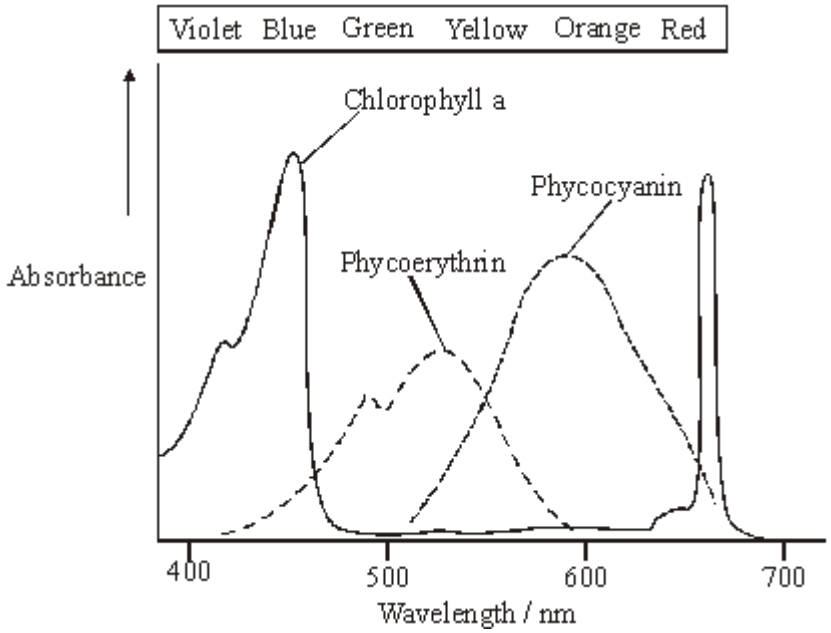
5.1 Energy transfers in and between organisms (A-Level Only)
Photosynthesis 2 – Questions

Q1.

The graph shows the absorption of different wavelengths of light by three photosynthetic pigments in a red seaweed.



(a) (i) Describe what the graph shows about the properties of chlorophyll a.

_____

_____

(1)

(ii) Describe the part played by chlorophyll in photosynthesis.

_____

_____

_____

_____

_____

_____

(3)

(b) The red seaweed lives under water at a depth of 2 metres. Suggest an advantage to the red seaweed of having other pigments in addition to chlorophyll a.

_____

_____

_____

_____

(2)

(Total 6 marks)

Q2.

(a) The table contains some statements relating to biochemical processes in a plant cell. Complete the table with a tick if the statement is true or a cross if it is not true for each biochemical process.

Statement	Glycolysis	Krebs cycle	Light-dependent reaction of photosynthesis
NAD is reduced			
NADP is reduced			
ATP is produced			
ATP is required			

(4)

(b) An investigation was carried out into the production of ATP by mitochondria. ADP, phosphate, excess substrate and oxygen were added to a suspension of isolated mitochondria.

(i) Suggest the substrate used for this investigation.

_____

(1)

(ii) Explain why the concentration of oxygen and amount of ADP fell during the investigation.

_____

_____

_____

_____

(2)

(iii) A further investigation was carried out into the effect of three inhibitors, **A**, **B** and **C**, on the electron transport chain in these mitochondria. In each of three experiments, a different inhibitor was added. The table shows the state of the electron carriers, **W–Z**, after the addition of inhibitor.

Inhibitor added	Electron carrier			
	W	**X**	**Y**	**Z**

A	oxidised	reduced	reduced	oxidised
B	oxidised	oxidised	reduced	oxidised
C	reduced	reduced	reduced	oxidised

Give the order of the electron carriers in this electron transport chain. Explain your answer.

Order _____ _____ _____ _____

Explanation _____

_____

_____

(2)

(Total 9 marks)

Q3.

(a) Describe how NADP is reduced in the light-dependent reaction of photosynthesis.

