CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 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 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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 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 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

© Cambridge International Examinations 2014

1 (a) *award two marks if correct answer within range 29 000 to 31 000 is given*
allow ±3 mm in reading the line, e.g.

$\frac{90\,000}{3.0}$ $\frac{90\times10^{3}}{3.0\times10^{-6}}$ $\frac{9.0\times10^{-2}}{3.0\times10^{-9}}$

(×) $30\,000 / 3 \times 10^{4}$ **;;**

one mark if not rounded to nearest whole number
one mark if a unit (mm, μm) is given
one mark if line is measured and given in mm or cm within accepted range and divided by 3.0 μm but incorrect conversion factor used for the line measurement or 3.0 μm [2]

(b)

feature	identity	name
provides motility	**F**	flagellum
stores genetic information	**G**	DNA **;** **I** *any description, e.g. loop of / circular* **A** chromosome(s) / nucleoid **R** plasmid / chromatid
partially permeable	**C**	cell surface / plasma, membrane **;** **A** phospholipid bilayer
composed of murein (peptidoglycan)	**E**	cell wall **;** **R** cellulose cell wall
site of translation	**A**	(70S / 18 nm) ribosome(s) **;** **R** 80S / 22 nm / larger, ribosome

[4]

© Cambridge International Examinations 2014

(c) **A** (double) membrane-bound organelles *only if* <u>no</u> *examples given* (true)

nucleus / nuclear envelope **;** **A** nuclear membrane **I** well-defined
chloroplast **;** **A** grana / thylakoid(s) **A** plastid
(permanent) vacuole / tonoplast **;** **R** vesicles *unqualified* **A** lysosome
mitochondrion / mitochondria **;** **A** cristae
Golgi (body / apparatus / complex) / dictyosome **;** **A** Golgi vesicle(s)

rough endoplasmic reticulum / rough (ER) / RER **;**
smooth endoplasmic reticulum / smooth ER / SER **;** **A** endoplasmic reticulum, *if RER* <u>*and*</u> *SER not given*
nucleolus **;**
linear / **AW**, chromosomes **;** **A** DNA + histones
<u>cellulose</u> cell wall **;**
starch grain / amyloplast **;**
plasmodesma(ta) **;**
larger / 80S / 22 nm, ribosomes **;** [max 3]

(d) *one mark for infected person with contaminated faeces, e.g.*
<u>faeces</u> / <u>sewage</u>, contaminates (drinking) water / cooking utensils / vegetable plots / crops / food **;**
A diarrhoea *for faeces*
R (human) waste unqualified
A *ref. to* houseflies landing on contaminated faeces

one mark for uninfected person
eating contaminated food / using contaminated utensils / drinking contaminated water **;**
A bacteria enters water in context of drinking
R infected food or water
I handling contaminated food

A faecal-oral route *for two marks* [2]

(e) pathogen is at most vulnerable when in transfer between hosts / **AW ;**
A idea of breaking the transmission cycle

2 max for the following control methods:
sewage treatment / (effective) sanitation / correct ref. to positioning of latrines **;**
do not use human faeces for fertiliser **;**
piped / treated / boiled / chlorinated / purified, (drinking) water **;**
A sanitised / clean, water
I cooking refs.
A water treatment with UV / ozone
bottled water **;**
water treatment plants upstream of sewage disposal **;**
(to reduce pool of infected people) <u>antibiotics</u> *or* oral / intravenous, rehydration (therapy) **;**
A ORT [max 3]

[Total: 14]

© Cambridge International Examinations 2014

2 **(a)** population **;**
community **;**
(photo)autotroph / (primary) producer **;**
(ecological) niche **;** [4]

(b) provides ammonium (ions) / ammonia / nitrogen(ous) compounds / fixed nitrogen / organic nitrogen **;** **A** organic compounds
R nitrate / nitrite
R nitrate / nitrite, and ammonia

A *formulae* NH_3 / NH_4^+
if only a formula is used then it must be completely correct

accept the following in context of plants / animals

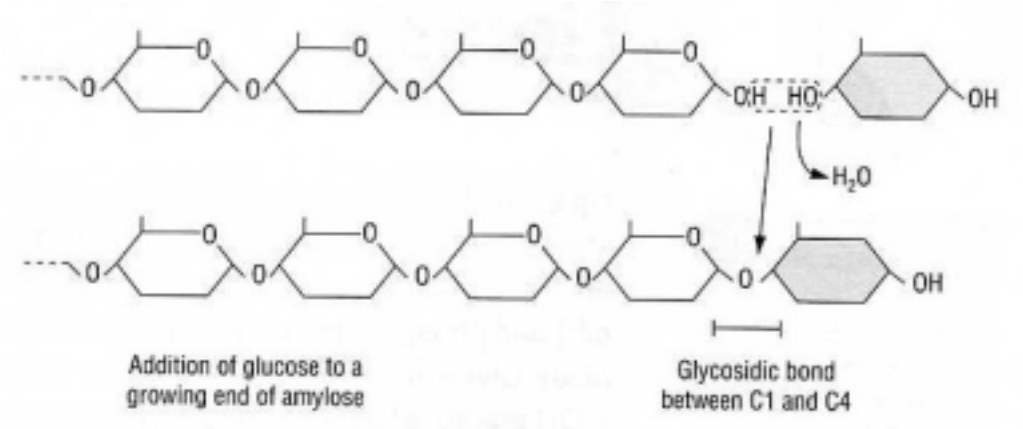
for synthesis of amino acids / nucleotides **;**
synthesis of protein / nucleic acids / DNA / RNA **;**

