## Microscopes

## Mark Scheme 1

| Level | International A Level |
| :--- | :--- |
| Subject | Biology |
| Exam Board | CIE |
| Topic | Cell Structure |
| Sub Topic | Microscopes |
| Booklet | Theory |
| Paper Type | Mark Scheme 1 |


| Time Allowed : | 65 minutes |  |
| :--- | :--- | :--- |
| Score |  | $/ 54$ |
| Percentage : | $/ 100$ |  |

Grade Boundaries:

| $A^{*}$ | A | B | C | D | E | U |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| $>85 \%$ | $77.5 \%$ | $70 \%$ | $62.5 \%$ | $57.5 \%$ | $45 \%$ | $<45 \%$ |

1 (a award two marks if correct answer within range 29000 to 31000 is given allow $\pm 3 \mathrm{~mm}$ in reading the line, e.g.

$$
\frac{90000}{3.0} \quad \frac{90 \times 10^{3}}{3.0 \times 10^{-6}} \quad \frac{9.0 \times 10^{-2}}{3.0 \times 10^{-9}}
$$

(×) $30000 / 3 \times 10^{4} ;$;
one mark if not rounded to nearest whole number one mark if a unit ( $\mathrm{mm}, \mu \mathrm{m}$ ) is given one mark if line is measured and given in mm or cm within accepted range and divided by $3.0 \mu \mathrm{~m}$ but incorrect conversion factor used for the line measurement or $3.0 \mu \mathrm{~m}$
(b)

| feature | identity | name |
| :--- | :---: | :--- |
| provides motility | F | flagellum |
| stores genetic <br> information | G | DNA; I any description, <br> e.g. loop of/circular <br> A chromosome(s)/nucleoid <br> R plasmid/chromatid |
| partially permeable | C | cell surface/plasma, membrane ; <br> A phospholipid bilayer |
| composed of murein <br> (peptidoglycan) | E | cell wall ; <br> R cellulose cell wall |
| site of translation | A | $(70 S / 18 \mathrm{~nm})$ ribosome(s) ; <br> R $80 \mathrm{~S} / 22 \mathrm{~nm} /$ larger, ribosome |

(c) A (double) membrane-bound organelles only if no examples given (true)
nucleus/nuclear envelope; A nuclear membrane I well-defined chloroplast; A grana/thylakoid(s) A plastid
(permanent) vacuole/tonoplast; $\mathbf{R}$ vesicles unqualified $\mathbf{A}$ lysosome
mitochondrion/mitochondria; A cristae
Golgi (body/apparatus/complex)/dictyosome; A Golgi vesicle(s)
rough endoplasmic reticulum/rough (ER)/RER ;
smooth endoplasmic reticulum/smooth ER/SER ; A endoplasmic reticulum, if RER and SER not given
nucleolus;
linear/AW, chromosomes; A DNA + histones
cellulose cell wall ;
starch grain/amyloplast ;
plasmodesma(ta) ;
larger/80S/22 nm, ribosomes;
(d) one mark for infected person with contaminated faeces, e.g.
faeces/sewage, contaminates (drinking) water/cooking utensils/vegetable plots/crops/food;
A diarrhoea for faeces
$\mathbf{R}$ (human) waste unqualified
A ref. to houseflies landing on contaminated faeces
one mark for uninfected person
eating contaminated food/using contaminated utensils/drinking contaminated water ;
A bacteria enters water in context of drinking
$\mathbf{R}$ infected food or water
I handling contaminated food
A faecal-oral route for two marks
(e) pathogen is at most vulnerable when in transfer between hosts/AW ;

A idea of breaking the transmission cycle
2 max for the following control methods:
sewage treatment/ (effective) sanitation/correct ref. to positioning of latrines ;
do not use human faeces for fertiliser ;
piped / treated/boiled/chlorinated/purified, (drinking) water ;
A sanitised / clean, water
I cooking refs.
A water treatment with UV/ozone
bottled water ;
water treatment plants upstream of sewage disposal ;
(to reduce pool of infected people) antibiotics or oral/intravenous, rehydration (therapy) ;
A ORT
(a (i) A - endothelial/squamous/epithelial (cell);
B-nucleus ;
(ii) $7(\mu \mathrm{~m})$;;
award two marks if correct answer given
award one mark if not rounded to nearest whole number
award one mark if given incorrect unit
if no answer given, award one mark if correct measurement
(38-41/3.8-4.1/38000-41000) is divided by 5700
(iii) for two marks - one structure and one function
only two functions = 1 mark
only two structures $=1$ mark
1 (capillary) wall is, thin/single layer of cells/one cell thick ;
A endothelium/epithelium for wall
2 short diffusion, pathway/distance/AW ;
$\mathbf{R}$ 'easy' diffusion
3 (many have) endothelial pores/fenestrations/gaps/spaces/openings ;
4 to allow named, substance/cell, to leave the blood ;
A idea of separation/selection, of named substance(s) by size
5 small diameter/small lumen/diameter of red blood cells;
6 slows down flow of red blood cells/(capillary/blood) close to cells ;
7 (capillaries have) large, surface area/surface area to volume ratio ;
8 idea that allows more exchange ;
Ignore faster exchange
(b) white blood cells

