

# **A-Level Biology**

## **Respiration**

### **Question Paper**

**Time available: 72 minutes**

**Marks available: 51 marks**

1.

(a) Describe the process of glycolysis.

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(4)

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

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

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(2)

(Total 6 marks)

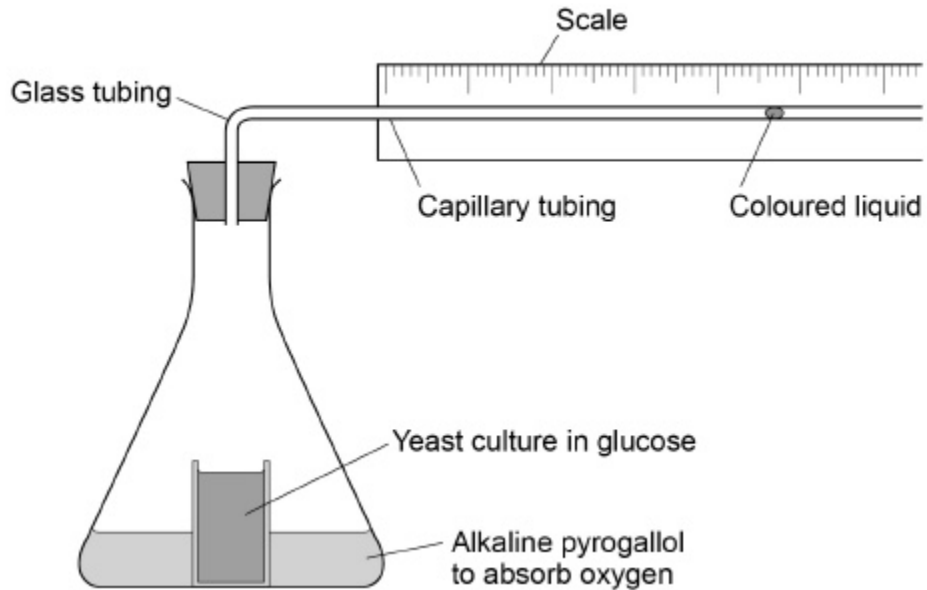
2.

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.

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(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  $\pi$  is 3.14 and  $l$  = length.

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

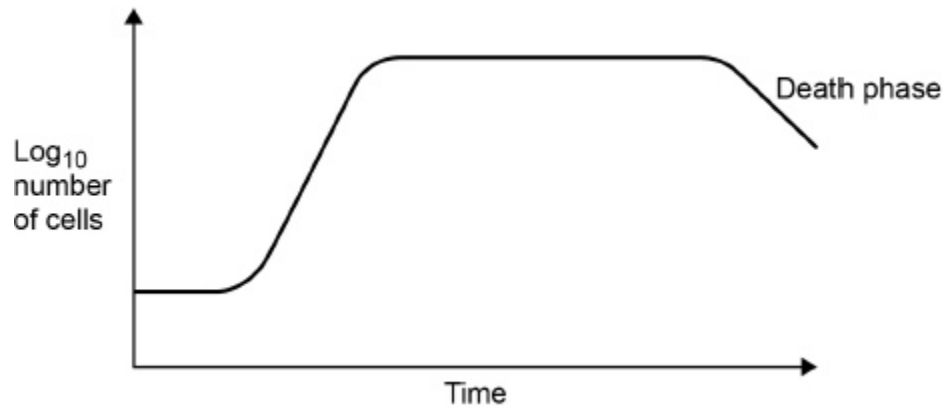
Show your working.

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

(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.

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(1)

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

Suggest **one** reason why.

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(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.

