

**AQA, OCR, Edexcel**

**A Level**

# **A Level Biology**

**Cells, Microscopes, Cell Cycle  
and Immunity Answers**

Name:

**M**

**M**

**E**

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Total Marks:

**M1.**

(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]*

**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.

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*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. 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]**
- M4.(a)** (i) Anaphase    **1**
- (ii) 1. Sister / identical chromatids / identical chromosomes;  
*Reject: Homologous chromosomes separate.*  
*Allow any reference to chromatids / chromosomes being identical e.g. same DNA*
2. To (opposite) poles / ends / sides;    **2**
- (b) (i) 1. 8.4 / cells with twice DNA content = replicated DNA / late interphase / prophase / metaphase / anaphase;  
*Any reference to interphase must suggest towards end of interphase.*  
*'Chromosomes replicate' is not enough for DNA replicates.*
2. 4.2 = DNA not replicated / (early) interphase / telophase / cell just divided / finished mitosis;    **2**
- (ii) 2.1;    **1 6]**
- M5.** (a) 1. Growth / increase in cell number;  
*Ignore growth of cells*
2. Replace cells / repair tissue / organs / body;  
*Ignore repair cells*  
*Reject bacteria*
3. Genetically identical cells;  
*'Produces 2 genetically identical cells' does not reach MP1 as well as MP3*
4. Asexual reproduction / cloning;  
*Allow example or description*

**2 max**

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(b) (i) (Ensures) representative (sample);

*Accept find some cells in mitosis / not in interphase.  
Accept 'more reliable' only if linked to percentage (of cells). 'Improves reliability' on its own does not gain this mark  
Neutral: Large sample* 1

(ii) 1. A = metaphase;

2. Chromosome / chromatids lie on equator;  
*Reject homologous chromosomes Allow centre / middle*

3. B = anaphase;

4. Chromatids / chromosomes separating / moving apart / moving to poles;  
*Reject homologous chromosomes* 4

(c) 2 hours / 120 minutes;

*Allow 1 mark if working shows candidate understood that mitosis would take 10%* 2 [9]

**M6.(a)** 1. Strands separate / H-bonds break;

*1. Q Neutral: strands split  
1. Accept: strands unzip*

2. DNA helicase (involved);

3. Both strands / each strand act(s) as (a) template(s);

4. (Free) nucleotides attach;  
*4. Neutral: bases attach  
4. Accept: nucleotides attracted*

5. Complementary / specific base pairing / AT and GC;

6. DNA polymerase joins nucleotides (on new strand);  
*6. Reject: if wrong function of DNA polymerase*

7. H-bonds reform;

8. Semi-conservative replication / new DNA molecules contain one old strand and one new strand;  
*8. Reject: if wrong context e.g. new DNA molecules contain half of each original strand*

**6 max**

(b) (i) 18; *Do not accept 17.5* 1

(ii) 10; 1

(iii) 1. Horizontal until 18 minutes;  
*Allow + / - one small box*

2. (Then) decreases as straight line to 0  $\mu\text{m}$  at 28 minutes;  
*2. Allow lines that start from the wrong place, ending at 0 at 28 minutes*

2

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- (c) (i) Two marks for correct answer of 19.68 or 19.7;;

*Accept 19hrs 41mins*

One mark for incorrect answers in which candidate clearly multiplies by 0.82;

*Allow one mark for incorrect answers that clearly show 82% of 24 (hours)* 2

- (ii) 1. No visible chromosomes / chromatids / visible nucleus; 1

- (iii) **D** (no mark)

1. Lower % (of cells) in interphase / higher % (of cells) in mitosis / named stage of mitosis;

*1. Accept: 'less' or 'more' instead of '%'*

*1. Do not accept: higher % (of cells) in each / all stage(s)*

2. (So) more cells dividing / cells are dividing quicker;

*2. Accept: uncontrolled cell division*

*2. Do not award if Tissue C is chosen*

2 [15]

**M7.(a)** Calculations made (from raw data) / raw data would have recorded initial and final masses. 1

- (b) Add 4.5 cm<sup>3</sup> of (1.0 mol dm<sup>-3</sup>) solution to 25.5 cm<sup>3</sup> (distilled) water.

