

Cell structure 2

Level: CIE A Level 9700

Subject: Biology

Exam Board: Suitable for all boards

Topic: Cell structure 2

Type: Mark Scheme

To be used by all students preparing for CIE Biology A Level 9700 foundation or higher tier but also suitable for students of other boards.

Mark schemes

- 1** (a) **A** – receptor /extrinsic (protein);
Accept glycoprotein/antigen
- B** – transmembrane/intrinsic/channel/carrier (protein);
Accept hydrophobic tail
- C** – phospholipid;
Ignore ref. to bilayer
- 3**
- (b) Cell wall;
Accept smaller/70S ribosome(s)
- Capsule/slime layer;
Accept DNA without histone
- (Bacterial) flagellum;
Reject capsid
- Circular DNA/chromosome;
- Plasmid;
- Mesosome;
- 2 max**
- 2** (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/transport/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]**



- 3**
- (a) (i) Ribosome(s); 1
- (ii) Plasma/cell (surface) membrane; 1
Accept membrane unless disqualify with, e.g. nuclear membrane
- (b) **Two** suitable comparisons, accepting bacterial cell has; 2 max
- Examples,
Bacterial cell has capsule/slime layer;
Cell wall;
(Bacterial) flagellum;
Mesosome;
Different size ribosomes;
Circular DNA;
Human cell has nucleus;
Membrane-bound organelles;
Two named examples of membrane-bound organelles;
Reject ref to thin and flat
- (c) Carry genetic information/genes; 1
Reject/ignore to carry DNA to carry genetic code
Accept genetic material with coded information –
information for protein synthesis
Ignore genetic material on its own
- 4**
- (a) (i) no cell wall / only has (plasma) membrane; 1
- (ii) has capsule / slime layer; 1
- (b) correct approach which makes use of scalebar; *ignore* reference to units. 1
- (c) cellulose / starch / amylose / amylopectin; 1
- (d) (i) water potential lower / more negative in cell;
(water enters by) osmosis; 2
- (ii) plant cell wall made of a different substance / cellulose / penicillin
does not affect cellulose; 1

[5]

[7]



5 (a) (i) Chloroplast; 1

(ii) Photosynthesis;
Uses light (energy);
To produce carbohydrates / starch / glucose / sugars / ATP / reduced NADP;
Note that candidates cannot be expected to have a detailed knowledge of photosynthesis. max 2

(b) (i) **A**; 1

(ii) **C**; 1

(c) (i) Slows enzymes / prevents enzymes being denatured / prevents / stops self-digestion;
Ignore references to bacteria. Reject enzymes not working 1

(ii) To remove organelle C / nuclei;
Which are larger / more dense; 2

[8]

6 (a) presence of nuclei; 1

(b) (i) 1 mark growth clearly calculated from difference between lengths at beginning and end of lesson
2 marks correct answer of 300 μm 2
(Allow for slight measurement errors)

(ii) divide by time (between measurements); 1

(c) blue-black / dark blue / purple / black;
iodine added to slide / specimen / granules; 2

[6]

7 (a) Measure diameter of field with ruler; And proportion taken up by the cell; or Measure length with (eyepiece) graticule / eyepiece scale;
Calibrated against stage micrometer / something of known length;
Reject divide apparent length by magnification 2



- (b) Membrane / cytoplasm shrinks / pulls away from cell wall / cell plasmolysed / goes flaccid;
Water moves down water potential gradient / to lower / more negative water potential; By osmosis; 3
- (c) (i) Reaches equilibrium / no further / maximum change in length;
Reject osmosis takes time 1
- (ii) Line / curve of best fit; Extrapolate (and read off) / find where it crosses x-axis; 2
- (iii) Greater decrease / length smaller; More water removed;
Greater difference in water potential / cell with higher / less negative water potential;
Starch is insoluble / has no effect on osmosis

max 2

[10]

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- (a) Any two from:
Loop of DNA; Non-cellulose cell wall;
Plasmid; Capsule;
Flagellum; Mesosome;
Accept small ribosomes 2
- (b) (i) (Granules) turn blue-black / dark blue / black / purple with iodine; 1
- (ii) Cellulose / pectin; 1
- (c) Use principle:
Feature of starch;
Consequence in terms of storage;
e.g.
Insoluble;
Therefore will not "wash" out of cell / affect water potential / affect osmosis;
OR
Molecule coiled / branched;
Therefore large amount stored in small space / compact
OR
Does not affect water potential;
So no effect on entry of water (into cell); 2

