

Model Answers: Medium

1a

a) The effect of increasing IAA concentration on the growth of plant shoots shown in Fig.1 is...

Any **three** of the following:

- At low concentrations, IAA causes no growth (response) in plant shoots / has no effect on plant growth; [1 mark]
- At medium concentrations, IAA causes an increase in plant shoot growth; [1 mark]
- At high concentrations, IAA inhibits/reduces plant growth; [1 mark]
- Correctly stated IAA concentrations to match any of the above points; [1 mark]

Accept approximate values or a value range quoted from the log scale.

[Total: 3 marks]

When describing data be sure to describe all of the different trends shown; here there is a section for no growth, a section for increased growth, and a section for decreased growth. It is always a good idea to use numbers to support your points when describing data.

1b

b) The effect of IAA on shoot growth at a concentration of 1 part per million in Fig.1 is due to...

Any **five** of the following:

- IAA/auxin binds to receptors/receptor proteins on the cell surface membrane (of plant cells); [1 mark]
- (This) causes hydrogen ion/proton/H⁺ pumps to pump/actively transport hydrogen ions/protons/H⁺ into the cell wall; [1 mark]
- The cell wall becomes acidic / the pH of the cell wall decreases; [1 mark]
- (Expansin proteins) loosen the bonds between cellulose microfibrils; [1 mark]
- Potassium ion channels open **AND** potassium ions move into the cell wall; [1 mark]
- The water potential of the cell wall decreases **AND** water moves into the cell wall by osmosis; [1 mark]
- The pressure exerted on the cell walls (due to the increased cell volume) increases, stretching/expanding the cell walls (and causing the cells to elongate); [1 mark]

[Total: 5 marks]

1c

c) The effect of IAA on plant roots differs from its effect on plant shoots in Fig.1 as follows...

- Low IAA concentrations increase root growth **WHILE** having no effect on shoot growth **OR** IAA concentrations that have no effect on shoot growth cause increased growth in roots; [1 mark]
- Medium IAA concentrations inhibit root growth **WHILE** increasing shoot growth **OR** IAA concentrations that increase growth in shoots cause decreased growth in roots; [1 mark]

[Total: 2 marks]

Plant growth factors such as IAA are more complicated than animal hormones; they do not have a single target tissue and can have different effects on different tissues within the plant. Here it can be seen that at IAA concentrations that do not affect shoot growth, root growth is increasing, while concentrations that cause increased growth in shoots inhibit growth in

roots.

2a

a) Structures A-C in Fig.1 are...

- A = Embryo; [1 mark]
- B = Endosperm; [1 mark]
- C = Aleurone layer; [1 mark]

[Total: 3 marks]

2b

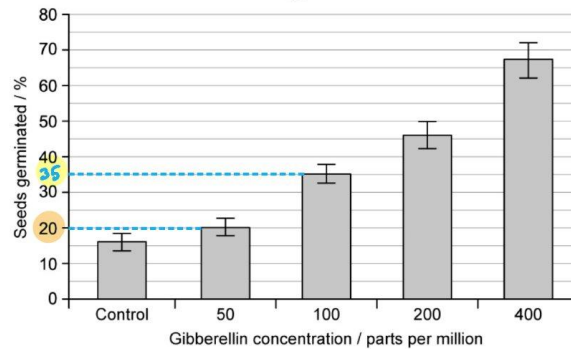
b) The percentage increase in the seeds germinated at a gibberellin concentration of 200 parts per million in comparison to the seeds germinated at 50 parts per million is...

- $15 \div 20$; [1 mark]
- 75 (%); [1 mark]

Full marks can be awarded for the correct answer in the absence of other calculations.

[Total: 2 marks]

Step ①: Use graph to identify required values.



Step ②: Calculate difference.

$$35 - 20 = 15$$

Step ③: Calculate % increase.

$$\begin{aligned} \% \text{ increase} &= (\text{increase} \div \text{starting amount}) \times 100 \\ &= (15 \div 20) \times 100 \\ &= \underline{\underline{75\%}} \quad [1 \text{ mark}] \end{aligned}$$

2c

c) Evaluative points regarding the conclusion that adding gibberellin increases germination in barley seedlings include...

In support of the conclusion:

Any **one** of the following:

- All concentrations of gibberellin show an increased germination percentage in comparison to the control; [1 mark]
- Gibberellin concentrations of 100, 200, and 400 parts per million significantly

increase seed germination; [1 mark]

Against the conclusion:

- The germination percentage at 50 parts per million is not significantly higher than the control; [1 mark]

[Total: 2 marks]

The question asks you to refer only to the data so you cannot add any information about the quality of the study, e.g. the sample size or the number of repeats. The most important point to note is that the standard deviations for the control and for 50 ppm overlap, showing that there is no statistically significant difference between these two sets of results, while the standard deviations for the higher concentrations do not overlap with the control, or with each other. Therefore, the student's conclusion is only partly correct, and you should explain how the student is correct and incorrect in their conclusion.

2d

d) The results in Fig. 2 are due to...

Any **five** of the following:

- Gibberellin causes the aleurone layer to release amylase; [1 mark]
- Transcription/expression of the genes for amylase production increases; [1 mark]
- Amylase hydrolyses starch in the endosperm; [1 mark]
- Starch is broken down into maltose/glucose; [1 mark]
- (Glucose) is used by the embryo in respiration; [1 mark]
- ATP is produced / energy is released; [1 mark]
- ATP/energy is used by the embryo for growth / fuels growth in the embryo; [1 mark]

Reject references to energy being produced or created.

[Total: 5 marks]

Fig. 2 already tells us that gibberellin is present so no marks are available for describing the conditions required by the seed or the stimulation of the release of gibberellin by the embryo.

3a

a) i) The type of protein represented by A is...

- (Auxin) receptor (protein); [1 mark]

ii) Proteins B, C and D are...

- B = proton/H⁺/hydrogen ion pump; [1 mark]
- C = potassium/K⁺ / ion channel; [1 mark]
- D = aquaporin; [1 mark]

[Total: 4 marks]

When writing about proteins that transport hydrogen ions you must indicate clearly that you are referring to **ions** and not to hydrogen atoms. This is achieved either by stating that C transports hydrogen **ions**, or by referring to the ions as **protons** or as **H⁺**. Credit will not be given for identifying B as a hydrogen pump.

3b

b) The effects on the cell wall of many hydrogen ions moving into the cell wall are...

Any **three** of the following:

- (Cell wall) pH decreases / becomes more acidic; [1 mark]
- Expansins (are activated as a result of the change in pH);[1 mark]

- (Expansins) break/loosen bonds/cross-links;[1 mark]
- (These bonds are between) cellulose microfibrils;[1 mark]
- The cell wall expands/stretches;[1 mark]
- Due to turgor pressure (on cell wall as a result of water moving into the cell by osmosis); [1 mark]

[Total: 3 marks]

Be careful not to confuse **microfibrils** in cellulose with myofibrils in muscles; they are not the same thing!

Note that expansins are not enzymes, so you should not refer to them as such.

3c

c) The consequences of an influx of potassium ions into the cell are...

Any **two** of the following:

- Water potential decreases / becomes more negative; [1 mark]
- Water moves into the cell by osmosis / down a water potential gradient; [1 mark]
- The cell expands/elongates; [1 mark]

[Total: 2 marks]