UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

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 must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of 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 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

1 **(a)** **A =** anaphase **;**
B = prophase **;**
C = metaphase **;** [3]

(b) ref. newly formed / daughter cells (following, telophase / mitosis) **;**
cells, entering / at early interphase **;**
cells, at synthesis stage / making proteins **;**
cells growing (to, mature/normal, size) *or* cells not grown to, mature / normal, size **;** AW **R** not elongated [max 1]

(c) *any 2 relevant e.g.*
cells metabolically active / AW **;**
protein synthesis **;**
transcription **;**
translation **;**
gene expression **;**
DNA / semi-conservative, replication **;**
respiration **;**
synthesising, organelles / named organelle(s) **;** e.g. **A** centrioles replicate
synthesising, macromolecules / named macromolecule **;** [max 2]

[Total: 6]

2 (a) (i) *habitat* = **B**
ecosystem = **A** ;

abiotic component = **C** ;

ecological niche = **F** ;

population = **E**
community = **D** ; [max 4]

(b) *seaweed* = (primary) producer **;** **A** first (trophic level)

limpet / P. vulgata	*crab / C. maenas*
primary consumer	secondary consumer
A 1° consumer	**A** 2° consumer
A second (trophic level)	**A** third (trophic level)

;

max 3 for energy losses

energy losses in
respiration **;**
heat loss, qualified **;** e.g. heat loss, from digestion / movement / metabolism
heat loss in respiration = 1 mark
indigestible parts **;** **A** named, e.g. cellulose
inedible parts **;**
excretion **;** **A** named excretory products
egestion **;** **I** waste
death, not eaten **;** [max 4]

[Total: 8]

3 (a) **1** small size / 6-8 μm (diameter), to squeeze through capillaries (7 μm) **;**
2 small size / 6-8 μm (diameter), so, haemoglobin (molecules) near to surface (of plasma membrane) / reduces distance for diffusion (in / out of rbc) **;**
3 no nucleus / lack of organelles, so more room for haemoglobin (so more oxygen transported) **;** **R** more room for oxygen
4 biconcave shape / diagram drawn, increases surface area for, diffusion / uptake / release (of oxygen) **;**
5 flexible / AW (membrane), to squeeze through capillaries **;** [max 3]

(b) **1** enzymes are proteins, protein synthesis does not occur **;**
2 no, nucleus / DNA / genes, so no, transcription / mRNA **;** } *
3 no <u>mRNA</u>, so no, translation / protein synthesis **;** }
***A** no nucleus, so no protein synthesis *for one mark*
4 no, RER / ribosomes, site of protein synthesis / AW **;**
5 no mitochondria, insufficient ATP (for synthesis) **;**
6 no RER for modification (of protein) **;** **A** Golgi apparatus [max 2]

(c) (i) iron **;** **A** Fe^{2+} / Fe^{3+} / ferrous / ferric [1]

(ii) amino acids / peptides **;** [1]

(d) <u>carbonic anhydrase</u> **;** [1]

(e) **1** <u>diffusion</u> of, carbon dioxide / CO_2**;**
2 into red blood cell from correct source **;**

3 description of <u>carbonic acid</u> formation followed by H^+ production **;**
4 ref. carbonic anhydrase) fast reaction**;** **A** ecf from **(d)**

5 haemoglobin has a higher affinity for hydrogen ions than oxygen **;**
A haemoglobin releases oxygen more easily in acidic conditions
accept idea of H^+ binding to haemoglobin bringing out oxygen release
6 ref. to, allosteric effect / change in tertiary structure **/** AW, in (oxy)haemoglobin, causes, release / AW, of oxygen **;**
7 formation of <u>haemoglobinic acid</u> **;** *must refer to, H^+ binding / decreased pH*
8 ref. higher partial pressures / AW, CO_2, linked to (oxy)haemoglobin releasing, more oxygen / oxygen more readily **;** *Bohr shift*
9 formation of <u>carbamino-haemoglobin</u> **;** **R** carboxyhaemoglobin

10 chloride shift, qualified **;**
e.g. as hydrogen carbonate ions move out of cell, chloride ions move in e.g. to maintain, electroneutrality / a balance of charge / ions **;** [max 5]

[Total: 13]

4 (a) *Mycobacterium, tuberculosis / bovis* ; 1

(b) (i) *2 marks for correct answer*
x 30 000 ;;
(image length = 60 mm) 60 000μm / 2μm **A** 59 / 61 mm (29 500 / 30 500)
1 mark if incorrect answer e.g. not converted correctly, but measurement and method correct [2]

(ii) *any 3 relevant e.g.*
DNA not surrounded by, nuclear, envelope / membrane ; AW
A no (true) nucleus
circular DNA ; **A** loop
DNA not complexed with histone proteins ; **A** naked DNA
(only) 70S / smaller / 18nm, ribosomes ; **A** ribosomes not attached to membranes
no double membrane-bound organelles; **A** no, mitochondria / chloroplasts
absence of named organelle ; e.g. Golgi apparatus, ER / RER / SER
if previous mp not given, **A** no membrane-bound organelles
capsule / slime layer ;
very small diameter / 0.5 to 5.0μm ;
cell wall of, murein / peptidoglycan ;

examples of other relevant points
pili / pilus ;
no 9+2 microtubule arrangement ;
flagellum not covered by cell surface membrane ;
presence of plasmids ; [max 3]

