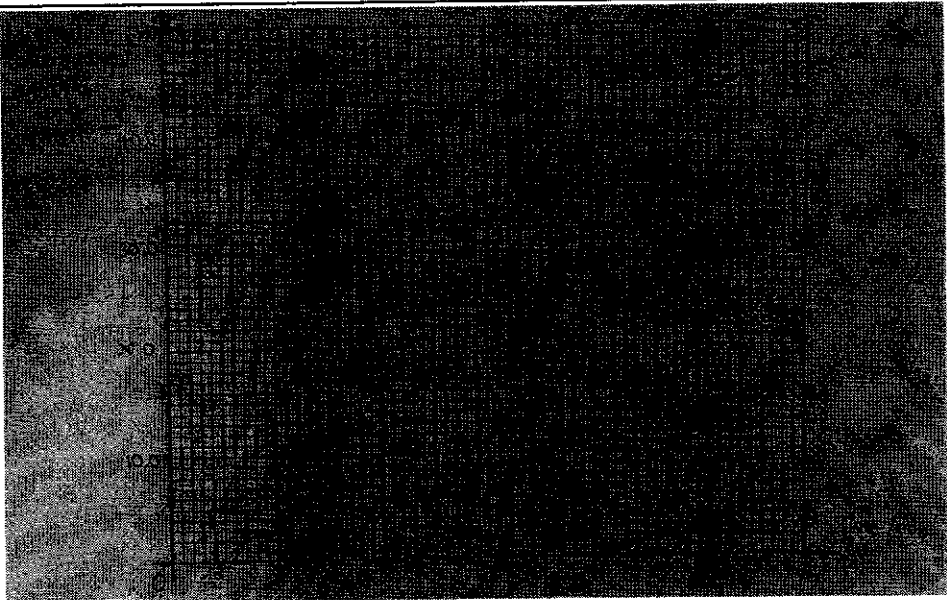
| Q1  | Q2  | Q3  | Q4  | Q5  | Q6  | Q7  | Q8  | Q9  | Q10 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| C   | A   | B   | C   | A   | D   | D   | A   | D   | C   |
| Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 |
| C   | D   | D   | A   | B   | C   | C   | D   | A   | B   |
| Q21 | Q22 | Q23 | Q24 | Q25 | Q26 | Q27 | Q28 | Q29 | Q30 |
| D   | A   | C   | D   | B   | A   | A   | D   | C   | A   |
| Q31 | Q32 | Q33 | Q34 | Q35 | Q36 | Q37 | Q38 | Q39 | Q40 |
| D   | C   | C   | D   | B   | A   | D   | D   | B   | A   |

**Paper 2 Section A (70 m)**

|   |   |                                                                                                                                                                                                                                                                                                         |   |
|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1 | a | Potato strips placed in 8 au sucrose solution had a decrease in mass of 3 au;<br>Water potential of sucrose solution is lower than that of potato strips;<br>Net movement of water molecules from potato strips to sucrose solution;<br>By osmosis<br><br>4 pts – 3m, 3 pts – 2m, 2 pts – 1m, 1 pt – 0m | 3 |
|   | b | 5 arbitrary units.<br><br>When concentration of sucrose solution is 5 au, there is no change in mass of potato strips;<br>There is no net movement of water molecules/osmosis between potato strips and sucrose solution                                                                                | 3 |
| 2 | a | Duration of 1 heartbeat = 0.8 s<br>Number of heartbeats per min = $60/0.8 = 75$<br><br>Working – 1m, Ans – 1m<br>1m for deriving answer from 1 heartbeat = 0.85 s                                                                                                                                       | 2 |
|   | b | R<br>S<br>P<br><br>3 pts – 2m, 2 pts – 1m, 1 pt – 0m                                                                                                                                                                                                                                                    | 2 |
|   | c | At Q, blood pressure of the left ventricle becomes higher than in the aorta.<br>Semilunar/aortic valve opens<br>Blood enters the aorta and blood pressure in the aorta increases.<br><br>3 pts – 2m, 2 pts – 1m, 1 pt – 0m <i>Changes in pressure</i>                                                   | 2 |
| 3 | a | Microvilli<br>Lacteal                                                                                                                                                                                                                                                                                   | 2 |

