



Exampro GCSE Biology

B2.2 Photosynthesis
Higher tier

Name:

Class:

Author:

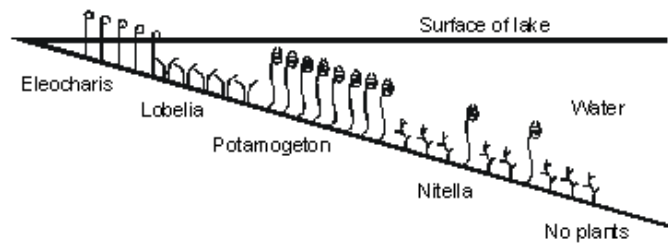
Date:

Time: 71

Marks: 71

Comments:

Q1. This is a diagram of a belt transect showing the major types of plants growing on the bottom of a lake.



(a) Suggest, and explain, **two** reasons why a much smaller population of *Nitella* plants is found amongst the *Potamogeton* plants than further down in the lake.

1.

2.

(4)

(b) Describe how you would use the belt transect technique to measure the abundance and distribution of plants which live on the bottom of a shallow lake.

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(3)

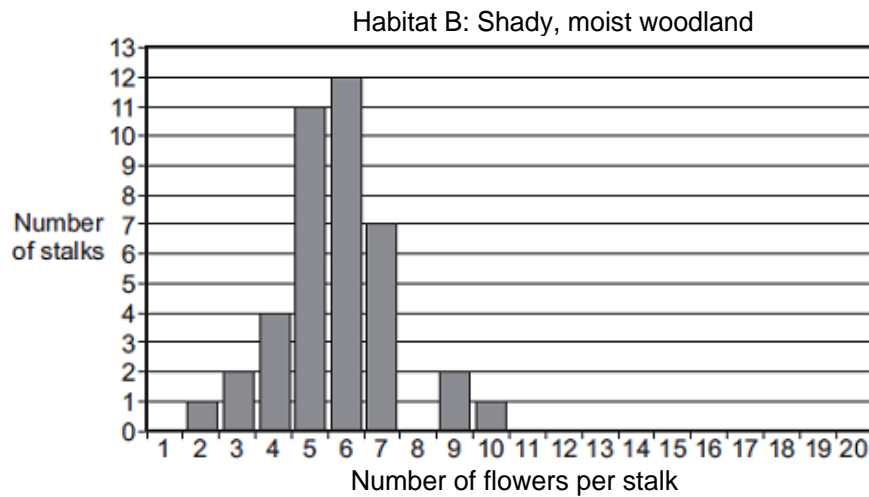
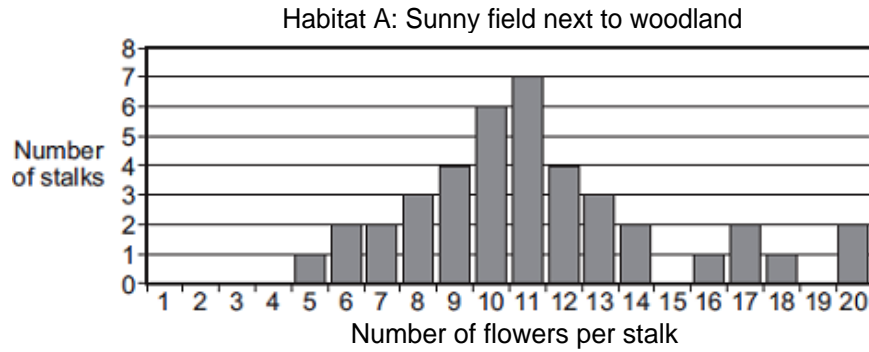
(Total 7 marks)

Q2. Some students studied bluebell plants growing in two different habitats.

Habitat **A** was a sunny field next to woodland.

Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat. The bar charts show the results.



(a) The students wanted to collect valid data. Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

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(2)

- (b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode =

(1)

- (ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

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(2)

- (iii) Suggest how the students could test their hypothesis for the two habitats.

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(2)

- (c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

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(2)

