CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9700 BIOLOGY

9700/22 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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CAMBRIDGE
International Examinations

Mark scheme abbreviations

;	separates marking points
/	alternative answers for the same point
R	reject
A	accept (for answers correctly cued by the equation, or by extra guidance)
AW	alternative wording (where responses vary more than usual)
underline	actual word given must be used by candidate (grammatical variants accepted)
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
AVP	alternative valid point

1 (a) *mp 1 for naming the cell types in the epithelium*
cell names not required for mps 2 and 4

1 goblet cells and ciliated epithelial cells **;** **A** ciliated cells

goblet cells
2 produce / **AW**, mucus **;** **R** ciliated cells produce mucus

3 mucus, traps / **AW**, pathogens / **AW** **;**
treat, dust / particles, as neutral unless qualified
e.g. allergens / asbestos dust *can be credited*

ciliated (epithelial) cells
4 cilia / ciliated cells waft / move mucus to back of throat / away from lungs / to be swallowed **;**
A away from alveoli / gas exchange system
R goblet cells waft
R *idea that cilia present all the way to the stomach*
R *idea that whole ciliated cells move* [max 3]

(b) *in context of smooth / involuntary muscle*
need a large supply of / **AW**, ATP / energy **;**
so able to synthesise large supply of ATP **;** **R** energy
energy / ATP, for muscle / contraction **;** [max 1]

(c) bronchi / bronchus, and trachea **;** [1]

[Total: 5]

2 (a) **X =** transpiration **;** **A** evaporation
Y = nitrification **;** **A** oxidation [2]

(b) *Nitrosomonas / Nitrobacter / Nitrococcus / Nitrosococcus* **;** [max 1]

(c) *stomata, open / are open*
stomata open for, gas exchange / entry of CO_2 **;**
inevitable consequence of gas exchange **;**
water potential gradient between (inside) leaf and atmosphere **;**
diffusion of water vapour out (of leaf) from high to low water potential **;**

occurs even if stomata closed
water is lost through, cuticles / lenticels **;**

balance between disadvantage and plant requirements
idea of maintains transpiration pull, qualified **;** e.g. to bring ions / for water for photosynthesis / to replace water lost / to maintain turgidity

I cooling effect [max 1]

(d) *treat as neutral smaller leaves / less SA*
any two from

stomata
- sunken ;
- in pits / in grooves / in crypts ;
- fewer (per square unit of area) ;
- only on the lower surface / underside ; **ora**
- closed during the day ;

leaves
- curled / rolled / folded inwards ;
- needle-like ; **I** spines / thorns

other
- thick cuticle ;
- trichomes / hairs ;
- epidermis / hypodermis, has layers ;
- thick walled epidermal cells ;
- **AVP** ; e.g. secretion of resins

[max 2]

(e) **1** active transport / uptake ; **A** description
A facilitated diffusion *(may occur in initial stages)*

2 carrier protein ; **A** *for active transport and facilitated diffusion*
transmembrane / integral / intrinsic / transport
A protein pump *only with active transport*
A channel protein *only with facilitated diffusion*

3 specific membrane protein / binding site ;

4 hydrophobic core / fatty acid tails / phospholipid bilayer prevents entry ; [max 2]

(f) **I** *descriptions across the root, e.g. symplastic and apoplastic route*
I *ref. to* hydrostatic pressure

1 nitrates dissolved in water ;

describe
- **2** in an apoplastic / a non-cytoplasmic route (in xylem) ;
- **3** passive (transport) / does not require energy ;
- **4** transpiration pull / idea of column of water pulled up ;

5 movement of water out of xylem creates tension ; **A** negative pressure

explain
- **6** cohesion of water molecules / explanation in terms of hydrogen bonding ;

7 adhesion of water molecules to cellulose / lining ; **I** lignin

8 **AVP** ; e.g. water potential gradient root to leaf
mass flow caused by evaporation [max 4]

(g) in bases / adenine / cytosine / guanine / uracil **;** **R** thymine
A A, U, C, G
A purines / pyrimidines [1]

[Total: 13]

3 **(a)** blood is in vessels / blood is in heart, arteries, veins, capillaries **;**
any three

pulmonary and systemic circulations / described
or
blood passes through heart twice for one circuit round the body / **AW ;** [2]

