

- M1.**
- (a) (i) A / dark band is mainly due to myosin filaments;
H zone only myosin filaments;
darker band has both types of filament;
light band has only actin filaments; 2 max
- (ii) H zone narrows;
light band narrows;
outer darker regions of A / dark band widen; 2 max
- (b) (i) breaks down ATP yielding energy;
used to form / break actomyosin bridges; 2
- (ii) **A and B**
tropomyosin covers binding site on actin;
no cross bridges formed /
ATPase activity on myosin head reduced; 2
- B and C**
calcium ions remove tropomyosin;
binding / calcium ions increase ATPase activity; 2
- [10]**

- M2.**
- (a) (i) Decreases;
Accept any word that means a decrease e.g. shorter / narrower / smaller etc 1
- (ii) Nothing / stays the same length / does not change; 1
- (b) 1. Two marks for correct answer of 29545-30455;
Correct answer = 2 marks outright. Range allows for a 1mm error in measuring
2. One mark for incorrect answers in which candidate clearly divides measured width by actual width;
Ignore rounding up 2

(c) (Idea ATP is needed for:)

1. Attachment / cross bridges between actin and myosin;
 1. *Accept the role of ADP in attachment*
2. 'Power stroke' / movement of myosin heads / pulling of actin;
 2. *Not just 'filaments slide' as given in the question stem*
3. Detachment of myosin heads;
4. Myosin heads move back/to original position / 'recovery stroke'

3 max

[7]

M3. (a) **W** = myosin
X = actin;

1

(b) myofibril is contracting in **Figure 3** / relaxing in **Figure 2**;
movement of actin fibres between myosin fibres;

2

(c) interact with/move/touch tropomyosin;
(allow troponin as alternative)

to reveal binding sites on actin;
(not active sites)

allowing myosin (heads) to bind/touch actin / actinomyosin formed;
activate ATPase / energy released from ATP;

4

[7]

M4. (a) (i) Contains more/large amount of succinic dehydrogenase;
Accept "the enzyme" since only one being discussed

(Slow fibres) have lots of mitochondria/(slow fibres)
respire aerobically;

2

(ii) Near edge/outside;

Short distance for diffusion of oxygen/Allows rapid
diffusion/more diffusion of oxygen;

Ignore glucose
Accept carbon dioxide

Oxygen used by mitochondria/electron transfer system in mitochondria;
*Accept effect of carbon dioxide on cell e.g. carbon dioxide changes
pH/carbon dioxide affects enzymes*

3

- (b) (i) Measure with graticule/eyepiece scale;

Calibrate against something of known size:

OR

Estimate/measure field diameter with a scale;

Estimate number of fibres to cover diameter;

Q Last point could be a calibrated slide/haemocytometer/red blood cell or reasonable alternative

Accept

Mount on ruler/haemocytometer/graph paper;

use this to measure size;

Note position of ruler must be specified and correct

2

- (ii) Equivalent measurements taken;

At random to avoid bias/avoid choice of particular fibres;

Large number to be representative/minimise effect of extremes/of anomalies;

As a stained slide is provided reject references to safety.

Ignore reliable

2 max

[9]

- M5.** (a) (i) **W** = actin;

1

- (ii) **X** = myosin;

1

- (b) In Fig 2, only actin / thin filaments present;
In Fig 3, actin / thin filaments and myosin / thick filaments present;
Actin /thin filaments have moved into myosin / thick filaments;

2 max

- (c) Hydrolysis/breakdown of ATP provides energy;
(Energy) for power stroke / breakage of actin-myosin cross bridges;
Calcium ions activate ATPase;
Calcium ions cause tropomyosin molecules to move / expose myosin-binding sites on actin;

Q Do not allow reference to ATP making energy.

As calcium ions is given in the question, allow references to 'calcium' (i.e. without ions in points 3 and 4.