_____

_____

_____

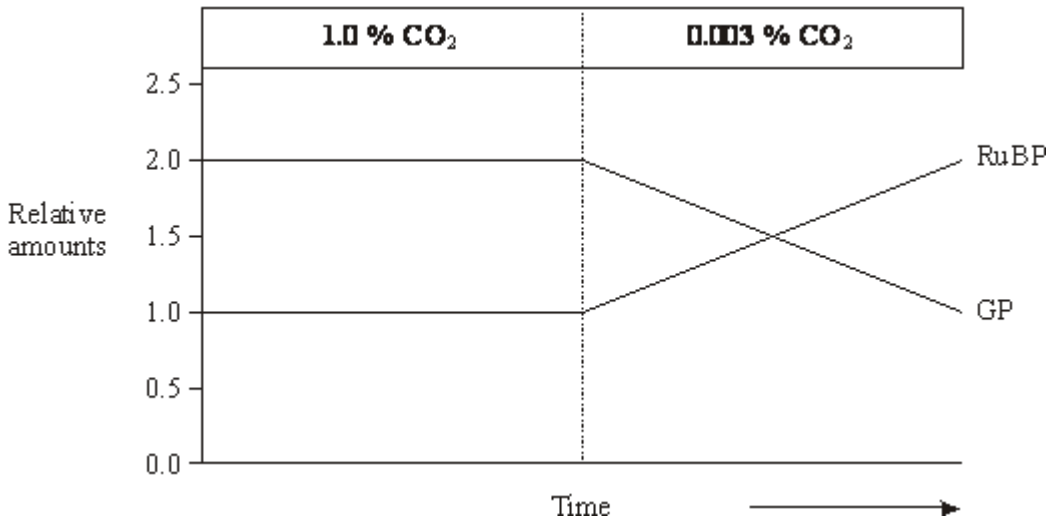
_____

(2)

(b) In an investigation of the light-independent reaction, the amounts of glycerate 3-phosphate (GP) and ribulose bisphosphate (RuBP) in photosynthesising cells were measured under different environmental conditions.

Figure 1 shows the effect of reducing the carbon dioxide concentration on the amounts of glycerate 3-phosphate and ribulose bisphosphate in photosynthesising cells.

Figure 1



(i) Explain why there is twice the amount of glycerate 3-phosphate as ribulose bisphosphate when the carbon dioxide concentration is high.

_____

_____

(1)

(ii) Explain the rise in the amount of ribulose bisphosphate after the carbon dioxide concentration is reduced.

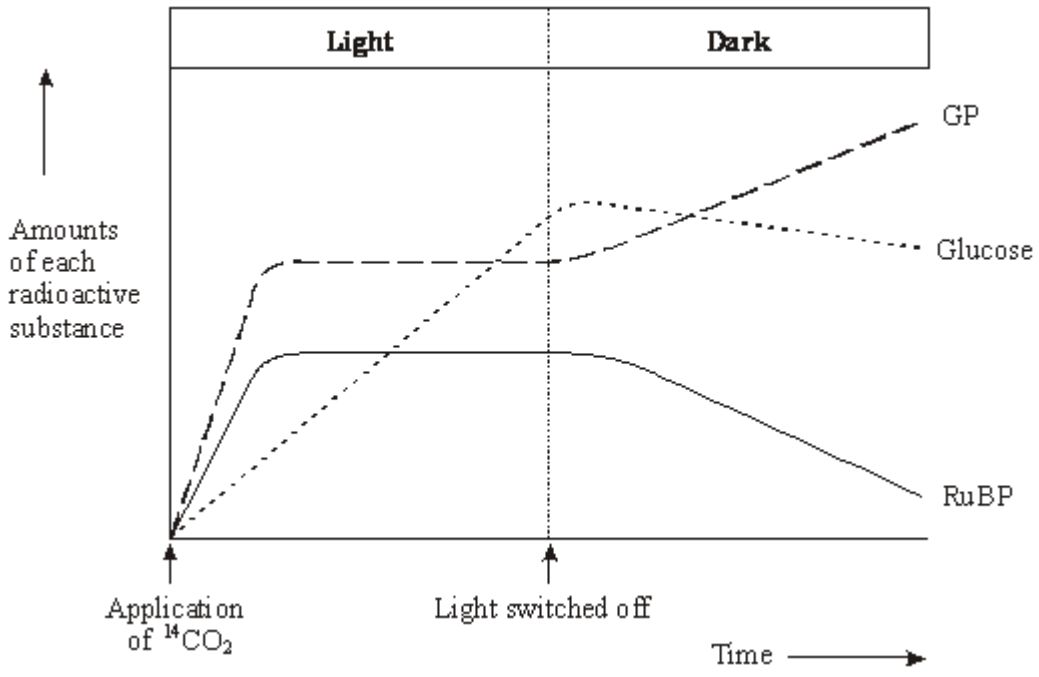
_____

_____

(1)

(c) **Figure 2** shows the results of an experiment in which photosynthesising cells were kept in the light and then in darkness.

