Skeletal Muscles: AQA A Level Biology Exam Questions by Topic

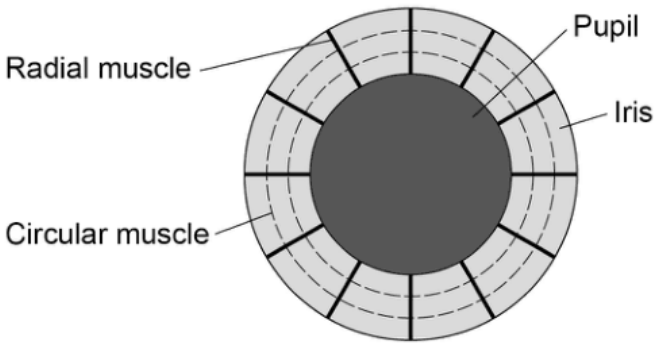
12 questions · 31 marks · about 40 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · November 2020 · Q01.1 · 2 marks

0 1 The iris in the human eye is a muscular structure. The iris changes the size of the pupil.

Figure 1 shows the muscles in the iris.

Figure 1



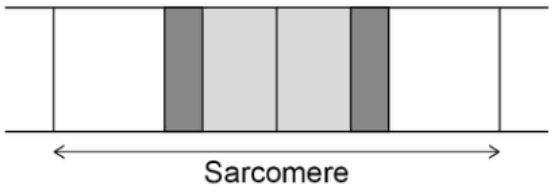
0 1 . 1 Suggest and explain how the interaction between the muscles labelled in **Figure 1** could cause the pupil to constrict (narrow).

[2 marks]

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0 4 **Figure 3** shows the banding pattern of a single sarcomere.

Figure 3



0 4 . 1 Explain the banding pattern shown in **Figure 3**.

[3 marks]

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Question 3 · A level Paper 2 · June 2023 · Q10.1 · 2 marks

1 0 Read the following passage.

ATP is essential for muscle contraction. The concentration of ATP in skeletal muscle is approximately 5×10^{-3} mmol g^{-1}. During maximum exercise, ATP in skeletal muscle is used at a rate of approximately 3.7 mmol kg^{-1} s^{-1}. If ATP was not resynthesised, maximum exercise would last a short time.

Some studies have suggested that taking creatine supplements can improve muscle performance during intense short-term exercise. Eating more carbohydrate, known as 'carbohydrate loading', for a few days before exercise can improve muscle performance when exercising for a long time.

During aerobic exercise, calcium ions in muscle cells have several roles. They activate the inclusion of glucose transport proteins, GLUT4, in the cell-surface membrane and the inclusion of fatty acid transport proteins, CD36, in mitochondrial membranes. An increase in muscle activity increases the concentration of carbon dioxide in the blood. This causes an increase in heart rate.

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

1 0 . 1 ATP is essential for muscle contraction (line 1).

Describe the roles of ATP in muscle contraction.

[2 marks]

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Question 4 · A level Paper 2 · June 2019 · Q04.2 · 3 marks

0 4 . 2 Another group of scientists suggested that a decrease in the force of muscle contraction is caused by an increase in the concentration of inorganic phosphate, Pi, in muscle tissues.

Their hypothesis is that an increase in the concentration of Pi prevents the release of calcium ions within muscle tissues.

Explain how a decrease in the concentration of calcium ions within muscle tissues could cause a decrease in the force of muscle contraction.

