1 (a) (i) Complete the word equation for photosynthesis.

carbon dioxide + ... (+ light energy) → glucose + ...

(2)

(ii) Most of the carbon dioxide that a plant uses during photosynthesis is absorbed from the air.

Give **one** other source of carbon dioxide for a plant.

Draw a ring around your answer.

the soil **respiration in the plant** **osmosis in the plant** **water**

(1)

A student investigated the conditions that plants need for photosynthesis.
The leaves of the plant he used had green and white parts.

Diagram 1 shows how part of one leaf was covered in black (opaque) card.
The plant was placed in a warm, sunny area and was watered well.
Eight hours later the leaf was removed from the plant and was tested for starch.

The results of the test are shown in **Diagram 2**, the shaded parts show where starch was present.

Diagram 1

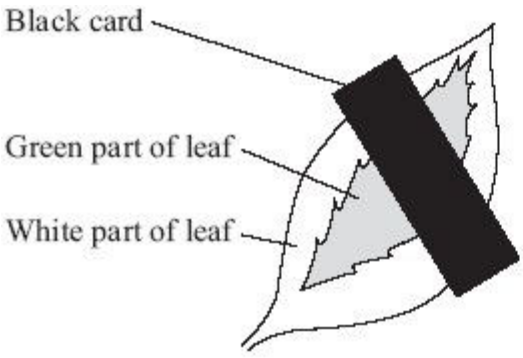
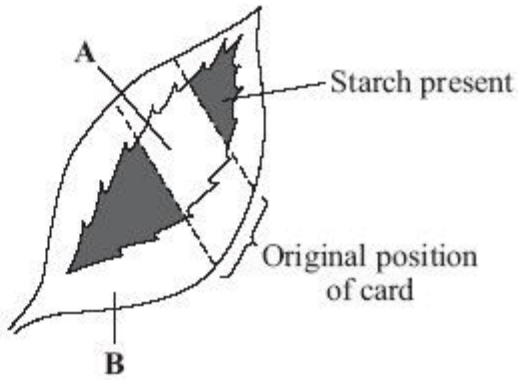


Diagram 2



(b) Name the **two** independent variables in this investigation.

1 .....

.....

2 .....

.....

(2)

(c) Why was no starch found in:

(i) the part of the leaf labelled **A**

.....

.....

(1)

(ii) the part of the leaf labelled **B**?

.....

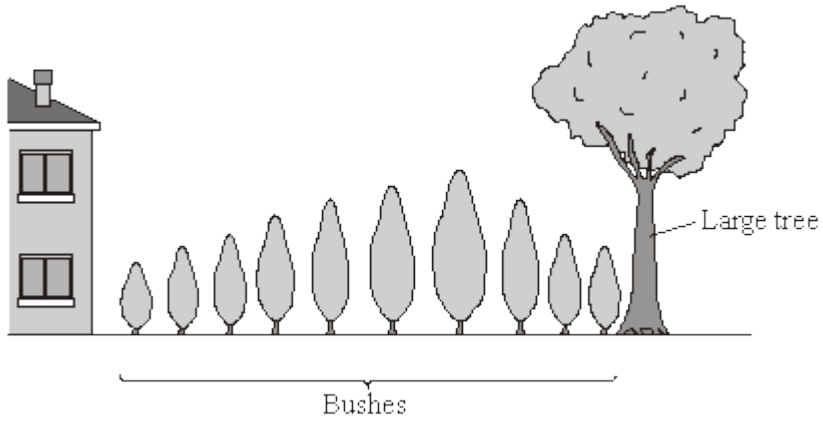
.....

(1)

(Total 7 marks)

2 The diagram shows bushes in a hedge growing near to a house.

The bushes were the same species and the same age.



(a) (i) The student said, "I have noticed that the short bushes grow next to the house. I think that the more light the bushes get, the faster they will grow."

Draw lines to match each of the student's statements to the correct term.

Draw only two lines.

Statement	Term
The short bushes grow next to the house.	A conclusion
Plants will grow faster if they get more light.	A prediction
	An observation

(2)

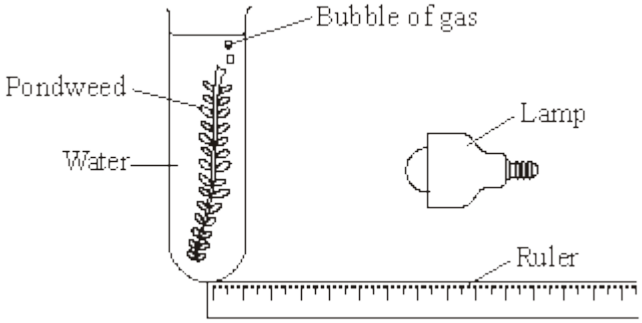
(ii) Complete the word equation for photosynthesis.

..... +water (+ light energy) ® ..... + oxygen

(2)

(b) The student decided to investigate the effect of light intensity on the rate of photosynthesis.

She used the apparatus shown in the diagram.



She measured the rate of photosynthesis by counting the number of gas bubbles given off each minute.

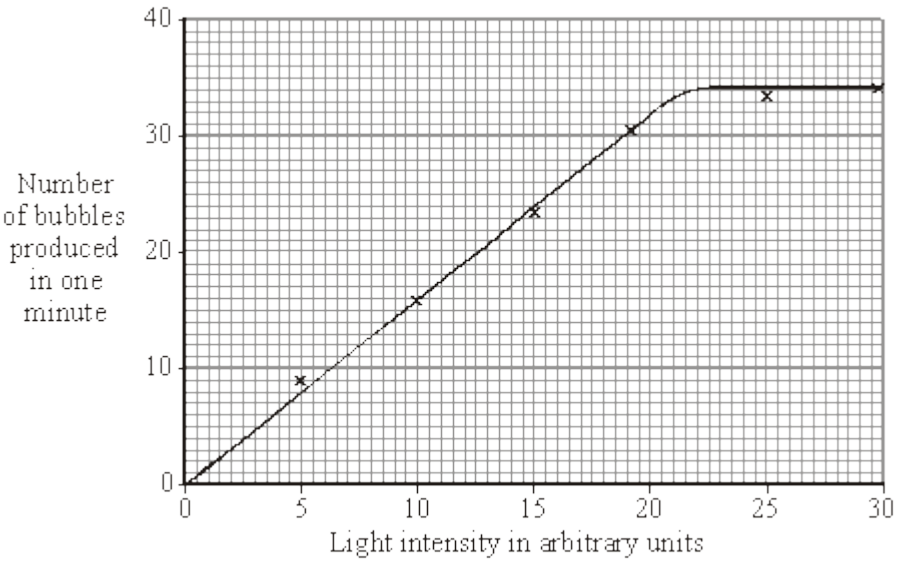
(i) Suggest how the student varied the intensity of the light received by the pondweed.

.....

.....

(1)

(ii) The student's results are shown on the graph.



Describe the pattern shown on the graph.

.....

.....

.....

.....

(2)

(iii) This is what the student wrote for her conclusion.

"Increasing the light intensity increases the rate of photosynthesis of the pondweed."

Why was her conclusion incomplete?

.....

.....

(1)

(Total 8 marks)

3 Green plants are able to make their own food.

Complete each sentence by drawing a ring around the correct answer in the box.

(a) Green plants make their own food during the process of

diffusion
photosynthesis
respiration

(1)

(b) This process can be summarised by the equation:

carbon dioxide + water → glucose +

mineral salts
light
oxygen

(1)

(c) The energy needed for this process is trapped for the plant by

chlorophyll
glucose
light

(1)

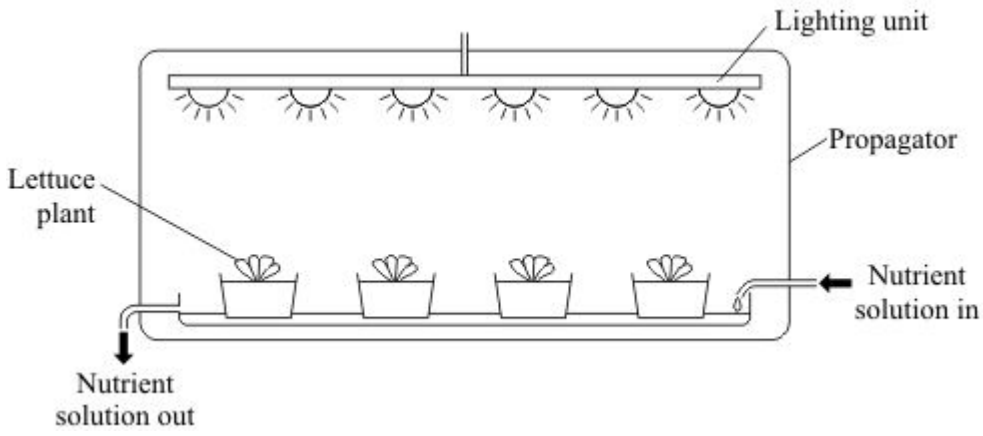
(d) Some of the food made by plants is stored as insoluble