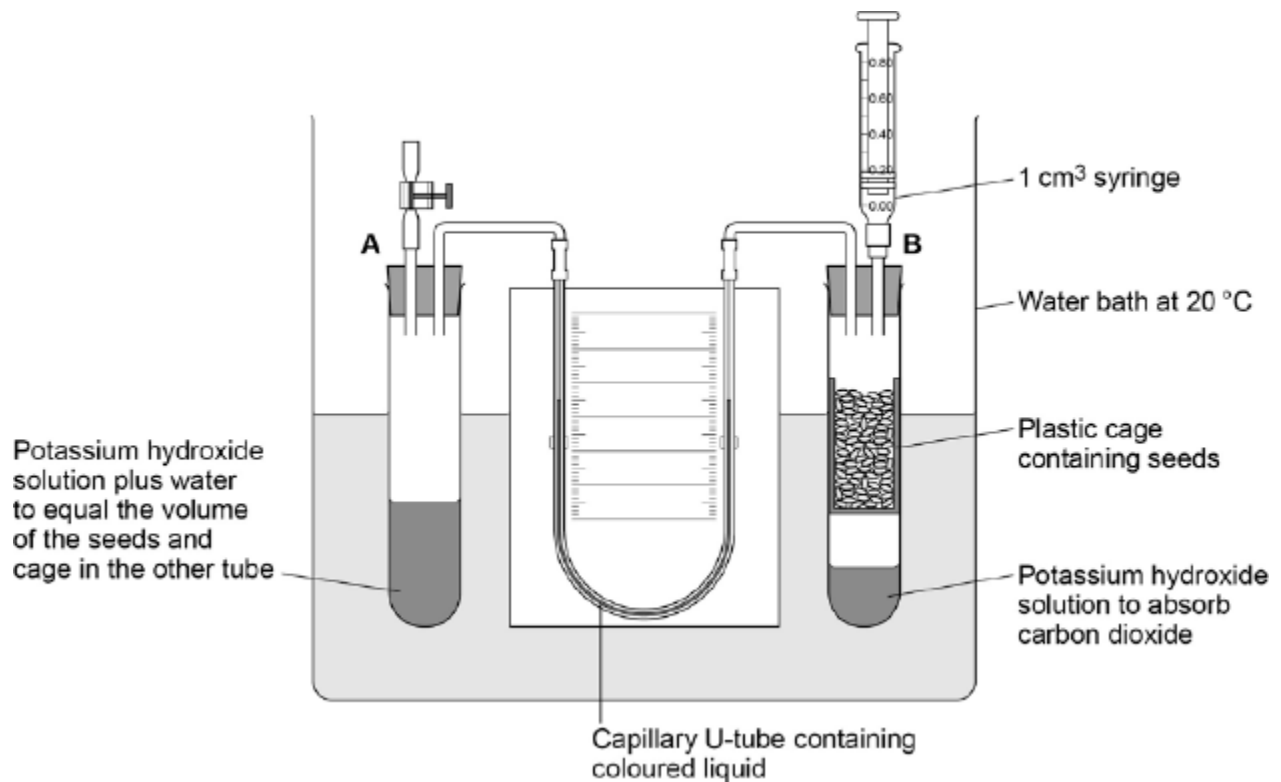
Answer = \_\_\_\_\_

(2)

(Total 9 marks)

3.

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.

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(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 <sup>3</sup>
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.

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(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  $\text{cm}^3 \text{g}^{-1} \text{hour}^{-1}$  by the seeds.

Show your working.

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

(2)

(Total 10 marks)

4.

Some plant seeds can respire aerobically and anaerobically. A summary of the process of anaerobic respiration is shown below.



- (a) (i) Where in a cell does **stage 1** occur?

\_\_\_\_\_

(1)

- (ii) Explain how **stage 2** enables **stage 1** to continue.

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

(2)

- (b) The Respiratory Quotient (RQ) can provide information on the type of respiration taking place in an organism. The following equation is used to calculate the RQ.

$$\text{RQ} = \frac{\text{volume of carbon dioxide produced during respiration}}{\text{volume of oxygen used during respiration}}$$

- (i) What would be the RQ for aerobic respiration of glucose?

(1)

- (ii) A student calculated that the RQ of germinating seeds was 1.8.