[3 marks]

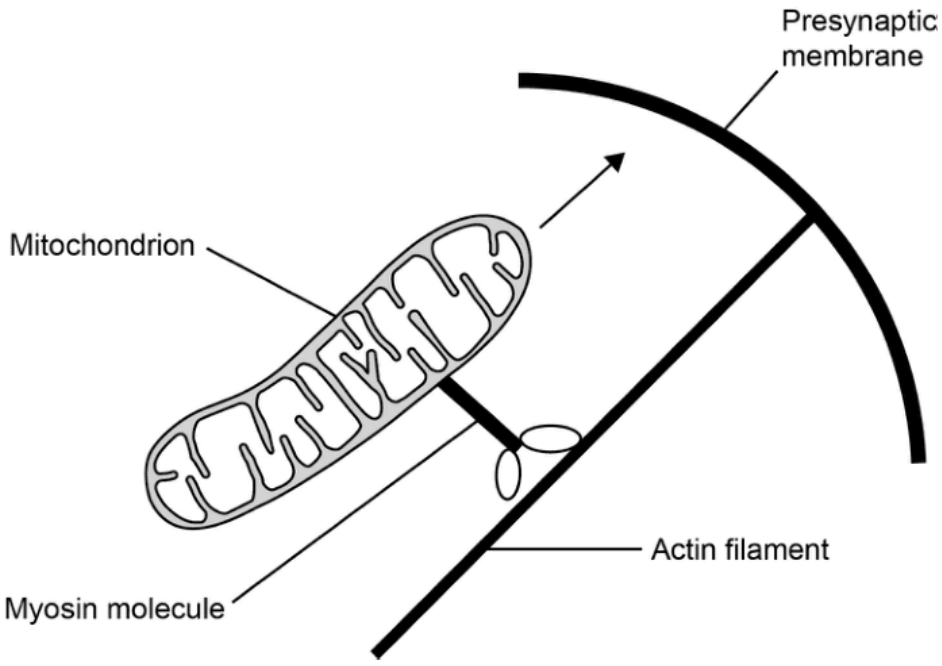
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Question 5 · A level Paper 3 · June 2017 · Q01.2 · 2 marks

0 1 . 2 The presynaptic knob contains actin filaments and myosin molecules.

The myosin molecules can attach to mitochondria and move them towards the presynaptic membrane, as shown in **Figure 1**.

Figure 1



Use your knowledge of how myosin and actin interact to suggest how the myosin molecule moves the mitochondrion towards the presynaptic membrane.

Do **not** include the roles of calcium ions and tropomyosin in your answer.

[2 marks]

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Question 6 · A level Paper 3 · June 2017 · Q01.3 · 2 marks

0 1 . 3 This movement of mitochondria happens when nerve impulses arrive at the synapse.

Suggest and explain **one** advantage of the movement of mitochondria towards the presynaptic membrane when nerve impulses arrive at the synapse.

[2 marks]

Question 7 · information from earlier in the question

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

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Question 7 · A level Paper 2 · June 2023 · Q10.3 · 5 marks

1 0 . 3 Describe and explain how taking creatine supplements (lines 5–6) and 'carbohydrate loading' (lines 6–7) can improve performance of different types of muscle fibres during different types of exercise.

[5 marks]

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Question 8 · A level Paper 2 · June 2024 · Q02.3 · 4 marks

0 2 . 3 Fast muscle fibres have a higher concentration of glycogen than slow muscle fibres.

Explain how the difference in glycogen concentration is related to the different properties of these muscle fibres.

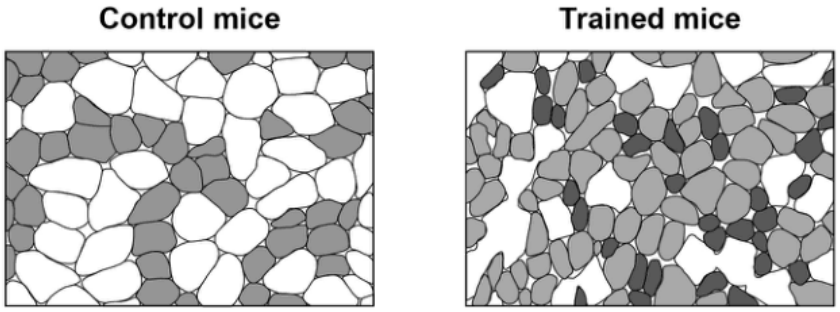
[4 marks]

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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



0 3 . 1 Succinic acid dehydrogenase is an enzyme used in the Krebs cycle.