*If incorrect, allow 1 mark for solution to water in a proportion of 0.15:0.85* 2

- (c) 1. Water potential of solution is less than / more negative than that of potato tissue; *Allow  $\Psi$  as equivalent to water potential*

2. Tissue loses water by osmosis. 2

- (d) 1. Plot a graph with concentration on the x-axis and percentage change in mass on the y-axis;
2. Find concentration where curve crosses the x-axis / where percentage change is zero;
3. Use (another) resource to find water potential of sucrose concentration (where curve crosses x-axis). 3 [8]

**M8.** (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;

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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]

**M9.(a)** 0.22;    1

- (b) 1. Uptake in flask **G** much greater than in flask **F**;  
2. Showing use of ATP in flask **G**;  
3. Sodium ion concentration in flask **G** falls to zero;  
4. Showing uptake against a concentration gradient.    4

- (c) 1. (Uptake of sodium ions occurring by) facilitated diffusion;  
2. Equilibrium reached / sodium ion concentrations in solution and in cells the same.    2 [7]

**M10.** (a) Does not have the resolution / cannot distinguish between points this close together; As light has longer wavelength;  
*The key ideas in marking this part of the question are resolution and wavelength.*

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- (b) Lipid soluble / small / non-polar / not charged; 1
- (c) (i) Concentration of sodium ions (outside cell);  
As concentration / independent variable increases so does  
the rate of diffusion; 2
- (ii) Sodium ions are passing through the channels / pores at their maximum rate;  
Rate is limited by the number of sodium channels / another limiting factor; 2 [7]

**M11.**

- (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  
shivel;  
*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]

- M12.(a)** Variable that is changed;  
*Reject 'the variable that changes'* 1

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- (b) 1. Idea of a confounding variable;
2. (So) genetically similar;  
*2. Do not accept 'genetically identical / same DNA'.*
3. (So) have similar salt tolerance / response to salt water / response to watering treatment;
4. (So) have similar yield / mass of seeds;  
*Do not accept 'amount / number of seeds' or 'growth rate' 2 max*

(c) Mitosis;

*Ignore cell division* 1

- (d) 1. Irrigation with sea water / **C** / **D** increased yield compared with no irrigation / **A**;  
*For 'yield' accept 'mass of seed' throughout.*
2. Yield was lower when irrigated with sea water / **C** / **D** compared with fresh water / **B**;  
*Only penalise once for use of 'amount / number of seeds'.*
3. Yield was lower when watered with sea water throughout growth and seed formation / **C** than when watered with sea water just at seed formation / **D**;  
*Accept use of figures from table.*  
*'It' refers to watering with seawater / mixture. 2 max*

- (e) 1. Irrigation with sea water / **C** / **D** increases concentration of salt in soil;  
*Ignore reference to standard deviation / quality of the data.*
2. Lower water potential in the soil linked to reduced uptake of water;
3. Salt concentration in the soil might / might not increase in the future;  
*Mark point 3 includes the principle for mark point 1 so mp3 gains 2 marks (for mp1 and mp3)*
4. Might decrease plant growth / yield in the future;
5. Less food / fewer seeds for future planting;  
*Mp 3 and 4. Allow 'further' for the idea of 'in the future'. 3 max [9]*

- M13.(a)** 1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;
2. Facilitated diffusion does not use ATP / is passive whereas active transport uses ATP;
3. Facilitated diffusion takes place down a concentration gradient whereas active transport can occur against a concentration gradient.  
*Since 'contrast', both sides of the differences needed 3*

(b) 3.3:1.

*Correct answer = 2 marks*

*If incorrect, allow 1 mark for 470–360 / 60 for rate in second hour 2*

- (c) 1. Group **A** – initial uptake slower because by diffusion (only);



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2. Group **A** – levels off because same concentrations inside cells and outside cells / reached equilibrium;
3. Group **B** – uptake faster because by diffusion plus active transport;
4. Group **B** fails to level off because uptake against gradient / no equilibrium to be reached;
5. Group **B** – rate slows because few / fewer chloride ions in external solution / respiratory substrate used up.

