Helicate

HELICATE · A-LEVEL BIOLOGY · TOPIC BANK

3.5.2 Respiration

Topic question bank · A-level only content

Version 2 · 15 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
8	65	No time limit	/ 65

Contents

Subtopic	Questions	Marks
Glycolysis and anaerobic respiration Specification 3.5.2	01–02	14
The link reaction, the Krebs cycle and other respiratory substrates Specification 3.5.2	03–04	18
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Required practical 9: rate of respiration of single-celled organisms Specification 3.5.2 (RP9)	07–08	21
Total		**65**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA A-level Biology (7402), specification section 3.5.2. Not affiliated with or endorsed by AQA.

Do not write outside the box

Glycolysis and anaerobic respiration 3.5.2

0 1 . 1 Which statement about glycolysis is correct?
Tick (✓) one box.

[1 mark]

- It takes place in the mitochondrial matrix. ☐
- Glucose is phosphorylated using ATP. ☐
- Triose phosphate is reduced to pyruvate. ☐
- It takes place only when oxygen is absent. ☐

0 1 . 2 ATP is used in glycolysis, but glycolysis produces a net gain of ATP.
Explain how.

[2 marks]

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Question 1 continues on the next page

Do not write outside the box

In anaerobic conditions, yeast converts pyruvate to ethanol and carbon dioxide. A mutant strain of yeast cannot convert pyruvate to ethanol. In anaerobic conditions, normal yeast grows but the mutant yeast does not grow.

0 1 . 3 Explain why the mutant yeast does not grow in anaerobic conditions.

[3 marks]

6

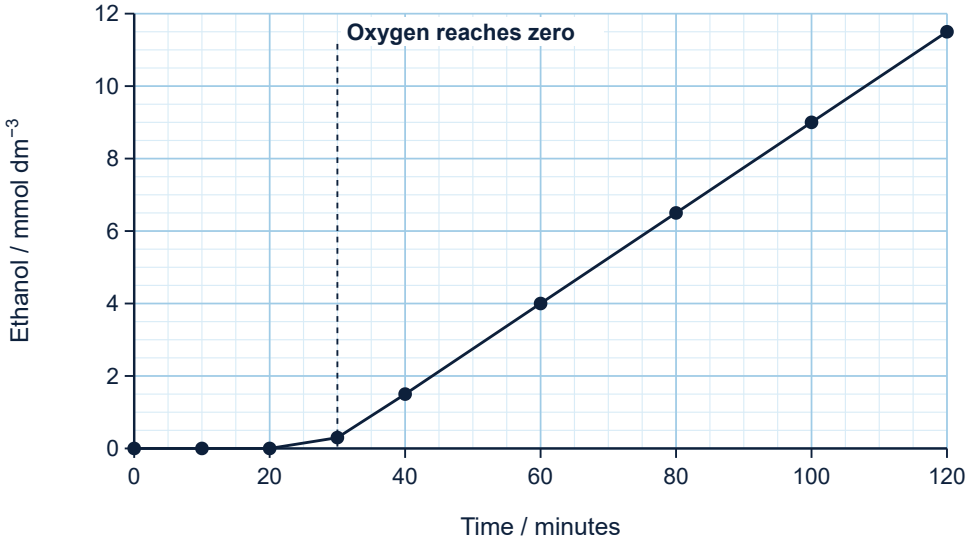
Turn over for the next question

Do not write outside the box

A scientist put a suspension of yeast in glucose solution into a flask and sealed it, with an outlet that let gas escape. In yeast, anaerobic respiration produces ethanol and carbon dioxide.

She measured the concentration of ethanol in the suspension at intervals. The dissolved oxygen concentration fell steadily from the start and reached zero at 30 minutes. Figure 1 shows her results.

Figure 1



0 2 . 1 Use Figure 1 to calculate the rate of ethanol production between 40 minutes and 120 minutes.
Give your answer in mmol dm^{-3} h^{-1}

[2 marks]

Answer ..... **mmol dm^{-3} h^{-1}**

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Explain why almost no ethanol was produced in the first 30 minutes.

[2 marks]

0 2 . 3 The yeast took up glucose much faster after 40 minutes than in the first 20 minutes.
Explain why.

[3 marks]

0 2 . 4 Figure 1 shows that some ethanol was produced before the dissolved oxygen concentration reached zero.
Suggest why.