Suggest **one** reason for the difference in the staining between the muscle fibres of the control mice and the trained mice.

[1 mark]

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0 4 Scientists investigated the effect of a decrease in pH on muscle contraction. The scientists did the investigation with four different preparations of isolated muscle tissue: **A**, **B**, **C** and **D**.

A - mouse muscle fibres at typical pH of mouse muscle tissue (control 1).

B - mouse muscle fibres at 0.5 pH units below typical pH.

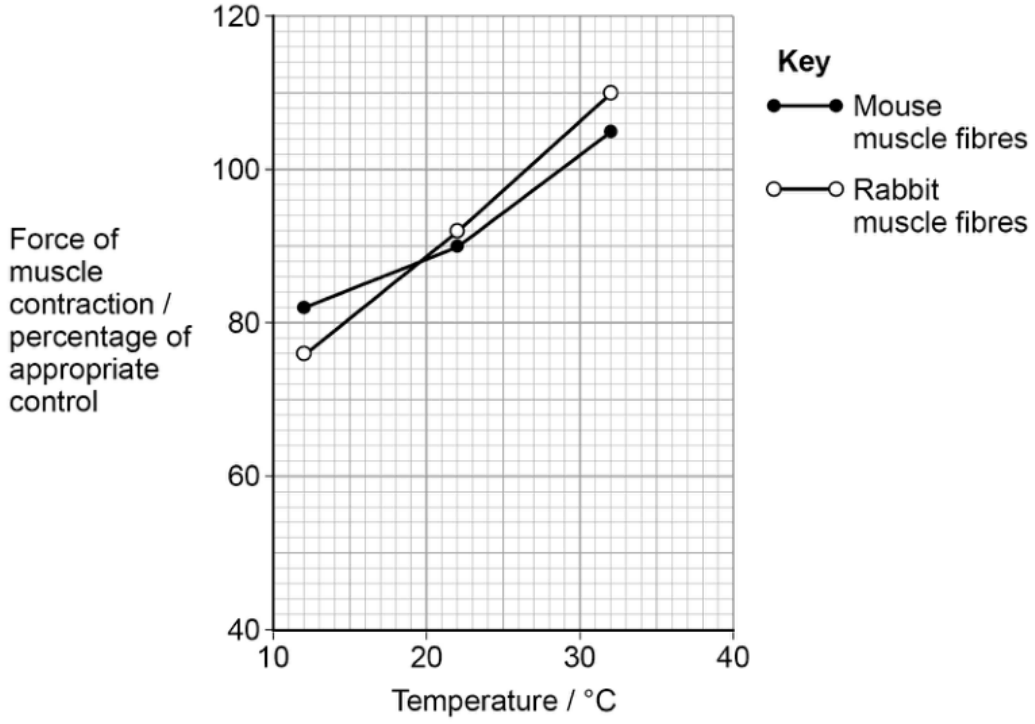
C - rabbit muscle fibres at typical pH of rabbit muscle tissue (control 2).

D - rabbit muscle fibres at 0.5 pH units below typical pH.

They measured the force of muscle contraction of the muscle fibres at 12 °C, 22 °C and 32 °C

Figure 3 shows the results the scientists obtained for **B** and **D** compared with the appropriate control.

Figure 3



0 4 . 1 A student looked at the results and concluded that a decrease in pH does cause a decrease in the force of muscle contraction.

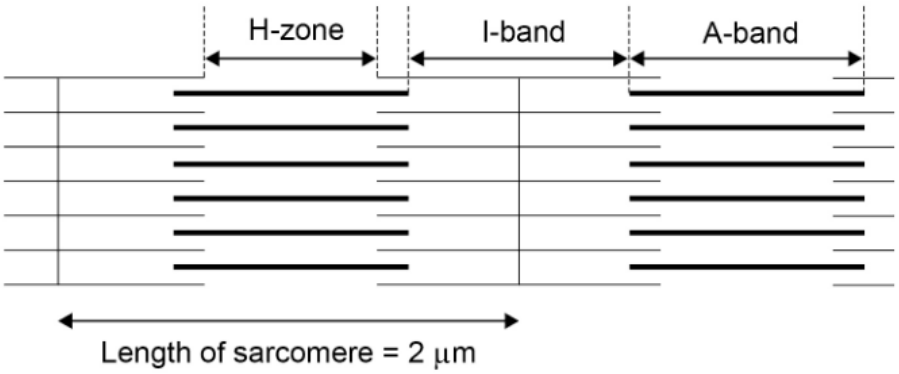
Use **Figure 3** to evaluate this conclusion.