chlorophyll
glucose
starch

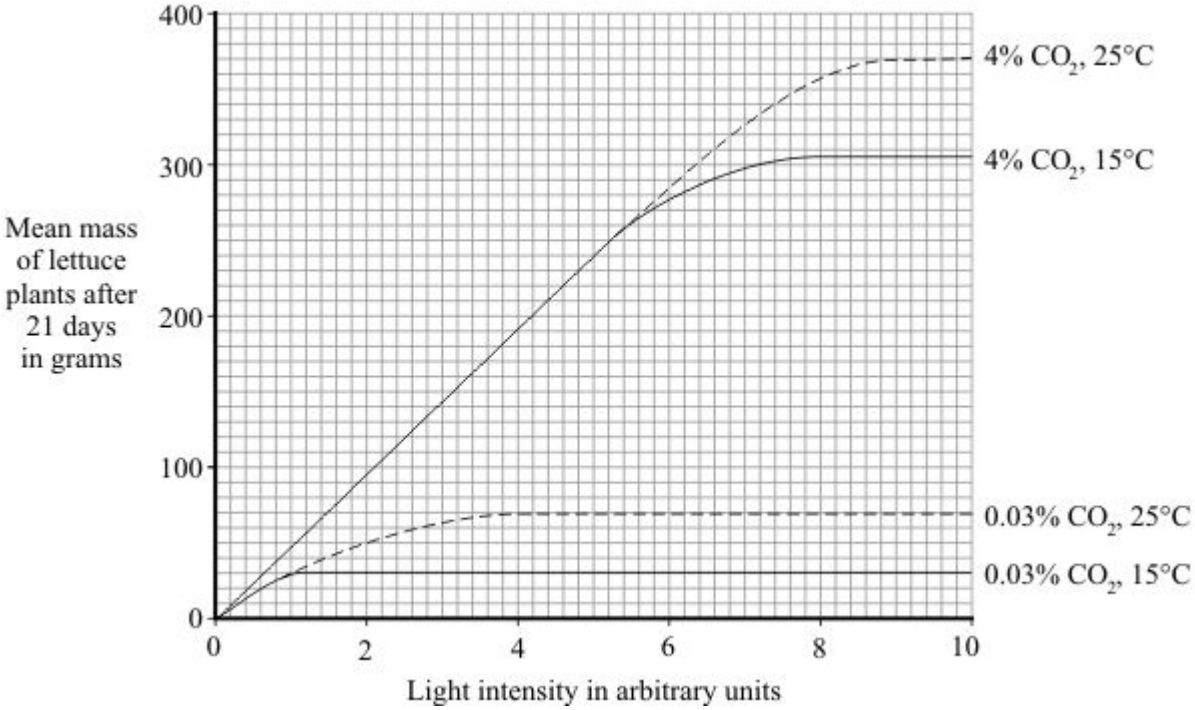
(1)
(Total 4 marks)

4 Changing the conditions in which plants grow affects how fast they grow.

The diagram shows a propagator in which scientists can control temperature, light intensity and carbon dioxide concentration.



The graph shows the effects of changing the temperature, light intensity and carbon dioxide concentration on the growth of lettuce plants.



(a) Describe and explain the effect of increasing light intensity on the mean mass of lettuce plants at 4% carbon dioxide and 15 °C.

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Growers wish to make maximum profits from their lettuces.

What do they need to consider before making decisions about the growing conditions for their lettuces?

.....

.....

.....

.....

(2)

(c) The nutrient solution contains nitrate ions and magnesium ions.

Complete the table to show the functions of these ions in plants and their deficiency symptoms.

Ion	Function in plants	Deficiency symptoms
Nitrate	.....	.....
	.....	.....
	.....	.....
Magnesium	.....	.....
	.....	.....
	.....	.....

(4)

(Total 9 marks)

5 (a) The equation describes the process of photosynthesis.

carbon dioxide + ... + light energy ⟶ glucose + ...

(i) Write in the names of the **two** missing substances.

(2)

(ii) Name the green substance which absorbs the light energy.

.....

(1)

(b) (i) In bright sunlight, the concentration of carbon dioxide in the air can limit the rate of photosynthesis. Explain what this means.

.....

.....

.....

(2)

(ii) Give **one** environmental factor, other than light intensity and carbon dioxide concentration, which can limit the rate of photosynthesis.

.....

(1)

(Total 6 marks)

6 The table shows the effects that two different concentrations of sulphur dioxide in the air had on the growth of rye grass plants.

Sulphur dioxide concentration in the air in micrograms per m^3	**9.0**	**191.0**
Number of leaves per plant	85.6	47.3
Total leaf area in cm^2	417.2	203.6
Dry mass of stubble in grams	0.48	0.22

(a) What human activity releases sulphur dioxide into the air?

.....

(1)

(b) (i) What effect does sulphur dioxide have on rainwater?

.....

.....

(1)

(ii) Use information from the table to describe **one** effect of sulphur dioxide on the leaves of the grass plants.

.....

.....

(1)

(c) The stubble consists of the bases of the stems of the plants and the roots left in the soil after harvesting.

Use your answer to part (b) to explain why the dry mass of the stubble was less at the higher concentration of sulphur dioxide.

.....

.....

.....

.....

(2)

(Total 5 marks)

7 Photosynthesis takes place in green plants.

(a) Name the substance that combines with water in photosynthesis.

.....

(1)

(b) Where does water enter the plant?

.....

(1)

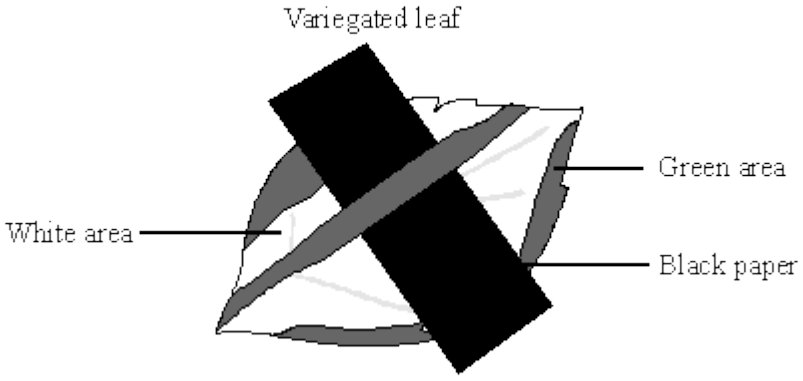
(c) Name **two** products of photosynthesis.

.....

(2)

(d) Variegated leaves have areas that are green and areas that are white. Some students used variegated leaves to investigate photosynthesis.

- They covered a variegated leaf with a black paper shape.
- The leaf was left in a sunny place.
- They tested the leaf for starch.
- The results were compared with a leaf that was not covered.



Area of the leaf tested	Start present after test	
	covered	**uncovered**
Green area	no	yes
White area	no	no

Explain why starch was present in only one of the tests.

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 8 marks)

8 (a) Complete the following sentences.

Green plants produce their own food by a process called photosynthesis. In this process the raw materials are ..... and carbon dioxide. Glucose and ..... are produced. ..... energy is absorbed by the green substance called ..... .

(4)

(b) Name **two** things that can happen in the plant to the glucose produced in photosynthesis.

1. .....

2. .....

(2)

(c) Plants need mineral salts.

(i) Through which part do mineral salts get into the plant?

.....

(1)

(ii) Explain why water is important in this process.

.....

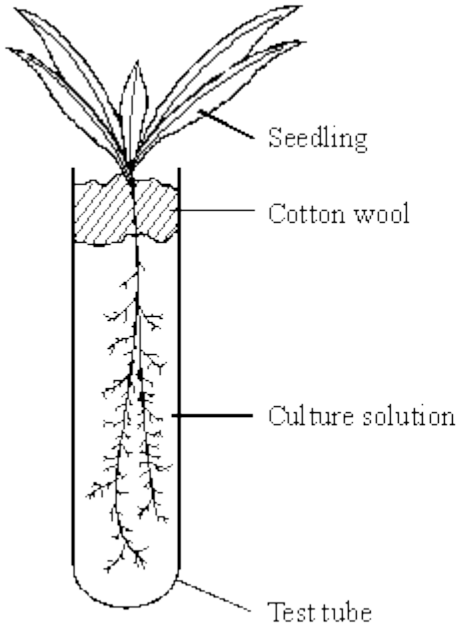
.....

.....

.....

(2)

Some students set up water cultures to find out how plants use nitrates.
They had two sets of nutrient solutions.
A full solution provided the plant with all the required nutrients.
The results table shows the average mass of the seedlings after 28 days of growth.



Culture solution	Average mass of seedling in g
distilled water	0.14
full solution with no nitrates	0.29
full solution	0.43

(d) (i) Give a conclusion you could make from these results.

.....

.....

(1)

(ii) Calculate the difference in average mass caused by the addition of nitrates to the culture solution.

.....

(1)

(iii) What are nitrates used for in the seedling?

.....

(1)

(iv) Some factors need to be controlled to keep this test fair. Name **two** of them.

1. .....

2. .....

