Respiration: AQA A Level Biology Exam Questions by Topic

17 questions · 44 marks · about 57 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2025 · Q01.1 · 2 marks

0 1 . 1 In the following passage, the numbered spaces can be filled with biological terms.

Glycolysis is the first stage of respiration. It occurs in the ____(1)____ of cells and is an anaerobic process. Glycolysis involves the ____(2)____ of glucose to glucose phosphate, using ATP. The oxidation of triose phosphate to ____(3)____ results in the net gain of ATP and reduced ____(4)____ .

Write the correct biological term beside each number below that matches the space in the passage.

[2 marks]

1 _____

2 _____

3 _____

4 _____

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Question 2 · A level Paper 2 · November 2021 · Q01.1 · 4 marks

0 1 . 1 Describe the process of glycolysis.

[4 marks]

Question 3 · A level Paper 2 · June 2019 · Q04.3 · 2 marks

0 4 . 3 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.

[2 marks]

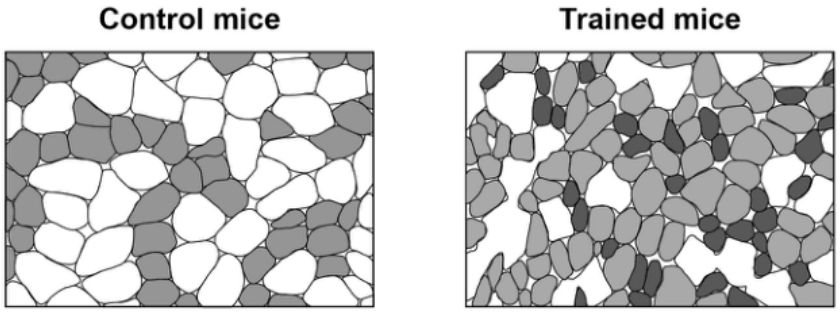
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Question 4 · information from earlier in the question

0 3 Scientists investigated the effect of regular exercise on skeletal muscle fibres in mice. The scientists compared the muscle fibres of mice after six weeks of regular exercise (trained mice) with those of mice that had not exercised (control mice). The scientists stained the muscle fibres from both sets of mice to show succinic acid dehydrogenase activity. The darker the stain the greater the succinic acid dehydrogenase activity.

Figure 3 shows a typical set of results they obtained.

Figure 3



Question 4 · A level Paper 2 · June 2017 · Q03.2 · 3 marks

0 3 . 2 The scientists then compared the length of time that the control mice and the trained mice could carry out prolonged exercise. The trained mice were able to exercise for a longer time period than control mice.

Explain why.

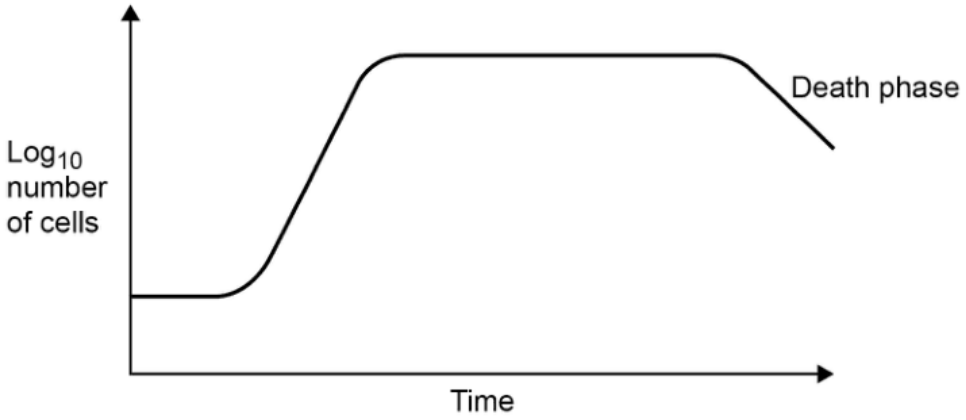
[3 marks]

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Question 5 · information from earlier in the question

Figure 4 shows a typical population growth curve for yeast under laboratory conditions.

