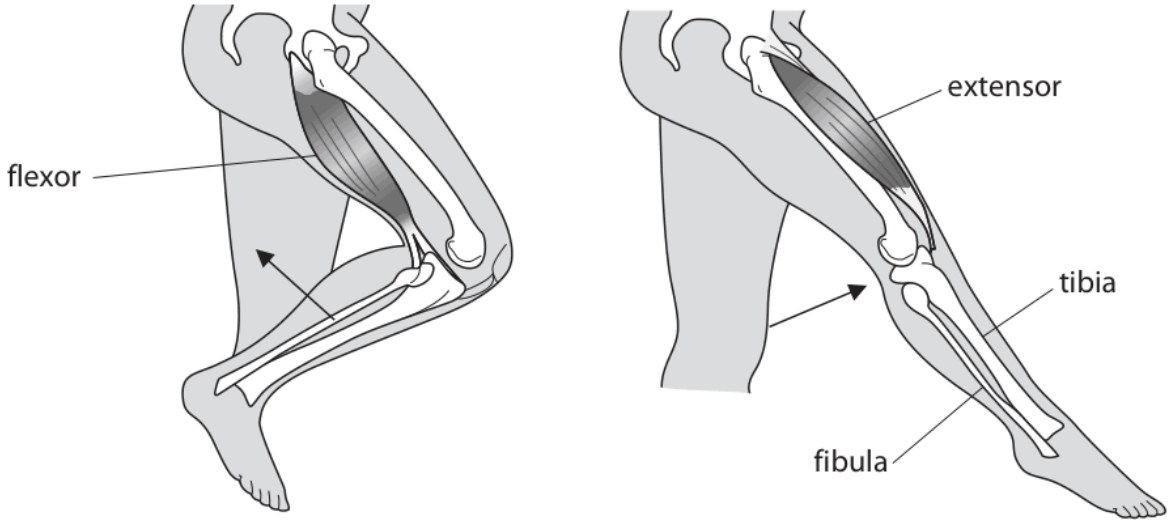
Muscles and Respiration (Topic 7): Edexcel SNAB A Level Biology Exam Questions by Topic

20 questions · 58 marks · about 70 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2018 · Q3(c)(i) · 2 marks

(c) Extensor and flexor muscles are involved in the movement of the lower leg as shown in the diagrams.



(i) Explain how the extensor and flexor muscles bring about movement of the lower leg.

(2)

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(ii) Individuals who have had limbs amputated can use prostheses to compete in athletic events.

A transtibial amputation involves the removal of part of the lower leg below the knee. Extensor and flexor muscles are still attached to the parts of the lower leg bones (the tibia and fibula) that remain.

The photograph shows Paralympic athletes competing in the 100m final in London 2012. The three athletes shown have all had transtibial amputations.



www.sciencephoto.com

Deduce how athletes with transtibial amputations are able to move their prosthetic limbs during a race.

(1)

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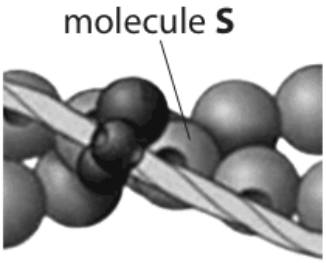
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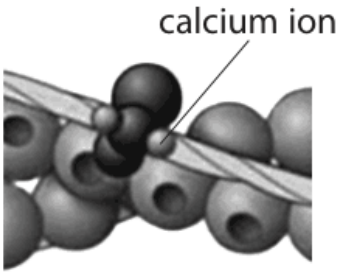
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Question 3 · information from earlier in the question

7 Muscle cells contain myofibrils. The diagrams show the arrangement of some of the molecules present in a myofibril when calcium ions are absent and when they are present.



calcium ions absent



calcium ions present

Question 3 · A level Paper 2 · June 2017 · Q7(b)(i) · 2 marks

(b) (i) Describe the changes caused when calcium ions bind to the molecules shown in the diagram.

(2)

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Question 4 · A level Paper 2 · June 2017 · Q7(b)(ii) · 4 marks

(ii) Explain how these changes cause muscles to contract.