|   |      |                                                                                                                                                                                                                                                                                                                                                                         |   |
|---|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | b    | X transports <b>fats</b> .<br>*1m given for fatty acids and glycerol                                                                                                                                                                                                                                                                                                    | 1 |
|   | ci   | W <b>increases surface area to volume ratio</b> of the epithelial cells to <b>increase rate of absorption</b> of nutrients.                                                                                                                                                                                                                                             | 1 |
|   | cii  | Y is <b>one cell thick</b> to <b>reduce distance</b> for nutrients to pass through to enter the blood capillary/lacteal.                                                                                                                                                                                                                                                | 1 |
|   | ciii | Z <b>releases energy</b> for <b>absorption of nutrients by active transport</b>                                                                                                                                                                                                                                                                                         | 1 |
|   |      |                                                                                                                                                                                                                                                                                                                                                                         |   |
| 4 | a    | X<br>T                                                                                                                                                                                                                                                                                                                                                                  | 2 |
|   | b    | Carbon dioxide <b>diffuses</b> into intercellular air spaces through stomata;<br>Carbon dioxide <b>dissolves</b> into thin film of moisture;<br>Dissolved carbon dioxide <b>diffuses</b> into spongy mesophyll cells.<br><br>No mention of diffusion, dissolving = 0m                                                                                                   | 3 |
|   | c    | Both have cell wall/nucleus/mitochondria etc.<br>Cell X has chloroplasts, while root hair cells do not.<br>Cell X has a regular shape, while root hair cells have long and narrow root hair protruding out.<br><br>Minimum 1 similarity or 1 difference. 3 pts – 2m, 2 pts – 1m, 1 pt – 0m.<br>All comparisons lumped together – Must fulfil above criteria, and max 1m | 2 |
|   |      |                                                                                                                                                                                                                                                                                                                                                                         |   |
| 5 | a    | Big fish - Primary consumer, Secondary consumer<br>Crocodile – Secondary consumer, Tertiary consumer<br>Smooth-coated otter – Secondary consumer, Tertiary consumer<br>Accept any other suitable answer.<br><br>No mention of the word 'consumer' – 1m if all correct. 0m for any mistakes.<br>Trophic level 1, 2, 3, 4 etc. – 0m                                       | 2 |
|   | b    | At each trophic level, around 90% of energy is lost<br>As heat through respiration, through metabolic processes, and as chemical energy through waste products (at least 2)<br>Moving up each trophic level, there will be insufficient energy to support a long food chain more than 4 trophic levels.                                                                 | 3 |
|   | c    | Fiddler crabs are also <b>decomposers</b><br>Fig 5.1 does not show the <b>transfer of energy from the other organisms</b> in the food web to the fiddler crabs upon their death.<br><br>Alternative answers:<br>The organisms in Fig 5.1 can get their energy from other food sources not shown in the diagram – 2m                                                     | 2 |
|   |      |                                                                                                                                                                                                                                                                                                                                                                         |   |
| 6 | a    | Branch of the renal artery<br>Distal convoluted tubule                                                                                                                                                                                                                                                                                                                  | 2 |
|   | b    | P does not have valves, Q has valves;<br>P has thicker, more muscular walls than Q<br>P has a smaller lumen than Q                                                                                                                                                                                                                                                      | 2 |
|   | ci   | The <b>partially permeable basement membrane</b> of glomerulus is <b>damaged/pores become larger/more permeable</b> ;<br>It allows <b>larger molecules</b> such as proteins to <b>pass through</b> into the glomerular filtrate.<br>S is affected (stated in the question already) – 0m<br>Prevent S from working (how?) – 0m                                           | 2 |

|               | cii                                      | Platelets, Red blood cells, White blood cells, hormones (any two)                                                                                                                                                                                                                                                                                    | 2         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|---------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------------------|---------------------------------------------------|---------|-----|-----|------|-----|---|---------------|------|------|---|
|               | ciii                                     | <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> <p>3 pts – 2m, 2 pts – 1m, 1 pt – 0m</p> | substance | concentration in blood / arbitrary units | concentration in dialysis fluid / arbitrary units | glucose | 5.5 | 5.5 | urea | 4.2 | 0 | mineral salts | 35.6 | 35.6 | 2 |
| substance     | concentration in blood / arbitrary units | concentration in dialysis fluid / arbitrary units                                                                                                                                                                                                                                                                                                    |           |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
| glucose       | 5.5                                      | 5.5                                                                                                                                                                                                                                                                                                                                                  |           |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
| urea          | 4.2                                      | 0                                                                                                                                                                                                                                                                                                                                                    |           |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
| mineral salts | 35.6                                     | 35.6                                                                                                                                                                                                                                                                                                                                                 |           |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
| 7             | a                                        | P: Amniotic fluid<br>R: Umbilical cord<br><br>Umbilical artery/vein accepted.                                                                                                                                                                                                                                                                        | 2         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|               | bi                                       | Cushions and protects fetus from physical injury                                                                                                                                                                                                                                                                                                     | 1         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|               | bii                                      | The fetus will die<br>Carbon dioxide and waste products cannot be transferred from fetus to placenta.<br>Oxygen and food substances cannot be transferred from placenta to fetus.                                                                                                                                                                    | 3         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|               | c                                        | Down syndrome<br>Fetus has an extra copy of chromosome 21                                                                                                                                                                                                                                                                                            | 2         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
| 8             | a                                        | 5 and 6 are Aa.<br>8 is aa, so it must inherit 1 copy of sickle cell allele from each parent.<br>5 and 6 are normal/not diseased, so they must be heterozygous.<br><br>5 is Aa because mother is either Aa or AA, and father is aa (does not explain why 6 is Aa) – 1m<br><br>Usage of wrong symbols (Not A and a) – 1m deducted                     | 3         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|               | b                                        | 50%<br><br>Answer – 1<br>Labels – 1<br>Content of diagram – 1                                                                                                                                                                                                                                                                                        | 3         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |
|               | c                                        | Carry less haemoglobin and transport less oxygen OR<br>Can get stuck in blood vessels and block bloodflow<br><br>Less oxygen available for aerobic respiration for release of energy for muscle contractions. OR<br>Fainting/sudden pains/death                                                                                                      | 2         |                                          |                                                   |         |     |     |      |     |   |               |      |      |   |

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

**Paper 2 Section B (10 m)**

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

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