2.5 STUDYING CELLS (2) – MARK SCHEME

Q1.

(a) X = mitochondria;
Y = (rough) endoplasmic reticulum;
Accept ribosomes/ER/RER for Y
Reject smooth endoplasmic reticulum for Y
2

(b) (i) (Sections cut at) different angles/in different planes;
Ignore name given to organelle
1

(ii) Z modifies/packages/transports/secretes mucus/ Z adds sugars to proteins;
X provides ATP/energy (for this);
Accept makes in relation to Z but not X
Ignore names of organelles if function correct
2

[5]

Q2.

(a) (D)CBEA.
1

(b)

Step	Reason
(Taking cells from the root tip)	Region where mitosis / cell division occurs;
(Firmly squashing the root tip)	To allow light through / make tissue layer thin;

2

(c) (Increase)
1. Chromosomes / DNA replicates;
(First decrease)

2. Homologous chromosomes separate;
(Second decrease)

3. Sister chromatids separate.
3

(d) 1. (DNA would) double / go to 2 (arbitrary units).
1

[7]

Q3.

(a) Stomata per mm^2 or cm^2
OR
Number per mm^2 or cm^2;

Accept: mm^{-2} or cm^{-2}.

Reject: per μm^2 or μm^{-2}.

Reject: the use of a solidus / as being equivalent to per.

Ignore: 'amount'.

1

(b) 1. Single/few layer(s) of cells;

Accept: more/too many/overlapping.

*'Single layer' without reference to cells/tissue should **not** be credited.*

2. So light can pass through;

2

(c) 1. Distribution may not be uniform
OR
So it is a representative sample;

Accept: more/fewer stomata in different areas.

Ignore: anomalies/random/bias.

2. To obtain a (reliable) mean;

Accept: 'average'.

2

(d) 1. Hairs **so** 'trap' water vapour and water potential gradient decreased;
2. Stomata in pits/grooves **so** 'trap' water vapour and water potential gradient decreased;
3. Thick (cuticle/waxy) layer **so** increases diffusion distance;
4. Waxy layer/cuticle **so** reduces evaporation/transpiration.
5. Rolled/folded/curled leaves **so** 'trap' water vapour and water potential gradient decreased;
6. Spines/needles **so** reduces surface area to volume ratio;

*1, 2 and 5. Accept: humid/moist air as 'water vapour' but **not** water/moisture on its own.*

1, 2 and 5. Accept: diffusion gradient as equivalent to water potential gradient.

1, 2 and 5. Accept: less exposed to air as an alternative to water potential gradient.

*6. Accept: spines/needles **so** 'reduce area'.*

2 max

(e) 1. Water used for support/turgidity;
2. Water used in photosynthesis;
3. Water used in hydrolysis;
4. Water produced during respiration;

2 max

[9]

Q4.

(a) 1. Fields of view randomly chosen;
2. Several fields of view;
3. All same <u>species</u> (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]

Q5.

(a) 1. Thin slice/section;
2. Put on slide in water / solution / stain;
3. Add cover slip;

Accept: 'between two slides'

Max 2

(b) 200 (µm);;

OR
1. Divide image length by key length eg 64/16 = 4;
2. Multiply by 50 eg 4 × 50;

Accept for 2 marks answers in the range of 185-217 (µm)

Max 1 mark for responses not within the range

Accept: measurements in the ranges 63-65mm and 15-17mm

2

(c) 1. Select large number of cells / select cells at random;

Accept: > 3 for "large number"

Accept: many fields of view for 'large number of cells'

Accept: all cells in field of view

2. Count number of chloroplasts;
3. Divide number of chloroplasts by number of cells;

Ignore: 'calculate the mean'

3

[7]

Q6.

(a) 6 (g dm^{-3});

1

(b) Correct answer of (−)0.14;
1 mark for correct difference in concentration (5) divided by 35 / (69 − 64) ÷ 35 / 1 ÷ 7

Ignore +/- sign

Ignore additional d.p.

