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**BIOLOGY** **0610/41**

Paper 4 Theory (Extended) **May/June 2025**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

**INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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**1** **(a)** Fig. 1.1 shows a pyramid of energy for an ecosystem.

View solution

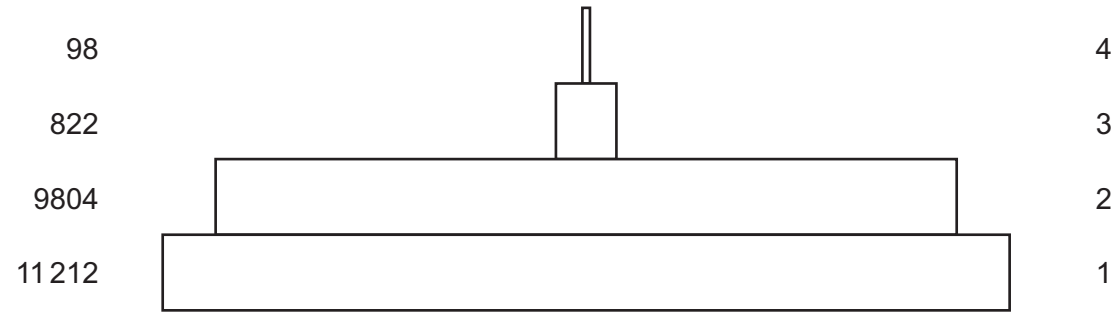


**Fig. 1.1**

**(i)** State where the organisms in trophic level 1 in Fig. 1.1 get their energy from.

..... [1]

**(ii)** Calculate the percentage of energy transferred between trophic levels 2 and 3 in Fig. 1.1.

Give your answer to **one** significant figure.

..... [2]

**(iii)** State **two** reasons why the energy decreases between trophic levels 1 and 4, as shown in Fig. 1.1.

1 .....

2 .....

[2]

**(iv)** Describe the advantages of representing food chains using a pyramid of energy compared with a pyramid of biomass.

.....

.....

.....

.....

..... [2]

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**(b)** A new species was introduced to an ecosystem.

Fig. 1.2 shows the changes in the population as the species established itself in the ecosystem.

View solution

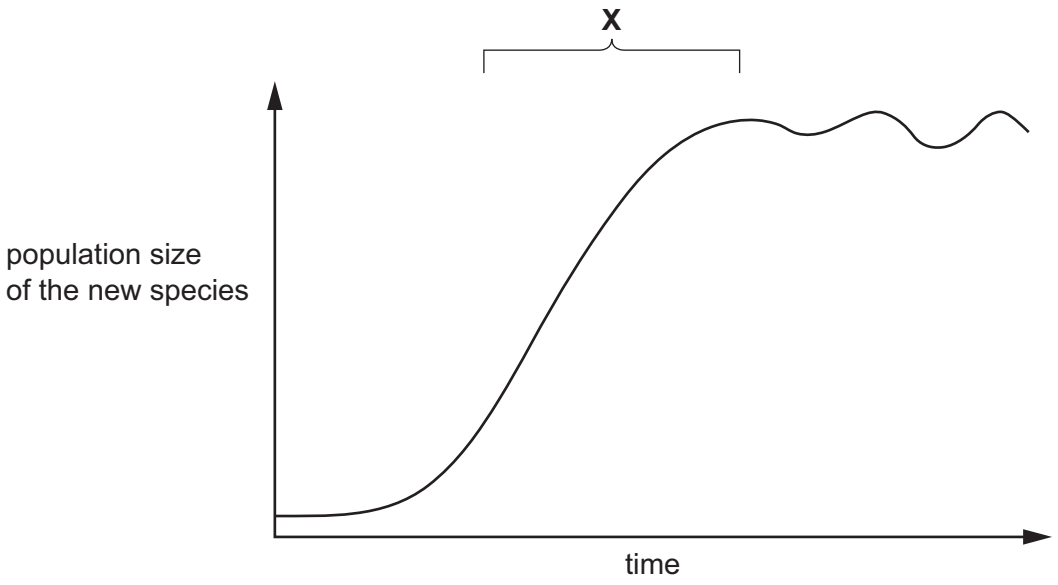


**Fig. 1.2**

**(i)** Complete the sentence to describe the term population.

A population is a group of organisms of one species living in the same ..... at the same ..... . [1]

