

Section 11 - Bioenergetics

Answer Key

11.1	Write a word and balanced symbol equation for photosynthesis.	W: Carbon dioxide and water -> Glucose and Oxygen S: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
11.2	Where does photosynthesis take place in a cell?	Chloroplast
11.3	What type of reaction is photosynthesis and why?	Endothermic because the leaf absorbs energy from the sunlight to turn carbon dioxide and water in to oxygen and glucose.
11.4	Name 4 limiting factors of photosynthesis.	Light intensity, carbon dioxide concentration, amount of chlorophyll and temperature.
11.5	State 3 ways that glucose is used in a plant.	<ol style="list-style-type: none"> 1. Respiration 2. Making new proteins 3. Making cellulose for the plant cell walls 4. Stored as starch 5. Active Transport
11.6	What minerals are absorbed from the soil to help a plant?	Magnesium and Nitrate (for Chlorophyll production and growth)
11.7	What is respiration and where in the cell does respiration happen?	Respiration is the process by which organisms break down glucose (from sugars and carbohydrates in their food) in order to release energy. Aerobic respiration occurs in the mitochondria. Anaerobic occurs in the cytoplasm.
11.8	Write a word and balanced symbol equation for aerobic Respiration.	W: Glucose + Oxygen -> Carbon Dioxide + Water S: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
11.9	State the word equation for the anaerobic respiration in a) plants and yeast cells B) animals	A: Glucose -> Ethanol + Carbon Dioxide B: Glucose -> Lactic Acid
11.10	Why is respiration important?	Mammals and birds need energy to maintain a constant body temperature . Energy is also needed for the following processes: Growth, cell division, muscle contraction, protein synthesis, active transport , nerve impulses and building new molecules.
11.11	What is oxygen debt?	The amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and removed from the cells.
11.12	What is metabolism?	The sum of all the reactions in a cell body.

