

**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:

<b>;</b>	separates marking points
<b>/</b>	alternative answers for the same point
<b>R</b>	reject
<b>A</b>	accept (for answers correctly cued by the question, or by extra guidance)
<b>AW</b>	alternative wording (where responses vary more than usual)
<b><u>underline</u></b>	actual word given must be used by candidate (grammatical variants excepted)
<b>max</b>	indicates the maximum number of marks that can be given
<b>ora</b>	or reverse argument
<b>mp</b>	marking point (with relevant number)
<b>ecf</b>	error carried forward
<b>I</b>	ignore
<b>AVP</b>	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  $\mu\text{m}$ ) apart but LM is 200 nm (0.2  $\mu\text{m}$ ) **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  $\mu\text{m}$  (units) given

$\times 1600$ ;;

**A** in range of  $\times 1400$  to  $\times 1800$

(8 000 /  $5\mu\text{m}$ )

7 000 /  $5\mu\text{m}$  = (1400)

9 000 / 5 = (1800)

award one mark if correctly measured and divided by  $5\mu\text{m}$  but incorrectly converted

award one mark if incorrect measurement (e.g. whole cell) but correct formula used

(i.e. divided by  $5\mu\text{m}$ )

[2]

- (d) (i) 1 amylopectin branched / AW; **ora**  
 2 amylose, spiral /spiralled / helix / helical; **ora**  
**R**  $\alpha$  – helix  
**R** coiled  
 allow ecf from mps 1 and 2 to award mp 3  
 3 amylose ( $\alpha$ ) 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 / *must extend across / through bilayer if channel protein must*  
channel / pore *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 energy, 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, conversion 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	<i>Vibrio cholerae</i>
HIV / AIDS	virus	human immunodeficiency virus;
malaria	protocist; <b>A</b> protozoa / protista <b>A</b> apicomplexa / sporozoa	<i>Plasmodium, vivax / ovale / falciparum / malariae</i> ; <b>A</b> <i>Plasmodium (spp)</i>
tuberculosis (TB)	bacterium / bacteria;	<i>Mycobacterium tuberculosis</i>

[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<sub>4</sub> (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) many 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 different sequence of bases / nucleotides;  
 2 (as a result of) mutation;  
 3 base substitution;  
 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 inhibitor;  
 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]**