CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

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

Cambridge will not enter into discussions about these mark schemes.

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Mark scheme abbreviations:

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

1 **(a)** *one mark for the stages of the cell cycle in the correct sequence*
one mark for correct matching of each stage with a cell

stage of mitosis	label from Fig. 1.1
prophase	**A** / **H** ;
metaphase	**G** ;
anaphase	**C** / **E** / **F** ;
telophase ;	**B** ;

[5]

(b) microtubules / spindle (fibres), attach to centromere / kinetochore (of chromosome during prophase) ; **I** metaphase
arranging / aligning / orienting / AW, chromosomes at the equator / metaphase plate ; **R** centre
fibres, shorten / contract / retract ; **A** microtubules disassemble / AW
move / pull, (sister) chromatids / (daughter) chromosomes, to opposite poles / centrioles ;
idea that equal number of chromosomes in each daughter, nucleus / cell ; [max 2]

(c) maintaining number of chromosomes ;
ensuring genetic stability / maintaining genetically identical cells / AW ;
asexual reproduction ; **A** vegetative reproduction / cloning
cloning / clonal expansion, of (named) lymphocytes ; **A** B / T cells
replacement of (worn out / dead / damaged) cells ;
regeneration, of (named) tissues / organs ;
(wound) repair (of tissues) ; **R** repair of cells
ref. to production of gametes ;
e.g. mitosis in gametogenesis / gamete production in plants
R 'copying of cells' [max 2]

(d) (i) *accept biological N fixation or Haber-Bosch process for mp1*

1 *either*
converts, (inorganic) nitrogen / dinitrogen / N_2, into organic nitrogen / ammonia / NH_3 / ammonium / NH_4^+ **;** **R** if nitrate given
or
lightning converts, nitrogen / ammonia / NH_3 / ammonium / NH_4^+, into, nitrite / nitrate (ions) **;**

2 reduces nitrogen / breaks triple bond **;**

3 makes (fixed) nitrogen available to, legumes / other organisms / community / AW **;** **A** ref. to amino acids / proteins
not to be awarded if it follows nitrification

4 increase soil fertility **;**

5 balances the loss of fixed nitrogen in, denitrification / ocean deposits **;** [max 2]

(ii) **1** *idea of* decay / decomposition **;**
e.g. breakdown by, (saprophytic) bacteria / fungi

2 legumes eaten by, detritivores **;** **A** named detritivores

3 decomposers produce proteases **;**

4 to, hydrolyse / convert / change / AW, protein to amino acids **;**

5 amino acids are deaminated **;**

6 (amino acids) to, ammonia / NH_3 / ammonium (ions) / NH_4^+ **;**

7 nitrifying bacteria / *Nitrosomonas*, convert ammonia to nitrite (ions)**;**

8 nitrifying bacteria / *Nitrobacter*, convert nitrite to nitrate (ions) **;**

if mp7 or mp8 not awarded allow one mark for the following as mp9
9 (named) nitrifying bacteria convert, ammonia / ammonium, to nitrate (ions) **;**

mp10 only to be awarded following nitrification
10 nitrate (ions) used for making, amino acids / proteins (hence increase in growth of cereals) **;**

[max 2]

[Total: 14]

2 (a) (i) **X** – (ciliated) epithelium **;**
Y – red blood cell / erythrocyte **;**

(ii) cilia beat to move mucus (up the bronchiole / towards the mouth / away from the lungs / AW) **;**
mucus as a barrier to entry into (epithelial) cells **;**
mucus traps, pathogens / bacteria / microbes **;** *accept in context of goblet cells*
capillary / blood vessel, brings, phagocytes / macrophages (to engulf bacteria) **;** [max 3]

(b) (i) **J** – phagocytosis / endocytosis / described in terms of engulfing *or* forming phagosome **;** [1]

(ii) digestion of bacteria / described **;**
to destroy bacteria / pathogen **; A** to prevent spread through the body
antigen, presentation / display on cell surface **;**
idea of selection of specific, B cells / T cells **;**
A recognition / binding of / activation of, appropriate B / T cells [max 2]

(c) 1 faster **;**
in context of whole secondary response

2 memory cells**;**
in context of production during the first response

3 *idea that* there are many more cells specific for this pathogen **;**

4 (so) increases chances of encountering pathogens more quickly / AW **;**
5 fast(er) production of, B lymphocytes / plasma cells / antibodies / helper (T) cells / cytotoxic T cells / cytokines **;**
6 greater concentration of antibodies (in, blood / lymph) *or* greater numbers of, B / plasma, cells **;**
A more, antibodies / plasma cells / B cells

7 pathogen, removed / killed, faster **;**
8 person does not become ill / no symptoms **;**
A pathogen does not, spread through the body / infect cells / AW [max 3]

(d) **(i)** little / no / slower / weak, immune response ;
stated function of T-lymphocytes, does not occur / occurs slowly ;
e.g. release of cytokines / stimulating macrophages / stimulating B cells / killing infected cells
high susceptibility to infectious diseases ;
R 'fighting disease' [max 1]

(ii) pathogen **not** recognised, as non-self / foreign ;
pathogen is recognised as self ; **A** non-foreign
ignore antigen concealment [max 1]

(iii) no, antibodies / plasma cells / memory (B) cells, produced ;
no humoral response ;
no antigen presentation by B cells ; [max 1]

[Total: 14]