[4 marks]

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0 2 . 1 **Figure 2** shows part of a relaxed myofibril.

Figure 2



The myofibril represented in **Figure 2** has 34 sarcomeres.
The length of every sarcomere is 2 μm
After contraction of this myofibril, the length of each sarcomere changed by 20%.

Use the information provided to calculate the length of the myofibril after contraction.

Give your answer in mm and in standard form.

Show your working.

[2 marks]

Answer _____ mm

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Question 12 · information from earlier in the question

1 0 Read the following passage.

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

Question 12 · A level Paper 2 · June 2023 · Q10.2 · 1 mark

1 0 . 2 Calculate how long maximum exercise would last if ATP was not resynthesised (lines 3–4).

[1 mark]

Answer _____ s

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Mark schemes

Question 1 · A level Paper 2 · November 2020 · Q01.1 · 2 marks

01.1	1. Circular muscle contracts; 2. Radial muscle relaxes;	2	1 and 2. Accept, for one mark 'both muscles contract' or 'both muscles relax' as names of muscles are in Figure 1. Reject muscles constrict.

Question 2 · A level Paper 2 · November 2020 · Q04.1 · 3 marks

04.1	1. Light/I band only actin; 2. H zone/band only myosin; 3. Darkest/overlapping region actin **and** myosin;	3	1, 2 and 3. Accept any suitable descriptions that distinguishes these regions e.g. 'white band' for 1, 'light grey' for 2 and 'dark grey' for 3. Ignore references to A band.

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Question 3 · A level Paper 2 · June 2023 · Q10.1 · 2 marks

10.1	1. To break actinomyosin (bridges); 2. To move/bend the myosin head/arm; 3. (So) actin (filaments) are moved (inwards); 4. For active transport of calcium <u>ions</u> (into the sarcoplasmic/endoplasmic reticulum);	2 max (2 x AO1)	1. Accept 'to form actinomyosin'. 1. Accept 'to detach or attach myosin and actin'. 1. Reject reference to 'active site'. 2. Accept 'to change shape of myosin head/arm'. 2. Accept ADP/Pi moves (myosin) head/arm. 2. Accept powerstroke/pivot /recocks etc. for movement. 3. Ignore 'sliding'.

Question 4 · A level Paper 2 · June 2019 · Q04.2 · 3 marks

04.2	1. (Less/No) <u>tropomyosin</u> moved from binding site **OR** Shape of <u>tropomyosin</u> not changed so binding site not exposed/available; 2. (Fewer/No) actinomyosin bridges formed; 3. Myosin head does not move **OR** Myosin does not pull actin (filaments) **OR** (Less/No) <u>ATP</u> (hydrol)<u>ase</u> (activation);	3	1 and 2. Reject active site only once. 1. Ignore troponin. 2. Accept actin and myosin do not bind. 3. Reject ATP synthase. Do not penalise reference to calcium rather than calcium ions. Credit all mark points even if context relates to what happens when calcium ions are present.