(4)

Question 5 · A level Paper 2 · June 2017 · Q7(c) · 3 marks

(c) Describe how the concentration of calcium ions around the myofibrils is controlled.

(3)

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Question 6 · A level Paper 2 · June 2023 · Q8(b)(i) · 3 marks

(b) Mitochondria move along the length of the axon in the cytoplasm.

The axon cytoplasm contains actin along its length. There is myosin on the surface of the mitochondria.

(i) Explain how the myosin head could move mitochondria along the axon.

(3)

Question 7 · information from earlier in the question

(b) An investigation was carried out to study the effect of calcium ion concentration on muscle fibres.

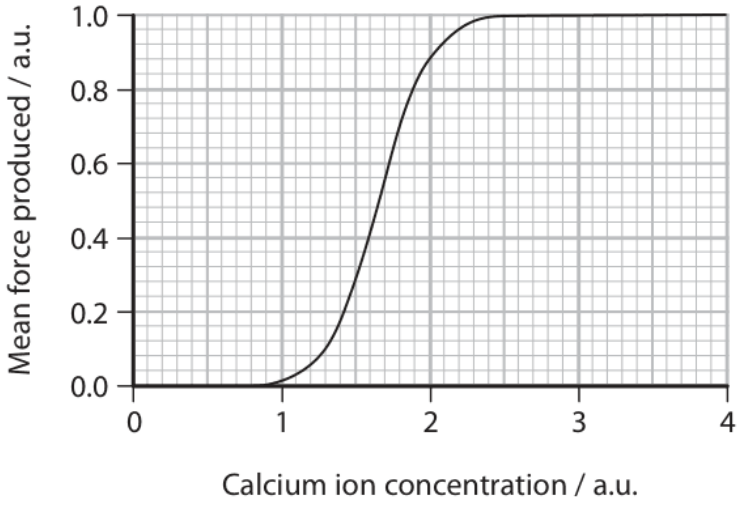
Individual fibres, from one sample of muscle, were provided with different calcium ion concentrations. The force produced by each fibre was recorded and a mean force was calculated for each calcium ion concentration.

All other variables were kept constant.

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Question 7 · A level Paper 3 · June 2018 · Q5(b)(ii) · 4 marks

(ii) The results are shown in the graph.



Explain the effect of increasing calcium ion concentration on the mean force produced by muscle fibres.

(4)

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7 Athletes compete in a range of environmental conditions.

(a) An investigation studied the effects of environmental conditions on athletes.

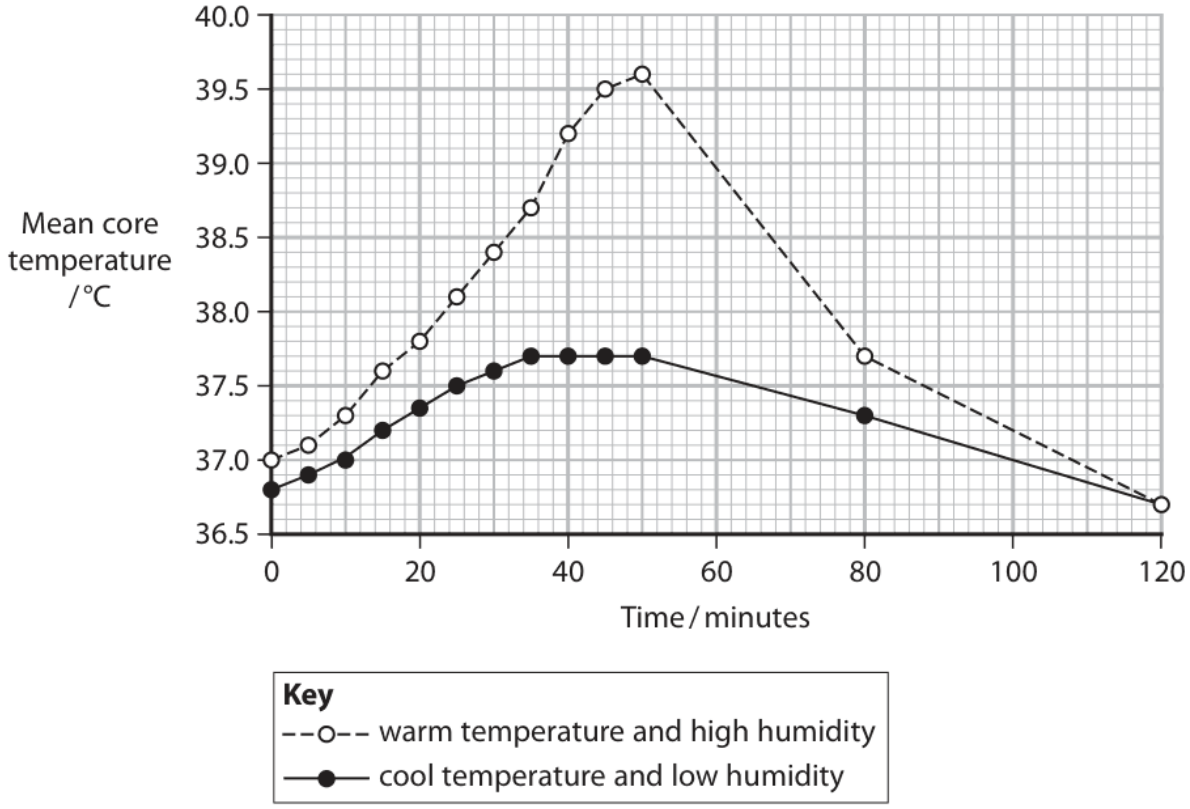
A group of nine athletes ran for 50 minutes in two sets of environmental conditions:

