Q1.

(a) Describe the process of glycolysis.

(4)

(b) Malonate inhibits a reaction in the Krebs cycle.

Explain why malonate would decrease the uptake of oxygen in a respiring cell.

(2)

(Total 6 marks)

Q2.

(c) In muscles, pyruvate is converted to lactate during prolonged exercise.

Explain why converting pyruvate to lactate allows the continued production of ATP by anaerobic respiration.

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(2)

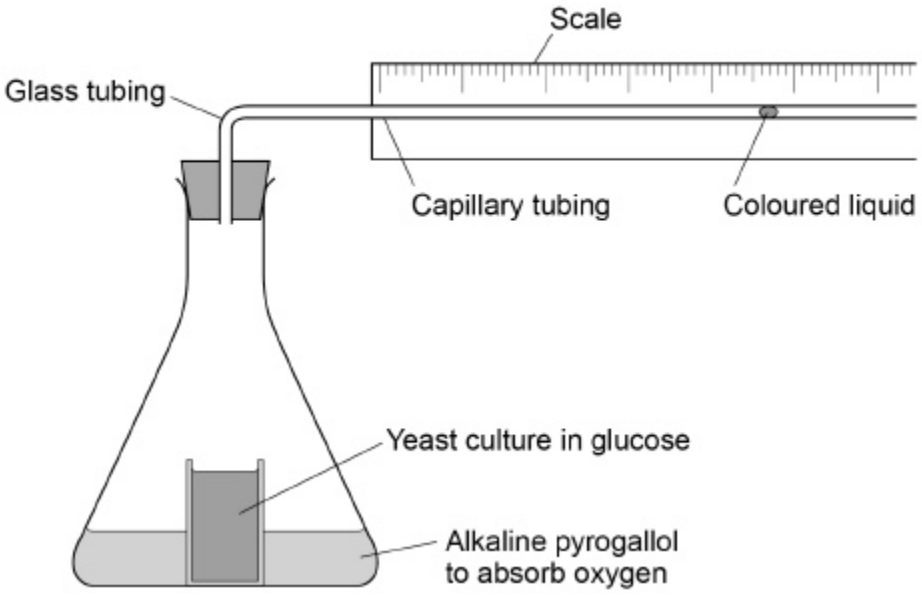
Q3.

Yeast cells can respire aerobically or anaerobically. A student used the apparatus shown in **Figure 1** to measure the rate of respiration in yeast.

She:

- positioned the flask in a water bath so that the yeast culture reached a constant temperature
- then left the apparatus for one hour before starting her investigation.

Figure 1



(a) Suggest **one** reason why it was important that the student left the apparatus for one hour after the yeast culture reached a constant temperature.

_____

_____

(1)

(b) During her investigation, the coloured liquid moved to the right.

Explain why it moved to the right.

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(2)

(c) The student found that the coloured liquid moved 1.5 cm in 24 hours. The diameter of the lumen (hole) of the capillary tubing was 1 mm.

The volume of a capillary tubing is given by $\pi r^2 l$, where π is 3.14 and l = length.

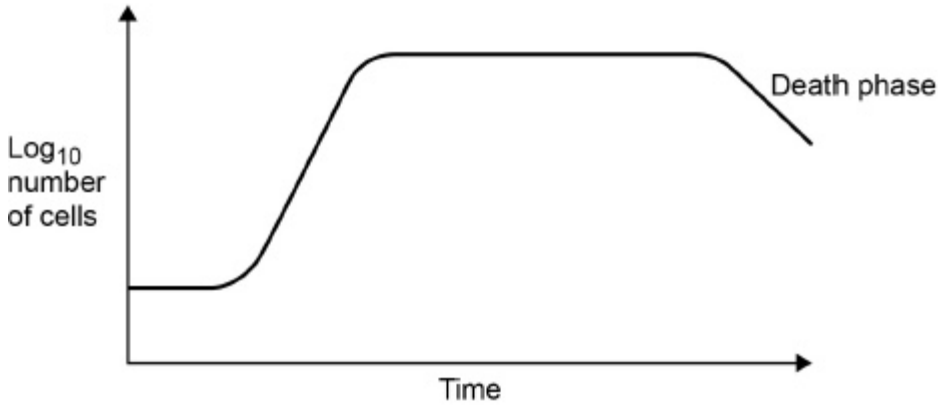
Calculate the volume of gas produced in $cm^3\ hour^{-1}$.
Show your working.