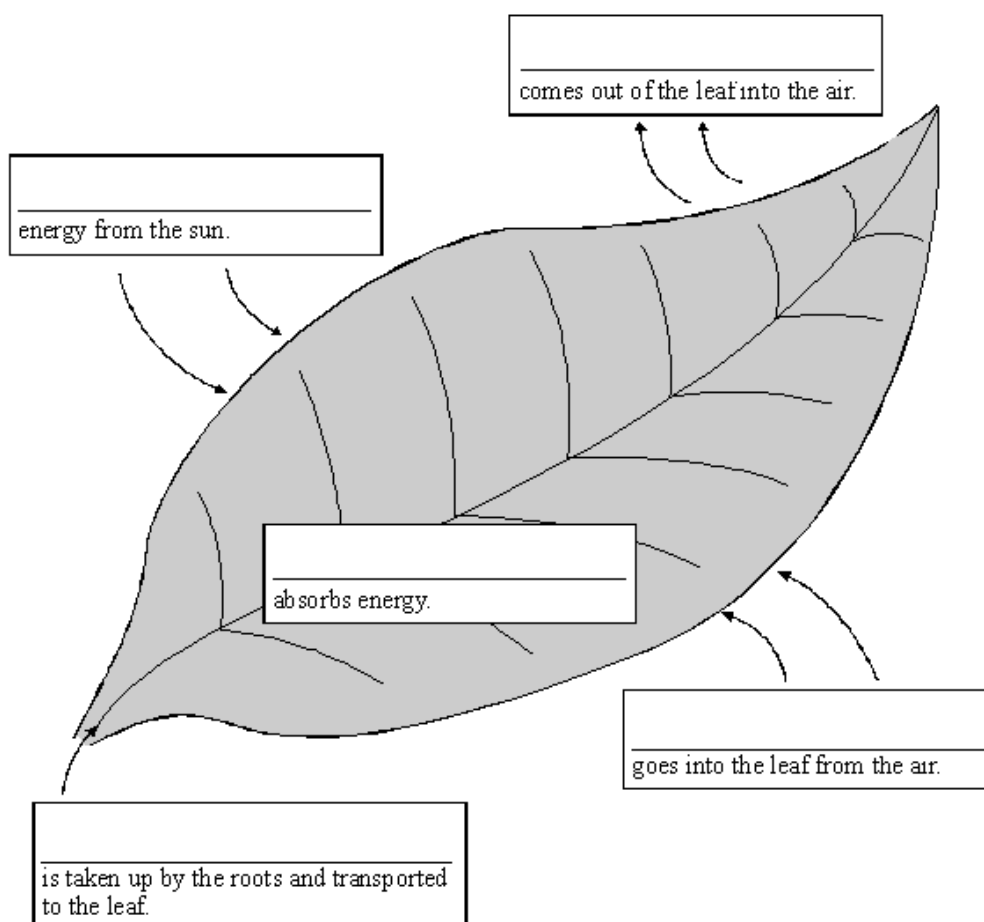
Foundation Tier

Q1.

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) Complete 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.

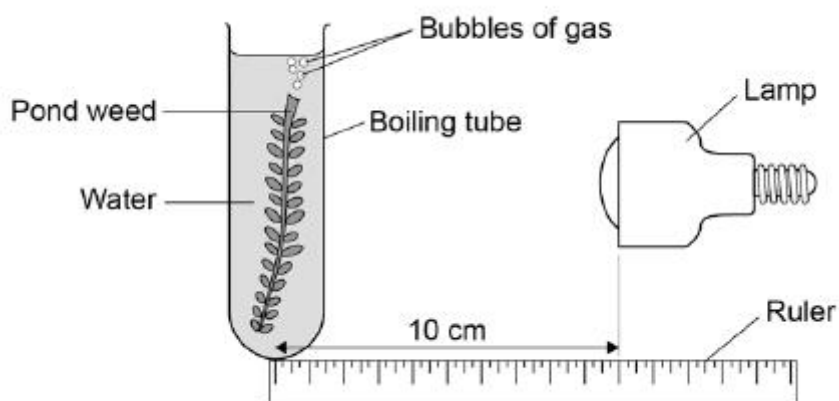
(1)

(Total 10 marks)

Q2.

A student investigated the effect of light intensity on the rate of photosynthesis.

The diagram shows the apparatus the student used.



This is the method used.

1. Set up the apparatus as shown in the diagram above.
2. Place the lamp 10 cm from the pondweed.
3. Turn the lamp on and count the number of bubbles produced in one minute.
4. Repeat with the lamp at different distances from the pondweed.

(a) Complete the hypothesis for the student's investigation.

'As light intensity increases, _____
_____.'

(1)

(b) What was the independent variable in this investigation?

Tick **one** box.

Light intensity

☐

Number of bubbles
produced

☐

Temperature

☐

Time

☐

(1)

- (c) The teacher suggests putting the boiling tube into a beaker of water during the investigation.

Suggest why this would make the results more valid.

(1)

Table 1 shows the student's results.

Table 1

Distance of lamp from pondweed in cm	Number of bubbles produced per minute			
	Trial 1	Trial 2	Trial 3	Mean
10	67	66	69	67
20	61	64	62	62.3
30	53	51	52	X
40	30	32	31	31
50	13	15	15	14

- (d) Calculate value **X** in **Table 1**.

X = _____ bubbles per minute

(1)

- (e) State **one** error the student has made when completing the results at 20 cm.

(1)

(f) What evidence in **Table 1** shows that the data is repeatable?

Tick **one** box.

The number of bubbles decreases as distance decreases.

☐

The numbers of bubbles at each distance are similar.

☐

The student calculated a mean for each distance.

☐

The student did the experiment three times.

☐

(1)

Another student investigated the effect of the colour of light on the rate of photosynthesis.

