

**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.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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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

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

[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)

<i>limpet</i> / <i>P. vulgata</i>	<i>crab</i> / <i>C. maenas</i>	
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]

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- 3 (a) 1 small size / 6-8  $\mu\text{m}$  (diameter), to squeeze through capillaries (7  $\mu\text{m}$ ) ;  
 2 small size / 6-8  $\mu\text{m}$  (diameter), so, haemoglobin (molecules) near to surface (of 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 mRNA, 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**  $\text{Fe}^{2+}$  /  $\text{Fe}^{3+}$  / ferrous / ferric [1]  
 (ii) amino acids / peptides ; [1]
- (d) carbonic anhydrase ; [1]
- (e) 1 diffusion of, carbon dioxide /  $\text{CO}_2$ ;  
 2 into red blood cell from correct source ;  
 3 description of carbonic acid formation followed by  $\text{H}^+$  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  $\text{H}^+$  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 haemoglobinic acid ; *must refer to,  $\text{H}^+$  binding / decreased pH*  
 8 ref. higher partial pressures / AW,  $\text{CO}_2$ , linked to (oxy)haemoglobin releasing, more oxygen / oxygen more readily ; *Bohr shift*  
 9 formation of carbamino-haemoglobin ; **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]

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

(b) (i) 2 marks for correct answer

x 30 000 ;;

(image length = 60 mm) 60 000 $\mu$ m / 2 $\mu$ m 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 5.0 $\mu$ m ;

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]

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(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]

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(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<sup>+</sup> / 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]