1 (named) white blood cells can, leave capillaries/enter tissue fluid ; A diapedesis/(suggestion that some) too large to leave the, blood/capillaries
2 high number in, lymph nodes/thymus/bone marrow/spleen; A stored/produced

## glucose

3 small (molecule) ;
4 filtered/diffuses/leaves/leaks, from blood/from capillaries/into tissue fluid;
5 taken up/used, by cells in respiration ; Ignore supply
protein
6 too large to, leave capillaries/enter lymph/enter tissue fluid ;
7 (in lymph / tissue fluid) antibodies/proteins, from/secreted by, lymphocytes/other cells;
(c) accept hydrogen carbonate (ions)/bicarbonate (ions)/ $\mathrm{HCO}_{3}^{-}$penalise $\mathrm{HCO}_{3}$ once only 1 carbon dioxide, reacts/combines, with (terminal amine/ $\mathbf{N}$ terminal, of) haemoglobin ;
$\mathbf{R}$ carried by/reacts with, haem
2 to form carbaminohaemoglobin ;
3 carbonic anhydrase catalyses, formation of carbonic acid $\left(\mathrm{H}_{2} \mathrm{CO}_{3}\right)$ /reverse reaction described (in the lungs) ;
4 (carbonic acid dissociates to) $\mathrm{HCO}_{3}^{-} / \mathrm{CHO}_{3}^{-} /$hydrogen carbonate (and $\mathrm{H}^{+}$) ;
5 hydrogen carbonate/ $\mathrm{HCO}_{3}{ }^{-}$, diffuses/moves/AW, out (into plasma) ;
(a A nucleus;

| A (eu)chromatin | $\mathbf{R}$ nucleolus |
| :--- | :--- |
| A mitochondria |  |
| A (R)ER | $\mathbf{R}$ smooth $/ \mathrm{S}$ |

B mitochondrion;
C (rough) endoplasmic reticulum ;
A (R)ER
R smooth/S
(b) (i) protein/polypeptide, synthesis/AW; A protein, transport/modification

A ecf if $\mathbf{C}$ is identified as Golgi or SERor ribosomes in $\mathbf{1}$ (a)
(ii) ignore refs to magnification
resolution/resolving power, low(er) ; ora
200 nm compared to 0.5 nm ; A resolution quoted in range 100-300 to 0.2-1.0 nm
ref. to visibility of structure $\mathbf{C}$; e.gs.
wavelength of light longer than size of, ribosomes/membrane
ribosomes/membrane, cannot be seen as less than 200nm diameter
ribosomes only 20-30 nm diameter A 15-20 nm
membranes 7-10 nm thick
small size linked to explanation of resolution
[2 max]
(c) any one relevant disadvantage e.g.
only dead specimens can be viewed;
mounted in vacuum/pre-treatment, may distort delicate structures; A artefacts
expensive, qualified ; e.g. to buy, maintain, increased cost electricity, costs associated with, time/training
requires, more electrical power ;
requires stable, high voltage supplies/currents;
sensitive to external magnetic fields ;
difficult to operate/requires technical training;
samples more difficult to prepare ; A examples e.g. thin sections
lengthy preparation time ;
monochrome/black and white only ;
not portable/can only be used in specific locations (e.g. with voltage supplies) ; [1 max]
(d) allow +/- 1 mm in reading the line award two marks if correct answer is given
$20000 / 6 \mu \mathrm{~m}=(3333.3) \quad$ A $19000 / 6=(3166.7) \quad$ A $21000 / 6=(3500.0)$
$3333(x) ; ; \quad 3167(x) \quad$ A $3500 n(x)$
award one mark if answer is given to one or more decimal places or award one mark if correctly measured and divided by $6 \mu \mathrm{~m}$ but incorrectly converted [2 max]
(a) electron microscope accept ora for light microscope
1 higher resolution / better resolving power;
A high only if further detail confirms understanding
2 more easily able to distinguish between two (separate) points / AW;
A if no comparative but mp 1 or relevant point in mp 3 gained
3 AVP; able to see points closer together than 200 nm A range $100-300 \mathrm{~nm}$ can see points up to $0.5 \mathrm{~nm}(0.0005 \mu \mathrm{~m})$ apart but LM is $200 \mathrm{~nm}(0.2 \mu \mathrm{~m})$ A range $0.2-1.0 \mathrm{~nm}$
electrons have shorter wavelength (than light)
wavelength of electrons shorter than size of additional structures seen
[max 2]
(b) each feature must be briefly qualified to gain max 3 penalise once if feature correct but not correctly qualified / or not qualified
detail of mitochondria; e.g. inner membrane / crista(e)
double membrane
ribosomes
(circular) DNA
2 detail of chloroplasts; e.g. double membrane internal membranes thylakoid(s) / grana / intergrana / lamellae ribosomes
ribosomes, qualified; e.g. visible as small dots
scattered throughout / in cytoplasm on RER

