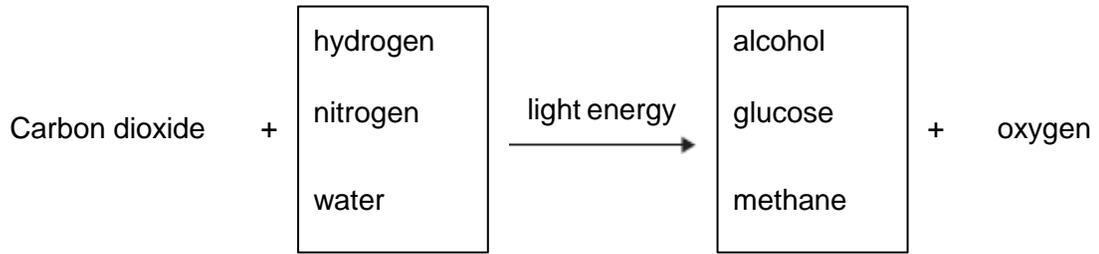


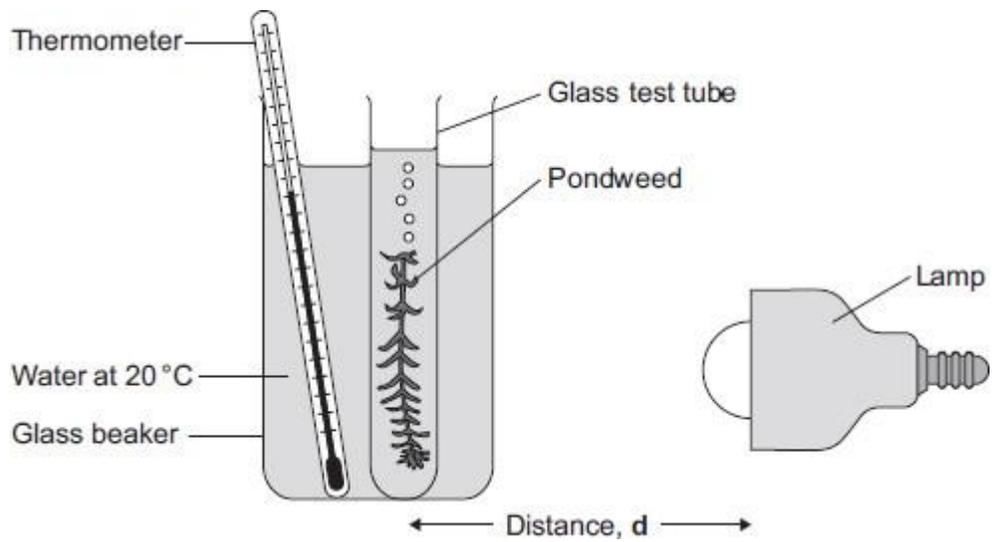
- 1 (a) Complete the equation for photosynthesis. Draw a ring around each correct answer.



(2)

Some students investigated the effect of light intensity on the rate of photosynthesis in pondweed.

The diagram shows the apparatus the students used.



The closer the lamp is to the pondweed, the more light the pondweed receives.

The students placed the lamp at different distances, **d**, from the pondweed.

They counted the number of bubbles of gas released from the pondweed in 1 minute for each distance.

- (b) A thermometer was placed in the glass beaker.

Why was it important to use a thermometer in this investigation?

(3)

- (c) The students counted the bubbles four times at each distance and calculated the correct mean value of their results.

The table shows the students' results.