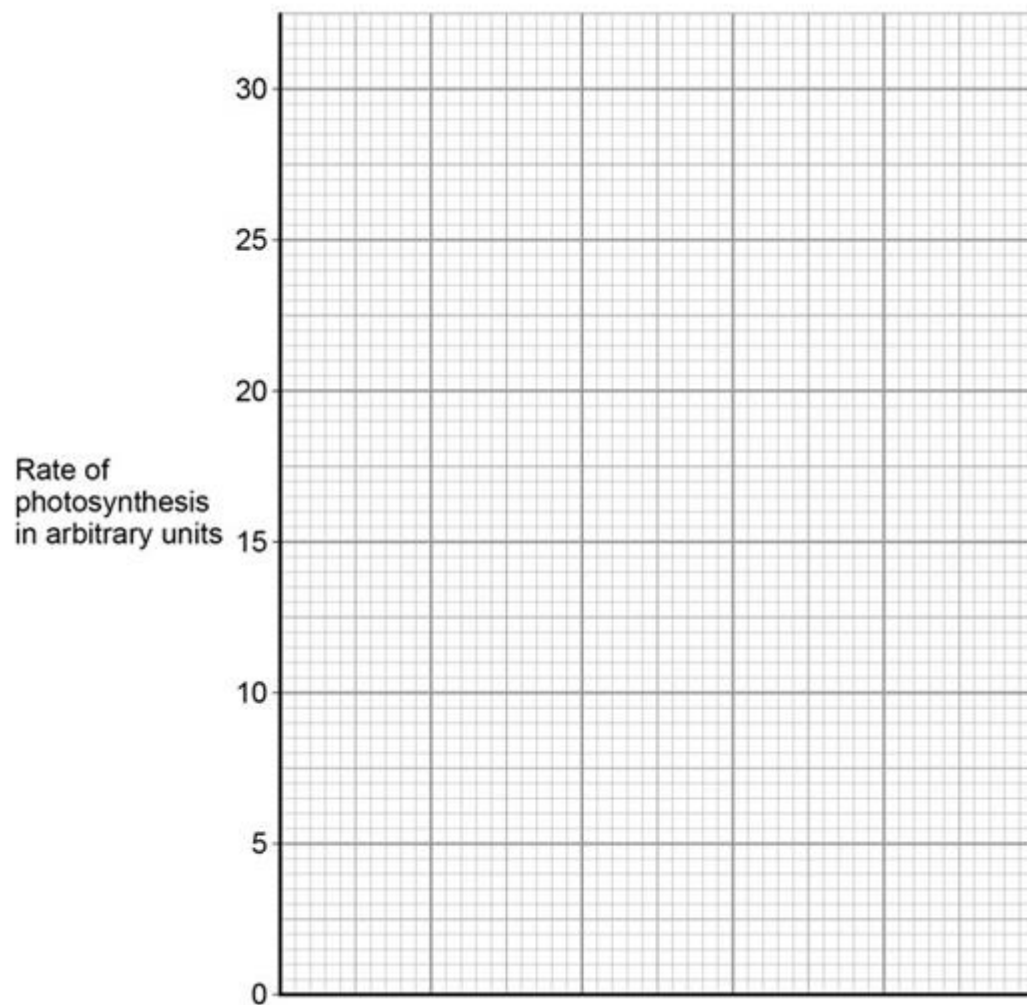
The results are shown in **Table 2**.

Table 2

Colour of light	Rate of photosynthesis in arbitrary units
Blue	24
Green	4
Red	17
Yellow	8

- (g) Plot the data from **Table 2** on the graph.

You should label the x-axis.



(3)

- (h) Give **two** conclusions from the graph above.

1. _____

2. _____

(2)

- (i) The glucose produced in photosynthesis can be converted into amino acids to make new proteins for the plant.

Complete the sentences.

The glucose produced in photosynthesis can also be used in other ways.

Glucose can be used in respiration to release _____ .