Figure 4



Question 5 · A level Paper 2 · June 2018 · Q03.5 · 1 mark

0 3 . 5 Many yeast cells die during the death phase.

Suggest **one** reason why.

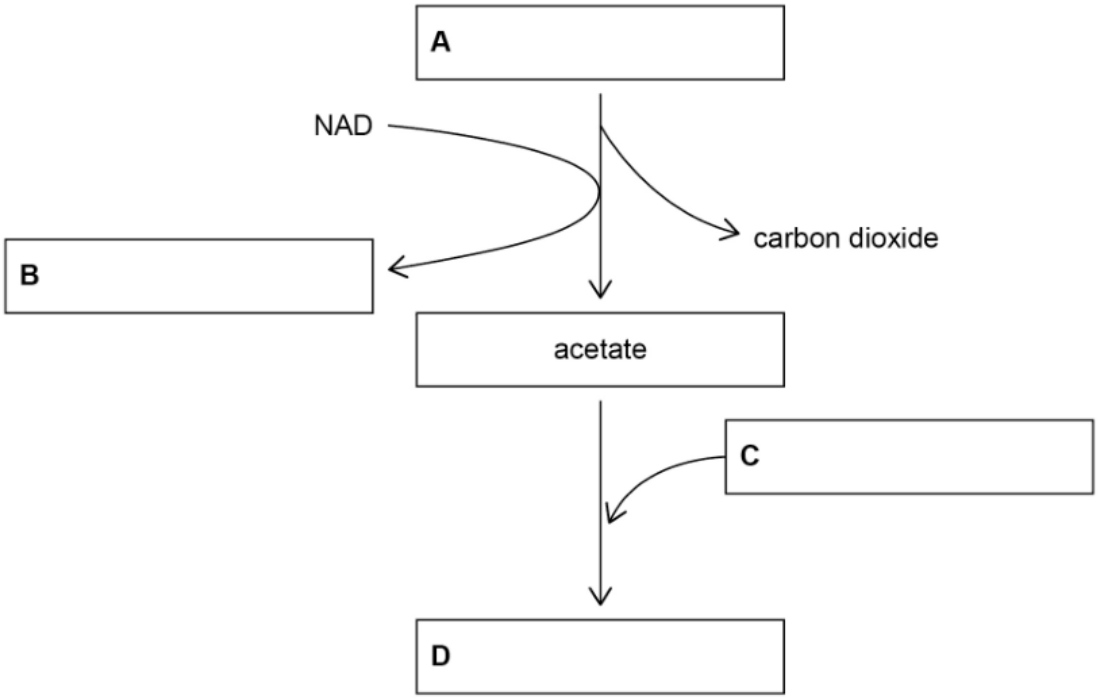
[1 mark]

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The accuracy of this method could be improved by

0 2 . 5 Complete the boxes **A** to **D** in **Figure 4** to show the link reaction.

Figure 4



[2 marks]

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Question 7 · A level Paper 2 · June 2025 · Q01.2 · 2 marks

0 1 . 2 The equation for the aerobic respiration of glucose is:

$$C_6H_{12}O_6 + 6\ O_2 \longrightarrow 6\ CO_2 + 6\ H_2O$$

Six carbon dioxide molecules are produced from each glucose molecule.

Use your knowledge of the link reaction **and** Krebs cycle to explain why.

[2 marks]

Question 8 · A level Paper 2 · November 2021 · Q01.2 · 2 marks

0 1 . 2 Malonate inhibits a reaction in the Krebs cycle.

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

[2 marks]

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Question 9 · A level Paper 2 · June 2025 · Q01.3 · 3 marks

0 1 . 3 An inhibitor of the electron transfer chain was added to aerobically respiring yeast cells.

As aerobic respiration was inhibited, the following changes occurred:

- oxygen uptake decreased
- ATP production decreased
- ethanol was produced.

Explain the changes in the yeast cells following the addition of the inhibitor.

[3 marks]

Oxygen uptake decreased _____

ATP production decreased _____

Ethanol was produced _____

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Question 10 · information from earlier in the question

1 0 Read the following passage.