Distance d in cm	Number of bubbles per minute				
	1	2	3	4	Mean
10	52	52	54	54	53
20	49	51	48	52	50
30	32	30	27	31	30
40	30	10	9	11	

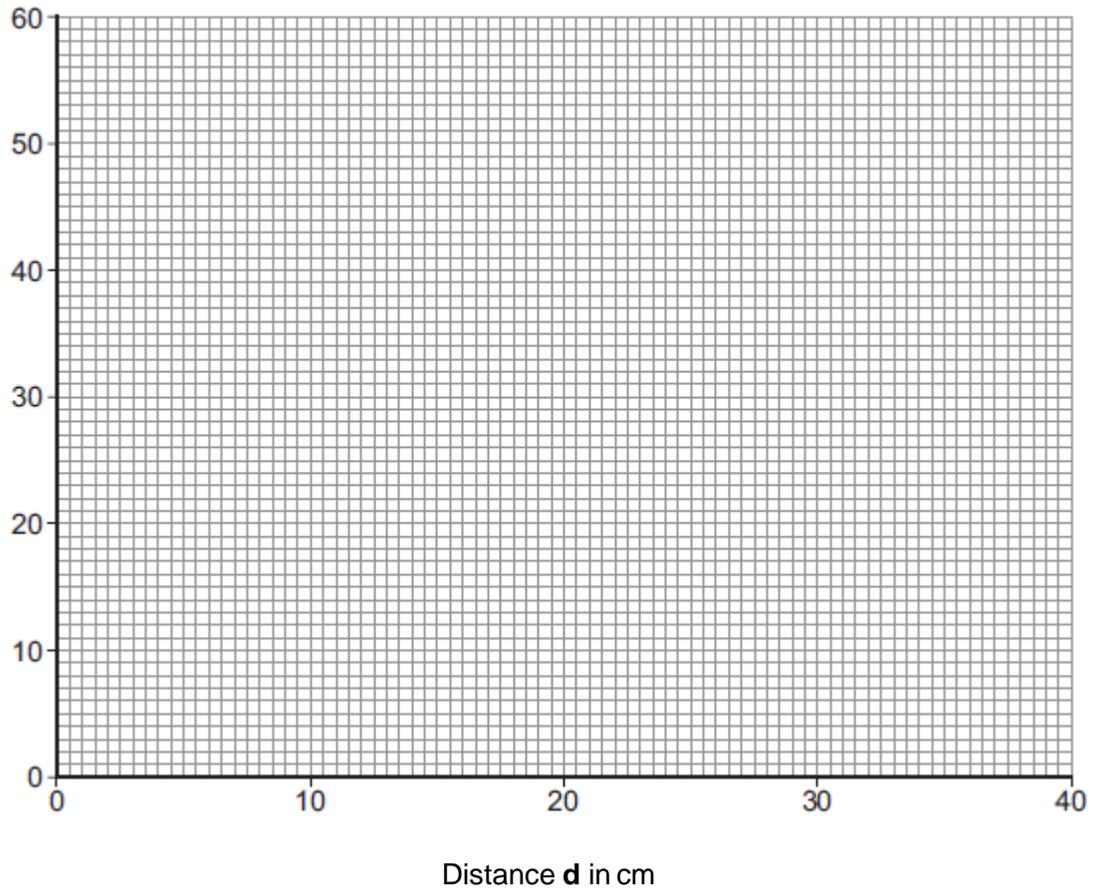
- (i) Calculate the mean number of bubbles released per minute when the lamp was 40 cm from the pondweed.

Mean number of bubbles at 40 cm = _____

(2)

(ii) On the graph paper below, draw a graph to show the students' results:

- add a label to the vertical axis
- plot the **mean values** of the number of bubbles
- draw a line of best fit.



(4)

(iii) One student concluded that the rate of photosynthesis was inversely proportional to the distance of the lamp from the plant.

Does the data support this conclusion?