Use the information provided to explain this result.

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(2)

- (c) Aerobic respiration produces more ATP per molecule of glucose than anaerobic respiration.

Explain why.

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(2)

(Total 8 marks)

5.

- (a) Describe how acetylcoenzyme A is formed in the link reaction.

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(2)

(b) In the Krebs cycle, acetylcoenzyme A combines with four-carbon oxaloacetate to form six-carbon citrate. This reaction is catalysed by the enzyme citrate synthase.

(i) Oxaloacetate is the first substrate to bind with the enzyme citrate synthase. This induces a change in the enzyme, which enables the acetylcoenzyme A to bind.

Explain how oxaloacetate enables the acetylcoenzyme A to then bind to the enzyme.

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(2)

(ii) Another substance in the Krebs cycle is called succinyl coenzyme A. This substance has a very similar shape to acetylcoenzyme A.

Suggest how production of succinyl coenzyme A could control the rate of the reaction catalysed by citrate synthase.

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(2)

(c) In muscles, pyruvate is converted to lactate during anaerobic respiration.

(i) Explain why converting pyruvate to lactate allows the continued production of ATP during anaerobic respiration.

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(2)

- (ii) In muscles, some of the lactate is converted back to pyruvate when they are well supplied with oxygen. Suggest **one** advantage of this.

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(1)

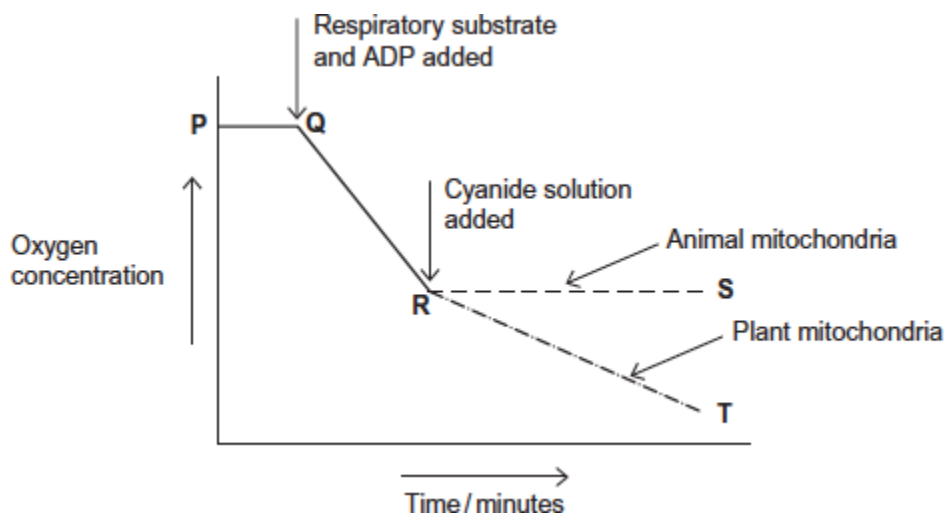
(Total 9 marks)

6.

Researchers investigated the effect of cyanide on oxygen uptake by mitochondria. They prepared a suspension of mitochondria from animal cells and a suspension of mitochondria from plant cells. They placed the suspensions in separate flasks containing isotonic solution, started the timer and began recording the concentration of oxygen in each flask.

- After 5 minutes, they added a respiratory substrate and ADP to each flask.
- After 13 minutes, they added cyanide solution to each flask.

The graph below shows their results. From **P** to **R** the curves for animal and plant mitochondria overlap.



- (a) Explain the line between **P** and **Q**.

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(2)

(b) (i) Explain the line between **Q** and **R**.

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(2)

(ii) The respiratory substrate and ADP added after 5 minutes (**Q**) were part of a buffered isotonic solution.

What other substance would the buffer or solution have to contain?

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(1)

(c) Describe and explain the difference between line **R** to **S** (animal mitochondria) and line **R** to **T** (plant mitochondria).

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(4)

(Total 9 marks)