North American black bears can hibernate for up to 7 months without food or water. The bears survive using the fat stores in their bodies. The bears build up the fat stores during the summer. During hibernation, the heart rate of black bears decreases from a summer mean of 55 beats per minute to 14 beats per minute. Their metabolic rate falls by 75%.

In many mammals, 'uncoupling proteins' help to maintain a constant body temperature during hibernation. Uncoupling proteins are found in the inner mitochondrial membrane and act as proton channels during chemiosmosis. However, these proton channels do not generate ATP.

In the mountains of North America, when winter changes into spring, the coat colour of snowshoe hares changes from white to brown. Climatic changes have caused the snow to melt earlier. This has reduced the survival rate of snowshoe hares in these habitats. The change in coat colour occurs when new fur replaces old fur. This is called moulting. Recent research has shown that snowshoe hares within a population moult at different times. Moulting at different times could be a major factor in ensuring the survival of snowshoe hare populations.

Use the information in the passage and your own knowledge to answer the following questions.

Question 10 · A level Paper 2 · November 2020 · Q10.3 · 2 marks

1 0 . 3 In many mammals, 'uncoupling proteins' help to maintain a constant body temperature during hibernation (lines 6–7).

Suggest and explain how.

[2 marks]

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Question 11 · A level Paper 3 · June 2025 · Q01.3 · 3 marks

0 1 . 3 Bedaquiline is a drug that inhibits ATP synthase in mycobacteria by stopping hydrogen ion (proton) movement.

Explain how bedaquiline can kill these bacteria.

[3 marks]

Question 12 · information from earlier in the question

0 3 A student investigated the effects of indoleacetic acid (IAA) on the growth of oat seedlings (young plants).

The student:

- removed the shoot tip from each seedling and cut out a 10 mm length of shoot
- placed 10 lengths of shoot into each of 5 Petri dishes
- added to each Petri dish an identical volume of 5% glucose solution
- added to each Petri dish 40 cm^3 of a different concentration of IAA solution
- left the Petri dishes at 20 °C in the dark with their lids on for 5 days
- removed the shoots after 5 days and measured them
- determined the mean change in length of shoot at each concentration of IAA.

Table 1 shows her results.

Table 1

IAA concentration added to Petri dish / parts per million	10^{-5}	10^{-3}	10^{-1}	1	10
Mean change in length of shoot / mm	0.0	0.1	1.3	2.4	3.1

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Question 12 · A level Paper 2 · June 2019 · Q03.2 · 2 marks

0 3 . 2 Explain why the student added glucose solution to each Petri dish.

[2 marks]

Question 13 · information from earlier in the question

0 3 Galacto-oligosaccharides (GOS) are polymers of galactose.

Question 13 · AS Paper 2 · June 2023 · Q03.4 · 3 marks

0 3 . 4 Prebiotics are foods used to promote good health in humans.

Prebiotics stimulate the growth of 'healthy' bacterial populations in the human digestive system.

The bacteria in these 'healthy' populations produce enzymes that hydrolyse GOS.

Suggest how GOS can work as a prebiotic.

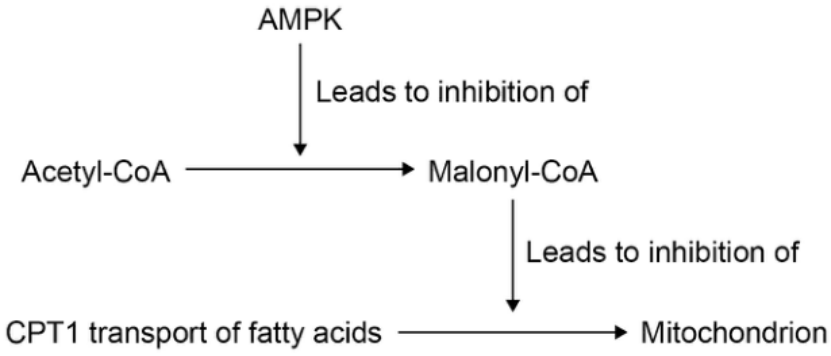
[3 marks]

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0 1 . 2 AMP-activated protein kinase (AMPK) is an enzyme that regulates a number of cellular processes. Exercise leads to activation of AMPK.