4 max

[9]

**M14.** (a) 2 marks for correct answer 0.2

*Accept concentration ÷ time*

1 mark for 6 / 30; 2

- (b) 1. (Uptake) decreases / slower, then no further uptake / uptake stops;
2. (Decreases) to 20 - 22 / no uptake after 20 / 22 minutes;  
*Accept: (only) 1.6 (arbitrary units) absorbed / (only) drops to 8.4*  
*Is for correct use of data from graph* 2

- (c) 1. Stops / reduces / inhibits respiration;  
*Accept: inhibits respiratory enzymes*
2. No / less energy released / ATP produced;  
*Ignore: less energy produced / made*
3. (ATP / energy needed) for active transport;  
*Accept ref to Na<sup>+</sup> pump / description of active transport*  
*Ignore consequences of less Na<sup>+</sup> in cel* 3 [7]

**M15.(a)** 1. Antibody has tertiary structure;  
 2. Complementary to binding site on protein. 2

- (b) 1. Prevents false negative results;  
 2. (Since) shows antibody **A** has moved up strip / has not bound to any *Plasmodium* protein. 2

- (c) 1. Person is infected with *Plasmodium* / has malaria;  
 2. Infected with (*Plasmodium*) *vivax*;  
 3. Coloured dye where antibody **C** present;  
 4. That only binds to protein from *vivax* / no reaction with antibody for *falciparum*.

*Person is infected with P. vivax / Plasmodium vivax = 2 marks*  
*(MP1 and MP2)* 4 [8]

**M16.** (a)

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At telophase of mitosis	26;	30;
From a sperm cell	13;	15;

4

- (b) Cancer cells often have faulty / damaged DNA;  
 Protein / p53 faulty / not made;  
 Cell (with faulty / DNA) divides / completes cell cycle;

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Uncontrolled division produces cancer;

*p53 refers to the protein so do not accept reference to p53 mutating.* 3

- (c) (i) Interphase / S phase / synthesis phase; 1  
(ii) Anaphase / **A**; 1 [9]

**M17.(a)** Regulator protein.

*Accept regulator protein antigen*

*Reject regulator protein receptor*

*Ignore regular protein*

1

- (b) 1. Lipid soluble / hydrophobic  
2. Enters through (phospholipid) bilayer  
**OR**  
3. (Protein part of) LDL attaches to receptor  
4. Goes through carrier / channel protein.  
*4. Accept by facilitated diffusion or active transport*  
*4. Reject active transport through channel protein*

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein

*Do not award MP1 if reference to active site.*

2. Binds to / forms complex with (regulator protein)

*"It" refers to monoclonal antibody in MP1 and MP2*

3. (So regulator protein) would not fit / bind to the receptor / is not complementary to receptor

*3. Reject receptor on LDL*

2 max

(d) 1. Injection with salt solution

*1. Accept inject placebo in salt solution*

2. Otherwise treated the same.

2

[7]

**M18.(a)** (i) 1. (Tumour suppressor) gene inactivated / not able to control / slow down cell division;

*Ignore: references to*

Page 10<sup>growth</sup>

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2. Rate of cell division too fast / out of control.

*1 and 2 Accept: mitosis*

*1 and 2 Reject: meiosis*

2

(ii) 1. (Genetic) code degenerate;

*Accept: codon for triplet*

*Accept description of degenerate code, e.g. another triplet codes for the same amino acid*

2. Mutation in intron.

*Accept: mutation in non-coding DNA*

1 max

(b) 1. Antibody has specific tertiary structure / binding site / variable region;

*Do not accept explanations involving undefined antigen*

2. Complementary (shape / fit) to receptor protein / GF / binds to receptor protein / to GF;

*Ignore: same shape as receptor protein / GF*

3. Prevents GF binding (to receptor).

3 [6]

