**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

**9700/21** 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)** *award two marks if correct answer (4500) is given*
*allow +/- 1 mm in reading the line*
*accept anything within range 4400 to 4600*

*max 1 mark if unit is given*

*award one mark if incorrect measurement just beyond acceptable range is divided by the actual length (10 $\mu$m) using same unit*

*expect calculation from measurement of scale bar, but look out for alternative method, e.g. measuring the image and then using the scale bar to determine the width in $\mu$m*

$\frac{45\,000}{10}$ $\frac{45\times10^{-3}}{10\times10^{-6}}$ $\frac{4.5\times10^{-2}}{10\times10^{-6}}$

4500 ;; [2]

**(b)** **A** = goblet cell(s), **B** = cilia / ciliated cell **;**

**A** / goblet cell, secrete / make / produce / release, <u>mucus</u> / <u>mucous</u> **;**
**R** excrete
bacteria / pathogens / dust / viruses / particles / dirt / AW, stick (to mucus) / trapped (in mucus) **;** **A** collects **R** 'contains'

**B** / cilia, move mucus, up(wards) / away from alveoli *or* bronchioles / away from lungs / up the trachea / to larynx / to mouth / to throat / AW **;**
bacteria / pathogens / dust / AW, do not accumulate / can be swallowed / do not cause infection (in the trachea) **;** **A** 'stops infections' **I** 'in the lungs'
*must be in context of cilia or cilia and mucus* [max 4]

**(c)** *marks can be taken from labels / annotations*
**1** chromatids / chromosomes / chromatin, condense / become shorter / become thicker / coil / supercoil / AW **;** **A** 'become (more) visible'
**2** centrioles, move to / reach, opposite <u>poles</u> **;** **R** ends
**3** nucleolus disappears **;**
**4** <u>spindle</u> is formed **;** **A** 'more developed' **A** *description in terms of spindle fibres*
**5** ref to assembly of <u>microtubules</u> **;** **A** 'makes' microtubules **R** 9+2
**6** nuclear envelope, disintegrates / breaks down / destroyed / AW **;** **A** membrane
**7** chromosomes, move to / at, equatorial plate / equator / metaphase plate / AW **;** *ignore* middle / centre
**8** centromeres attach to, spindle / fibres **;**
**9** ref to random arrangement of chromosomes **;** **A** 'not in pairs' **R** scattered [max 5]

**[Total: 11]**

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**2 (a)** diffusion / diffuses ;
down concentration gradient / from high concentration to low concentration / from high to low partial pressure ;
description of pathway ;
*two of the following*
cell (surface) membrane of (respiring) cell, tissue fluid, (pore in) capillary wall / endothelium / endothelial cell, basement membrane / plasma [max 2]

**(b)** *assume answer refers to Y unless told that it refers to X*
less pressure ; **A** low pressure
less oxygen ; **A** deoxygenated
less glucose ; *only accept more glucose if identified as liver*
fewer / more, amino acids / fatty acids ;
less water / lower water potential / lower solute potential / higher osmotic pressure / higher concentration of solutes *and / or* rbcs ;
**A** 'blood is more concentrated'
fewer ions ;
more of **named** cell product ; e.g. insulin / glucagon / albumen / AW

(more), urea / excretory waste ; **R** waste unqualified [max 3]

**(c) (i)** carbonic anhydrase ; [1]

**(ii)** (catalyses very) fast / AW, reaction ;
(carbon dioxide as) hydrogen carbonate ions / bicarbonate ions ;
diffuse / move / leaves, out of the (red blood) cell ;
in(to) the plasma ; **R** 'into blood'
(so that) blood can transport more than could be transported as carbon dioxide (in solution) / 80 – 90% $CO_2$ transported this way ;
*idea that*
reaction maintains concentration gradient for $CO_2$ from, tissues / tissue fluid, to blood ;
if carbon dioxide transported then pH would decrease ;
(therefore) maintains pH / prevents pH decreasing / acts as a buffer ; [max 3]

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**(d) (i)** 55 (%) **A** 54 - 56 (%),
32 (%) **A** 31 / 31.5 (%) **;** [1]

**(ii)** hydrogen ions / protons **;** **A** $H^+$
*either*
react *or* combine with haemoglobin / form haemoglobinic acid / form HHb **;**
**A** 'picks up' / absorb
*or*
carbon dioxide combines with haemoglobin / forms carboxyhaemoglobin **;**
(so) stimulate haemoglobin to release more oxygen (in areas of low $pO_2$) **;**
ref. to, allosteric effect / change in tertiary *or* quaternary structure *or* shape **;**
**A** conformational change
*either*
haemoglobin has a higher affinity for hydrogen ions than oxygen = 2 marks
*or*
haemoglobin has a higher affinity for carbon dioxide than oxygen = 2 marks [max 2]

**(iii)** Bohr (effect / shift) **;** [1]

**(iv)** **1** carbon dioxide influences percentage saturation of haemoglobin with oxygen / AW **;**
**2** tissues / cells, with high rate of (aerobic) respiration **;**
**3** high demand for oxygen **;**
**4** haemoglobin / blood, releases more oxygen **;** **R** faster
**5** than it would in absence of carbon dioxide **;**
**6** at same partial pressure of oxygen **;** [max 3]

