1.0 Figure 1 shows a plant cell.

![Figure 1: Plant cell diagram](image)

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

<table>
<thead>
<tr>
<th>Part of the cell</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td>Where most of the chemical reactions take place</td>
</tr>
<tr>
<td>Chloroplast</td>
<td>Absorbs light energy to make food</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>Carries out respiration</td>
</tr>
<tr>
<td></td>
<td>Controls the activities of the cell</td>
</tr>
</tbody>
</table>

1.2 Respiration takes place in the cell.

Use a word from the list to complete the sentence.

- amino acids
- energy
- glucose
- oxygen

All cells use respiration to release __________. 
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.

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:

\[
\text{cardiac output} = \text{heart rate} \times \text{stroke volume}
\]

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 = __________________cm³ blood per minute
3.0 Figure 4 shows a single-celled alga which lives in fresh water.

**Figure 4**

- Flagellum
- Light-sensitive spot
- Vacuole
- Nucleus
- Chloroplast
- Cell wall

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.

- The starch is converted into oxygen. [1 mark]
- 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]

_____________________________________________________________________
_____________________________________________________________________

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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](image)

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

\[ \text{glucose} \rightarrow \text{lactic acid} \]

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]

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

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## MARK SCHEME

<table>
<thead>
<tr>
<th>Qu No.</th>
<th>Extra Information</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Nucleus – Controls the activities… Chloroplast – Absorbs light energy… Mitochondria – Carries out respiration</td>
<td>1 mark for each correct line mark each line from left hand box two lines from left hand box cancels mark for that box</td>
</tr>
<tr>
<td>1.2</td>
<td>energy</td>
<td>1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Qu No.</th>
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<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>cell wall</td>
<td>1</td>
</tr>
<tr>
<td>3.2</td>
<td>osmosis</td>
<td>1</td>
</tr>
<tr>
<td>3.3</td>
<td>cell becomes turgid / swollen</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>any two from:</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• light sensitive spot detects light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• tells flagellum to move towards light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• more light = more photosynthesis</td>
<td></td>
</tr>
<tr>
<td>Qu No.</td>
<td>Extra Information</td>
<td>Marks</td>
</tr>
<tr>
<td>--------</td>
<td>------------------</td>
<td>-------</td>
</tr>
<tr>
<td>4.1</td>
<td>the starch is stored for use later</td>
<td>1</td>
</tr>
</tbody>
</table>
| 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     |
| 4.4    | Light intensity | 1     |
| 4.5    | Temperature/carbon dioxide / CO₂ | Allow heat  
allow CO₂  
do not allow CO² | 1     |

<table>
<thead>
<tr>
<th>Qu No.</th>
<th>Extra Information</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>no oxygen (is used)</td>
<td>1</td>
</tr>
<tr>
<td>5.2</td>
<td>muscles become fatigued / stop contracting (because) not enough energy is transferred</td>
<td>1</td>
</tr>
<tr>
<td>5.3</td>
<td>carbon dioxide</td>
<td>1</td>
</tr>
<tr>
<td>5.4</td>
<td>count the bubbles or measure volume of gas in a given time</td>
<td>1</td>
</tr>
<tr>
<td>Qu No.</td>
<td>Extra Information</td>
<td>Marks</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------</td>
<td>-------</td>
</tr>
<tr>
<td>6.1</td>
<td>light is trapped / absorbed / used by chlorophyll / chloroplasts</td>
<td>extra answers cancel mark ignore solar / sunshine if no other marks awarded, allow 1 mark for photosynthesis / equation for photosynthesis</td>
</tr>
<tr>
<td>6.2</td>
<td>(to make) starch (for storage)</td>
<td>ignore for growth (unqualified) ignore respiration</td>
</tr>
<tr>
<td></td>
<td>(to make) fat / oil (for storage)</td>
<td>allow for active transport allow any other correct, named organic substances (eg DNA / ATP / chlorophyll / hormone)</td>
</tr>
<tr>
<td></td>
<td>(to make) amino acids / proteins / enzymes</td>
<td>if no named examples, allow ‘to make named cell structures’ for max. 1 mark</td>
</tr>
<tr>
<td></td>
<td>(to make) cellulose / cell walls</td>
<td></td>
</tr>
</tbody>
</table>