EXAM PAPERS PRACTICE

Studying cells 1

Level: AQA A Level 7402
Subject: Biology
Exam Board: Suitable for all boards
Topic: Studying cells 1
Type: Mark Scheme

To be used by all students preparing for AQA A Level Biology 7402 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1

(a) (Plasma / cell) membrane;

Reject: nuclear membrane

1

(b) Nucleus / nuclear envelope / nuclear membrane / nucleolus;

Accept: membrane-bound organelles only if an example has not been given

Mitochondrion;

(Smooth / rough) ER;

Lysosome;

Microvillus / brush border;

Neutral: villi

Golgi;

Linear / non-circular DNA / chromosome;

Neutral: DNA strands

80S / denser / heavier / larger ribosomes;

Neutral: ribosomes

2 max

(c) (i) Higher resolution / higher (maximum) magnification / higher detail (of image);

OR

Allows internal details / structures within (cells) to be seen / cross section to be taken;

Accept: 'better' instead of 'higher'

Neutral: shorter wavelength

Reject: longer wavelength

Reject: can be used on living specimens

***Q** Do not accept 'clearer' image*

1

(ii) Thin sections do not need to be prepared / shows surface of specimen / can have 3-D images;

Accept: can be used on thick(er) specimens

Reject: can be used on living specimens

Neutral: refs. to staining / preparation / artefacts / colour

1

(d) Two marks for correct answer of 0.42 – 0.46;;

One mark for incorrect answers in which candidate clearly divides measured width by magnification;

Correct answer = 2 marks outright

Accept: 0.4 or 0.5 only if working is correct for 2 marks

Do not award a mark for 0.4 or 0.5 if there is no working out

Ignore rounding up

2

(e) As height increases, the number of deaths decrease / inversely proportional / negative correlation;

Correct reference to increase / decrease at 14-30m;

Accept: converse statement

Must give a trend and not simply give individual points

Do not penalise for 'more likely to get cholera'

2

[9]

2

(a) Peptide;

***Q** Do not accept polypeptide*

Neutral: covalent

1

(b) (F) H J E (K);

All three boxes correct = 2 marks

Two boxes correct = 1 mark

2

(c) (Site of aerobic) respiration;

Release ATP / energy for active transport / transport against the concentration gradient / protein synthesis / exocytosis;

***Q** Reject: anaerobic respiration*

***Q** Reject: produces / makes energy*

Accept: produces ATP for energy

Reject: produces ATP for respiration

Neutral: protein secretion

2

(d) (i) Breaks open cells / disrupts cell membrane / releases cell contents / releases organelles / break up cells;

Reject: breaks down cell wall

Neutral: separates the cells

Reject: breaks up cells so they can be separated

Reject: breaks up / separates organelles

1

(ii) Removes (cell) debris / complete cells / tissue;

*Neutral: to isolate organelle **G** / mitochondria*

Neutral: removes unwanted substances / impurities

Reject: removes organelles / cell walls

1

(iii) Reduces / prevents <u>enzyme</u> activity;

Reject: ref. to denaturation

1

(iv) Prevents osmosis / no (net) movement of water / water does not enter organelle / water does not leave organelle;

So organelle / named organelle is not damaged / does not burst / does not shrivel;

Neutral: ref. to water potential

***Q** Ref. to cells rather than organelles negates the second mark only*

Reject: ref. to turgid / flaccid for second mark

Reject: organelle 'explodes' for second mark

2

[10]

3

(a) 1. Push hard – spread / squash tissue;
2. Not push sideways – avoid rolling cells together / breaking chromosomes.

Neutral – to see cells clearly

2

(b) No (no mark)
Yes (no mark)

1. Chromosomes / chromatids are (in two groups) at poles of spindle / at ends of spindle;

Do not accept 'ends of cell'

2. V-shape shows that (sister) chromatids have been pulled apart at their centromeres / that centromeres of (sister) chromatids have been pulled apart.

2

(c) 28.8 / 29.

If incorrect, allow:

$\frac{6}{200} \times 960$ = *1 mark*

2

[6]

4

(a) (To diagnose AIDS, need to look for / at)
1. (AIDS-related) symptoms;
2. Number of helper 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 so 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]

5

(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]

6

(a) 1. Add drop of water to (glass) slide;
2. Obtain thin section (of plant tissue) and place on slide / float on drop of water;
3. Stain with / add iodine in potassium iodide.

3. Allow any appropriate method that avoids trapping air bubbles

4. Lower cover slip using mounted needle.

4

(b) 1. **W** – chloroplast, photosynthesis;
2. **Z** – nucleus, contains DNA / chromosomes / holds genetic information of cell.

