IB · SL · Biology

1 hour 16 questions

Structured Questions

Cell Respiration

Adenosine Triphosphate (ATP) / Cell Respiration / Cell Respiration: Skills

Easy (7 questions)	/30
Medium (4 questions)	/30
Hard (5 questions)	/27
Total Marks	**/87**

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Easy Questions

1 (a) State an appropriate chemical equation to represent the production of ATP in respiration.

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(1 mark)

(b) ATP is an energy source required for many processes in the human body.

Identify **two** uses of ATP in the human body.

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(2 marks)

(c) State the word equation for aerobic respiration.

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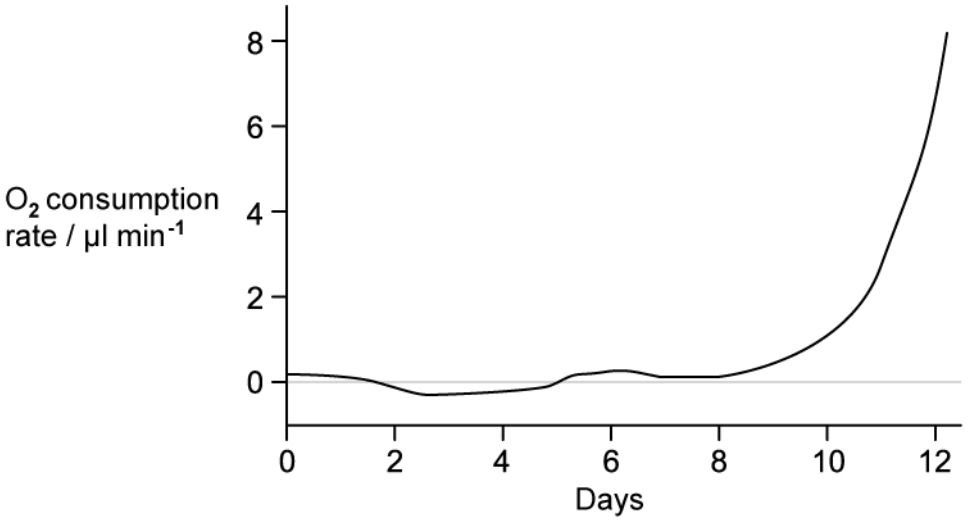
(2 marks)

2 (a) When farmers store animal feed, moisture levels need to be kept as low as possible to prevent the growth of fungi. Animal feed was exposed to 10 % moisture and placed into a respirometer. O_2 consumption by fungi was monitored using a respirometer over a period of 12 days. The results are shown below.



A specific amount of soda-lime was added to the respirometer before data collection began.

State why this alkali was added.

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(1 mark)

(b) State **two** conclusions that could be drawn from the results shown in the graph in part (a).

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(2 marks)

(c) List **one** variable (other than humidity) that should be controlled in this experiment.

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(1 mark)

