CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the October/November 2013 series

9700 BIOLOGY

9700/23 Paper 2 (AS Structured Question), 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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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
AVP	alternative valid point (examples given)

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1 (a) (i) variable region / antigen binding site ; **A** antigen binding region
A light, polypeptide / chain **R** antigen receptor [1]

(ii) disulfide ; **I** bridge
A disulphide **R** disulfite / covalent [1]

(iii) two or more / more than one , polypeptide(s) / tertiary structure(s) ;
R any specific number of polypeptide on its own
R more than one type of polypeptide / many polypeptides
R more than two / several, polypeptides
I ref to prosthetic group [1]

(b) 1 antigen recognised as / AW, non-self / foreign ;
accept once for macrophage, B-lymphocyte or T-lymphocyte
A non-self / foreign, antigen leads to immune response
2 *idea of* phagocytosis leading to antigen presentation ;
3 antigen (on pathogen or APC) binding to, receptor / membrane, of B-cell(s) / B-lymphocyte(s) ; **A** clonal selection of B-lymphocytes occurs
4 (helper) T-cell / T-lymphocyte, activate B-cells ; **I** killer T-cells
A release cytokines to stimulate B-cells
5 B-cells / B-lymphocytes, divide by mitosis ; **A** replicates / proliferates by mitosis
A clonal expansion of B-cells
6 plasma cells, formed / AW ;
7 plasma cells / B-cells / B-lymphocytes, produce / secrete / AW, antibody / immunoglobulin / Ig ; [max 4]

(c) *parasite / Plasmodium / pathogen / protoctist / protist / protozoan must be mentioned at least once somewhere in the answer to gain any marks*
e.g. 'malaria / disease has many antigens' = 0

if malaria is caused by a virus / bacterium penalise once only

1 (malarial) parasite / pathogen / *Plasmodium*, (is eukaryotic) has many genes ;
A has greater genetic complexity cf smallpox / AW
2 different (malarial) parasite, species / strains / AW, have different antigens ;
R 'strands'
3 (malarial) parasite has different antigens in different stages of its life cycle ;
4 (malarial) parasite / *Plasmodium*, switches antigens / idea of antigens changing during infection / different genes coding for antigens switching on / AW ;
R 'active sites' of antigens changing
R 'antigens mutate'
5 parasite / antigen / stages of the life cycle, inside (host / liver / red blood) cells ; [max 2]

[Total: 9]

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2 **(a)** 1 nitrogen, converted / reduced / fixed, to, ammonium / ammonia (in root nodules) ;
A correct equation $N_2 \left(+ 6e^- + 8H^+\right) \rightarrow (2)NH_4^+ / (2)NH_3$
R if nitrogen fixation is said to happen in the soil
I nitrogen fixation is carried out by leguminous plant
2 (catalysed by) nitrogenase ; *accept if part of equation*
3 ATP, hydrolysed / AW ; *accept if part of equation*
4 ref. to anaerobic conditions ;
5 ammonia (converted) to amino acids to protein (in plants) ;
6 plant protein, digested / hydrolysed / broken down, by animals (into amino acids and absorbed) ;
7 amino acids used to synthesise (animal) protein ; [max 5]

(b) UAC ; [1]

(c) mRNA, less stable / broken down sooner / used only for a short time / does not last long / is temporary / has short (half-) life ; **I** 'used up'
tRNA is re-used (for a longer time); no ora
unless correct ref. to mRNA 'shelf life' [max1]

(d) 1 translation (*in correct context*) / genetic code used to make a sequence of amino acids / AW ;
2 attach / assemble around / moves along / AW, mRNA ;
A ref. to bind mRNA / mRNA 'lies within' the ribosome
R mRNA enters ribosome
3 tRNA(s) carrying amino acid(s), bind to / AW, mRNA ;
A provides two sites for tRNAs carrying amino acids to bind to mRNA
4 binding / pairing / AW, between anticodon on tRNA to codon on mRNA ;
5 (catalyse) formation of peptide bond (to form polypeptide) ;
6 any further detail of translation ;
e.g. peptidyl transferase
ribosome moves along one codon at a time
start codon is AUG
stop codon *in context*
correct roles of P and A sites [max 3]