proteins required for, growth / enzymes / tissue repair / **AW** **;**
nucleic acids for storage of genetic information / **AW** **;**

idea of offsets loss of, (fixed) nitrogen / nitrate ions **;**
reduces effect of (fixed) nitrogen as a limiting factor (for growth) **;** [max 3]

[Total: 7]

3 **(a)** **(i)** –H and –OH indicated **;** **A** *–OH on end of amylose and –H on alpha glucose*
water eliminated / condensation **;** **A** dehydration
oxygen bridge / glycosidic bond, drawn between C1 and C4 **;**



If the whole glucose molecule and / or the end of the amylose molecule has not been drawn, then only award mp3 if C1 and C4 are indicated in some way, e.g. by numbering them or putting in the hydrogens. [3]

(ii) (1,4 / 1,6) glycosidic **;** **A** glucosidic **A** phonetic spelling of glycosidic [1]

© Cambridge International Examinations 2014

(b)

feature	amylose	glycogen	cellulose
type of glucose	α-glucose	α-glucose	β-glucose ;
branched or unbranched molecule	unbranched	branched	unbranched / not branched ;
role in organisms	energy storage	energy storage	structural / (component of) cell walls / tensile strength / dietary fibre / roughage ; **I** support

[3]

(c) (i) *maltase and maltose must be correctly referenced*
ignore references to reversible/irreversible

(ascorbase) binds to / fits into / enters active site ;
complementary (shape) to active site ;
so substrate / maltose, cannot enter / cannot bind ;
A no / few, ES complex
A prevents formation of ES complexes
A ascorbase forms enzyme inhibitor complex

competes with substrate / competitive inhibition ;
slows the (rate of), digestion / hydrolysis / breakdown, of maltose ;
R 'stops the reaction'
R if in context of starch

alternative answer if candidates assume ascorbase is an enzyme:
ascorbase, breaks down / digests / hydrolyses, maltase ;
A ascorbase destroys the active site of maltase
so no enzymes to digests maltose ;
slows / stops, reaction / digestion / hydrolysis / breakdown, of maltose ; [max 3]

(ii) inhibits / slows down / prevents, breakdown / (catalysing) hydrolysis / digestion, of maltose (to glucose) ; **I** starch

less glucose is absorbed / passes across membranes / enters blood ; [2]

[Total: 12]

© Cambridge International Examinations 2014

4 (a) (i) *non-self*
foreign / **AW** ; **A** ref. to epitope(s) **I** pathogen / organism

antigen
macromolecule / (glyco)protein / carbohydrate / polysaccharide / oligosaccharide ;
stimulates / **AW**, an immune response / production of antibodies ;
A results in formation of antigen-antibody complexes
A other described events in an immune response [max 2]

(ii) antibody / immunoglobulin / IgG, on cell surface / on cell membrane ;
(act as) receptors ;
ref. to antigen-binding / **AW** ;
(shape) specific / complementary, to antigen ; [max 2]

(b) (i) DNA / gene transcribed / mRNA using DNA as template / **AW** ;
A transcription unqualified
idea of mRNA associating with ribosome(s) ;
ref. to tRNA with specific amino acid (carried to ribosome) ;
pairing / **AW** of codons on mRNA with anticodons on tRNA ;
formation of peptide bonds (between adjacent amino acids) ;
antibody / protein / polypeptide(s), enters RER / moves to Golgi body ;
ref. to forming, secondary / tertiary structure ;
antibody / protein / polypeptide(s), modified / processed / glycosylated / formation of quaternary structure / formation of disulphide bond(s) in Golgi (body / apparatus / complex) ; **I** *ref. to* packaging [max 4]

(ii) vesicles move to cell / surface / plasma, membrane (via cytoskeleton) ;
R secreting vesicles unqualified
vesicles fuse with cell (surface) membrane / exocytosis ; **R** active transport
movement of vesicle / exocytosis requires energy *or* ATP / is active ; [max 2]

