

- M1.(a)**
1. Splitting / breakdown / hydrolysis of ATP;
  2. (Muscle) contraction requires energy / ATP;  
*Accept 'uses energy'. Reject idea of 'movement' of muscles requiring energy.  
 Reject suggestion that 'energy is produced'.*
  3. Use of ATP by myosin.  
*Accept a reference to any use of ATP by myosin. No credit for any further detail.*

2 max

- (b) Fast because (lots of) ATPase allows rapid **hydrolysis** of ATP  
 OR  
Slow because (lots of) ATPase allows rapid **synthesis** of ATP.  
*Accept either approach as some texts refer to ATPase as the enzyme at the end of the ETC in mitochondria.*

1

- (c)
1. Need light to see colour / brown / yellow;  
*Requires reference to light.*
  2. Cannot see colour / brown / yellow with electrons / an electron microscope;  
*Requires reference to electrons / electron microscope.  
 Accept 'see black and white with electrons / electron microscope'.*
  3. No organelles are visible.  
*Accept appropriate named examples of organelles.*

2 max

[5]

**M2.(a)**

Function	Name
Attaches to Z line at the end of	1. <b>Actin</b> ;

the sarcomere	
Breaks down ATP	<b>2. ATPase / myosin (head);</b>
Covers binding site on actin in relaxed myofibril	<b>3. Tropomyosin;</b>

*Accept water  
Accept troponin*

3

- (b)
1. Can't form myosin / thick filaments;  
*Neutral: prevents actin and myosin sliding filament action*
  2. Can't pull / can't move actin / slide actin past / (myosin) have to be joined / fixed to pull actin;  
*Accept: myosin can't pull on each other*
  3. Myosin moves / if attached doesn't move;
  4. Can't move actin towards each other / middle of sarcomere / between myosin / can't shorten sarcomere / can't pull Z lines together.  
*Accept: contract for shorten*

3

[6]

- M3.(a)**
1. Fields of view randomly chosen;
  2. Several fields of view;
  3. All same species (of animal / hamster);  
*Reject general statements related to sample size. All mark points relate directly to information provided in Resource A.  
Accept 'all (Mesocricetus) auratus'.*
  4. Same muscle / organ used / only diaphragm used;
  5. Used at least 8 (animals) in each (age) group.

4 max

- (b) (i) 15

*Correct answer = 2 marks.  
Allow 1 mark for showing*

$$69 \div 4.6$$

OR

answer of 10 / 10.1 (correct calculation using fast in error.)

2

- (ii) 1. (Calculation) used mean (number of capillaries);  
2. Variation in number of capillaries per fibre.  
*Note: maximum of 1 mark for this question.  
Ignore reference to an anomaly or calculation errors.*

1 max

- (c) (i) (Removing diaphragm means) animals / hamsters are killed.

1

- (ii) 1. (Suggests) significant (difference) between young and adult;  
*MP1, MP2, MP4 and MP5 can include use of figures but check figures are used correctly.*
2. (Suggests) not significant (difference) between adult and old;  
*Statements related to 'results being significant / not significant' do not meet the marking points. It is the difference that is significant or not. However, only penalise this error once.*
3. For slow **and** fast fibres;  
*This MP can be given in the context of either MP1 or MP2 but only allow once. As well as this context there must be a reference to 'both' types of fibre.*
4. (Suggests) significant (difference) between young and old for fast (fibres)  
OR  
(Suggests) not significant (difference) between young and old for slow (fibres);  
*All aspects of either approach required to gain credit.*
5. (Suggests) significant (difference) where means  $\pm$  SD do not overlap  
OR  
(Suggests) not significant (difference) where means  $\pm$  SD overlap;  
*All aspects of either approach required to gain credit.*
6. Stats test is required (to establish whether significant or not).

4 max

[12]

- M4.(a)** (i) (Group) 5 / marathon runners.  
*Must only include this group and no other.*

1

- (ii) 1. (5 / marathon runners) have highest percentage of slow fibres;  
*Maximum of 1 mark if the wrong fibres have been identified.*
2. (Slow fibres) use aerobic respiration / aerobic respiration occurs in mitochondria;  
*Either approach requires identification of aerobic respiration.*
3. (Slow fibres) best for endurance / long periods of exercise / to avoid fatigue.

2 max

- (b) 1. No (overall) change in number of fibres;  
*Reject any suggestion of an increase in number of fibres.*
2. Increase in diameter of fibres;  
*'Size' without qualification is insufficient.*
3. (Due to) training / exercise;
4. (Long-distance) cyclists have more / higher percentage of slow fibres (than fast);  
*A comparison is required to meet this MP.*
5. Slow fibres of wider diameter than fast fibres;
6. (Long-distance) cyclists have more mitochondria;
7. (Long-distance) cyclists have more capillaries (in muscles).  
*Idea of 'more' (than non-athletes) is required to gain credit.*  
*Accept converse (for non-athletes) in MP4, MP6 and MP7.*

3 max

- (c) 1. Weightlifting favoured by / weightlifters have a high proportion of fast / low proportion of slow fibres  
OR  
Weightlifters have more fast / fewer slow fibres than non-athletes;  
But (cannot tell because):

*Reward for general statement or comparison with non-athletes.*

*For 'proportion', accept percentage (or idea of a ratio).*

2. Do not know what 'weightlifters' (tested) were born with / had before started weightlifting / training  
OR  
Don't know if there has been a change (in proportion due to weightlifting / training);

3. No information about age / gender / number of weightlifters (in sample).

*For this MP, accept another relevant factor that might affect 'weightlifter' e.g. weights lifted, sex, diet, ethnicity, country of birth.*

*Ignore general statements about 'other factors'.*

2 max

[8]

- M5.(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]

- M6.(a)**
1. (Phosphocreatine) provides phosphate / phosphorylates;

*Accept P<sub>i</sub> 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. Fast muscle fibres used for rapid / brief / powerful / strong contractions;
  2. Phosphocreatine used up rapidly during contraction / to make ATP;
  3. (As people get older) slower metabolic rate / slower ATP production / slower respiration;
  4. ATP used to reform phosphocreatine;

4

[7]

**M7.** (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;  
*Accept the role of ADP in attachment*

2. 'Power stroke' / movement of myosin heads / pulling of actin;  
*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]