[Total: 10]

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3 (a) (i) **R** *if more than one stage given*
A = prophase ; **I** early / late
B = interphase ; [2]

(ii) *no ecf from* **(a)(i)**
I *information about other phases*
1 chromatin / chromosomes / chromatids, condense / become visible ;
A described e.g. coiling, supercoiling, shorten, thicken
2 each chromosome is two (sister) chromatids joined together (at a centromere) ;
R 'two chromatids, join together / pair up'
3 nucleolus disappears ;
4 nuclear envelope, disassembles / breaks down / AW ;
5 centrioles / centrosomes, move to poles ;
A MTOC / microtubule organising centre
R 'ends' / 'sides'
6 ref to spindle ; e.g. spindle (fibres) start to form
centrioles organise microtubules (to form spindle fibres)
microtubules assemble [max 4]

(b) 6 ;;

if answer not given or incorrect allow one mark for correct measurement and correct use of formula

distance between **P** and **Q** is 30 mm, conversion to micrometres = 30 × 1000

either (magnification) $= \frac{30000}{5000}$

or $5000 = \frac{30 \times 100}{\text{actualsize}}$

look carefully for correct use of standard form
allow a tolerance of ± 2 mm (28–32 mm, i.e. 28 000–32 000 in formula) [2]

(c) **I** *general references to LM v EM*
A ora *for electron microscope*

1 living cells can be viewed (with light microscope) ;
2 can watch the cell cycle happen (in real time / time lapse) / AW ;
3 all chromosomes can be seen (at once) ;
4 can see, whole chromosomes / all the stages of mitosis or cell cycle ;
5 do not need take sections to see mitosis ;
6 dyes / stains, can be used ; **I** ref. to natural colours of specimens
A ref. to fluorescence microscopy [max 3]

[Total: 11]

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4 (a) **W** right atrium labelled in lumen / wall ;
X tricuspid valve labelled ; **A** valve flap / chordae tendinae *see encircled area on diagram*
Y aorta labelled ; [3]



(b) *needs to be a sequence, not events in the cardiac cycle e.g.* ***I*** *valves*

aorta, body (tissues / blood vessels) / capillaries / systemic circulation, vena cava ;
A body cells
right atrium and right ventricle ;
pulmonary artery (to lungs) ; **R** if blood comes from left ventricle [3]

(c) *max 2 for structural features*
I *fast diffusion, efficient diffusion, reduces diffusion distance*
mps 4, 6, 8 and 10 – can be awarded if related structure is not given but is implied

1 many alveoli ;
2 large surface area ; **I** high SA:V ratio / increase SA
3 many capillaries / network of capillaries ; **I** good blood supply
4 (so) maintain, diffusion / concentration / partial pressure, gradient(s) ;
5 lining / epithelium / wall, of, alveoli / gas exchange surface, is thin / one cell thick / squamous ; **I** thin interstitium
R 'cell walls of' **R** lungs **R** alveoli are one cell thick **R** endothelium / membrane
6 (so) short diffusion distance / only diffuse through two cells ;
7 ref. to, elastin / elastic fibres ; **I** alveoli are elastic
8 (so) allows alveoli to, increase in volume / expand / stretch / stop bursting / recoil ;
R contract
9 (alveolar type II cells secrete) surfactant ;
10 (so) reduces surface tension ; [max 4]

[Total: 10]

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5 (a) *mark both parts together to a maximum of four marks*

