OCR
Oxford Cambridge and RSA

Wednesday 7 June 2023 – Afternoon

A Level Biology A

H420/01 Biological processes

Time allowed: 2 hours 15 minutes

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **36** pages.

ADVICE
- Read each question carefully before you start your answer.

Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 Which description of biological molecules is correct?

A DNA and RNA are both polymers of nucleotides.

B Hydrolysis of sucrose produces fructose and β-glucose.

C Proteins are polymers of amino acids and are broken down in condensation reactions.

D Starch is a polymer of the monosaccharide maltose.

Your answer ☐ **[1]**

2 Which statement about lipids is correct?

A Phospholipids are formed by esterification of glycerol with three molecules of fatty acid.

B Phospholipids containing unsaturated fatty acids can increase the fluidity of cell membranes.

C Triglycerides are good energy stores although they release less energy than an equal mass of polysaccharide.

D Triglycerides form the bilayer of the plasma membrane.

Your answer ☐ **[1]**

3 Which statement about the structure of amino acids is **not** true?

A Amino acids contain amino and carboxyl groups.

B Amino acids contain the elements hydrogen, carbon and oxygen only.

C Each amino acid has a unique R group.

D The R groups in amino acids can be polar or non-polar.

Your answer ☐ **[1]**

4 Which of the options is a feature of collagen?

A It allows alveoli to recoil

B It dissolves in water

C It is flexible

D It is the main protein found in hair

Your answer ☐ **[1]**

5 Increasing the pH of an enzyme solution from 7.4 to 8.0 causes the rate of the reaction to fall by 90%. When the pH of the solution returns to 7.4 the rate of reaction returns to its original value.

Which of the statements about this enzyme-controlled reaction explains these observations?

A Increasing the pH from 7.4 to 8.0 breaks hydrogen bonds but returning the pH to 7.4 allows them to re-form.

B Increasing the pH from 7.4 to 8.0 changes the shape of the active site and so the substrate binds more tightly.

C Increasing the pH from 7.4 to 8.0 denatures the enzyme.

D Reducing the pH below 7.4 will reduce the rate of reaction.

Your answer ☐ **[1]**

6 Which of the options describes movement of water through a plant?

A The Casparian strip forces water to enter the cytoplasm before it can enter the xylem.

B Water can move across the root by the apoplast pathway because of plasmodesmata between cells.

C Water is drawn up the xylem because of adhesion between water molecules.

D Water moves by osmosis from a low water potential to a high water potential.

Your answer ☐ **[1]**

7 Which of the statements about the heart is correct?

A Contraction of the ventricles is known as ventricular systole.

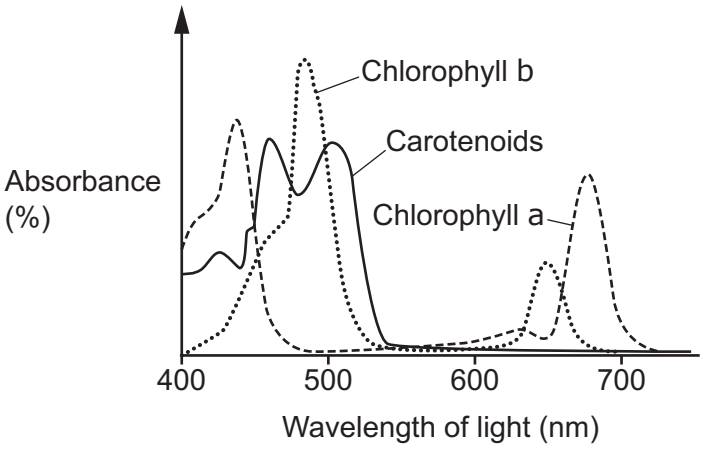
B Deoxygenated blood enters the heart by the pulmonary vein.

C The pressure in the ventricles is always greater than in the atria because of the thicker ventricle wall.

D The wall of the left ventricle is less thick because it only has to pump blood to the lungs.

Your answer ☐ **[1]**

8 The diagram shows the absorption spectra of different photosynthetic pigments.



Which of the statements about the absorption spectra shown in the diagram is **not** correct?

A Absorption of light energy by accessory pigments such as chlorophyll b and carotenoids increases the efficiency of light harvesting.