[6]



- 9** (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]**
- 10** (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; 2
- max 6**
- [13]**
- 11** (a) (i) Golgi; 1
- (ii) Exocytosis; 1



- (b) (i) Joining together of amino acids / synthesis / production of thyroglobulin / makes protein;
Do not credit synthesis of amino acids 1
- (ii) Electron microscope has high / greater resolution;
Because it uses electrons which have smaller wave(length); 2
- [5]

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- (a) Epithelium of alveolus, capillary wall / epithelium / endothelium, plasma; 1
- (b) Cell wall;
Capsule;
Flagellum;
Mesosomes;
Plasmid;
Genetic material / DNA / nucleoid;
Ribosomes;
Accept references to size only if some idea of range is given max 2
- (c) Large (surface) area;
For diffusion;
or
Short distance to centre of cell / to all haemoglobin;
For diffusion; 2
- (d) (i) Correct answer of approximately 7800 / 8000 = 2 marks
Incorrect answer but clearly derived by
dividing diameter of cell A by 7 = 1 mark 2
- (ii) Idea of cut through maximum diameter / middle; 1
- [8]

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- (a) (i) 31 / 31.2; 1
- (ii) Ratio would be less / smaller;
Cell is thin / has large surface area / (adapted) for diffusion;
Accept converse. Must relate to concept of ratio. 2
- (b) (i) 6; 1
- (ii) 11; 1



(c) Water potential inside vesicle more negative / lower;
Water moves into vesicle by osmosis / diffusion; 2

(d) Mitochondria supply energy / ATP;
For active transport / absorption against concentration
gradient / synthesis / anabolism / exocytosis / pinocytosis;
*Do not credit references to making,
creating or producing energy.* 2

(e) 1 Phospholipids forming bilayer / two layers;
2 Details of arrangement with “heads” on the outside;
3 Two types of protein specified;
e.g. passing right through or confined to one layer /
extrinsic or intrinsic /
channel proteins and carrier proteins /
two functional types
4 Reference to other molecule e.g. cholesterol or glycoprotein;
5 Substances move down concentration gradient / from high to low
concentration;
Reject references to across or along a gradient
6 Water / ions through channel proteins / pores;
7 Small / lipid soluble molecules / examples pass between phospholipids /
through phospholipid layer;
8 Carrier proteins involved with facilitated diffusion;
*Ignore references to active transport.
Credit information in diagrams.* max 6

[15]

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(a) On diagram, correctly labelled:
Light-dependent: granum / thylakoid membranes – labelled ‘X’
AND
Light-independent: stroma – labelled ‘Y’; 1

(b) Any two from:
(Water) forms H^+ / hydrogen ions and electrons / e^- ;
 O_2 / oxygen formed; [NOTO, NOTO⁻]
(Light) excites electrons / raises energy level of electrons / electrons to
chlorophyll / to photosystem; max 2



- (c) (ATP) Provides energy for GP → TP / provides P for RuP / TP → RuBP;
(Reduced NADP) Provides H / electrons for GP → TP / reduces GP to TP;

2

[5]

15

- (a) (i) A mitochondrion and B nucleus;
(*need both for one mark*)

1

- (ii) increased surface area;
for respiration / enzymes;

2

- (b) *any suitable feature*
e.g. plasmid / capsule / 70S ribosomes / smaller
ribosomes / complex cell wall / mesosome / no nucleus;

1

- (c) use of differential centrifugation / or description;
first / low-spin pellet discarded / spin at low speed to remove cell
wall material / cell debris;
supernatant re-spun at higher speed / until pellet with chloroplasts is found;
method of identifying chloroplasts e.g. microscopy;

3 max

[7]

16

- (a) 16 gains 2 marks;
(*accept 15.5 . 16.5*)
(*principal of calculation i.e.*
measured distance (31-33mm / 3.1-3.3cm) gains 1 mark)
Mag

2



- (b) relevant adaptation;
and explanation for second mark; e.g.

idea of many chloroplasts / lots of chlorophyll;
to trap or absorb light (energy);

elongated cells;
idea of maximum light absorption / light penetration;

chloroplasts move;
to trap or absorb light (energy);

range of pigments;
can absorb a range of wavelengths / colours / for max light absorption;

large S.A. or cell wall feature e.g. thin / permeable;
for (rapid) CO₂ absorption;