[1 mark]

8

Turn over for the next question

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Do not write outside the box

The link reaction, the Krebs cycle and other respiratory substrates 3.5.2

0 3 . 1 Which of these are **both** produced in the link reaction?
Tick (✓) one box.

[1 mark]

- Acetylcoenzyme A and ATP ☐
- Pyruvate and reduced NAD ☐
- Acetylcoenzyme A and reduced NAD ☐
- A six-carbon molecule and reduced NAD ☐

0 3 . 2 Describe how acetylcoenzyme A is used in the Krebs cycle, and how the Krebs cycle produces reduced coenzymes and ATP.

[4 marks]

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 No oxygen is used in the Krebs cycle, but the Krebs cycle stops if oxygen is not available.
Explain why.

[3 marks]

8

Turn over for the next question

Do not write outside the box

Scientists isolated mitochondria from liver cells. They put the same mass of mitochondria into each of five chambers. Each chamber contained a buffer solution with ADP and phosphate. They added different substances to the chambers and measured the rate of oxygen uptake with an oxygen sensor.

Substance **X** binds to the carrier protein that moves pyruvate across the inner mitochondrial membrane into the matrix.

Table 1 shows their results.

Table 1

Chamber	Substance(s) added	Rate of oxygen uptake / nmol min^{-1} per mg of mitochondrial protein
A	Nothing	3
B	Glucose	3
C	Pyruvate	52
D	Pyruvate and substance **X**	5
E	Fatty acids, with the substances needed for them to enter mitochondria	41

0 4 . 1 Explain why the rate of oxygen uptake in chamber **B** was the same as in chamber **A**.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 2 By what percentage did substance **X** reduce the rate of oxygen uptake by mitochondria supplied with pyruvate?
Show your working.

[2 marks]

Answer ..... **%**

0 4 . 3 Explain the effect of substance **X** on the rate of oxygen uptake.

[3 marks]

0 4 . 4 Explain the result for chamber **E**.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 Suggest the purpose of chamber **A**.

[1 mark]

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10

Turn over for the next question

Not affiliated with or endorsed by AQA.

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Oxidative phosphorylation 3.5.2

0 5 . 1 What is the role of oxygen in aerobic respiration?
Tick (✓) one box.

[1 mark]

- It accepts electrons at the end of the electron transfer chain. ☐
- It combines with carbon from glucose to form carbon dioxide in the Krebs cycle. ☐
- It oxidises triose phosphate in glycolysis. ☐
- It provides energy to move protons across the inner mitochondrial membrane. ☐

0 5 . 2 Explain how ATP is produced by oxidative phosphorylation in a mitochondrion.

[5 marks]

6

Turn over for the next question

Do not write outside the box

Scientists grew mammalian cells in a culture medium containing glucose and oxygen. They added substance **R** or substance **T** to some of the cultures.

- Substance **R** binds to the last carrier in the electron transfer chain, so electrons cannot be passed to oxygen.
- Substance **T** makes the inner mitochondrial membrane permeable to protons.

10 minutes after adding each substance, the scientists measured the rate of oxygen uptake, the ATP concentration and the rate of heat release of the cells. Table 2 shows their results.

Table 2

Substance added	Rate of oxygen uptake / nmol min^{-1} per 10^6 cells	ATP concentration / nmol per 10^6 cells	Rate of heat release / μW per 10^6 cells
None	4.2	8.0	30
R	0.2	3.1	11
T	7.0	2.8	52

Question 6 continues on the next page

Do not write outside the box

0 6 Use your knowledge of respiration to explain the results for substances **R** and **T** in Table 2.

[6 marks]

6

Turn over for the next question

Do not write outside the box

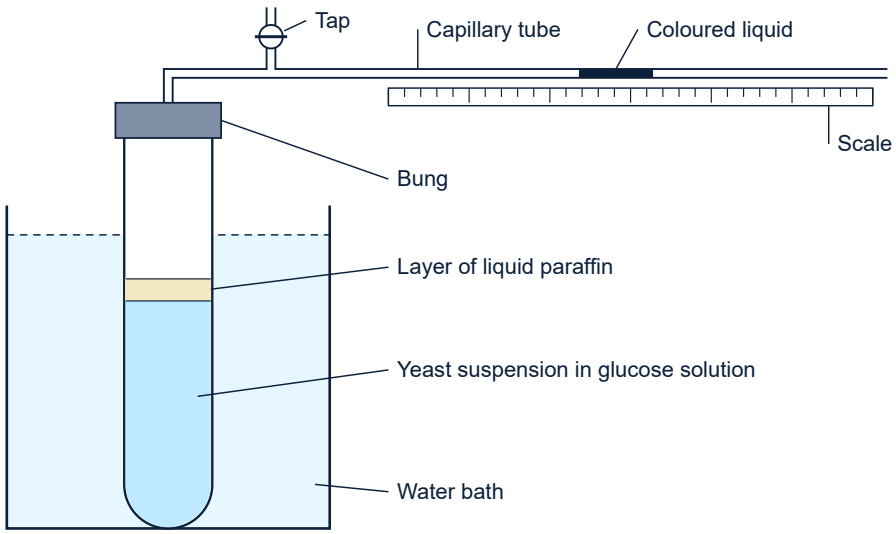
Required practical 9: rate of respiration of single-celled organisms 3.5.2 (RP9)

