**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

# MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

## 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.

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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)** **P** to protein on right hand side (closed carrier protein) **;**
**Q** to channel protein on left (open carrier protein) **;**
*allow 1 mark if **P** and **Q** wrong way round*

**R** to, central / left, sugar chain on glycoprotein **;**
**S** to circles of phospholipids on the lower surface **;**
**T** to cholesterol **;**
***accept*** names instead of labels
***accept*** if letters put on the appropriate structures without using label lines, letter must be within each structure [5]

**(b)** attachment (of bacteria) to receptor(s) **;** AW
ref. ability to attach to antibody (bound to antigen on bacterium)

infolding / invagination / AW, of membrane **;** **A** membrane engulfs **A** pseudopodia form (round bacterium)
fusion / AW, of membrane **;**
formation of, vacuole / vesicle **;** [max 3]

**[Total: 8]**

**2 (a) (i)** tangent drawn on the graph as close as possible to time 0 e.g. 1.6 / 6 **;**
0.27 **;**

accept
correct volume of gas — e.g. 2.5 / 10 or 4.3 / 20
stated time, up to and including 20 secs
or
tangent drawn on the graph before 20 secs — e.g. 5.8 / 20
**;**
correct calculation **;** e.g. 0.25 ($cm^3 s^{-1}$), 0.22 ($cm^3 s^{-1}$) **A** 0.215
e.g. 0.29
*award one mark if the time is 21–40 s but the calculation is completed correctly* [2]

**(ii)** *accept hydrogen peroxide or reactant for substrate*
initially high concentration of substrate so, rate of reaction high / enzyme activity at a maximum / AW **;**
(rate slows as) concentration of substrate decreases **;** **A** substrate being used up
no further change in volume / AW, reaction has stopped **;**
correct data quote to support explanation(s) **;**

correct ref. to number of (successful) collisions**;**
correct ref. to enzyme-substrate complexes / active sites occupied**;** [max 3]

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**(b)** **1** (copper ions act as enzyme) inhibitor **;** **R** competitive inhibitor
**2** non-competitive (inhibition) **;**
**3** (non-competitive) inhibitor / $Cu^{2+}$, combines with enzyme at site other than active site **;**
**4** active site shape / tertiary structure / 3D shape, changes **;**
**5** active site no longer accepts substrate / enzyme-substrate complex not formed / AW **;**
**6** independent of substrate concentration / increase in substrate concentration has no effect / AW **;**
**7** comparative rates quoted from Fig. 2.2 **;**
e.g. max, 3.25 $cm^3\ s^{-1}$ v 0.22–0.25 $cm^3\ s^{-1}$
**8** AVP **;** e.g. actual rate depends on the relative concentration of inhibitor / AW
$V_{max}$ not reached
effect of ion presence on tertiary structure [max 4]

**(c)** enzymes are proteins **;**
ref. transcription **;** *accept description*
ref. to mRNA **;** } *in correct context*
ref. translation **;** *accept description*
ref. to further folding / glycosylation / modifying, in, RER / Golgi body **;** [max 3]

**[Total: 12]**

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**3 (a)** *primary*
sequence / arrangement / order / AW, of amino acids **;**

*secondary*
α, helix / helices **;** **A** description *ignore any ref to β / pleated, sheet*

*tertiary*
folding of, one / each, polypeptide / globin **;** **A** coiling
(shape) held in place by interactions between, R-groups / side chains **;**
**A** three or more named interactions

*quaternary*
(arrangement / interaction, of) four polypeptides / four globins / two α and two β globins **;** **A** chains **A** ref. to more than one polypeptide if specific ref. to α and β chains
haem / prosthetic group **;** **A** porphyrin [max 4]

**(b)** six / first five and seventh, amino acids are the same **;** ora amino acid at position 6 is different
both are 1. val-2.his-3.leu-4.thr-5.pro….7.glu **;** *take from diagram*
variant 1 is, glutamic acid / glu (whereas), variant 2 is, valine / val **;** [3]

**(c) (i)** withstands pressure **;**
prevents, overstretching / AW **;**
prevents, bursting / rupture / AW **;** [max 1]

**(ii)** *assume answer is about collagen unless told otherwise*
**1** polypeptides are not identical (v. 2 identical, α / β, polypeptides) **;**
**2** triple helix *or* three, polypeptides / helices (v. 4 polypeptides) **;**
**3** only composed of amino acids *or* no, prosthetic group / haem / iron **;**
**4** (fibrous so) not globular **;**
**5** no complex folding / AW (v. complex folding) **;** **A** no tertiary structure
**6** glycine is repeated every 3rd position / more glycine **;**
**7** repeating triplets of amino acids / large number repeating amino acid sequences (v. greater variety) **;**
**8** AVP **;** e.g. different primary structure / AW
variation in amino acid sequences (v specific sequences)
all polypeptides, helical / AW (v. α different to β, polypeptides)
hydrogen bonds between polypeptides (v. Van der Waals)
covalent bonds between molecules (to form fibrils) (v. none)
300nm long polypeptides (v 5–10nm)
each polypeptide over 1000 amino acids (each 141 / 146 amino acids) [max 1]

