

1 Photosynthesis takes place the leaves of green plants.

(a) Write a balanced chemical equation for the formation of glucose by photosynthesis.

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(3)

(b) Describe **two** ways that the rate of photosynthesis can be decreased without lowering the temperature.

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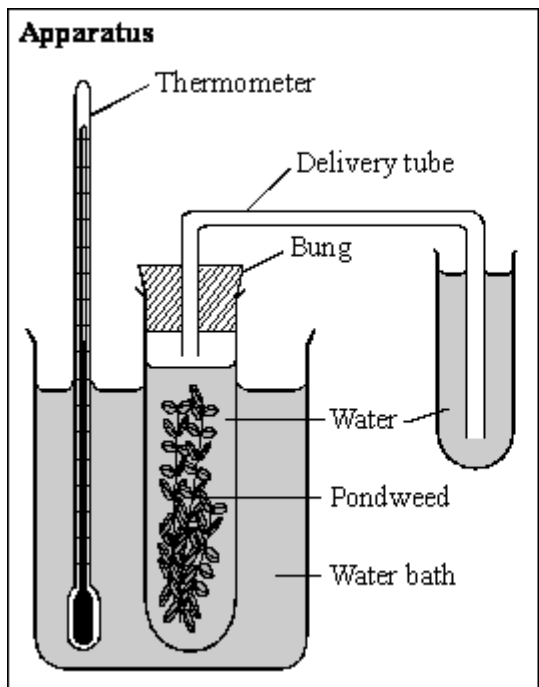
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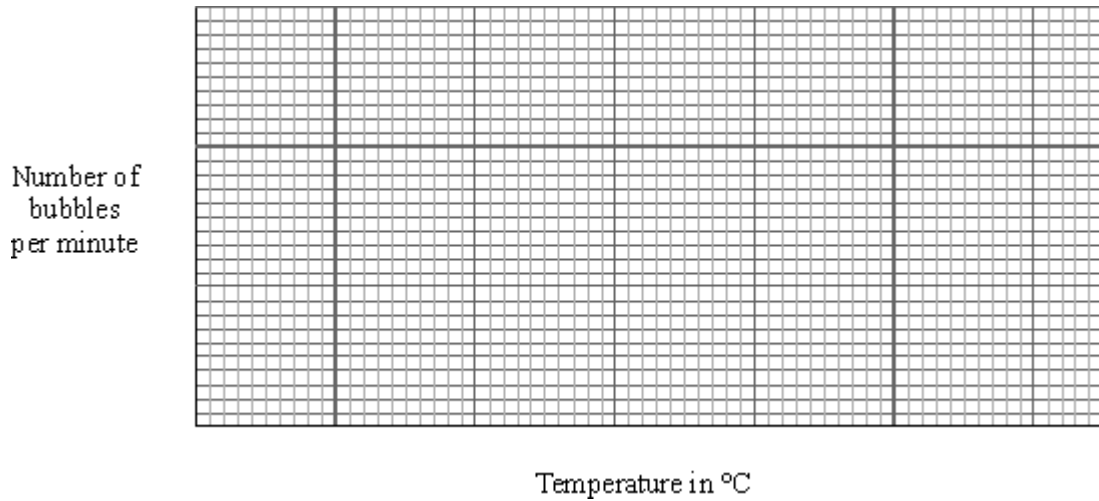
(2)

(c) Some students decided to investigate the effect of temperature on the rate of photosynthesis in pond weed. They set up the apparatus and altered the temperature using ice and hot water. They counted the number of bubbles given off in a minute at different temperatures. They obtained the following results.



Results	
Temperature in °C	Number of bubbles per minute
10	6
20	15
30	21
40	23
50	19

- (i) Plot the points on the graph.



**(3)**

- (ii) Use your graph to predict the number of bubbles per minute at 25 °C.

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**(1)**

- (iii) Suggest a reason why the rate of photosynthesis seems to decrease in this pondweed after 40 °C.