3 **(a)** increased / faster, movement / diffusion, of, assimilates / amino acids / sucrose / water / solutes / ions / molecules ;
I substances / particles / carbohydrates
I freely / easily / efficiently
I osmosis

(because) more, (symplast) pathways / passages / AW ;
accept in context of blockage of some plasmodesmata

correct ref. to symplast pathway in context of an advantage ;

e.g. of complex plasmodesmata ;
from companion cell into sieve tube (elements) / when loading sucrose into phloem

AVP ; e.g. selectivity / control / regulation, of movement [max 2]

(b) **1** mass flow ; **A** pressure flow

2 sucrose / solutes / assimilates / sugars, decreases, water potential / solute potential ; **A** symbol(s) Ψ

3 water enters (sieve tubes), down water potential gradient / by osmosis ;

4 increase in / high(er), <u>hydrostatic</u> <u>pressure</u> ;

5 unloading / removal, of sucrose at the sink lowers the (hydrostatic) pressure ;

6 movement (from source to sink) is by gradient in (hydrostatic) pressure ; [max 4]

[Total: 6]

4 (a) enzyme **A** uses 'lock and key' **and** enzyme **B** uses induced fit **;**
A enzymes work by 'lock and key' and induced fit
enzyme **A** / lock and key, (shape of) active site is complementary / AW, to (shape of) substrate (molecule) **;**
enzyme **B** / induced fit, has an active site that, moulds around / AW, the substrate **;** [3]

(b) (i) 1 **P** is β-pleated sheet, **Q** is α-helix **;**
accept if P and Q are identified by a description

2 determined by, coiling / folding / sequence, of amino acids / polypeptide **;**
A primary structure for sequence of amino acids

3 stabilised / held / AW, by hydrogen bonds **;**

4 between C = O and H–N (of peptide bonds) **;**
A carbonyl / carboxyl group, and, amine / amino group

5 ref to, parallel / anti-parallel, nature of β-pleated sheet **;** [max 3]

(ii) 1 catalyses reaction between carbon dioxide and water to form carbonic acid **;**
A correct, formulae / equation

2 very fast reaction **;**

3 in (cytoplasm of) red blood cell / erythrocyte **;**

4 (so there are) hydrogen ions / protons, and hydrogencarbonate ions **;**

5 hydrogen ions promotes oxyhaemoglobin dissociation / AW **;**
e.g. reduces affinity of haemoglobin for oxygen / (oxy)haemoglobin gives up oxygen more readily

6 increases supply of oxygen to (respiring) tissues **;**

7 carbon dioxide is transported as hydrogencarbonate ions **;**

8 in the plasma **; A** carbon dioxide diffuses from red blood cell to plasma

9 AVP **;** e.g.
carbonic anhydrase catalyses reverse reaction in the lungs
ref to hydrogencarbonate ions as buffer in plasma (as a consequence of reaction)
R buffering action of haemoglobin in red blood cells [max 4]

[Total: 10]

5 (a)

structural feature	triglyceride	phospholipid
phosphate (group) / contains phosphorus	×	✓
nitrogen	×	✓
charged / polar	×	✓
(number of) fatty acids	3	2
number of ester bonds	3	2
number of phosphate ester bonds	0	1
award one mark for any of the following comparisons		
number of double bonds (in hydrocarbon chain)	0	1
number of saturated fatty acids / ORA	3	1
presence of double bonds	×	✓
presence of unsaturated fatty acids	×	✓

These are alternatives – award one mark only

[max 2]

(b) *answer may be phrased in the context of amylase / trypsin*
ignore anything before Golgi, e.g. shuttle vesicles from RER

1 vesicles, form from / 'pinch off', Golgi (apparatus / body / complex) ;

2 vesicles moves, through cytoplasm / to cell (surface) *or* plasma membrane ;

3 role of cytoskeleton / microtubules in movement of vesicles ;

4 energy / ATP, is required (movement of vesicles / fusion with membrane) ;

5 vesicle fuses with / AW, cell (surface) / plasma, membrane ;
I bind / attach **A** join / merge / becomes part of

6 exocytosis / vesicle 'opens up' so that enzyme molecules are released ;

7 ref to fluid nature of, membranes / phospholipid bilayer, that makes this possible ; [max 4]

(c)

role of water	property of water
solvent for glucose and ions	dipolar / polar ; **A** description of polarity of water
transport in the xylem	hydrogen bonding ; **I** cohesion / adhesion
helps to decrease body temperature in humans	high latent heat of vapourisation / high specific heat (capacity) / high enthalpy heat of vapourisation / lots of energy required for evaporation ;

[3]

[Total: 9]

6 **(a)** **P** – thymine ; **R** thiamine / thiamin / thyamine
Q – cytosine ;
R – guanine ;
S – uracil ; [4]

(b) **1** copy of the, DNA / gene, (coding) for a, polypeptide / globin ; **A** protein

2 travels from, DNA / nucleus / chromosome, to ribosome ;
A mRNA made in nucleus, attached to ribosome *so movement is implied*

3 for translation / for (haemo)globin production ;

4 mRNA codes for, sequence / order, of amino acids ; **A** for primary structure

5 *idea that* (nucleotide / base) sequence is a series of codons ;

6 base pairing / AW, between codon on mRNA and anticodon on tRNA ;
e.g. of AW
hydrogen bonds between bases
examples of base pairing: A–U / C–G
R binding between bases [max 3]

[Total: 7]