Accept 0.31(4) for 1 mark if female data used

2

(c) 1. Protein content decreases with age and decreases more in females;
2. Difference (between sexes) only significant at 95 years because SDs do not overlap;
OR
Differences not significant because 2 × SD would overlap;

2

(d) 1. Produce known concentrations of protein;
2. Measure absorbance of each concentration
OR
Measure each concentration with colorimeter;
3. Plot a graph of absorbance on y-axis against concentration (on x-axis) and draw curve;
4. Use absorbance of sample to find protein concentration from curve;

1. Idea of known concentrations required.

Accept % transmission / absorption for absorbance

3 max

(e) 1. (Lower plasma protein concentration suggests) fewer antibodies;

Ignore ref. to other proteins.

Reject answers which refer to white blood cells as proteins.

1

[9]

Q7.

(a) (To diagnose AIDS, need to look for / at)

1. (AIDS-related) symptoms;
2. Number of <u>helper</u> T cells.

Neutral: 'only detects HIV antibodies' as given in the question stem

2

(b) 1. HIV antibody is not present;

Accept HIV antibodies will not bind (to antigen)

2. (So) second antibody / enzyme will not bind / is not present.

2

(c) 1. Children receive (HIV) antibodies from their mothers / maternal antibodies;

2. (So) solution will always turn blue / will always test positive (before 18 months).

Allow 1 mark for the suggestion that the child does not produce antibodies yet <u>so</u> test may be negative

2

(d) (Shows that)

1. Only the enzyme / nothing else is causing a colour change;
2. Washing is effective / all unbound antibody is washed away.

2

[8]

Q8.

(i) cold - no / reduced enzyme action / e.g. stops autolysis;

(reject "cell activity reduced")

isotonic - stops osmotic effects / description of effect on cells or organelles;
buffer - prevents damage to enzymes / proteins;

3

(ii) break open the cells / release the cell contents;

1

(iii) supernatant / liquid above the pellet;
spun at a high(er) speed;

(mark as independent points)

2

[6]

Q9.

(a) (i) Mitochondria site of respiration;

Production of ATP / release of energy;
For contraction;

Do not award credit for making or producing energy.

3

(ii) Enzymes are proteins;
Proteins synthesised / made on ribosomes;

2

(b) Lysosomes produce / contain enzymes;
Which break down / hydrolyse proteins / substances / cells of tail;

2

(c) 1. Chop up (accept any reference to crude breaking up);
2. Cold;
3. Buffer solution;
4. Isotonic / same water potential;
5. Filter and centrifuge filtrate;
6. Centrifuge supernatant;
7. At higher speed;
8. Chloroplasts in (second) pellet;

max 6

[13]

Q10.

(a) *two environmental or developmental variables <u>and</u> explanation;*

examples,

all plants of the same age, so same time for cell divisions / differentiation;
all plants given the same watering, so same amount of water for cell expansion;
(reject reference to photosynthesis)
all plants given same light, so same rate of photosynthetic;
same temperature, so enzymes / named metabolic process at optimum temperature;
same named ion / minerals in soil(e.g. nitrate),
so same available for a named function,
(e.g. amino acid / protein synthesis);

2 max

(b) count cells using microscope;
count number of cells in cell division / where chromosomes visible;
and then the total number of cells in field of view;

2 max

(c) only cells at tip have ability to divide / cells further back don't divide;
cells further back differentiating / named example of
(accept reference to loss of totipotent cells)
differentiated tissue / too old / reduction in plant hormone;
cell wall too thick / vacuole too large to allow division;

2 max

(d) new cells added at tip;
cells increase in volume / larger;
increase in length (of cells);
as vacuole s get larger;
due to uptake of water (by osmosis);

3 max

[9]

Q11.