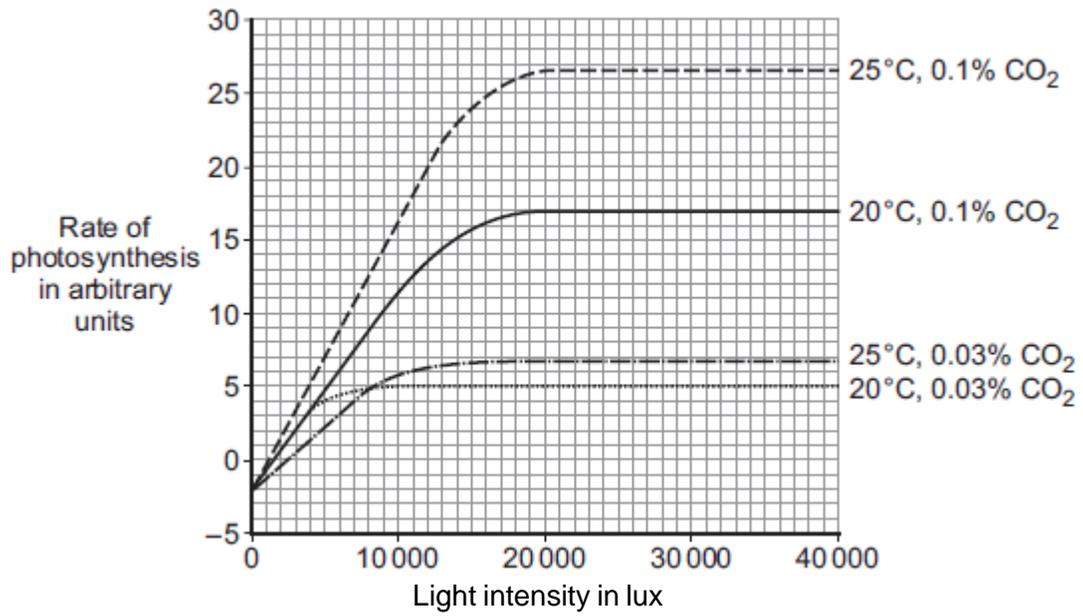
Explain your answer.

(2)

- (d) Light intensity, temperature and concentration of carbon dioxide are factors that affect the rate of photosynthesis.

Scientists investigated the effects of these three factors on the rate of photosynthesis in tomato plants growing in a greenhouse.

The graph below shows the scientists' results.

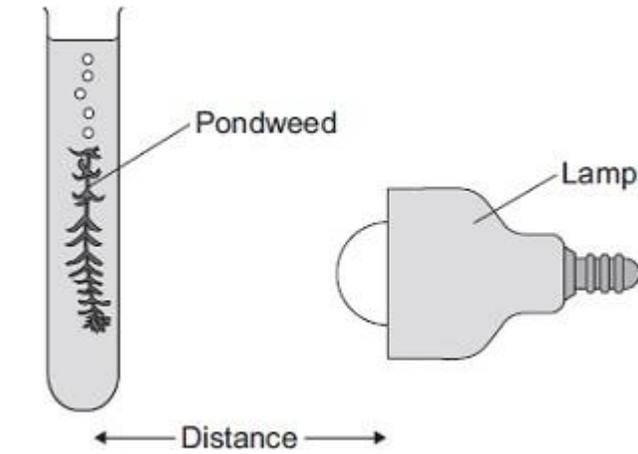


2

Some students investigated the effect of light intensity on the rate of photosynthesis.

They used the apparatus shown in **Diagram 1**.

Diagram 1



The students:

- placed the lamp 10 cm from the pondweed
- counted the number of bubbles of gas released from the pondweed in 1 minute
- repeated this for different distances between the lamp and the pondweed.

(a) The lamp gives out heat as well as light.

What could the students do to make sure that heat from the lamp did **not** affect the rate of photosynthesis?

(1)

(b) The table shows the students' results.

Distance in cm	Number of bubbles per minute
10	84
15	84
20	76
40	52
50	26

(i) At distances between 15 cm and 50 cm, light was a limiting factor for photosynthesis.

What evidence is there for this in the table?