(b) **1** globular (shape) **;** **A** rounded / spherical **R** circular

2 hydrophilic, amino acids / R-groups, face cytosol
or
hydrophobic, amino acids / R-groups, to the interior **;** **AW**

3 (so) soluble **or** dissolved in cytoplasm / cytosol **;**

4 *ref. to* haem / prosthetic (group) / porphyrin (ring) / Fe^{2+} / ferrous ion / iron (ion), binding oxygen **;** **R** forms bonds with

5 four polypeptides / haems / **AW**, so 4 oxygen molecules / 8 oxygen atoms **;**
A four polypeptides, each carrying an oxygen molecule / O_2

6 cooperative binding / allostery / described **;**

7 **AVP ;** e.g. tertiary structure allows association of prosthetic group [max 4]

(c) 13–15% **;;**

one mark for correct data extraction
96 / 97% at sea level and 82 / 83% at altitude [2]

(d) **1** more haemoglobin (molecules) / Hb **;**

2 *idea of* compensation **;** e.g. for decreased saturation of haemoglobin as less oxygen available so more can be taken up / transported so tissues receive same / sufficient concentration of oxygen [2]

(e) **1** reduces (rate of enzyme activity) **;**

2 binds at a site on the enzyme other than at the active site / allosteric site **;**

3 change in tertiary structure **;**

4 change in shape / conformation / configuration of active site **;**

5 substrate unable to bind / product unable to form / ES complexes do not form / fewer ESC **;**

6 **AVP ;** e.g. V_{max} not reached / increasing substrate concentration no effect [max 3]

(f) *accept Hb for haemoglobin throughout*

1 carbon monoxide binds to Hb / Hb has higher affinity for CO than O_2 **;**
A carboxyhaemoglobin forms (heavy smoker)

2 (with CO) Hb reaches lower % saturation / lower percentage saturation (after 3.6–, 4.0–4.2 kPa) **;**
A correct figures quoted
R lower saturation at <u>all</u> partial pressures of oxygen

3 less oxygen taken up, in lungs / at higher partial pressures
or
reduces the volume of oxygen transported **; AW**

4 below 3.6–4.2 kPa (with CO), curve shifts to left / Hb has (relatively) higher saturation **;**

5 less oxygen unloaded at lower partial pressures / in tissues **;**

6 heart rate increases to deliver sufficient oxygen **;**

7 *ref. to* insufficient oxygen to heart muscle and effect on people with CHD **;** [max 3]

[Total: 16]

4 (a) (i) *neutral points = poor diet / poor living conditions*

look for comparative statements
***A** points if both sides are compared even without ref. to high or low economic country*
*if not comparative, **A** if stated as low (or high if **ora**) economic status country*
max 1 if no points stated as low or high but all points themed as low or high

points below are for low economic status countries – **ora** *for high*

poor sanitation **;**
water
no / poor water treatment
or
ref. to unable / do not know to boil water **;**

no bottled water
or
have to drink contaminated / unsafe / unclean water **;**

sewage
inadequate / poor treatment of sewage
or
sewage contamination of crops **;**

medical
no / poor access to (oral) rehydration therapy **;**
vaccines not available / effective (because poor diet) **;**
I vaccination programmes in Canada
antibiotics / drugs / medication not available **;**

other
greater number of refugee camps / squats **;**
less able to cope after natural disasters **;**
less education about disease prevention / transmission **;**
poor hygiene / described **;** e.g. not washing hands after defecating [max 3]

(ii) 1 Angola / Cameroon, comparative data to show decrease in cases over time

or

comparative data, Cameroon fewer than Angola for 2006 / 2008 **;**

2

	2006		**2008**		**2010**
Angola	67257 (66335) ↓	(of 56746)	10511	(of 9027)	1484
		→ decrease (of 65773) →			
Cameroon	922	decrease	0		

3 explanations for decrease in cases (Angola / Cameroon) / fewer cases in Cameroon (than Angola) **;;** *examples in context of cholera*

4 control methods prevent transmission / spread **; AW ora**

5 pool of infected people reduced, reducing transmission **; AW ora**

6

	2006		**2008**		**2010**
Cameroon			0	increase	10759

Cameroon, steep / **AW** increase, 2008–2010
or
cases increase in Cameroon from 0 to 10759 **;**