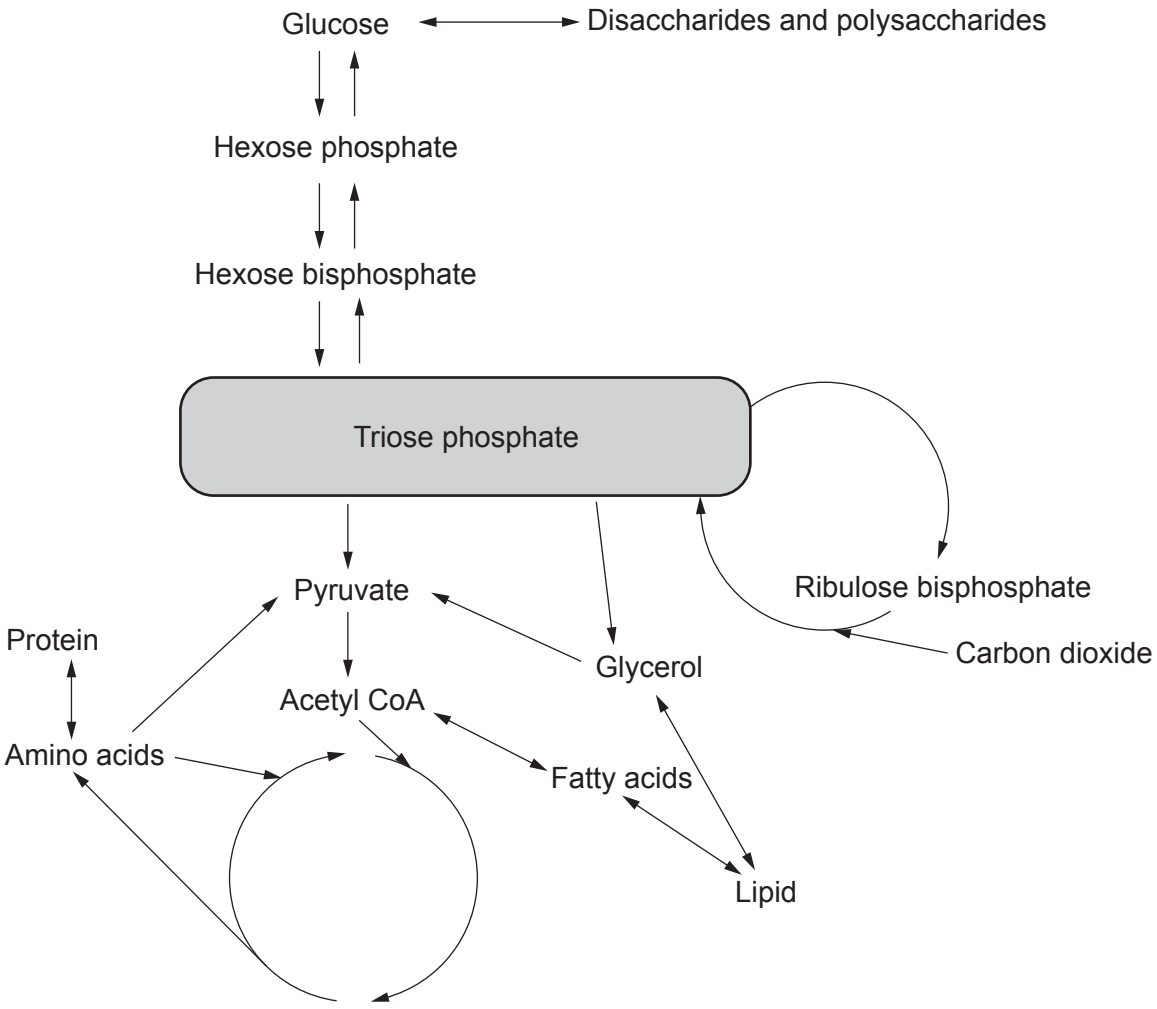
B Chlorophyll a absorbs red light but not blue light and chlorophyll b absorbs blue light but not red light.

C Chlorophyll b and carotenoids are described as accessory pigments because they are not involved directly in the light dependent reaction of photosynthesis.

D The absorption spectra explain why plants appear green because they absorb red and blue wavelengths of light.

Your answer ☐ **[1]**

9 The diagram shows some of the reactions that take place in a leaf cell in a flowering plant.



Which of the following statements about triose phosphate is/are correct?

1 Six turns of the Calvin cycle produces 6 molecules of triose phosphate.
2 Triose phosphate from the Calvin cycle can be recycled to ribulose bisphosphate.
3 Triose phosphate from the Calvin cycle can be used to make cellulose, lipids and proteins.

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

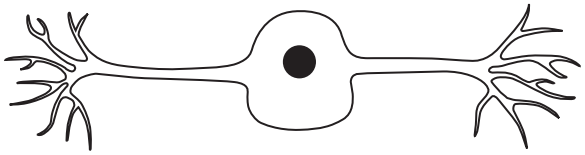
C Only 2 and 3 are correct

D Only 1 is correct

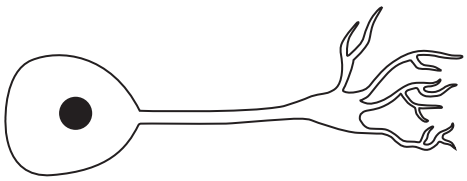
Your answer ☐ **[1]**

10 Which of the diagrams shows a neurone that connects to an effector?

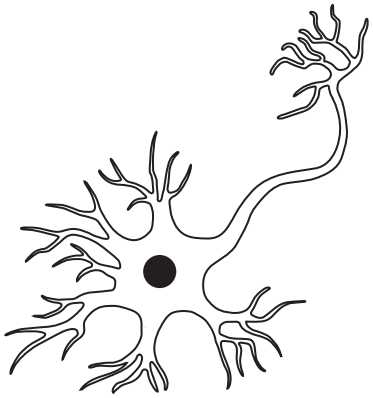
A



B



C



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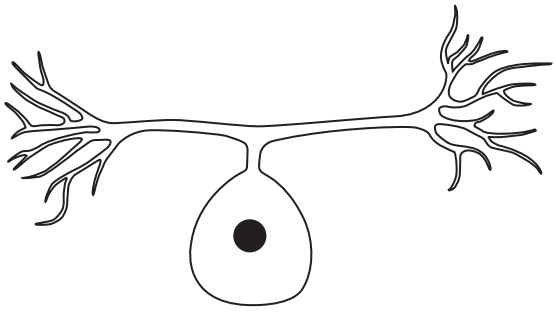
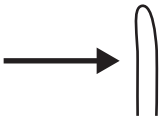
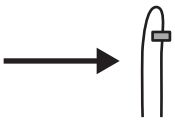
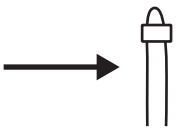


Your answer ☐ **[1]**

11 In a phototropism investigation oat seedlings were illuminated from one side as shown by the arrow in the table. The table shows the results of four different experiments.

Experiment	Method	Result
1		
2	 Shoot tip covered with lightproof cap	
3	 Impermeable sheet inserted on shaded side	
4	 Shoot tip removed and replaced on top of a permeable agar block	

Which option correctly explains the experimental results?

A Experiment 1 shows that auxin increases cell division on the shaded side.

B Experiments 1 and 2 show that photoreceptors are in the tip of the seedlings.

C Experiments 1, 3 and 4 show that electrical signals control stem elongation.