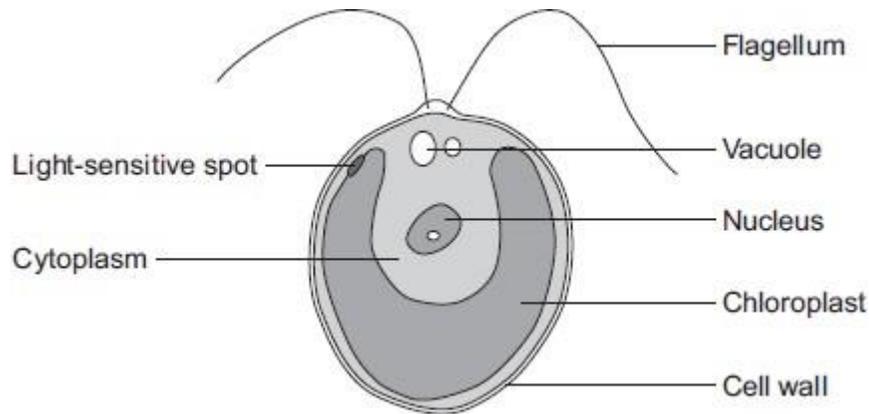
(1)

(ii) Give **one** factor that could have limited the rate of photosynthesis when the distance was between 10 cm and 15 cm.

(1)

3

The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

(1)

(ii) is made of cellulose?

(1)

(b) In the freshwater environment water enters the algal cell.

(i) What is the name of the process by which water moves into cells?

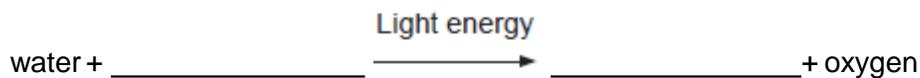
(1)

(ii) Give the reason why the algal cell does not burst.

(1)

(c) (i) The alga can photosynthesise.

Complete the **word** equation for photosynthesis.



(2)

- (ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

Suggest how this might happen.

(2)

- (d) Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

(3)

(Total 11 marks)

4

One factor that may affect body mass is *metabolic rate*.

- (a) (i) What is meant by *metabolic rate* ?

(1)

- (ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1. _____

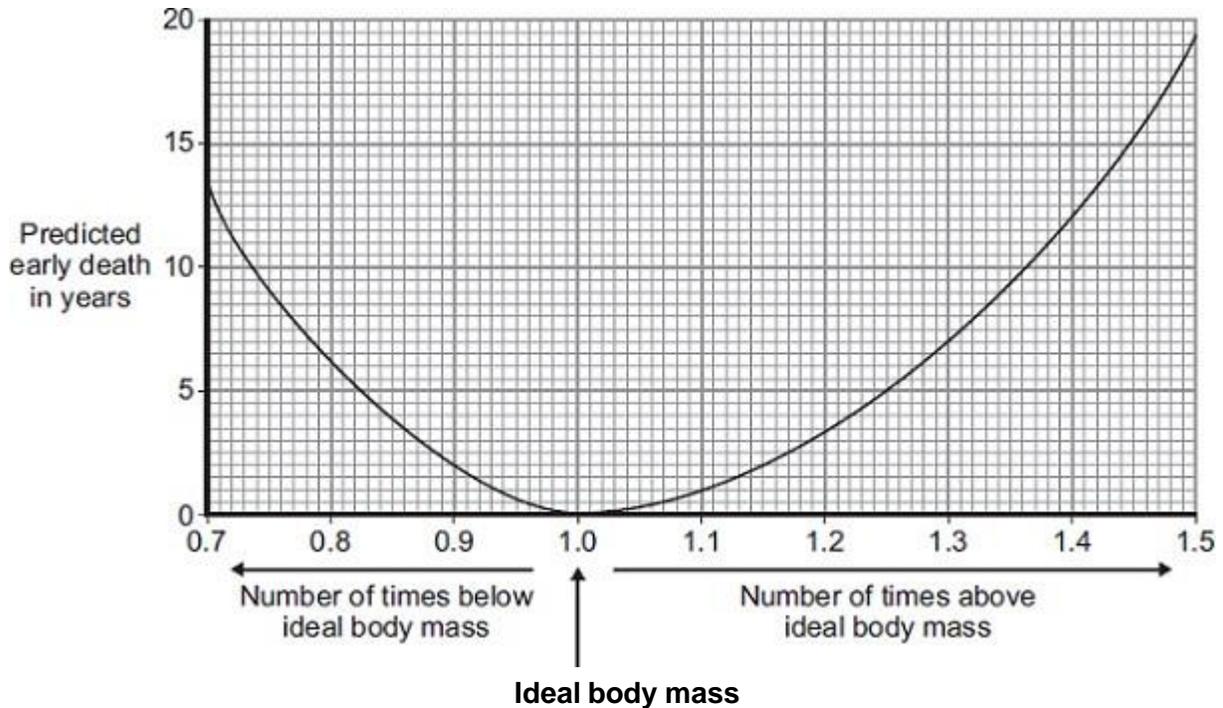
2. _____

(2)