2

[4]

17

- (a) matrix;

1

- (b) pyruvate;
ADP;
P / inorganic phosphate;
reduced NAD;
oxygen;

2 max

- (c) larger surface area for electron carrier system / oxidative phosphorylation; provide ATP / energy for contraction;

2

[5]

18

- (a) (i) **D** plasmid / ribosome(s) / cytoplasm / storage granules;
(accept any sensible structure)

E (slime / mucous) capsule

OR

slime / mucous layer;

2

- (ii) protection / maintain shape / prevent lysis / strength / support;

1



- (b) two of the following:
nucleus;

OR

nuclear envelope / mitochondria / chloroplasts / sER / rER /
golgi apparatus / 80s ribosomes

linear DNA / chromosomes / lysosomes / vacuole / vesicles /
cellulose cell wall;

2 max

- (c) (i) starch digested / broken down;
by amylase / carbohydrase;

2

- (ii) any sensible suggestion e.g. no secretion of amylase /
functional amylase /
piece of fungus might have died;

(accept carbohydrase / enzyme for amylase)

(reject "no digestion" without qualification)

1

[8]

19

- (a) (i) homogeniser / blender / pestle and mortar / description
e.g. grind with sand;

1

- (ii) centrifuge / description e.g. spin at high speeds;

1

- (b) (i) chloroplast;

1

[3]

20

- (a) X protein synthesis / translation;
Y movement;

2

- (b) (i) cytoplasm;
ribosomes;
phospholipid membranes / cell membrane / semipermeable
membrane;

(accept folded membrane for two marks)

2 max



- (ii) *(it = bacterium)*
cell wall;
capsule;
flagellum;
mesosome;
no nucleus / nuclear membrane / DNA free;
no mitochondria;
(accept 'no membrane-bound organelles' if neither nucleus nor mitochondria mark scored)

no microvilli;
no Golgi;
no ER;
70S / smaller ribosomes;

2 max

[6]

- 21** (a) chloroplast, so cell photosynthesises and moves to optimum / best light intensity for photosynthesis;
avoids damage due to bright light;

2

- (b) (i) 2700

1

(ii)
$$\frac{242 \times 7500 \times 900}{60} = 27\,225\,000 / 27 \times 10^6 = 2 \text{ marks}$$

(allow 1 mark for principle: $\frac{\text{amino acids} \times \text{proteins}}{\text{time}}$)

2

- (c) (i) rate slightly slower / not affected in first 20 / 30 minutes / lower peak than control;
then decreases / much lower (than control);

(allow 1 mark for increase in first 20 / 30 minutes, then decreased, if not compared with control / normal)

(disqualify flagellum grows longer)

2

- (ii) 1. actinomycin has no effect (on growth of flagella);
even though mRNA production / transcription prevented;
(accept references to 'expt 1')
2. (re)growth little affected by puromycin at first;
protein synthesis inhibited, so likely to be using proteins present;

4

[11]



- 22** (a) A mitochondria;
B ribosomes (*accept ribosomes and rER*) 2
- (b) idea of sections or cuts;
idea of mitochondria orientated differently or in different positions / description of 3D structure of mitochondria, e.g. sausage-shaped; 2
- (c) translation / protein / polypeptide synthesis; 1
- (d) provide / produce energy or ATP (*reject create energy*);
(*disqualify first mark if ' for respiration*)
high respiration (rate) (*accept lots*) for active uptake / transport
(*accept description*);
absorption of digested food / substances / products / correctly named product
(*only accept monosaccharides, amino acids, dipeptides*); 3
- [8]
- 23** (a) A – granum / thylakoid;
chlorophyll molecules to trap light / light absorbing pigments /
light dependent reaction / part of light dependent reaction; 2
- B – stroma;
(contains enzymes for) carbon dioxide fixation / light-independent reaction /
part of light-independent reaction;
(*allow ribosome role of protein in photosynthesis*) 2
- (b) (i) C – starch; 1
- (ii) from glucose in a condensation / polymerisation reaction / many
glucose molecules joined together; 1
- [6]
- 24** (i) named organelle e.g. nucleus / nuclear envelope; vacuole;
chloroplast; RER; mitochondrion; no membrane bound organelles;
(*only award if no organelles named*)
(*reject ribosomes, cell membrane, cell wall*)

ref to large(r) size 2 max
- (ii) $94/95/96 \times \frac{10}{44/45/46} \frac{(\text{measured distance } \mathbf{Y} - \mathbf{Z})}{\text{length of scale bar}}$
20.4 – 21.8
(*correct answer 2 marks*) 2