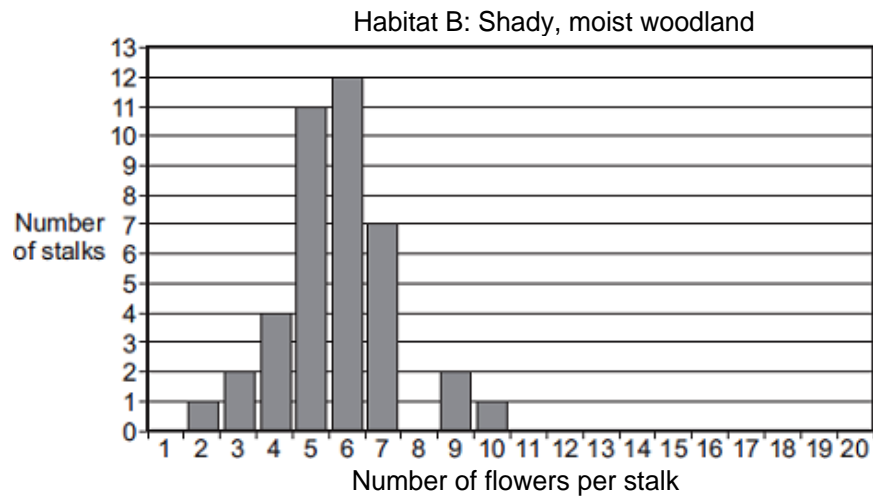
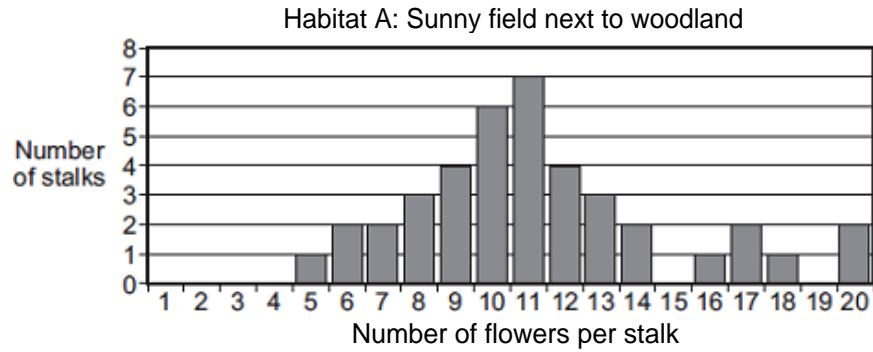
(Total 9 marks)

Q3. Some students studied bluebell plants growing in two different habitats.

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(2)

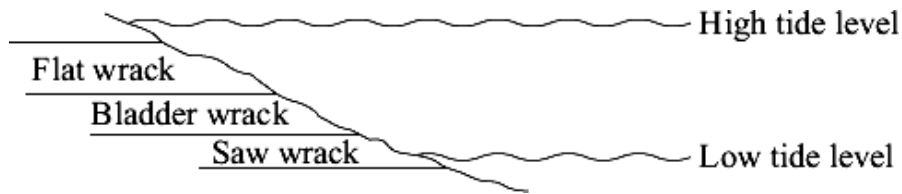
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(2)

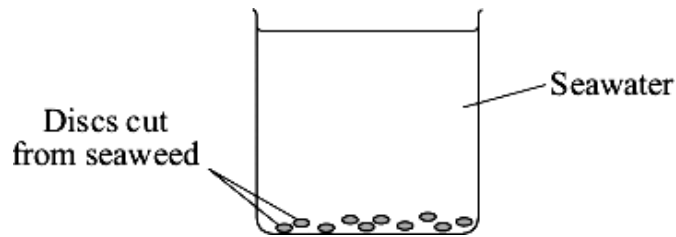
(Total 9 marks)

Q4. The diagram shows where three seaweeds live on a seashore. As the tide moves in and out, these seaweeds are covered with seawater for different lengths of time.



Some students investigated the rate of photosynthesis in these seaweeds.

- They cut ten small discs from one seaweed.
- They dropped the discs into seawater in a beaker.
- They recorded the time taken for the fifth disc to float to the surface.
- They repeated this experiment with the other two seaweeds.



(a) (i) Suggest why the discs floated to the surface.

