CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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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

1 (a) (i) **A –** endothelial / squamous / epithelial (cell) **;**
B – nucleus **;** [2]

(ii) 7 (μm) **;;**
award two marks if correct answer given
award one mark if not rounded to nearest whole number
award one mark if given incorrect unit
if no answer given, award one mark if correct measurement (38–41 / 3.8–4.1 / 38000–41000) is divided by 5700 [2]

(iii) *for two marks - one structure and one function*
only two functions = 1 mark
only two structures = 1 mark

1 (capillary) wall is, thin / single layer of cells / one cell thick **;**
A endothelium / epithelium for wall
2 short diffusion, pathway / distance / AW **;**
R 'easy' diffusion
3 (many have) endothelial pores / fenestrations / gaps / spaces / openings **;**
4 to allow named, substance / cell, to leave the blood **;**
A *idea* of separation / selection, of named substance(s) by size
5 small diameter / small lumen / diameter of red blood cells **;**
6 slows down flow of red blood cells / (capillary / blood) close to cells **;**
7 (capillaries have) large, surface area / surface area to volume ratio **;**
8 *idea that* allows more exchange **;**
Ignore faster exchange [max 2]

(b) *white blood cells*
1 (named) white blood cells can, leave capillaries / enter tissue fluid **;**
A diapedesis / (suggestion that some) too large to leave the, blood / capillaries
2 high number in, lymph nodes / thymus / bone marrow / spleen **;**
A stored / produced

g*lucose*
3 small (molecule) **;**
4 filtered / diffuses / leaves / leaks, from blood / from capillaries / into tissue fluid **;**
5 taken up / used, by cells in respiration **;**
Ignore supply

p*rotein*
6 too large to, leave capillaries / enter lymph / enter tissue fluid **;**
7 (in lymph / tissue fluid) antibodies / proteins, from / secreted by, lymphocytes / other cells **;** [max 5]

(c) *accept hydrogen carbonate (ions) / bicarbonate (ions) / HCO_3^- penalise HCO_3 once only*

1 carbon dioxide, reacts / combines, with (terminal amine / **N** terminal, of) haemoglobin **;**
R carried by / reacts with, haem

2 to form carbaminohaemoglobin **;**

3 carbonic anhydrase catalyses, formation of carbonic acid (H_2CO_3) / reverse reaction described (in the lungs) **;**

4 (carbonic acid dissociates to) HCO_3^- / CHO_3^- / hydrogen carbonate (and H^+) **;**

5 hydrogen carbonate / HCO_3^-, diffuses / moves / AW, out (into plasma) **;** [max 3]

[Total: 14]

2 **(a)** (infected) person, sneezes / coughs / talks / breathes out, (airborne) droplets / aerosol / moist air **;**
ignore contact
inhaled / inspire / breathed in, by uninfected, person **;**
ignore transplacental transmission [2]

(b) **(i)** *variable region*
binds / attaches / combines, to antigen **;**
R receptor site **R** 'fit'
ref. to specificity **;**
ignore complementary shape (to antigen)
R same / similar shape [max 2]

(ii) *disulphide bond*
ignore ref. to hinge

holds, polypeptides / heavy chains / long chains, together **;**
i**gnore** constant as description of chains
maintains, tertiary / quaternary / 3D, structure / shape **;**
R shape unqualified [max 1]

(iii) *constant region*
binds to, receptors / cell (surface) membrane, on, phagocytes / macrophages **;**
antigen, marking / tagging, for, phagocytosis / macrophage action **;** AW
A ref. to opsonisation
R agglutination [max 1]

[Total: 6]

3 (a) **R** CO_2 diffusion is a consequence of transpiration
stomata open(ings) to allow carbon dioxide in **;**
carbon dioxide required for photosynthesis **;**
ignore ref. to oxygen
water vapour diffuses out through stomata **;**
A water if evaporation (from mesophyll walls) described
A water as a gas [3]

(b) **1** both show, little / low / lowest, transpiration, at night / 22.00 to 24.00 / 00.00 to 04.00 **;**
2 both, increase to / peak, at mid day / 12.00 **;**
3 ref. to second peak at 16.00 **;**
4 both, dip / decrease, at 14.00 **;**
5 transpiration (always) lower for trees at exposed site / ora **;**
6 both decrease from 16.00 **;**
for mps 1–4 and mp 6, allow a description at one site only
R if contradictory description given for the other site
7 comparative data quote to support above marking points **; ;**
8 to compare the transpiration rate at two locations at the same time
or transpiration rate at one location at different times
to award data marks arbitrary units (au) must be used at least once [max 5]

(c) *identification of the following features*
1 stomata close (for longer), during the day / when hot / when dry **;**
2 stomata in pits / sunken stomata **;**
3 stomata only on lower surface of the leaf **;**
4 hairs / trichomes **;**
5 low number of / few(er) / less, stomata (per unit area) **;**
ignore 'less open stomata'
6 thick(er) cuticle**;**
7 reflective cuticle (on upper epidermis) **;**
8 thick(er) epidermis / more than one layer of epidermal cells **;**
9 curled / rolled / AW, leaves **;** [max 3]

[Total: 11]

4 (a) **J** thymine ;
K guanine ;
L hydrogen bond ;
ignore H / H_2 bond [max 3]