**(ii)** Describe **and** explain the reasons for the shape of the graph at **X** in Fig. 1.2.

View solution

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..... [5]

[Total: 13]

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**2** **(a)** The human retina contains receptor cells called rods and cones.

View solution

Fig. 2.1 shows the distribution of receptor cells in a human retina.

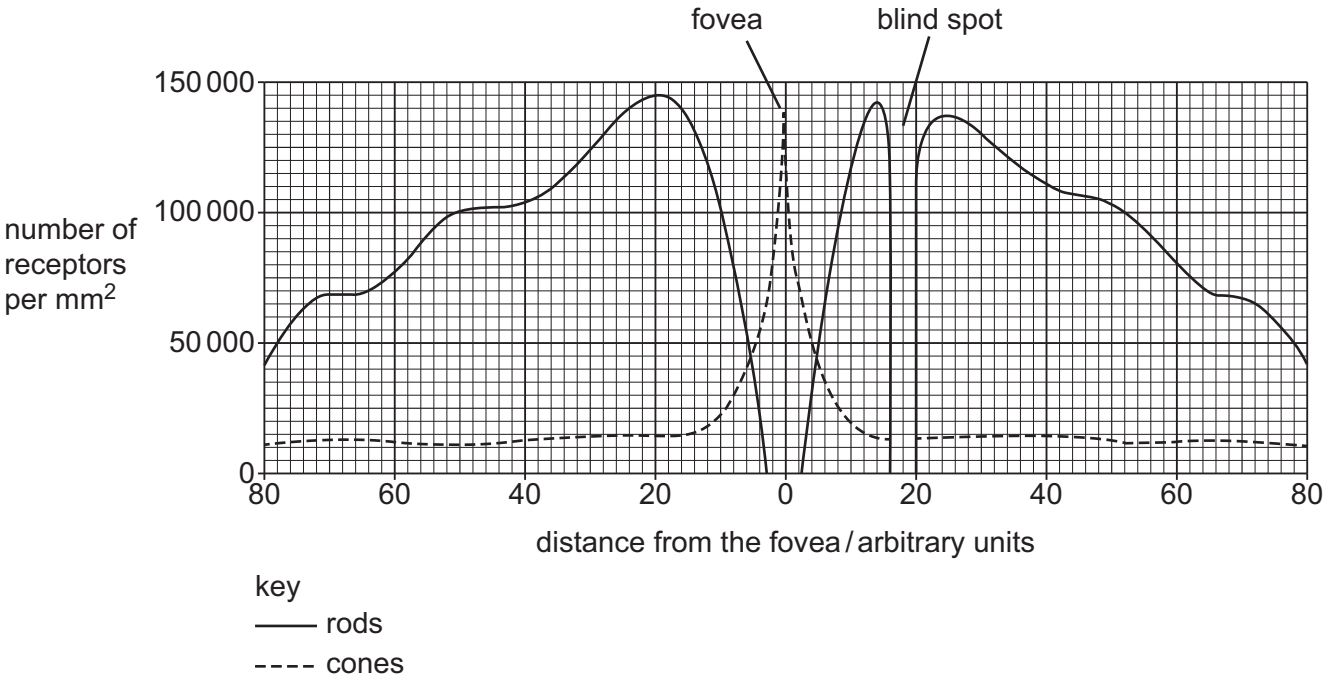


**Fig. 2.1**

Using the information in Fig. 2.1, describe the differences in the distribution of rods and cones.