Answer = _____ $cm^3\ hour^{-1}$

(2)

Figure 2 shows a typical population growth curve for yeast under laboratory conditions.

Figure 2



(d) Explain why a log scale is used to record the number of cells.

_____

_____

_____

(1)

(e) Many yeast cells die during the death phase.

Suggest **one** reason why.

_____

_____

_____

_____

(1)

(f) The following equation can be used to make predictions of the growth in the population of yeast cells under ideal laboratory conditions.

$$X_t = X_0 e^{rt}$$

X_t = the population after a certain time
X_0 = the population at the start
e = 2.72 (base of natural logarithm)
r = growth rate
t = time period in hours over which r applies

A population of 2000 yeast cells was left for 10 hours.
The value for the growth rate was 0.5

Assuming no yeast cells died, calculate the predicted size of the population after 10 hours. Show your working.

Answer = _____

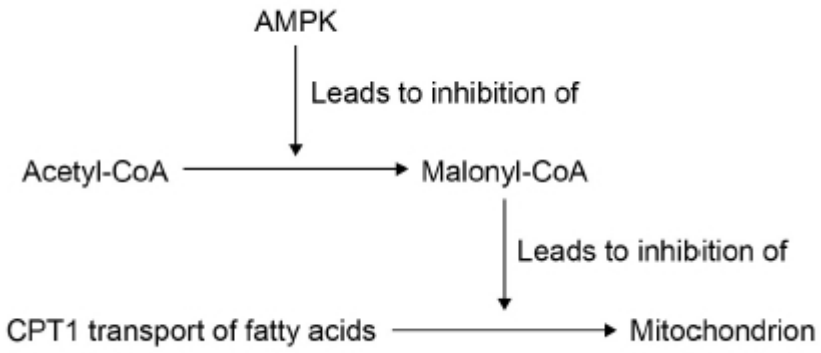
(2)

(Total 9 marks)

Q4.

(b) AMP-activated protein kinase (AMPK) is an enzyme that regulates a number of cellular processes. Exercise leads to activation of AMPK.

The diagram shows one effect of activation of AMPK during exercise.



CPT1 is a channel protein that transports fatty acids into mitochondria.

Using the diagram above, explain the benefit of activation of AMPK during exercise.

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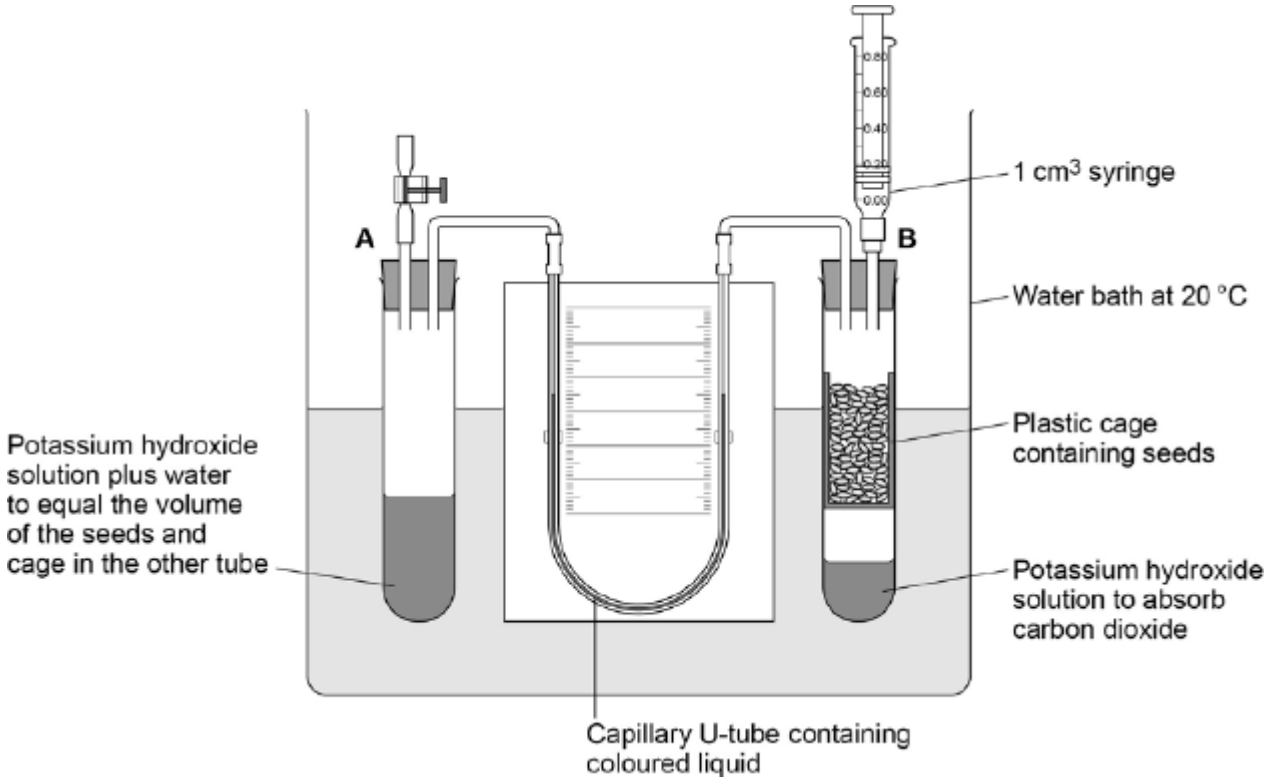
(3)