D Experiments 1, 3 and 4 show that soluble inhibitors of elongation move down the illuminated side.

Your answer ☐ **[1]**

12 Which of the statements about communication systems is correct?

A Cell signalling acts only over short distances.

B Communication systems are required to coordinate responses and maintain a near-constant internal environment.

C Effectors that respond to hormones do not respond to nervous stimulation.

D Plants do not require communication systems because, unlike animals, they do not respond to their environments.

Your answer ☐ **[1]**

13 The Pacinian corpuscle is a type of sensory receptor that detects pressure.

Which of the options describes the action of a Pacinian corpuscle?

A A strong stimulus at a Pacinian corpuscle produces a generator potential that exceeds a threshold value.

B A strong stimulus at a Pacinian corpuscle produces a larger action potential.

C Pressure on the Pacinian corpuscle causes the neurone membrane to become less permeable to sodium ions.

D The Pacinian corpuscle is a transducer that converts pressure into chemical energy.

Your answer ☐ **[1]**

Use the following information to answer questions **14** and **15**.

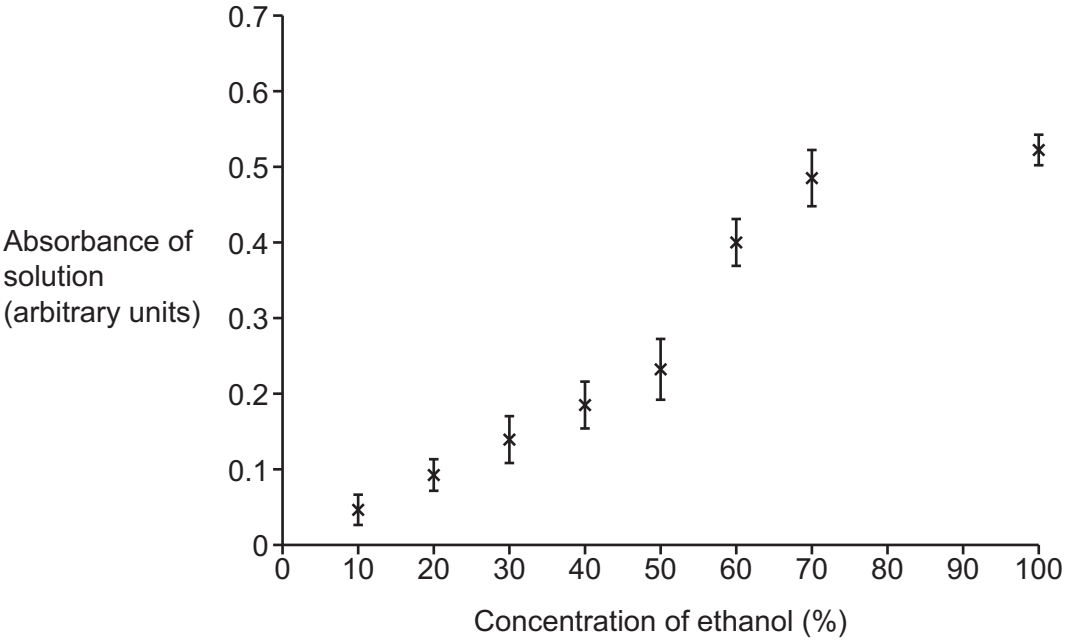
Beetroot cell vacuoles contain a red pigment.

Some students are investigating the effect of ethanol on the permeability of plant cell membranes.

This is the method that they use:

- Soak identical pieces of beetroot for 30 minutes in different concentrations of ethanol.
- After 30 minutes, measure the redness of the ethanol solution using a colorimeter.

The graph shows the students' results. Each data point shows the mean ± 2 standard deviations.



14 One student made the following observations:

1 Ethanol disrupts the cell membranes leading to increased permeability.
2 The permeability of the cell membranes is proportional to concentration of ethanol between 0% and 50% ethanol.
3 The cell membranes are completely disrupted in 60% ethanol.

Which observation(s) is / are correct?

A 1, 2 and 3 are correct

B Only 1 and 2 are correct

C Only 2 and 3 are correct

D Only 1 is correct

Your answer ☐ **[1]**

15 The students were asked to decide whether the permeability of the membrane is significantly greater with 50% ethanol compared to 40% ethanol.

Which statistical test should they use?

A Chi squared (χ^2)