(2)

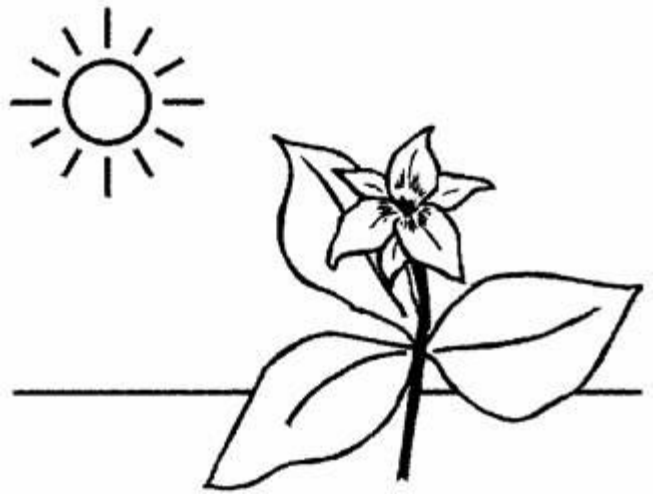
(v) Suggest **one** way you could improve the experiment.

.....

(1)

(Total 15 marks)

9 (a) Plants make their own food by photosynthesis.



Use the following words to fill in the gaps. You can use each word once or not at all.

carbon	chlorophyll	cytoplasm	light	nitrogen
oxygen	sound	starch	water	

During photosynthesis ..... dioxide and ..... are converted into glucose and ..... . The energy needed to do this is ..... energy which is trapped by a green pigment called ..... .

The plant can change the glucose into ..... which is insoluble so it can be stored.

(6)

(b) Which part of a plant is adapted for photosynthesis?

.....

(1)

(c) How do the **two** raw materials for photosynthesis get into the plant?

1. .....

.....

2. .....

.....

(2)

(d) Describe **one** way you could speed up photosynthesis.

.....

.....

(1)

(Total 10 marks)

10 (a) Photosynthesis is a process that takes place in green plants.

(i) What type of energy is needed for this process?

.....

(1)

(ii) What substance in the plant absorbs this energy?

.....

(1)

(iii) In which part of the plant cell does photosynthesis take place?

.....

(1)

(iv) Write a balanced chemical equation for photosynthesis.

..... → .....

(3)

(b) Describe **two** ways you could speed up photosynthesis.

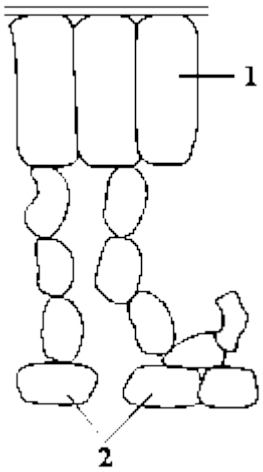
.....

.....

.....

(2)

(c) The diagram shows the outline of a cross-section of a leaf. Name cells **1** and **2** and describe how they are involved in photosynthesis.



.....

.....

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.....

.....

.....

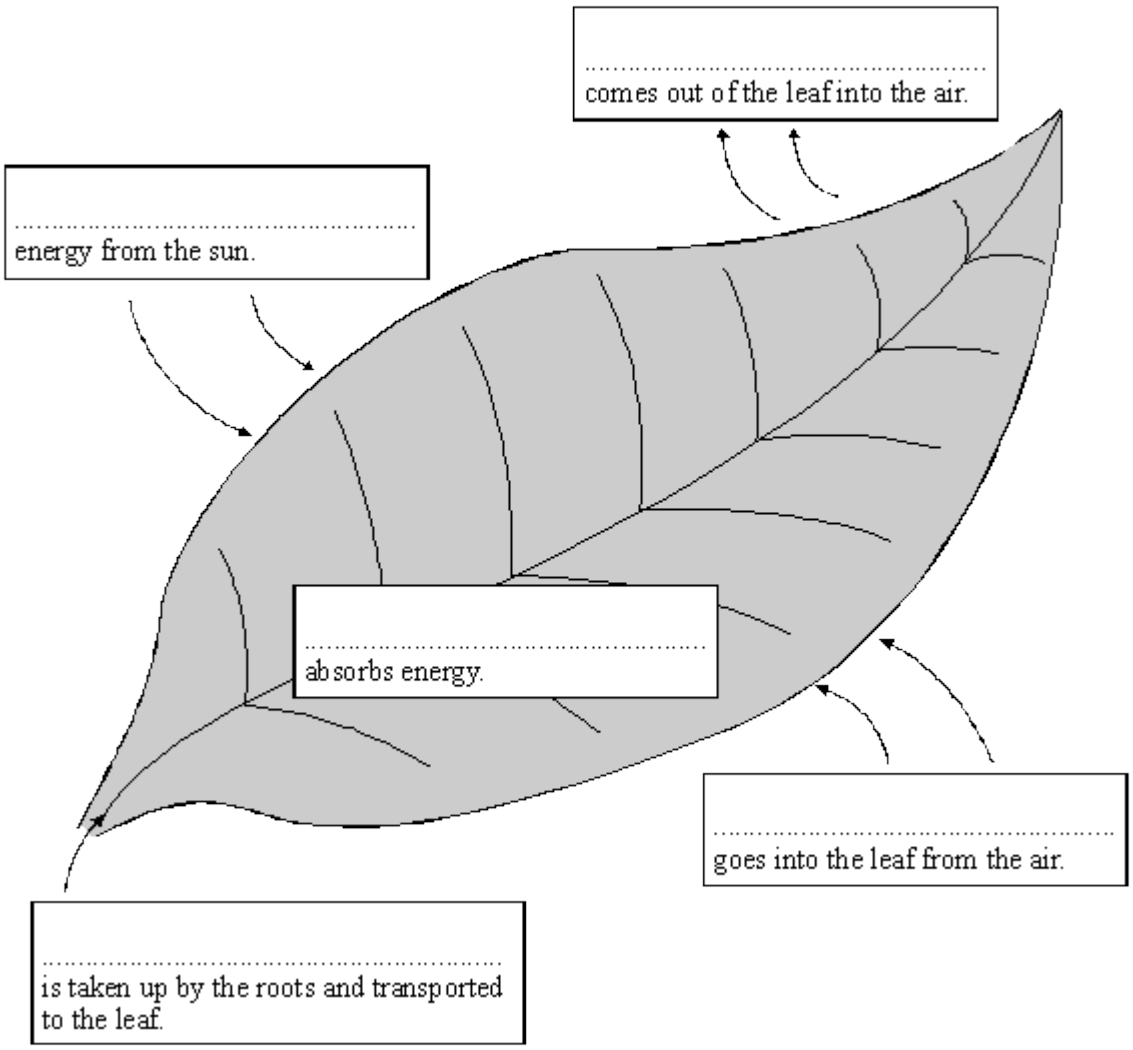
.....

(4)
(Total 12 marks)

11 The diagram shows how a leaf of a green plant makes glucose.

(a) Use words from the box to complete the labels on the diagram. You may use each word once or not at all.

carbon dioxide	chlorophyll	glucose	heat
light	oxygen	water	



(5)

(b) (i) Compete the following sentence.

Glucose in food is a type of ..... . When we eat it, it gives us energy.

(1)

(ii) The plant turns some of the glucose into starch. Why is starch useful to the plant?

.....

.....

(1)

(iii) What does the plant do with the rest of the glucose?

.....

(1)

(c) (i) What is the name of the process outlined in the diagram?

.....

(1)

(ii) Give **one** way that leaves are adapted to do this process.

.....

(1)
(Total 10 marks)

12 Photosynthesis takes place the leaves of green plants.

(a) Write a balanced chemical equation for the formation of glucose by photosynthesis.

.....

(3)

(b) Describe **two** ways that the rate of photosynthesis can be decreased without lowering the temperature.

.....

.....

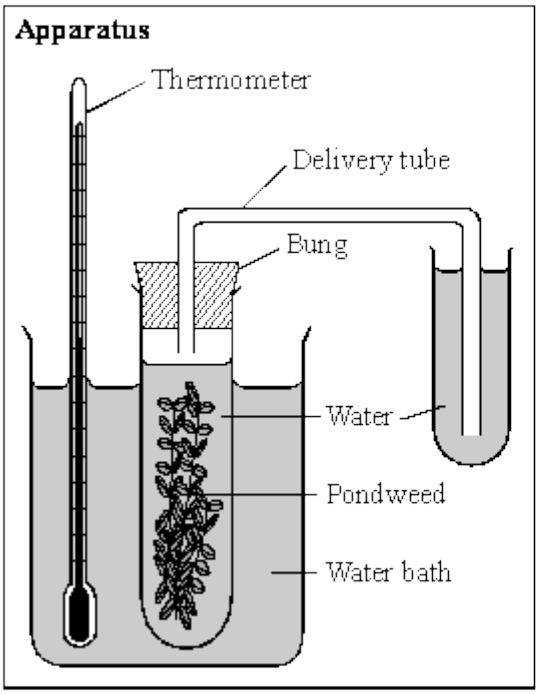
.....

.....

.....