(c) memory cells ; **A** form immunological memory **I** 'gives immunity'
remain / stay in circulation / blood / lymphatic system ;
R 'last a long time / long lived' unqualified
for secondary response ;
fast(er) response when exposed again to same pathogen / same antigen ;
A fast(er) clonal selection / fast(er) clonal expansion
A divide quickly / rapidly
A long(er) lasting response
to form plasma cells (and more memory cells) ;
more antibodies produced / higher concentration of antibodies ;
R if in context of memory cells
to prevent person feeling ill / to prevent symptoms ; [max 3]

© Cambridge International Examinations 2014

(d) **W** – cytokinesis / cytoplasmic division / cell divides into two **;**
I cell division
R mitosis / telophase

Z – (semi-conservative) replication (of DNA) **;**
I S phase / interphase of cell cycle
R copying of DNA
R protein synthesis
R if replication is given in any other phase of the cell cycle [2]

(e) 1 breathing in / inhale smoke / 'second hand' smoke / sidestream smoke **;**
A passive smoking
I exposed to smoke
2 (tobacco smoke contains) carcinogen(s) **;**
3 causes mutation / described **;**
e.g. change to / alters / damages, DNA **R** if in wrong type of cell
4 leads to uncontrolled cell division / mitosis / growth **;**
5 forming a tumour / mass of cells **;**
6 correct ref. to (proto-)oncogenes / tumour suppressor genes **;**
e.g. formation of oncogenes / mutation of tumour suppressor genes / 'switching off' tumour suppressing genes

mutation of correct named gene = 2 marks
e.g. mutation of tumour suppressor gene

P53 (gene) mutates = 2 marks [max 3]

[Total: 18]

5 **(a)** more / thicker, (cardiac) muscle (tissue) in left ventricle **;** **A** ora
A thicker muscular wall

either
atrium pumps blood at lower pressure / against less resistance / to ventricle / short(er) distance / with less force **;**

or
ventricle pumps blood to the body / into systemic circulation / long(er) distance / against greater resistance / at higher pressure / with more force **;**
R ventricle wall withstands high pressure [max 2]

© Cambridge International Examinations 2014

(b) valve opens to allow blood flow from atrium into ventricle / when pressure in atrium is greater than pressure in ventricle / during atrial systole **;**

valve closes when ventricle contracts / when pressure in ventricle is greater than pressure in atrium / during ventricle systole **;**

during contraction of ventricles
papillary muscles contract to 'pull on' tendons **;** **R** if tendons are said to open the valve
tendons prevent valve, inverting / going inside out / everting / **AW ;** [max 3]

(c) 1 sino-atrial node / SAN sends out, waves of excitation / waves of depolarisation / (electrical) impulses / action potential(s) **;**
R nervous impulses / signal / message *penalise once only*

2 wave of excitation / **AW** / SAN stimulates, (both) atria to contract / atrial systole **;**

3 fibrous ring / non-conducting tissue / insulating tissue (between atria and ventricles), prevents impulse reaching the ventricles / prevents atria and ventricles contracting at the same time **;**

4 atrio-ventricular node / AVN delays impulse (by 0.1 s) / prevents ventricles contracting at the same time as atria **;**

5 allows, atria to empty / ventricles to fill **;**

6 AVN sends out, waves of excitation / impulses to Purkyne tissue / Bundle of His (in septum) **;**

7 causes ventricles to contract together / at the same time / simultaneously / **AW ;** [max 4]

[Total: 9]

© Cambridge International Examinations 2014

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

© Cambridge International Examinations 2014

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)
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 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

© Cambridge International Examinations 2014

1 **(a)** arrow towards food web box **;** [1]

(b) respiration ; A respiring [1]

(c) saprophytic / saprobiotic / saprotrophic **;** **A** saprobic **A** detritivore

ammonifying / putrefying **;**

bacteria **;** **A** bacterium **R** nitrifying / denitrifying, bacteria

fungi **;** **A** fungus [max 1]

(d) excretion **;** **A** excrete **A** urination / urinating **A** release / **AW**, of urine

egestion **;** **A** egest / defaecation **A** release / **AW**, of faeces

death **;** **R** decay ***A*** death and decay **A** dying

idea of shed body parts **;** e.g. leaf fall / shed petals / fruit drop / moulting [max 2]

[Total: 5]

© Cambridge International Examinations 2014

2 (a) **A =** nucleus **;** **R** nucleolus **R** nuclear **R** nuclei

B = chloroplast **;** **A** chloroplasts

C = vacuole **;** **A** vacuoles **A** large / central / **AW**, vacuole [3]

(b) *both must be correct*

microvillus / microvilli
centriole / centrioles
cilium / cilia
flagellum / flagella
} *any two structures for one mark* **;**
A lysosome(s) [1]

(c) **1** apoplast = cell wall (and intercellular spaces) (pathway) **;**
A between cell walls
R if cell wall and, cytoplasm / vacuole / plasmodesmata
R if linked to osmosis / facilitated diffusion / active transport