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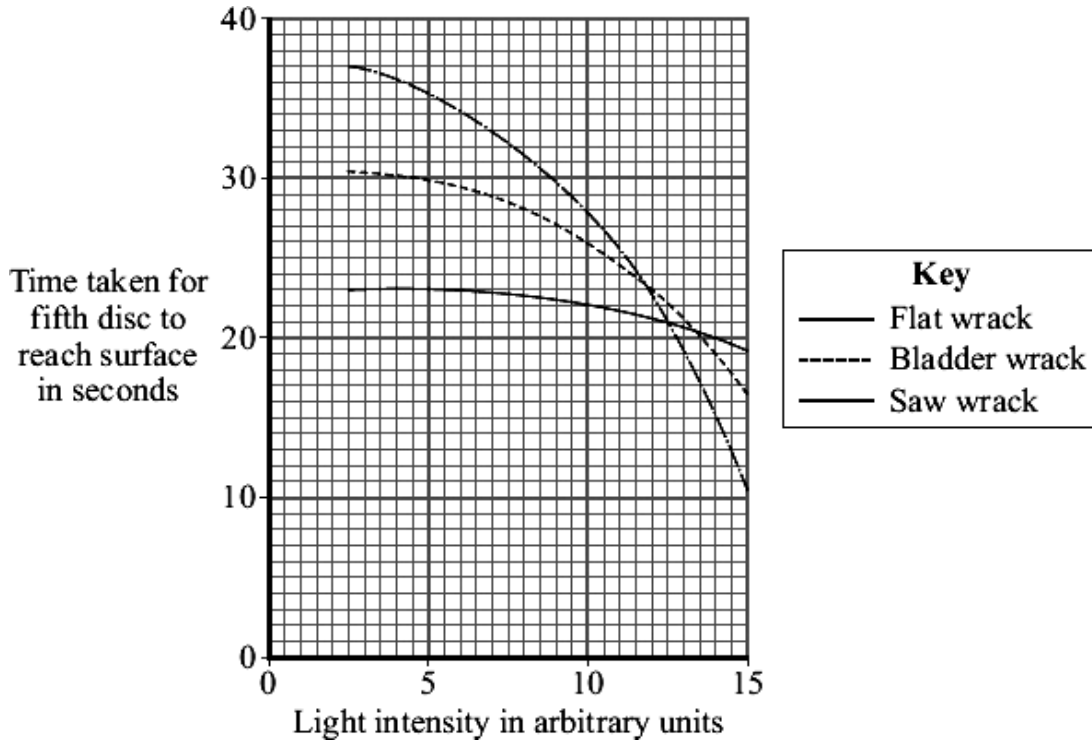
(1)

(ii) Suggest the advantage of recording the time taken for the fifth disc to reach the surface, rather than for the tenth disc.

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(1)

- (b) The students carried out their experiments at different light intensities. The graph shows the results they collected.



- (i) Compare the rate of photosynthesis for flat wrack with the rate for saw wrack at different light intensities.

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(2)

- (ii) Seawater absorbs light.

The growth rate of saw wrack is less than the growth rate of bladder wrack.

Suggest why.

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(2)

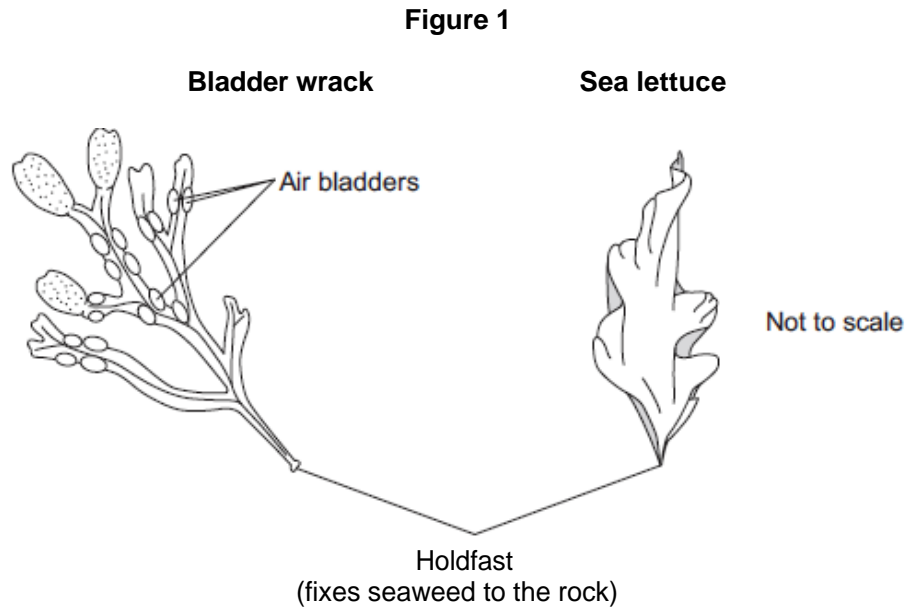
(Total 6 marks)

Q5. At the seashore, the tide comes in and goes out twice each day.

Some students investigated whether two different species of seaweed could live only at certain positions on a rocky shore.

Seaweeds are plant-like organisms that make their food by photosynthesis.

Figure 1 shows the two species of seaweed that the students investigated.