(2)

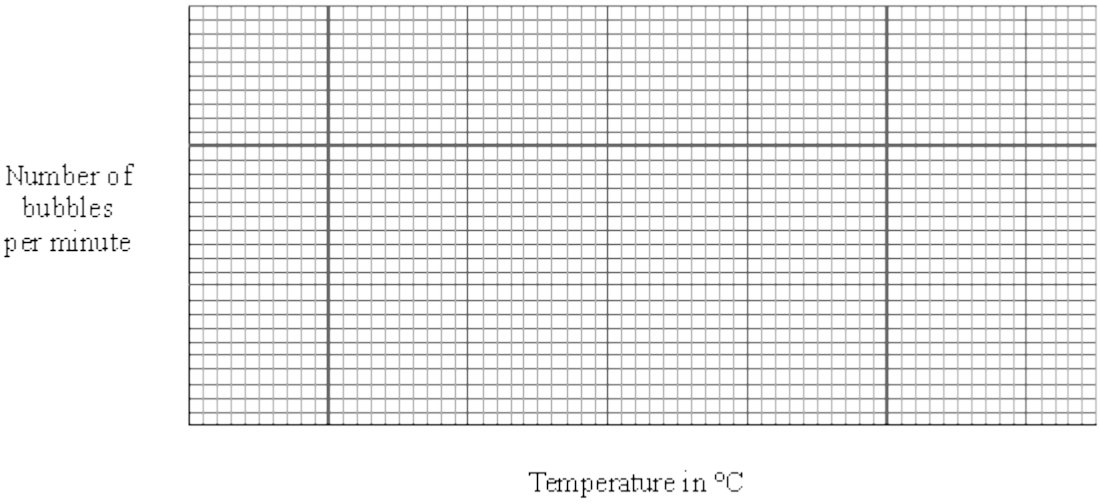
(c) Some students decided to investigate the effect of temperature on the rate of photosynthesis in pond weed. They set up the apparatus and altered the temperature using ice and hot water. The counted the number of bubbles given off in a minute at different temperatures. They obtained the following results.



Results

Temperature in °C	Number of bubbles per minute
10	6
20	15
30	21
40	23
50	19

(i) Plot the points on the graph.



(3)

(ii) Use your graph to predict the number of bubbles per minute at 25 °C.

.....

(1)

(iii) Suggest a reason why the rate of photosynthesis seems to decrease in this pondweed after 40 °C.

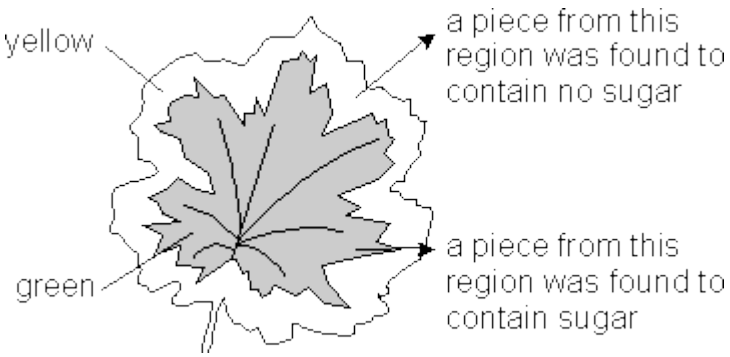
.....

.....

(1)

(Total 10 marks)

13 A plant with variegated (two-coloured) leaves was left in sunlight for several hours. Pieces of one of its leaves were then detached (removed) and tested for sugar. The diagram below shows the results.



Explain, as fully as you can, why the yellow region of the leaf had not produced sugar.

.....

.....

.....

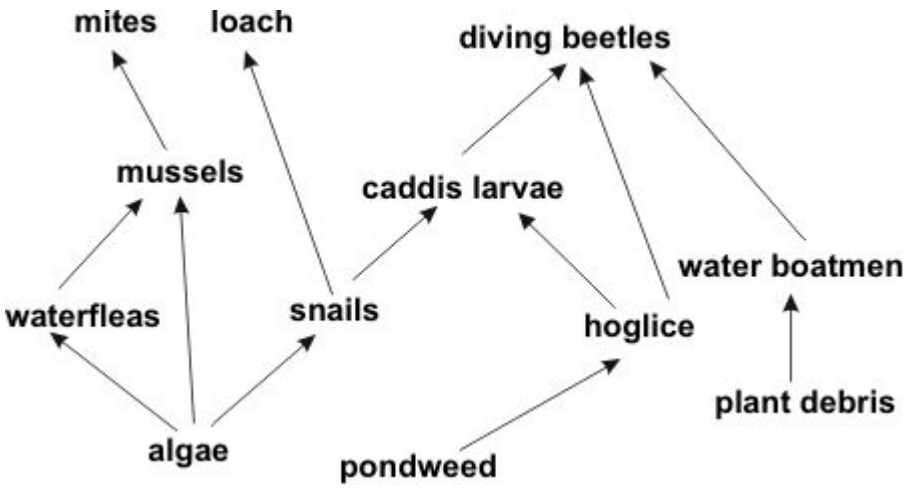
.....

.....

.....

(Total 2 marks)

14 The diagram below shows a food web for some of the organisms which live in a pond.



(a) (i) Name **one** secondary consumer in this food web.

.....

(1)

(ii) The algae are small green plants.

Give **three** conditions needed by green plants to produce sugars.

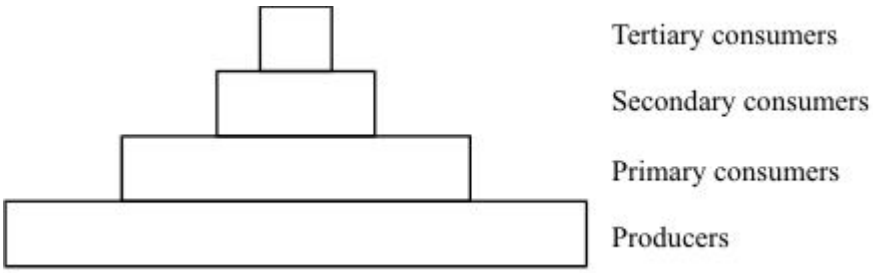
1 .....

2 .....

3 .....

(3)

(b) This is a pyramid of biomass for the organisms in the aquarium.



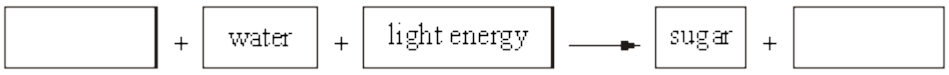
Some of the biomass of the producers is **not** transferred to the tertiary consumers.

Explain, as fully as you can, what happens to this biomass.

(6)

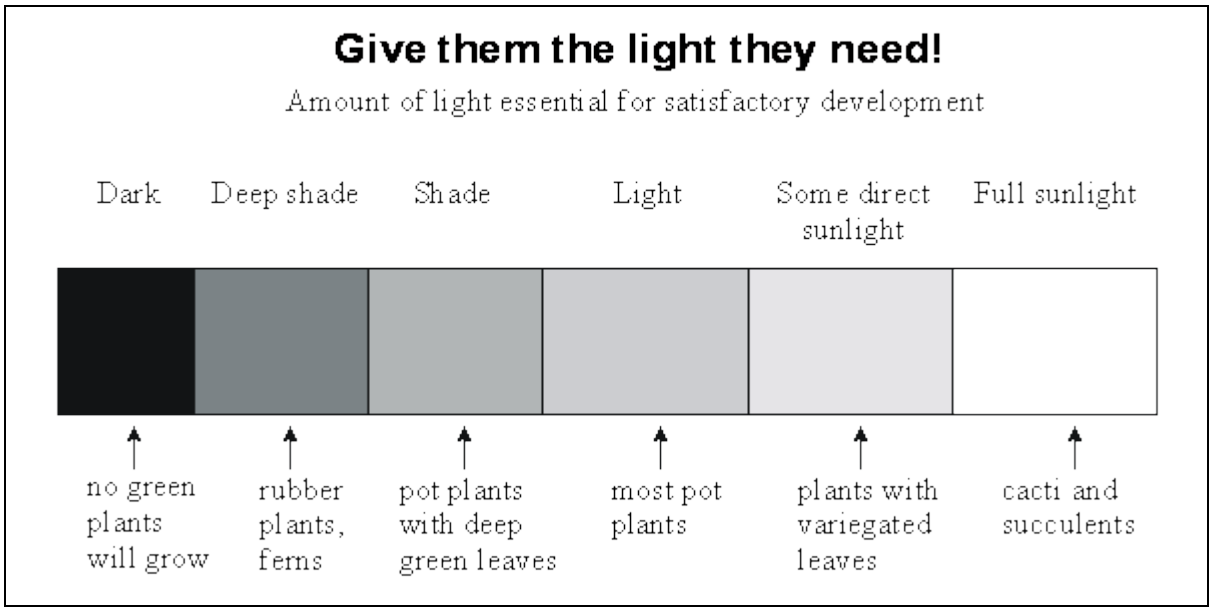
(Total 10 marks)

15 (a) Complete the equation for photosynthesis.



(2)

(b) The diagram below is printed in a plant care manual.



Use information from the diagram to answer the following questions.

(i) Name **one** type of plant which could live on the floor of a dense forest in the middle of summer.

.....

(1)

(ii) Explain the reason for your answer to (i) above.

.....

.....

(1)

(iii) The drawing shows one type of plant with variegated leaves.

The manual says that these plants need direct sunlight.