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..... [4]

**(b)** Nocturnal animals are active at night.

Suggest how the number of receptor cells in the retina of a nocturnal animal differs from those in the retina of an animal that is active in the day.

Explain your suggestion.

View solution

.....

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.....

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..... [2]

**(c)** In humans, the size of the iris increases in bright light conditions.

View solution

During this response one effector in the iris contracts and one effector relaxes.

**(i)** State the name of this response.

..... [1]

**(ii)** State the name of the effector that contracts in this response.

View solution

..... [1]

**(iii)** State the name of the type of action shown by the paired effectors during this response.

..... [1]

View solution

**(d)** The optic nerve contains many neurones.

View solution

Fig. 2.2 shows a synapse between two neurones.

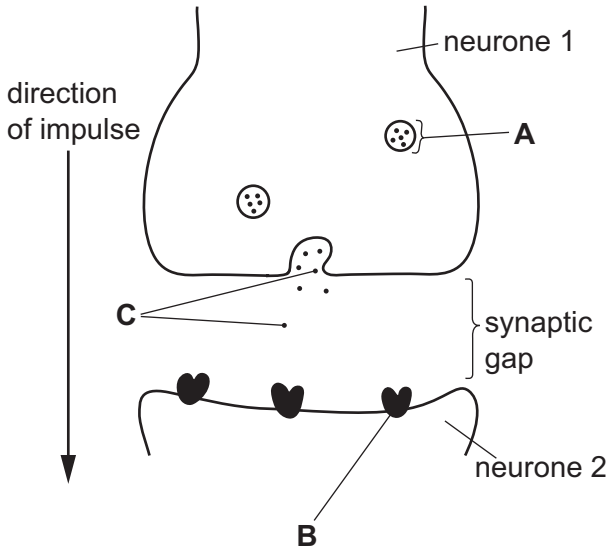


**Fig. 2.2**

**(i)** State the names of the parts labelled **A**, **B** and **C** in Fig. 2.2.

**A** .....

**B** .....

**C** .....

[3]

**(ii)** Explain how part **C** in Fig. 2.2 moves across the synaptic gap.

View solution

.....

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..... [2]

[Total: 14]

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**3** **(a)** Fig. 3.1 shows one stage involved in plant reproduction after pollination.

View solution

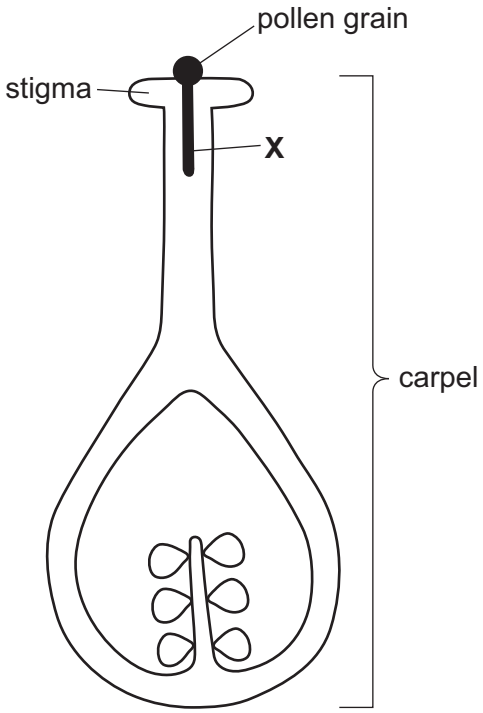


**Fig. 3.1**

**(i)** State the name of the part labelled **X** in Fig. 3.1.

..... [1]

**(ii)** Describe the events that occur after the stage shown in Fig. 3.1 that result in fertilisation.

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..... [3]

View solution

**(b)** A species of plant can use self-pollination and cross-pollination.

**(i)** Suggest reasons for this species of plant to use self-pollination rather than cross-pollination.

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..... [3]

**(ii)** Discuss the potential effects of only using self-pollination in a population of plants.

View solution

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..... [3]

**(c)** Meiosis produces gametes and is a source of genetic variation.

View solution

State **two other** sources of genetic variation in populations.