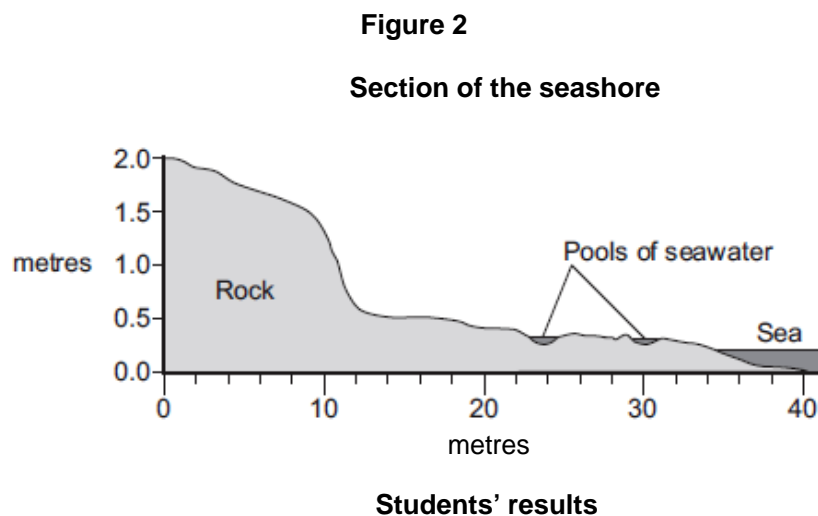


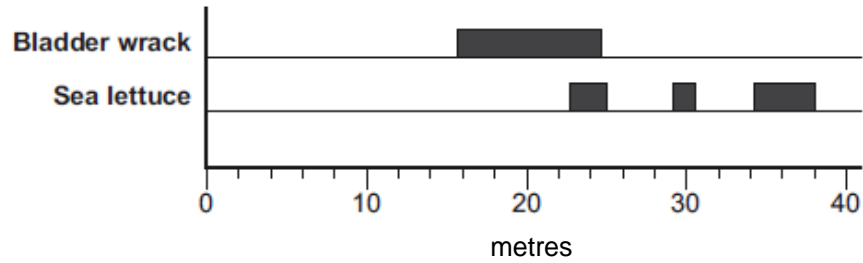
(a) The students:

- 1 placed a 50-metre tape measure on the rocks at right angles to the sea
- 2 placed a quadrat next to the tape measure
- 3 recorded whether each species was present or not.

The students repeated steps 2 and 3 every metre down the shore.

Figure 2 shows a section of the seashore and the students' results.





- (i) The students placed the quadrat at regular intervals along a transect line rather than placing the quadrat at random positions anywhere on the rocky shore.

Explain why.

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(2)

- (ii) How could the students have improved their investigation to ensure that they produced valid data?

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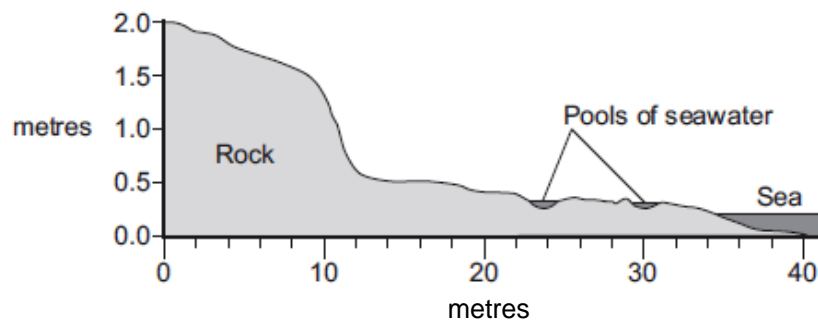
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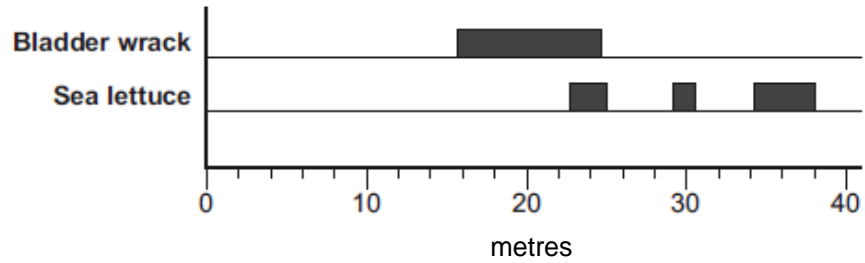
- (iii) **Figure 2** is repeated here to help you answer this question.

Figure 2

Section of the seashore



Students' results



The students concluded that bladder wrack is better adapted than sea lettuce to survive in dry conditions.

What is the evidence for this conclusion?

Use information from **Figure 2**.

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.....

(2)

- (b) The bladder wrack has many air bladders.
The air bladders help the bladder wrack to float upwards when the sea covers it.

Suggest how this helps the bladder wrack to survive.

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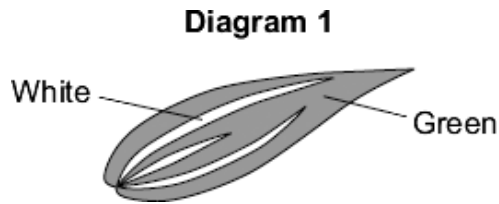
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(2)

(Total 8 marks)

Q6. Students investigated the effect of changing the carbon dioxide concentration on the rate of photosynthesis in pieces of leaf.