**[Total: 16]**

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**3 (a)** **D** – uracil ;
**E** – adenine ;
**F** – ribose ; **I** pentose / sugar
**G** – phosphate ; **A** phosphate [4]

**(b)** *answers must be in pairs*

| mRNA | DNA |
|---|---|
| ribose | deoxyribose ; |
| *differences between pentoses / sugar may be described in terms of OH on C2* | |
| uracil / no thymine | thymine / no uracil ; |
| single, polynucleotide / strand / chain | two, polynucleotides / chains / strands ; **A** double |
| no hydrogen bonds | hydrogen bonding ; |
| not a helix / straight chain | (double) helix ; |
| ratio of A+G to C+T varies / AW | ratio of A+G to C+T = 1 / AW ; |
| no base pairing (within molecule) | base pairing ; |
| base pairing A-U with, tRNA / anticodon | base pairing is A-T |
| shorter | longer ; |
| found in cytoplasm / leaves nucleus | found in nucleus ; |
| attached to ribosome(s) | not attached to ribosome(s) ; |
| short-lived | long-lived ; |
| transfer of information (to ribosome) | information storage / AW ; |
| codes for one polypeptide | codes for more than one polypeptide ; |
| produced by transcription | produced by (semi-conservative) replication |

[max 3]

**(c)** **1** translation ; **R** *if transcription given as well, unless in correct context*
**A** use of, nucleotide / base, sequence, to make, amino acid chain / polypeptide / protein
**I** protein / polypeptide, synthesis
**2** moves towards / combines with, ribosome ;
**3** ref to small and/or large sub-units ; **I** small / large ribosome
**4** codon(s) ; *only accept in correct context*
**5** transfer / t, RNA, bringing, amino acid(s), to mRNA / ribosome ;
**6** anticodon(s) ; *only accept in correct context*
**7** (complementary) base pairing ;
**8** any e.g. of codon:anticodon base pairing ; *need six bases*
**9** ref to polyribosome(s) / used by many ribosomes ;
**10** (mRNA short-lived) ref to production of protein for short period of time ; [max 4]

**[Total: 11]**

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**4 (a) (i)** hydrolysis / hydrolysing **;** **I** catabolic / digestive **R** hydrolsis [1]

**(ii)** to stop the reaction **;** **R** 'stop it working'
by denaturing, the enzyme / sucrase **;** **R** incorrect context
**A** 'change shape of active site'
to make the Benedict's solution, react / AW **;** [2]

**(b)** *description to max 2*

rate increases to a, maximum / plateau **;** **A** 'levels off' / remains constant
*idea that* increase in rate slows **;**
11.5 (arbitrary units / au) at 80 - 90, g $dm^{-3}$ **;** **A** range 11.4 – 11.6

*explanation to max 4 – accept ora where appropriate*

substrate concentration is limiting (factor) **;**

(at low concentration) *may be given in terms of increasing concentration*
few collisions between enzyme and substrate **;**
few, enzyme-substrate / E-S, complexes formed **;**
active sites unoccupied **;**

(at high concentration / >80 g $dm^{-3}$)
enzyme concentration is limiting (factor) **;**
**A** 'not enough enzyme for substrate to bind to'
maximum number of enzyme-substrate complexes formed **;**
active sites , saturated / always occupied **;** **A** ref to $V_{max}$ [max 5]

**[Total: 8]**

**5 (a)** *put ticks and crosses against the boxes*
*1 – 4 and 7 – one letter only – if more than one letter mark as wrong*
*allow two or three correct letters for 5*
*allow two correct letters for 6*

| | statement | letter |
|---|---|---|
| **1** | contains peptide bonds | **H** |
| **2** | part of the molecule forms the hydrophobic part of cell membranes | **L** |
| **3** | contains 1-4 and 1-6 glycosidic bonds | **K** |
| **4** | forms the primary structure of a protein | **H** |
| **5** | used for energy storage in plants | **K / M / H** |
| **6** | forms a helical structure | **M / H** |
| **7** | the sub-unit molecule is β-glucose | **J** |

**[Total: 7]**

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**6 (a)** *assume answer refers to active immunity unless told otherwise*
*accept ora if answer focuses on passive immunity*

immune response **;** **A** 'immune system responds'
to antigen **;**
clonal selection occurs / ref to B cells *or* T cells activated **;**
antibodies made **;** **A** ora for passive
memory cells produced **;**
long-lived / long-term effect / permanent **;**
not immediate / slow **;** one week minimum

*passive only* – antibodies removed from circulation **;** [max 3]

**(b)** *no mark for passive immunity as in the question*

antibodies from, mother / colostrum / across placenta **;** **R** 'immunity from mother'
interact with, antigen / measles antigens / virus / pathogen **;**
(so) prevents an (active) immune response **; A** no immune response

too early for immune response to occur / T cells *or* B cells not mature **;**
**A** not immunocompetent / immune system not developed [max 2]

**(c)** *idea that*
all countries with >90% of districts reporting 90% of children vaccinated have very low death rates (for children under 5 years of age) **;**

ref to any percentage(s) <90% with wide variation in death rates **;**

data quote, giving % and death rate(s) **;** e.g. 95%, less than 50 deaths per 1000

herd immunity / described , decreases transmission **;**
**A** description of transmission e.g. 'spread' [max 2]

**[Total: 7]**

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