

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

**MARK SCHEME for the May/June 2011 question paper  
for the guidance of teachers**

**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 must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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Mark scheme abbreviations:

<b>;</b>	separates marking points
<b>/</b>	alternative answers for the same point
<b>R</b>	reject
<b>A</b>	accept (for answers correctly cued by the question, or by 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 excepted)
<b>max</b>	indicates the maximum number of marks that can be given
<b>ora</b>	or reverse argument
<b>mp</b>	marking point (with relevant number)
<b>ecf</b>	error carried forward
<b>I</b>	ignore

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1 (a) (i) metaphase ; [1]

(ii) chromosomes / (sister) chromatids, line up at the, equator / equatorial plate / metaphase plate ; **A** move to **I** middle / centre  
centromeres attached to, spindle / spindle fibres ;  
**A** (spindle) microtubules **A** kinetochore  
centrioles, reach / located at / AW, poles ; **R** ends  
ref. spindle fully formed ; **A** spindle fibres extend from poles / AW  
**R** ref. to nuclear envelope absent (in anaphase also) [max 3]

(b) replacement of cells ;  
repair of tissue ; **R** repair of cells  
growth / increase in cell numbers ;  
asexual reproduction / vegetative propagation ; **R** cloning  
maintains / same, number of chromosomes ; **A** two sets of chromosomes / diploid / 2n  
genetically identical to parents ;  
**A** produces daughter cells that are genetically identical **A** ref. clone(s)  
ref to rejection / self vs non-self ; [max 3]

(c) ref. coordination of growth / limiting growth ;  
ref. minimising exposure to mutations / alterations to DNA (during replication) / AW ;  
prevent tumour formation ; **A** prevent, cancer / uncontrollable growth  
effect of, tumour / cancer ; e.g. compress other organs / invades other tissues or organs  
AVP ; e.g. example of timing of cell cycle linked to cell function / idea of producing cells when  
required [max 2]

**[Total: 9]**

2 (a) one mark per complete correct row

DNA	RNA
two, polynucleotides / chains / strands <b>A</b> double	single, polynucleotide / strand / chain ;
(double) helix	not a helix / straight chain ; ;
deoxyribose	ribose ; <i>differences between pentoses / sugar may be described in terms of OH on C<sub>2</sub></i> ;
<u>thymine</u> / no uracil	uracil / no <u>thymine</u> ;
hydrogen bonding (between all bases)	hydrogen bonds between some bases ; <b>A</b> no hydrogen bonds ;
ratio of A+G to C+T = 1 / AW	ratio of A+G to C+T varies ;
longer	shorter ;
one type	more than one type / three types / mRNA + tRNA + rRNA ;

[max 3]

(b) (GCG) CGC ;  
(ACA) UGU ; [2]

(c) 714 ;; **A** 717 / 720  
*if, no / incorrect, answer given, award one mark for correct working* [2]

(d) 1 (tRNA) carries amino acid to ribosome ;  
2 ref. to specificity of amino acid carried ; **A** role in ensuring correct primary structure  
3 ref. anticodon (on tRNA): codon (on mRNA) binding ;  
4 ref. complementary / base pairing ; **A** A-U, C-G  
5 ref to tRNA binding sites within ribosome ;  
6 two tRNAs bound to, mRNA / ribosome, at same time ;  
7 amino acids held close to each other / AW ;  
8 (for) peptide bond formation ;  
9 (tRNA) can be reused / binds another amino acid ; [max 4]

[Total: 11]

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- 3 (a) (i)** active, transport / uptake ; [1]  
carrier / transport, protein ; **A** pump protein **R** channel protein  
ref. (protein) changing shape / conformational change ;  
ref to specificity ;  
ATP / energy, required ; [max 2]
- (ii)** ATP / ADP / DNA / RNA / nucleic acid / NADP / phospholipid ;  
**A** nucleotide / named nucleotide / nucleoside **A** phospholipid bilayer [1]
- (b) (i)** W in the central X-shaped region ; [1]
- (ii)** osmosis *in correct context* ; e.g. through, cell surface / partially permeable, membrane or  
into, cytoplasm / cell  
diffusion, into / through, cell walls ;  
  
from (region of), high(er) / less negative, water potential, to (region of), low(er) / more  
negative, water potential *or* down a water potential gradient ;  
  
transpiration pull ; [max 2]
- (iii)** through cortex / via cortical cells ;  
  
*apoplast pathway*  
(by) via cell walls (of adjacent cells) ; **R** *if named as symplast pathway* ;  
*symplast pathway*  
via cytoplasm and plasmodesmata ; **R** *if named as apoplast pathway*  
ref. vacuolar pathway ;  
  
ref. apoplast to symplast / pathway described, at endodermis ;  
(via) passage cells ;  
ref to, suberised / Casparian, strip ; *in correct context* [max 4]