2 symplast = cytoplasmic (pathway) **;** **R** if facilitated diffusion / active transport
reference to only cytoplasmic / not including vacuoles

mps 1 and 2 allow one mark only if no ref. to terms apoplast and symplast
e.g.cell wall v cytoplasmic pathway

symplast

3 osmosis, linked to passage across membranes **;** *must be in correct context*

4 detail of membranes involved **;** *either* tonoplast / vacuolar membrane *or* cell (surface) membrane of, 'first cell' entered directly from xylem / **AW**

5 via plasmodesmata **;** *ignore ref. to mechanism*

6 (includes) vacuolar pathway / (through) vacuoles **;**

apoplast

7 non-living pathway **; ora**

8 *ref.* greater volume / higher rate / less resistance / **AW ; ora**
A faster / fastest **R** amount *for volume*

9 *ref. to*, hydrogen bonding / adhesion, to cell walls **;** [max 4]

© Cambridge International Examinations 2014

(d) (i) (maintain) turgor / turgidity / prevents flaccidity / prevents plasmolysis **;**
A provides support for cell **R** provides support for plant
A pushes chloroplast to edge (of cell)

(reactant in) photosynthesis **;**

hydrolysis (reactions) **; A** named reaction that involves hydrolysis solvent
A (medium) for cell, / metabolic / chemical, reactions (to take place)
R *if in context of outside cell or entering cell or as a transport medium* [max 2]

(ii) (part / used in synthesis, of) chlorophyll (molecule) **;**
R gives chlorophyll green colour

in translation / joining of large and small subunits (of ribosomes) **;**

enzyme, cofactor / activator / described **;** *idea of role in enzyme catalysis*
A correctly named enzymes, e.g. DNA polymerase

AVP ;
e.g. stabilizing, cell wall / proteins / nucleic acids / membranes **;**
important in energy transfers / ATP synthesis **;**
DNA, synthesis / replication **;**
ref. to role in, light absorption / capture (for photosynthesis) **;** [max 1]

[Total: 11]

© Cambridge International Examinations 2014

3 **(a)** trachea and, bronchi / bronchus **;** **A** windpipe *for trachea*
R *if* bronchioles *also included* [1]

(b) **(i)** (as altitude increases), both of them / atmospheric pressure and oxygen partial pressure, decrease **;**
(one) correct comparative data quote **;**
altitude and pressure, with units once, for either atmospheric pressure ***or*** *oxygen partial pressure*

non-linear decrease **;** **A** almost linear decrease
decrease in oxygen partial pressure proportionate to decrease in atmospheric pressure **;** [max 2]

(ii) difference of / reduction of, 34 kPa **;;**
A 33 / 35 kPa
A – 34 / 35 / 33, kPa
A 33 / 34 / 35% decrease for two marks only if evidence of kPa in working

100 kPa at sea level – 66 kPa at 3500 m ***A*** *65 / 67kPa*

one mark only if correct answer but no units / kPa

one mark if correct values taken from graph but no subtraction carried out

one mark if 3500 m value read as 63 kPa, so answer stated as 37 kPa [2]

© Cambridge International Examinations 2014

(c) *lower, atmospheric pressure / partial pressure of oxygen so*

lower partial pressure of / less / **AW**, oxygen in, alveolar / inspired / inhaled, air**;**
A breathed in *for inspired*
A less oxygen goes into lungs

decreased, diffusion / concentration / pressure, gradient **;**

between, alveolus / alveoli, and capillary **;**

less / **AW**, oxygen, enters / **AW** (pulmonary) capillaries / the blood **;**
A less / **AW**, oxygen, transported / **AW**, by, haemoglobin / red blood cells / blood (to tissues)

(so) percentage saturation of haemoglobin is lower **;**
A haemoglobin is less saturated
A fewer molecules of / less, oxygen combine with haemoglobin

(as) haemoglobin has lower affinity (for oxygen than at sea level) **; AW**
A *ref. to* effect of 2,3 DPG
allow correct explanation in terms of oxygen dissociation curve

ref. to insufficient red blood cells to compensate **;**
ora e.g. more red blood cells, need to be / will be, produced [max 4]

(d) (i) greater concentration of / (proportionately) more / **AW**, red blood cells (through pulmonary capillaries per unit time) / **AW ;**
A haemoglobin for red blood cells

increases, the haematocrit / the percentage of red blood cells to the total blood volume / **AW ;** [max 1]

(ii) more, blood / red blood cells, flowing to lungs (per unit time) **;**
A blood flows faster to lungs

to maximise oxygen uptake (from alveoli) / takes in more oxygen / **AW** / compensates for lack of oxygen **;**

more blood pumped through, systemic circulation (per unit time) / rest of body / to tissues / **AW ; A** blood flows faster *for more blood*

compensates for the lowered plasma volume
or
ref. need to, maintain supplies of required substances / remove waste / prevent decrease in pH **;**
allow named required substances e.g. glucose / oxygen / amino acids
allow named waste substances e.g. carbon dioxide [max 2]