Glucose can be converted to cellulose to strengthen the _____ .

Glucose can be stored as _____ .

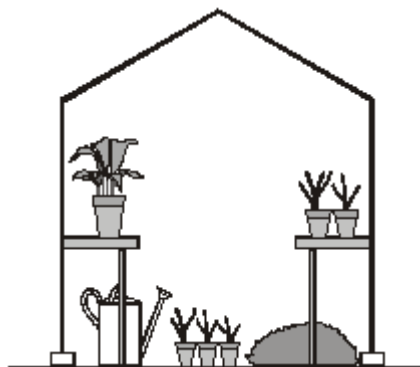
(3)

(Total 14 marks)

Higher Tier

Q3.

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.

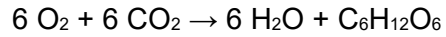
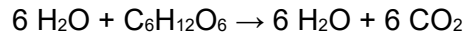
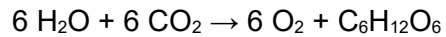
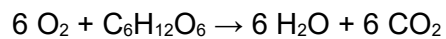
(Total 4 marks)

Q4.

All living organisms respire.

- (a) What is the chemical equation for aerobic respiration?

Tick (✓) **one** box.

☐☐☐☐

(1)

- (b) Name the sub-cellular structures where aerobic respiration takes place.

(1)

- (c) Energy is released in respiration.

Give **two** uses of the energy released in respiration.

1 _____

2 _____

(2)

- (d) Describe **two** differences between aerobic and anaerobic respiration in humans.

Do **not** refer to oxygen in your answer.

1 _____

2 _____

(2)

(e) What are the **two** products of anaerobic respiration in plant cells?

Tick (✓) **two** boxes.

Carbon dioxide

☐

Ethanol

☐

Glucose

☐

Lactic acid

☐

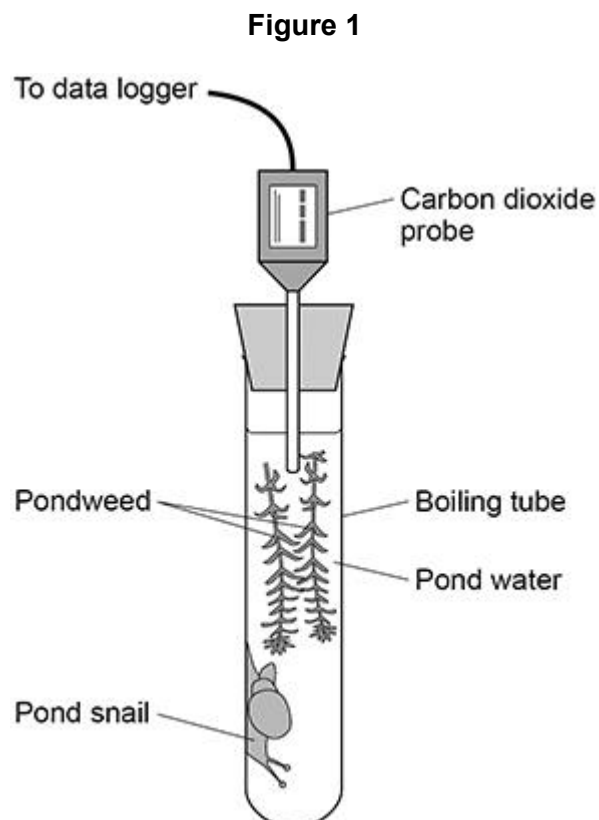
Water

☐

(2)

A scientist investigated respiration and photosynthesis using some pondweed and a pond snail.

Figure 1 shows the apparatus used.



