CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9700 BIOLOGY

9700/22 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Mark scheme abbreviations:

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the question, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore
AVP	alternative valid point (examples given)

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1 **(a)** 1.4 mm ; ;
two marks for the correct answer
A 1.3 / 1.34 / 1.37 / 1.43 / 1.46 / 1.5

tolerance on measurement of 49 mm = ± 2 mm (i.e. 47 to 51 mm)

if answer not given or incorrect allow one mark for correct measurement and correct use of formula (measurement divided by the magnification of 35 ***or*** *showing the rearranged formula)* [2]

(b) 1 large / wide, lumen (relative to thickness of wall) ;
A artery narrow lumen

2 irregular shape ; AW
A flattened / oval / not round(ed) (shape) ;
A artery, round(ed) / regular (shape)
I ref. to (vein) not spherical / artery spherical

3 thin / AW, tunica media / middle layer / (smooth) muscle and elastic layer
or
(proportionately) less, elastic / (smooth) muscle, in, tunica media / middle layer ;

4 (relatively) thin, tunica externa / tunica adventicia / outer layer / fibrous coat / fibrous layer ;
R small(er)

5 tunica intima / tunica interna / inner layer / endothelium, smooth / not 'crinkly' / not wavy / AW ;

alt *if mp 3 not awarded, award 1 mark only for*
thin (smooth) muscle layer / less (smooth) muscle }
thin elastic layer / less elastic tissue } [max 3]

(c) **(i)** short distance for diffusion (of molecules / ions / named) ;
A reduced distance / thin / short pathway / AW

increased rate / AW, of diffusion (of molecules / ions / named) ;
A fast(er) / (more) efficient
I easy / better [max 1]

(ii) 1 small size allows contact with (many body) cells / AW ;
A *idea of* extending into small spaces

2 red blood cell, close to, (body) cells / tissue for (efficient), diffusion / AW ;
A in contact with / close to, capillary wall / endothelium, for diffusion

3 red blood cells / blood flow, slow(s) down / *idea of* more time,
for (efficient) diffusion / cells to obtain sufficient nutrients / AW ;
treat ref. to lower pressure as neutral

4 (plasma / blood, containing), glucose / nutrients / named nutrient / oxygen,
close to / AW, body cells ; [max 1]

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(d) (i) *(produce genetically identical daughter epithelial cells for)*

1 (for tissue) repair ;
R cell repair

2 *idea of* replacing, dead / destroyed / damaged / worn-out / AW, cells ;
A replacement of cells, unqualified *if mp 1 gained*

3 ref. protection of, underlying tissue / muscle and elastic layer / tunica media / AW ;

4 meiosis produces, haploid cells / cells with n chromosomes / cells with one set of chromosomes ;
A cells with half the number of chromosomes

5 meiosis for gamete formation ;
A sex cells
R meiosis in gametes [max 2]

(ii) *ignore ref. to 23/46 chromosomes*

(mitosis to), maintain genetic stability / produce genetically identical cells / produce clones ora
or
meiosis produces genetically different cells ;

(mitosis), ensures cells retain function / cells function as tissue / AW ;
(mitosis) maintains chromosome number ;
A maintains, diploid number / 2n
meiosis produces, haploid cells / cells with n chromosomes / cells with one
A cells with half the number of chromosomes
meiosis for gamete formation ;
A sex cells
R meiosis in gametes [max 2]

(e) *ignore labels*
max 1 if nuclear, membrane / envelope, shown
no marks if chromosomes with two chromatids drawn

1 four separate, chromatids / daughter chromosomes, shown in each half ;

2 all centromeres leading
A 'V' shapes if centromere not obvious *(point of V towards pole)*
or
all centromeres attached to spindle fibres ; [2]

[Total: 13]

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2 (a)

Keratin and chitin have structural functions

cellulose ;
collagen ;

allow <u>only one</u> incorrect molecule to be listed for max 1

Keratin is a fibrous protein

collagen ;

no marks if other molecules given

The monomers of chitin have β-1,4 linkages between them

cellulose ;

no marks if other molecules given

Keratin and chitin contain nitrogen

collagen / haemoglobin ; *1st mark*
mRNA ; *2nd mark*

allow <u>only one</u> incorrect molecule to be listed for max 1

[max 5]