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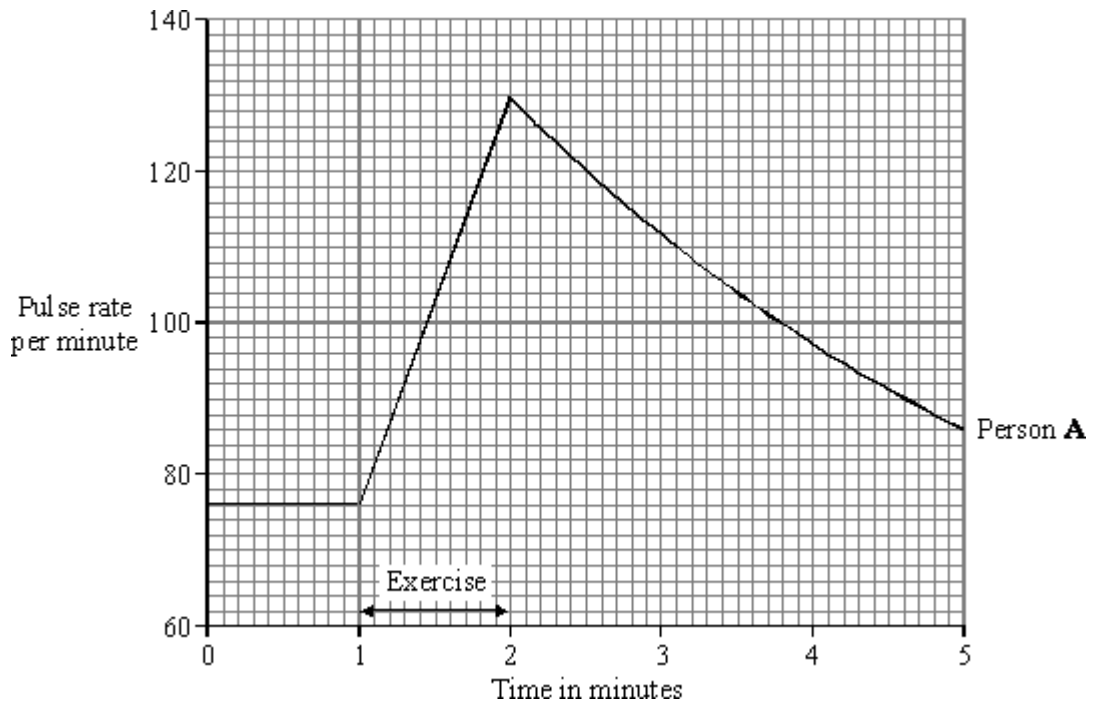
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**(1)**

**(Total 10 marks)**

2

**Person A** and **Person B** measured their pulse rates over a period of five minutes. For one minute of this time they exercised by stepping on and off a box. At other times they sat still. The graph shows the results for **Person A**.



(i) What does the graph tell you about the changes in the pulse rate of **Person A** within the five minute period?

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(3)

(ii) What was the pulse rate of **Person A** at the end of the five minute period?

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(1)

(iii) The table shows the results obtained for **Person B**.

<b>Time in minutes</b>	<b>Pulse rate per minute</b>
0	68
1	68
2	110
3	96
4	80
5	68

Plot these results on the graph.

(2)  
(Total 6 marks)

**3** Regular exercise is important, as it helps to maintain an efficient supply of blood to the muscles, the heart and the lungs. This is helped by an increase in the heart rate during exercise.

Explain why it is necessary for the heart rate to increase during exercise.

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(Total 4 marks)

4

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.

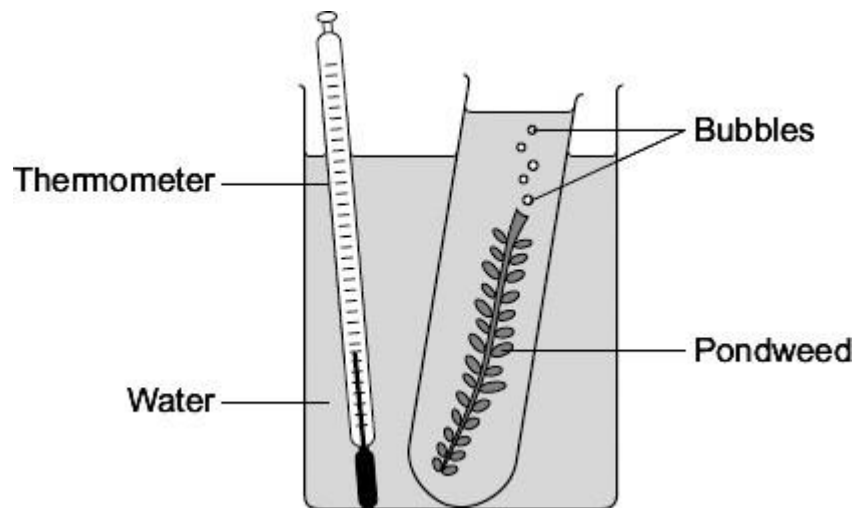
The starch is stored for later use.