3 Define cellular respiration.

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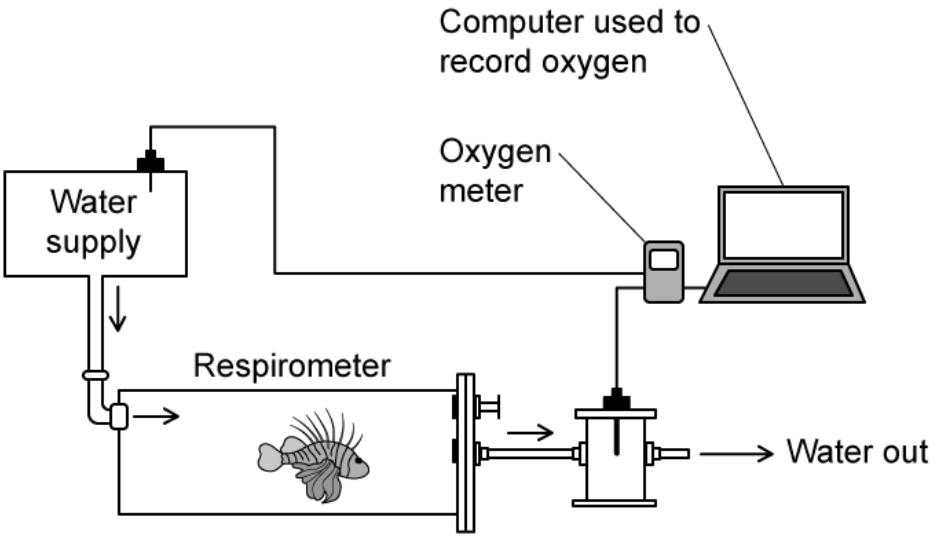
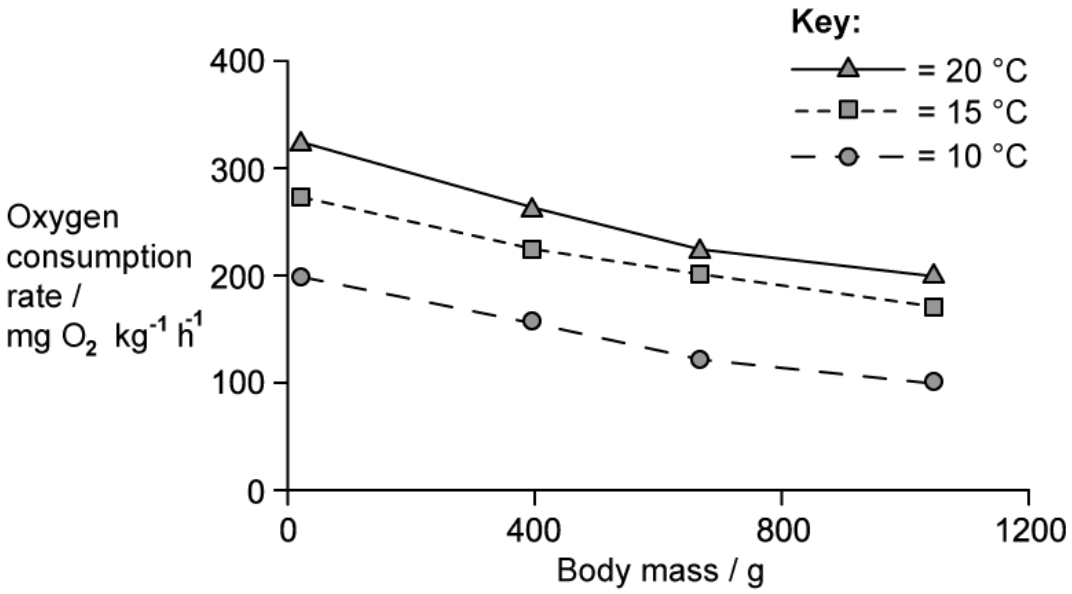
(2 marks)

4 (a) The oxygen consumption rate of the red lionfish (*Pterois volitans*) was examined in a respirometer at three different water temperatures and at four different body masses.

The experimental set-up used and the results of the experiment are shown below.





Suggest how the oxygen consumption rate of *Pterois volitans* is determined.

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(2 marks)

(b) State the relationship between body mass and the oxygen consumption of *Pterois volitans*.

.....

(1 mark)

(c) Based on the data, suggest what the effects of global warming on aerobic respiration in fish might be.

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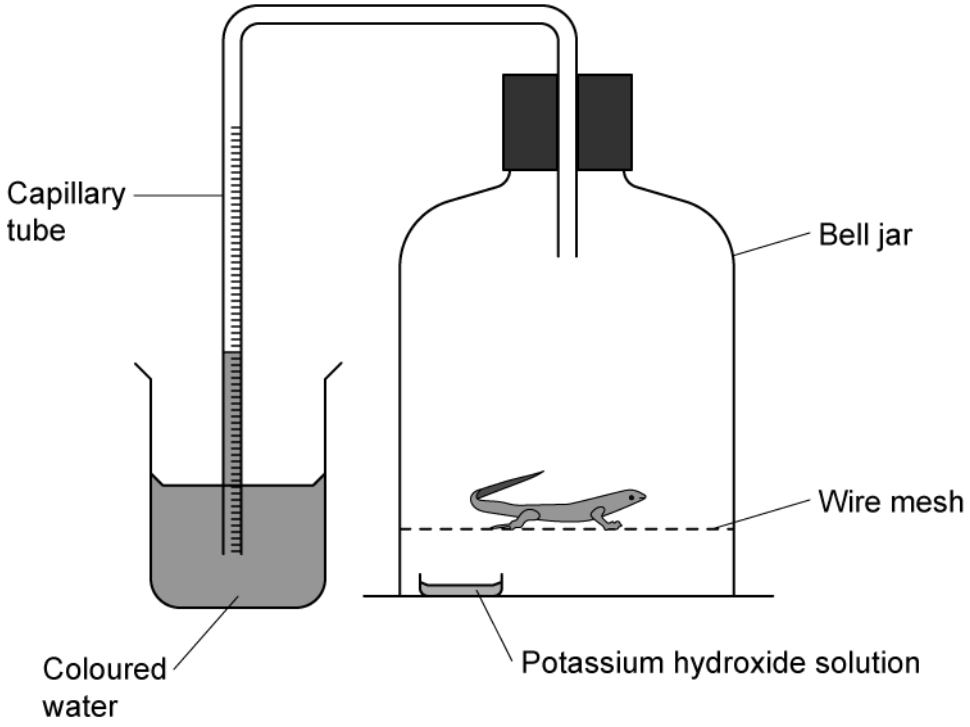
(2 marks)

