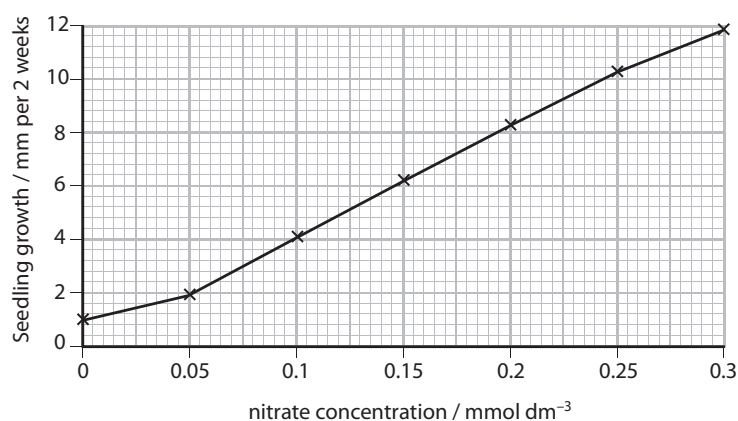


- 3 A student investigated the effect of nitrate ion concentration on the growth of wheat seedlings.

She took seven wheat seedlings and measured the length from the shoot tip to the root tip of each seedling. She placed each seedling in a different test tube so that its roots were in a mineral ion solution. Each tube contained a mineral ion solution with a different concentration of nitrate ions.

She left the seedlings on a window sill for two weeks and then measured the new length between the shoot tip and the root tip of each seedling. She then calculated the difference between the final length and initial length of each wheat seedling.

The results are shown in the graph below.



- (a) After her investigation, she said "I conclude that nitrates are needed for seedling growth and the higher the nitrate concentration the greater the growth."

(i) Give **one** piece of evidence from the graph that supports her conclusion.

(1)

.....

.....

.....

(ii) Give **one** piece of evidence from the graph that does not support her conclusion

(1)

.....

.....

.....



(iii) State the nitrate ion concentration of the solution that acted as the control.

(1)

..... mmol dm<sup>-3</sup>

(iv) Explain why it is better to use the difference in length as the measure of seedling growth rather than just the final length.

(1)

.....

.....

.....

.....

(v) Suggest why calculating the difference between final mass and initial mass of each seedling may be an even better indicator of growth than measuring length.

(1)

.....

.....

.....

.....

(vi) Suggest **three** variables that the student would need to keep constant to ensure the reliability of her data.

(3)

1 .....

2 .....

3 .....

(b) The student repeated the investigation using another wheat seedling. However, she replaced the mineral ion solution with soil from her garden. After two weeks the wheat seedlings had grown. She found the total increase in length to be 5.2 mm.

Use the graph to estimate the nitrate ion concentration of her soil.

(2)

Answer .....



(c) Inorganic ions are used by plants to make molecules. The table below refers to two inorganic ions, the molecules made and the main role of these molecules in a plant. Complete the table by writing the most appropriate word or words in each of the empty boxes.

(2)

Inorganic ion	Molecule made	Main role of the molecule in a plant
Nitrate		Plant growth
Calcium	Calcium pectate (pectin)	

(Total for Question 3 = 12 marks)