Q5.

The figure below shows the apparatus used for measuring the rate of oxygen consumption in aerobic respiration by seeds.



(a) For the first 10 minutes, the tap attached to tube **A** was left open and the syringe from tube **B** was removed.

Suggest **three** reasons why the apparatus was left for 10 minutes.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) Suggest and explain why the chosen temperature was 20 °C for this experiment.

_____

_____

_____

_____

(2)

After 10 minutes, the tap attached to tube **A** was closed and the syringe was attached to tube **B**. Every minute, the syringe plunger was moved until the levels in the U-tube were the same. The reading on the syringe volume scale was then recorded.

The results are shown in the table below.

Time / minutes	**Reading on syringe volume scale / cm^3**
0	0.84
1	0.81
2	0.79
3	0.76
4	0.73
5	0.70
6	0.68
7	0.66
8	0.63
9	0.62
10	0.58

(c) During the experiment, the coloured liquid in the tubing moved towards tube **B**.
Explain what caused this.

_____

_____

_____

_____

_____

_____

(3)

(d) The mass of the seeds was 1.6 g. Use the information in the table above to calculate the rate of oxygen consumption in $cm^3\ g^{-1}\ hour^{-1}$ by the seeds.

Show your working.

Rate = _____ $cm^3\ g^{-1}\ hour^{-1}$

(2)

(Total 10 marks)

Q6.

(a) Describe the advantage of the Bohr effect during intense exercise.

_____

_____

_____

_____

_____

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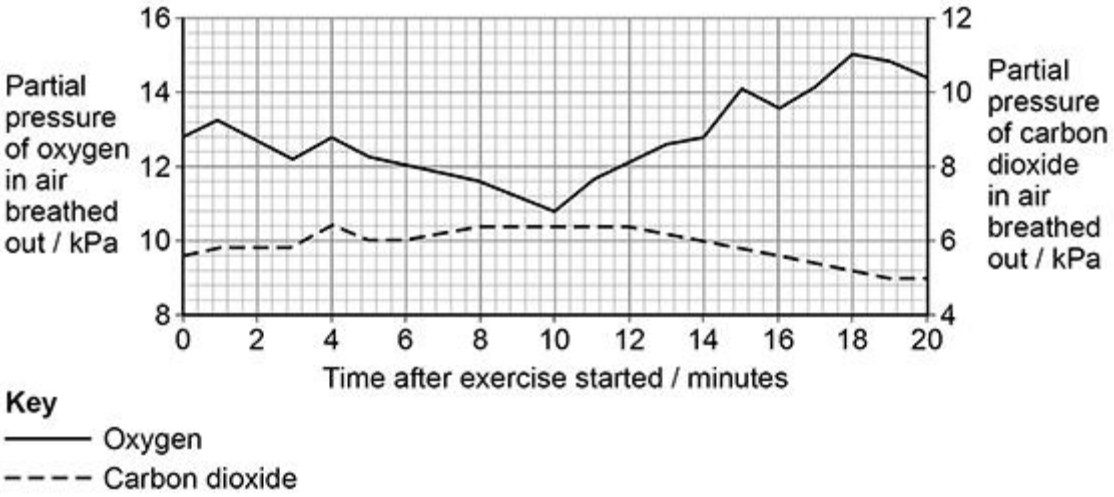
(2)