- (iii) no cell wall (permanent) / (large) vacuole / chloroplasts / smaller;
(accept microvilli)

1 max

[5]

25

- (a) memory B / T cells do not recognise (new antigens);
antibodies previously produced are not effective
as shape not complementary to new antigen;

2

- (b) (i) antigen in membrane presented to lymphocytes /
produce cytokinins;

1

- (ii) mitochondria provide (more) ATP / energy;
(more) RER / ribosomes synthesise proteins;
(more) Golgi body secretes / modifies or packages proteins /
produces glycoproteins;
(B lymphocytes) produces antibodies;

4

[7]

26

- (a) (i) microvilli; (*reject brush border*)

1

- (ii) increased surface area (for diffusion);

1

- (b) (i) $\frac{16 \times (1000)}{0.1}$ / principle of $\frac{\text{measuring scale bar}}{\text{dividing by 0.1}}$;
(15 – 17 tolerance)

160000;

(correct answer award 2 marks)

2

- (ii) electron microscope has a greater resolving
power / objects closer
together can be distinguished;
electron (beams) have a shorter wavelength;

2

- (c) short diffusion pathway / short pathway to the centre / large SA:V ratio
for faster, more diffusion;

1

[7]



27

- (a) phospholipids in a double layer / area covered is twice total surface area of red blood cells;
evidence of calculation of number \times surface area ($4.74 \times 10^9 \times 99.4 \mu\text{m}^2$) /

calculation of area of 1 cell $\frac{0.92}{4.74 \times 10^{-9}}$;

$0.471 \text{ m}^2 \approx 0.5 \times 0.92 \text{ m}^2 / 194 \mu\text{m} \approx 2 \times 99.4$;

3

- (b) EITHER feature + explanation
red blood cells do not contain organelles / nucleus;
so only surface membrane / no internal membranes in macerate;
OR
red blood cells have simple / regular / spherical shape;
so easy to calculate surface area;
OR
any two features, e.g.
simple / regular shape;
all same size;

2

[5]



28

- (a) Nucleus; 1
- (b) Enables organism to remain in area (of food source) / prevent its removal;
Q To attach' is not sufficient unless qualified 1
- (c) (i) Correct answer of 222(%);;
Incorrect answer that clearly identifies difference in number of cases as 5800
–1800 or 5.8 – 1.8;
Correct answer gains two marks 2
- (ii) More water-related activities / more 'organisms' with increased temperature;
Q Allow any reference to growth or replication of 'organisms'. Do not penalise reference to bacteria.
Q Do not allow increase in water consumption. 1
- (d) (i) All have same shape / only binds to *Giardia* / one type of / specific antigen; 1
- (ii) Has complementary (shape) / due to (specific) tertiary structure / variable region (of antibody);
Q Binds / fits not sufficient unless qualified; 1
- (iii) Enzyme / second antibody would remain / is removed by washing;
Enzyme can react with substrate (when no antigen is present); 2

[9]

29

- (a) (Group of) similar / identical cells / cells with a common origin;
Q Ignore references to function 1
- (b) (i) Add iodine / stain specific for starch to the slide / cells / tissue / add iodine / stain specific for starch and examine under microscope;
Blue-black / blue / black / purple;
Reject sample 2
- (ii) Need a single layer of cells / only a few cells thick / not too many layers / detail obscured by cells underneath;
Light must be able to pass through; 2



(c) Both are polymers / made of monomers;

Joined by condensation / molecules can be broken down by hydrolysis;

Both have 1-4 links;

Contain C(arbon), H(ydrogen) and O(xygen) / both made up of glucose;

Both insoluble;

Both contain glycosidic bonds;

Accept other valid answers.

Ignore ref to unbranched.

2 max

[7]

30

Advantages:

1 Small objects can be seen;

2 TEM has high resolution as wavelength of electrons shorter;

Accept better

Limitations:

3 Cannot look at living cells as cells must be in a vacuum / must cut section / thin specimen;

4 Preparation may create artefact

5 Does not produce colour image;

[5]