- (b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

- (i) Use the information from the graph to predict the age of this woman when she dies.

Age at death = _____ years

(2)

(ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. _____

2. _____

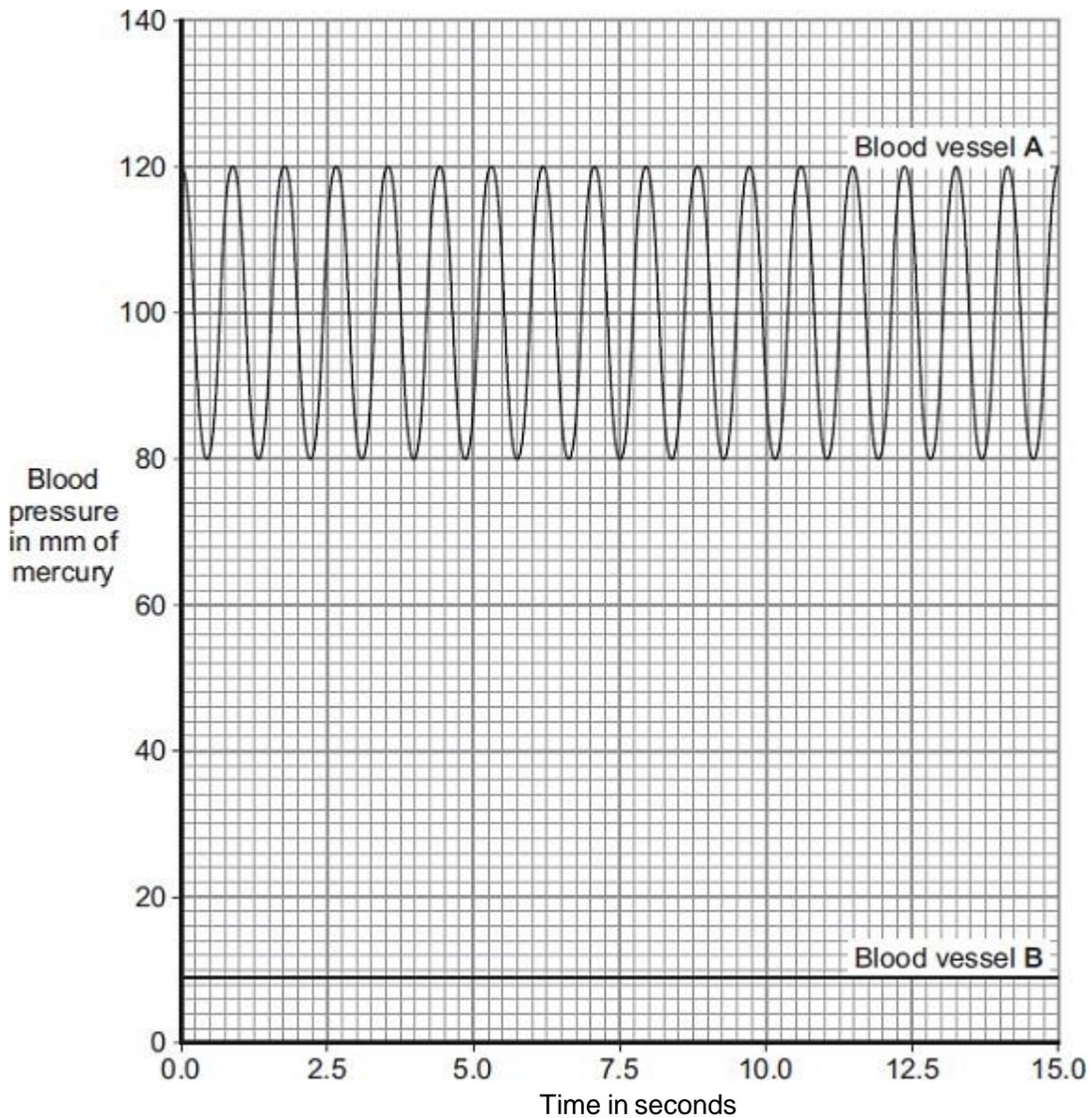
(2)