A cyclist completed a fitness test on an exercise bike. The intensity of the exercise was increased every 10 seconds. The test finished when he was unable to cycle any further. The partial pressure of oxygen (pO_2) and of carbon dioxide (pCO_2) in air breathed out was measured.

The graph below shows the results of the cyclist's fitness test.



Ventilatory threshold (VT) is a measure of the point when anaerobic respiration increases because aerobic respiration alone can no longer maintain muscle contraction.

(b) VT can be identified as the **first** point when there is an increase in pO_2 breathed out, without an equivalent increase in pCO_2 breathed out.

Use the graph above to determine the **time** after the exercise started when the cyclist reached VT.

Calculate the **ratio** of pO_2 to pCO_2 in breathed-out air at this time.

Show your working.

Time when the cyclist reached VT = _____ min

Ratio of pO_2 to pCO_2 at VT = _____ :1

(2)

(c) An increase in the intensity of exercise produces an increase in the volume of carbon dioxide produced.

However, the graph above shows that the pCO_2 in air breathed out did **not** show a large increase during the exercise.

Suggest **one** physiological change that would cause this result. Explain how the physiological change would allow for the removal of the increase

in the volume of carbon dioxide produced.

Physiological change _____

_____

Explanation _____

_____

_____

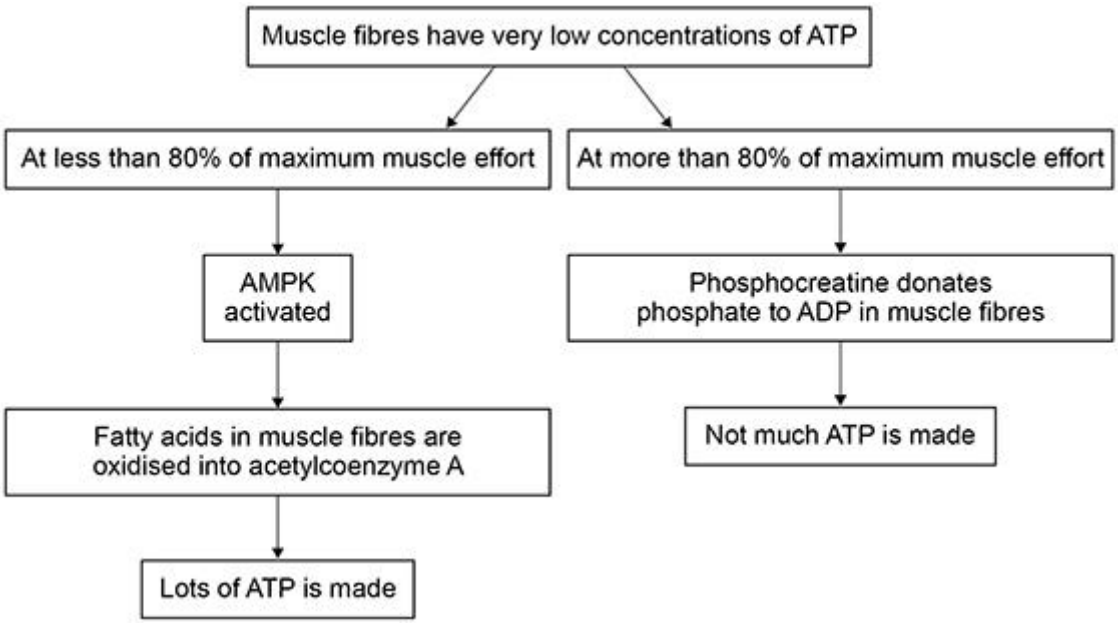
_____

(2)

When muscle fibres have very low concentrations of ATP, they may get ATP in the following ways.

- AMPK (an enzyme) oxidises fatty acids.
- Phosphocreatine donates phosphate to ADP in anaerobic conditions.