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Question 5 · A level Paper 3 · June 2017 · Q01.2 · 2 marks

01.2	1. Myosin head attaches to actin **and** bends/performs powerstroke; 2. (This) pulls mitochondria past/along the actin; 3. Other/next myosin head attaches to actin (and bends/performs powerstroke);

2 max	1. Accept change shape/change angle 2. Ignore pulls actin along 2. Ignore refs to cytoskeleon Accept plural or singular statements

Question 6 · A level Paper 3 · June 2017 · Q01.3 · 2 marks

01.3	1. (Mitochondria) supply (additional) ATP/energy; 2. To move vesicles/for active transport of ions/for myosin to move past actin OR Re-synthesis/reabsorption of neurotransmitter/named neurotransmitter;	2	1. Reject produces energy 2. Ignore ref. to ATP for opening calcium ion channels/making vesicles fuse with membrane

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10.3	1. Fast (skeletal muscle) fibres used during short-term/intense exercise; 2. Slow (skeletal muscle) fibres used during long(er)-term exercise; 3. Creatine used to form phosphocreatine; 4. (Phosphocreatine) combines with ADP to form ATP; 5. (Carbohydrate/glucose) stored as glycogen **OR** Glycogenesis; 6. Glycogen hydrolysed to glucose **OR** Glycogenolysis; 7. Glucose for respiration;	5 max (5 x AO2)

Max 3 marks from mark points 3, 4, 5, 6 and 7.

1 and 2. Accept examples of short-term/intensity exercise e.g. sprint and longer-term/endurance exercise, e.g. marathon or low(er) intensity exercise.

1. Accept fast twitch fibres for fast (skeletal muscle) fibres

2. Accept slow twitch fibres for slow

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02.3	1. Fast (fibres) <u>contract</u> quickly whereas slow (fibres) <u>contract</u> slowly **OR** Fast (fibres) used for short time whereas slow(fibres) used for long time; 2. Fast (fibres mainly) use anaerobic respiration **OR** Slow (fibres) use aerobic respiration; 3. Fast (fibres) produce ATP quickly **OR** Slow (fibres) produce ATP slowly **OR** Less ATP/energy (per glucose) from anaerobic respiration **OR** More ATP/energy (per glucose) from aerobic respiration; 4. Glycogen is a store of glucose **OR** Glycogen hydrolysed to glucose **OR** <u>Glycogenolysis</u>;	4 (4 x AO2)

1. Accept fast <u>contract</u> quick<u>er</u> **OR** slow <u>contract</u> slow<u>er</u> **OR** fast used for short<u>er</u> time **OR** slow used for long<u>er</u> time.

1. Accept examples of short time / power

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Question 9 · A level Paper 2 · June 2017 · Q03.1 · 1 mark

03.1	Increase in aerobic respiration OR Increase in/more mitochondria OR Increase in/more slow muscle fibres;	1 max	Ignore: reference to Krebs cycle as this in the stem of the question.

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04.1	1. Lower (force of contraction) in mouse/**B** (than control/100%) below 29 °C **OR** Lower (force of contraction) in rabbit/**D** (than control/100%) below 26.5 °C; 2. Higher (force of contraction) in mouse/**B** (than control/100%) above 29 °C **OR** Higher (force of contraction) in rabbit/**D** (than control/100%) above 26.5 °C; 3. Only (used) mouse **and** rabbit **OR** No other organism/species used; 4. Body temperature of mouse/rabbit higher (than temperatures investigated); 5. Only used one/0.5 pH (below typical pH) **OR** (Should) use more pH values; 6. (Used) isolated muscle tissue; 7. No stats test to see if (difference is) significant;	4 max

1. Accept any temperature below 29 °C for mouse/**B** or any specified temperature below 26.5 °C for rabbit/**D.**

2. Accept any temperature above 29 °C for mouse/**B** or any temperature above 26.5 °C for rabbit/**D.**

1. and 2. Accept 27

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Question 11 · A level Paper 2 · June 2024 · Q02.1 · 2 marks

02.1	Correct answer of 5 / 5.4 / 5.44 x 10^{-2} = **2 marks**;; Incorrect answer but shows 5 / 54 / 544 (ignore position of any decimal point or preceding/subsequent zeros) = **1 mark**;	2 (2 x AO2)	10^{-2} is essential for **two marks**.

Question 12 · A level Paper 2 · June 2023 · Q10.2 · 1 mark

10.2	1.35 **OR** 1.4;	1 (AO2)	Accept numbers after 1.35.

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