Figure 1 shows one effect of activation of AMPK during exercise.

Figure 1



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

Using **Figure 1**, explain the benefit of activation of AMPK during exercise.

[3 marks]

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1 0 Read the following passage.

North American black bears can hibernate for up to 7 months without food or water. The bears survive using the fat stores in their bodies. The bears build up the fat stores during the summer. During hibernation, the heart rate of black bears decreases from a summer mean of 55 beats per minute to 14 beats per minute. Their metabolic rate falls by 75%.

In many mammals, 'uncoupling proteins' help to maintain a constant body temperature during hibernation. Uncoupling proteins are found in the inner mitochondrial membrane and act as proton channels during chemiosmosis. However, these proton channels do not generate ATP.

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Use the information in the passage and your own knowledge to answer the following questions.

1 0 . 1 Black bears can hibernate for up to 7 months without food or water (lines 1–2).

Suggest and explain how.

[3 marks]

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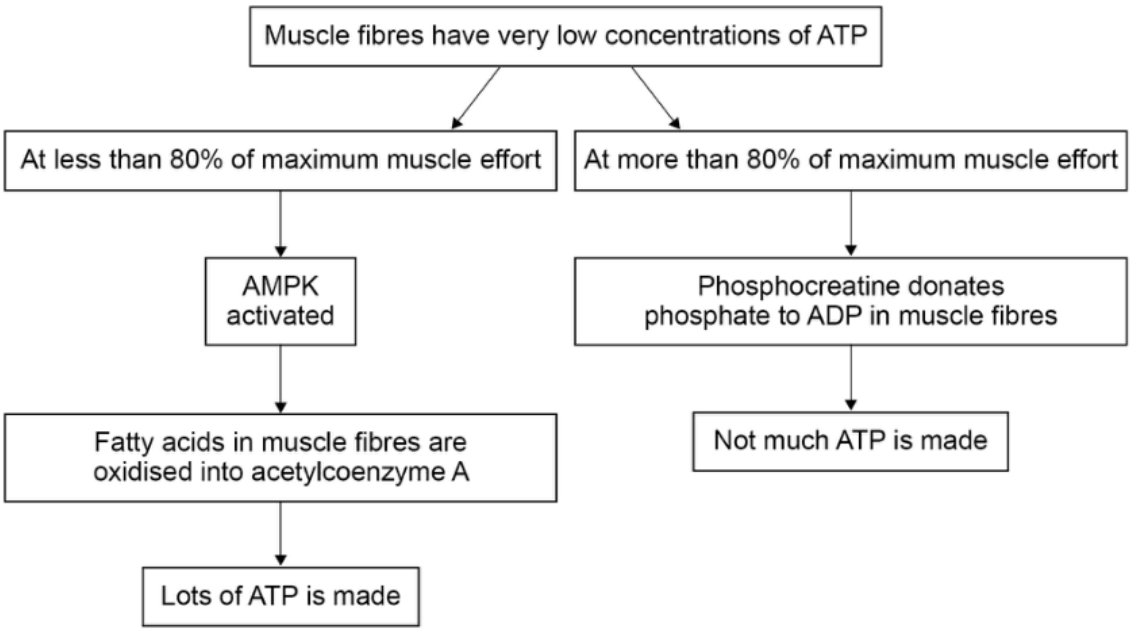
Question 16 · information from earlier in the question

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.

Figure 4 shows how these chemicals work.

Figure 4



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Question 16 · A level Paper 3 · November 2020 · Q06.5 · 4 marks

0 6 . 5 GW1516 is a performance-enhancing drug. GW1516 activates AMPK **and** develops slow muscle fibres at rest.

Use **Figure 4** to justify why professional athletes are **not** allowed to take GW1516.