5 (a) The apparatus shown below was used as a basic respirometer to measure the oxygen consumption of a lizard.



Describe how the experimental set-up shown above can be used to measure the oxygen consumption of the lizard.

(4 marks)

(b) Discuss the suitability of the apparatus shown in part (a) for measuring the oxygen consumption of a green plant during respiration.

(3 marks)

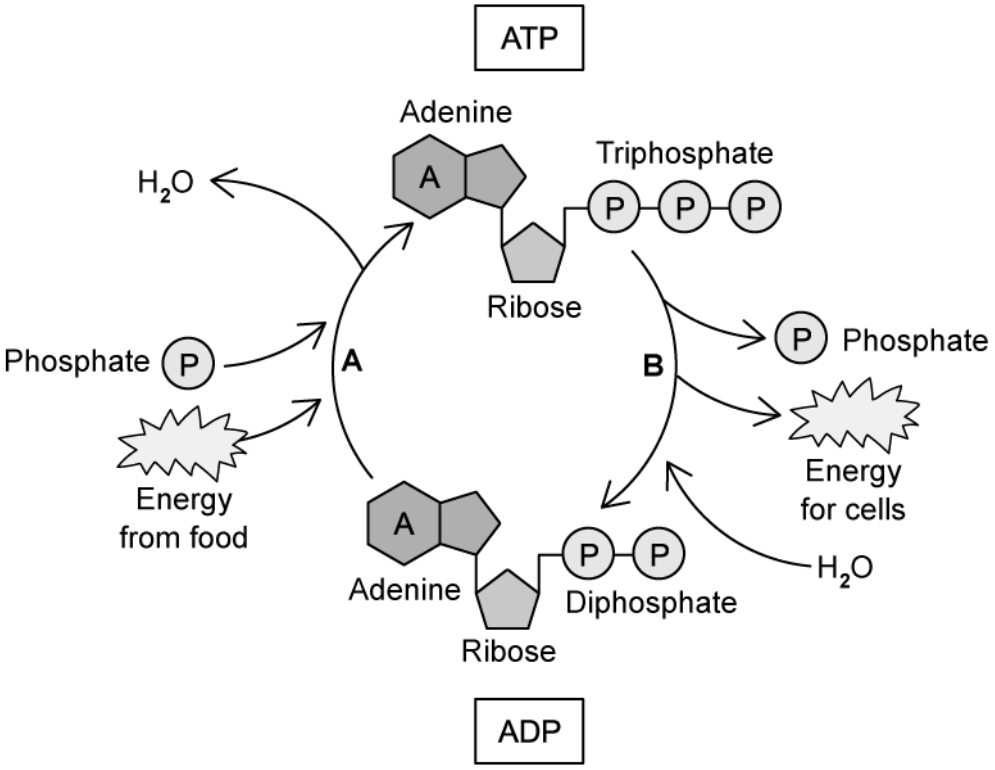
6 (a) Respiration can be represented by a chemical equation.

State the balanced chemical equation for aerobic respiration.

(2 marks)

(b) The diagram below shows the cyclic formation of ATP from ADP.

Use the diagram to identify which of processes **A** and **B** is the process of phosphorylation.



(1 mark)

7 Describe the role of the inner membrane of the mitochondria.

(4 marks)

Medium Questions

1 (a) ATP is a chemical substance generated in cellular respiration; it is an immediate source of energy for the cell. ATP can easily be hydrolysed or re-synthesised.

State **two** products created when ATP is hydrolysed by water.