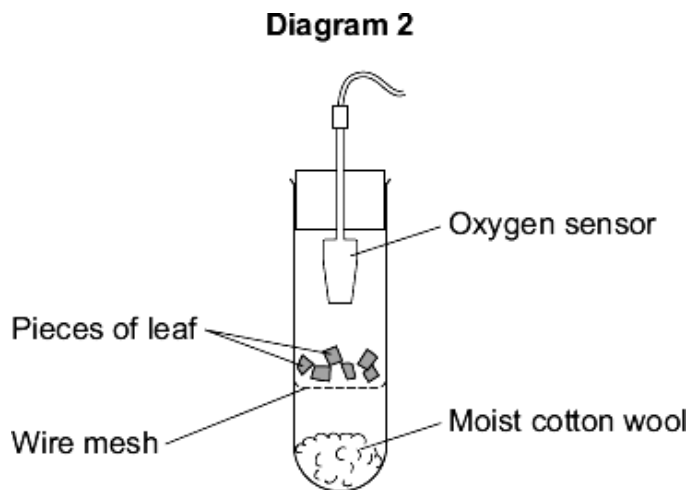
Diagram 1 shows the type of leaf used by the students.



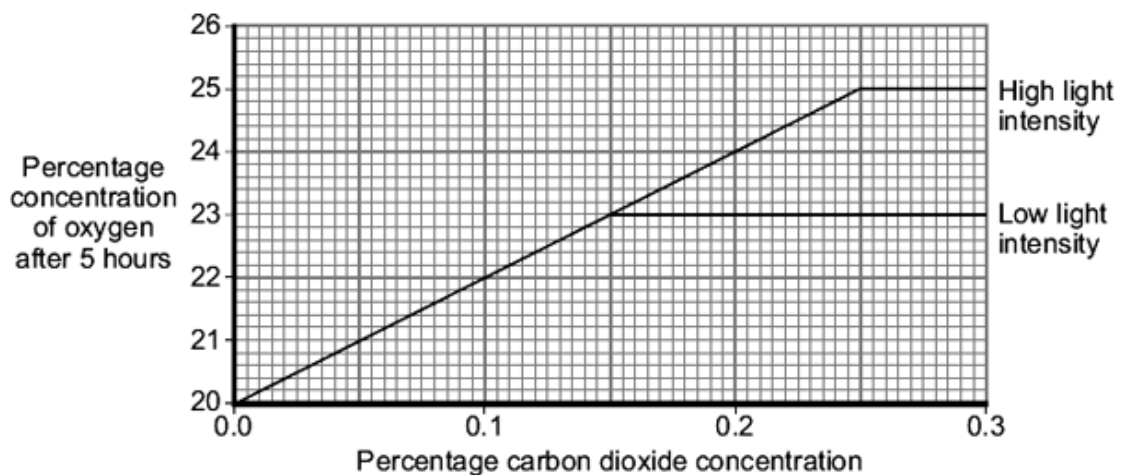
The students:

- cut pieces of leaf from the green region
- put the pieces into tubes
- added different concentrations of carbon dioxide to each tube
- shone lights on the tubes with either high or low light intensity
- recorded the concentration of oxygen in the tubes after 5 hours.

Diagram 2 shows how each experiment was set up.



The graph shows the results of the investigation.



(a) (i) Describe the effect of increasing carbon dioxide concentration on the rate of

photosynthesis at low light intensity.

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(1)

(ii) Explain the effect that you have described.

In your answer you should refer to limiting factors.

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(2)

(b) What would have been the effect on oxygen concentration over the five-hour period if a white region of the leaf had been used, instead of a green region?

Effect

Explain your answer.

Explanation

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.....

(2)

(c) Some people keep indoor plants which have variegated leaves (leaves with green and white regions).

If plants with variegated leaves are kept in dim light conditions the white areas of the leaves start to turn green.

This is an advantage to the plant.

