CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9700 BIOLOGY

9700/23 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 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

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1 **(a)** **A** = chloroplast **;** **A** granum / grana
B = (intercellular) air space **;**
C = nucleolus **;** **A** nucleus [3]

(b) *two marks for correct answer*
9 (μm) **;;**
award one mark if not to nearest micrometre, 9.3 / 9.28
or correct measurement incorrectly converted but correct formula used
64 / 65 / 66 mm ÷ 7000 [2]

(c) **1** phospholipid bilayer **;**
A lipid bilayer
2 phospholipids have, phosphate / hydrophilic, heads, and, hydrophobic tails / fatty acid chains **;**
3 ref. to, labile nature of bilayer structure / phospholipid (molecules) moving (within their monolayer) **;**
4 protein molecules, interspersed / scattered / not a complete layer **/** AW **;**
5 many / AW, different / AW (protein molecules) **;**
6 example of type of protein **;**
7 *idea of* (most) proteins, moving / not in fixed position **;**
8 reference to cholesterol **;** [max 4]

(d) **1** ref. to movement, down water potential gradient / from high(er) to low(er) **;**
2 apoplastic / cell wall, pathway from xylem to cell walls of (palisade mesophyll) cells **;**
3 ref. to osmosis **;** *in context of* movement, into cell / through cell surface membrane / through tonoplast,
R osmosis from xylem to vacuole
4 symplastic / cytoplasmic, pathway (within cell) **;**
5 via plasmodesmata **;** *in context of water arriving from adjacent cell*
6 ref. to channel proteins / aquaporins **;**
7 solutes / named, in vacuole **;** [max 3]

[Total: 12]

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2 (a) (i) cells have machinery for protein synthesis / AW ;
A plant / animal, cells have RER
(assumption that) cells will continue to produce protein at high rate ;
large number of / many / AW, ribosomes ;
available supply of / AW, amino acids ;
ref. to presence of tRNA molecules ;
ATP available ;
ref. to easier to harvest high levels of protein ; [max 2]

(ii) *idea that* any added mRNA, has easier access to / can reach, ribosomes / RER ;
so that the cell's own, DNA / mRNA can be accessed / AW ;
easier to, harvest / extract, protein products ; [max 1]

(iii) only the desired protein is produced / AW ; ora
unwanted protein does not have to be separated from desired protein ;
idea that inefficient process if translation machinery used to produce other proteins ;
cell's proteins may, inhibit / affect / hinder / AW, process ; [max 1]

(iv) ref. to ribosome function not altered ;
R ref. to prokaryotic and eukaryotic ribosomes being the same
mechanism of translation / described, is the same in all cells ;
e.g. tRNA can respond to introduced mRNA
all types of cells use mRNA for protein synthesis ;
mRNA only has one role ;
genetic code / codons, are the same in all cells ;
A genetic code is universal
mRNA, contains only exons / introns removed, so translation can occur ; [max 2]

(b) different, structure / rRNA, (of ribosomes) ;
(ribosomes), larger / 80S, in eukaryotes *or* smaller / 70S in prokaryotes ;
(some) attached to / AW, (eternal surface of) RER in eukaryotes ; ora
A only found in cytoplasm in prokaryotes [max 2]

(c) other organelles / components, damaged *or* whole cell all organelles intact ;
some, ribosomes / RER, lost / damaged ;
idea that cell-free system is disorganised ; ora
fewer amino acids available ; ora
no / reduced, respiration ; AW
other, components / AW, required are, lost / at lower levels ;
organelles / components, not replaced ; ora
ref. to difficulty in creating identical conditions to cell environment ;
may be able to use cells that can replicate (hence continuous production) ;
AVP ; [max 1]

[Total: 9]

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3 (a) (i) **A =** denitrification / reduction **;**
B = nitrogen fixation / lightning **;**
C = nitrification / oxidation [3]

(ii) decomposition / decay **;**
A reference to decomposers
saprotrophs / bacteria / fungi **;**
A detritivores
digest / breakdown / hydrolyse, organic nitrogen / protein / amino acids / urea **;**
protease / urease **;**
deamination **;**
production of ammonium (ions) / ammonification **;**
nitrification / ammonium (ions) to nitrate (ions) **;**

accept correct formulae for ammonium ions, nitrite ions and nitrate ions [max 3]

(b) (i) *phosphate*
any one relevant **;**
e.g. part of structure of
AMP / ADP / ATP
nucleotide
nucleic acid / DNA / RNA / polynucleotide
phospholipid
A phospholipid bilayer
phosphorylation / enzyme activation
bone tissue

nitrate
any one relevant **;**
e.g. (nitrogen for) amino acids / proteins / enzymes / named (e.g. haemoglobin)
AMP / ADP / ATP
nucleotide
nucleic acid / DNA / RNA / polynucleotide named nitrogen base (adenine / cytosine / thymine / uracil / guanine)
(some) phospholipids [2]