**[Total: 11]**

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- 4 (a) (i) red blood cells / erythrocytes / red blood corpuscles ; [1]
- (ii) *myoglobin* 78%    **A** 77%  
*haemoglobin* 21%    } ;    *must have both correct for 1 mark* [1]
- (iii) *myoglobin* has higher affinity for oxygen / *myoglobin* binds oxygen while *haemoglobin* releases oxygen ; ora  
*(myoglobin)* acts as a store of oxygen ;  
*myoglobin* will only release oxygen, at (very) low oxygen partial pressures / AW when oxygen demand (in muscles) exceeds supply ; **A** during exercise  
AVP ; e.g. *myoglobin* has, one / fewer haem groups, so no cooperative binding effects  
e.g. allows aerobic respiration to continue (in muscle) [max 2]
- (b) (i) fetal haemoglobin has higher oxygen affinity (than adult / maternal haemoglobin) / AW ;  
(higher oxygen affinity) over all  $ppO_2$  / use of data at more than one  $ppO_2$  (from Fig. 4.1) ;  
oxygen uptake from, adult / maternal, blood / AW ;  
or  
gas exchange taking place between fetal and, adult / maternal, blood ;  
ref. to fetal reliance on mother to supply oxygen / mother only source of oxygen for fetus ; [2]
- (ii) at lower  $ppO_2$  both, unload / AW, oxygen ;  
sufficient / more, adult haemoglobin present or adult haemoglobin provides sufficient oxygen / AW ;  
ref. to compensating by producing additional red blood cells ;  
AVP ; e.g. ref. to similarity of position of both curves [max 1]
- (c) (all) to the right of given curve, same overall shape as adult haemoglobin curve ;  
to the right of given curve, begins at 0.2 kPa, ends at 97% ;  
**A** within range of 0–0.4kPa and 95–99% [2]

[Total: 9]

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- 5 (a) (phloem) sieve plate ; [1]
- (b) (i) sucrose / amino acids / named amino acid / AVP ; R sugar [1]
- (ii) source – leaf / named photosynthetic part ;  
sink – roots / seeds / fruits / petals / bud / named non-photosynthetic part ; [2]
- (c) accept, assimilate / named assimilate, throughout  
allow ecf from (b)(i)
- 1 H<sup>+</sup> / protons, (move) out of companion cells by, active transport / AW ;  
R diffuse by active transport
  - 2 H<sup>+</sup> / protons, diffuse (back) in with / cotransport sucrose, into companion cells ;  
A description of (facilitated) diffusion  
R active transport  
*ref. to companion cell required only once for mps 1 and 2*
  - 3 via, cotransporter / cotransporter described ;
  - 4 sucrose, diffuses / AW, into (phloem) sieve, tube / element, via plasmodesmata ;
  - 5 (entry of sucrose into sieve tube so) water potential lowers ;
  - 6 water enters by osmosis ;
  - 7 (hydrostatic) pressure builds up ; A pressure difference created
  - 8 unloading at, sink / named sink, gives a difference in pressure (between source and sink) ; AW
  - 9 (so) mass flow ; *term to be used in context* [max 5]
- (d) any one relevant e.g.  
obtain, sucrose / amino acids / other named assimilate ; R nutrients unqualified  
pressure forces, sap / AW, into aphid ; [max 1]

**[Total: 10]**

Page 8	Mark Scheme: Teachers' version	Syllabus	Paper
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6 (a) (i) denitrification ; [1]

- (ii) nitrate required for, amino acid / protein / nucleic acid, production in plants ;  
**A** other relevant named N-containing biochemicals  
nitrogen (gas) not useable form for (most) plants ;

*removal of nitrate*

slows / AW, growth of plants ; **A** reduces crop yield **A** plants need nitrates for growth  
decreases fertility of soil / fertilisers need to be added to soil ; [2]

(b) (i) nitrification ; [1]

- (ii) *P. stutzeri* / bacteria, can be (added to the water and) used to, remove nitrate / carry out  
denitrification ;  
detail ; e.g. use of filter bed  
ref. to leave for sufficient time to remove nitrates  
nitrogen escapes to air [2]

- (c) 1 air / oxygen, will not get into soil ;  
2 lack of oxygen reduces uptake of ions by plants / AW ;  
3 ref. saprobiotic bacteria and fungi / nitrifying bacteria / (some) nitrogen fixing bacteria,  
are aerobic ;  
4 ref. reduced populations (of bacteria in mp 2) ;  
5 example of effect on nitrogen cycle ; ;  
6 e.g. slower rate / AW, of decomposition / decay  
nitrogen fixation cannot occur (as rapidly)  
nitrification cannot occur / nitrate will not be produced / less nitrate produced  
(more) denitrification will occur  
7 crops / plants, will use up remaining nitrate ;  
8 ref. leaching of, nitrates / other nutrients, for growth or (only) low levels of nitrates / other  
nutrients, for growth remain in soil ; **A** ref. leaching reducing soil fertility  
9 AVP ; e.g. named example of another nutrient, with role  
will take time to, recover nitrate levels / resume nitrogen fixation ;  
fertilisers (previously) applied washed away ; [max 4]

**[Total: 10]**