**M1.**

(a)

| | |
|---|---|
| Protein synthesis | **L;** |
| Modifies protein | **H;** |
| Aerobic respiration | **N;** |

**3**

(b) 1800−2200;

*1.8, 2.0 or 2.2 in working or answer = 1 mark.*

*Ignore units in answer.*

1 mark for an incorrect answer in which student clearly divides measured length by actual length (of scale).

*Accept I / A or I / O for 1 mark but ignore triangle.*

*Accept approx 60mm divided by 30µm for 1 mark*

**2**

**[5]**

**M2.**(a) Any **five** from:

1. Cell homogenisation to break open cells;

   *1. Accept suitable method of breaking open cells.*

2. Filter to remove (large) debris / whole cells;

   *2. Reject removes cell walls.*

3. Use isotonic solution to prevent damage to mitochondria / organelles;

   *3. Ignore to prevent damage to cells.*

4. Keep cold to prevent / reduce damage by enzymes / use buffer to prevent protein / enzyme denaturation;

5. Centrifuge (at lower speed / 1000 g) to separate nuclei / cell fragments / heavy organelles;

   *5. Ignore incorrect numerical values.*

6. Re-spin (supernatant / after nuclei / pellet removed) at higher speed to get mitochondria in pellet / at bottom.

*6. Must have location*

*Reject ref to plant cell organelles only once*

**5 max**

(b) Principles:

1. Electrons pass through / enter (thin) specimen;
2. Denser parts absorb more electrons;
3. (So) denser parts appear darker;
4. Electrons have short wavelength so give high resolution;

*Principles:*

*Allow maximum of 3 marks*

Limitations:

5. Cannot look at living material / Must be in a vacuum;
6. Specimen must be (very) thin;
7. Artefacts present;
8. Complex staining method / complex / long preparation time;
9. Image not in 3D / only 2D images produced.

*Limitations:*

*Context of limitation must be clear, not simply explaining how TEM works*

*E.g "allows you to see organelles as a thin section is used" is not a limitation*

*Allow maximum of 3 marks*

*Ignore ref to colour*

**5 max**

**[10]**

**M3.**(a) 1. DNA replicated;

*Reject: DNA replication in the wrong stage*

2. (Involving) specific / accurate / complementary base-pairing;

*Accept: semi conservative replication*

3. (Ref to) two identical / sister chromatids;

4. Each chromatid / moves / is separated to (opposite) poles / ends of cell.

*Reject: meiosis / homologous chromosomes / crossing over*

*Note: sister chromatids move to opposite poles / ends = 2 marks for mp 3 and mp 4*

*Reject: events in wrong phase / stage*

**4**

(b) (i) 1. To allow (more) light through;
*Accept: transparent*

2. A single / few layer(s) of cells to be viewed.
*Accept: (thin) for better / easier stain penetration*

**2**

(ii) 1. More / faster mitosis / division near tip / at 0.2 mm;
*Neutral: references to largest mitotic index*

2. (Almost) no mitosis / division at / after 1.6 mm from tip;
*Accept: cell division for mitosis*
*Penalise once for references to meiosis*

3. (So) roots grow by mitosis / adding new cells to the tip.
*Accept: growth occurs at / near / just behind the tip (of the root)*
*Accept: converse arguments*

**2 max**

**[8]**

**M4.**(a) 1. Large / dense / heavy cells;
2. Form pellet / move to bottom of tube (when centrifuged);
3. Liquid / supernatant can be removed.
*Must refer to whole cells.*

**3**

(b) Break down cells / cell parts / toxins.
*Idea of 'break down / digestion' needed, not just damage*

**1**

(c) 1. To stop / reduce them being damaged / destroyed / killed;
*Reject (to stop) bacteria being denatured.*

2. By stomach acid.
*Must be in context of stomach.*

**2**

(d) 1. More cell damage when both present / A;

2. Some cell damage when either there on their own / some cell damage in B and C;

*MP1 and MP2 − figures given from the graph are insufficient.*

3. Standard deviation does not overlap for A with B and C so difference is real;

*MP3 and MP4* ***both*** *aspects needed to gain mark.*

4. Standard deviations do overlap between B and C so no real difference.

*MP3 and MP4 accept reference to significance / chance for 'real difference'*

**3 max**

(e) 1. Enzyme (a protein) is broken down (so no enzyme activity);

*Accept hydrolyse / digested for 'broken down'.*

2. No toxin (as a result of protein-digesting enzyme activity);

*Must be in the correct context.*

3. (So) toxin is protein.

*This must be stated, not inferred from use of 'protein−digesting enzyme'.*

**3**

**[12]**

**M5.**(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 ÷ 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 <u>fast</u> (fibres)
OR
(Suggests) not significant (difference) between young and old for <u>slow</u> (fibres);

*All aspects of either approach required to gain credit.*

5. (Suggests) significant (difference) where means ± SD do not overlap
OR
(Suggests) not significant (difference) where means ± 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]**

**M6.**(a) 1. How to break open cells and remove debris;
2. Solution is cold / isotonic / buffered;
3. Second pellet is chloroplast.

**3**

(b) 1. **A** stroma;
2. **B** granum.

*Accept thylakoid*

**2**

(c) $\left(\frac{\textit{length of chloroplast}}{\textit{length of bar}}\right)$ µm

**1**

(d) **Two** of the following for **one** mark:
Mitochondrion / ribosome / endoplasmic reticulum / lysosome / cell-surface membrane.

**1 max**

**[7]**