- warm temperature and high humidity
- cool temperature and low humidity.

All other variables were kept constant including the level of exercise.

The core temperature of each athlete was recorded during the exercise and for 70 minutes following the exercise.

The results are shown in the graph.



(i) Explain why there was a change in core temperature during the first 20 minutes of exercise.

(2)

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Question 9 · information from earlier in the question

(b) If the heart of an animal is removed from its body, the heart will continue to beat for a period of time.

The left atrium stops contracting if it is separated from the rest of the heart.

However, the right atrium and the rest of the heart will continue to beat.

Eventually, the right atrium and the rest of the heart will also stop beating.

Question 9 · A level Paper 3 · June 2023 · Q1(b)(iii) · 2 marks

(iii) Explain why the right atrium and the rest of the heart eventually stop beating.

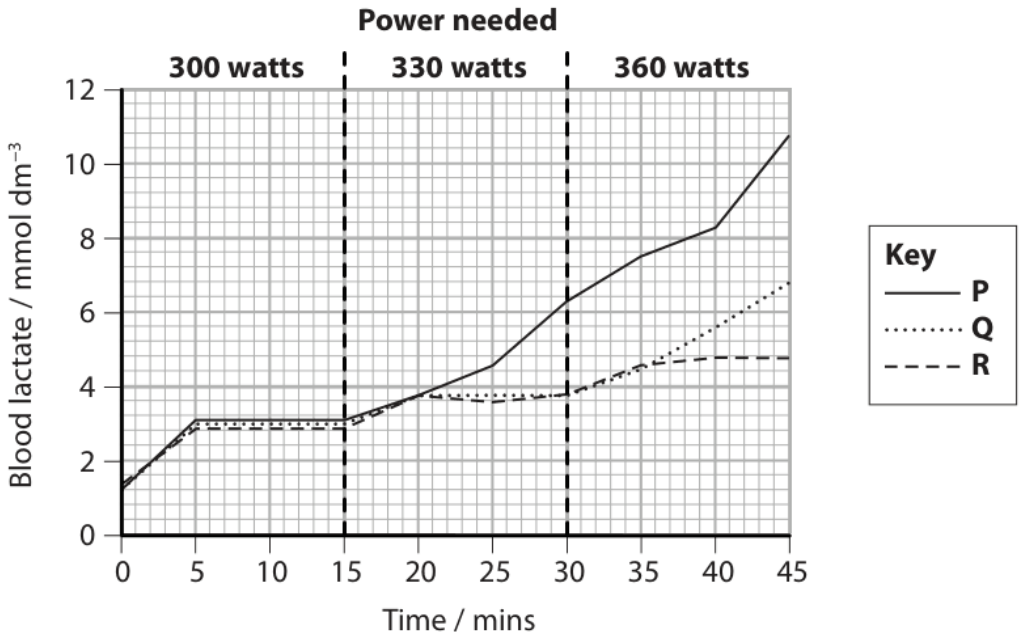
(2)

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6 Athletes monitor the effect of different levels of exercise on their blood lactate concentration. This helps them to train effectively.

