

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

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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)
<u>underline</u>	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]

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(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 3]

[Total: 14]

Page 5	Mark Scheme	Syllabus	Paper
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- 2 (a) (i) X – (ciliated) epithelium ;
Y – red blood cell/ erythrocyte ; [2]
- (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]

Page 6	Mark Scheme	Syllabus	Paper
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(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), hydrostatic pressure ;

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]

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- 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	x	✓
nitrogen	x	✓
charged / polar	x	✓
(number of) fatty acids	3	2
number of ester bonds	3	2
number of phosphate ester bonds	0	1
<i>award one mark for any of the following comparisons</i>		
number of double bonds (in hydrocarbon chain)	0	1
number of saturated fatty acids / ORA	3	1
presence of double bonds	x	✓
presence of unsaturated fatty acids	x	✓

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 / thiamine
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]