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** of these variables.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

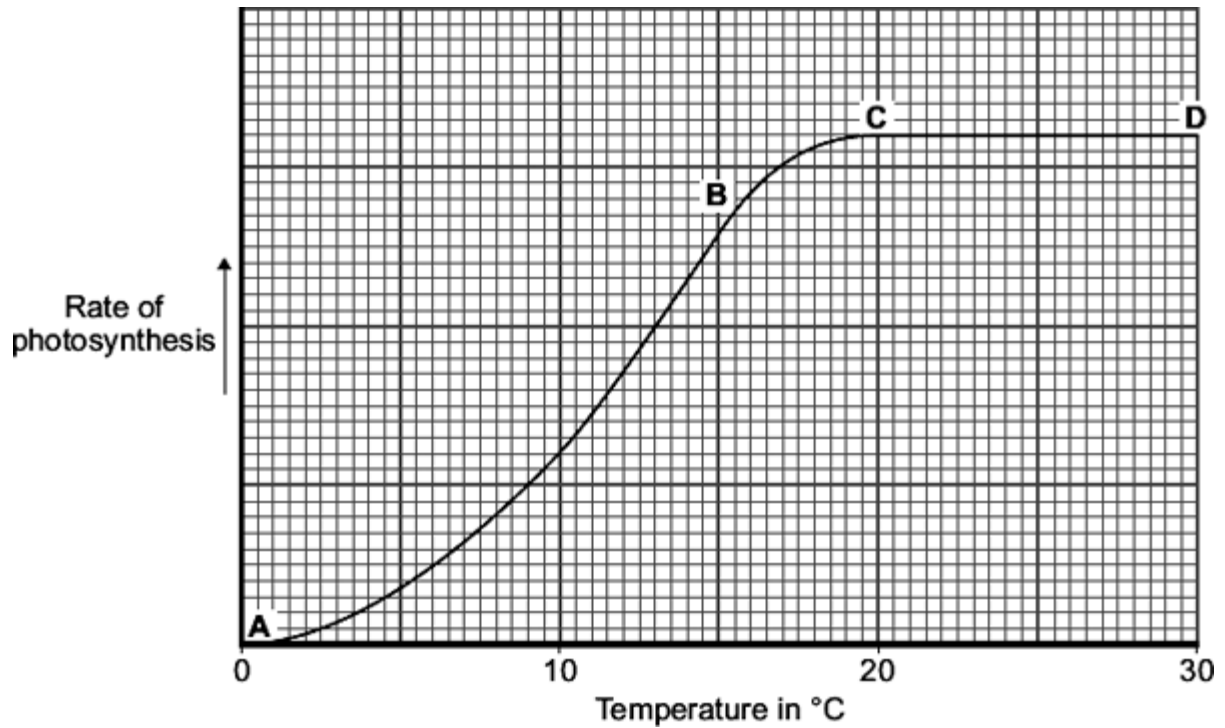
(ii) The bubbles of gas are produced only while photosynthesis is taking place.

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.



(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)

5

The table shows the amounts of energy used in running and in walking at different speeds by people of different body masses.

Activity	Energy used in kilojoules per hour			
	34 kg person	50 kg person	70 kg person	90 kg person
Running, 9 km per hour	1530	1850	2770	3700
Running, 11 km per hour	2140	2560	3860	5120
Running, 16 km per hour	2980	3570	5380	7140
Walking, 3 km per hour	530	670	1010	1340
Walking, 5 km per hour	740	880	1340	1760
Walking, 7 km per hour	1030	1240	1850	2480

(a) Describe **two** patterns you can see in the data.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(b) Our breathing rate is much higher when running than when walking.

