CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 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.

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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 accepted)
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)

1 (a) ATP production ; **A** supply energy (to the cell / for cell reactions) **R** energy production
(site of) aerobic respiration / oxidative phosphorylation ;
AVP ; e.g. lipid metabolism / beta oxidation [max 1]

(b) crista / cristae / inner membrane ; [1]

(c) (×) 48 571 **or** (×) 50 000 ;;

$\frac{34\,000}{0.7}$ **or** $\frac{35\,000}{0.7}$

if answer incorrect award one mark for:
correct measurement (34 or 35 mm) and correct formula used (M= I/A), as above
but incorrect conversion to μm
or
correct calculation but units given
or
correct calculation but decimal places given [2]

(d) **1** resolution / resolving power, too low ;
2 further detail ; e.g. only 250 nm resolution
resolution only half wavelength of light
wavelength of light, too long / not short enough
width of membranes only 7 nm ;
3 (such) thin sections not possible ;
4 inner membrane / cristae / internal structure, could not be seen ;
5 magnification this high not possible ;
mp1 and mp5 allow correct comparative statement with electron microscope [max 2]

(e) circular DNA ;
small / similar, size ; **A** 0.5–15 μm
70S / small(er) / 18 nm, ribosomes ;
AVP ; e.g. binary fission / naked DNA [max 2]

[Total: 8]

2 (a) (i) facilitated diffusion **;** [1]

(ii) ions are, charged / water-soluble **; A** hydrophilic
unable to pass, through hydrophobic core / hydrophobic (fatty acid) tails of, phospholipid bilayer / phospholipids(s) **;**
(channel of) protein lined with amino acids with, hydrophilic / polar, R groups / side chains **; A** hydrophilic channels [max 2]

(b) (i) quaternary / 4°, (structure) **;** [1]

(ii) secondary structure **; A** alpha / α, helix [1]

(c) *bonds must be named in the correct context of maintaining 4° structure and interactions with phospholipids*

polypeptides held together
bonds between, R groups / side chains **;**
two named bond types **;** *from*
- ionic
- hydrogen
- hydrophobic interactions
- disulfide
- van der Waal's forces

I peptide bond

polypeptides interact with phospholipids
(regions with) hydrophilic / charged / polar (R groups / side chains, of) amino acids interact with, phosphate / hydrophilic head , of phosholipid **;**
(regions with) hydrophobic / non-polar (R groups / side chains, of) amino acids interact with, fatty acid / hydrocarbon / hydrophobic, tails / chains **;**

further detail of named bond **;** [max 3]

[Total: 8]

3 **(a)** (late) anaphase / (early) telophase **;** **R** early anaphase [1]

(b) produce more genetically identical cells / AW **;**
for growth (of the root) **;**
asexual reproduction **;**
replace (old / worn out) cells **;**
repair (damaged tissue) **;** **A** *ref. to* wounds **R** repair cells [max 2]

(c) **(i)** 8 **;** [1]

(ii) for sexual reproduction **;**
to form gametes **;** **A** pollen and, egg / ovum **R** sperm

ref. to diploid number must be restored (in zygote)
or
fusion / fertilisation, of two haploid cells results in, diploid cell / zygote **;**

prevents chromosome number doubling each generation **;** [max 3]

(d) **1** DNA double helix unwinds **;** **I** unzips **R** DNA strand unwinds
2 hydrogen bonds break between, base pairs / bases / strands **;**
3 both strands used as templates **;**
4 catalysed by / AW, DNA polymerase **;**
5 *ref. to* (free) activated nucleotides / AW **;**
6 complementary DNA nucleotides added **;**
A described in terms of complementary base pairing
7 step-by-step / sequentially / AW **;**
8 *idea that* process, occurs / continues, along whole DNA molecule **;**
9 replication bubbles / described
or
ref. to Okazaki fragments **;**
10 replication is semi-conservative / each newly formed molecule contains one original and one newly synthesised strand
11 AVP **;** e.g. *ref. to* repair / proofreading
ref. to, helicase / ligase *in correct context* [max 5]

[Total: 12]