The diagram below shows how these chemicals work.



(d) At more than 80% of maximum muscle effort, ATP can only be made for a limited time.

Use the diagram above to suggest **one** reason why.

Tick (✓) the correct box.

ATP cannot move into muscle fibres at a fast-enough rate.	☐
Muscle fibres have a limited amount of phosphocreatine.	☐
Muscle fibres produce too much lactate.	☐
Muscle fibres quickly run out of ADP.	☐

(1)

(e) GW1516 is a performance-enhancing drug. GW1516 activates AMPK **and** develops slow muscle fibres at rest.

Use diagram above to justify why professional athletes are **not** allowed to take GW1516.

Do **not** include details of chemiosmotic theory in your answer.

(4)

EPO is another performance-enhancing drug. It can increase the haematocrit (the percentage of red blood cells in blood).

(f) A heart attack is caused by a lack of glucose and oxygen being delivered to cardiac muscle via the coronary arteries. The overuse of EPO can increase the risk of a heart attack.

Suggest how.

_____

_____

_____

_____

_____

_____

(2)

(g) The normal haematocrit for human males is 47(±5)%. For professional male cyclists, the maximum haematocrit allowed is 50%.

A student suggested that professional male cyclists should be allowed to use EPO until their haematocrit is 50%.

Give **two** reasons why this suggestion is **not** valid.

1 _____

_____

_____

2 _____

_____

_____

(2)

(Total 15 marks)

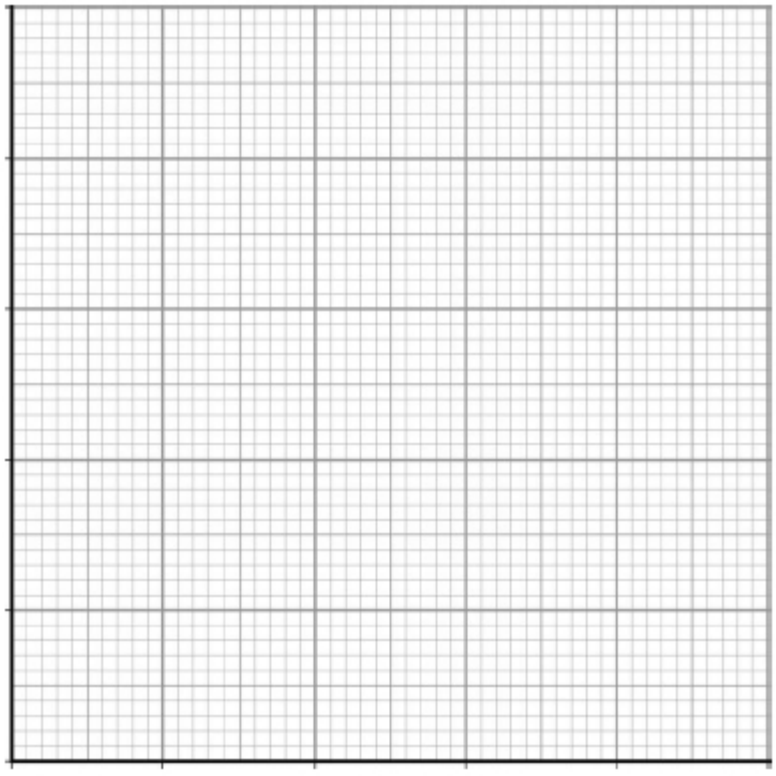
Q7.

Scientists measured the rate of carbon dioxide release by three groups of insects of the same species at 10 °C, 20 °C and 30 °C. They also determined the mean mass of each group of insects.

The scientists results are shown in the table.

Temperature / °C	**Mean mass / g**	**Rate of carbon dioxide release / μdm^3 $minute^{-1}$**	**Rate of carbon dioxide release per gram / μdm^3 g^{-1} $minute^{-1}$**
10	0.047	0.12	
20	0.046	0.33	
30	0.048	0.56	

(a) Complete the table above and plot a graph of your calculated values against temperature on the graph paper. Express your calculated rates with the appropriate number of significant figures.