In a study, three athletes, **P**, **Q** and **R**, used an exercise bicycle for 45 minutes. The power needed to maintain a constant speed was increased every 15 minutes. Their blood lactate concentration was measured at 5-minute intervals.

The results are shown in the graph.



(a) Explain the increase in blood lactate concentration observed between 0 and 5 minutes.

(2)

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Question 11 · A level Paper 2 · June 2019 · Q7(c)(ii) · 2 marks

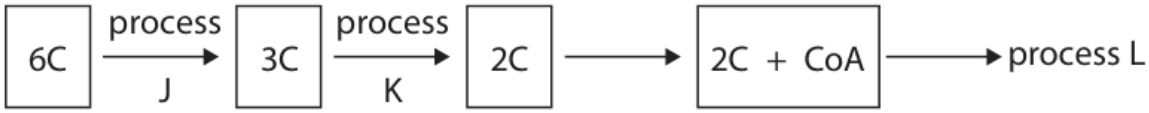
(ii) Explain why some ATP is broken down during glycolysis.

(2)

Question 12 · information from earlier in the question

6 Cellular respiration is a metabolic process essential for life.

(a) The diagram represents part of aerobic respiration in a muscle cell.



Key
nC = number of carbons present in the molecule
For example, 6C = a six-carbon molecule

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Question 12 · A level Paper 2 · June 2023 · Q6(a)(ii) · 2 marks

(ii) Describe what would happen to the three-carbon molecule (3C) if process K stopped.

(2)

Question 13 · A level Paper 2 · June 2025 · Q7(b) · 4 marks

(b) The matrix of a mitochondrion contains a range of enzymes.

Describe the role of enzymes in the link reaction.

(4)

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Question 14 · A level Paper 2 · June 2019 · Q7(c)(iii) · 3 marks

(iii) The electron transport chain occurs in the cristae of mitochondria. The electron transport chain involves a number of carrier molecules.

Explain the role of these carrier molecules in the electron transport chain.

(3)

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Question 15 · A level Paper 2 · June 2025 · Q7(c) · 5 marks

(c) Proton pumps are found in mitochondria.

Explain the role of proton pumps in aerobic respiration.

(5)

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Question 16 · A level Paper 2 · November 2021 · Q8(b)(ii) · 4 marks

(ii) The outer mitochondrial membrane is not permeable to hydrogen ions (H^+).

Explain the importance of this feature of the membrane.

(4)

Question 17 · A level Paper 2 · June 2019 · Q7(a)(ii) · 2 marks

(ii) Cells produce lactate during anaerobic respiration. Lactate travels in the blood to the liver.

Liver cells can absorb lactate from the blood.

Deduce what happens to the lactate in these cells.

(2)

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Question 18 · A level Paper 2 · October 2020 · Q8(a) · 3 marks

8 There are many reasons why humans may lose muscle mass.

Two known causes are hip replacement surgery and some genetically inherited conditions.

(a) A muscle fibre is a specialised body cell.

Explain how the structure of a muscle fibre is related to its specialised function.

(3)

Question 19 · A level Paper 2 · June 2024 · Q4(c) · 3 marks

(c) Mutations can affect the metabolism of glycogen in fast twitch muscle fibres.

Explain why fast twitch muscle fibres contain more glycogen than slow twitch muscle fibres.

(3)

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7 Muscles and eyes are examples of organs found in the human body.

(a) Skeletal muscle tissue contains several types of muscle fibre that have different properties. Two of these are shown in the table.

Properties	Muscle fibre	
	Type I	Type II
Speed of contraction	slow	four times the speed of type I
Time taken to fatigue	long	short
Concentration of mitochondria	high	low
Level of anaerobic respiration carried out	low	high

The proportion of type I and type II muscle fibres in the skeletal muscle of long distance runners and sprinters is different.