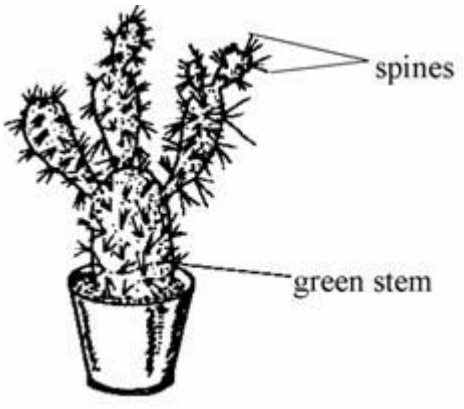
Suggest and explain why this plant needs 'some direct sunlight' in order to develop satisfactorily.

.....

.....

(2)

(iv) The drawing shows a cactus.



Suggest and explain why cacti can only develop satisfactorily if they receive full sunlight.

.....

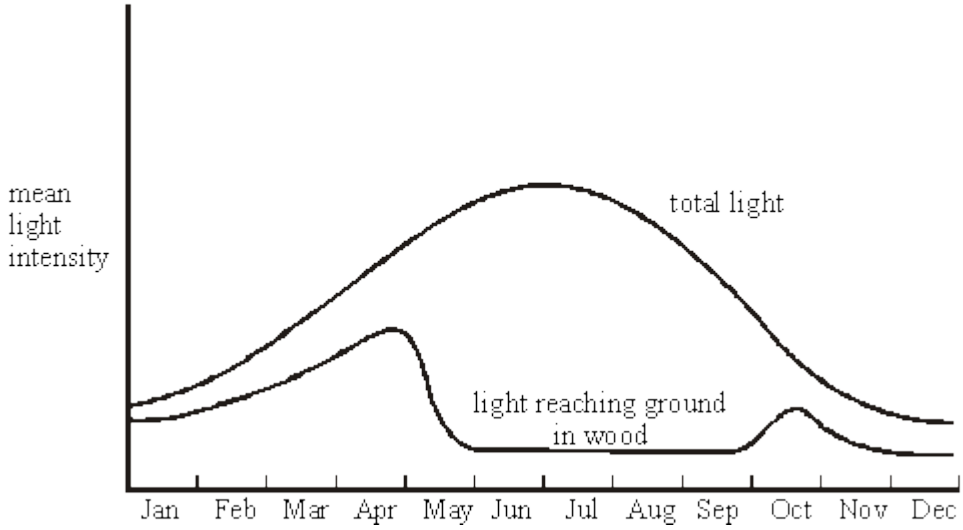
.....

.....

.....

(2)
(Total 8 marks)

16 The graph shows the mean light intensity at different times of the year in an oak wood.



(a) (i) In which month would you expect the rate of photosynthesis in the oak trees to be greatest?

.....

(1)

(ii) There are plants living on the ground in the wood. In which month would you expect their rate of growth to be fastest?

.....

Explain your answer.

.....

.....

.....

.....

(3)

(b) Name **two** factors, other than light intensity, that would affect the rate of photosynthesis in the oak trees.

1 .....

2 .....

(2)

(Total 6 marks)

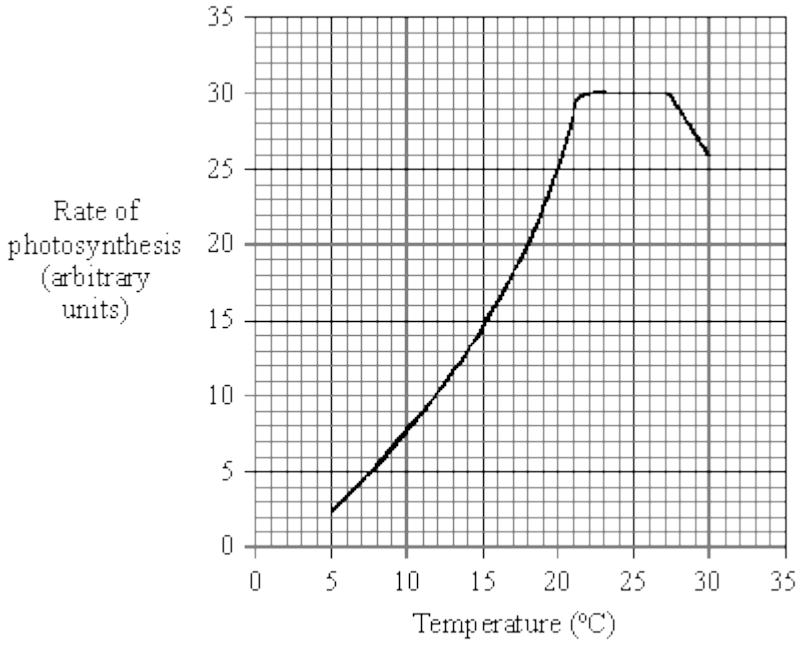
17 Green plants make food in their leaves.

(a) From where do the leaves get the energy that they need to make food?

.....

(1)

(b) The graph shows the effect of temperature on the rate of photosynthesis.



(i) Between which temperatures is the rate of photosynthesis fastest?

..... and ..... °C

(1)

(ii) Suggest why the rate of photosynthesis stays the same between these two temperatures.

.....

.....

.....

.....

(2)

(iii) A greenhouse owner wants to grow lettuces as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the lettuces as quickly and cheaply as possible?

..... °C

Explain your answer.

.....

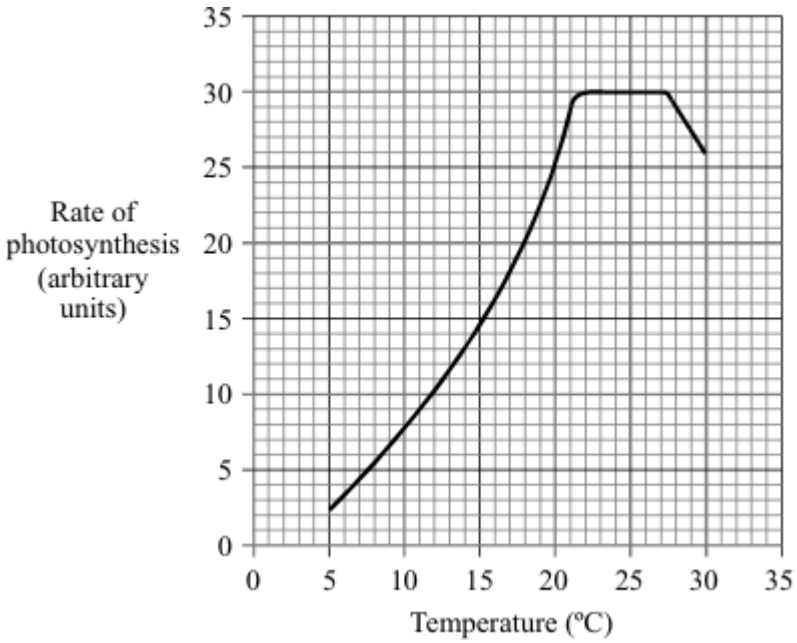
.....

.....

.....

(3)
(Total 7 marks)

18 The graph shows the effect of temperature on photosynthesis.



(a) Between which temperatures is the rate of photosynthesis fastest?

..... and ..... °C

(1)

(b) Suggest why the rate of photosynthesis stays the same between these two temperatures.

.....

.....

.....

.....

(2)

(c) A greenhouse owner wants to grow lettuces as quickly and cheaply as possible in winter.

At what temperature should he keep his greenhouse in order to grow the lettuces as quickly and cheaply as possible?

..... °C

Explain your answer.

.....

.....

.....

.....

(3)
(Total 6 marks)

19 Busy lizzie plants produce flowers with many different colours.

A gardener wants to produce busy lizzie plants to fill a flower bed in her garden.
She decides to grow them from cuttings rather than seeds.

(a) Give **one** condition that she should supply to the new cuttings so that they grow well.

.....

(1)

Busy Lizzie plants can produce flowers which are white, pink or red.
A gardener wants to grow a display containing all three colours of flowers.

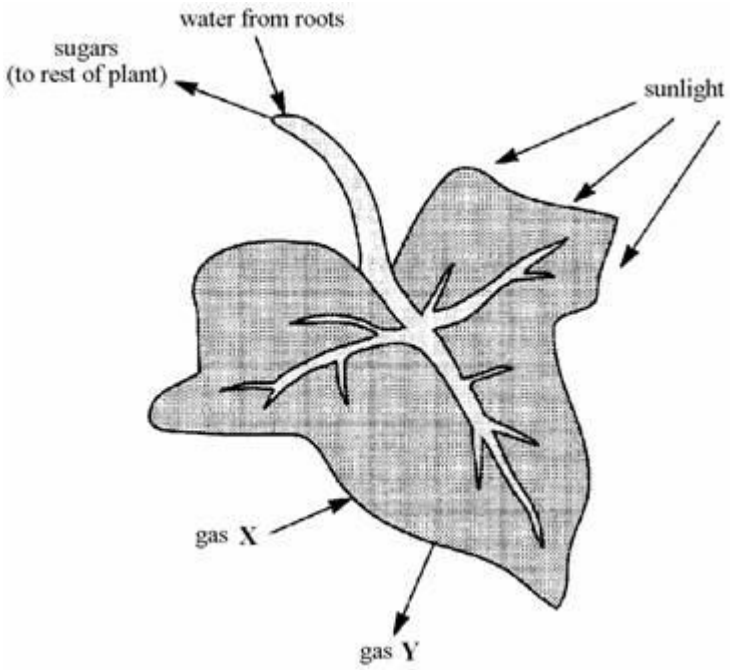
(b) Give **one** advantage and **one** disadvantage to the gardener of growing Busy Lizzie plants from cuttings rather than seeds.