(c) (i) *any 1 relevant e.g.*
ref. (BCG) vaccine / vaccination programme ;
improvements in housing conditions / less overcrowding (housing) / better ventilated homes ; **R** better standards of living *unqualified*
earlier detection / mass, chest X-ray / screening ; *i.e. in preventing spread*
improvements in diet (leading to better immune system) / AW ;
improved awareness of, transmission / AW ; **R** better education unqualified
contact tracing / explained ;
ref. testing / treating, cattle / milk ; [max 1]

(ii) *any 3 relevant e.g.*
development of antibiotic resistance (by organism) ; **A** drug resistance
R immunity
ref. impact of HIV infection ;
higher rate of immigration from countries with high incidence / AW ;
increase in tourism to countries with high incidence ;
reduced surveillance leading to undetected cases (and hence spread) ;
(detected cases, MDR) unwillingness / AW, to maintain drug regimen / AW ;
ref. to vaccination programmes no longer taking place ;
ref. to poor / overcrowded, housing (in cities) / AW ; *must be in context of developed countries* [max 3]

(d) (i) binding of tRNA prevented ;
(so) no anticodon-codon binding ;
peptide bond formation prevented ;
mRNA attachment prevented ;
inhibition of enzymes involved in translation ;
ribosome movement along mRNA, hindered / prevented ;
inhibits association of large and small subunits / AW ; [max 2]

(ii) *mammalian cell*
cell surface membrane impermeable ;
degraded, before entry into / within, the cell ;
broken down by enzymes ;
eukaryotic / 80S (22nm) / larger / different, ribosomes / ribosome structure ; [max 1]

[Total: 13]

5 (a) **A** = glycerol ;
B = ester bond ; **I** covalent
C = fatty acid *or* hydrocarbon, chain / tail ; [3]

(b) (i) 2, fatty acid / hydrocarbon, chain / tails ;
(third fatty acid replaced by a) phosphate group ;
AVP ; (most) contain, nitrogen / choline (attached to phosphate in, head / polar portion) ; [max 2]

(ii) can form a bilayer ;
link between, hydrophobic core / AW, and barrier to water-soluble substances ; **A** polar / ionic
idea of, hydrophilic / phosphate, head, forming H bonds with water ;
A facing, water / watery environment / aqueous environment / cytoplasm / cytosol

ref. contribution to fluid nature of membrane ;
further detail ; e.g. mainly saturated fatty acids, less fluid e.g. mainly unsaturated fatty acids, more fluid
ref. to control over membrane protein orientation ; e.g. hydrophobic – hydrophobic interaction for 'floating' proteins [max 3]

(c) optimum pH *or* pH at which, lipase / enzyme, works best ; [1]

(d) (i) pH, decreases / AW, over time ;
steep decrease / high rate, in first 5 minutes ; **A** faster
less steep decrease / levels out, correct time ref ; **A** slower
correct, manipulation of data / comparative data quote (ref. to both axes) ;
e.g. pH 8 – 7.3 from 0 – 5 min
pH 7.3 – 6.45 from, 50 / 60, min [2]

(ii) triglyceride / oil, hydrolysed / broken down / digested, to produce (fatty) acids ;
increasing, acids / H^+ / hydrogen ions, decreases / AW, pH ;

accept, triglyceride / lipid, for substrate throughout

steep decrease
ref. enzyme has high initial turnover rate *or* high rate of, collision between enzyme and substrate / ES complex formation ;
(because initially) high concentration of, substrate / triglyceride ;

less steep / levelling / plateau,
substrate, being used up / used up / limiting ;
active sites available *or* fewer enzyme substrate collisions / fewer ES complexes formed;
ref. presence of hydrogen ions, partial denaturation (less steep) / denaturation (plateau);
A description of denaturation [4]

[Total: 15]

6 (a) ref. to coronary arteries ; *in correct context*
makes platelets sticky, so causing blood to clot ;
increases risk of thrombosis in, coronary arteries / arteries to heart (muscle) ;
leading to plaque / atheroma / atherosclerosis / AW ;
increases heart rate ;
increased blood pressure ;
damage to, tunica intima / endothelium /endothelial lining / arterial lining ; [max 4]

(b) *any one valid statement for 1 mark*

agree
less addicted to smoking cigarettes so fewer smoked ;
fewer smoked, so reduced risk of smoking-related diseases ; **A** named disease
fewer smoked so reduced risk from, (effects of) tar / carbon monoxide ;

disagree as people may smoke more
may smoke more to, increase their nicotine levels / satisfy need for nicotine / AW ;
more smoked, so increased risk of smoking-related diseases ; **A** named disease
may smoke more so increased risk from, (effects of) tar / carbon monoxide ;

AVP ; *for either agree or disagree*
e.g. disagree as may still smoke and there are still other carcinogenic chemicals such as tar
[max 1]

[Total: 5]