(Total 7 marks)

5

The heart pumps the blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest. The blood pressure was measured in an artery and in a vein.



(a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel _____

Give **two** reasons for your answer.

Reason 1 _____

Reason 2 _____

(2)

(b) Use information from the graph to answer these questions.

(i) How many times did the heart beat in 15 seconds? _____

(1)

(ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

Heart rate = _____ beats per minute

(1)

(c) During exercise, the heart rate increases.

The increased heart rate supplies useful substances to the muscles at a faster rate.

Name **two** useful substances that must be supplied to the muscles at a faster rate during exercise.

1. _____

2. _____

(2)

(Total 6 marks)

6

This question is about photosynthesis.

- (a) Plants make glucose during photosynthesis. Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick (✓) **one** box.

The starch is converted into oxygen.

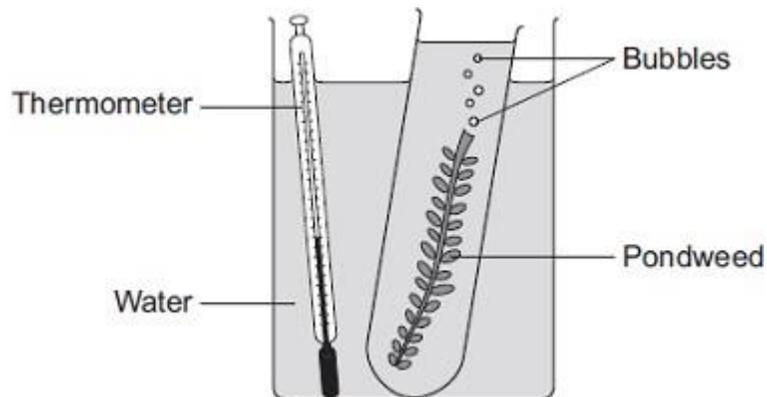
The starch is stored for use later.

The starch is used to make the leaf green.

(1)

- (b) A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The diagram shows the way the experiment was set up.



- (i) The student needed to control some variables to make the investigation fair.

State **two** variables the student needed to control in this investigation.

1. _____

2. _____

(2)