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

[4 marks]

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Question 17 · information from earlier in the question

0 4 Mitochondrial DNA (mtDNA) is a small circular DNA molecule located in mitochondria. It is 16 569 nucleotides long and contains 37 genes and a control region.

Sports scientists investigated whether a mutation in the control region of mtDNA in human males was related to an ability to exercise for longer.

- The males in Group **T** had thymine at nucleotide position 16 519
- The males in Group **C** had a mutation resulting in cytosine at nucleotide position 16 519

Group **T** and Group **C** completed the same 8-week training programme. The following measurements were taken at the start of the 8-week programme, and again at the end.

1. $VO_{2\,max}$ (a measure of maximal oxygen uptake).
2. Citrate synthase (CS) activity (CS is an enzyme involved in the Krebs cycle).

The scientists then calculated the percentage increase in each measurement in both groups.

Figure 4 and **Figure 5** show their results.

Figure 4

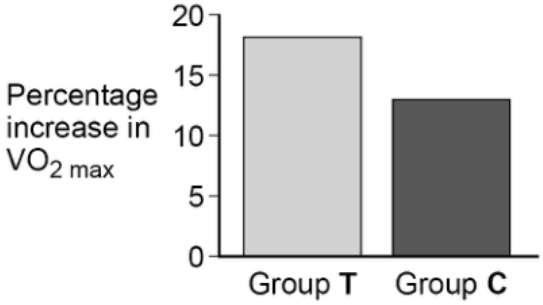
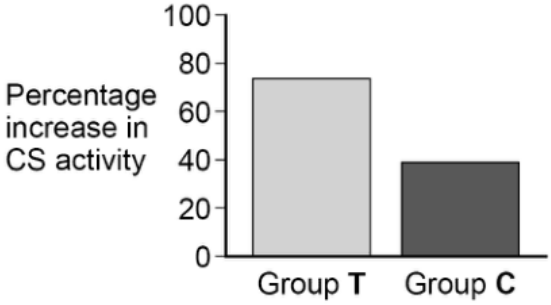


Figure 5

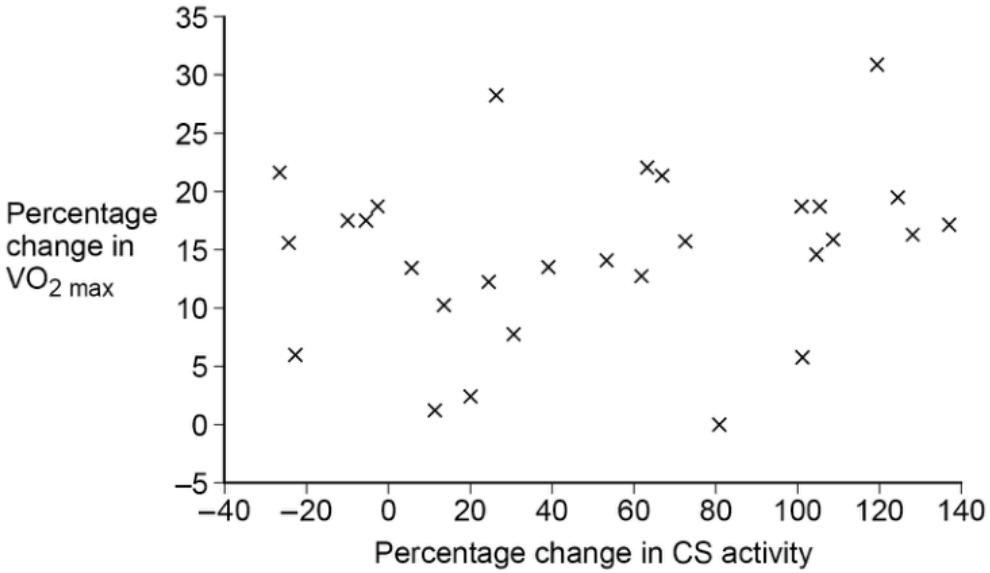


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The sports scientists investigated whether there was a correlation between the percentage change in VO_{2max} and percentage change in CS activity in Group **T**.

Figure 6 shows their results.