1 .....

2 .....

[2]

**(d)** Describe mitosis and its roles in organisms.

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..... [4]

**(e)** State the name of the unspecialised cells that divide by mitosis.

..... [1]

[Total: 17]

View solution

**4** The kidney is an organ in the excretory system.

**(a)** Describe what is meant by the term excretion.

View solution

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..... [2]

**(b)** State the name of the substance excreted by the lungs.

View solution

..... [1]

**(c)** Fig. 4.1 shows a simplified diagram of a cross-section of a kidney.

View solution

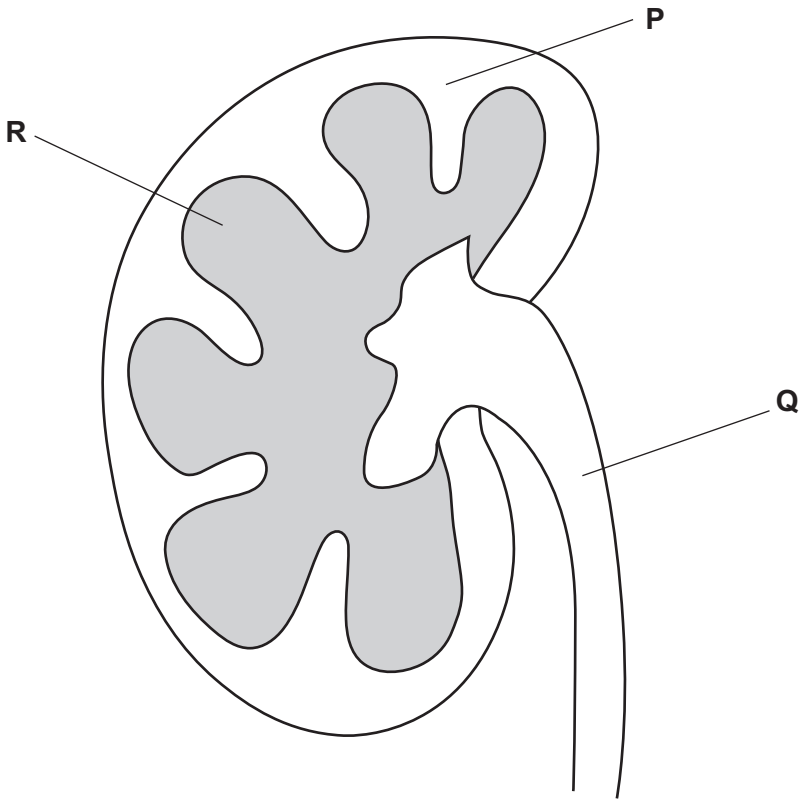


**Fig. 4.1**

State the names of the parts labelled **P**, **Q** and **R** in Fig. 4.1.

**P** .....

**Q** .....

**R** .....

[3]

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**(d)** Fig. 4.2 shows the structure of a kidney nephron.