**M19.(a)** Has more than one / four polypeptide chains / made up of polypeptide chains; 1

(b) 1. Antibody / variable region has specific amino acid sequence / primary structure;

2. The shape / tertiary structure of the binding site is complementary to / fits / binds with these antigens;

*2. Do not accept active site for this point.*

3. Forms complex between antigen and antibody;

3 [4]

**M20.(a)** 1. Infected by / susceptible to (other) pathogen(s) / named disease caused by a pathogen (from environment);

*Context is where immune system cannot prevent or stop these events*

*Allow attack / kill*

2. Pathogen(s) reproduce / cause disease (in host);

*MPs not given in context of HIV*

3. Damage cells / tissues / organs;

4. Release toxins;

3 max

(b) (i) 1. (HIV enters cells) before antibodies can bind to / destroy it;

*Ignore SAFETY comments*

*1. and 2. Relate to antibodies*

2. Antibodies cannot enter cells (to destroy HIV) / stay in blood;

**OR**

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3. (Enters cells) before (secondary) immune response caused / before memory cells have time to respond;  
*3. and 4. Relate to virus*
4. So no antibodies present (to attack HIV);

**OR**

5. Vaccine taken up too quickly to cause immune response;  
*5. and 6. Relate to vaccine*
6. So no antibodies / memory cells formed; **2 max**

- (ii)
1. Antigen (on HIV) changes;  
*Accept mutates*
  2. (Specific) antibody / receptor no longer binds to (new) antigen;  
*Ignore SAFETY comments*

**OR**

3. Many different strains of HIV / many antigens present on HIV;
4. Not possible to make a vaccine for all antigens / vaccine may not stimulate an antibody for a particular antigen;

**2 max**

- (c) 3 suitable suggestions;;;;  
*QWC ignore reference to HIV cells*

E.g.

1. Inactive virus may become active / viral transformation;
2. Attenuated virus might become harmful;
3. Non-pathogenic virus may mutate and harm cells;
4. Genetic information / protein (from HIV) may harm cells;
5. People (may) become / test HIV positive after vaccine used;  
*Vaccinated people may develop disease from a different strain to that in the vaccine*
6. This may affect their work / life;  
*May continue high risk activities and develop or pass on HIV*

**3 max**

**[10]**

- M21.** (a) molecule / part of molecule / protein / glycoprotein / named molecule;  
that stimulates an immune response / eq;

**2**

- (b) divide by mitosis / form clones; produce plasma cells; (plasma cells)  
make antibodies;  
(plasma cells) produce memory cells;

**4**

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- (c) (i) glycoprotein AND  
different shape to body proteins / RNA and reverse transcriptase  
inside virus / phospholipids same as body's / on the surface  
of the virus; 1

- (ii) 187.5;;  
*Accept 187 – 188*  
*1 mark for HIV = 80nm;* 2 max [9]

- M22.** (a) divide by mitosis / form clones;  
produce plasma cells;  
(plasma cells) make antibodies;  
(plasma cells) produce memory cells;

4

- (b) glycoprotein;  
different shape to body proteins / body phospholipids are the same /  
located on the outside of the cell / the haemoglobin is located  
inside the cell;

2

[6]

- M23.(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]

- M24.(a)** Any **two** from:

1. (Decrease linked to) few(er) cases of whooping cough;
2. (Decrease linked to) risk of / fear of side effects;
3. Insufficient vaccine available / too expensive to produce /

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distribute.

3. *Too expensive unqualified is insufficient for mark*

2 max

- (b) 1. Vaccination rate increases;  
2. Fewer people to spread the disease / whooping cough / more people immune / fewer susceptible.

*2. Neutral – greater herd effect*

*2. Allow description of immune*

*Q Reject 'resistant'.*

2

- (c) 1. More people are immune / fewer people carry the pathogen;

*If neither point 1 or 2 awarded*

*Herd immunity = 1 mark*

*Unvaccinated does not mean infected*

*1. Q Do not accept disease for pathogen*

2. So susceptible / unvaccinated people less likely to contact infected people.

2

**[6]**