Explain the advantages for long distance runners of having both type I and type II muscle fibres, but not in equal quantities.

(5)

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Mark schemes

Question 1 · A level Paper 2 · June 2018 · Q3(c)(i) · 2 marks

Question Number	Answer
3(c)(i)	An explanation that makes reference to two of the following: • tendons attach muscles to bones (1) • (flexor and extensor) muscles act as an antagonistic pair (1) • when the {extensor muscle contracts, it pulls on the tibia to extend the leg / flexor muscle contracts, it pulls on the fibula flexing the leg} (1)

Additional Guidance	Mark
ALLOW marks for correctly annotated diagram ALLOW reference to a tendon attaching a named muscle to a named bone ALLOW quadriceps for extensor and hamstring for flexor	**(2)**

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Question 2 · A level Paper 2 · June 2018 · Q3(c)(ii) · 1 mark

Question Number	Answer
3(c)(ii)	• the muscles are still attached to (bones in) the lower leg and the prosthetic limb is attached to the lower leg (allowing movement)

Additional Guidance	Mark
ALLOW reference to tibia and/or fibula instead of lower leg. No marks if reference made to muscle attachment to prosthetic limb.	**(1)**

Question 3 · A level Paper 2 · June 2017 · Q7(b)(i) · 2 marks

Question number	Answer	Additional guidance	Mark
7(b)(i)	A description that makes reference to the following points: • tropomyosin is moved (by troponin) (1) • myosin binding sites (on actin) are exposed (1)	 ALLOW tropomyosin moves ALLOW actin-myosin binding site	(2)

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Question 4 · A level Paper 2 · June 2017 · Q7(b)(ii) · 4 marks

Question number	Answer
7 (b)(ii)	An explanation that makes reference to four of the following points: • myosin heads can bind to binding sites (1) • (bound) myosin changes shape (1) • actin filaments { slide / pulled } over the myosin (1) • (therefore) { muscle fibres / myofibril / sarcomeres } shorten (1) • ATP hydrolysed / ADP and { inorganic phosphate / Pi } released (1)

Additional guidance	Mark
ALLOW actin – myosin bridges form ALLOW description of head 'nodding' or 'dipping' forward ALLOW actin moves towards the M line ALLOW Ca^{2+} activates ATPase	(4)

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Question 5 · A level Paper 2 · June 2017 · Q7(c) · 3 marks

Question number	Answer
7(c)	A description that makes reference to three of the following points: • calcium ions released from sarcoplasmic reticulum (1) • in response to { nerve impulse / action potential / depolarisation } (at neuromuscular junction) (1) • calcium channels open (to allow calcium ions to cross the membrane / enter the sarcoplasm) (1) • calcium ions taken back up into the sarcoplasmic reticulum by active transport (1)

Additional guidance	Mark
ALLOW Ca^{2+} for calcium ions ALLOW calcium ions moving through channel protein	(3)

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Question 6 · A level Paper 2 · June 2023 · Q8(b)(i) · 3 marks

Question Number	Answer
8(b)(i)	An explanation that makes reference to the following: • attaches to {myosin-binding site / actin} (1) • splits ATP / acts as an ATPase (1) • (myosin head) changes position (to move mitochondria on) (1)

Additional Guidance	Mark
ALLOW ATP split into ADP and Pi, ATP hydrolysed ALLOW myosin detaches from actin ALLOW myosin head changes shape (moving mitochondria)	[3]

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Question 7 · A level Paper 3 · June 2018 · Q5(b)(ii) · 4 marks

Question Number	Answer
5(b)(ii)	An explanation that makes reference to four of the following: • no force produced at { low / less than 1.0 a.u. } calcium ion concentration (1) • (as calcium ion concentration increases) force produced increases (1) • (because more) { actin and myosin interact / myosin binding sites exposed } (1) • there is no increase in force produced at { high / from 2.4 a.u. } calcium ion concentration (1) • as all actin and myosin are { interacting / all myosin binding sites occupied } (1)