View solution

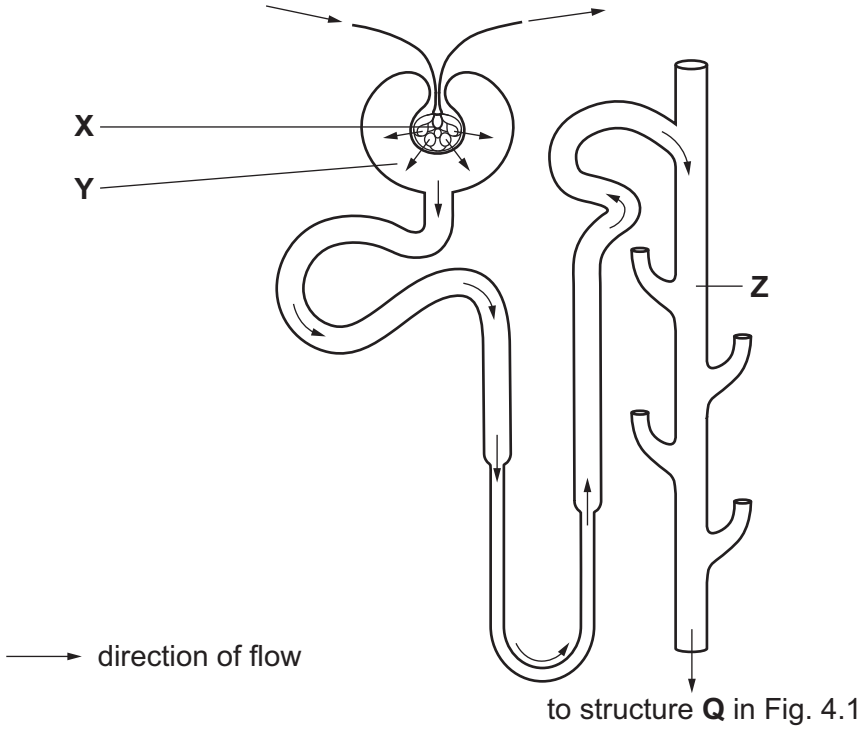


**Fig. 4.2**

Describe **and** explain the difference in the composition of the fluids in structures **X**, **Y** and **Z** in Fig. 4.2.

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..... [6]

**(e)** The liver is also involved in excretion.

View solution

Describe **two** ways that amino acids are processed in the liver.

1 .....

2 .....

[2]

[Total: 14]

**5** **(a)** Organisms can be classified by their features and by studying the sequence of bases in their DNA.

Fig. 5.1 is a diagram showing the evolutionary relationships between some different groups of organisms.

Each branch shows the point at which organisms developed new features that classify them as a new group.

The point where the branch starts also indicates a common ancestor shared by the new groups.

