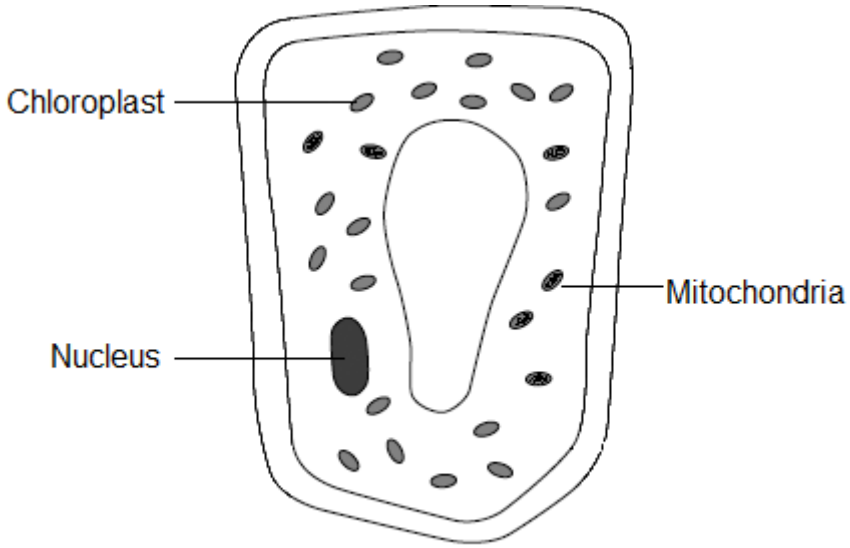
4-4 Bioenergetics – Biology

1.0 **Figure 1** shows a plant cell.

Figure 1



1.1 Draw one line from each part of the cell to its function.

[3 marks]

Part of the cell	Function
Nucleus	Where most of the chemical reactions take place
Chloroplast	Absorbs light energy to make food
Mitochondria	Carries out respiration
	Controls the activities of the cell

1.2 Respiration takes place in the cell.

Use a word from the list to complete the sentence.

[1 mark]

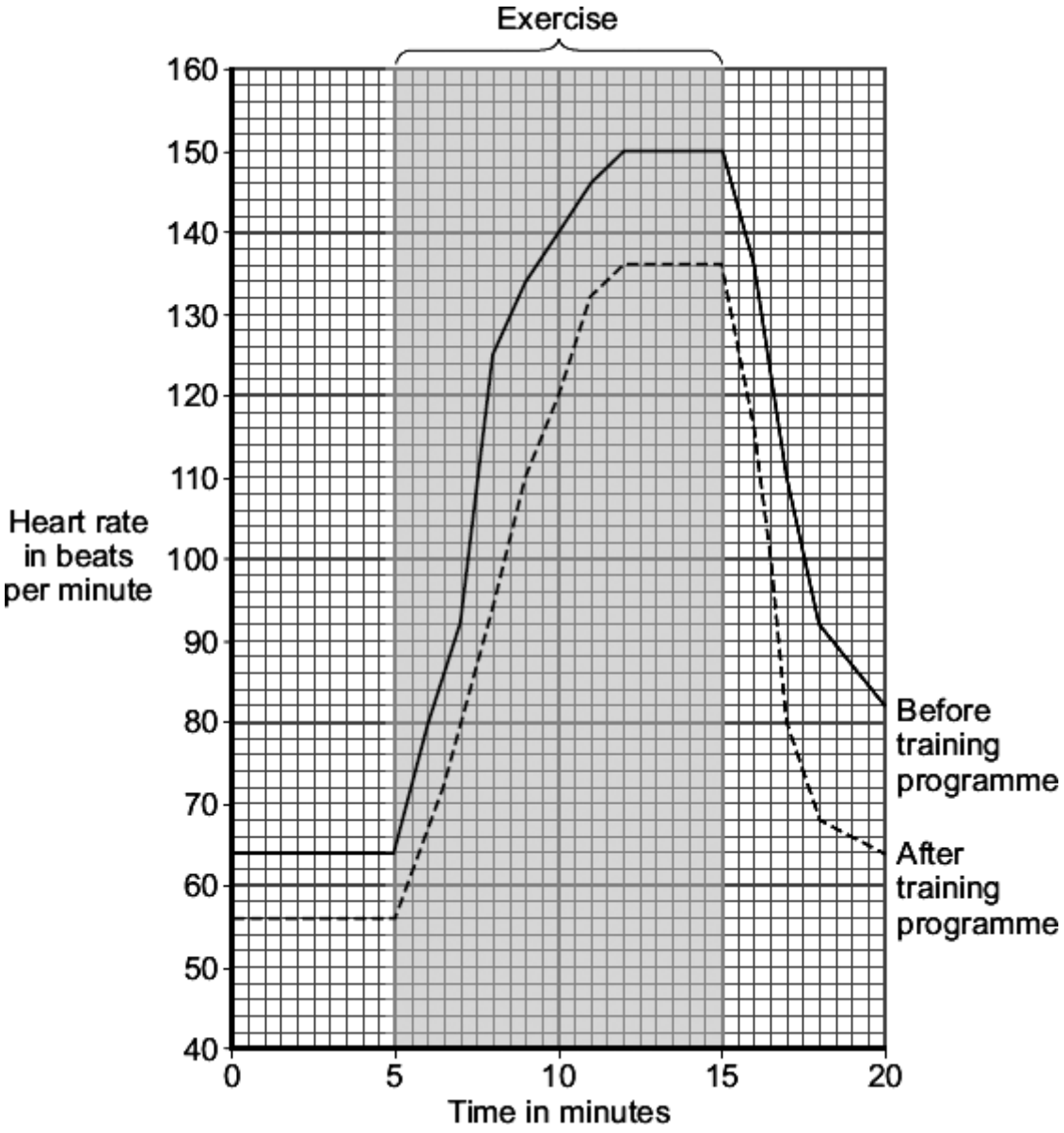
amino acids **energy** **glucose** **oxygen**