Figure 2



(i) In the experiment the cells were supplied with radioactively labelled $^{14}CO_2$. Explain why the carbon dioxide used was radioactively labelled.

_____

_____

(1)

(ii) Explain how lack of light caused the amount of radioactively labelled glycerate 3-phosphate to rise.

_____

_____

_____

_____

(2)

(iii) Explain what caused the amount of radioactively labelled glucose to decrease after the light was switched off.

_____

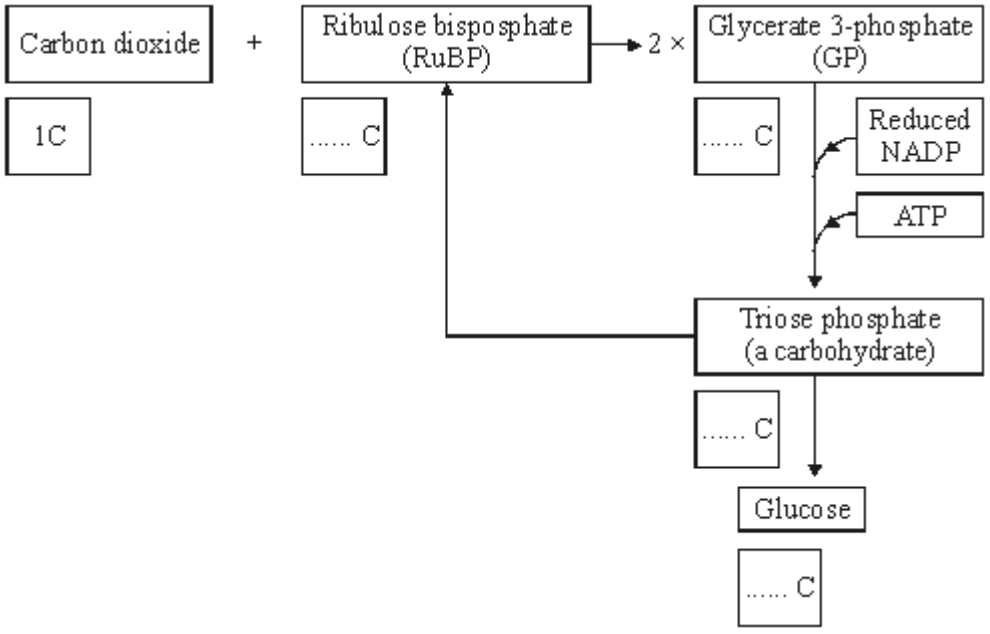
_____

(1)

(Total 8 marks)

Q4.

The diagram shows a summary of the light-independent reaction of photosynthesis.



(a) (i) Complete the boxes to show the number of carbon atoms in the molecules.

(2)

(ii) In which part of a chloroplast does the light-independent reaction occur?

_____

(1)

(iii) Which process is the source of the ATP used in the conversion of glycerate 3-phosphate (GP) to triose phosphate?

_____

(1)

(iv) What proportion of triose phosphate molecules is converted to ribulose bisphosphate (RuBP)?

_____

(1)

(b) Lowering the temperature has very little effect on the light-dependent reaction, but it slows down the light-independent reaction. Explain why the light-independent reaction slows down at low temperatures.