B Spearman's rank correlation coefficient

C Standard deviation

D *t*-test

Your answer ☐ **[1]**

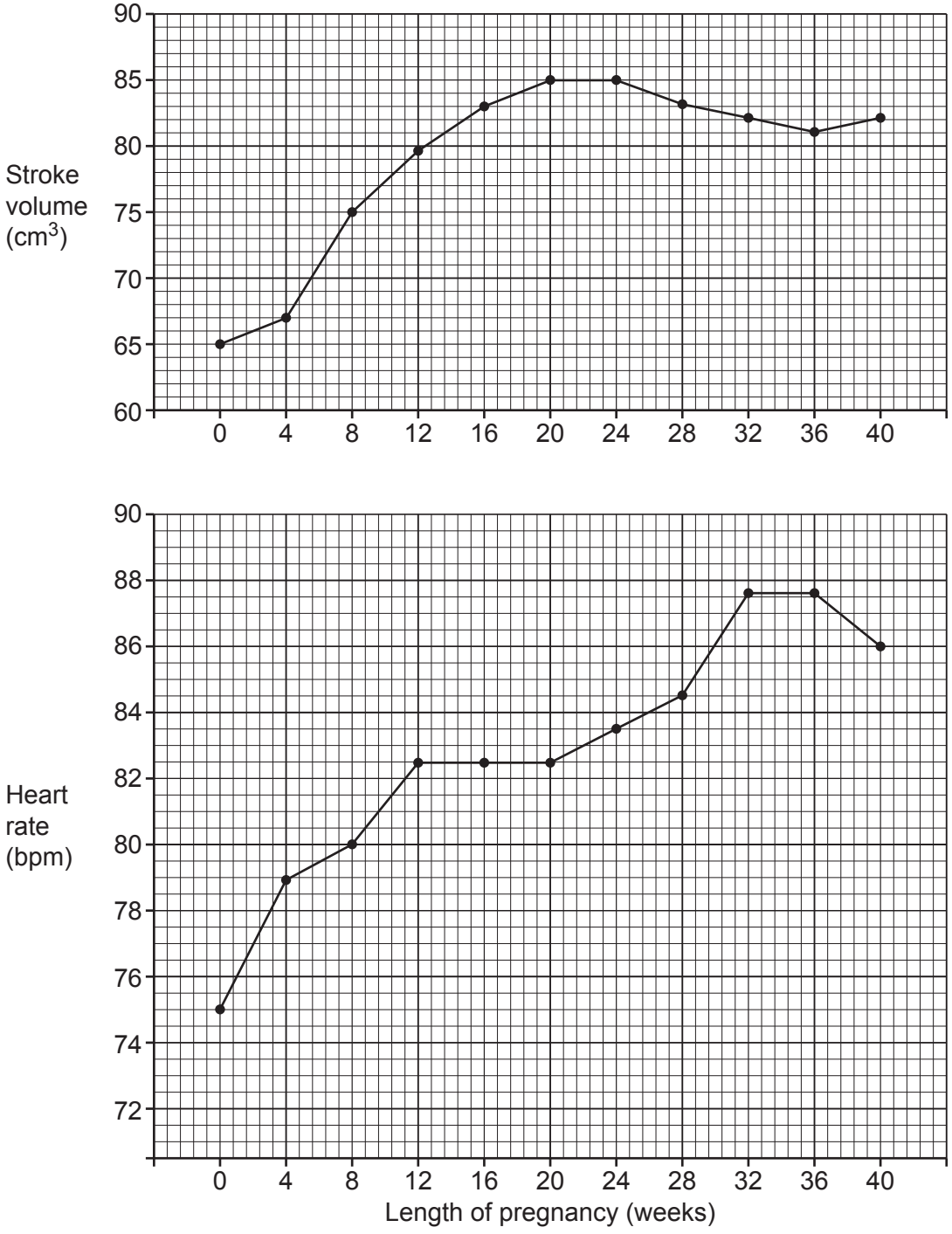
Section B

16 During pregnancy the mother's body undergoes several physiological changes to support the developing fetus. These changes affect every organ system in the body.

(a) Changes to the heart and circulatory system begin in the first few weeks of pregnancy.

Fig. 16.1 shows the changes in stroke volume and heart rate that occur during pregnancy.

Fig. 16.1



(i) Use the data in **Fig. 16.1** to calculate the cardiac output in week 20.

Cardiac output = ... Unit ..... **[3]**

(ii) Suggest an advantage of the increase in cardiac output.

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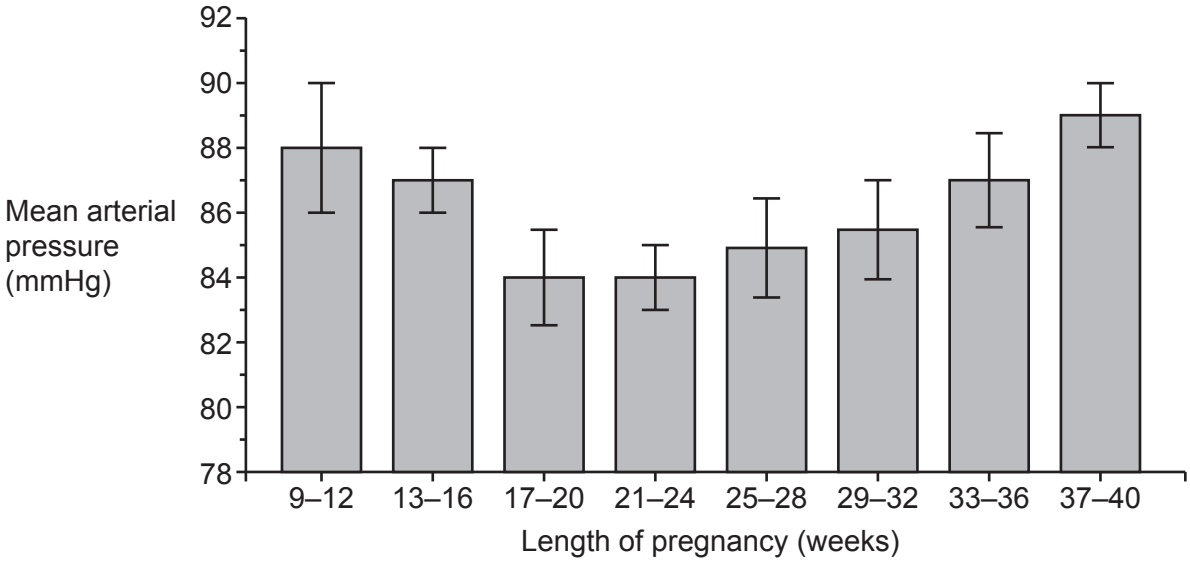
(iii) **Fig. 16.2** shows how blood pressure varies throughout pregnancy.

Fig. 16.2



A student looked at the data in **Fig. 16.1** and **Fig. 16.2** and drew the following conclusion:

'As cardiac output increased blood pressure dropped so there must have been a decrease in vascular resistance.'

Evaluate this conclusion.

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(b)* Describe the flow of blood through the **left** side of the heart during the cardiac cycle **and** explain the role of valves and pressure differences in this process.

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Additional answer space if required.