Advantage .....

Disadvantage .....

(2)
(Total 3 marks)

20 The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas **X**; .....

(ii) gas **Y**. .....

(2)

(b) Why is sunlight necessary for photosynthesis?

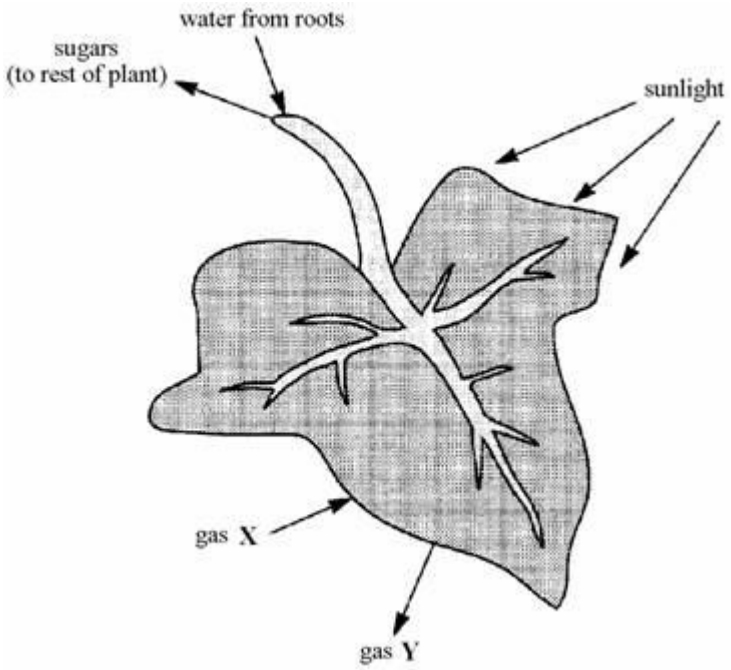
.....

.....

(1)

(Total 3 marks)

21 The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas **X**; .....

(ii) gas **Y**. .....

(2)

(b) Why is sunlight necessary for photosynthesis?

.....

.....

(1)

(c) Some of the sugars produced by photosynthesis are stored as starch in the roots. Explain, as fully as you can, why it is an advantage to the plant to store carbohydrate as starch rather than as sugar.

.....

.....

.....

.....

.....

.....

(3)

(Total 6 marks)

22 Low light intensity is one factor that limits the yield of a crop.

In Britain, many tomato growers use artificial lights to increase the yield of tomato crops.

The table shows the amount of natural daylight and artificial lamplight received by a tomato crop grown in a greenhouse.

Month	Natural daylight received by tomato plant		Artificial lamplight given to tomato plant		Total light energy received by plant per day in J/cm^2	Percentage increase in growth resulting from artificial light
	Day length in hours	Light energy received by plant per day in J/cm^2	Hours of light given per day	Light energy received by plant per day in J/cm^2		
January	8.1	239	18	492	731	206
February	9.9	492	18	492	984	100
March	11.9	848	12	328	1176	39
April	13.9	1401	2	55	1456	4
May	15.5	1786	0	0	1786	0
June	16.6	1960	0	0	1960	0
July	16.2	1849	0	0	1849	0
August	14.7	1561	0	0	1561	0
September	12.8	1064	2	55	1119	5
October	10.6	614	11	301	915	49
November	8.8	288	18	492	780	171
December	7.6	183	18	492	675	269

(a) Describe the pattern for the amount of light energy received from natural daylight by a tomato plant during the day.

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(3)

(b) A tomato plant needs 600 J of light energy per cm^2 each day to grow and produce tomatoes.

Use this information and data from the table to suggest an explanation for the pattern of the artificial light given to the tomato plants.

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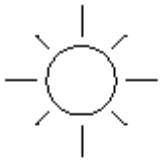
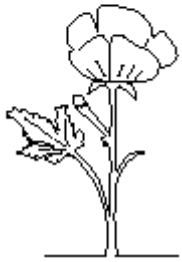
(2)
(Total 5 marks)

23

Energy for living organisms comes from the Sun.





Complete the sentences by using the correct words from the box.

animals	**carbohydrates**	**carbon dioxide**	**oxygen**	**plants**	**water**

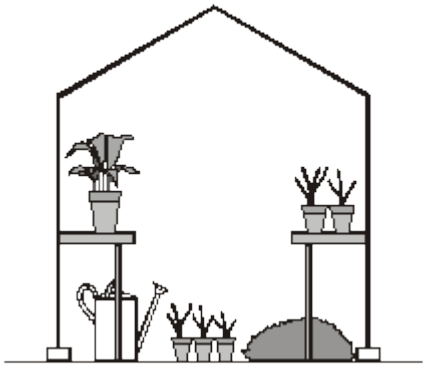
Light energy is captured by green ..... .

They use this energy to make ..... .

To do this, they also use ..... .

(Total 3 marks)

24 The diagram shows some plants growing in a greenhouse on a hot summer's day.



Which **one** of the following factors is most likely to limit the rate of photosynthesis at this time?

- carbon dioxide concentration
- light intensity
- temperature

Factor .....

Explain the reason for your answer.

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(Total 4 marks)

25 Carnation plants have attractive flowers.

(a) Carnation plants are grown from cuttings.

Complete the sentences by using the correct words from the box.

asexual	**clones**	**genes**	**mutation**	**sexual**

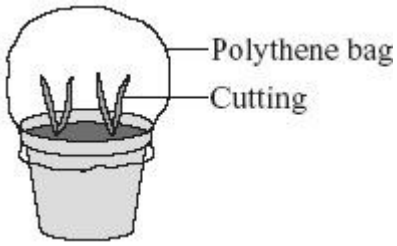
Carnations grown from cuttings have the same ..... as their parents.

This type of reproduction is ..... .

The new plants are known as ..... .

(3)

(b) Gardeners usually cover the cuttings with a polythene bag as shown in the diagram below.



Why do the cuttings grow better if gardeners do this?

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.....

(1)
(Total 4 marks)

26 Nitrate fertilisers are important in agriculture. They help to increase crop yields and so make food cheaper to buy. Some of the nitrate fertilisers run off into rivers and get into drinking water. The problem is that the nitrates can react with iron in our blood. This reduces the blood's ability to carry oxygen. If the amount of nitrate in drinking water is too high, it can cause 'blue baby syndrome', in which babies look blue due to lack of oxygen.

The table shows the amount of nitrate fertilisers used and the crop yield.

Nitrate fertilisers in kilograms per hectare of land	0	150	250
Crop yield in tonnes per hectare of land	5	8	7

Use the information above to suggest what should be done, by farmers and government, to prevent 'blue baby syndrome'. Explain the reasons for your suggestions.

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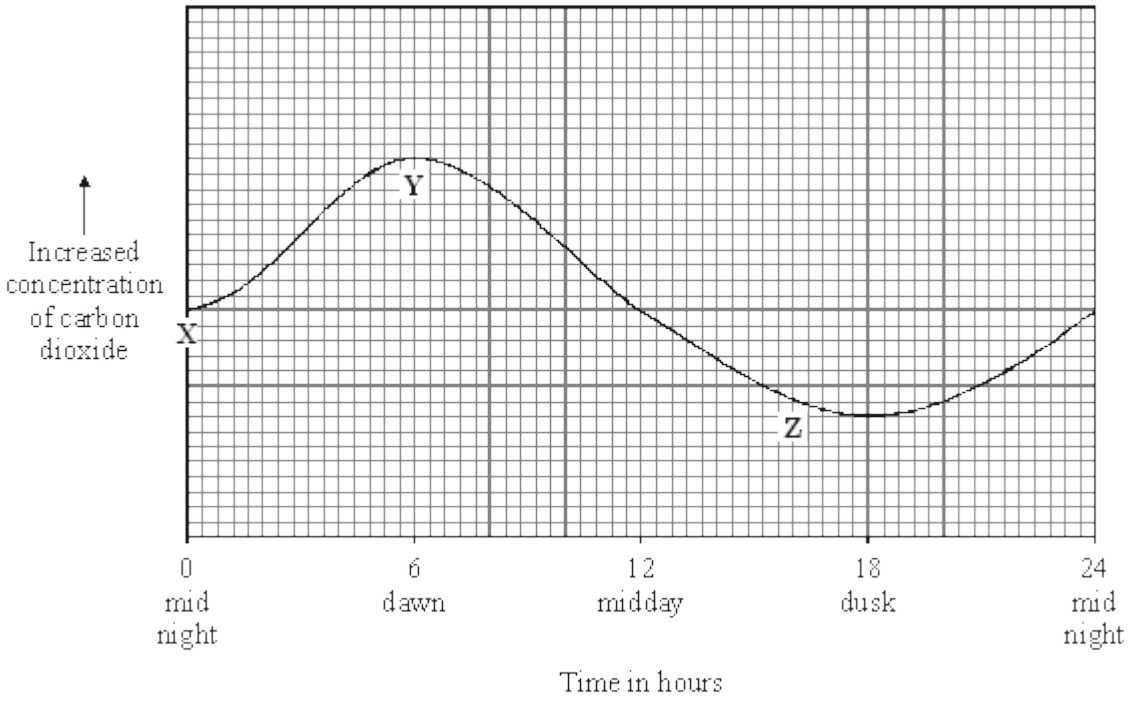
(Total 3 marks)

27 The graph shows the concentration of carbon dioxide in the air in a greenhouse full of tomato plants, measured over a period of 24 hours.