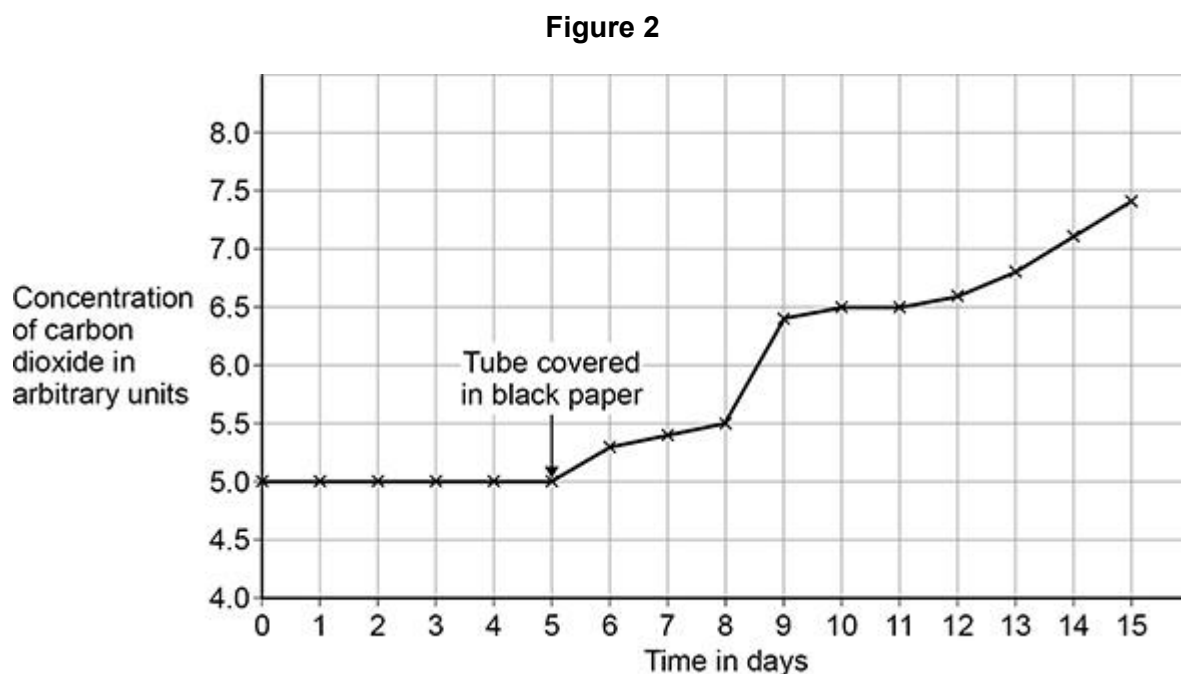
The apparatus was left in a well-lit room for 5 days.

The data logger recorded the concentration of carbon dioxide continuously.

After 5 days, the scientist completely covered the boiling tube with black paper.

The data logger continued to record the concentration of carbon dioxide.

Figure 2 shows the concentration of carbon dioxide inside the boiling tube over 15 days.



- (f) Explain why the concentration of carbon dioxide in the tube stayed the same between day 0 and day 5.

(2)

- (g) Suggest why the concentration of carbon dioxide increased between day 5 and day 10.

(1)

- (h) On day 10, the pond snail died.

Explain why the death of the pond snail caused the concentration of carbon dioxide to increase after day 10.

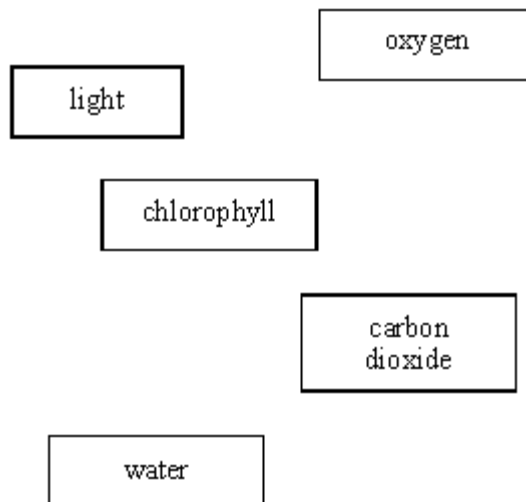
(3)

(Total 14 marks)

Mark schemes

Q1.