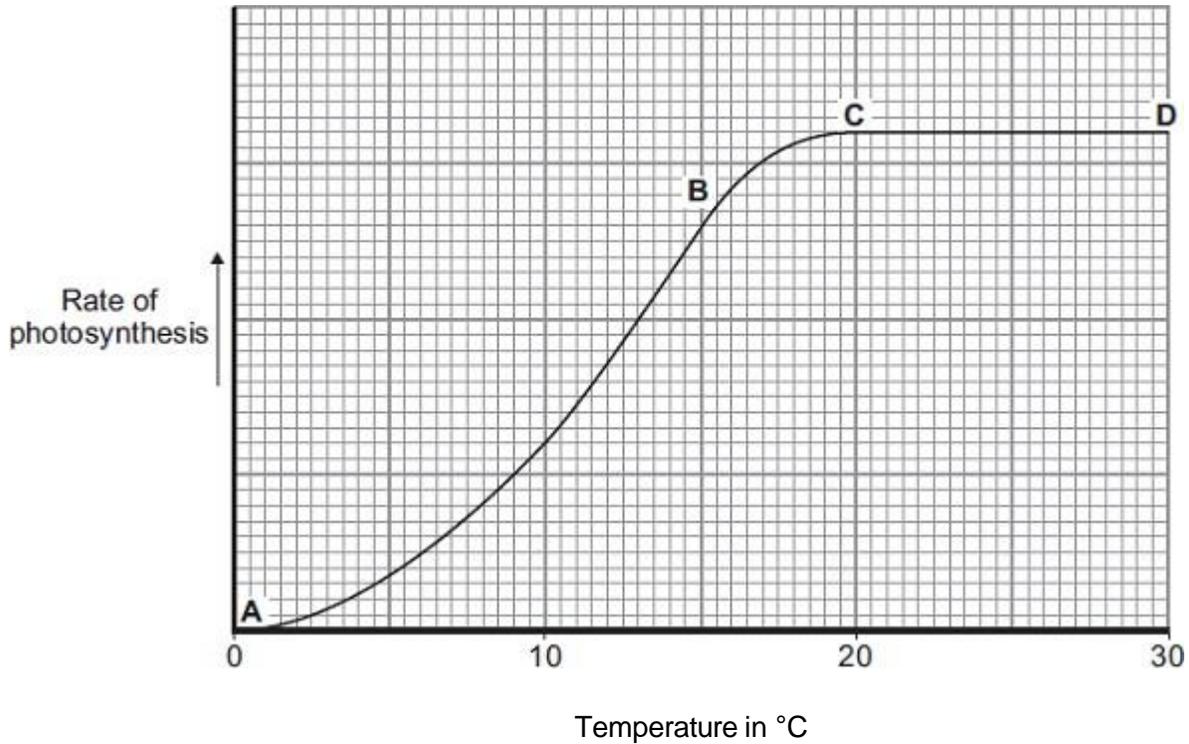
(ii) The bubbles of gas are only produced while photosynthesis is taking place.

What **two** measurements would the student make to calculate the rate of photosynthesis?

1. _____
2. _____

(2)

(c) The graph shows the effect of temperature on the rate of photosynthesis in the pondweed.



(i) Name the factor that limits the rate of photosynthesis between the points labelled **A** and **B** on the graph.

(1)

(ii) Suggest which factor, carbon dioxide, oxygen or water, might limit the rate of photosynthesis between the points labelled **C** and **D** on the graph.

(1)

(Total 7 marks)

Mark schemes

- 1** (a) LHS = water 1
- RHS = glucose 1
- (b) any **three** from:
- (measure) temperature
ignore reference to fair test
 - to check that the temperature isn't changing
 - rate of reaction changes with temperature
 - temperature is a variable that needs to be controlled
allow lamp gives out heat
- 3
- (c) (i) 10
- correct answer = **2** marks
- allow 1 mark for: $\frac{(10+9+11)}{3}$
- allow 1 mark for correct calculation without removal of anomalous result ie 15 2
- (ii) graph:
- allow ecf from **(c)(i)**
- label on y-axis as 'number of bubbles per minute' 1
- three** points correct = **1** mark
allow ± 1 mm
- four** points correct = **2** marks 2
- line of best fit = smooth curve 1
- (iii) as distance increases, rate decreases – pro
- allow yes between 20 – 40 1
- but should be a straight line / but line curves – con / not quite pro
allow not between 10 – 20
if line of best fit is straight line, allow idea of poor fit 1

(d) any **four** from:

- make more profit / cost effective
- raising temp. to 25 °C makes very little difference at 0.03% CO₂
- (at 20 °C) with CO₂ at 0.1%, raises rate
- (at 20 °C with CO₂ at 0.1%) → >3x rate / rises from 5 to 17
- although 25 °C → higher rate, cost of heating not economical
- extra light does not increase rate / already max. rate with daylight

accept ref to profits c.f. costs must be favourable

4

[17]

2

(a) any **one** from:

ignore 'check temperature'

- add a water bath
- heat screen
- use LED
- low energy bulb / described

1

(b) (i) rate / number of bubbles decreases

*accept converse with reference to increasing light **or** shorter distance*

or

less oxygen / gas released

ignore reference to rate of photosynthesis

1

(ii) temperature / CO₂ (concentration)

*accept 'it was too cool' **or** not enough CO₂*

accept number of chloroplasts / amount of chlorophyll

allow heat

allow CO₂

*do **not** allow CO₂*

1

- (c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a brief description of at least 1 tissue **or** at least 1 function of an indicated part of the leaf.