_____

_____

_____

_____

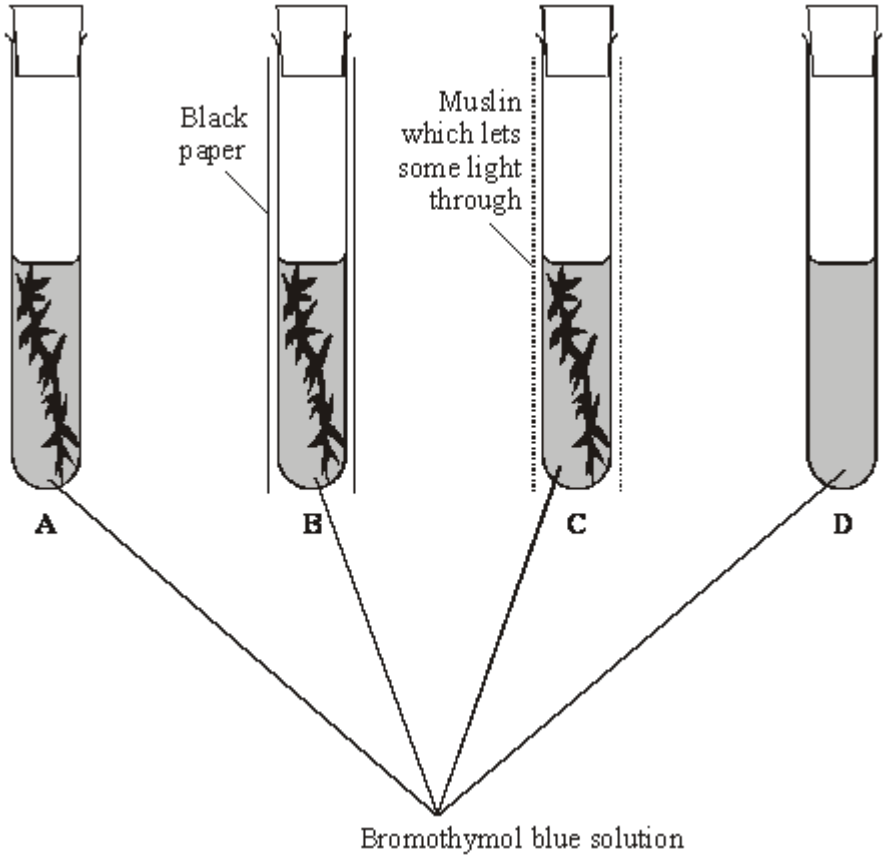
(2)

(Total 7 marks)

Q5.

Gas exchange in an aquatic plant was investigated by placing shoots in tubes containing bromothymol blue indicator solution. Bromothymol blue indicator is yellow below pH 6, green between pH 6.1 and 7.5, and blue at pH 7.6 and above. Into each of four tubes, **A**, **B**, **C** and **D**, 10 cm^3 of bromothymol blue solution were placed. Each tube was closed with a bung and left for 10 minutes. Similar-sized shoots of an aquatic plant were then placed into each of tubes **A**, **B** and **C**. The tubes were treated as shown in the diagram.

They were then placed at equal distances from a 60 watt lamp and left for one hour.



The table shows the initial and final colours of the indicator in the four tubes.

Tube	Treatment	Initial colour of indicator	Colour of indicator after one hour
A	Uncovered	Green	Blue
B	Covered with black paper	Green	Yellow
C	Covered with muslin	Green	Green
D	Uncovered	Green	Green

(a) Explain the results for

tube **A**;

_____

_____

_____

_____

tube **B**;

_____

_____

tube **C**.

(4)

(b) (i) Explain how the results from tube **D** help to confirm that the explanations for the other tubes are valid.

(1)