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(2 marks)

(b) Cells hydrolyse ATP to provide energy for other reactions, or to add phosphate to other substances to make them more reactive. However, ATP needs to be re-synthesised to provide energy for future reactions.

Describe how ATP may be re-synthesised.

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(2 marks)

(c) Give **two** ways in which the properties of ATP make it a suitable source of energy for biological processes.

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(2 marks)

(d) Each day, the human body synthesises more than its weight in ATP during aerobic respiration.

Explain why it is necessary to synthesise such large amounts of ATP.

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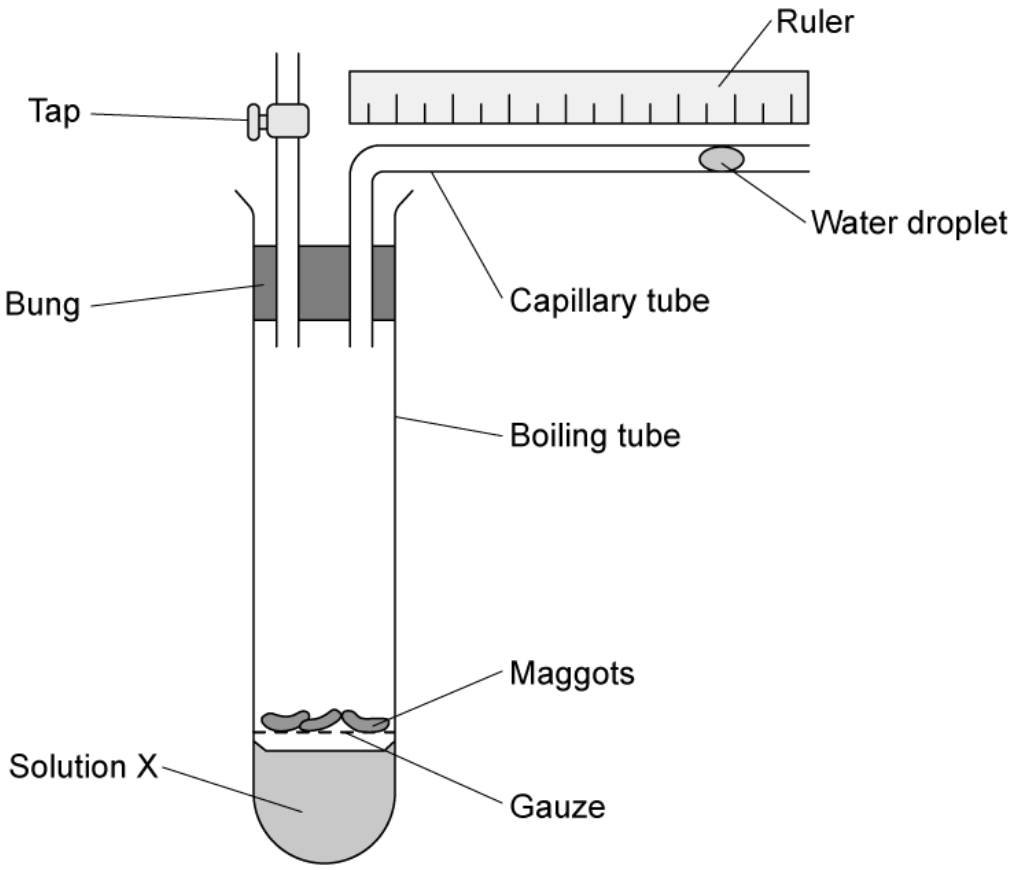
(2 marks)

2 (a) The following apparatus was set up to measure the rate of aerobic respiration by a student.



Suggest what solution **X** might be and its function within the experiment.

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(2 marks)

(b) Describe what ethical concerns the student should consider during this experiment.

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(3 marks)

(c) The student found the water droplet had moved by 2 cm in 24 hours. The diameter of the lumen of the tube is 1 mm.

The volume of the tubing is given by the equation $\pi r^2 l$;
Use the value of 3.14 to represent π and note that l refers to the length.

Use the equation to calculate the volume of gas produced in cm^3 $hour^{-1}$, give your answer in standard form.