4

[8]

- M6.** (a) (i) H band not visible/reduced / little/no thick filament/myosin only region / ends of thin filaments/actin close together;
I band not visible/reduced / little/no thin filament/actin only region;
A band occupies nearly all sarcomere / thick filament/myosin close to Z line;
Large zone of thick-thin overlap;
- max 2**
- (ii) *Calcium ions:*
Bind to troponin;
Remove blocking action of tropomyosin /
expose myosin binding sites;
- ATP:*
Allows myosin to detach from actin / to break cross bridge;
[allow attach and detach]
Releases energy to recock/swivel/activate myosin head / drive power stroke;
- max 3**
- (b) (i) Depolarisation of axon membrane/influx of Na⁺ establishes local currents;
Change permeability to Na⁺ /open Na⁺ gates of adjoining region;
Adjoining region depolarises / influx of Na⁺ ;
This process repeated along axon / self propagation;
Correct reference to/description of saltatory conduction;
- max 3**
- (ii) Depolarisation of (presynaptic) membrane;
Ca²⁺ channels open / increased permeability to Ca²⁺ ;
Influx of Ca²⁺ ;
Vesicles move towards presynaptic membrane;
Vesicles fuse with presynaptic membrane;
[If ions mentioned once assume candidate is referring to ions throughout; if no mention of ions penalise once only]
- max 3**
- (c) (i) 1. Correct axes labelled, correct orientation, linear scale;
2. Key points (100%, 90% and 50%) plotted correctly;
3. Plots joined by straight lines;
[allow reasonable hand-drawn straight lines]
- 3**
- (ii) Fast fibres used (in explosive exercise);
[allow reverse for slow fibres]
- 1**

[15]

- M7.** (a) calcium ions;
bind to/displace tropomyosin; (*allow troponin*)
reveal binding site on actin;
myosin binds to exposed sites on actin/actomyosin formed/
cross bridges form between actin and myosin;
activates ATPase;
- 3 max
- (b) distance single actin filament moves divided by distance moved
using 1 ATP;
15 ATP;
- 2
- (c) respiration stops;
no ATP produced;
ATP required for separation of actin and myosin/cross bridges;
- 2 max
- [7]

- M8.** (a) (i) A band;
- 1
- (ii) H zone and I band;
- 1
- (b) filaments in I / thin filaments / actin filaments slide in between myosin /
thick filament; thin filaments enter H zone / meet in middle of A band /
pull Z lines closer;
- 2
- (c) correct answer: 22.5 mm ;; = 2 marks
OR relaxed sarcomere length = $\frac{48}{16} = 3 \mu\text{m}$; = 1 mark
- 2 max

- (d) (i) In table:

low	high
low	high
high	low

(1 mark per row;;;)

3

- (ii) 1 overall rate of contraction limited by rate of ATP-splitting;
2 ATPase splits ATP / hydrolyses ATP / converts ATP to ADP
(+ phosphate);
3 ATP-splitting provides energy for *any TWO from* myosin-actin
interaction; myosin head movement / actin to move relative
to myosin; to 'cock' myosin head;

4 max

(iii) lactate = product of anaerobic respiration;

type 1 has higher activity of glycolytic enzymes / has lower activity of Krebs cycle enzymes / has fewer mitochondria;

2

[15]

M9.

- (a)
1. e.m. gives high resolution;
 2. due to short wavelength of electrons;
 3. antibodies attach specifically to target proteins;
 4. gold particles are electron dense;
 5. electrons must pass through a vacuum;
 6. material must be dead / fixed for e.m.;
 7. cross-bridge cycling requires living cells / metabolism / named aspect-e.g. ATP synthesis;

5 max

- (b)
1. Ca^{2+} removes blocking molecules / uncovers binding site on actin;
 2. correct references to Ca^{2+} binding to troponin / moving tropomyosin;
 3. allows myosin heads to attach to actin filaments;
 4. allows sliding of the actin and myosin filaments;
 5. binding of ATP causes myosin (head) to detach (from actin);
 6. (hydrolysis of) ATP releases energy;
 7. which changes the configuration / cocking of the myosin head;

5 max

[10]