© Cambridge International Examinations 2014

(e) 1 nucleotide / base, sequence of, DNA / gene, changed / **AW ;**
A new allele (formed)

2 base substitution (mutation) / (DNA) thymine replaced by adenine / (DNA is) CTC to CAC / CTT to CAT (template codon) **;**
this cannot be used for mp 1 as well

3 altered / changed, mRNA codon **;** *(allow codons)* **A** *idea of different mRNA*
R altered genetic code

4 (mRNA codon is) GAG to GUG / GAA to GUA **;**

5 glutamic acid, substituted / replaced / AW, by valine **; A** glutamate
A glu *and* val

6 tRNA / anticodon, with different amino acid (to ribosome) **;**
A tRNA with different anticodon

7 AVP ;
e.g.amino acid substitution at position 6
valine, hydrophobic / **AW** (R-group)
glutamic acid, polar / **AW** (R-group) [max 3]

[Total: 15]

© Cambridge International Examinations 2014

4 **(a)** *5/6 correct = 3 marks 3/4 correct = 2 marks 1/2 correct = 1 mark*
hint: use green blobs for correct

infectious disease	name of causative organism(s)	type of causative organism	main mode of transmission
HIV/AIDS	human immunodeficiency virus (HIV)	virus	sexual contact
cholera	*Vibrio cholerae*	bacterium **A** bacteria	ingestion of contaminated water and food
tuberculosis	*Mycobacterium, tuberculosis* or *M. bovis*	bacterium	aerosol / droplet infection **A** described **A** airborne droplets **R** air droplets alone
measles	*Morbillivirus* **;** **A** morbillivirus **A** Morbilivirus **A** Morbilli	virus	aerosol / droplet, infection
malaria **;**	*Plasmodium vivax* or *P. malariae* or *P. falciparum* or *P. ovale*	protoctist **;** **A** protozoa **A** protist(a)	feeding / sucking blood / **AW**, by *Anopheles* / mosquito **;** **A** mosquito / *Anopheles*, bite **A** mosquito / *Anopheles*, is vector

[max 3]

(b) *responses do not have to be presented as a table or confined to any one column*
for <u>each</u> numbered mark point, accept point either in left hand column or right hand column

***A** femidom for condom where relevant*
***A** prophylactic for condom*

© Cambridge International Examinations 2014

mp	factors to consider	recommendations
1	(geographical) availability of condoms	condoms should be available (in all relevant locations) **;**
2	where available, insufficient stock of condoms	condoms should be stocked in sufficient quantities **;**
3	condoms (available but) unaffordable	free / affordable, condoms (should be provided) **;** **A** condoms should be provided
4	low level / no, advertising campaigns for condom use	*ref.* advertising campaigns for, condom use / safe sex / protective sex **;**
5	poor condom storage (idea of deterioration)	safe storage of condom supplies (to avoid deterioration) **;**
6	lack of education in, use of condoms / how HIV is spread / other relevant **R** low level of awareness of HIV / lack of education about HIV	*ref.* education **;** e.g. should use condoms / proper use of condoms **A** (should practice) safe sex / protective sex
7	low level of (interest in) condom use or, religious / cultural, objections **A** few people use condoms	*ref.* changing perception of people to encourage use (of condoms) **;**
8	identifiable, high risk / named high risk, groups e.g. sex workers, (male) homosexuals, multiple partners, IV drug abusers *(in context of sexual activity)*	idea of targeting, high risk / named high risk, groups **;** e.g. sex workers, homosexual males, multiple partners, IV drug abusers IV drug abusers *(in context of sexual activity)*
9	low rate of male circumcision	encourage circumcision procedure / train health personnel **;**
10	poor treatment of sexually transmitted infections	treatment of sexually transmitted infections (as risk of contracting HIV increases) **;**
11	no / poor / **AW**, antiretroviral therapy	*ref.* antiretroviral therapy reducing risk of sexual transmission **;**
12	*ref.* extent of contact tracing	*ref. to* contact tracing **;**

[max 4]

© Cambridge International Examinations 2014

(c) (i) correct sequence **;**
mark sequentially from first stated process as this is a cycle

growth		DNA replication
DNA replication	**or**	growth
mitosis		mitosis
cytokinesis		cytokinesis

[1]