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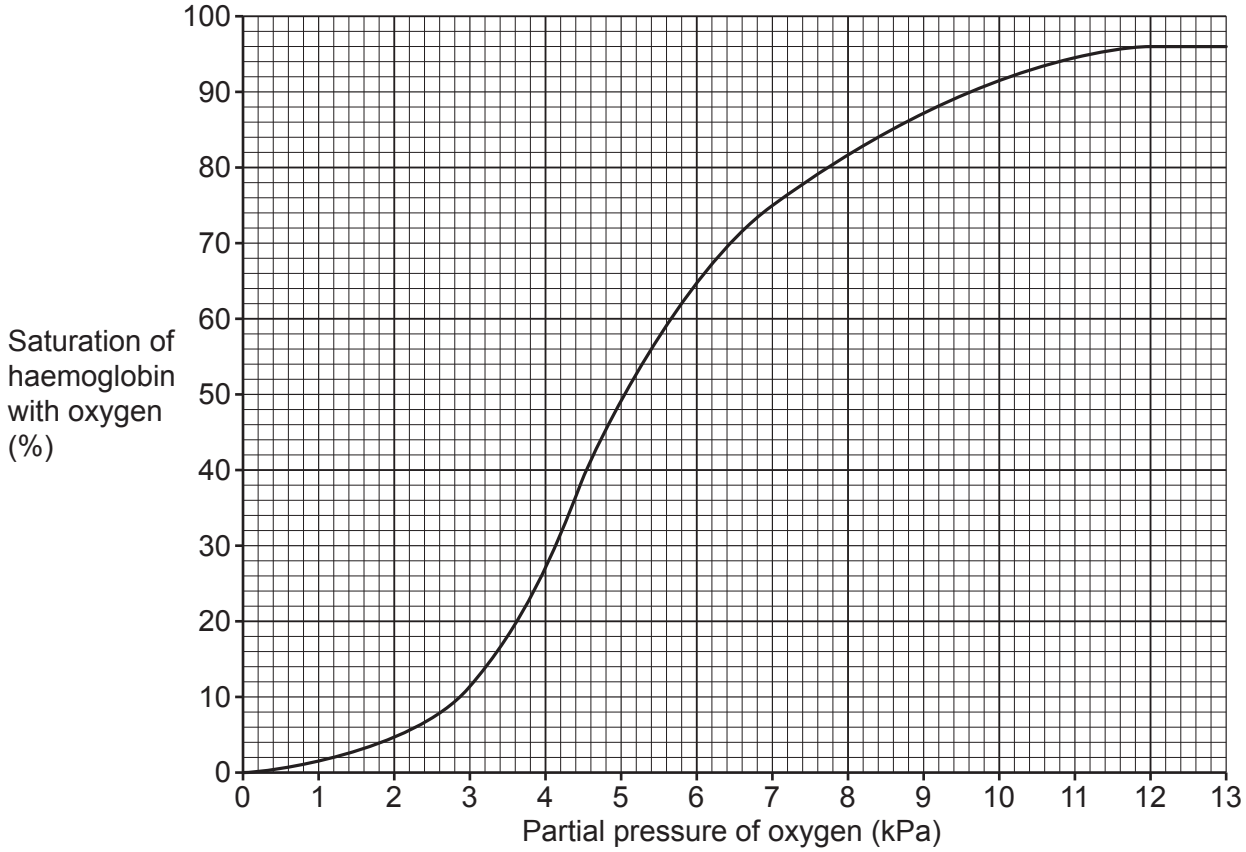
(c) Another change that occurs in pregnancy is an increase in oxygen uptake by the mother. This is partly due to an increase in the mother's metabolic rate and partly to supply the developing fetus.

Fig. 16.3 shows the oxygen dissociation curve for the mother's haemoglobin.

Fig. 16.3



(i) Sketch the oxygen dissociation curve for fetal haemoglobin.

Answer on **Fig. 16.3**. **[1]**

(ii) Explain how the different affinities of maternal and fetal haemoglobin enable transfer of oxygen from the maternal circulation to the fetus.

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(d) Changes to kidney function during pregnancy can be confused with some diseases, such as chronic kidney disease or kidney failure.

The estimated glomerular filtration rate (eGFR) in a healthy 30–39-year-old is 107 $cm^3 min^{-1}$. The eGFR usually decreases with age but in pregnancy, can increase by between 50 and 85%.

The table shows the results of some of the physiological measurements that a clinic carried out on two 35-year-old women. One of the patients was pregnant.

Measurement	Patient A	Patient B
eGFR ($cm^3 min^{-1}$)	162	35
Blood glucose concentration	Normal	Slightly high
Urine glucose concentration	Moderately high	Slightly high
Urine protein concentration	Slightly high	Very high
Blood electrolytes Na^+, K^+, Cl^-	Normal	High

A doctor concluded that patient A was undergoing a normal pregnancy whereas patient B was suffering from kidney failure.

Explain the doctor's conclusion.

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..... **[4]**

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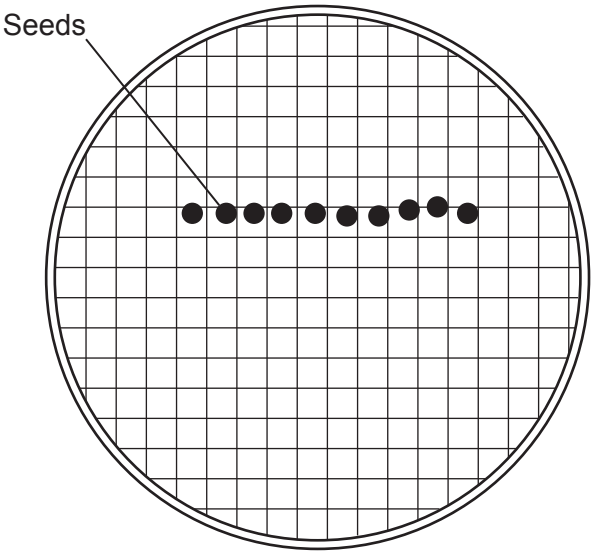
17 Some students investigate the effect of IAA (auxin) concentration on the growth of roots and shoots in mustard seedlings.

