CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 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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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) *electron microscope*
accept ora for light microscope

1 higher resolution / better resolving power;
A high *only if further detail confirms understanding*

2 more easily able to distinguish between two (separate) points / AW;
A *if no comparative but mp 1 or relevant point in mp 3 gained*

3 **AVP**; able to see points closer together than 200 nm **A** range 100 – 300 nm
can see points up to 0.5 nm (0.0005 μm) apart but LM is 200 nm (0.2 μm) **A** range 0.2 – 1.0 nm
electrons have shorter wavelength (than light)
wavelength of electrons shorter than size of additional structures seen [max 2]

(b) *each feature must be briefly qualified to gain max 3*
penalise once if feature correct but not correctly qualified / or not qualified

1 detail of mitochondria; e.g. inner membrane / crista(e)
double membrane
ribosomes
(circular) DNA

2 detail of chloroplasts; e.g. double membrane
internal membranes
thylakoid(s) / grana / intergrana / lamellae
ribosomes

3 ribosomes, qualified; e.g. visible as small dots
scattered throughout / in cytoplasm
on RER

4 smooth endoplasmic reticulum / SER, qualified; e.g. no ribosomes / tubular / membranous

5 rough endoplasmic reticulum / RER, qualified; e.g. ribosomes / membranous / flattened cisternae;

4/5 endoplasmic reticulum / ER, qualified; e.g. smooth and rough / membranous / throughout cytoplasm

6 Golgi vesicles / secretory vesicles / lysosomes qualified;
e.g. forming from Golgi
ref. exocytosis (not for lysosomes)
seen as (small) sacs / AW
membranous

7 heterochromatin darker staining / euchromatin lighter staining;
A chromosomes seen as heterochromatin and euchromatin

8 nucleus has, nuclear envelope / two membranes;

9 nuclear pores in nuclear envelope;

10 cell surface membrane, qualified; e.g. to the inside of the cell wall

11 *idea that* (cell) membranes are visible, qualified; e.g. thin / round / within organelles /

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named organelle [max 3]

(c) *award two marks if correct answer is given, only one mark if μm (units) given*

× 1600;;
A in range of × 1400 to × 1800

(8 000 / 5 μm)
7 000 / 5 μm = (1400)
9 000 / 5 = (1800)

award one mark if correctly measured and divided by 5 μm but incorrectly converted
award one mark if incorrect measurement (e.g. whole cell) but correct formula used (i.e. divided by 5 μm) [2]

(d) (i) 1 amylopectin branched / AW; **ora**
2 amylose, spiral /spiralled / helix / helical; **ora**
R α – helix
R coiled
allow ecf from mps 1 and 2 to award mp 3
3 amylose (α) 1 – 4 linkages but 1 – 4 and 1 – 6 linkages in amylopectin / amylose has 1 – 4 linkages only;
accept from clearly labelled diagram(s) [max 2]

(ii) *any one valid; e.g.*
1 for chlorophyll, structure / synthesis / formation / AW
2 for ATP functioning **A** required for energy transfers
3 for enzyme, functioning / cofactor
4 signalling ion / regulates carbon fixation
5 for, DNA / RNA, synthesis
6 stabilises, DNA / RNA, structure
7 required in, translation / joining, small and large subunits (of ribosomes) [1]

[Total: 10]

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2 (a) (i) 1 obvious bilayer (of phospholipids) shown, phospholipid with single head and two tails;
must have inner / outer membrane label(s) to gain mp 2 and 3
allow 1 mark if both glycoprotein and glycolipid on one side and no inner / outer label

2 glycoprotein labelled; } **A** glycocalyx *for one mark, must have inner / outer label*
3 glycolipid labelled; }

4 one type of protein drawn and labelled as protein;
treat description as neutral

5 protein type qualified; e.g. if protein is labelled as

integral / intrinsic	*must extend into hydrophobic core and be in phosphate head portion*
transmembrane / transport / carrier / channel / pore	*must extend across / through bilayer if channel protein must show channel*
peripheral / extrinsic	*must be on surface / on one side*
aquaporin	
gated protein	