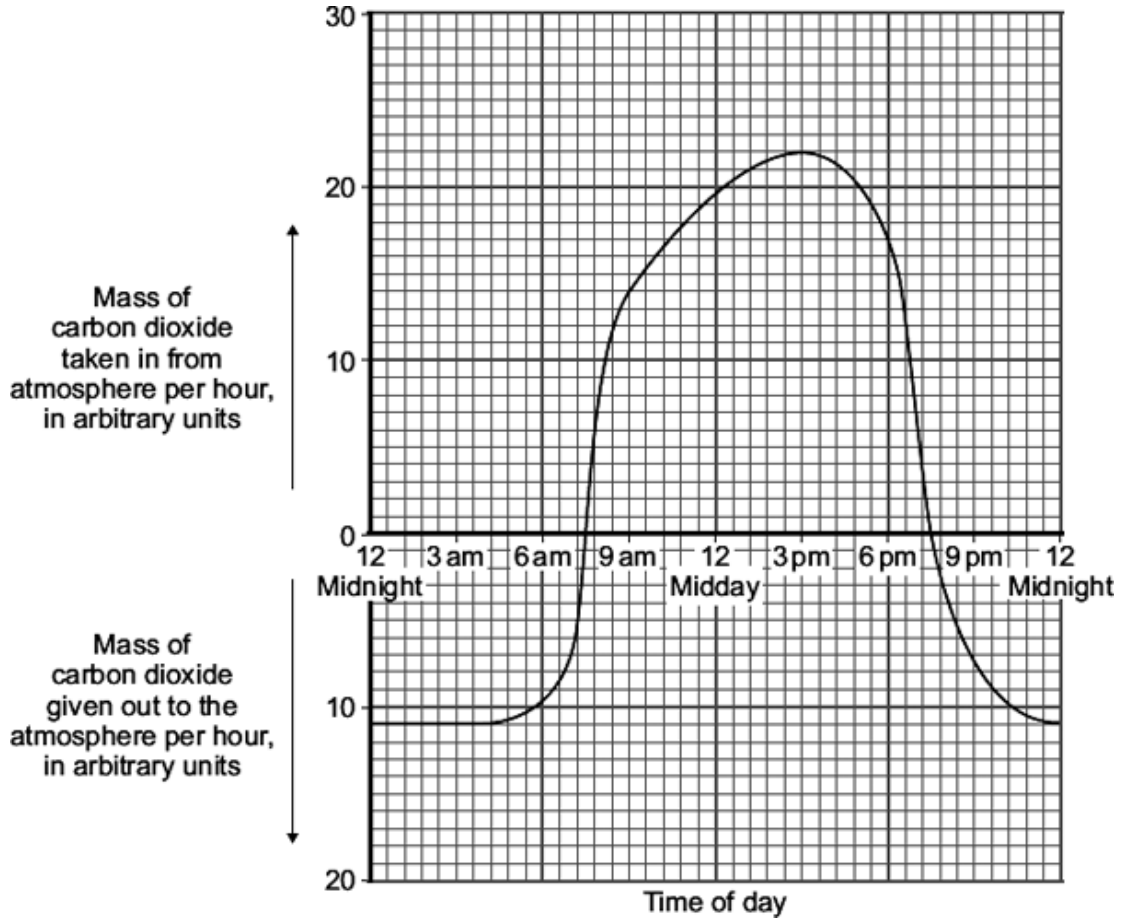
Suggest why.

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(2)

(Total 7 marks)

Q7. The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



(a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1 2

(1)

(b) The bean plant respire at the same rate all through the 24 hour period.

(i) How much carbon dioxide is released each hour during respiration?

..... arbitrary units

(1)

(ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

.....

Answer = arbitrary units

(1)

- (c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean plant.

Explain, in detail, why this was important for the bean plant.

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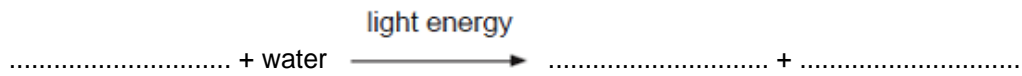
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(2)
(Total 5 marks)

- Q8.** (a) Complete the equation for photosynthesis.



(3)

- (b) The rate of photosynthesis in a plant depends on several factors in the environment. These factors include light intensity and the availability of water.

Describe and explain the effects of **two other** factors that affect the rate of photosynthesis.

You may include one or more sketch graphs in your answer.

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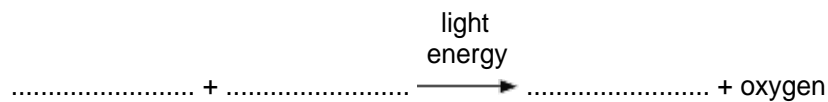
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(5)
(Total 8 marks)

- Q9.** (a) Complete the equation for photosynthesis.



(2)

- (b) Scientists investigated how temperature affects the rate of photosynthesis. The scientists grew some orange trees in a greenhouse. They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

- (i) The leaf discs did not produce any oxygen in the dark.

Why?

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(1)

- (ii) The leaf discs took in oxygen in the dark.

Explain why.