This is the method that they use with 8 different concentrations of IAA:

- Place a filter paper on a bed of cotton wool in the Petri dish and soak it with IAA solution.
- Place 10 seeds in a horizontal line on the damp filter paper.
- Cover with a lid that has a grid marked on it, as shown in the diagram.
- Repeat this process with each different concentration of IAA.
- Add distilled water to one Petri dish in place of IAA solution.
- Place the Petri dishes vertically in a warm dark place for 2 to 3 days until the seeds have germinated and the roots and shoots have started to grow.
- Measure the length of the shoots and roots by counting the number of grid squares the shoot or root covers.



(a) (i) Explain why the Petri dishes were placed vertically and in the dark.

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(ii) Explain the purpose of the Petri dish containing distilled water instead of IAA solution.

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(b) One of the students recorded the result shown in **Table 17.1**.

Table 17.1

Mean root length in test solution (number of grid squares)	Mean root length in water (number of grid squares)
16.5	13.9

Calculate the percentage change in mean root length in test solution compared with water.

Give your answer to **2** significant figures.

Change = ... % **[2]**

(c) One student's results are shown in **Table 17.2**.

The results have been rounded to the nearest 5%.

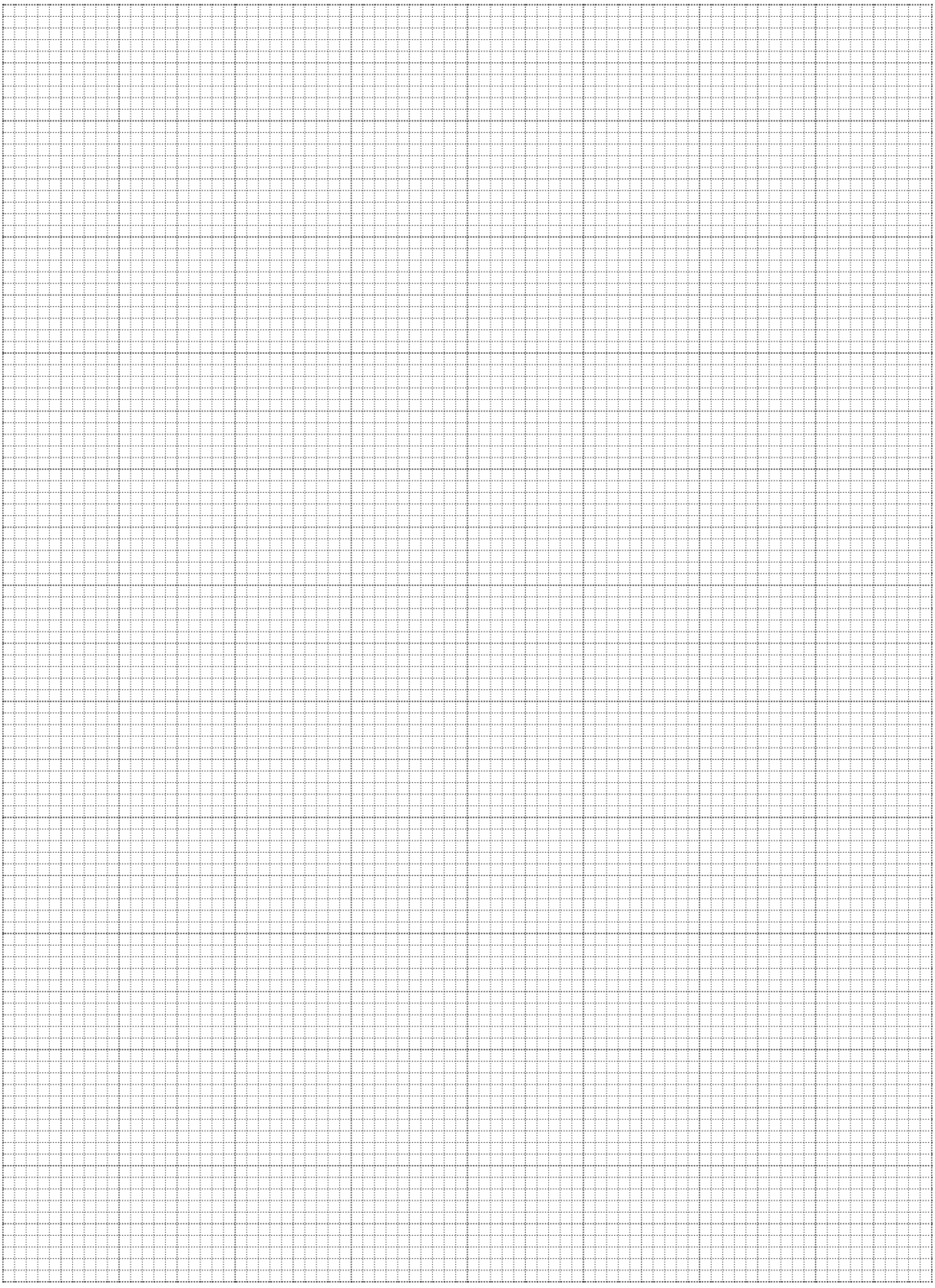
Positive values represent increased growth and negative values represent decreased growth.

The concentration of IAA was measured in parts per million (ppm).

Table 17.2

Concentration of IAA (ppm)	% change in length	
	Root	Shoot
1×10^{2}	–100	0
1×10^{1}	–100	+200
1×10^{0}	–75	+140
1×10^{-1}	–45	+70
1×10^{-2}	+25	+30
1×10^{-3}	+65	+10
1×10^{-4}	+70	0
1×10^{-5}	+55	0

(i) Plot a graph of the data in **Table 17.2**. **[4]**



(ii) The students were given an IAA solution of concentration 100 ppm.

Outline a procedure the students could use to prepare the 8 test solutions required for the experiment.

