

**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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<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2015</b>	<b>9700</b>	<b>21</b>

Mark scheme abbreviations:

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

<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2015</b>	<b>9700</b>	<b>21</b>

- 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	<b>A/H ;</b>
metaphase	<b>G ;</b>
anaphase	<b>C/E/F ;</b>
telophase ;	<b>B ;</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]

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2015</b>	<b>9700</b>	<b>21</b>

(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]**

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	21

- 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]

<b>Page 6</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2015</b>	<b>9700</b>	<b>21</b>

- (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)  $\Psi$
- 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]**

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9700	21

- 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  $\beta$ -pleated sheet, **Q** is  $\alpha$ -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  $\beta$ -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 ; <b>A</b> description of polarity of water
transport in the xylem	hydrogen bonding ; <b>I</b> 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]