4/5 endoplasmic reticulum / ER, qualified; e.g. smooth and rough / membranous / throughout cytoplasm

Golgi vesicles / secretory vesicles / lysosomes qualified;
e.g. forming from Golgi
ref. exocytosis (not for lysosomes)
seen as (small) sacs / AW
membranous
heterochromatin darker staining / euchromatin lighter staining;
A chromosomes seen as heterochromatin and euchromatin
8 nucleus has, nuclear envelope / two membranes;
9 nuclear pores in nuclear envelope;
10 cell surface membrane, qualified; e.g. to the inside of the cell wall
11 idea that (cell) membranes are visible, qualified; e.g. thin / round / within organelles /
(c) award two marks if correct answer is given, only one mark if $\mu \mathrm{m}$ (units) given
$\times 1600 ;$;
A in range of $\times 1400$ to $\times 1800$
(8 $000 / 5 \mu \mathrm{~m}$ )
$7000 / 5 \mu \mathrm{~m}=(1400)$
$9000 / 5=(1800)$
award one mark if correctly measured and divided by $5 \mu \mathrm{~m}$ but incorrectly converted award one mark if incorrect measurement (e.g. whole cell) but correct formula used (i.e. divided by $5 \mu \mathrm{~m}$ )
(d) (i) 1 amylopectin branched / AW; ora

2 amylose, spiral /spiralled / helix / helical; ora
$\mathbf{R} \alpha$-helix
$\mathbf{R}$ coiled
allow ecf from mps 1 and 2 to award mp 3
3 amylose ( $\alpha$ ) 1-4 linkages but 1-4 and 1-6 linkages in amylopectin / amylose has 1-4 linkages only;
accept from clearly labelled diagram(s)
(ii) any one valid; e.g.

1 for chlorophyll, structure / synthesis / formation / AW
2 for ATP functioning A required for energy transfers
3 for enzyme, functioning / cofactor
4 signalling ion / regulates carbon fixation
5 for, DNA / RNA, synthesis
6 stabilises, DNA / RNA, structure
7 required in, translation / joining, small and large subunits (of ribosomes)
[Total: 10]
(a)

1

2

| transport of water and mineral ions ; A minerals |
| :--- |
| elongated cells / cells end to end <br> (to form) <br> tubes for transport ; A (e)long(ated) tubes for transport |
| no, end / cross, walls or end / cross, walls broken down <br> so <br> minimal resistance to / unimpeded / free, flow of water ; AW <br> hollow / no cytoplasm / no contents / no organelles / empty, ignore dead <br> so <br> more space for greater volume to flow / greater volume per unit <br> or <br> minimal resistance to / unimpeded / free, flow of water ; AW <br> cellulose lining A cellulose walls <br> so <br> hydrophilic / adhesion of water molecules / for movement of water up stem / to <br> maintain column of water / AW ; <br> A hydrophilic lining, for movement of water up stem / to maintain column of water <br> lignified (walls) / walls contain(s) lignin A thickened walls <br> $\mathbf{R}$ lined with lignin <br> so <br> prevents (inward) collapse / withstands negative pressure <br> $\mathbf{R ~ p r e v e n t s ~ b u r s t i n g ~}$ <br> lignified (walls) / walls contain(s) lignin A thickened walls <br> $\mathbf{R}$ lined with lignin <br> so <br> waterproof / prevents loss of water / prevents leakage / maintains column <br> additional ref. to lignin ; e.g. for support of plant <br> spiral / annular, thickening allows elongation (of stem) <br> for support of plant <br> (relatively) wide to transport maximum volume of water <br> pits / pitted walls <br> to <br> allow, sideways / lateral, movement (of water) <br> or to connect to all parts of plant / AW ; |

[max 5]
(b) look for ora

1 can observe living tissue ; A observing processes (e.g. like mitosis)
2 ref. portability ; e.g. ref. to size, easy to move, no requirement for special room (e.g. vibration-free )

3 ease of use, qualified ; e.g. no technical training required, slide preparation easier, takes less time

4 see (actual / natural / real-life) colour ;
5 ref. to, differential staining / staining particular types of tissue ;
6 fewer problems with artefacts ;
7 lower cost of, purchase / maintenance / running / AW ;