(ii) **1** growth linked to, increase in cell size / cell number **;**
2 growth linked to, increase in biomass / reproduction **;**
3 increases energy available as food for next trophic level **;**
4 nitrogen is in, amino acids / proteins, for growth **;**
5 ATP (containing phosphate) required for, transcription / protein synthesis / enzyme synthesis / anabolic reactions / growth **;**
6 *idea that,* growth of cells / cell division, requires membrane synthesis **;**
7 nitrogen in membrane proteins / phosphate in membrane phospholipids **;**
8 (cell division and), DNA, synthesis / replication **;**
9 *idea that* more biomass (per unit time) returned to soil **;**
10 AVP **;** e.g. ref. to phosphate taken up by plants and passed into food chain **;** [max 3]

[Total: 11]

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4 **(a)** any one valid **;**
e.g.(first) appearance of (brown) colour
use of, colour standards / colour charts
use of colorimeter
time-lapse photography / video [1]

(b) *allow catechol for substrate throughout*
rate of reaction 0 au, no substrate to act on / AW **;**

at substrate concentrations lower than 5mM
substrate (concentration) is limiting (factor in rate of reaction) **;**
presence of free active sites / enzyme is in excess **;**
few collisions between enzyme and substrate **;**
rate increases with substrate concentration as more, active sites can be occupied / E-S complexes can form **;**
one data quote to support response
V_{max} reached / rate becomes maximum, at 4.5–5 mM substrate concentration**;**
rate constant / levels out / AW, from 4.5–5 mmol substrate concentration **;**

at substrate concentrations greater than 5 mM
enzyme (concentration) becomes limiting (factor) **;**
all active sites, saturated / occupied **;**
(so) further increase in substrate concentation does not increase rate **;** [max 5]

(c) **(i)** curve always lower than that with no inhibitor **;** *must be similar shape*
curve reaches the maximum **;** **A** curve heading to maximum [2]

(ii) PHBA / inhibitor, similar shape to, substrate / catechol **;**
(so) binds to active site **;**
blocks access to substrate / fewer (successful) enzyme-substrate collisions **;**
reduces rate of, reaction / conversion of substrate to product **;**
AVP **;**
e.g. inhibitor has a greater effect on rate at lower substrate concentrations
V_{max} reached at higher substrate concentrations
inhibitor forms same interactions with R-groups in active site [max 2]

(d) enzymes work in a limited pH range / either side of optimum pH rate decreases **;**
(acid so) presence of H^+ ions, partially denatures / denatures (some), enzymes **;**
further detail **;** e.g. ref. to breaking ionic or hyrdrogen bonds
change of active site shape means substrate can no longer fit **;**
AVP **;** e.g. ref. to antioxidant effect of, lemon juice / citric acid / vitamin C [max 2]

[Total: 12]

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5 **(a)** growth (by increase in cell number) **;**
production of genetically identical cells **;**
replacing (damaged) cells **;**
repair (of tissue) **;** *allow 'regeneration' if mp3 and mp4 not awarded*
R repair cells
asexual reproduction **;**
A cloning **A** vegetative propagation [max 3]

(b) one tick in each box **;** [1]

(c) appearance of chromosomes / condensation of chromatin / AW **;**
chromosomes visible as two, sister chromatids / chromatids joined by a centromere **;**
spindle formation / spindle fibres form / microtubules assemble / AW **;**
centrioles, move to / reach, opposite poles **;**
R sides / ends
disappearance of nucleolus **;**
disassembly / breakdown of, nuclear envelope **;**
A nuclear membrane [max 4]

(d) mitosis / prophase, will begin again, too soon / immediately **;**
uncontrolled / repeated, cell division / mitosis **;**
ignore (risk of), tumour formation / cancerous growth
ref. to consequences on the timing of the cell cycle **;** [max 3]

[Total: 11]

6 **(a)** causes (mainly) linked to habits during life of person / AW **;**
result of choices made by person / AW **;**
example **;**
e.g. (tobacco) smoking / exposure to asbestos at work [max 2]

(b) *pathogen* = virus **;**
ignore Morbilli / measles
transmission: aerosol, infection / transmission *or* droplet, infection / transmission **;**
A aerosol route described from infected to uninfeccted
ignore contact [2]

(c) (infected), visitors / immigrants / returning residents, from countries where measles occurs **;**
unvaccinated people returning from travel abroad **;**
reduction in vaccination rates **;**
percentage cover too low **;**
change in reporting pattern **;**
existing vaccine no longer, effective / AW **;**
AVP **;**
e.g. mutation of virus produces new antigens, vaccines ineffective
increase in malnourished children, no immune response to vaccine [max 1]

[Total: 5]

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