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(iii) Describe **two** precautions the students should take to make sure the concentrations of the solutions they prepare are accurate.

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[2]

(iv) Suggest why the range of IAA concentrations could be described as logarithmic.

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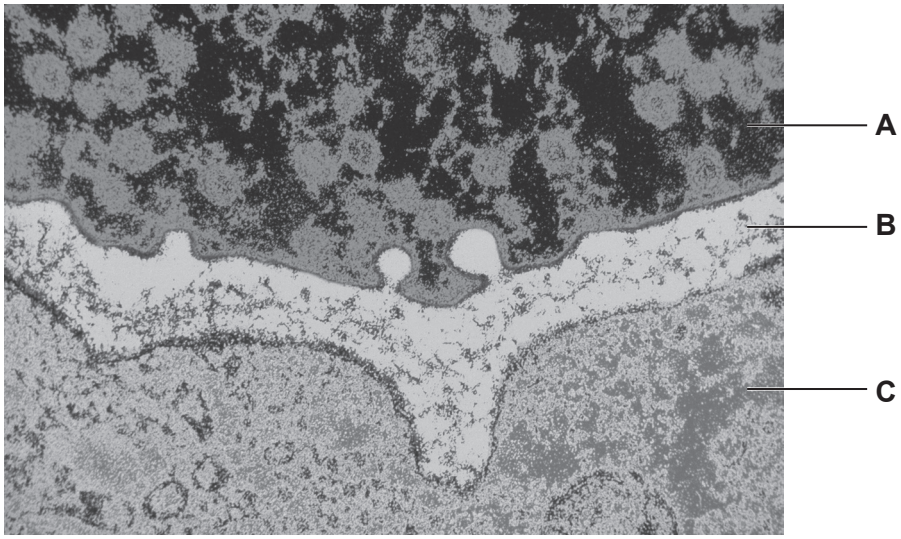
18 (a) The electron micrograph shows the junction between two neurones.



(i) State the name given to the region labelled **B**.

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(ii) Identify whether structure **A** or structure **C** is the first neurone in the pathway.

Use **one** piece of evidence visible in the electron micrograph to explain your choice.

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(iii) Complete the sentences about the action potential.

The action potential involves rapid opening of voltage-gated sodium ion channels.

This is an example of ..... feedback. During the action potential, the inside of the neurone becomes more positive than the outside. This is known as ..... of the membrane.

[2]

(b) Mutations in genes coding for proteins in the cytoskeleton have been associated with several diseases of the nervous system, including neurodegenerative disorders.

(i) Give **three** functions of the cytoskeleton.

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[3]

(ii) Suggest how a mutation in cytoskeleton genes could cause a disease of the nervous system.

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19 (a) Which statements about excretion and homeostasis are true, and which are false?

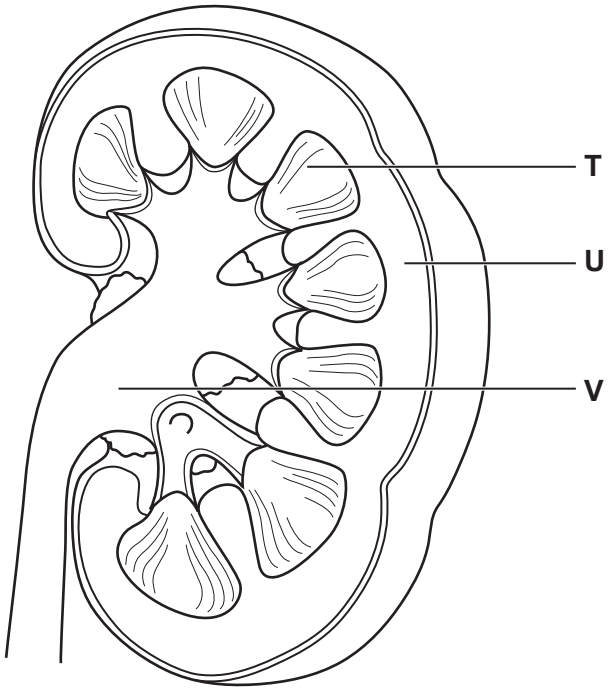
Tick (✓) **one** box in each row.

Statement	True	False
The liver, kidneys, lungs and skin are all involved in excretion.		
Carbon dioxide is formed by deamination of excess amino acids.		
Urea is less soluble and less toxic that ammonia.		
Breakdown of haem from haemoglobin produces bile pigments that are excreted in the faeces.		

[2]

(b) (i) **Fig. 19.1** is a drawing of a longitudinal section of a kidney.

Fig. 19.1



Identify the parts of the kidney labelled **T**, **U** and **V**.

T .....

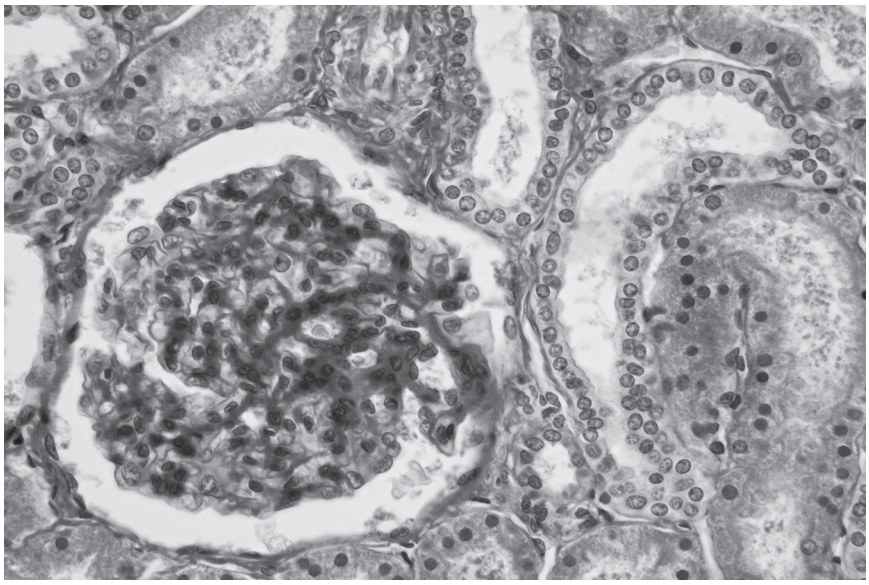
U .....