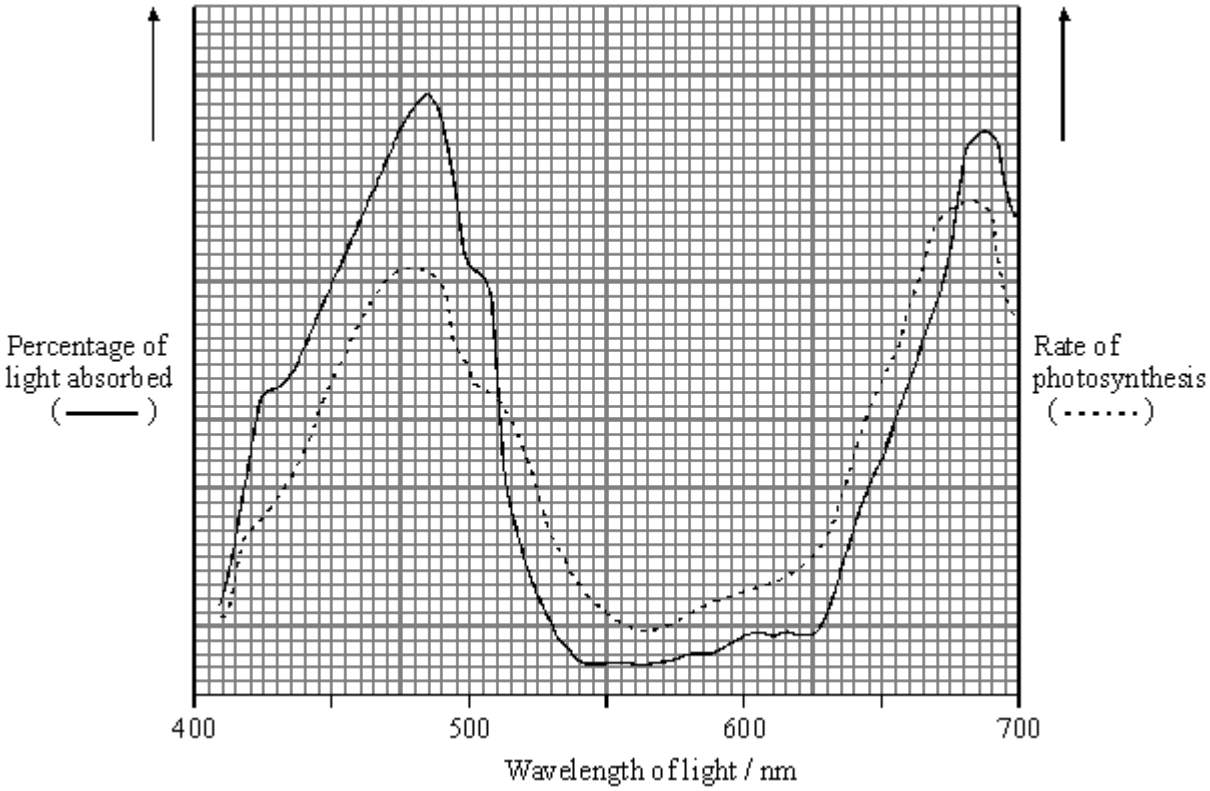
(ii) Explain why all the tubes were placed the same distance from the lamp.

(1)

(Total 6 marks)

Q6.

The percentage of light absorbed by an aquatic plant was measured when it was exposed to different wavelengths. The rate of photosynthesis was also measured at each wavelength of light. The results are shown in the graph.



(a) Describe and explain the relationship between light absorption and the rate of photosynthesis for the wavelengths of light between 410 nm and 500 nm.

_____

_____

_____

_____

(2)

(b) Give **one** dependent variable you could measure in order to determine the rate of photosynthesis in an aquatic plant.

_____

(1)

(c) Use the graph to identify the range of wavelengths of light that would be green in colour.

Give a reason for your answer.

Wavelengths _____ to _____ nm

Reason _____

_____

(2)

(d) A suspension of chloroplasts was isolated from an aquatic plant and a reagent was added. The reagent is blue when oxidised and is colourless when reduced.

(i) The suspension of chloroplasts in blue reagent was exposed to sunlight. The blue colour disappeared. Use your knowledge of the light-dependent reactions of photosynthesis to explain why.

_____

_____

_____

_____

(2)

(ii) Another suspension of chloroplasts was set up as before. Small quantities of ADP and phosphate ions were added and then the tube was exposed to light. The blue colour disappeared more quickly. Explain why.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q7.

(a) (i) Give **two** products of the light-dependent stage of photosynthesis.

1. _____

2. _____

(2)

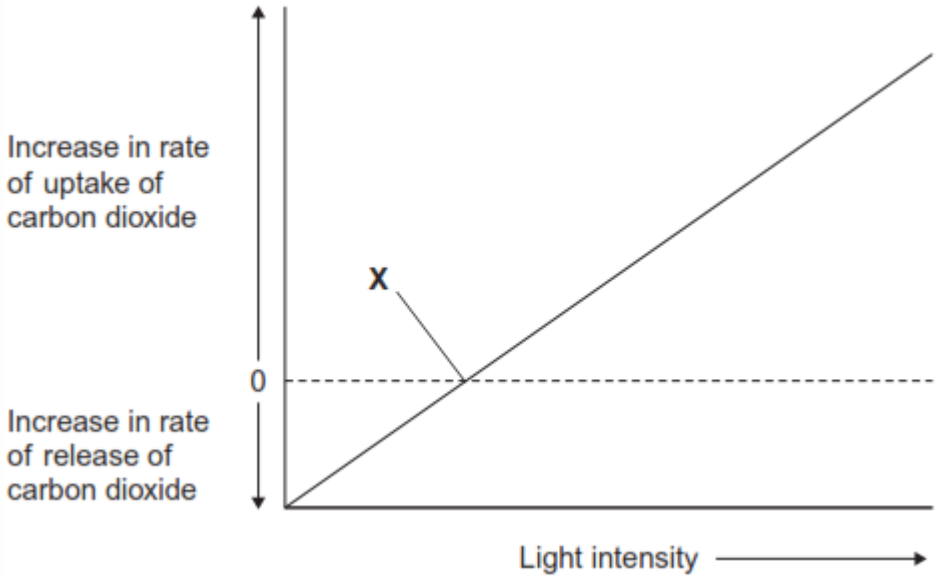
(ii) The products of the light-dependent stage are used in the light-independent stage of photosynthesis. What are these products used for?