View solution

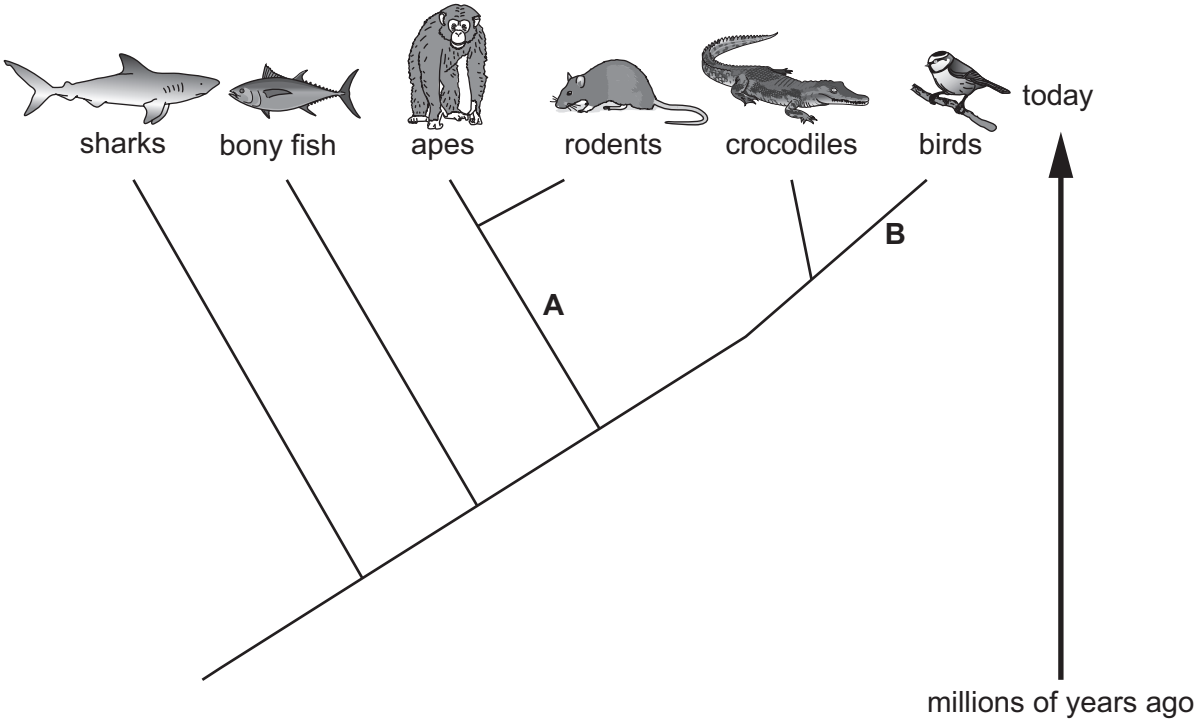


**Fig. 5.1**

**(i)** Suggest which visible features have developed at **A** and **B** in Fig. 5.1.

**A** .....

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

**(ii)** Identify the names of the **two** groups that share the most recent common ancestor in Fig. 5.1.

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

**(iii)** Suggest the groups with the most similar and least similar DNA base sequences to crocodiles in Fig. 5.1.

most similar .....

least similar .....
[2]

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**(b)** Describe the structure of a DNA molecule.

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..... [4]

**(c)** Outline how the base sequences in DNA control cell function.

View solution

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..... [3]

[Total: 12]

**6** **(a)** Some maize seeds were pinned on a board and provided with light from all directions.

View solution

The board was placed in a clinostat that rotated the board.

The board was rotated continuously as the seeds germinated and the roots grew.

Fig. 6.1 shows the apparatus and results after 5 days.

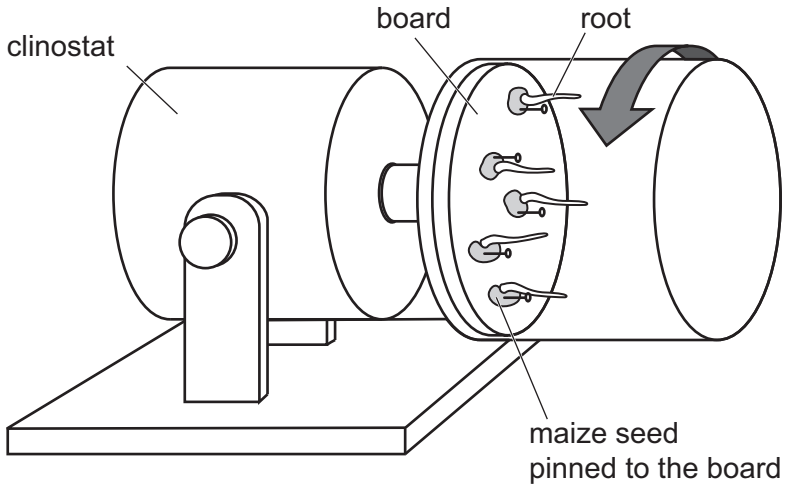


**Fig. 6.1**

**(i)** Complete the sentences to explain the root growth in Fig. 6.1.

Auxin is produced in shoot and root ..... . The auxin travels

down the root by the process of ..... .

As the clinostat rotates, the effect of ..... on all sides of the root is equal.

This causes the distribution of auxin in the root to be ..... .

Auxin stimulates cell ..... causing the roots to grow horizontally.

[5]

**(ii)** The rotation of the clinostat was stopped.

View solution

Predict the change in growth that will occur in the germinating maize seeds in Fig. 6.1.

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..... [1]

**(iii)** State the name of the tropic response to light.

..... [1]

View solution

**(b)** A student observed cells from a plant that had wilted.

View solution

State **and** explain the expected appearance of the cells.

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..... [3]

[Total: 10]

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