

Mark schemes

Q1.

- (a) 1. Light/I band only actin;
 2. H zone/band only myosin;
 3. Darkest/overlapping region actin **and** myosin;
*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.*

3

Q2.

- (a) 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;
*Accept any temperature below 29 °C for mouse/**B** or any specified temperature below 26.5 °C for rabbit/**D**.
 Accept 27 °C for 26.5 °C and accept 28.5 °C for 29 °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;
*Accept any temperature above 29 °C for mouse/**B** or any temperature above 26.5 °C for rabbit/**D**.
 Accept 27 °C for 26.5 °C and accept 28.5 °C for 29 °C.*
3. Only (used) mouse **and** rabbit
OR
 No other organism/species used;
Accept only two animals/species used.
4. Body temperature of mouse/rabbit higher (than temperatures investigated);
Accept body temperature of mouse/rabbit not known
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;
Ignore SD.

4 max

- (b) 1. (Less/No) tropomyosin moved from binding site
OR
 Shape of tropomyosin not changed so binding site not exposed/available;
Ignore troponin.
Reject active site only once.
2. (Fewer/No) actinomyosin bridges formed;
Accept actin and myosin do not bind.
Reject active site only once.
3. Myosin head does not move
OR
 Myosin does not pull actin (filaments)
OR
 (Less/No) ATP (hydrol)ase (activation);
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.

3

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

2

[9]

Q3.

- (a) Increase in aerobic respiration
OR
 Increase in / more mitochondria
OR
 Increase in / more slow muscle fibres;
Ignore: reference to Krebs cycle as this in the stem of the question.

1 max

- (b) 1. (More aerobic respiration) produces more ATP;
 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.*

3

- (c) 1. Correct answer in range 84 to 84.2 = 2 marks;
 2. For one mark accept incorrect answer but shows r (radius) = 0.63 (mm)
OR
 d (diameter) = 1.26 (mm);
 2. *Ignore: numbers after 0.63 and 1.26.*

2

- (d) 1. A numerical comparison of range = **2 marks** i.e.
 Young (fibres) range 14/15 – 47/48 (µm) **and** adult (fibres) 17/18 – 86/87/88 (µm)
OR
 Young (fibres) range 32/33/34 **and** adult (fibres) range 68/69/70/71;
 2. Comparison of range without numbers = one mark i.e.
 Adult (fibres) greater range / spread / variation (of diameters)
OR
 Young (fibres) smaller range / spread (of diameters);
 3. Comparison of mode = one mark i.e.
 Adult (fibres) peak/most common/frequent/mode at 50 (µm) and young (fibres) peak/most common/frequent/mode at 30 (µm);
 1. *Accept: **one** mark for comparison of minimum values i.e.
 14/15 compared to 17/18
 Allow **one** mark for comparison of maximum values i.e.
 47/48 compared to 86/87/88.*
 1. *Note: comparison of both maximum and minimum values = **2 marks**.*
 3. *Accept: adult (fibres) peaks at higher diameter or young (fibres) peak / most frequent at lower diameter.*
 3. *Reject: reference to mean / average.*

2 max

[8]

Q4.

- (a) C = M line / M disc / myosin filament

D = mitochondrion

E = myofibril

3

- (b) Sarcomere

- 1
- (c) Answer in range 1.14–1.18 1
- (d) 1. As a store of glucose
Ignore provide energy
OR
 To be hydrolysed to glucose;
2. For respiration / to provide ATP; 2
- (e) 1. Low pH changes shape of calcium ion receptors
Do not accept tropomyosin does not move
2. Fewer calcium ions bind to tropomyosin;
Accept troponin
3. Fewer tropomyosin molecules move away;
4. Fewer binding sites on actin revealed;
5. Fewer cross-bridges can form
- OR**
- Fewer myosin heads can bind
Must include idea of fewer at least once
- 3 max
- [10]**

Q5.

- (a) 1. Calcium ions diffuse into myofibrils from (sarcoplasmic) reticulum;
2. (Calcium ions) cause movement of tropomyosin (on actin);
3. (This movement causes) exposure of the binding sites on the actin;
4. Myosin heads attach to binding sites on actin;
5. Hydrolysis of ATP (on myosin heads) causes myosin heads to bend;
6. (Bending) pulling actin molecules;
7. Attachment of a new ATP molecule to each myosin head causes myosin heads to detach (from actin sites).
- 5 max
- (b) 1. Releases relatively small amount of energy / little energy lost as heat;
Key concept is that little danger of thermal death of cells
2. Releases energy instantaneously;
Key concept is that energy is readily available

3. Phosphorylates other compounds, making them more reactive;
4. Can be rapidly re-synthesised;
5. Is not lost from / does not leave cells.

2 max

[7]

Q6.

- (a) 1. (Reaction with ATP) breaks/allows binding of myosin to actin/actinomyosin bridge;
2. Provides energy to move myosin head;
1. *Credit 'breaks' or 'allows' binding to actin (because cyclical)*
 2. *Allow in context of 'power stroke' or 're-cocking' (because cyclical)*
 2. *Ignore contraction on its own*

2

- (b) (i) Any value between 68.5 and 69.49 (%);;
- If get difference of 0.9 but calculation of percentage incorrect, then award 1 mark;

2

- (ii) (Mutant mice)
1. Unable to make phosphocreatine/ less phosphate available to make/recycle ATP;
 2. So less energy/so less ATP available for contraction/fast muscle fibres;
 - 1 and 2. *Reject production/creation of energy once*
 2. *Accept less energy for grip*
 2. *Accept no energy/no ATP for contraction/fast muscle fibres*

2

- (c) 1. (Heterozygous) have one dominant/normal allele (for creatine production);
2. (This) leads to production of enough/normal amount of creatine;
1. *Accept has one allele/one copy of the gene for/that is making creatine*

2

[8]