All cells use respiration to release _____.

2.0 An athlete did a 6-month training programme.

Figure 2 shows the effect of the same amount of exercise on his heart rate before and after the training programme.

Figure 2



2.1 What was the minimum heart rate of the athlete before the training programme?

[1 mark]

Minimum heart rate = _____beats per minute

2.2 Give **two** differences between the heart rate of the athlete before and after the training programme.

[2 marks]

_____

_____

2.3 Which **two** substances need to be supplied to the muscles in larger amounts during exercise?

Draw a ring around **two** substances from the list.

[2 marks]

Carbon dioxide Glucose Lactic acid Oxygen Urea

2.4 Use **Figure 2** to find the heart rate of the **trained** athlete 3 minutes after he stopped exercising.

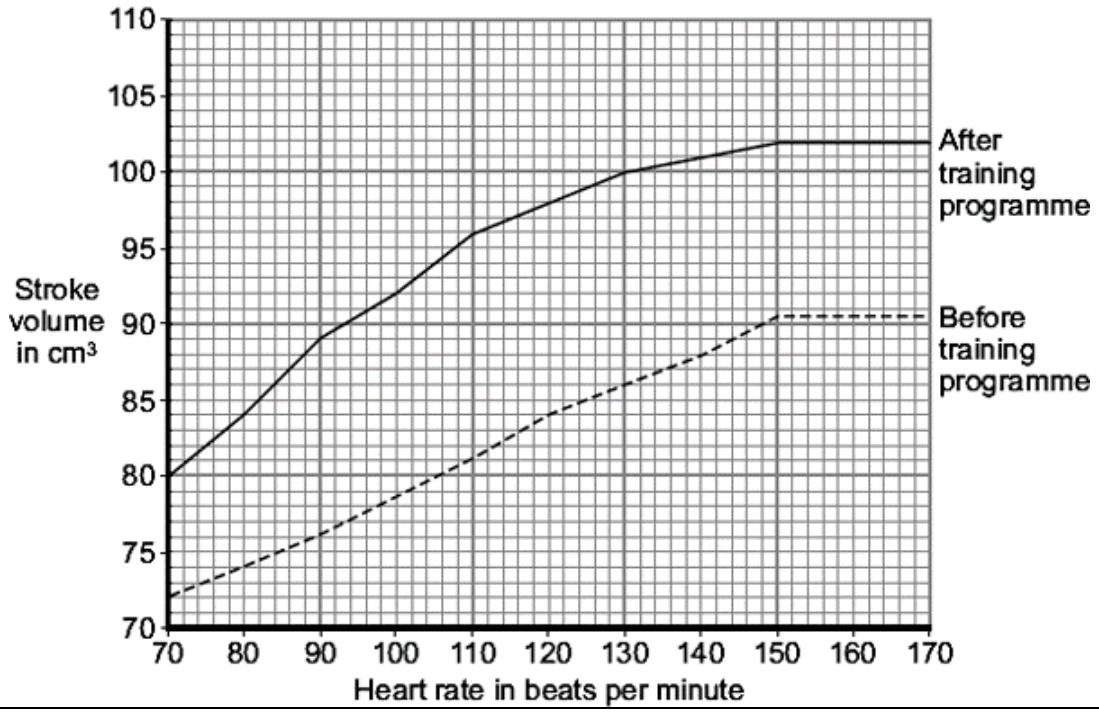
[1 mark]

