UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9700 BIOLOGY

9700/21 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 must be read in conjunction with the question papers and the report on the examination.

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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

1 **(a)** pulmonary artery ; **A** pulmonary arteries [1]

(b) phagocyte / macrophage ;
A neutrophil / polymorphonuclear leucocyte **R** PMN
R leucocyte / white blood cell unqualified
R any incorrect qualification [1]

(c) B-lymphocyte / (effector) B (cell) / plasma (cell) ; **R** lymphocyte alone
R effector cell unqualified [1]

(d) goblet (cell) ; [1]

(e) cartilage ; ignore plates / rings [1]

[Total: 5]

2 **(a)** **1** electron microscope has, higher / AW, resolution (than LM) / ora ;
2 explanation of resolution as ability to differentiate between two points (close together) ;
3 ref. to (internal) membranes (of **A** and **B**) which cannot be seen in LM ;
A named membranes e.g. cristae, grana
4 AVP ; e.g.
(resolution of) EM is 0.5 nm (0.0005μm) and LM is 200 nm (0.2μm)
A 0.5 to 1 nm (0.001μm)
resolution is equal to half the wavelength (of medium used)
ref. to shorter / AW, wavelength (of electrons) / ora (must have a comparison)
ref. to, width of membranes / distance apart of membranes, e.g. width of membranes in A and B is 7 nm (+/– 1) [max 3]

(b) **C** – rough endoplasmic reticulum ; *penalise once only for ER instead of endoplasmic reticulum*
D – ribosome ; **A** ribosomes ignore 70S
E – smooth endoplasmic reticulum ; **A** smooth ER *if full term used for* ***C***

award one mark if ***E*** *= rough endoplasmic reticulum and*
C *= smooth endoplasmic reticulum* [3]

(c) *any one relevant e.g.*

store of / holds, cell sap ; **R** if contains organelles
store of / holds, water / ions / named ion(s) / minerals / salts / pigments / (named) sugars ;
R substances / molecules
R storage unqualified
pushes chloroplast to edge of cell ;
gives, turgidity / turgor pressure / hydrostatic pressure / support / AW ;
A makes, firm / rigid
A controls / maintains, turgidity
R gives shape / strengthen
store of / holds, waste (products)

R reactions occur in vacuole, unqualified [1]

(d) *no marks for identifying* ***F*** *and* ***G***
if only ***F*** *or* ***G*** *described max 3*
if ***F*** *and* ***G*** *incorrectly identified, accept mark points correctly linked to membrane and wall to max 3*

1 **F** partially permeable A selectively permeable
and **G** (fully / freely / AW), permeable / porous ;

F *is partially permeable cell surface membrane*
2 phospholipid (bilayer);
3 permeable to, lipid-soluble molecules / oxygen ;
A other terms for lipid-soluble
treat reference to water as neutral
4 impermeable to, water-soluble / AW, molecules / ions / AW ;
A other terms for water-soluble
treat reference to water as neutral
5 aquaporins / proteins, provide (increased) permeability to water ;
6 transport proteins provide permeability to, ions / polar molecules ;
A channel / pore / carrier, proteins

G is permeable cell wall
7 cellulose ;
8 fibres ;
9 ref. to, spaces / gaps / holes / pores, (between, fibres / other cell wall components) ; [max 4]

(e) **1** allows transport of, water / sucrose / amino acids / organic substances / ions /minerals / salts / lipids / hormones / ATP, (from cell to cell / between cells) ;
R if linked to an incorrect transport mechanism e.g. sucrose moves by osmosis
2 without crossing, membranes / walls ; **A** without going through protein channels
3 this is movement through the symplast ;
4 any e.g. ; companion cell to (phloem) sieve tube (element / cell)
between mesophyll cells
mesophyll cell to companion cell
cortical cell to cortical cell / across cells of the cortex
cortical cell to endodermal cell
endodermal cell to, pericycle cell / xylem / phloem
ignore between sieve tube elements
5 allows, communication / signalling, between cells ; [max 3]

[Total: 14]

3 **(a)** **(i)** *no mark if no units used at all*
L – 3.6 kPa ; *award the mark if units only used once*
M – 4.5 kPa ; **A** in range 4.45 to 4.55 [1]

(ii) *ignore any similarities*
1 to the right / lower (affinity) / qualified ; e.g. lower percentage saturation
2 at, higher / lower, partial pressures, small(er) difference in percentage saturation (than others) ; **A** ora
3 comparative data quote ; *must refer to **L** and **M***
allow ecf from (i) [3]

(b) **1** at partial pressures in the tissues ; *where oxygen is unloaded from Hb*
2 haemoglobin is less saturated (than **L**) ;
3 because, haemoglobin / Hb, dissociates more readily ;
A idea of unloading oxygen more readily *even if Hb not mentioned*
4 to compensate for, fewer / less effective, red blood cells / Hb ; [max 3]