Additional Guidance	Mark
ALLOW there is a threshold concentration for calcium ion concentration ALLOW more tropomyosin displaced or more actin-myosin cross bridges formed ALLOW 2.5 a.u. ALLOW all troponin has Ca^{2+} bound to it , no troponin available or no more actin-myosin cross bridges can be formed	**(4)**

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Question 8 · A level Paper 2 · June 2022 · Q7(a)(i) · 2 marks

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	An explanation that makes reference to: • heat is {released / generated} (1) • (due to) increased respiration (1)	ALLOW heat energy or thermal energy	(2)

Question 9 · A level Paper 3 · June 2023 · Q1(b)(iii) · 2 marks

Question number	Answer
1(b)(iii)	An explanation that makes reference to two of the following: • (heart / muscle cells) run out of oxygen (1) • (aerobic) respiration stops (1) • (heart / muscle cells) stop making ATP (1)

Additional guidance	Mark
ALLOW heart (muscle) does not have a blood supply (from the lungs) ALLOW anaerobic respiration takes place ALLOW resulting in accumulation of lactic acid	(2)

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Question 10 · A level Paper 2 · June 2017 · Q6(a) · 2 marks

Question number	Answer
6 (a)	An explanation that makes reference to the following points: • (muscles cells release lactate into blood) due to anaerobic respiration (1) • insufficient oxygen for aerobic respiration / aerobic respiration cannot meet the demand for energy (1)

Additional guidance	Mark
	(2)

Question 11 · A level Paper 2 · June 2019 · Q7(c)(ii) · 2 marks

Question Number	Answer
7(c)(ii)	An explanation that makes reference to two of the following: • (because the breakdown of ATP) {donates phosphate to / phosphorylates} the glucose (1) • (ATP) supplies energy to break down the glucose (1) • to produce (phosphorylated) 3-carbon compounds (1)

Additional Guidance	Mark
ALLOW 'hexose' for 'glucose'. ALLOW production of fructose diphosphate ALLOW to make the glucose more reactive, activate the glucose e.g. for 3-carbon compounds: GALP / glyceraldehyde-3-phosphate / glycerate-3-phosphate / GP/ PGAL / G3P / GA3P / GADP / GAP / TP / triose phosphate	**(2)**

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Question 12 · A level Paper 2 · June 2023 · Q6(a)(ii) · 2 marks

Question Number	Answer
6(a)(ii)	A description that makes reference to two of the following: • it would be used in anaerobic respiration (1) • reduced NAD provides hydrogen (1) • reduced to { lactate / lactic acid } (1)

Additional Guidance	Mark
ALLOW mark for anaerobic respiration ALLOW binds with hydrogen from reduced NAD ALLOW converted for reduced	[2]

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Question 13 · A level Paper 2 · June 2025 · Q7(b) · 4 marks

Question Number	Answer
7 (b)	A description that makes reference to four of the following: • { catalyses / lowers the activation energy } (1) • to remove {carbon / carbon dioxide} / decarboxylation (1) • to remove hydrogen (atoms) / reduction of NAD (1) • add {coenzyme A / CoA} (1) • to synthesise acetyl CoA (1)

Additional Guidance	Mark
ALLOW speeds up reaction IGNORE production of carbon dioxide IGNORE reference to ions	**(4)**

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Question 14 · A level Paper 2 · June 2019 · Q7(c)(iii) · 3 marks

Question Number	Answer
7(c)(iii)	An explanation that makes reference to three of the following: • receive hydrogen from reduced { NAD / FAD } / to allow reduced { NAD / FAD } to be oxidised (1) • break hydrogen into { protons / H^+ / hydrogen ions } and electrons (1) • electrons transferred by a series of redox reactions (1) • energy released is used to pump { hydrogen ions / protons / H^+ } into intermembranal space (1)

Additional Guidance	Mark
ALLOW NAD red / NADH + H^+ for reduced NAD and NAD or NAD^+ for oxidised NAD ALLOW e^- for electrons ALLOW a series of reduction and oxidation reactions ALLOW 'actively transported / moved into / moved up the concentration gradient' for 'pump'	(3)