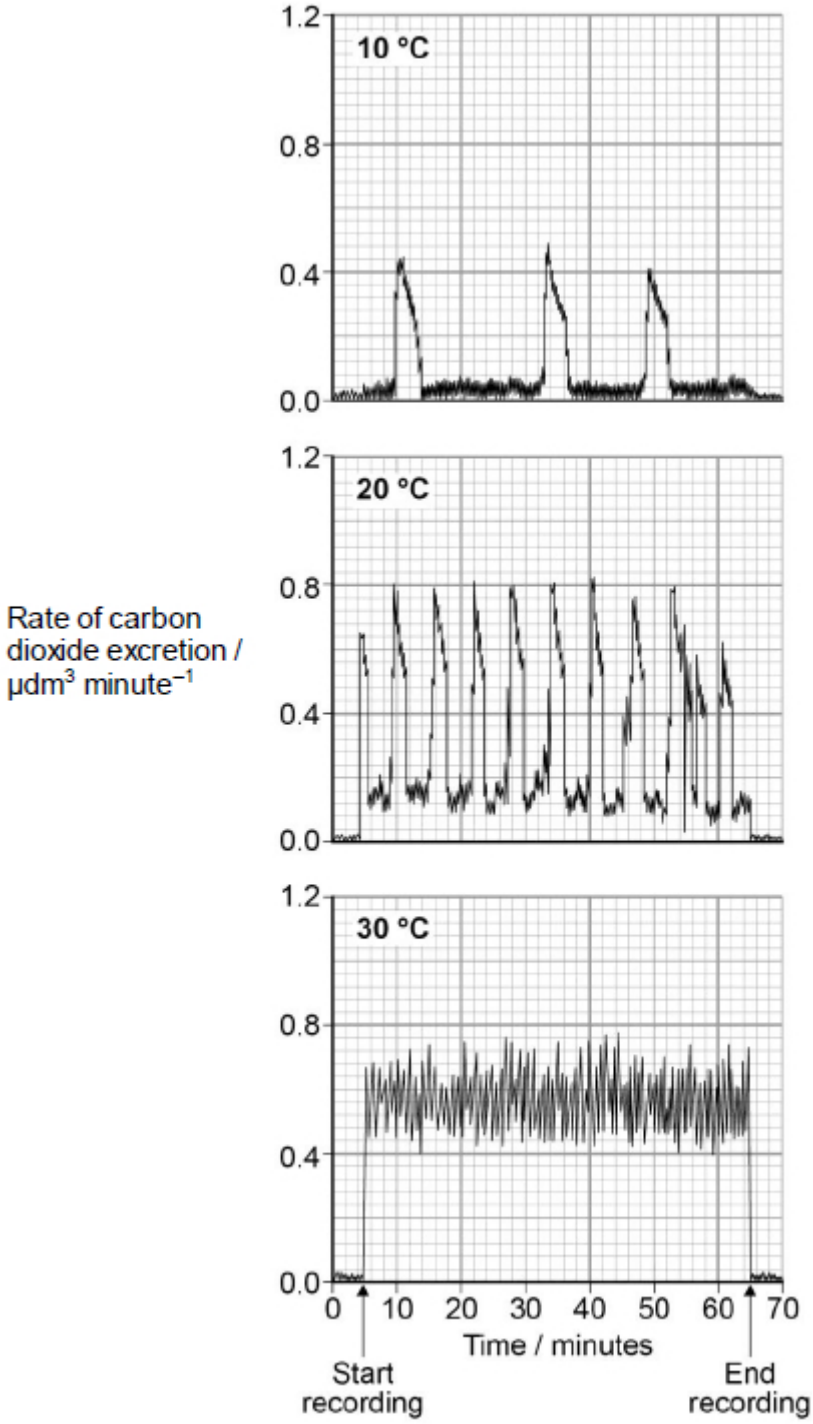


(3)

The body temperature of the insects was largely determined by the temperature they were kept at. At each temperature, the scientists recorded rate of carbon dioxide release by individual insects over time. This rate depends upon spiracles

opening or closing.

The graphs below show results for three insects.



(b) Calculate the change in the rate per hour of opening of the spiracles between 10 °C and 20 °C.

_____

_____

(1)

(c) Explain how you could determine the total amount of carbon dioxide secreted at 30 °C during the period of recording.

_____

_____

(1)

(d) Suggest an explanation for the effect of temperature on the rate of carbon dioxide release.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)