(a) (i) break open cells / release cell contents;

1

(ii) keep pH the same / controls pH;
prevent change to / denaturing of proteins / enzymes;

2

(b) (i)

(supernatant) **C**	(pellet) **B**;	(pellet) **A**;

2

(ii) site of respiration which releases energy / ATP;
required for movement against concentration gradient;
ignore first point for thermodynamically incorrect statements such as "making energy".

2

[7]

Q12.

(a) removes debris / intact cells / sand;
which would contaminate sediment A / interfere with the results;

2

(b) (i) nuclei;

1

(ii) ribosomes / endoplasmic reticulum / membrane / Golgi;

1

(c) density / size / mass / weight;

1

(d) an electron microscope has a higher resolution;
electrons with shorter wavelength;

2

[7]

Q13.

(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]

Q14.

(a) Correct answer: 1.25;

Ignore working

OR (if wrong answer)

$$\frac{\text{measurement in µm}}{40000} \;/\; \frac{\text{measurement in mm}}{40} = 1 \text{ mark}$$

125 but wrong order of magnitude = 1 mark

2

(ii) **C** has myosin / thick (and actin / thin) filaments;

OR

A has only actin / thin (/ no myosin / no thick) filaments;

1 max

(b) When contracted:

Thick & thin filaments/myosin & actin overlap more;

Interaction between myosin heads & actin / cross-links form;

Movement of myosin head;

Thin filaments / actin moved along thick filaments / myosin;

Movement of thin filaments / actin pulls Z-lines closer together;

Displacement of tropomyosin to allow interaction;

Role of Ca^{2+};

Role of ATP;

Allow ref. to 'sliding filament mechanism' / described if no other marks awarded

4 max

(c) (i) 8 has DMD but 3 and 4 do not / 12 has DMD but 6 and 7 do not / neither parent has the condition but their child has;

Allow parents 3 and 4 give 8, parents 6 and 7 give 12

1

(ii) 4 ***AND*** 7;

1

(iii) Parental genotypes: 6 = $\mathbf{X^DY}$ AND 7 = $\mathbf{X^DX^d}$

AND

Gametes correct for candidate's P genotypes – e.g.

$\mathbf{X^D}$ and $\mathbf{Y}$ + $\mathbf{X^D}$ and $\mathbf{X^d}$;

Offspring genotypes <u>correctly derived</u> from gametes e.g.

$\mathbf{X^DX^D}$ + $\mathbf{X^DX^d}$ + $\mathbf{X^DY}$ + $\mathbf{X^dY}$;

Male offspring with MD correctly identified: $\mathbf{X^dY}$;

Probability = 0.25 / correct for candidates offsprings genotypes;

Accept ¼ / 1 in 4 / 1:3 / 25%

NOT '3:1' / '1:4'

4

(d) (i) No gene fragment **G**;

1

(ii) Only one copy of gene fragment **F**;

Male has only one X-chromosome / is XY (c.f. female has two / is XX);

2

(iii) 10 has only one copy of gene fragment **G**;

10 has only one normal X-chromosome / has one abnormal / has only one normal allele / has one X^d / is X^DX^d / is heterozygous;

11 has two normal X-chromosomes / has 2 normal alleles / is X^DX^D / has not got X^d / has 2 copies of (F and) G;

3

(e) (i) To prevent rejection / prevent antibody production vs. injected cells / injected cells have (foreign) antigen (on surface);

1

(ii) Shows effect of cells / not just effect of injection / not just effect of salt solution;

1

(iii) Only one person tested so far – need more to see if similar results / need more to see if reliable;

Need to assess if new (dystrophin positive) muscle fibres are functional / if muscle becomes functional;

Can't tell how widespread effect is in the muscle / sample taken near injection site;

Need to test for harmful side effects;

Need to test if successful for other mutations of dystrophin gene;

Need to assess permanence / longevity of result/insufficient time allowed in investigation;

(In this patient) only small response / %;

Further sensible suggestion;

4 max

[25]