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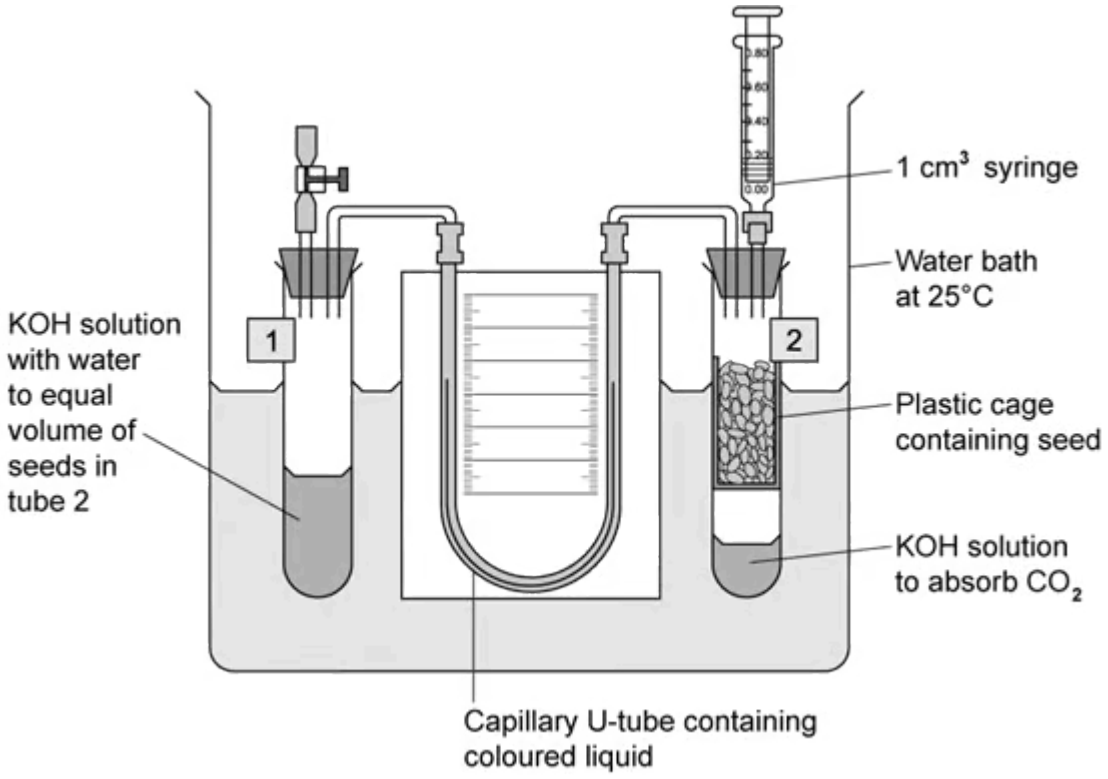
(3 marks)

3 (a) The diagram below shows the respirometer apparatus used by a teacher for measuring the rate of oxygen consumption of seeds during aerobic respiration.



For the first 12 minutes, the tap attached to tube **1** was left open and the syringe from tube **2** was taken away.

Suggest **two** reasons why this was done.

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(2 marks)

(b) A temperature of 25 ^{o}C was used during the experiment. The teacher explained it was very important to keep the temperature constant.

Explain why it is important to keep the temperature constant.

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(2 marks)

(c) After 12 minutes, the tap connected to tube **1** was closed and the syringe was attached to tube **2**. Every 60 seconds, the syringe plunger was moved to make the levels in the U-tube identical. The reading on the volume scale of the syringe was then recorded. The results are shown in the table below.

Time (minutes)	Reading on volume scale of syringe (cm^3)
0	0.86
1	0.83
2	0.80
3	0.77
4	0.75
5	0.73
6	0.70
7	0.68
8	0.65
9	0.62
10	0.59
11	0.57
12	0.54

Predict, with a reason, whether the coloured liquid in the U-tube would move towards tube **1** or tube **2** during the experiment.

(3 marks)

(d) The mass of the seeds was 1.8 g.

Using the information provided in the table, calculate the rate of oxygen consumption $cm^3\ g^{-1}\ hour^{-1}$ by the seeds. Show your working.

(2 marks)

4 Compare and contrast aerobic respiration and anaerobic respiration.

(5 marks)

Hard Questions

1 (a) A Sports Scientist was investigating aerobic respiration in an athlete. The equation below summarises how ATP is produced, using energy from the oxidation of glucose, for this particular athlete.

glucose + oxygen + (ADP + Pi) → carbon dioxide + water + ATP

170 g 124.4 dm^3 17.25 kg 124.4 dm^3 107 g 17.25 kg

Calculate the mass of ATP produced per dm^3 of oxygen for the athlete.