(b) **1** zidovudine , competitive inhibitor and efavirenz , non-competitive ;
2 zidovudine, complementary to active site ;
3 efavirenz, binds to allosteric site / reference to allostery ;
4 efavirenz changes the, shape / structure, of the active site ;
A denatures / changes tertiary structure so substrate will not fit
R changes shape unqualified
5 *either*
the effect of zidovudine is, reduced / reversed, by increasing the substrate concentration
or
the effect of efavirenz is not, reduced / reversed, by increasing the substrate concentration ; [max 4]

(c) **1** virus may be resistant to one or more of the drugs / very low chances that HIV is resistant to all of the drugs ;
R virus immune
2 (resistance due to) change to, active site / allosteric site / tertiary structure, of enzyme ;
A drug can no longer fit into active site
3 some drugs may be more effective than others / AW ;
4 reduces risk of drug resistance developing ;
5 HIV, has a high mutation rate / changes surface proteins / changes antigens ;
A antigen(ic), shift / drift
6 person may have mixture of strains of HIV ;
7 *idea that* virus will be at different stages in its, life / replication, cycle ;
8 AVP ;
e.g. more than one competitive to reduce chances of, ES complexes / AW
drugs work better in combination / synergy idea
drugs inhibiting two different enzymes, so more effective [max 2]

(d) **1** antibiotics are not effective against HIV *or* viruses / antibiotics are effective against, (named) bacteria / bacterial disease ;
A fungi / protoctists / protists / malaria
R antibiotics prevent infection
2 *idea that* viruses have no, sites / targets, where antibiotics can work ;
3 viruses have no, cell walls / ribosomes / cell membranes ;
A have different enzymes
4 viruses are within cells, *idea that* antibiotics cannot reach them ;
5 people with HIV are more susceptible to bacterial infections / reference to immune suppression / weak immune system ; [max 2]

[Total: 11]

5 (a) P – moves, polar substances / hydrophilic molecules / ions, through membrane / in *or* out (of cells) **;**
A facilitated diffusion / active transport / described
Q – receptor / recognition site / cell recognition / binding site **;**
A cell adhesion / 'receives' named signal
A stabilises membrane (as forms hydrogen bonds with water)
R – regulates / AW, fluidity of, membrane / (phospholipid) bilayer **;**
A contributes to hydrophobic layer / impermeability to ions [3]

(b) 7.0 nm **;** [1]

(c) *fluid*
idea of <u>phospholipid</u> (and protein) molecules, move about / diffuse (within their monolayer) **;**

mosaic to max 1
protein (molecules), interspersed / scattered / not a complete layer / AW **;**
different / AW, proteins (molecules) **;** [max 2]

(d) 1 water molecules are polar **;**
R hydrophilic / charged
2 *idea that* few polar molecules pass through the <u>phospholipid</u> (bilayer) **;**
ora for non-polar molecules
A none pass / repelled
3 core of membrane / phospholipid tails, are hydrophobic **;**
A hydrophobic core
4 channels (through aquaporins), are hydrophilic **;**
A core of channel proteins / described as R-groups of amino acids
5 (aquaporins) increase <u>permeability of membrane</u> to water **;**
6 example **;**
e.g. root hairs / small intestine epithelium / nephron
7 role of water in a cell **;**
e.g. solvent / reactant / reaction medium / turgidity *or* support in plant cell
ignore references to osmosis / bursting / crenation / regulation [max 3]

[Total: 9]

6 (a) ref. to mutation(s) ;
in context of initiating uncontrolled mitosis OR as a consequence of uncontrolled mitosis
proto-oncogenes convert to oncogenes / oncogenes switched on / tumour suppressor genes switched off ;
(cell division is by) mitosis ;
formation of, tumour / mass of (unspecialised) cells ;
no response to (extracellular / intracellular) signals to control mitosis / AW ;
no contact inhibition / AW ;
no cell death / no apoptosis ;
immune system does not recognise the cells as foreign and destroys them ;
A reference to, not non-self / self
metastasis / described ; [max 3]

(b) **R** way in which cancer develops / epidemiological evidence
A beagles for dogs

1 tar painted on skin of, mice / rabbits / rats / (small) mammal, led to development of (cancerous / malignant) tumour ;
2 dogs that smoked (plain) cigarettes developed, cancer / tumour ;
3 dogs that smoked filter-tipped cigarettes did not develop cancer / tumour ;
A developed precancerous changes
4 control group / dogs, which did not smoke and did not develop, cancer / tumour ;
5 AVP ;
e.g. evidence from any other named mammal
e.g. inhaling substances from, tar / tobacco [max 3]

(c) *similarities*
1 all (named) countries, increase and decrease / reach a peak and decrease ;

differences
2 peaks / AW, have occurred at different years in at least two countries ;
3 all maximum mortality rates are different ;
4 any comparative, data quote / calculation, with units given at least once ;
e.g. dates and mortality rates for at least two countries
e.g. mortality rates for one country at two different dates [max 3]

accept a range or a single figure within the ranges given

countries	peak mortality rate	year
USA	53–57	1984–1990
Spain	45-48	1993–1997
Finland	69–71	1970–1973
UK	72–75	1970–1975
Hungary	83–87	1996–2000

[Total: 9]