The account lacks clarity or detail.

Level 2 (3-4 marks)

There is a clear description which includes at least 1 named tissue and at least 1 correct function described for an indicated part of the leaf.

Level 3 (5-6 marks)

There is a detailed description of most of the structures and their functions.

Examples of responses:

- epidermis
- cover the plant
- mesophyll / palisade
- photosynthesises
- phloem
- xylem
- transport.

The following points are all acceptable but beyond the scope of the specification:

- (waxy) cuticle – reduce water loss
- epidermis – no chloroplasts so allows light to penetrate
- stomata / guard cells – allow CO₂ in (and O₂ out) **or** controls water loss
- palisade (mesophyll) – many chloroplasts to trap light
 - near top of leaf for receiving more light
- spongy (mesophyll) – air spaces for rapid movement of gases

3	(a)	(i)	chloroplast	1
		(ii)	cell wall	1
	(b)	(i)	osmosis <i>accept diffusion</i>	1
		(ii)	cell wall (prevents bursting)	1
	(c)	(i)	carbon dioxide <i>allow correct formula</i>	1
			glucose <i>allow sugar / starch</i>	1
		(ii)	any two from:	
			<ul style="list-style-type: none"> • light sensitive spot detects light • tells flagellum to move towards light • more light = more photosynthesis 	2
	(d)		(cell has) larger SA:volume ratio	1
			short (diffusion) distance <i>allow correct description</i>	1
		(diffusion) via cell membrane is sufficient / good enough		
		or		
		flow of water maintains concentration gradient	1	
			[11]	
4	(a)	(i)	<u>rate of chemical reactions</u> (in the body)	1

(ii) any **two** from:

- heredity / inheritance / genetics
- proportion of muscle to fat **or** (body) mass
allow (body) weight / BMI
- age / growth rate
- gender
accept hormone balance or environmental temperature
ignore exercise / activity

2

(b) (i) 77

correct answer with or without working gains 2 marks
*allow 1 mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar

*allow go on a diet **or** take in fewer calories*

ignore lose weight

ignore medical treatments such as gastric band / liposuction

1

[7]

5

(a) A

no mark - can be specified in reason part

if B given - no marks throughout

if unspecified + 2 good reasons = 1 mark

high(er) pressure in A

allow opposite for B

*do **not** accept 'zero pressure' for B*

pulse / described in A

accept fluctuates / 'changes'

allow reference to beats / beating

ignore reference to artery pumping

2

(b) (i) 17

1

(ii) 68

accept correct answer from student's (b)(i) × 4

1

(c) oxygen / oxygenated blood
allow adrenaline
ignore air

glucose / sugar

*extra wrong answer cancels - eg sucrose / starch / glycogen /
glucagon / water*

allow fructose

ignore energy

ignore food

2

[6]

6

(a) The starch is stored for use later
no mark if more than one box is ticked

1

(b) (i) any **two** from:
*do **not** accept temperature*
apply list principle
ignore reference to time

- carbon dioxide (concentration)
- light intensity
- light colour / wavelength
allow 1 mark for light if neither intensity or colour are awarded
- pH
- size / amount of pondweed / plant
- same / species / type pondweed
- amount of water in the tube
ignore amount of water alone

2

(ii) number / amount of bubbles **or** amount of gas / oxygen
allow volume of bubbles (together)
ignore 'the bubbles' unqualified

1

(relevant reference to) time / named time interval

allow how long it bubbles for

*do **not** accept time bubbles start / stop*

ignore speed / rate of bubbling

ignore instruments

*do **not** accept other factors eg temperature*

*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature

allow heat / cold / °C

1

(ii) carbon dioxide / CO₂

allow CO₂

*do **not** accept CO²*

1

[7]