(a) Explain why the concentration of carbon dioxide in the air in the greenhouse increased between **X** and **Y**.

.....

.....

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.....

(2)

(b) Explain why the concentration of carbon dioxide in the air in the greenhouse decreased between **Y** and **Z**.

.....

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.....

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(2)
(Total 4 marks)

28 (a) Balance the following equation for photosynthesis.

..... CO_2 + ... H_2O → $C_6H_{12}O_6$ + ... O_2

(1)

(b) Give **two** conditions necessary for photosynthesis apart from a suitable temperature range and the availability of water and carbon dioxide.

1. .....

2. .....

(2)

(a) Plants have leaves which contain guard cells and palisade cells. Explain how **each** of these kinds of cell assists photosynthesis.

Guard cells .....

.....

.....

.....

(2)

Palisade cells .....

.....

.....

.....

(2)

(d) Glucose is a product of photosynthesis. Give **three** uses which green plants make of glucose.

1. .....

2. .....

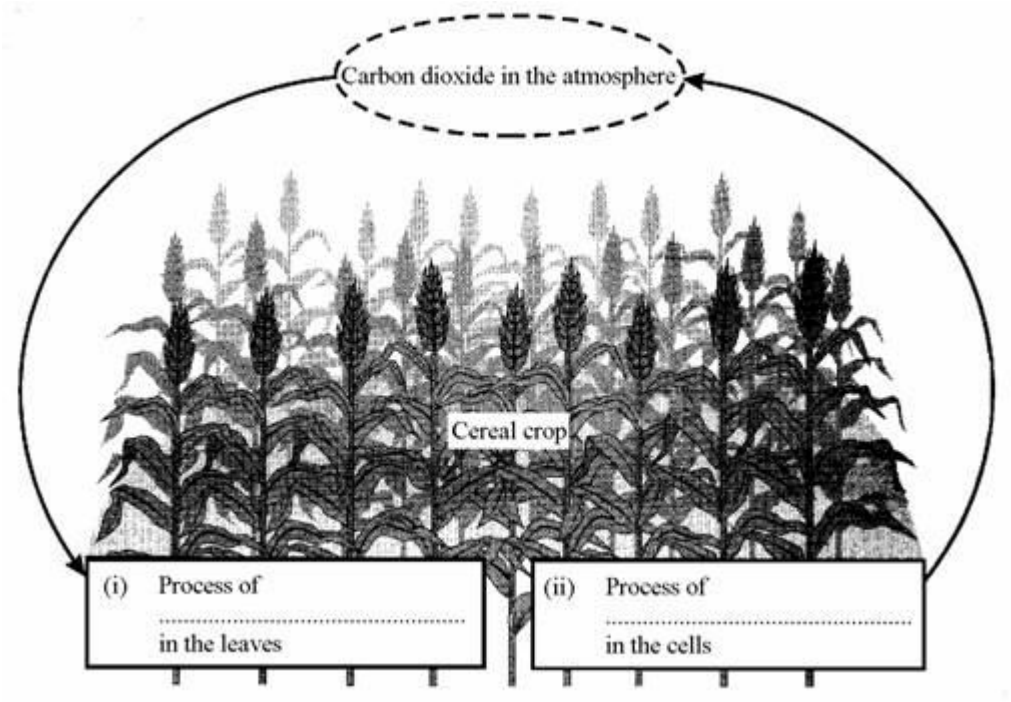
3. .....

(3)

(Total 10 marks)

29 (a) The diagram shows a cereal crop.

Complete spaces (i) and (ii).



(2)

(iii) What sort of weather may cause the cereal crop to wilt?

.....

(1)

(b) Describe the process of transpiration in plants.

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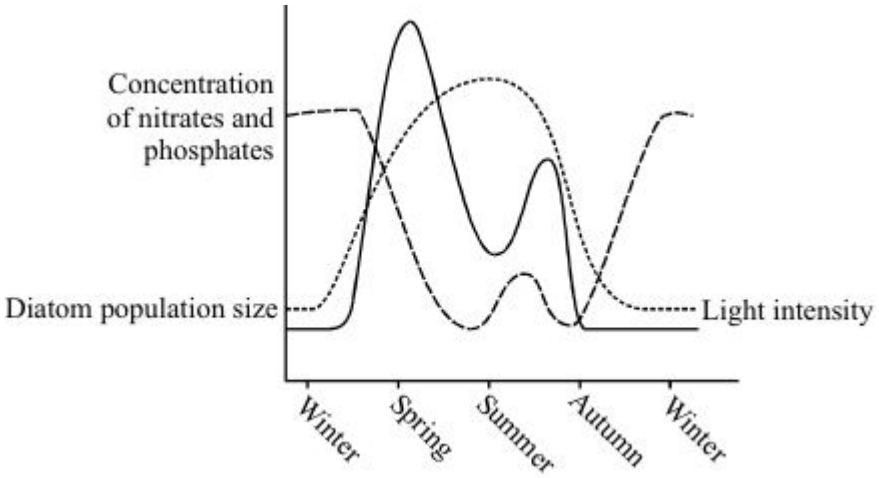
(3)
(Total 6 marks)

30 A food chain in the North Atlantic Ocean is:

diatoms → small fish → large fish

The graphs show how over a year:

- the population size of diatoms in the North Atlantic varies;
- the light intensity alters;
- the concentration of nitrate and phosphate minerals alters.



(a) Explain why the light intensity is a major factor in controlling the numbers of diatoms.

.....

.....

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(2)

(b) (i) Suggest **two** reasons why the population of diatoms decreases between spring and summer.

1. .....

.....

2. .....

.....

(2)

(ii) Give **two** reasons why the population of diatoms decreases in autumn.

1. .....

.....

2. .....

.....

(2)

(c) Use the information on the graph to suggest what change causes the number of diatoms to increase in the late summer. Give a reason for the change.

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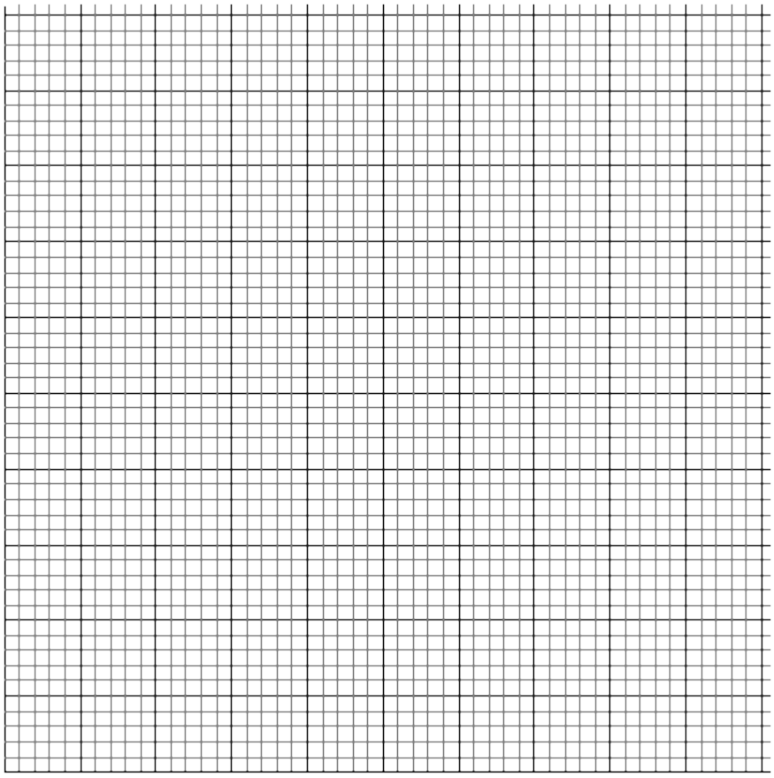
(2)
(Total 8 marks)

31 The figures below show how the yield of a wheat crop is affected by adding nitrogen fertiliser.

Nitrogen fertiliser added (kg/hectare)	Yield (tonnes/hectare)
0	26
50	28
75	31
100	34
125	40
150	43
175	44
200	44

(a) Display these results on the graph paper in the most suitable way.



(4)

(b) What conclusions can you draw from the graph?