_____

_____

(1)

(b) The graph shows the rate of uptake or release of carbon dioxide by a plant at different light intensities.



Explain the rate of carbon dioxide exchange at point **X**.

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_____

_____

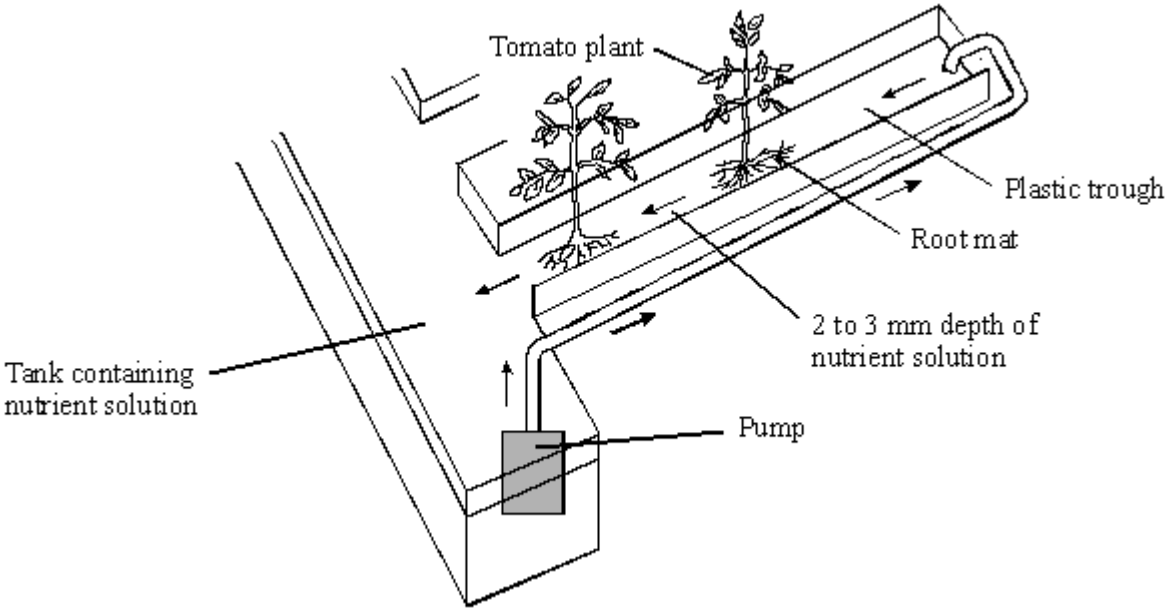
_____

(2)

(Total 5 marks)

Q8.

Tomato growers have increased the yield of fruit from 100 to 400 tonnes per hectare by growing the tomato plants in automatically heated glasshouses and enhancing the carbon dioxide concentration. To control the nutrient supply to the roots, the plants are grown without soil in plastic troughs, as shown in the diagram.



(a) Explain how enhancing the carbon dioxide concentration helps to increase the yield.

(2)

(b) Maintaining a high temperature in a glasshouse in winter, when the light intensity is low, may reduce the yield. Explain how.

(2)

(c) Tomato fruits have a high percentage of water. When making tomato ketchup, it is more economical to use fruits which have a low percentage of water. Growers can reduce the water content of the fruit by adding sodium chloride to the nutrient solution in the plastic trough.

Explain how adding sodium chloride can reduce the water content of the fruit.

(2)

(Total 6 marks)