Explain the advantage of this to the body.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

(Total 5 marks)

6

(a) The table shows the effect of exercise on the action of one person's heart.

	At rest	During exercise
Heart rate in beats per minute	72	165
Volume of blood leaving the heart in each beat in cm <sup>3</sup>	75	120
Heart output in cm <sup>3</sup> per minute	5400	

(i) Calculate the heart output for this person during exercise.

Show clearly how you work out your answer.

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Answer = \_\_\_\_\_ cm<sup>3</sup> per minute

(2)

(ii) During exercise, more oxygen is carried to the working muscles.

Explain why this is helpful during exercise.

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(2)



(b) Give **two** other changes in the body that help to increase the amount of oxygen delivered to the working muscles during exercise.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 6 marks)

7

(a) (i) Complete the word equation for photosynthesis.

carbon dioxide + \_\_\_\_\_ (+ light energy) → glucose + \_\_\_\_\_

(2)

(ii) Most of the carbon dioxide that a plant uses during photosynthesis is absorbed from the air.

Give **one** other source of carbon dioxide for a plant.

Draw a ring around your answer.

**the soil      respiration in the plant      osmosis in the plant      water**

(1)

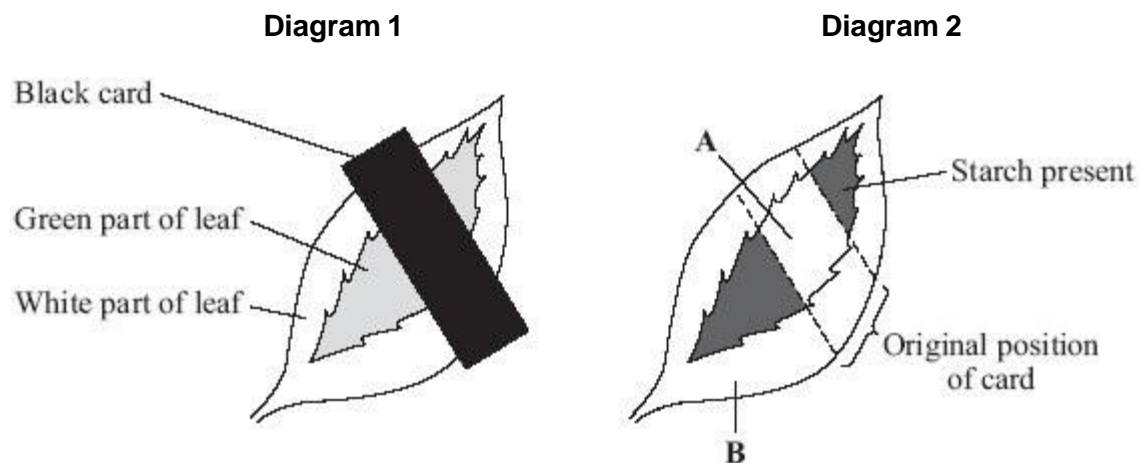
A student investigated the conditions that plants need for photosynthesis. The leaves of the plant he used had green and white parts.

**Diagram 1** shows how part of one leaf was covered in black (opaque) card.

The plant was placed in a warm, sunny area and was watered well.

Eight hours later the leaf was removed from the plant and was tested for starch.

The results of the test are shown in **Diagram 2**, the shaded parts show where starch was present.



(b) Name the **two** independent variables in this investigation.

1. \_\_\_\_\_  
\_\_\_\_\_  
2. \_\_\_\_\_  
\_\_\_\_\_

(2)

(c) Why was no starch found in:

(i) the part of the leaf labelled **A**

\_\_\_\_\_  
\_\_\_\_\_

(1)

(ii) the part of the leaf labelled **B**?

\_\_\_\_\_  
\_\_\_\_\_

(1)

(Total 7 marks)

**8**

(a) The equation describes the process of photosynthesis.

carbon dioxide + \_\_\_\_\_ + light energy  $\longrightarrow$  glucose + \_\_\_\_\_

(i) Write in the names of the **two** missing substances.