(a)



5

(b) (i) sugar **or** carbohydrate

1

(ii) it can be stored **or** it is insoluble
accept it has no osmotic effect

1

(iii) any **one** from:
respires it **or** releases **or** transfers
energy
turns it **or** stores it as fructose **or**
sucrose **or** lipid **or** protein **or**
cellulose

1

(c) (i) photosynthesis

1

(ii) any **one** from:
flat surface
stomata
thin
chloroplasts
veins
large surface area
air spaces
do not accept chlorophyll

1

[10]

Q2.

- (a) rate of photosynthesis increases
or
number of bubbles produced (in one minute) increases
or
volume of gas / oxygen produced (in one minute) increases
allow decreases / stays the same throughout 1
- (b) light intensity 1
- (c) reduces the effect of heat from the lamp
or
prevents temperature affecting photosynthesis 1
- (d) 52 1
- (e) should be 62
or
is to 3 s.f. / not rounded
allow inconsistent number of significant figures / decimal places 1
- (f) the numbers of bubbles at each distance are similar 1
- (g) x-axis correctly labelled (colour of light) **and** bars identified as correct colour
bars can be identified by labels beneath the x-axis or with a key 1
- bars plotted correctly
*all 4 correct = 2 marks 3 correct = 1 mark
if wrong type of graph drawn, max 2 marks* 2
- (h) blue light gives highest (rate of) photosynthesis
allow ecf from candidate's graph allow blue light is best 1
- green light gives the lowest (rate of) photosynthesis
allow green light is worst 1
- (i) energy
in this order only 1
- cell wall(s)

allow cell
do not accept (cell) membrane

1

starch / fat / oil / lipid

1

[14]

Q3.

carbon dioxide concentration

1

since atmospheric concentration very low / value give e.g. 0.03%

allow carbon dioxide used up

1

temperature high

allow if light chosen as a factor

1

light intensity high

allow If temperature chosen as a factor

1

[4]

Q4.

(a) $6\text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{H}_2\text{O} + 6\text{CO}_2$

1

(b) mitochondria / mitochondrion

1

(c) any **two** from:

- movement / muscle contraction
- keeping warm
- active transport
- building larger molecules

ignore reference to metabolism
unqualified

allow examples of movement

allow examples of building larger
molecules e.g. making (named) proteins
/ cellulose

allow cell division

ignore growth

2

(d) any **two** from:

- anaerobic produces lactic acid **and** aerobic does not
allow anaerobic creates an oxygen debt
and aerobic does not

<ul style="list-style-type: none"> aerobic produces carbon dioxide and anaerobic does not aerobic produces water and anaerobic does not aerobic occurs (mainly) in the mitochondria and anaerobic does not 	
<ul style="list-style-type: none"> <i>allow anaerobic only occurs in the cytoplasm</i> anaerobic releases less energy than aerobic <i>allow anaerobic releases less ATP (than anaerobic)</i> <i>do not accept anaerobic produces / makes / creates less energy</i> 	2
(e) carbon dioxide	1
ethanol	1
(f) pondweed takes in CO ₂ for photosynthesis	1
snail and pondweed are respiring producing CO ₂ <i>if no other mark awarded allow rate of respiration = rate of photosynthesis for 1 mark</i>	1
(g) (no light so) no photosynthesis or plant is not taking in CO ₂ and snail and plant are respiring and so are releasing CO ₂	1
(h) snail is being decayed / decomposed / broken down <i>ignore being fed on</i>	1
(by) decomposers / bacteria (in pond water / snail) <i>allow fungi / microbes / microorganisms</i>	1
(therefore) respiration (of decomposers / bacteria) releases CO ₂ <i>do not accept anaerobic respiration</i>	1
	[14]