

# Studying cells 1

Level: Edexcel A Level 9BN0

Subject: Biology

Exam Board: Suitable for all boards

Topic: Studying cells 1

Type: Mark Scheme

To be used by all students preparing for Edexcel Biology A Level 9BN0 foundation or higher tier but also suitable for students of other boards.

## Mark schemes

- 1** (a) (Plasma / cell) membrane;  
*Reject: nuclear membrane*
- (b) Nucleus / nuclear envelope / nuclear membrane / nucleolus; 1  
*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 enzyme 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*





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:*

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

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  $\times$  1000.

1

[9]



7

(a) Stomata per mm<sup>2</sup> or cm<sup>2</sup>

**OR**

Number per mm<sup>2</sup> or cm<sup>2</sup>;

*Accept: mm<sup>-2</sup> or cm<sup>-2</sup>.*

*Reject: per μm<sup>2</sup> or μm<sup>-2</sup>.*

*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 ( $\mu\text{m}$ );;

OR

1. Divide image length by key length eg  $64/16 = 4$ ;  
2. Multiply by 50 eg  $4 \times 50$ ;

*Accept for 2 marks answers in the range of 185-217 ( $\mu\text{m}$ )*

*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	<b>L;</b>
Modifies protein	<b>H;</b>
Aerobic respiration	<b>N;</b>

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) 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]



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*

$$69 \div 4.6$$

*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]



15

(a)

Statement	Starch	Cellulose	Glycogen
Found in plant cells	✓	✓	
Contains glycosidic bonds	✓	✓	✓
Contains $\beta$ -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 both 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 water potential;

*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)  $\left(\frac{\text{length of chloroplast}}{\text{length of bar}}\right) \mu\text{m}$

1

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

1 max

[7]