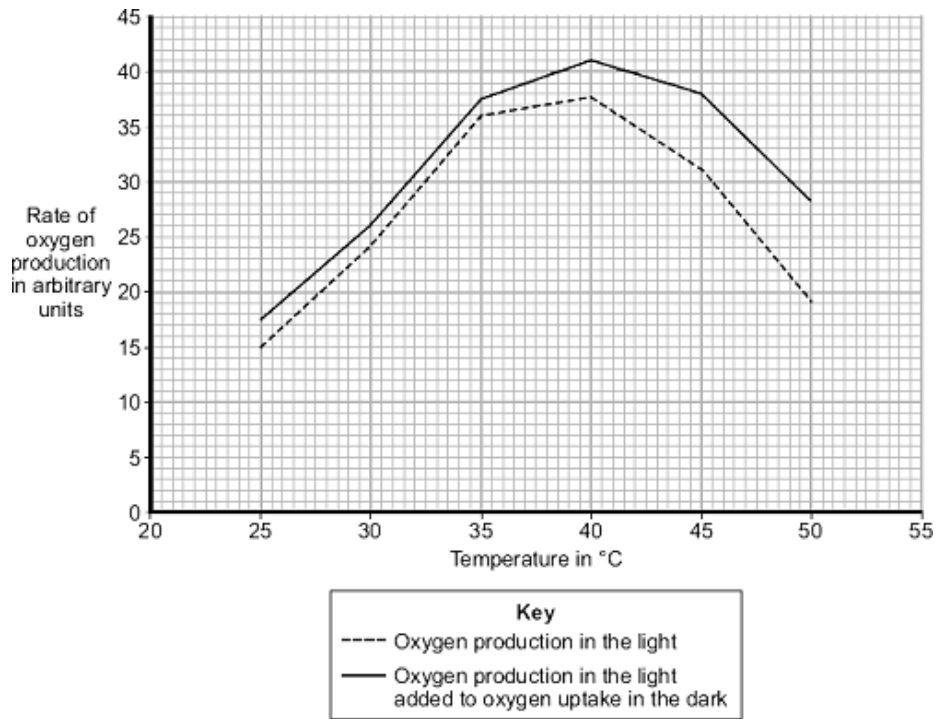
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(2)

- (c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

- (i) Describe the effect of temperature on oxygen production in the light.

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(2)

- (ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

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from 40 °C to 50 °C.

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(2)

- (d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

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(3)
(Total 12 marks)

M1.	(a) e.g.: competition for light because potamogeton plants taller competition for nutrients taller plants may have longer roots <i>each for 1 mark</i>	4	
	(b) descriptions of: measuring tape or similar quadrat method of estimating cover (inside quadrat) <i>each for 1 mark</i>	3	[7]
M2.	(a) use of quadrat / point frame <i>allow description</i>	1	
	<u>randomly</u> placed / <u>random</u> sampling <i>ignore reference to transects</i>	1	
	(b) (i) 6	1	
	(ii) more <u>light</u> in A / in field / where sunny <i>ignore sun</i>	1	
	more / better / faster photosynthesis in A / with more light <i>allow converse</i>	1	
	(iii) use light meter / measure light <u>intensity</u> in both habitats	1	
	take many measurements at same time of the day	1	
	or		
	laboratory / field investigation with 2 batches high light and low light (1)		
	count or number of flowers in each (1) <i>counting point is dependent on investigation point</i>		
	(c) more glucose / energy available <i>allow other named product eg protein</i> <i>allow if more energy produced</i>	1	

for growth

dependent on 1st mark

1

[9]

M3. (a) use of quadrat / point frame

allow description

1

randomly placed / random sampling

ignore reference to transects

1

(b) (i) 6

1

(ii) more light in A / in field / where sunny

ignore sun

1

more / better / faster photosynthesis in A / with more light

allow converse

1

(iii) use light meter / measure light intensity in both habitats

1

take many measurements at same time of the day

1

or

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)

counting point is dependent on investigation point

(c) more glucose / energy available

allow other named product eg protein

allow if more energy produced

1

for growth

dependent on 1st mark

1

[9]

M4. (a) (i) oxygen produced

1

(ii) any **one** from:

- average / mean / median
ignore reliable / precise / accurate
- some may be anomalous
allow some may not float

1

(b) (i) *do **not** allow answers in terms of time only*
if candidate answers in terms of comparing rate of change then the rate of change of photosynthesis must be in the correct direction for 1 mark

any **two** from:

- low intensity / below 12.5 / 2.5 - 12.5 (units of light) flat wrack /it, rate of photosynthesis faster **or** saw wrack rate of photosynthesis slower
allow any value in range
- high intensity / above 12.5 / 12.5 - 15 (units of light) flat wrack / it,rate of photosynthesis slower **or** saw wrack rate of photosynthesis faster
allow any value in range
- same (rate) at 12.5 units