Figure 6



0 4 . 4 'Having thymine at nucleotide position 16 519 in Group **T** causes an increase in ability to exercise for longer.'

Evaluate this conclusion.

Use **all** the data in this question.

[3 marks]

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Mark schemes

Question 1 · A level Paper 2 · June 2025 · Q01.1 · 2 marks

01.1	1. Cytoplasm 2. Phosphorylation 3. Pyruvate 4. NAD;;	2 max (2 x AO1)	4 correct = **2 marks** 2–3 correct = **1 mark** 0–1 correct = **0 marks** 2. Reject substrate-level or oxidative phosphorylation 3. Accept pyruvic acid 4. Reject NADP but accept any reduced form of NAD e.g. NADH / $NADH_2$ / NADH + H

Question 2 · A level Paper 2 · November 2021 · Q01.1 · 4 marks

01.1	1. Phosphorylation of glucose using ATP; 2. Oxidation of triose phosphate to pyruvate; 3. Net gain of ATP; 4. NAD reduced;	4 max	Accept all mark points in diagrams. 2. Accept removal of hydrogen from triose phosphate for oxidation. 3. Accept any description that indicates a net gain e.g., 4 produced, 2 used. 4. Accept $NADH/NADH_2/NADH + H^+$ produced.

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Question 3 · A level Paper 2 · June 2019 · Q04.3 · 2 marks

04.3	1. Regenerates/produces NAD 2 **OR** oxidises reduced NAD; 2. (So) glycolysis continues;	1. Reject NADP and any reference to FAD. 1. Accept descriptions of oxidation e.g. loss of hydrogen. 2. Accept description of glycolysis e.g. glucose to pyruvate. 2. Accept 'for oxidising/converting triose phosphate to pyruvate'.

Question 4 · A level Paper 2 · June 2017 · Q03.2 · 3 marks

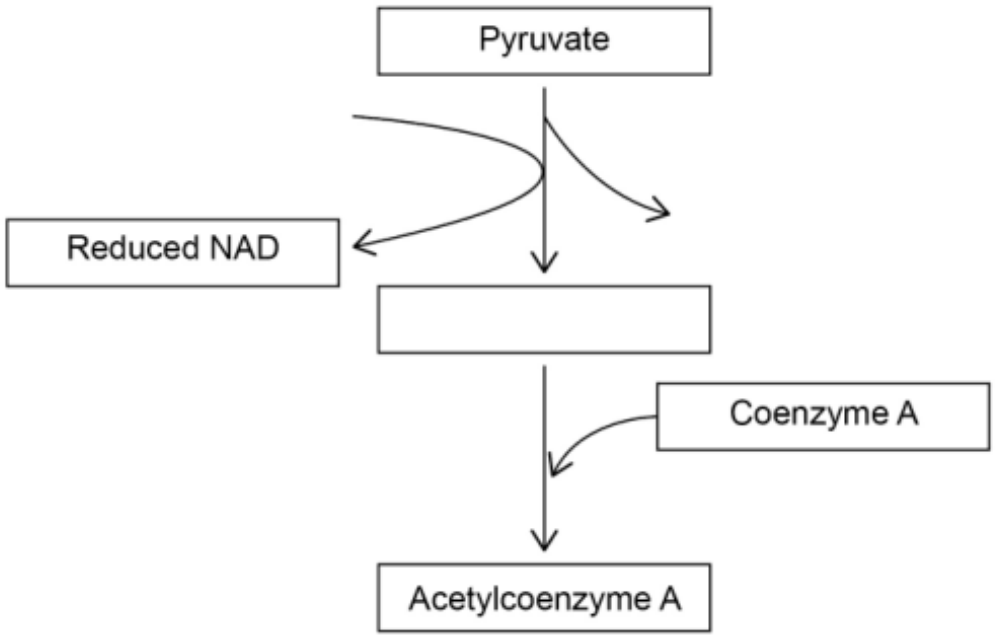
03.2	1. (More aerobic respiration) produces more ATP; 3 2. Anaerobic respiration delayed; 3. Less or no lactate;	1. Accept: produces ATP faster. 2. Accept: aerobic respiration can continue. 2. Accept : no anaerobic respiration. 3. Accept: lactic acid.