V .....

[3]

(ii) **Fig. 19.2** is a photomicrograph of a cross-section of part of the kidney.

Fig. 19.2



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Using the letter **T**, **U** or **V** from **Fig. 19.1**, identify the part of the kidney that was used to make the cross-section in **Fig. 19.2**.

Give a reason for your identification.

Letter representing part of the kidney .....

Reason .....

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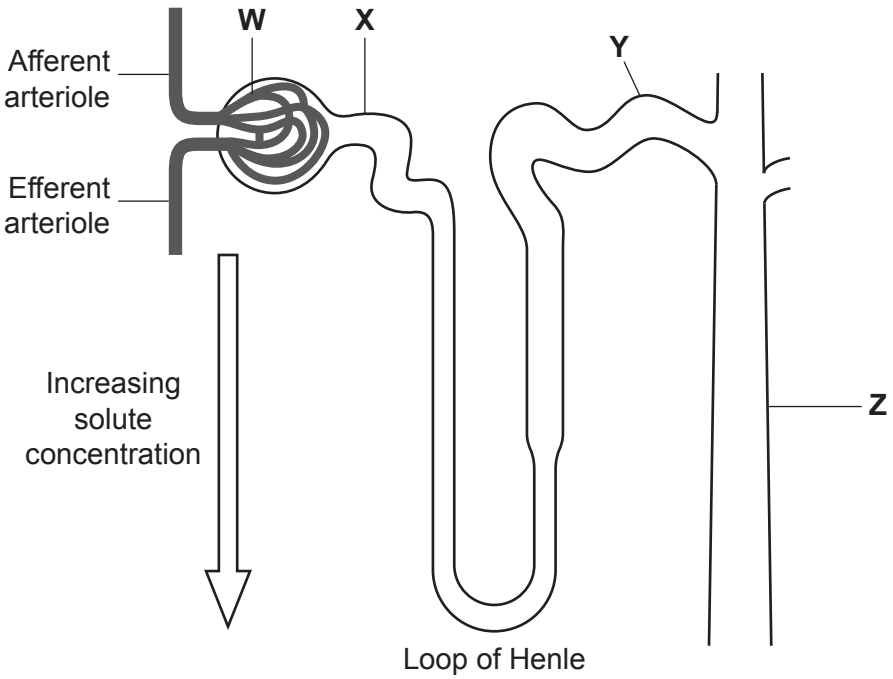
[2]

(c) **Fig. 19.3** is a diagram of a single nephron.

Fig. 19.3



(i) Complete the table using the most appropriate letter or letters, **W** to **Z**, to show which part(s) of the nephron correspond to each of the statements.

Each letter may be used once, more than once or not at all.

Statement	**Letter or letters**
ADH increases the permeability of the walls	
This region has the highest hydrostatic pressure	
Movement of mineral ions occurs to maintain the balance of mineral ions in the blood	

[3]

(ii) **Fig. 19.3** shows an increasing solute concentration.

Outline the processes in the loop of Henle that cause the solute concentration to increase.

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

(d) An adult was advised to change their diet to reduce their body mass before undergoing surgery.

Over a period of several weeks their body mass reduced by 1 kg.

Suggest what happened to the 1 kg of body mass.

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

20 **(a)** Organisms can be ectotherms or endotherms.

(i) Define the term **endotherm**.

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

(ii) Suggest **one** advantage and **one** disadvantage that ectotherms have compared to endotherms.

Advantage .....

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Disadvantage .....

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[2]

(b)* During a class discussion, one student stated:

‘Ectotherms cannot control their body temperature.’

Another student stated:

‘Ectotherms control their body temperature by behavioural responses, but endotherms do not.’

Discuss, using examples, whether these two statements are correct.

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Additional answer space if required.

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(c) Infection by pathogens such as bacteria and viruses often causes release of pyrogens into the blood.

Pyrogens stimulate the enzyme COX-2 to produce the compound PGE_2.

PGE_2 binds to receptors in the hypothalamus and this results in an increase in the thermogenic set point.

(i) Suggest the consequences of an increase in the thermogenic set point.

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(ii) PGE_2 receptors are located on the cell surface membrane.

State **two** functions of the cell surface membrane that are illustrated by the action of PGE_2.

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[2]

21 **(a)** In 1933 two scientists published a study in which they investigated the movement of coloured dyes in the transpiration stream of the stems of sycamore trees growing in a wood.

They bored holes in the stems and poured dye solution into the borehole. Then they sealed the hole with impermeable tape.

(i) Describe what is meant by the term **transpiration stream**.

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

(ii) Suggest why the scientists sealed the borehole with tape.

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(iii) The scientists found that the dye moved both up and down the stems.

A student wanted to investigate this in the laboratory. They devised an experiment using water-soluble food dyes injected into the stems of sunflower plants growing in pots.

Suggest how they could observe the route taken by the dyes.

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(b) Plants are often watered with a solution containing minerals to help them grow.

While preparing a class practical a technician accidentally watered some sunflower plants with a mineral concentration that was 1000 times higher than normal.

(i) Explain why the plants wilted, even though they were given a lot of water.

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(ii) The teacher suggested that the same effect would be seen if the plants had been watered with a solution containing cyanide ions that inhibit ATP synthesis.

Explain whether the teacher was correct.

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(iii) Explain why plants growing in high light intensity require more water than plants growing in shade, even when the temperatures are the same.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).