Heart rate = _____ beats per minute

The stroke volume of the heart is the volume of blood pumped out of the left side of the heart in one heart beat.

Figure 3 shows the relationship between the stroke volume and the heart rate before and after the athlete did the training programme.

Figure 3



2.5 The **cardiac output** is calculated using the following equation:

cardiac output = heart rate × stroke volume

Calculate the cardiac output of the athlete **after** training, 8 minutes after the start of the exercise. Use information from **Figure 2** and **Figure 3.**

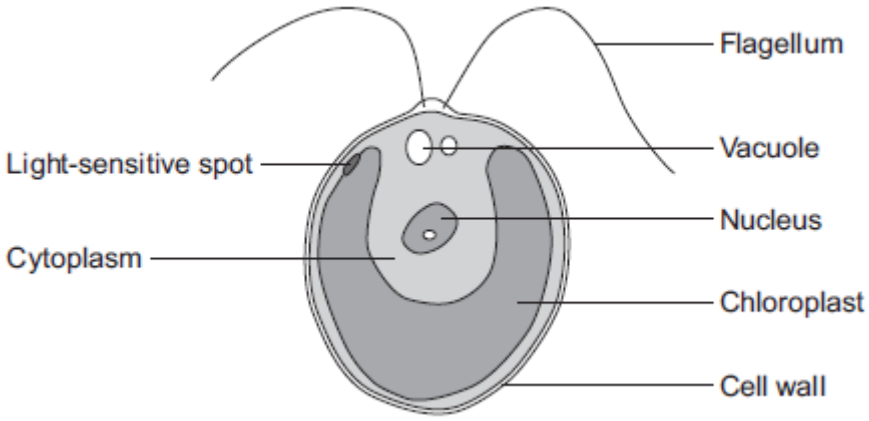
[2 marks]

Show clearly how you work out your answer.

Cardiac output = _____ cm^3 blood per minute

3.0 **Figure 4** shows a single-celled alga which lives in fresh water.

Figure 4



3.1 Which part of the cell labelled above is made of cellulose?

[1 mark]

_____

3.2 Water enters and leaves the algal cell.

State the name of the process by which water moves into cells.

[1 mark]

_____

3.3 Describe what happens to the algal cell as water moves into the cell.

[1 mark]

_____

3.4 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 marks]

_____

4.0 This question is about photosynthesis.

4.1 Plants make glucose during photosynthesis.
Some of the glucose is changed into insoluble starch.

What happens to this starch?

Tick **one** box.

[1 mark]

The starch is converted into oxygen. ☐

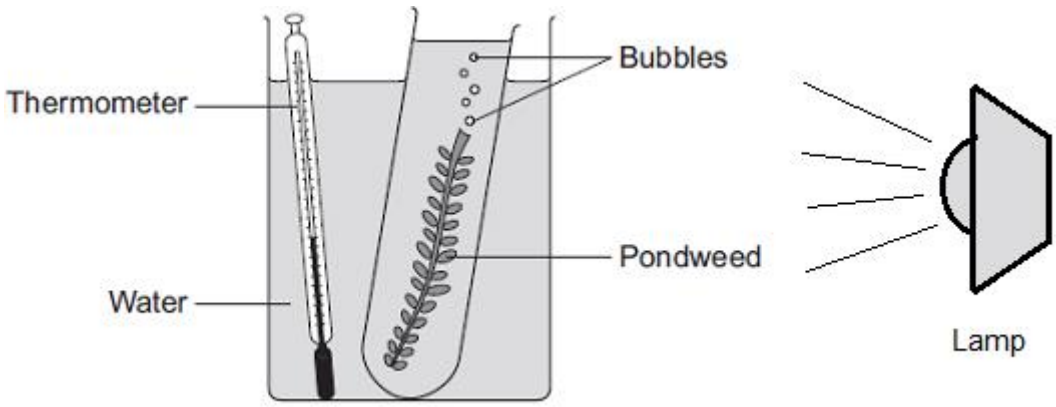
The starch is stored for use later. ☐

The starch is used to make the leaf green. ☐

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

Figure 5 shows the way the experiment was set up.