(3 marks)

(b) The Sports Scientist then decided to measure the volume of oxygen consumed and the mass of ATP produced by the athlete when they ran different length races.

Some of the results for the athlete are shown in the table below.

Length of race/m	Volume of oxygen consumed in cell respiration during race/dm^3	Mass of ATP produced/kg
1 500	40	
10 000	160	
25 000		48.545
42 000		95.703

Complete the table by calculating the missing values.

(2 marks)

2 (a) A group of researchers wanted to investigate ATP production in the preparation of isolated mitochondria taken from a person with mitochondrial disease. They suspended the mitochondria in an isotonic solution and added ADP, phosphate and a respiratory substrate. Oxygen was supplied throughout the preparation.

Explain why the solution used was isotonic.

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(2 marks)

(b) Researchers measured the rate of CO_2 production by three groups of insects of the same species at 15 °C, 25 °C and 35 °C. The mean mass of each group of insects was also recorded. Their results can be seen in the table below.

Temperature / °C	Mean mass / g	Rate of CO_2 release / $\mu dm^3\ min^{-1}$	Rate of CO_2 release per gram / $\mu dm^3\ g^{-1}\ min^{-1}$
15	0.051	0.15	
25	0.050	0.39	
35	0.052	0.61	

(i) Calculate the rate of carbon dioxide release per gram for each temperature in the table. Give your answer to two decimal places.

[1]

(ii) Sketch a graph of your values against temperature.

[2]

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(3 marks)

(c) (i) Describe the effect of temperature on the rate of CO_2 release for these insects.

[1]

(ii) Explain this effect.

[2]

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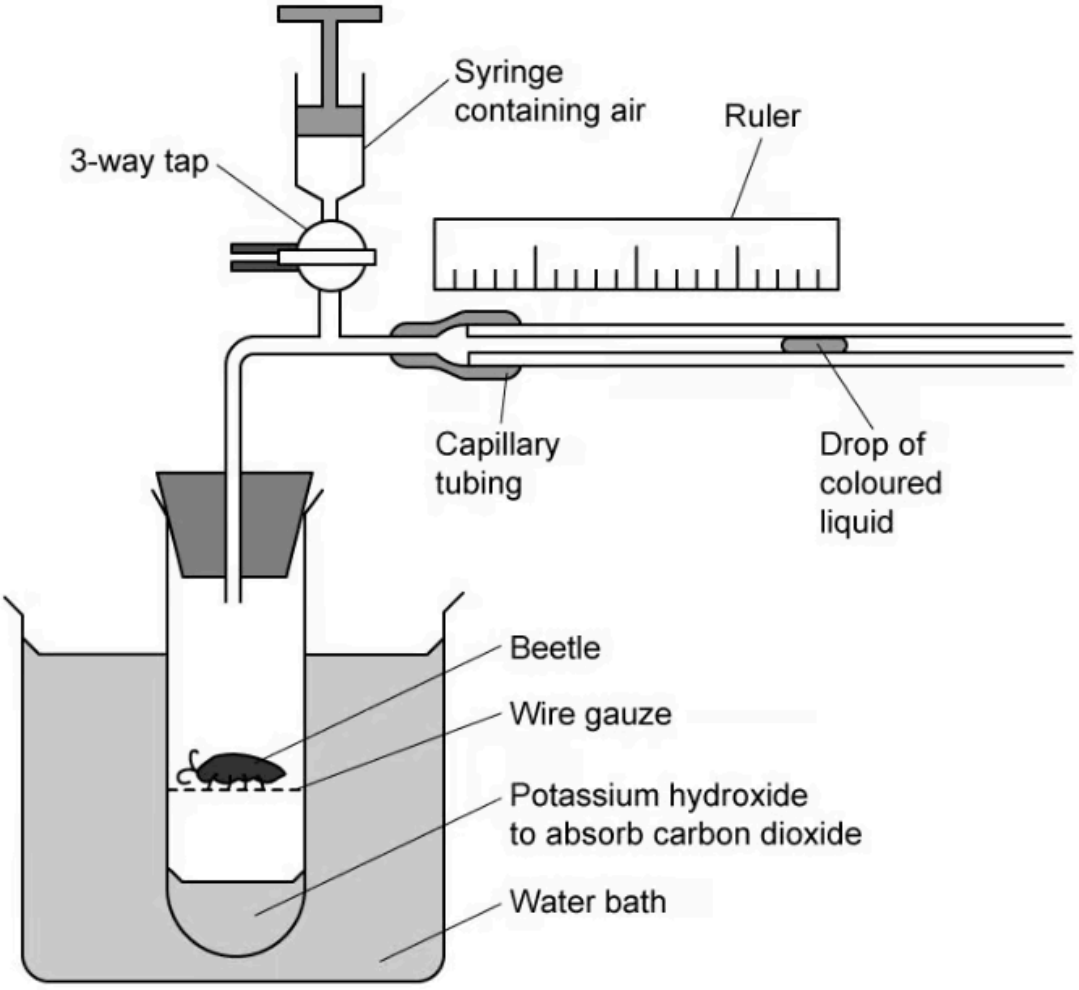
(3 marks)