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Question 5 · A level Paper 2 · June 2018 · Q03.5 · 1 mark

03.5	1. Decrease/no glucose/substrate **OR** Increase in ethanol/carbon dioxide/acidity;	1	Accept decrease/no oxygen as Figure 4 is not linked to Figure 3. Accept competition for glucose/oxygen. Accept any named sugar Accept decrease in pH Accept increase in toxins 1. Ignore food/nutrients

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02.5	All 4 correct **= 2 marks**;; Any 2 or 3 correct **= 1 mark**  	2 (2 x AO1)

Accept pyruvic acid for pyruvate

For reduced NAD accept NADH, NADH + H^+ or $NADH_2$

For reduced NAD reject reduced NAD**P** / NAD**P**H / NAD**P**H_2 / NAD**P**H + H^+

For acetylcoenzyme A accept acetyl co A

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01.2	**Mark in pairs, 1 and 2 OR 3 and 4.** (Pair 1 and 2) 1. One carbon dioxide from the link reaction and two carbon dioxide from the Krebs cycle; 2. Link reaction and Krebs cycle occur twice (per glucose) **OR** Two pyruvate (per glucose); (Pair 3 and 4) 3. (Overall/per glucose) two carbon dioxide from the link reaction; 4. (Overall/per glucose) four carbon dioxide from the Krebs cycle;	2 (2 x AO2)

1, 2, 3 and 4. Accept 'carbon(s)' for carbon dioxide

1. Accept release of carbon dioxide from specified link and Krebs cycle reactions

1, 3 and 4. Accept 'decarboxylation' for 'carbon dioxide'

1 and 2. Accept in a diagram

2. Accept pyruvic acid

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Question 8 · A level Paper 2 · November 2021 · Q01.2 · 2 marks

01.2	1. Less/no reduced NAD/coenzymes **OR** Fewer/no hydrogens/electrons removed (and passed to electron transfer chain); 2. Oxygen is the final/terminal (electron) acceptor;	2	1. Accept less/no FAD reduced.

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01.3	**Mark points 1 and 2 can be awarded in either of the first two sub-headings.** (Oxygen uptake decreased)	3 (3 x AO2)

1. (Less/no) oxygen (required as) is final electron acceptor

OR

(Less/no) oxygen (required as) at end of electron transfer/carrier chain;

(ATP production decreased)

2. Less/no oxidative phosphorylation

OR

Less/no proton/H^+ movement/gradient

OR

Less/no chemiosmosis;

(Ethanol was produced)

3. Anaerobic respiration occurs

OR

Pyruvate is reduced (to ethanol);

1. Accept less/no oxygen to join to protons/H^+ **and** electrons

2. Ignore 'hydrogen'

3. Accept equation showing reduction of pyruvate by reduced NAD to ethanol

3. Ignore fermentation

3. Reject reference to lactic acid

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Question 10 · A level Paper 2 · November 2020 · Q10.3 · 2 marks

10.3	1. Allow passage of protons/H^+; 2. (Energy) released as heat;	2	1. Ignore direction of movement/diffusion/active transport. 2. Accept 'produces heat' but reject 'produces 'heat energy'.

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01.3	1. Fewer/no protons/hydrogen ions/H^+ diffuse/move through ATP synthase; 2. Less/no **energy** to add phosphate to ADP **OR** Less/no **energy** for phosphorylation of ADP **OR** Less/no **energy** to form ATP **OR** Less/no oxidative phosphorylation; 3. (Bacteria die due to) less/no ATP/energy for cellular/metabolic processes;	3 (3 x AO2)

1. Accept no/less chemiosmosis
1. Reject reference to protons/hydrogen ions/H^+ diffusing if in mitochondrion
1. Accept hydrogen/H for protons/hydrogen ions/H^+ (as told hydrogen ion in stem of question)

2. or 3. Reject less/no energy produced once

2. Accept (P), P_i or PO_4^{3-} for phosphate
2. Reject phosphorous/P
3. Accept named

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Question 12 · A level Paper 2 · June 2019 · Q03.2 · 2 marks

03.2	1. For respiration; 2. Provide ATP/energy (for growth);	2	1.Ignore photosynthesis. 1. Ignore aerobic/anaerobic (respiration). 1. Reject glucose used in photosynthesis. 2. Reject produce energy. 2. Do **not** credit photosynthesis provides ATP.