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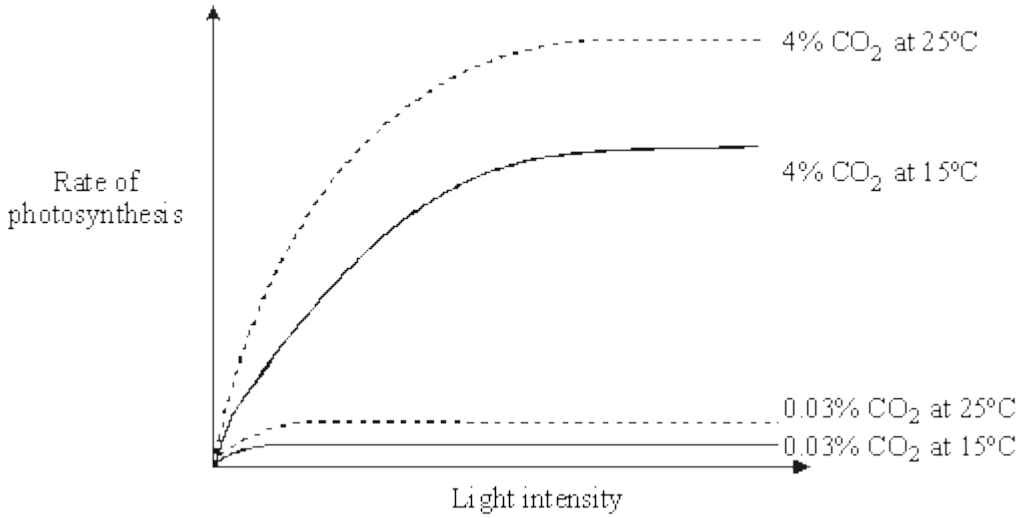
(3)
(Total 7 marks)

32 The graph shows how the rate of photosynthesis is affected by different conditions.



(a) What patterns can you find from this graph?

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.....

(5)

(b) How useful could this information be to a grower using glasshouses? Give reasons for your answer.

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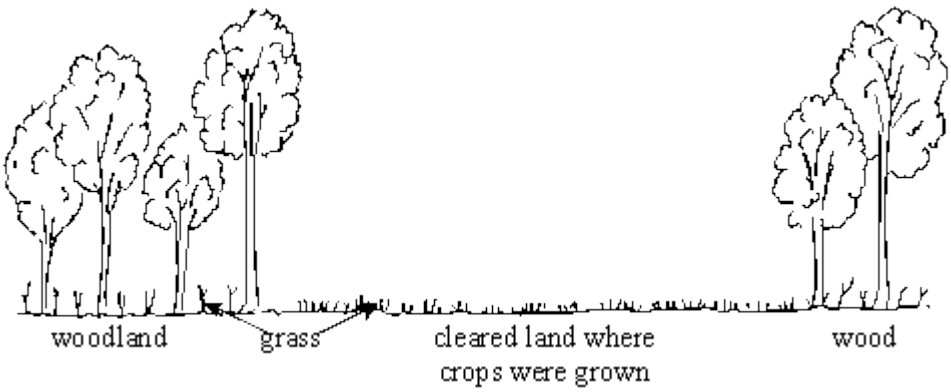
.....

.....

(2)
(Total 7 marks)

33 In some developing countries woodland is cut down and burned. The ash acts as fertiliser. Crops are grown for three years. The land is then left as it is too poor to grow any more crops.



(a) In the original woodland trees and plants died and grew for hundreds of years. When cleared the land grew crops for only three years. Explain this difference in as much detail as you can.

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(3)

(b) What could farmers do to make crops grow on the cleared land for more than three years?

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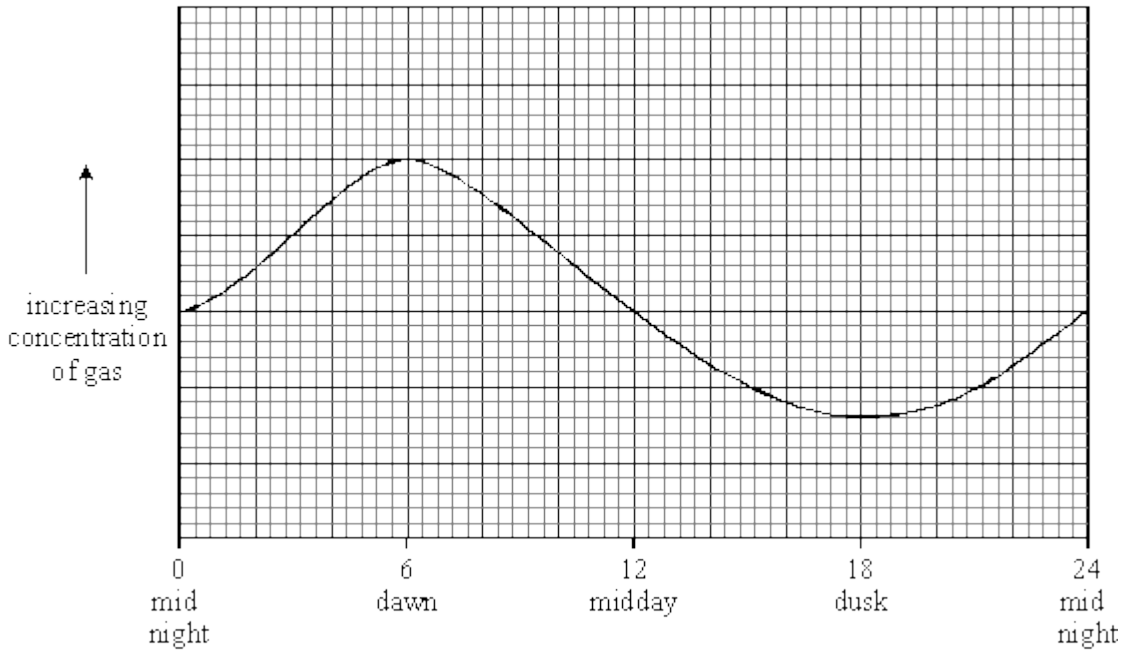
(2)
(Total 5 marks)

34 Plants produce glucose by a process called photosynthesis.

$$\text{carbon dioxide + water} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{oxygen + glucose}$$

The plant uses glucose to grow.

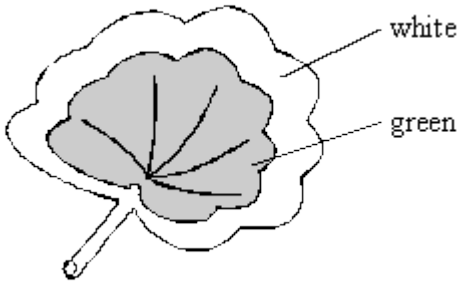
(a) The graph shows the change in concentration of carbon dioxide in a glasshouse full of plants over 24 hours.



Draw a line on the graph to show how the concentration of oxygen changes in the glasshouse.

(3)

(b)



Some plants have variegated leaves with white parts which contain no chlorophyll.

How do you think a variegated geranium would grow compared to a similar sized geranium with all green leaves?

Explain your answer.....

.....

.....

(2)
(Total 5 marks)

35 Plants are grown in glasshouses to protect them from the weather or extend the growing season.

Plants make food by photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{light}]{\text{energy from}} C_6H_{12}O_6 + 6O_2$$

glucose

In winter, when days are shorter, glasshouses are heated to keep the enzyme reactions in plants at optimum rates.

What else should a grower do to make sure that the plants are photosynthesising at the optimum rate? Give a reason for your answer.

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(Total 3 marks)

36

The table below shows a wheat farmer's calendar.

October	Winter Wheat is sown and germinates. Phosphate/potash fertiliser is applied.
March	Wheat plants resume growth. Nitrate fertiliser is applied.
April	Ammonium nitrate, the main fertiliser, is applied. Fungicide may be sprayed to control mildew or rust on wheat.
May	Extra ammonium nitrate fertiliser may be applied. A second spraying of fungicide may be needed. Dwarfing hormone sprayed to keep wheat straw (stalks) short.
June	Insecticide spray against aphids may be needed. Extra spraying of fungicide may be needed.
August	Wheat is harvested.
August/ September	Ground sprayed with weedkiller. Stubble (remains of wheat plants) is ploughed in ready for the next crop.

This process uses expensive fertilisers and pesticides to grow pest free crops which may be produced in excess.

What are the reasons for and against growing wheat in this way?

For .....

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.....

(3)

Against .....

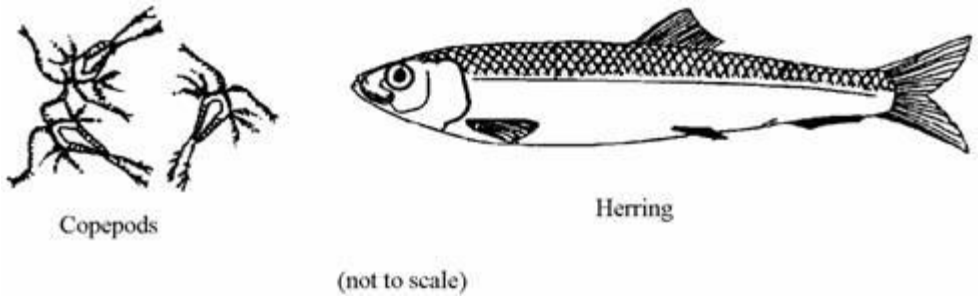
.....

.....

(4)

(Total 7 marks)

37 Copepods are tiny animals which live in the sea.



During the day they live deep down near the sea bed.
At night they move up to the surface where they feed on tiny plants.
When the sun rises they move down to the bottom again.

(a) Suggest why the tiny **plants** live near the surface of the sea.

.....

.....

(2)

(b) Herring feed on copepods.

Where will herring be found during the day? Give a reason for your answer.

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(2)
(Total 4 marks)