**[Total: 9]**

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**4 (a) (i)** chemical carcinogens **;** **A** *named carcinogenic chemical e.g.* asbestos / tar / benzpyrene / aniline dyes / mustard gas / ethidium bromide **;** *allow two named chemicals for two marks*
virus, qualified **;** e.g. with oncogene / ability to convert host proto-oncogene / named virus e.g. HPV / retrovirus / HIV / HTLV
ionizing radiation / X-rays / gamma rays / particles from radioactive decay / ultraviolet light / alpha particles / beta particles **;**
*allow two named radiation examples for two marks*
free radicals **;**
hereditary predisposition / AW **;**
tobacco smoking **;**
obesity **;** **A** qualified ref. to diet
AVP **;** e.g. if immunocompromised [max 2]

**(ii)** not transmissible from one person to another / AW **;**
not caused by a pathogen **;** **R** bacterium / virus / fungus / AW / 'worm' [max 1]

**(b)** both drugs effective in treating tumours (compared to no drug) **;**
comparative data quote, both drugs compared to no drug **;**

ref. T138067 more effective than vinblastine against, tumour A (after day 18) / tumour B / both tumours (A and B)
relevant comparative data quote **;** e.g. volume of 220 v 160 $mm^3$ at day 25 for tumour A
little difference in effectiveness between vinblastine and T138067 against tumour A up to day 18 **;** AW
ref. similar effectiveness against tumour B until after day 15 **;**
ref. to effectiveness of both drugs detectable from about 7–10 days **;** AW
both drugs, not completely effective in stopping growth / tumours continue to grow **;**
AVP **;** e.g. greater effectiveness of, T138067 with B / vinblastine with A [max 4]

**(c)** ref. growth of tumour involves mitosis **;** **A** cell division
not simple enlargement of cells / AW **;**
mitosis stops / metaphase → anaphase → telophase, cannot proceed **;**
*accept two named stages*
ref. to role of spindle during stages of mitosis **; ;**
e.g. (prophase) to attach to chromosomes
(metaphase) to align chromosomes
(anaphase) to separate chromatids
} *if stage named, must be correct*
no separation of chromatids at centromere **;**
AVP **;** e.g. detail of assembly of microtubules
ref. apoptosis when cell cycle disrupted [max 3]

**[Total: 10]**

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**5** **(a)** 9 µm **;;**
*award one mark if 8.9 or 9.1µm given*
*or*
*correct measurement is divided by the magnification (x 10 000) but conversion factor incorrect* [2]

**(b)** *explanation to max 4*
hydrogen ion / $H^+$, pumped / AW, out of, transfer cell / companion cell **;**
**R** if to sieve tube element
active / using ATP / energy requiring **;**
hydrogen ion gradient build-up **;** AW
hydrogen ions, co-transport / with / AW, sucrose **;** *in context of <u>into</u>, transfer / companion cells*
diffusion / facilitated diffusion (of hydrogen ions and sucrose) through co-transporter (membrane protein) **;**
**A** through membrane protein *if 'cotransport' already used*
sucrose, diffuses / AW, through plasmodesmata into sieve tube element **;**

*ref. to Fig. 5.1*
mitochondria for ATP production **;**
ref to infoldings of cell wall **;**
large surface area of cell membrane **;**
for more, protein pumps / co-transporter proteins **;** [max 5]

**(c)** *sucrose / assimilates / phoem sap, in sieve tube (elements) in, source / leaf*
low(ers) / less negative, water potential **;**
water enters, qualified **;** e.g. by osmosis / from surrounding tissue**;**

increases the <u>hydrostatic</u> pressure **;**

sucrose unloaded at sink **;**
lowers water potential in surrounding tissue **;**
water moves out and decreases <u>hydrostatic</u> pressure (in source) **;** *allow ecf if hydrostatic not used*

pressure difference (causes flow) **;**
(pressure difference) forces sap through sieve tubes / causes mass flow (towards sink) **;** AW [max 4]

**[Total: 11]**

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**6 (a)** bone marrow **;** [1]

**(b) (i)** **A** = macrophage / APC **;** **A** monocyte
**B** = B, lymphocyte / cell **;**
**C** = T, lymphocyte / cell **;**

*allow one mark if lymphocyte given for both B and C but not qualified or incorrectly qualified* [3]

**(ii)** thymus **;** [1]

**(c)** *max 4 if no reference to, antigen / non-self*

foreign / AW, antigens are non-self **;**
non-self / foreign antigens, induce immune response **;** AW ora

*macrophage / APC (**A**)*
phagocytosis / described **;**
cuts up / AW, bacterium / pathogen **;**
presents antigens / becomes antigen presenting cell / antigens on cell surface **;**

*B/T, cells (**B** and **C**)*
antigen recognition by lymphocytes **;**
(with) complementary / specific, receptors / immunoglobulins (B) / antibodies (B) **;**
divide by mitosis **; A** clonal expansion
ref. formation of memory cells (for secondary response)**;**

*$T_h$ cells (**C**)*
secrete cytokines to stimulate B cells **;**
cytokines stimulate macrophages **;**

*Tc/k cells (**C**)*
ref. destroy pathogen / AW **;**
produce perforin / AW **;**

*B cells (**B**)*
B cells become plasma cells **;**
(plasma cells) secrete antibodies **;**

AVP **;** e.g.
macrophages, non-specific / faster response
ref. specificity of, lymphocytes / B and T cells
antibody variable region is the antigen binding site **;** [5 max]

**[Total: 10]**

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