(b) (i) 47.5 ˚C ; [1]

(ii) *accept activity for relative activity throughout*
accept manipulated data quotes and penalise once for, incorrect / no, units

Fig. 2.2 (relative activity of enzyme at different temperatures)

1 as temperature increases, activity increases up to, optimum / 47.5 ˚C (*allow ecf from* **(i)**, then decreases ;
A peaks (*for increase then decrease)*

2 activity increases from 30 ˚C to 47.5 ˚C, then decreases to 70 ˚C ; *also mp 1*
or
increase <u>or</u> decrease, described with comparative data (*activity and temperature compared with another activity and temperature*)

3 at higher temperatures (compared to most others) enzyme still active ;

4 high optimum temperature (compared to most other enzymes) ;

Fig. 2.3 (stability over time for enzyme maintained at different temperatures)

5 enzyme becomes less stable over time ;
A activity decreases over time
A description if at least two temperatures described

6 data quote to support ; *activity at two times for any one temperature*
if time 0 or 'start', then assume 100% relative activity
if 100%, assume time 0

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7 (over the time period) the lower the temperature, the more stable the enzyme ; ora
A enzyme has higher activity at the lower temperatures
A stated temperatures (at least two) to illustrate the point
e.g. 28 ˚C higher activity than 40 ˚C throughout
A 28 ˚C, highest activity / enzyme most stable (throughout)

8 data quote to support ; *temperatures and (relative) activity (with one time)*

discussion points

9 AVP ; ;

10 *e.g. Fig 2.2*
reason for increasing activity up to optimum / decrease after optimum
e.g. ref. collisions, kinetic energy increase e.g. denaturation at 60–70 ˚C
R denaturation at 50 ˚C (but **A** denaturation begins)
suggested reason for higher optimum temperature e.g. more bonds

Fig. 2.3
(suggests that) more molecules become, denatured / inactive, as time progresses
greater stability / higher activity, at 40 ˚C than 37 ˚C between 40–50 hours

Fig. 2.2 and 2.3
optimum temperature for activity not most stable temperature
steep decrease in stability at 60 ˚C in a short time as (nearly complete) denaturation occurs *allow once only*
commercial application e.g. if hydrolysis occurs over a longer time period, better to use a lower temperature than optimum [max 5]

[Total: 11]

3 (a) 1 large (size / volume / organism) ;
A multicellular / many cells
A larger

2 (so) small(er) / low, surface area : volume ;
as size increases, SA:V decreases = 2 marks

3 diffusion (alone), not enough / too slow (to supply needs) ;

4 explanation ; e.g. surface too far from, centre / AW, of plant
distances too far to supply required, nutrients / substances
requires, supplies in bulk / mass flow

5 (so require) xylem and phloem, qualified ;
e.g. transport in different directions
xylem transports water (and mineral ions) and phloem transports, assimilates / photosynthates / sugars / amino acids [max 3]

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(b) (i) *cell **A*** = companion cell
A companion ;
*cell **B*** = (phloem) sieve tube element
A sieve tube, sieve tube cell [1]

(ii) *allow ecf from* **(i)** *for incorrect names of cells*
*cell **A** / companion cell*

1 mitochondria for, aerobic respiration / oxidative phosphorylation / ATP, production / AW ;
R ATP energy
A release / supply, ATP / energy (for the cell)
treat as neutral cell B also has mitochondria

2 RER / many ribosomes, for, polypeptide / protein, production ;
if mps 1 and 2 not given, one mark for mitochondria and, ribosomes / RER

3 ref. nucleus and, genes coding for (required) proteins / synthesis of ribosomes
or
nucleolus synthesises ribosomes ;
*cell **B** / sieve tube element*

4 (at least) one main structural feature ;
R hollow
peripheral cytoplasm / AW e.g. pushed against walls
no nucleus / no RER / no vacuole / no Golgi / few organelles / reduced ER / few mitochondria
R no organelles

5 (to) minimise / reduce, resistance to (mass) flow ; AW
e.g. uninterrupted flow / more efficient transport of sucrose

6 (so) maximum volume transported (/unit time) ;
A *idea of*

7 sieve plates, qualified ; e.g. stop bulging
allow mass flow / reduce barrier to flow
become plugged with, P-protein / callose, to prevent losses / after damage

