



Exampro A-level Biology

3.5.3 - Effectors

Name:

Class:

Author:

Date:

Time: 95

Marks: 78

Comments:

M1. (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]

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) (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]

- M4.** (a) (i) actin (*Accept* tropomyosin);

1

- (ii) myosin head;

1

- (b) (i) Ca^{2+} binds to [part of] the actin / troponin; this causes tropomyosin to be displaced; uncovers [myosin] binding sites [on actin] / allows actin to bind;

max 2

- (ii) myosin heads bind to actin / cross bridge formation / actomyosin formed; myosin heads / crossbridges swivel / ratchet mechanism; causing actin to slide relative to myosin; energy provided by hydrolysis of ATP;

max 3

- (c) (i) (number lightly stained fibres / total number of fibres) × 100;
(actual numbers are 10/18 × 100) 1
- (ii) sample not representative / large enough;
individual muscle fibres different sizes / contain different
number of myofibrils; max 1
- (d) all some stain = 1
fast dark and slow lighter = 2 2
- (e) change in base sequence in DNA;
addition / deletion / substitution of a base in DNA of the gene
which codes for myosin;
change in amino acid sequence / primary structure;
causes a different tertiary structure;
which alters the binding properties of myosin; max 4

[15]

- M5.** (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]

- M6.** (a) (i) 1. Moves out of the way when calcium ions bind;
1. Accept shape change with Ca²⁺
1. Don't accept just "calcium"
2. Allowing myosin to bind (to actin) / crossbridge formation;
1. Accept presence of calcium ions leads to movement instead of binds
Accept references to troponin 2

- (ii) 1. Head (of myosin) binds to actin and moves / pulls / slides actin past;
Q
2. (Myosin) detaches from actin and re-sets / moves further along (actin)
 1. *Accept myosin power stroke (to move actin)*
 1. *Accept push*
 1. *Accept crossbridges form instead of myosin head binds to actin*
 1. *Must refer to myosin head or crossbridges*
3. This uses ATP;

2 max

- (b) (i) 1. (Glycogen broken down) gives (lots of) glucose for glycolysis / anaerobic respiration;
 1. *Give if context of anaerobic respiration clear*
2. Glycolysis / anaerobic respiration not very efficient / only yields 2 ATP per glucose;
 2. *Accept anaerobic respiration is a quick source of ATP for exercise*
 2. *Accept very little ATP*

2

- (ii) 1. (Many capillaries) give high concentration / lots of oxygen / shorter diffusion pathway for oxygen / large surface area for oxygen exchange / diffusion;
2. Good glucose supply with little glycogen present;
3. Allows high rate of / more aerobic respiration **OR** prevents build-up of lactic acid / (muscle) fatigue;
 3. *Accept idea of aerobic respiration during endurance events / long periods of exercise*

2 max

[8]

- M7.** (a) 1. (Phosphocreatine) provides phosphate / phosphorylates;
Accept P_i or P in circle
Reject phosphorus
2. To make ATP;
Accept:
 $ADP + CP \rightarrow ATP + C$
Neutral – provides ATP

2

(b) One suitable suggestion;

eg

1. Genetic differences;
2. Level of fitness / amount of regular exercise done / mass of muscle;
3. Sex;
4. Ethnicity
5. Metabolic rate;
6. Number of fast / slow muscle fibres
Neutral lifestyle / diet / illness

1 max

- (c) 1. (From graph, phosphocreatine) takes longer to remake as people get older;
Accept positive correlation between age and time to re-form phosphocreatine
2. Fast muscle fibres used for rapid / brief / powerful / strong contractions;
 3. Phosphocreatine used up rapidly during contraction / to make ATP;
 4. Anaerobic respiration involved;
 5. (As people get older) slower metabolic rate / slower ATP production / slower respiration;
 6. ATP used to reform phosphocreatine;
 7. Lots of phosphocreatine in fast fibres;

4 max

[7]

M8.

- (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]