Figure 5



The student needed to control some variables to make the investigation fair.
State **two** variables the student needed to control in this investigation.

[2 marks]

_____

_____

4.3 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?

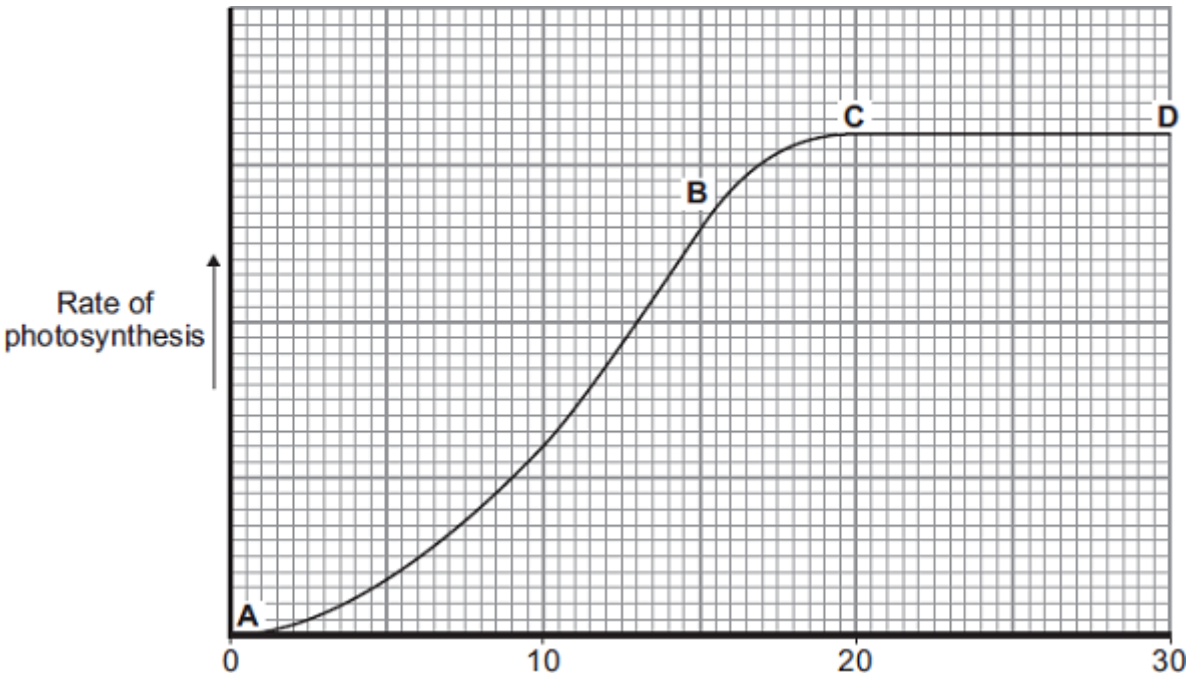
[2 marks]

_____

_____

4.4 **Figure 6** shows the effect of light intensity on the rate of photosynthesis in the pondweed.

Figure 6



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

[1 mark]

_____

4.5 Suggest which factor might be limiting the rate of photosynthesis between the points labelled **C** and **D** on the graph.

[1 mark]

_____

5.0 Anaerobic respiration happens in muscle cells and yeast cells.

The equation describes anaerobic respiration in muscle cells

glucose ⟶ **lactic acid**

5.1 How can you tell from the equation that this process is anaerobic?

[1 mark]