6 cholesterol, labelled; *must extend into hydrophobic core*
if, circular / globular, must be smaller diameter than phospholipid head or have a single tail
R *if indistinguishable from a protein drawn on diagram*

7 detail of phospholipid, labelled; e.g. phosphate / hydrophilic head
fatty acid / hydrocarbon / hydrophobic tail
saturated / unsaturated fatty acid tails

8 hydrophobic core, labelled;
look for label to include both layers

9 **AVP**; e.g. cytoskeletal filaments [max 5]

(ii) *fluid*
1 molecules (of membrane) move about / AW; **A** *idea of membrane flowing*
2 further detail; ref. to phospholipid and protein molecules moving or ref. to (lateral) diffusion
phospholipid and protein molecules move about = 2 marks

mosaic
3 protein molecules, interspersed / scattered / not a complete layer / AW;
4 many / AW, different / AW (protein molecules); [max 3]

[Total: 8]

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3 (a) (i) all arrow heads in correct direction (phytoplankton to herring / krill, krill to herring, herring and krill to whale); [1]

(ii) secondary / tertiary, consumer;
A third / fourth (trophic level) [1]

(iii) 1 plenty of food available / AW;
A feeding on more than one trophic level
2 further detail; e.g. phytoplankton efficient at converting light energy
phytoplankton blooms
little / no competition
ref. efficient feeding mechanism
3 short food chains / fewer links of the food chain;
4 less energy lost overall;
A *idea in terms of* percent lost at each level
5 few, indigestible / inedible parts; [max 3]

(b) 1 fat / blubber = triglyceride;
2 fat / blubber / triglyceride, used as <u>energy</u>, store / reserve;

decreases
3 less fat in cells; ora
A fewer fat-filled cells / less adipose tissue
4 mobilised / respired / converted to fatty acids (**A** glucose), to release energy (during non-feeding season);
5 energy (from fat mobilisation) used, qualified; e.g. for movement

increases
6 food eaten / during feeding season, <u>conversion</u> to, fat / AW (for storage);
7 ref. thermal insulation;
A *idea of* prevents heat loss **R** keeps it warm [max 2]

(c) 1 (good) solvent / AW; e.g. (many) ions / minerals dissolve (in water)
A idea of (sufficient) dissolved respiratory gases (to support life)
2 provides, buoyancy / support / AW;
A *idea of floating*
3 (buoyancy / support) enables some to attain a large size / supports large mass / enables phytoplankton to remain, near / at surface;
4 high specific heat (capacity);
5 qualified; aquatic environment, more temperature stable / slow to change temperature / helps whale to maintain constant body temperature
6 ice, floats / less dense than water;
7 acts as insulator / prevents heat loss from water / water is underneath allowing survival in the winter;
8 transparent, for light penetration / for photosynthesis / for visual cues;
9 (density changes causing convection) currents, maintain circulation of nutrients / make nutrients available to support phytoplankton;
10 **AVP**; e.g. ref. to surface tension prevents sinking (small organisms) ref. to gamete movement [max 3]

[Total: 10]

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4 (a)

name of disease	type of causative organism	name of causative organism
cholera	bacterium / bacteria	*Vibrio cholerae*
HIV / AIDS	virus	human immunodeficiency virus;
malaria	protoctist; **A** protozoa / protista **A** apicomplexa / sporozoa	*Plasmodium, vivax / ovale / falciparum / malariae;* **A** *Plasmodium (spp)*
tuberculosis (TB)	bacterium / bacteria;	*Mycobacterium tuberculosis*

[4]

(b) (i) cholera; [1]

(ii) antibiotics / antibacterials / antimicrobial and one reason;
e.g. kill / inhibit, bacteria
bacterial infection / caused by bacterium
do not kill humans
A harmless to human / AW [1]

(iii) 1 vaccinated children, are immune / AW;
ignore resistant
2 herd effect;
3 explained; e.g. sufficient / AW, vaccinated / immune, to prevent spread (to susceptible individuals)
4 example of another factor that became effective; e.g. less money spent on drugs so more for better diet
prevention method described to avoid, food / water, contamination [max 2]