7 explanation for steep increase in / high number of cases **;**
e.g. war
natural disaster
refugee camps
breakdown of infrastructure (due to population increase)
influx of immigrants with cholera
can be credited if linked to high number of cases in Angola in 2006 [max 4]

(b) (i) *look for **AW** throughout*

1 required percentage cover not reached / high percentage cover required / not enough people vaccinated **;**

2 some do not respond successfully to vaccine **;**

3 poor diet / lack of vitamin A **;**

4 poor storage of non-thermostable vaccine **;**

5 vaccine not cost-free to population **;**

6 inaccessible vaccination stations for some of the population **;**

7 *ref.to* difficulty in giving boosters **;**

8 *ref.to* reluctance to have children vaccinated **;**

9 lack of advertising / campaigns / education to encourage vaccination **;**

10 different strain (to the one used in vaccine) / antigens changing **;**
R *ref.to* resistance [max 2]

(ii) 1 *ref. to* secondary (immune) response **;**

2 memory (B), lymphocytes / cells **;**

3 recognition of / binding to antigens **; A** clonal selection
A proteins / glycoproteins (on *Morbillivirus*)

4 clonal expansion / described **;**

5 plasma cells secrete antibodies **;**

6 *idea of* faster production / higher levels of antibody **;**

7 *ref. to* T (helper)-lymphocytes, release cytokines / stimulate humoral response **;**
[max 3]

[Total: 12]

5 (a)

event	three marks	two marks	one mark
impulses pass down septum through conducting fibres known as the bundle of His	**4**	any four / five correct **;;**	any two / three correct **;**
atrioventricular node sends out impulses	**3**		
impulses travels across atrial walls	**2**		
impulses reach base of ventricles (apex of heart)	**5**		
impulses pass up through Purkyne fibres in ventricle walls	**6**		
sinoatrial node sends out impulses	**1**		

[3]

(b) following ventricular systole / contraction
or
when ventricles in diastole / relaxation **;**

when pressure in arteries higher than that of ventricles
or
when pressure in ventricles lower than in arteries **;**
A aorta / pulmonary artery [2]

(c) *in blood*
idea that red blood cells too large to leave capillaries **;**
idea that (some plasma) proteins too large to leave capillaries **;**

higher concentration of oxygen, qualified **;**
e.g. from lungs
not yet unloaded (from haemoglobin)
not yet diffused out (from red blood cell)
not yet forced out of capillary (in plasma)

(higher concentration of) glucose / nutrients / named nutrient, qualified **;**
e.g. to be delivered to cells / from absorption

tissue fluid contains
ref. to products excreted by cells (yet to enter blood) **;**
e.g. waste products / (more) carbon dioxide / lactate [2]

[Total: 7]

6 (a) 1 proteins produced (for growth) **;**

2 DNA replication **;**

3 organelles / named organelles synthesised **; A** more organelles

4 uncontrolled mitosis / **AW**
or continuous cell cycle
or cell cycle checkpoints not controlled **;**

5 (new cells) do not differentiate **; A** do not become specialised

6 loss of function (of tissue) **; A** changed function / new cells do not function as tissue of origin

7 (abnormal) mass of cells formed **;**

8 **AVP ;** e.g. no programmed cell death / apoptosis / cells immortal / cells grow independently of normal programming / no contact inhibition [max 4]

(b) travels in phloem / phloem sap / translocation **; R** in xylem
from cell to cell via plasmodesmata **;**
in symplast pathway **;**
in apoplast pathway **; R** in xylem
ref. to bacterial motility, e.g. flagella **;** [max 1]

(c) 1.1–1.13 (μm) **;;** **OR** 1.2–1.22 (μm) **;;**

$\left[\frac{13\,\text{mm}/13000\,\mu\text{m}}{11500}\right]$ $\left[\frac{14\,\text{mm}/14000\,\mu\text{m}}{11500}\right]$

one mark only for
correct formula and measurement (13 / 14 mm) but incorrect conversion
or for correct formula used with a measurement of 12 or 15 mm **2**

[Total: 7]