Question 13 · AS Paper 2 · June 2023 · Q03.4 · 3 marks

03.4	1. Provides galactose/sugar/monosaccharide; 2. (Bacteria use the galactose/sugar) for respiration; 3. (Bacteria use the galactose/sugar) for binary fission;	
3 (3 x AO3)		Reject 'glucose' for galactose/sugar once only 3. Accept (cell) division /replication/reproduction for binary fission 3. Reject mitosis;

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Question 14 · A level Paper 2 · June 2017 · Q01.2 · 3 marks

01.2	1. Less/no malonyl-CoA; 2. (More) fatty acids transported/moved into mitochondria; 3. Respiration/oxidation of fatty acids provides ATP;

3	1. 'Inhibition of malonyl-CoA' on its own is not enough but accept production of malonyl-CoA is inhibited. 2. Accept: 'transport of fatty acids into mitochondria is not inhibited'. 2. Ignore: method of entry. 3. Accept: for respiration any stage of aerobic respiration e.g. Krebs (cycle), link (reaction) etc. 3. Reject: production of energy, **but** accept production of energy in the form of ATP. 3. Accept: acetyl CoA can enter Krebs cycle/mitochondria to provide ATP.

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10.1	1. Fat (store) used in respiration/metabolism; 2. Less energy/food (store) is required due to low respiration/metabolism **OR** Less energy/food (store) is required due less movement; 3. Gluconeogenesis; 4.Low surface area to volume reduces heat loss **OR** Fat (layer/insulation) reduces heat loss; 5. Long loop of Henle so less water lost; 6. Water provided from respiration; 7. Reduced/no urination; 8. Less evaporation;

3 max	**Mark points 1 to 4 = 2 max.** **Mark points 5 to 8 = 2 max.** 1 and 2. Reject respiration 'uses energy' or 'produces energy'. 3. Accept description in terms of using glycerol, fatty acids or amino acids.

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06.5	1. More acetylcoenzyme A would enter the Krebs cycle; 2. (So) the Krebs cycle generates (more) reduced coenzymes **OR** (So more) reduced coenzymes pass their electrons to the electron transfer chain; 3. (So more) ATP would be produced; 4. Athletes could build (slow) muscle (fibres) without exercising; 5. (Having more) slow muscle (fibres) would increase endurance;	4 max

1. 2. and 3. idea for more is required once
2. Accept examples of reduced coenzymes
2. Reject production of reduced NADP or $NADPH_2$
4. Ignore 'develop (slow) muscle (fibres) at rest' as in stem of question
4. Accept description of not exercising, eg without training
5. Accept descriptions of endurance in terms of delayed onset of anaerobic respiration

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04.4

For (no mark) 3 max

1. (From **Figure 5** Group **T** have) increased CS activity for Krebs cycle;
2. (from **Figure 4** Group **T** have) increased $VO_{2\ max}$ **so** more oxygen (available)

OR

(from **Figure 4** Group **T** have) increased $VO_{2\ max}$ **so** more aerobic respiration

OR

(from **Figure 4** Group **T** have) increased VO_{2max} **so** delayed anaerobic respiration;

Against (no mark)

3. No correlation between (percentage change in) $VO_{2\ max}$ and CS activity

OR

No correlation on **Figure 6**;

4. It might not be thymine causing the increase

OR

There may be other differences in the control region (of Group **T**) that cause the increase;

5. $VO_{2\ max}$/CS activity not the only measures of ability to exercise for longer;

Max 2 marks for mark points 3, 4 and 5

Ignore any answers relating to sample size or duration of investigation

Ignore 'correlation does not mean causation' unless

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