(c) (i) 1 bacterial (surface) antigens / epitopes, act as, non-self / foreign antigens;
2 human cells have self antigens;
3 (antigens are), proteins / polysaccharides;
4 (non-self antigen) will trigger phagocytosis / phagocytes have receptor (only) for, bacterial / non-self, antigens / proteins; **ora** for self antigens
5 ref. to non-self and self antigens containing different sequences of amino acids / self antigens are products of body's genotype / AW;
6 *idea that* phagocytes bind to antibodies complexed with (non-self) antigens (and human cells will not have bound antibody); [max 3]

(ii) *any reasonable; e.g.*
mechanism to prevent, phagosome formation / lysosome fusion with phagocytic vacuole
able to withstand attack by (hydrolytic) enzymes
contain enzyme inhibitors
able to degrade (hydrolytic) enzymes
protective capsule [max 1]

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(iii) reduction in numbers of T (h) lymphocytes; **A** CD_4 (cells) macrophages
ref. to role of T(h) cells e.g. enhanced humoral response, increase macrophage action; lowered immune system / poor immune response / AW; e.g. unable to produce sufficient T/B cells / insufficient stem cells available [max 2]

[Total: 14]

5 **(a)** 1 complementary bases / base pairing, hold(s) strands together / AW;
2 (because of) <u>many</u> hydrogen bonds;
R if between adjacent nucleotides
if mp 1 and 2 not awarded
1/2 hydrogen bonds hold strands together;
3 sugar-phosphate backbone / AW, with covalent / phosphodiester, bonds;
4 double helix structure protects bases;
5 **AVP**; coiling protects from, chemical / enzyme, attack [max 2]

(b) 1 (information is) ref. (different) sequence / order of bases / nucleotides (in the polynucleotide strand);
A described in terms of sequence of bases
2 DNA / gene, contains / AW, information for the synthesis of a, polypeptide / protein / enzyme;
3 *idea that* (coded because) information becomes sequence of amino acids;
4 *idea that* information passed on (cell to cell / parent to offspring); [max 2]

(c) (late) interphase / S phase / synthesis phase; [1]

(d) 1 <u>different</u> sequence of bases / nucleotides;
2 (as a result of) mutation;
3 base <u>substitution</u>;
4 CTT replaced by CAT;
A GAA replaced by GUA (for mRNA codon)
5 glu(tamate) substituted by val(ine); [max 3]

(e) 1 increasing concentration of ara-ATP decreases enzyme activity;
can be comparison between 0 and 5 / 20 or between 5 and 20
A ref. to rate of DNA synthesis for enzyme activity
2 ara-ATP acting as an <u>inhibitor;</u>
3 substrate unable to bind with active site / fewer enzyme-substrate complexes (formed);
4 further detail;
for either competitive
e.g. competes with substrate for (binding to) the active site / similar, structure / shape, as substrate *or* complementary shape to active site
or non-competitive inhibition
e.g. binds to site other than active site / changes shape of active site [max 3]

[Total: 11]

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6 **(a)** *one mark each correct label to max 3;;;* [max 3]

(b) **X** marked over coronary artery section before graft joins; [1]

(c) cure for, coronary artery disease / atherosclerosis in artery;
A arteriosclerosis
so less risk of, myocardial infarction / heart attack / AW;

prevention of coronary artery disease to avoid bypass surgery
one example; e.g. no smoking
increase exercise
low, (saturated) fat / cholesterol, diet
reduce alcohol consumption
reduce salt intake
statins
avoid, excessive / AW, sugar
avoid obesity

ref. to difficulties in getting people to change lifestyle to prevent;

disadvantage of, surgical procedure / cure;
accept ora prevention
e.g. invasive / painful
costly medical
lost time / money, by absence from work
risk of complications / graft rejection / infection
risk / graft becoming diseased / collapsing

AVP; e.g. *idea that* as cure is available, more difficult to encourage prevention [max 3]

[Total: 7]

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