(2)

(ii) Name the green substance which absorbs the light energy.

\_\_\_\_\_

(1)

(b) (i) In bright sunlight, the concentration of carbon dioxide in the air can limit the rate of photosynthesis. Explain what this means.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

- (ii) Give **one** environmental factor, other than light intensity and carbon dioxide concentration, which can limit the rate of photosynthesis.

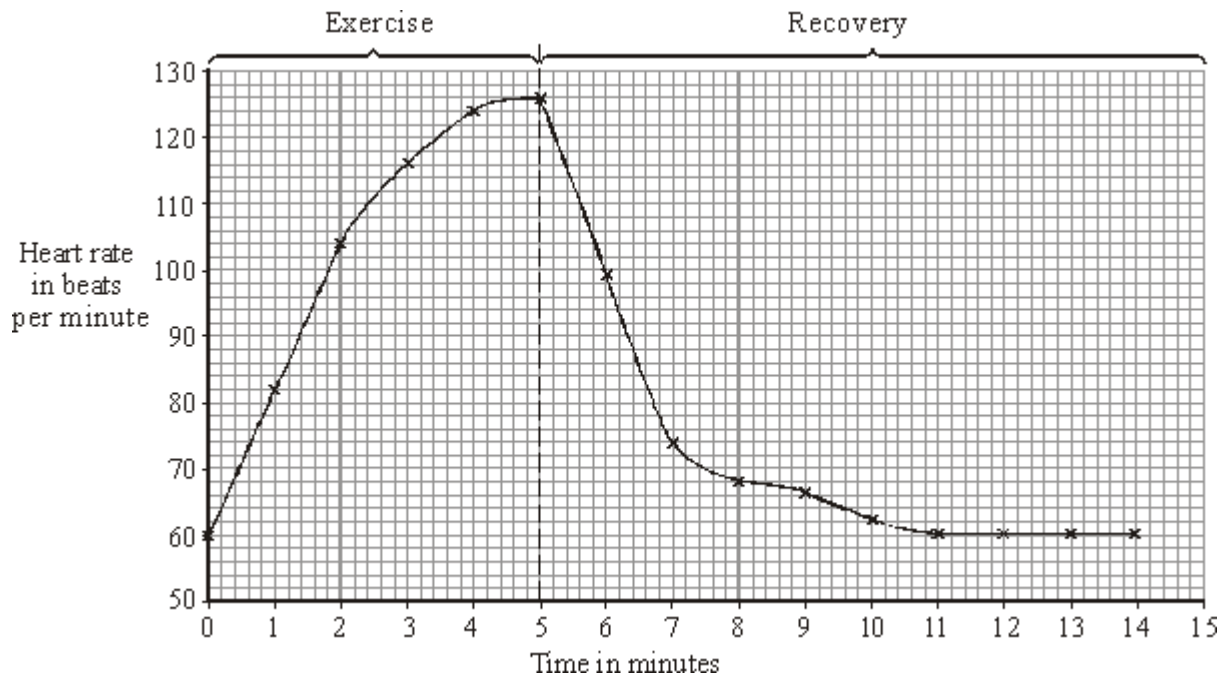
(1)

(Total 6 marks)

9

A student pedalled an exercise cycle at constant speed for 5 minutes. The student's heart rate was recorded at one-minute intervals during the exercise and also during recovery.

The results are shown in the graph.



- (a) Describe, in as much detail as you can, the changes in heart rate between 0 and 14 minutes.

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(3)

(b) How do arteries supplying the leg muscles alter the rate of blood flow through them during exercise?

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**(1)**

(c) Explain how an increase in heart rate helped the student during exercise.