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Question 15 · A level Paper 2 · June 2025 · Q7(c) · 5 marks

Question Number	Answer
7 (c)	An explanation that makes reference to five of the following: • chemiosmosis (1) • so protons (from the matrix) are moved into the inter-membrane space (1) • creating an electrochemical gradient (1) • so protons can diffuse (down the gradient) (1) • through {the stalked particle / ATP synthase} (1) • so ATP can be synthesised (in the mitochondrion) (1)

Additional Guidance	Mark
ALLOW { H^+ / hydrogen ions} for protons NB: space between the inner and out membranes = inter-membrane space ALLOW concentration gradient, proton gradient ALLOW protons move back into the matrix down the gradient ALLOW ATP generated during oxidative phosphorylation	**(5)**

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Question 16 · A level Paper 2 · November 2021 · Q8(b)(ii) · 4 marks

Question Number	Answer
8(b)(ii)	An explanation that makes reference to four of the following: • to stop H^+ diffusing out (of mitochondrion) / into cytoplasm (1) • (therefore) maintaining a high concentration (of H^+) in the intermembrane space (1) • so {hydrogen ions / protons / H^+} can move down {concentration / electrochemical} gradient (1) • (by) chemiosmosis (1) • to synthesise ATP (1)

Additional guidance	Mark
ALLOW moves out for diffuses out ALLOW enabling/allowing/establishing for maintaining	**(4)**

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Question 17 · A level Paper 2 · June 2019 · Q7(a)(ii) · 2 marks

Question Number	Answer
7(a)(ii)	An answer that makes reference to two of the following: • (lactate is) { oxidized to form / converted to } pyruvate (1) • (pyruvate is) converted to { glucose / glycogen } (1) • (pyruvate / glucose) used in respiration (1)

Additional Guidance	Mark
ALLOW glucose produced from the lactate ALLOW correct named stage e.g. glycolysis for glucose or link reaction for pyruvate	**(2)**

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Question 18 · A level Paper 2 · October 2020 · Q8(a) · 3 marks

Question Number	Answer
8(a)	An explanation that makes reference to three of the following: • { cell surface membrane / sarcolemma } contains voltage-gated channels to allow depolarisation (of muscle fibre) (1) • many mitochondria for { (aerobic) respiration / to supply ATP } (1) • presence of { myofibrils / actin and myosin } (1) • (myofibrils) allow contraction (of muscle) (1)

Additional Guidance	Mark
ALLOW T tubules to allow depolarisation to be transferred to sarcoplasmic reticulum / sarcoplasmic reticulum { stores / releases } calcium ions ALLOW description of interaction of actin and myosin for contraction	**(3)**

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Question 19 · A level Paper 2 · June 2024 · Q4(c) · 3 marks

Question Number	Answer
4(c)	An explanation that makes reference to three of the following: • (glycogen provides) a store of { energy / glucose } (1) • glycogen provides glucose (1) • glucose for respiration / {energy / ATP} for contraction (1) • fewer {capillaries / blood vessels} in fast twitch muscles means less glucose supplied (1)

Additional Guidance	Mark
ALLOW reverse arguments for why slow twitch need less glycogen, e.g. slow twitch uses glucose from liver. IGNORE reference to anaerobic/aerobic ALLOW slow twitch needs less glycogen as they have more capillaries to supply glucose	3

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Question 20 · A level Paper 2 · June 2023 · Q7(a) · 5 marks

Question Number	Answer
7(a)	An explanation that makes reference to five of the following: • predominance of {type I / slow twitch} muscle fibres (1) • (long duration activity so) require muscle fibres that are slow to fatigue (1) • low level of anaerobic respiration reduces lactic acid build up (1) • {ATP needed over a longer time frame / (overall) more ATP needed} so provided by (more efficient process) {aerobic respiration / oxidative phosphorylation / chemiosmosis} (1) • high mitochondria concentration for (more) aerobic respiration (1) • {type II / fast twitch} muscle fibre allows runner to run faster (towards the end) (1)

Additional Guidance	Mark
ALLOW fatigue resistant ALLOW reduces cramp due to anaerobic respiration ALLOW converse ALLOW reduces oxygen debt	[5]

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