(ii) *this may be answered in one of two ways* ***ora***

mp	*because normally T_h cells so,*	*without / with fewer, T_h cells*
1	release / **AW**, cytokine / lymphokine / interleukin **;**	no / less,cytokine / lymphokine / interleukin ased / **AW ;**
2	stimulate / **AW**, humoral / B-lymphocyte / B-cell, response **;** humoral / B-lymphocyte / B-cell, response not stimulated **;** **R** beta-cells	
3	(stimulate B-cell response so) antibodies produced **;** **A** secreted / released **R** if antibodies from T-cells	poor / **AW**, antibody production / **AW ;** **A** no antibodies **A** secrete / release **R** if antibodies from T-cells
4	stimulate / **AW**, **A** (result in) angry macrophages **A** make macrophages more active (in phagocytosis)	macrophages / phagocytes, not stimulated / **AW ;** **A** fewer / no, angry macrophages **A** macrophages less active (in phagocytosis)
5	remain in circulation for second encounter with antigen **; AW**	none remain in circulation for second encounter with antigen **; AW**

[max 3]

[Total: 11]

© Cambridge International Examinations 2014

5 **(a)** (gives) flexibility / described, e.g. *ref. to*, changing orientation / movement to bind antigen / allows binding when two antigens are apart / allows each antigen binding site to move independently **;**
A (acts as) hinge region [1]

(b) **(i)** antigen binding sites / bind to antigen / both bind to same (type of) antigen **;**
A *other terms for binding* e.g. attaches to antigen *ignore ref. to receptor* [1]

(ii) binding to phagocyte / monocyte / macrophage / neutrophil / B-lymphocyte / named cell type with Fc receptor **;**
A gives class of antibody / determines the class of antibody **;** [max 1]

(c) *secreted*
(antibodies need to be) soluble (to function) **;** **AW** e.g. needs to be transported in, aqueous / watery plasma

located on surface
(**X** is region required to) hold / anchor / **AW**, (antibody), in membrane **/** phospholipid bilayer **;**

ref. hydrophobic core / fatty acid tails of phospholipids hydrophobic **;**

interaction provides, stability / anchorage / **AW ;**

ref. hydrophobic region of antibody will have tendency to move back into membrane as repelled by, hydrophilic / watery, exterior solution **;** [max 2]

(d) **(i)** one / 1 ; [1]

(ii) folding / coiling (to form tertiary structure) **;**

ref. interaction of, side chains / R groups (of amino acids) **;** **R** react

two of ionic / electrovalent, bond
hydrogen bond
disulfide bonds
hydrophobic interaction
Van der Waal's (forces) **;** *one mark only for any two*

hydrophobic, side chains / R-groups / amino acids, in centre / **AW ;**
A hydrophobic region faces, towards centre / **AW**
or
amino acids with hydrophilic R groups face, outwards / watery environment / **AW ;**
A hydrophilic amino acids *for hydrophilic R groups* [max 2]
[Total: 8]

© Cambridge International Examinations 2014

6 (a) small / **AW**, surface area to volume ratio / SA:V (compared to unicellular) **;**
ora large volume to surface area

A as organisms increase in size, surface area to volume ratio / SA:V, decreases

ref. long(er) distances (to reach cells / tissues) **;**
A transport system reduces diffusion distance *(as it takes materials close to cells)*

diffusion (alone), too slow / insufficient / unable to satisfy needs / **AW ;**
A transport system decreases time to supply cells
ignore ref. to named substances diffusing

ref. efficient / **AW**, supply (to cells) of, glucose / amino acids / dissolved food **;**
/ nutrients / hormones **;**
A *idea of* greater volume (containing required materials) or higher concentration of materials
R oxygen, *unless only transport in mammals*

ref. xylem, phloem, circulatory system **;** *must have all three*
A arteries and veins / blood transport system / blood vessels [max 3]

(b) (i) **P** = atria / atrium / auricle, **Q** = ventricle / ventricles **;** [1]

(ii) *any sequence of letters within each row*

systole	**V Y ;**
diastole	**W X Z ;**

[2]

(c) 1 assimilates / sucrose, lowers water potential **;**
A more negative / decreases, water potential
A Ψ for water potential
2 water enters by osmosis **;**

3 (increased volume) increases hydrostatic pressure **;**
ref. to hydrostatic required once only in mp 3 or 5

4 assimilates / sucrose, leave at the, sink / named sink **;**

5 (so) lowers hydrostatic pressure / low pressure at sink **;**

6 mass flow **;**

7 down pressure gradient / from high to low (hydrostatic) pressure **;** [max 4]

[Total: 10]

© Cambridge International Examinations 2014

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

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 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 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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 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 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

© Cambridge International Examinations 2014

1 (a) (i) **B ;** [1]

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

(iii) **A ;** [1]

(b) (i) amylose / amylopectin / glycogen **;** **A** starch [1]

(ii) part **1** is saturated / part **2** is unsaturated **;**

part **1** has no double bonds / part **2** has one double bond **;**

part **1** has 27 hydrogens and part **2** has 25 **;**
A part **1** has more hydrogens **ora** [max 1]

(iii) *any two from:*
ionic / electrovalent (bond) **;**
hydrophobic (interaction) **;**
hydrogen (bond) **;**
disulfide (bond) **;**
A Van der Waal's (forces) [max 2]