4 (a) (i) loss from, leaves / aerial parts of plant **;**
of water vapour **;** *link to first point*

plus one from:
evaporation of water, from surface of spongy mesophyll cells / into air spaces **;**
diffusion of water vapour, out / to atmosphere **; R** evaporation
movement / diffusion, (out) through (open) stomata **; R** evaporation
water vapour moves (out) down the water potential gradient **;**

[max 3]

(ii) *adaptation for 1 mark, explanation to max 2*

thick (waxy) cuticle **;**
explanation
idea that wax is, (mainly) impermeable to water / hydrophobic / barrier to water vapour movement **;**
reduces, water loss from parts with no stomata / uncontrolled water loss / cuticular transpiration **;**
idea that increased distance decreases rate of diffusion of water vapour
or
reflective cuticle **;**
explanation
reduces heat load **;**
reduces evaporation (from spongy mesophyll cells surfaces) **;**
reduces rate of diffusion of water vapour (through cuticle) **;**
or
folded inner surface / AW **; A** trichomes / hairs **;**
explanation
traps water vapour / AW **;**
reduces, diffusion / water potential, gradient **;**
(water potential gradient) between sub-stomatal air space and outside / AW **;**
or
no stomata (visible) on the, outer / exposed, surface **;**
explanation
idea that stomata are main route for water loss **;**
idea that reduces area where there is a high rate of water loss **;**
surface directly exposed to air currents has no stomata **;** ora

R curled or rolled *given as adaptation but allow explanation to max 2*
explanation
stomata on inside **;**
no / away from, air currents **; A** increases humidity within enclosed space / AW
reduces, diffusion / water potential, gradient (between sub-stomatal air space and outside)**;**

[max 3]

(b) (i) 18 g h^{-1} **;;**

one mark if no units given
one mark if incorrect answer but correct values extracted from Fig. 4.2 (60–42 g h^{-1}) [2]

(ii) *describe to max 3*
rate of, transpiration / water absorption, increases and decreases / reaches a peak **;**
time delay between high rates of transpiration and water absorption / AW **;**
lower values for water absorption until (approx.) 1645 **; ora A** 1630 to 1700
data quote to support **;**

explain to max 3
ref. to daylight and night and stomatal, opening / closure / AW **;**
higher light intensity / greater stomatal opening, higher rate of transpiration **;**
ora
idea that transpiration drives water absorption **;**
further detail **;** e.g. explanation in terms of water potential gradient
ref. to cohesion-tension from leaf to root [max 4]

(iii) xerophyte **;**
example of xeromorphic feature **; A** *ref. to* adaptation(s) (for dry areas)
high light intensity during middle of day / AW (for species **P**) **;**
idea that loss of water during the day needs to be minimised **;**
suggestion that (most) stomata, closed during the day / only open at night **;** [max 2]

[Total: 14]

5 **(a)** Morbillivirus ; [1]

(b) *must have one ref. to either infected or uninfected to gain max*
aerosol, infection / route ; **A** droplet infection **I** *ref. to* contact
infected person, sneezes / coughs / talks / spits, to release airborne droplets;
inhaled by, uninfected / healthy, person ; [max 2]

(c) RNA nucleotides ;
contains uracil ; **A** no thymine
ribose (instead of deoxyribose) ;
no (double) helical structure ;
AVP ; e.g. small enough to pass through nuclear pores ; [max 2]

(d) cell has no enzyme for RNA replication ;
ref. to enzyme specificity ;
RNA polymerase (in cell) uses DNA template / not RNA template / AW ; [max 2]

(e) *ref. to* recognition and activation by presence of antigen (on APCs / infected cells) ;
T helper and T killer, lymphocytes / cells ; **A** T cytotoxic
T helper
secrete cytokines ;
(cytokines) stimulate / AW, (specific) B-lymphocytes ; **A** humoral response
stimulate / AW, macrophages / phagocytes / phagocytosis / T killer response ;
T killer
kill infected cells ;
detail of killing ; e.g. perforin / H_2O_2
punching 'holes' in membrane
ref. to T lymphocytes become memory cells (for secondary immune response) ; [max 5]

[Total: 12]

6 **(a)** **(i)** grass ; [1]

(ii) rabbit(s) / grasshopper(s) ; [1]

(iii) fox(es) ; [1]

(b) denitrification ;
nitrification ;
nitrogen fixation ; **A** Haber process [3]

[Total: 6]