(c) **1** haemoglobin less well saturated (in lungs at high altitude) ;
2 data quote from Fig. 3.1 ; **A** 80–90% saturated at 'about 7.5 kPa'
3 produce more red blood cells / increase in number of RBCs ;
4 more haemoglobin ;
5 *idea* of compensates for, smaller volume of oxygen absorbed / lower saturation (of haemoglobin) ;

also accept the following adaptations
6 increase in haematocrit / AW / decrease in plasma volume ;
A increase in RBCs per unit volume
R decrease in blood volume
7 increase in, breathing rate / tidal volume / heart rate / stroke volume ;
8 increase in, capillary density / number of mitochondria / myoglobin / respiratory enzymes, in muscle ;
9 ref. to (increased) secretion of, erythropoietin / EPO ;
10 increase in (2,3), BPG / DPG, in red blood cells ; **A** rightward shift in curve [max 4]

(d) **1** not caused by (named type of) pathogen / non-infectious / non-transmissible / non-communicable / AW ;
2 genetic / inherited / AW, disease ; **A** caused by a mutation / AW
A 'passed down from parent(s)'
R idea of congenital diseases
R 'you get it from your mother'
3 ref. to, no immune response / no antigen(s) ;
4 affects all red blood cells so vaccine would lead to their destruction ; [max 2]

[Total: 13]

4 **(a)** *this can be answered in the context of penicillinase*

1 complementary shape ;
2 substrate, fits into / enters / binds to / with, active site ;
A enzyme-substrate complex / ESC
3 ref. to specificity ;
4 lock and key / induced fit ; **A** description of induced fit
5 ref. to temporary bonds form with, active site / R groups (of amino acid residues) ;
[max 3]

(b) *shown to max 2*

secondary structure ;
α / alpha, helix ; **R** 'helix' / helical structure unqualified by alpha
β pleated sheet ;
tertiary structure / folding ; **ignore** 3D shape or structure
globular ;

not shown to max 2

amino acids / primary structure / sequence of amino acids ;
(types of) R groups ;
bonds / named bonds ; **A** peptide
quaternary structure ;
prosthetic group ; [max 3]

(c) **(i)** one lower peak inside line than uncatalysed ;
start and finish at, dotted lines / same energy levels as uncatalysed ; [2]

(ii) activation (energy) / (energy of) activation ; [1]

(d) **1** do not prescribe for viral diseases ;
2 only use when necessary / do not overprescribe ;
3 only available on prescription / not available 'over the counter' ;
4 people must, complete the course / take as instructed ;
R take a long course
5 test to find out which is most appropriate antibiotic to use ;
A use most, appropriate / effective, antibiotics
A use narrow-spectrum antibiotics
6 details of sensitivity test ;
7 rotate / AW, antibiotics / use in combination ; **R** use many antibiotics
8 do not use same antibiotics for humans and animals ; [max 2]

[Total: 11]

5 **(a)** *ignore **Y***
X = mitosis ;
Y = meiosis / mitosis [1]

(b) **1** chromosome number is halved / 2n → n / diploid → haploid ;
A 2 sets of chromosomes → 1 set of chromosomes

explanation to max 1
2 restore diploid number on fusion ; **R** restore full set if not qualified
3 avoids number doubling with each generation ;
4 allows expression of (recessive) alleles / AW ;
5 allows variation / new combinations of chromosomes ; [2]

(c) *if only use formulae, these must be correct – otherwise ignore*

1 nitrification / nitrifying / oxidation ;
2 ammonium ions to nitrite ions ;
3 nitrite ions to nitrate ions ; **A** one mark for ammonium to nitrate
4 *one named microorganism in correct context*
Nitrosomonas / Nitrobacter ; **R** *Rhizobium*
5 ammonium / nitrate / AW, absorbed by plants / leached / AW ;
R used by plant [max 3]

(d) **1** ammonium ions are (positively) charged ; **A** hydrophilic / polar / water-soluble
2 cannot pass through, phospholipid bilayer / membrane ;

either
3 active transport ;
4 moved against concentration gradient ;
or
3 facilitated diffusion ;
4 moves down its concentration gradient ; [max 2]

[Total: 8]

6 (a) (i) *hydrogen bonds drawn onto Fig. 6.1*

lines must go between O-H, N-H as follows

two lines between A and T H — O and N — H ;
three lines between C and G H — O and N — H and O — H ; [2]

(ii) **1** hydrogen bonds hold (two), polynucleotides / strands / chains, together ;
A hold, (complementary) nucleotides / base pairs, together
A ora e.g. prevents, unwinding / strand separation
2 (many hydrogen bonds) give stability / DNA is stable molecule / DNA is long lasting / AW ; *ignore ref. to strength*
3 can be broken for, transcription / replication ;
4 ref. to (double) helix ; [2]

(b) **1** (named) base / nucleotide, pairing ;
2 purine – pyrimidine ;
3 percentage of A = percentage of T ; **A** very similar
4 percentage of C = percentage of G ; **A** very similar
5 data quote in support ; [max 3]

(c) (i) *idea that*

percentages of, A and T / C and G, are not the same / three percentages are similar; [1]

(ii) single-stranded <u>DNA</u> / not double-stranded / not a double helix ;
A may be other bases ; [1]

[Total: 9]