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**(4)**

**(Total 8 marks)**

## Mark schemes

- 1** (a) reactants:  $\text{CO}_2 + \text{H}_2\text{O}$  1
- products:  $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$  1
- balance:
- $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$  1
- (b) **1** mark each for any of the following ideas:
- lower  $\text{CO}_2$  concentration
- lower light intensity
- decrease water availability
- alter light wavelength **or** colour  
*accept more green light* 2
- (c) (i) scales correctly constructed  
*i.e. equal intervals along each axis* 1
- points plotted correctly 1
- appropriate line correctly drawn  
*accept dot to dot or line of best fit*  
*cancel if line extends through zero or beyond  $50^\circ\text{C}$*  1
- (ii) 18 – 19 (bubbles per minute) 1
- (iii) heat denatures enzymes **or** destroys membranes **or** ruptures cells **or** destroys cells  
*do not accept kills enzymes* 1

[10]

2

(i) with exercise rate rises;

*accept between 1 – 2 minutes rate rises*

1

(when exercise stops) rate falls slowly;

*accept gentle fall **or** steady fall*

*for answers which just describe a rise then a fall allow one mark only as an alternative to the first two points*

1

rate does not return to normal **or** to starting **or** to resting rate

*accept rate returns to normal after five minutes **or** three minutes of rest **or** after recording ended*

1

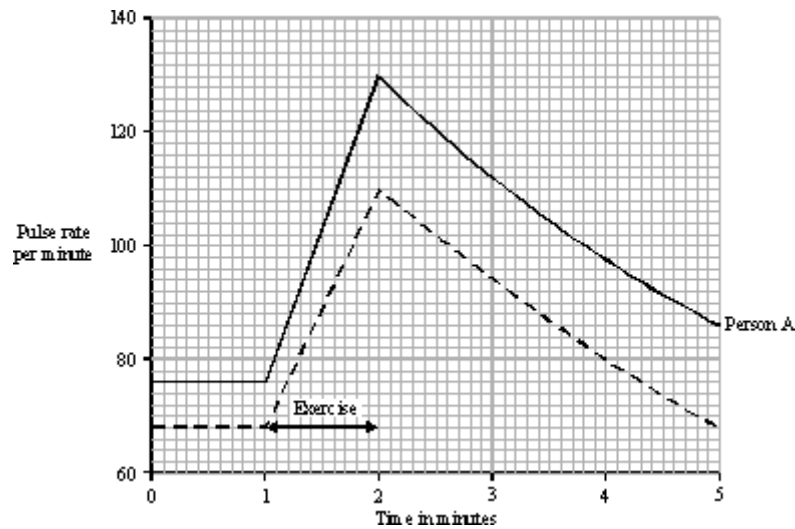
(ii) 86 (per minute);

1

(iii) plotting points;

*deduct one mark for each error to max of two*

*if 68 wrongly plotted count as one error (ignore the quality of the line)*



2

[6]

3 any **four** from:

more energy / respiration required

*accept it prevents / reduces anaerobic respiration **or** less / no lactic acid*

*reference to increase must be made,*

*but only needed once, provided*

*inference is clear for remainder of points.*

*accept 'delivered more quickly' for 'increase'*

increase oxygen uptake into blood (in lungs)

increase oxygen delivery to muscles

increase glucose delivery to muscles

increase removal of heat from muscles **or** increase delivery of heat to skin

increase removal of carbon dioxide from muscles

increase removal of carbon dioxide from blood (in lungs)

[4]

4 (a) the starch is stored for later use.

1

(b) (i) any **two** from:

*do **not** accept temperature-apply list principle*

*ignore reference to time*

- carbon dioxide (concentration)
- light intensity  
*allow **one** mark for light if neither intensity or colour are awarded*
- light colour / wavelength
- pH
- size / amount plant
- same / species / type plant  
*allow 'the plant'*
- 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 bubbles*  
*ignore instruments*  
*do **not** accept other factors eg temperature*  
*accept how many bubbles per minute for **2** marks*

1

(c) (i) temperature  
*allow heat / °C / cold*

1

(ii) carbon dioxide / CO<sub>2</sub>  
CO<sub>2</sub> / CO<sup>2</sup> / Co<sub>2</sub> / Co<sup>2</sup> / co<sub>2</sub> / co<sup>2</sup>  
*do **not** accept CO / 2CO*

1

[7]

5

(a) increased speed  
**or** harder exercise / running  
→increased need / use / loss of energy

1

*allow further you run / walk the more energy you need*

increased mass / bigger → increased use of energy

1

(b) any **three** from:

- supply / using (more / enough) oxygen  
**or** get (more) oxygen in blood(\*)
  - remove (more) CO<sub>2</sub>(\*)
  - doing (more) work  
**or**  
using (more) energy allow produce energy(\*)  
(\**need reference to 'more' ONCE only for full marks*)
- for respiration
- prevent build up of lactic acid  
**or** prevent oxygen debt  
**or** prevent anaerobic (respiration)  
**or** allow aerobic (respiration)

3

[5]



<b>6</b>	<p>(a) (i) 19 800  <i>for correct answer ignore working or lack of working</i>  <i>165 × 120 but no answer / wrong answer = 1 mark (<u>ignore extras</u>)</i></p>	2
	<p>(ii) any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• for respiration <i>ignore oxygen debt</i></li> <li>• energy released <i>allow energy produced</i></li> <li>• prevents anaerobic respiration</li> <li>• prevents build-up of lactic acid</li> </ul>	2
	<p>(b) any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• increased breathing rate(*)</li> <li>• increased depth of breathing <b>or</b> deepbreathing(*)  <i>(*)more breathing is max 1 mark</i>  <i>ignore increase in heart rate</i>  <i>allow heavier breathing</i>  <i>do <b>not</b> allow harder breathing</i></li> <li>• dilation of arteries / vasodilation  <i>allow blood vessels dilate</i>  <i>do <b>not</b> allow veins / capillaries dilate</i></li> <li>• blood diverted from elsewhere  <i>ignore name of organ</i></li> </ul>	2
		<b>[6]</b>
<b>7</b>	<p>(a) (i) water / H<sub>2</sub>O  <i>allow hydrogen oxide</i></p>	1
	<p>oxygen / O<sub>2</sub> / O  <i>allow upper and lower case symbols and superscripts</i>  <i>answers must be in this order</i></p>	1
	<p>(ii) respiration in the plant  <i>allow clear indication of correct response</i></p>	1

- (b) light (no light) / light intensity  
*ignore references to the card / covered / uncovered* 1
- chlorophyll (no chlorophyll) / chloroplast  
*allow leaf colour **or** both green **and** white given* 1
- (c) (i) no light (received) **or** it's dark  
*allow no photosynthesis*  
*do **not** allow little light / photosynthesis*  
*ignore sun*  
*apply list principle for other factors* 1
- (ii) no chlorophyll / chloroplasts (present)  
*allow no / little photosynthesis*  
*allow white **or** not green **or** little chlorophyll / few chloroplasts*  
*apply list principle for other factors* 1
- 8** (a) (i) L.H.S. – water / H<sub>2</sub>O 1
- R.H.S. – oxygen / O<sub>2</sub>  
*accept H<sup>2</sup>O*  
*accept O<sup>2</sup> / O* 1
- (ii) chlorophyll  
*must make it clear that it is the chlorophyll*  
*do **not** credit chloroplast on its own*  
*do **not** accept chloroplast / chlorophyll*  
*without indication that it is chlorophyll* 1
- (b) (i) light intensity / temperature is high enough for higher rate or light /  
temperature is not limiting 1
- low CO<sub>2</sub> available or not enough CO<sub>2</sub>  
available **or** rate would be higher with more CO<sub>2</sub> 1

[7]

(ii) temperature

*allow water / rain*  
*allow (too) cold / hot as a minimum*  
*allow wave length / frequency / colour*  
*ignore ions*  
*ignore heat*

1

[6]

9

(a) any **three** from:

- rose rapidly (during exercise) / use of approximate figures
- then more slowly (during exercise)  
*accept rate (of increase) slows down*
- to max 126 / at 5 minutes / end of exercise
- rapid fall (during recovery) **or** use of approximate numbers
- then less rapid fall / use of approximate numbers
- returned to resting rate (60 bpm) by 11 minutes

3

(b) arteries dilate / widen

*accept muscle in wall relaxes*

1

(c)

any **four** from:

- muscles using more energy **or** more energy released
- muscles respire faster
- supply more oxygen
- supply more glucose / sugar
- remove more CO<sub>2</sub>
- remove lactic acid
- remove heat / to cool

do **not** accept energy produced

allow for aerobic respiration  
**or** to prevent anaerobic respiration

'more' needed ONCE  
only for full marks

4

[8]