A student used the apparatus in Figure 2 to investigate the effect of temperature on the rate of anaerobic respiration of yeast. In anaerobic respiration, yeast produces ethanol and carbon dioxide. She:

- boiled some glucose solution and then cooled it
- put 8 cm^3 of the glucose solution and 2 cm^3 of a dilute yeast suspension into a boiling tube, and covered the surface with a layer of liquid paraffin
- left the tube in a water bath at the set temperature for 15 minutes with the tap open
- closed the tap and measured the distance the coloured liquid moved in 10 minutes.

The capillary tube had an internal diameter of 0.80 mm. She carried out 3 repeats at each temperature.

Figure 2



Question 7 continues on the next page

Do not write outside the box

0 7 . 1 Suggest why the student:

[2 marks]

boiled the glucose solution and then cooled it before adding the yeast

covered the surface with a layer of liquid paraffin

0 7 . 2 Suggest **two** reasons why the student left the tube in the water bath for 15 minutes with the tap open before taking readings.

[2 marks]

1

2

Question 7 continues on the next page

Do not write outside the box

The volume of a cylinder = $\pi r^2 l$, where r is the radius and l is the length. Assume that the movement of the coloured liquid was caused only by carbon dioxide released by the yeast.

Table 3

Temperature / °C	Distance moved by coloured liquid in 10 minutes / mm			Mean distance / mm
	Repeat 1	Repeat 2	Repeat 3	
15	6	8	7	7
25	19	21	20	20
35	47	50	47	48
45	33	18	35	
55	4	6	5	5

0 7 . 3 Table 3 shows the student's results.
Calculate the rate of carbon dioxide production at 35 °C in $cm^3\ h^{-1}$.
Give your answer in standard form to 2 significant figures.

[3 marks]

Answer _____ **$cm^3\ h^{-1}$**

Question 7 continues on the next page

Do not write outside the box

0 7 . 4 The mean distance at 45 °C is missing from Table 3.
Identify the anomalous result at 45 °C and calculate the mean distance without it.

[2 marks]

Anomalous result ..... mm

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Mean ..... mm

0 7 . 5 The student concluded that the optimum temperature for respiration in yeast is 35 °C.
Evaluate this conclusion.

[3 marks]

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0 7 . 6 Explain why the rate of respiration was lower at 55 °C than at 35 °C.

[2 marks]

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Turn over for the next question

Do not write outside the box

In a separate investigation, a student used a redox indicator to compare dehydrogenase activity in yeast at different glucose concentrations. The indicator is blue when oxidised and colourless when reduced. The reduced indicator turns blue again if it is oxidised.

She mixed yeast suspension, indicator and glucose solution in tubes in a water bath at 30 °C, without shaking them. She timed how long the blue colour took to disappear. She did this 5 times for each glucose concentration. Table 4 shows her results.

Table 4

Glucose concentration / g dm^{-3}	Mean time for blue colour to disappear / s	Standard deviation / s
0	Still blue after 1800 s	
5	612	48
10	395	30
20	248	22
40	231	25

0 8 . 1 Explain why the blue colour disappeared.

[2 marks]

0 8 . 2 Suggest why the student did not shake the tubes while she was timing the colour change.

[1 mark]

Question 8 continues on the next page

Do not write outside the box

0 8 . 3 Suggest why the student included a tube with 0 g dm^{-3} glucose.

[1 mark]

0 8 . 4 The student concluded that increasing the glucose concentration above 20 g dm^{-3} does not increase dehydrogenase activity in yeast.
Use Table 4 to evaluate this conclusion.

[3 marks]

7

END OF QUESTIONS

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