1 (polymer / polysaccharide of) β-glucose ; *allow glucose if β given for bond*
2 (1-4, β) glycosidic, bonds / linkages ; **A** glucosidic
R if 1-6 also given
3 ref. to (β) glucose units, linked at 180° to each other / alternately orientated / AW ;
4 many –OH groups projecting out (in different directions) ;
5 unbranched (polymer) / straight chain / linear ;
6 many hydrogen bonds between molecules ;
7 (straight chain allows) molecules lie parallel to each other ;
8 (form) microfibrils ;
9 many microfibrils form (cellulose) fibres ;
10 ref. to fibres at angles / criss-cross / AW ;
11 (cellulose) cell wall is permeable ;
A *idea* of many gaps, in wall / between fibres, allowing passage of water / (named) substances
12 ref. to strength to, prevent cell bursting / withstanding (turgor) pressure / AW ; [max 4]

(b) (i) *data quote may help to decide if mp2 is matched*
units must be used at least once in the answer to award mp3

1 as retention time increases percentage of cell wall material digested increases / positive correlation ;
A 'time for digestion' / reverse relationship
R directly proportional
2 results scattered / not all animals fit the pattern / varying percentages for the same retention time ; *not just a data quote*
3 data quote with units (% and h) using both axes ;
e.g. (highest percentage) 65% at 78 hours
(lowest percentage) 35.5 ± 0.5%, 35 hours
4 no retention time shorter than 35 hours and none longer than 88 hours ;
A lowest / shortest and highest / longest
A reverse relationship **A** 'time for digestion'
5 none of the (24) herbivores can digest the cell wall material completely ;
A no more than 65% is digested
not just a data quote [max 3]

(ii) more digestion means that there is more energy available to the animal ;
ora = undigested material means less energy to the animal

2 more digested material means more energy for, secondary consumers / carnivores / next trophic level / for the food chain ; ora

3 more digested material means more trophic levels ; ora

4 more undigested material provides more energy to decomposers / AW ;

5 AVP ; e.g. ref. to (named) animal productivity
A secondary, production / productivity [max 2]

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(c) *one mark per line*

similarities

use, membrane / integral / intrinsic / transmembrane / transport / carrier, proteins ;
R channel proteins
are specific / have specific binding site ;
involve conformational / shape, change of protein ;
(movement of (named)), ions / polar molecules / water soluble molecules / hydrophilic molecules / lipid insoluble molecules ;
I large molecules **A** charged
(movement) across membranes / into *or* out of the cell ; [max 2]

*differences **A** ora*

facilitated diffusion is (movement from), high(er) to low(er) concentration /
down concentration gradient ; ora **A** diffusion gradient
I 'along a concentration gradient'
facilitated diffusion, is passive process / does not require energy *and / or* ATP (from the cell) ;
R ATP energy
R the cell makes energy for active transport [max 2]

[Total: 13]

6 **(a)** *look at any labelling on the diagram*

cell contents / cytoplasm / not hollow ; **I** ref. to any organelles (not visible)
A xylem vessels are hollow
thin walls ;
A no, thickened walls / lignified walls / lignin
A xylem vessels have, thick walls / lignin
sieve plates / end walls / cross walls ;
A end walls not broken down
A xylem vessels have no end walls
R 'end' unqualified
I end plates / cell plates
no pits ; **A** xylem vessels have pits [max 2]
***I** ref. to companion cells*

(b) dissolved in, water / sap ; **A** in solution
mass flow ;
down (hydrostatic) pressure gradient / moves from high(er) to low(er) pressure (potential) ;
A symbol – ψ_p
AVP ; e.g. from source to sink
loading by, companion / transfer cells, requires ATP / is active ;
I ATP required for mass flow [max 2]

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(c) *answers may be general or in the context of phloem transport*

active site (with shape) complementary to substrate ;
A description in terms of lock and key (either way round)
I structure
induced fit / described ;
substrate binds to active site / enzyme-substrate complex forms / ESC forms ;
ref. to specificity of enzymes ;
activation energy of reaction is lowered ;
example of how activation energy lowered ;
e.g. reactants held close together for bond formation
transfer of electrons
strain on bonds
alternative pathway
holding the substrate in such a way that the bonds needed to be broken are exposed
product released from, enzyme / active site ;
A enzyme can be used again / enzyme unchanged at end of reaction [max 3]

[Total: 7]

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