8 no plasmodesmata (*as on Fig. 3.1*) to maintain pressure
or
plasmodesmata (*not shown*) for diffusion of sucrose into sieve tube / AW ; [max 5]

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(c)

	transport system in mammals	*transport system in plants*
1	arteries, veins, capillaries **A** delivery to cells by arteries and capillaries	xylem and phloem ; **A** vascular bundle
2	heart / pump	no heart / no pump / (xylem and phloem) have different mechanisms for (mass) flow ; **A** transpiration pull in xylem / pressure gradients in phloem
3	double circulation	no double circulation / xylem unidirectional flow / phloem source to sink / AW ; **R** single circulation
4	closed circulation	not closed circulation / pits / plasmodesmata ; **A** open
5	one (circulatory) system / water and organic molecules transported in same vessels / AW	two (separate) systems / water transport in separate vessels to organic molecules ;
6	(all) living cells	living and dead cells ; **A** dead cells in xylem
7	transports, (respiratory) gases / oxygen / carbon dioxide	respiratory gases not transported ;
8	transports glucose *accept within correct list*	(phloem) transports sucrose ; *accept within correct list*
9	faster rate of flow	slower rate of flow ;
10	rate of flow controlled by, nervous system control of heart / action of heart / vasoconstriction and vasodilation / AW *accept ref. endocrine system*	rate of flow, not controlled by nervous system / (in xylem) controlled by external factors / (in xylem) controlled by transpiration rate ;
11	components include blood cells	cells not transported / AW ;
12 13 14	AVP ;;; homeostasis involved / concentration of dissolved substances controlled ref. to defence e.g. immune system e.g. blood clotting organ-based valves present	no homeostasis / AW ; no equivalent to immune system callose formation ; tissue-based ; no valves ;

[max 4]

[Total: 13]

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4 (a) (i) *penalise once if the term genetic material is used instead of DNA*

1 no nuclear envelope / no (true) nucleus ;
A no nuclear membrane
A no nucleus envelope
A DNA free in cytoplasm ora
A DNA as nucleoid

2 DNA, loop / circular ;
A DNA not linear

3 DNA, not in chromosomes / DNA not associated with, histones / proteins ;
A naked DNA

4 no nucleolus ;

5 (presence of) plasmids ;

6 (only) have, 70S / small / 18–20 nm, ribosomes ;

7 presence of, capsule / slime layer ;

8 ref. small (cell) size / less than 5 μm / (only) 1 μm ;
A ora for eukaryotes [max 3]

(ii) *plant cell*
cellulose ; *treat as neutral ref. to microfibrils / fibres*

bacterial cell
murein / peptidoglycan ;
A peptoglycan / polysaccharide and amino acid [2]

(b) 1 cell contents shrink / cytoplasm shrinks ; AW
R cell shrinks *unless clear that the cell wall remains, intact / same size*

2 cell (surface) membrane / plasma membrane, peels away / AW, from cell wall ;
A plasmolysis occurs **/** cell becomes flaccid

3 (movement of) water out by osmosis ;
4 down water potential gradient / from high to low water potential / to lower water potential /from less negative to more negative water potential ;
A ψ for water potential [max 3]

(c) 1 (mutation involves) change in sequence of, bases / nucleotides (of DNA);
A (mutation leads to) altered, mRNA / codons
A change leads to new alleles
(genes code for, polypeptides / proteins, so)

2 different, protein structures / proteins, possible / synthesised ;
A different, primary / tertiary / 3-D, structure

3 (so) range of / different, functions possible / AW ; [max 2]

[Total: 10]

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5 (a) *max 2 if no examples from passage given*
population

1 all individuals / all organisms / AW, of,
Trichophilus welckeri
three-toed sloths / *Bradypus variegatus*
one / a, species of roundworm
one / a, species of insect *any one* ;
one / a, species of saprotrophic fungi
one / a, species of algae
A one (particular), species **/** kind / type
I e.g. the roundworms etc.
treat as neutral same organisms

2 *idea of* in, an (specified) area / AW ; e.g. place / habitat e.g. (sloths) in the, forest / trees (at one time)in central / south America
in the sloth's fur / on the sloth

3 at the same time ; *allow once only*

4 (named organisms) share same gene pool / ref. isolated from other populations (of the same species) ;
community