[Total: 7]

2 (a) (i) **1** (method to) stimulate / AW, an immune response **;**
A gives immunological memory

2 giving / **AW**, antigens **;**

3 (method to provide long-term) artificial active immunity **;**

4 one relevant detail **;**
e.g. no ability to cause disease
ref. to, harmless / **AW**, form of pathogen used
(protection through) production of (specific) memory cells
(contains, pathogen / antigen) in an injection or an oral dose

A (to provide long-term) artificial active immunity
if not already credited in mp 3 [max 2]

(ii) (disease) caused by, a pathogen / microorganism **;**
A *two of* bacteria, virus, fungus, protoctist

one relevant detail e.g.
transmissable / communicable / passed from one organism to another / **AW ;**
A spread to others *if qualified*

affecting the normal function of the body / causing ill health **;** [max 2]

© Cambridge International Examinations 2014

(b) (number of cases per 100 000) shows, proportion / **AW**, of population affected **;** **AW**

idea that easier to visualise, the severity of the problem **;**

useful / more reliable, qualified **;** e.g. for making comparisons between different countries

(as) countries with larger populations will usually have more cases **/** higher number of cases may just mean larger population of country **;**

comparative data quote to support **;** [max 2]

(c) **1** infected person, coughs / sneezes / breathes out / **AW**, droplets **;**

2 droplets containing, bacteria / pathogen / *M. tuberculosis* **;**

3 airborne droplets / droplets in air / moist air, inhaled / inspired / breathed in (by uninfected person) **;**
A droplets if mp 2 given
A by, aerosol, infection / transmission

4 consumption of, milk / meat, containing, bacteria / pathogen / *M. tuberculosis* / *M. bovis* **;** [max 3]

(d) (HIV/AIDS leads to) weak immune system / reduced immunity (to disease) **;**

detail **;** e.g. reduced action of phagocytes
Th lymphocytes low in number
B-lymphocyte response low

(so TB) pathogens, can multiply faster / are not destroyed before they cause disease **;**

idea that important, organs / systems, may already be suffering from consequences of HIV / AIDS (so more likely to stop functioning) **;**

ref. to, inactive / dormant / latent, TB more likely to become active **;** [max 2]

[Total: 11]

© Cambridge International Examinations 2014

3 (a) *allow mps 1, 5 and 6 if non-competitive or both described*

1 (glutamycin) similar shape to, substrate / glutamyl-tRNA **;**

2 competes with substrate / competitive inhibition **;**

3 (glutamycin) binds to / fits into / enters, active site **;**

4 (glutamycin) complementary (shape) to active site **;**

5 (so) substrate / glutamyl-tRNA, cannot, enter / bind **;**
A no / few, ES complexes
A prevents formation of ES complexes
A glutamyl-tRNA forms enzyme inhibitor complex

6 slows the rate of reaction / **AW ;**

7 *ref. to* increasing concentration of inhibitor has greater effect on inhibition**;** [max 4]

(b) transport is against the concentration gradient / **AW ;**

requirement of, energy / ATP **;**

use of, membrane / carrier / transport / pump, protein **;**
R channel / pore, protein

ref. to conformational change (of pump protein) **;**

ref. to specificity **;** [max 3]

(c) (i) nitrogen fixation **;** [1]

(ii) *idea that Rhizobium* will receive, photosynthates / assimilates (from plant) **;**
gains, carbohydrate / amino acids **;**
for energy / growth / replication **;**
receives oxygen **;**
idea of (nodules provide) correct living conditions / ideal habitat / anaerobic conditions (for nitrogenase) / **AW ;**
A *ref. to* protection, qualified mutualistic relationship **;** **A** described [max 2]

(iii) production of, ammonium / NH_4^+ / ammonia / NH_3 **;**

(fixed / useable) nitrogen transferred to plant **;**

used for amino acid production (in plants) **;**

ref. to other uses relevant to growth **;** e.g. in DNA replication / transcription

increased / used in, protein synthesis **;** **A** named protein

(for) production of new, cells / tissues **;** [max 2]

[Total: 15]

© Cambridge International Examinations 2014

4 **(a)** stomata in, pits / cavities / chambers / crypts **;** **I** sunken stomata

no stomata on upper surface **;**

few stomata **;**

hairs / trichomes **;**

thick (waxy) cuticle **;**

thick walled epidermal cells **;**

several layers of, upper epidermis / hypodermis **;** [max 3]

(b) 300 **;;**

(18 000 / 60 or 19 000 / 60 or 20 000 / 6)

allow one mark
if correct measurement is divided by magnification but incorrect conversion factor is used if answer not to nearest 100 μm [2]