_____

5.2 Exercise **cannot** be sustained when anaerobic respiration takes place in muscle cells. Explain why.

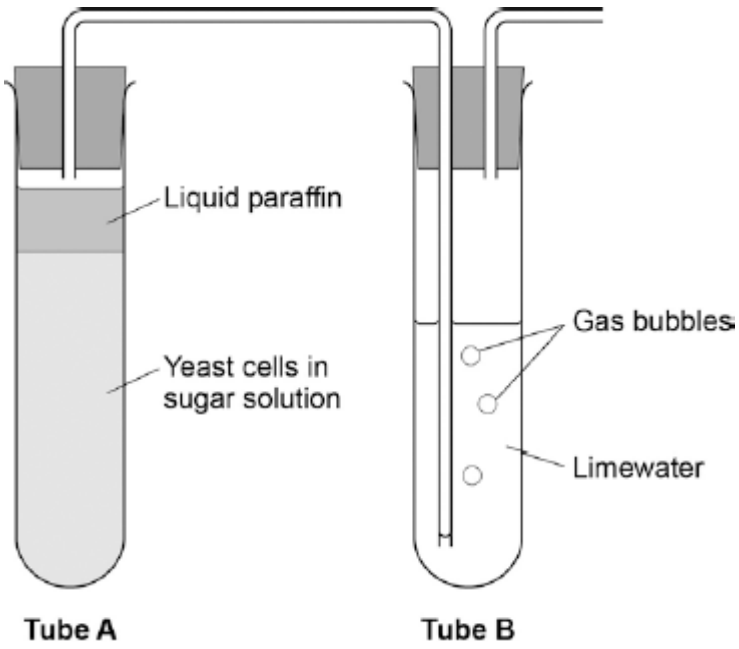
[2 marks]

_____

_____

5.3 **Figure 7** shows an experiment to investigate **anaerobic** respiration in yeast cells.

Figure 7



What gas will bubble into Tube **B**?

[1 mark]

Draw a circle around **one** gas.

Carbon dioxide Hydrogen Oxygen Nitrogen Water vapour

5.4 Describe how you could use tube **B** to measure the rate of the reaction in tube **A**.

[2 marks]

6.0 Green plants can make glucose.

6.1 Plants need energy to make glucose.

Describe how plants get this energy.

[2 marks]

6.2 Plants can use the glucose they have made to supply them with energy.

Describe **four** other ways in which plants use the glucose they have made.

[4 marks]

MARK SCHEME

Qu No.		Extra Information	Marks
1.1	Nucleus – Controls the activities… Chloroplast – Absorbs light energy… Mitochondria – Carries out respiration	1 mark for each correct line mark each line from left hand box two lines from left hand box cancels mark for that box	3
1.2	energy		1

Qu No.		Extra Information	Marks
2.1	64 (beats per minute)		1
2.2	any **two** from: • lower resting pulse • lower rate during exercise • recovers faster after exercise	accept correct use of numbers accept lower pulse rate if neither of the first two marking points awarded, allow 1 mark for 'lower rate'.	2
2.3	glucose oxygen		1 1
2.4	68		1
2.5	(136 × 100.5) = 13,668	Allow 13000 to 13800. if answer incorrect, allow one mark for obvious attempt to read both graphs and multiply	2

Qu No.		Extra Information	Marks
3.1	cell wall		1
3.2	osmosis	allow diffusion	1
3.3	cell becomes turgid / swollen		1
3.4	any **two** from: • light sensitive spot detects light • tells flagellum to move towards light • more light = more photosynthesis		2

Qu No.		Extra Information	Marks
4.1	the starch is stored for use later		1
4.2	any **two** from: • carbon dioxide (concentration) • temperature • light colour / wavelength • pH • size of pondweed / plant • same species / type of pondweed • volume of water in the tube	ignore reference to time allow 1 mark for light if colour is not already awarded. ignore volume of water unqualified	2
4.3	number / amount of bubbles **or** amount of gas / oxygen (relevant reference to) time / named time interval	ignore the bubbles unqualified allow how long it bubbles for do not allow time bubbles start / stop ignore speed / rate of bubbling ignore instruments do not allow other factors e.g. temperature accept how many bubbles per minute for 2 marks	1 1
4.4	Light intensity		1
4.5	Temperature/carbon dioxide / CO_2	Allow heat allow CO2 do not allow CO^2	1

Qu No.		Extra Information	Marks
5.1	no oxygen (is used)		1
5.2	muscles become fatigued / stop contracting (because) not enough energy is transferred		1 1
5.3	carbon dioxide		1
5.4	count the bubbles **or** measure volume of gas in a given time		1 1

Qu No.		Extra Information	Marks
6.1	light is trapped / absorbed / used	extra answers cancel mark ignore solar / sunshine	1
	by chlorophyll / chloroplasts	if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis	1
6.2	(to make) starch (for storage)	ignore for growth (unqualified) ignore respiration	1
	(to make) fat / oil (for storage)		1
	(to make) amino acids / proteins / enzymes	allow for active transport allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone)	1
	(to make) cellulose / cell walls	if no named examples, allow 'to make named cell structures' for max. 1 mark	1