2

(ii) any **two** from:

- saw wrack receives less light
accept converse if clear reference to bladder wrack
 - less photosynthesis
if first and second responses, 'less' needed only once
- or**
- less carbohydrate / sugar / starch production
 - when tide is in **or** at high tide **or** any tide above low tide
accept saw wrack covered by water / submerged longer / more reference to position on shore is insufficient

2

[6]

M5. (a) (i) to get data re position of seaweed / of organism

1

in relation to distance from sea / distance down shore / how long each seaweed was exposed

1

	(ii)	repeat several times <i>minimum = 2 repeats</i>	1
		elsewhere along the shore	1
	(iii)	bladder wrack is further up the shore (than the sea lettuce) / exposed for longer <i>ignore found in dry areas / on bare rock</i>	1
		sea lettuce (only) in rock pools / in the sea / (only) in water	1
	(b)	gets more light / closer to light <i>allow better access to CO₂</i>	1
		(so) more photosynthesis <i>allow 1 mark for light for photosynthesis</i> <i>allow 1 mark for CO₂ for photosynthesis</i> <i>ignore reference to oxygen for respiration</i> <i>'more' only needed once for 2 marks</i>	1
			[8]
M6.	(a)	(i) increase (and then level off) and max / up to at 0.15 (%) (carbon dioxide) <i>ignore references to oxygen concentration only</i> <i>ignore mention of 23</i>	1
		(ii) <u>CO₂</u> is limiting at low CO ₂ / at first <i>ignore specific numbers</i>	1
		light is limiting at high CO ₂ / at end	1
	(b)	mark both parts together effect: (oxygen) falls	1
		explanation: (oxygen) used for respiration if no other marks awarded allow (effect) no change and (explanation) no photosynthesis for 1 mark	1
	(c)	more chlorophyll / chloroplasts	1

allows more photosynthesis / description
for both marks must refer to more at least once

1

[7]

M7. (a) 7.15 to 7.45 am **and** 7.15 to 7.45 pm
both required, either order
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33
allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used
allow more food made than used
- so plant able to grow / flower
accept plant able to store food

2

[5]

M8. (a) LHS – carbon dioxide / CO₂
allow CO2
ignore CO²

1

RHS

in either order

glucose / carbohydrate / sugar

allow starch

allow C₆H₁₂O₆ / C6H12O6

ignore C⁶H¹²O⁶

1

oxygen

allow O₂ / O2

ignore O² / O

1

(b) any **five** from:

- factor 1: CO₂ (concentration)
- effect - as CO₂ increases so does rate and then it levels off or shown in a graph
- explanation:
(graph increases) because CO₂ is the raw material or used in photosynthesis / converted to organic substance / named eg
or
(graph levels off) when another factor limits the rate.
accept points made via an annotated / labelled graph
- factor 2: temperature
allow warmth / heat
- effect – as temperature increases, so does the rate and then it decreases or shown in a graph
allow 'it peaks' for description of both phases
- explanation:
(rise in temp) increases rate of chemical reactions / more kinetic energy
allow molecules move faster / more collisions
or
(decreases) because the enzyme is denatured.
context must be clear = high temperature

*allow other factor plus effect plus explanation:
eg light wavelength / colour / pigments / chlorophyll / pH / minerals / ions / nutrients / size of leaves*
2nd or 3rd mark can be gained from correct description and explanation

5

[8]

M9. (a) LHS: carbon dioxide **AND** water

in either order

*accept CO₂ **and** H₂O*

allow CO2 and H2O

if names given ignore symbols

*do **not** accept CO² / H²O / Co / CO*

ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept C₆H₁₂O₆

allow C6H12O6

*do **not** accept C⁶H¹²O⁶*

1

- (b) (i) light is needed for photosynthesis
or
 no photosynthesis occurred (so no oxygen produced) 1
- (ii) oxygen is needed / used for (aerobic) respiration
full statement
*respiration occurs **or** oxygen is needed for anaerobic respiration*
gains 1 mark 2
- (c) (i) (with increasing temperature) rise then fall in rate 1
- use of figures, ie
 max. production at 40 °C
or maximum rate of 37.5 to 38 1
- (ii) 25 – 35 °C
either faster movement of particles / molecules / more collisions
or particles have more energy / enzymes have more energy 1
- or** temperature is a limiting factor over this range
40 – 50 °C
 denaturation of proteins / enzymes
ignore denaturation of cells
ignore stomata 1
- (d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate 1
- so waste of money **or** less profit / expensive 1
- because respiration rate is higher at > 35 °C
or
 respiration reduces the effect of photosynthesis 1

[12]