3 The researcher then wanted to measure and compare the rate of aerobic respiration in different species of beetle (with different masses) using the experimental set-up shown below.



(i) Outline the different measurements that the researcher would need to take in order to calculate the aerobic respiration rate and to accurately compare these respiration rates between different beetle species.

[4]

(ii) Suggest suitable units of respiration rate, based on the different measurements that the researcher would need to take.

[1]

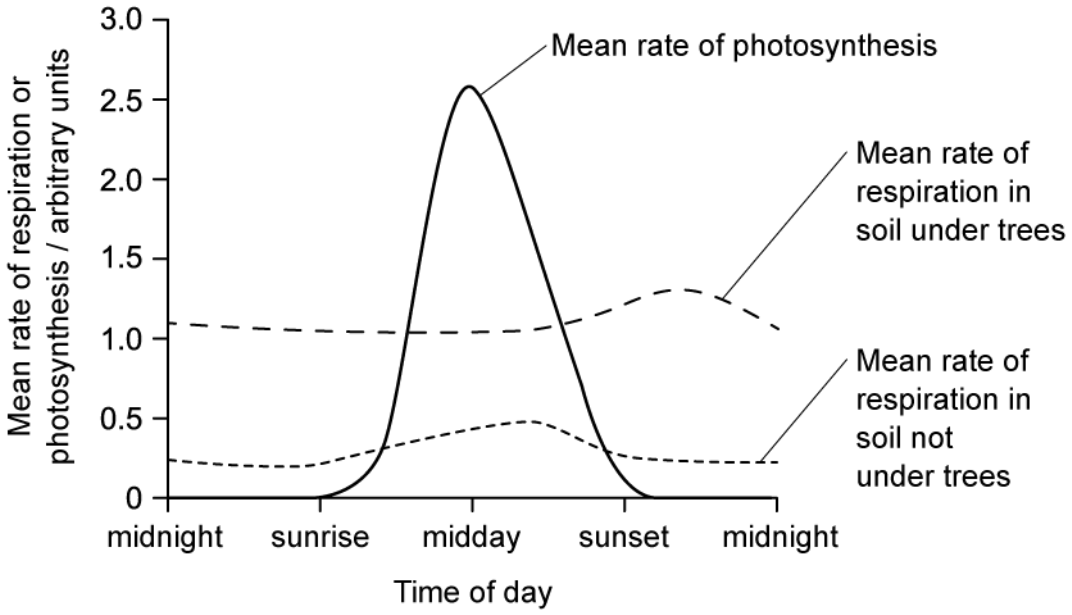
(5 marks)

4 Explain how temperature influences the rate of ATP production in respiration.

(3 marks)

5 (a) A group of scientists measured the mean rate of respiration in soil found under trees and soil that was not from under trees within the same woodland. The mean rate of photosynthesis in leaves was also measured. The measurements were taken throughout a 24 hour period during the summer.

The diagram below shows the scientists' results.



Suggest an explanation for the mean rate of respiration in soil not under the trees between midday and sunset.

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(2 marks)

(b) The mean rate of respiration is higher in soil under the trees throughout the 24hours. The scientists suggested the mean rate of photosynthesis was the cause of this.

Suggest how the rise in the mean rate of photosynthesis could lead to the rise in the mean rate of respiration in soil under trees.

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(2 marks)

(c) State the measurements needed for the scientists to calculate the rate of carbon dioxide production.

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(2 marks)