2

(c) 1. High resolution;
2. Can see internal structure of organelles.

2

(d) Length of bar in mm × 1000.

1

[9]

7

(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]

8

(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]

9

(a) 1. Antigen stimulates immune response / activates B/T cells;
2. B/T cells divide OR antibodies produced;
3. Antibodies/T cells attack myelin sheaths;

Ignore references to antigen binding to myelin

3

(b) 1. Fewer cristae/smaller surface area (of cristae);
2. So less electron transport/oxidative phosphorylation;
3. (So) not enough ATP produced

OR

Not enough energy to keep neurones alive;

1. Accept 'inner membrane' as 'cristae'

2. Accept fewer ATP synthase enzymes

2. Accept lower rate of electron transfer/oxidative phosphorylation

3. Accept less use/stimulation of neurone leads to death of cell

3. Accept no/less ATP produced/no energy to keep neurones alive

3. Ignore references to glycolysis/ Krebs cycle

3

(c) (i) (Transmission) electron (microscope) – **no mark**

Need high resolution (to see structure of mitochondria)

Accept 'scanning electron microscope' /TEM/SEM

Accept – optical microscope not high enough resolution

1

(ii) 1. Took photographs/areas at random;
2. Counted total number (of normal) and number of unusual mitochondria;
3. Divided number of unusual mitochondria by total number and multiplied by 100;

1. Accept (very) large number of areas/photos/samples

MP 3 = 2 marks (includes MP2)

3

[10]

10 (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]

11 (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) <u>Principles:</u>

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

<u>Limitations:</u>

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.

   <u>Limitations:</u>

   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]

12

(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]

13

(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]

14 (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 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 ± 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]

15 (a)

Statement	Starch	Cellulose	Glycogen
Found in plant cells	✓	✓	
Contains glycosidic bonds	✓	✓	✓
Contains β-glucose		✓	

One mark for each correct row

3

(b) Hydrolysis;

Accept: if phonetically correct

Do not accept: 'hydration'

1

(c) 1. Coiled / helical / spiral;

Feature = one mark

Explanation = one mark

Note: these are independent marking points

These must be related for <u>both</u> marks but can be in reverse order

2. (So) compact / tightly packed / can fit (lots) into a small space;

3. Insoluble;

4. (So) no osmotic effect / does not leave cell / does not affect <u>water potential</u>;

Accept: prevents osmosis

5. Large molecule / long chain;

6. (So) does not leave cell / contains large number of glucose units;

4. and 6. Accept: can' t cross membranes

7. Branched chains;

8. (So) easy to remove glucose;

2 max

(d) Two marks for correct answer of 479 - 521;

Accept: measured and actual lengths in different but correct units for 1 mark

One mark for incorrect answers in which candidate clearly divides measured length by actual length;

The actual range is 23 - 25mm, If they just divide this by 48 they gain 1 mark

Just writing the formula is insufficient, numbers must be used

2

[8]

16

(a) (i) Golgi (apparatus / body);

1

(ii) 1. Nucleus;

Accept: nucleolus / nuclear envelope / nuclear membranes

2. Mitochondrion;

Accept cristae / mitochondrial membranes

3. Endoplasmic reticulum / ER;

Ignore reference to rough / smooth

4. Lysosome;

Reject lysozyme

2 max

(b) (Aerobic) respiration / ATP production / provide energy;

Accept Krebs cycle / electron transport.

Ignore 'produces energy'

Reject anaerobic respiration

Ignore what energy is used for

1

(c) 1. High / better resolution;

2. Shorter wavelength;

3. To see internal structures / organelles / named organelles;

Accept ultrastructure

2 max

[6]

17

(a) **B** Golgi (body / apparatus);

C Mitochondria / mitochondrion;

2

(b) 1. Chloroplasts / plastids

2. Cell wall

3. Cell vacuole

4. Starch grains / amyloplasts;

*Any **2** for **1** mark*

1 max

(c) 1. Ice-cold – Slows / stops enzyme activity to prevent digestion of organelles / mitochondria;

2. Buffered – Maintains pH so that enzymes / proteins are not denatured;

Reject reference to cells

3. Same water potential – Prevents osmosis so no lysis / shrinkage of organelles / mitochondria / **C**;

Ignore damage

For each mark must link reason to relevant property

3

(d) 1. Break open cells / homogenise / produce homogenate;

2. Remove unbroken cells / larger debris;

2

(e) Nucleus / nuclei;

1

(f) Mitochondria / organelle **C** less dense than nucleus / organelle in first pellet;

Accept 'lighter' for less dense

1

[10]

18

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

1

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

1 max

[7]