(c) **1** loss of water vapour from, leaves / aerial parts of the plant **;**

2 water evaporates from, walls / surface, of mesophyll cells **;**

3 into air spaces **;**

4 water vapour diffuses(out to atmosphere) **;** **A** water *if mp2 awarded*

5 through open stomata (to atmosphere) **;**

6 down a water potential gradient **;**

A *idea that* water potential gradient established [max 4]

[Total: 9]

© Cambridge International Examinations 2014

5 (a) *accept Hb for haemoglobin throughout*

low(er), partial pressure / **AW**, of oxygen / O_2 **;**

high(er), partial pressure / **AW**, of, carbon dioxide / CO_2 **;**

formation of carbaminohaemoglobin **;**

carbonic acid disocciation to form, hydrogen ions / H^+ (and hydrogen carbonate ions) **;**

formation of haemoglobinic acid / binding (of Hb) with, hydrogen ions / H^+, causes release of oxygen **;** *allow HHb*

ref. to Hb affinity for oxygen **;** e.g.
Hb has higher affinity for, hydrogen ions / H^+, than oxygen **;**
reduces / lowers, affinity of Hb for oxygen

Bohr effect **;**

AVP **;** e.g. *ref. to* allosteric effects [max 3]

(b) lower, partial pressure / **AW**, of oxygen (at high altitudes) ***or*** less oxygen in inhaled air / **AW ;**

(so) percentage saturation of haemoglobin is lower **;**
A haemoglobin is less saturated
A fewer molecules of / less, oxygen combine with haemoglobin

more haemoglobin needed (so more red blood cells) **;**
A (more red blood cells) so more haemoglobin / more oxyhaemoglobin can be formed

idea of compensation **;** e.g. (to transport) same amount of oxygen to, cells / tissues **;**

ref. to (increased) secretion of, erythropoietin / EPO **;** [max 3]

(c) (i) making a (complementary) copy of, DNA**;** **A** a gene
ref. information / **AW**, for production of a polypeptide **;**

one (DNA) strand acts as a template **; AW**
production of (pre) mRNA **;**
detail of process **;** e.g. assembly of nucleotides
RNA polymerase [max 3]

© Cambridge International Examinations 2014

(ii) nucleotide / base, sequence of, DNA / gene, changed / **AW ;**
A new allele (formed)

ref. to altered mRNA / **AW ;**
this may be in context of a named type of mutation
consequence on tRNA

tRNA / anticodon, with different amino acid (to ribosome) **;**
A tRNA with different anticodon

change in amino acid(s) / different amino acid sequence / change in primary structure **;**

affects, secondary structure / tertiary structure / 3D shape / function, of protein ;

ref. to one type of mutation **;**
e.g. base substitution means
deletion / insertion, leads to frameshift
ref. to premature stop codon [max 3]

(iii) *may prevent*
breaking of hydrogen bonds between, base pairs / bases / nucleotides,
(and access of RNA polymerase) **;**

attachment of, RNA polymerase (to DNA) **;**

progress / functioning, of RNA polymerase (along gene) **;**

synthesis / elongation of (pre) mRNA **;**

AVP **;** e.g. interfere with action of helicase [max 2]

[Total: 14]

6 (a) (i) deposit / build-up / presence / **AW**, of atheroma / (atheromatous) plaque **;**

thicker wall **;**

narrowing of the lumen **;** **R** lumen, blocked / clogged

lumen no longer round **;**

rougher / **AW**, lining **;** **A** idea of damaged endothelium [max 2]

(ii) damage / **AW**, to, endothelium / tunica intima / **AW ;**

promotes blood clotting / makes platelets sticky / increases risk of thrombosis / **AW ;**

(so) contributes to plaque / atheroma **; A** atherosclerosis

ref. (vaso) constriction **;** **A** reduces diameter
A reduces resistance to blood flow [max 1]

© Cambridge International Examinations 2014

(b) (i) *one correct structural feature with one relevant corresponding function e.g.*

thick / muscular, wall **;** **A** thick tunica media **A** smooth muscle
withstand high blood pressure / maintains pressure / provides strength **;**

elastic tissue ;
provide, stretch / recoil / **AW** ;

smooth tunica intima ;
maintain, laminar / smooth, flow ; **AW**

presence of collagen ;
prevents rupture / **AW** ;

allow the function mark for general statement
transports blood away from the heart to the (lungs and) rest of the body **;** [max 2]

(ii) one cell thick (wall) / endothelium only / thin wall / **AW ;**
short diffusion distance / high rate of diffusion **; I** easy diffusion

pores / gaps / spaces, between, cells in wall / endothelium **;**
to allow exchange of substances / example described / formation of tissue fluid **;**

small, diameter / cross sectional area **; A** range 7–12 μm
ref. efficient, exchange / delivery / collection, of materials **;**
e.g. reaches all cells / **AW**
slows down blood flow
maximises time for red blood cells to collect / deliver, oxygen
reduces distance for diffusion to cells [max 2]

[Total: 7]

© Cambridge International Examinations 2014