5 all populations of all species / all organisms / AW, living in a (particular) area / AW ;

6 examples ; all the organisms living on the sloths fur
or
roundworms, insects, fungi, algae, on sloth's fur/ in same area
in second example do not need ref. to fur or area if mp 5 given

7 at, the same / one, time ; *allow once only* [max 4]

(b) 1 has biotic and abiotic components / biological and physical components ;
A living and non-living components

2 described by use of examples from text ; e.g. water and organisms
A fur as an abiotic factor

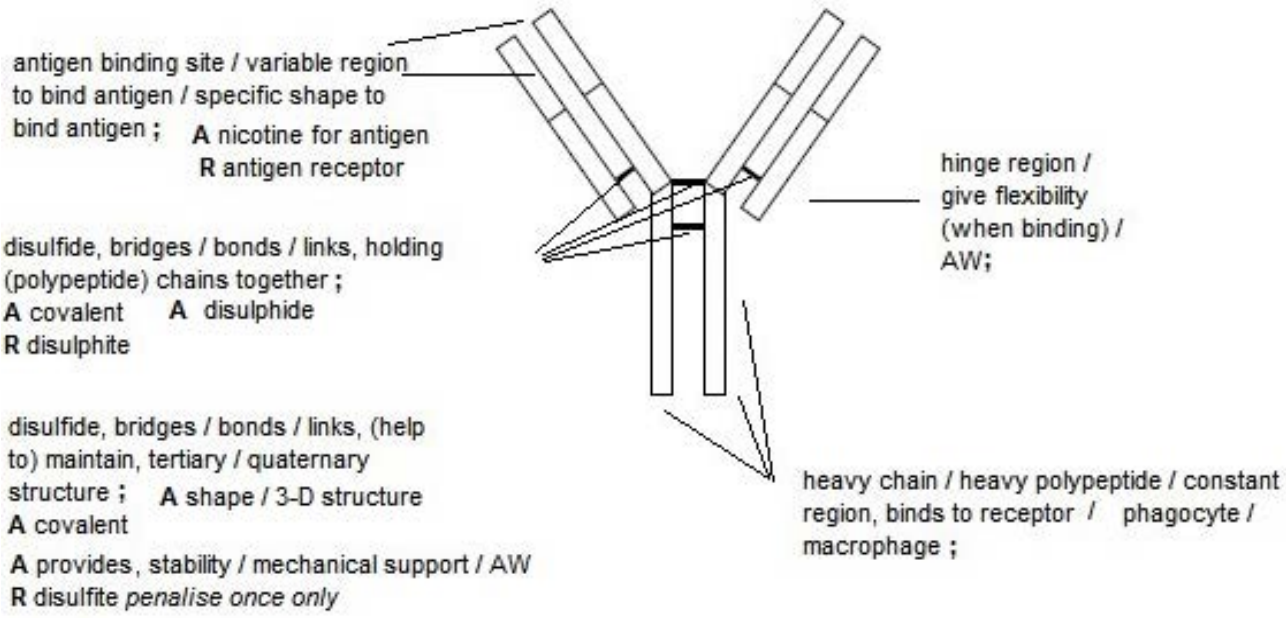
3 ref. energy flow / nutrient cycling ;
A described e.g. food web, algae as producers, fungi as decomposers
A food chains *look for at least one link*

4 ref. interactions / functional entity ; AW e.g. self-contained / self-sustaining / inter-relationships [max 3]

[Total: 7]

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6 **(a)** *labels to correct areas, mark to max 3*



AVP ; e.g.
light and heavy polypeptide chain, ref. forming variable region / different primary structure(s) giving different shapes ;
heavy / polypeptide, chain constant region gives antibody class ; AW [max 3]

(b) **1** increases heart rate ;
A heart, pumps / beats faster

2 increased blood pressure **/** hypertension ;

3 damage to, endothelial / arterial, lining ;
A damage to, tunica intima / lining of veins

4 (so) contributes to plaque / atheroma ;
A atherosclerosis

5 vasoconstriction
or
constricts / reduces diameter of, arterioles / blood vessels ;
A more resistance to blood flow *must be in context*

6 reduced blood flow to extremities / AW ; [max 3]

[Total: 6]

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