

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

**MARK SCHEME for the May/June 2011 question paper  
for the guidance of teachers**

**9790 BIOLOGY**

**9790/02**

Paper 2 (Structured), maximum raw mark 85

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.

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Abbreviations, annotations and conventions used in the Mark Scheme

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
R	=	reject
( )	=	words which are not essential to gain credit
<u>    </u>	=	(underlining) key words which <b>must</b> be used to gain credit
ecf	=	error carried forward
AW	=	alternative wording
A	=	accept
ora	=	or reverse argument

- 1 (a) (i) bacterium / prokaryote ; **A** bacteria / bacillus [1]
- (ii) **A** – cell wall ;  
**B** – cell membrane ;  
**C** – (bacterial) chromosome / DNA / chromoneme ; **A** nucleoid [3]
- (iii) (70S) ribosome ; [1]
- (iv) *award two marks for the correct answer with appropriate unit  
(0.35  $\mu\text{m}$ , 350 nm, 0.00035 mm)  
if incorrect answer or no answer award one mark for dividing measurement by  
magnification, accept  $\pm 1$  mm*
- actual size = 35 mm
- $\frac{35 / 35\,000 / \text{AW}}{100\,000}$
- 0.35  $\mu\text{m}$  / 350 nm / 0.00035 mm ;;
- A** 0.34 – 0.36  $\mu\text{m}$  / 340 - 360 nm / 0.00034 – 0.00036 mm / 3.4 – 3.6  $\times 10^{-4}$  mm [2]
- (b) 1 (bacteria stained) blue / purple, are Gram +ve ;  
2 Gram +ve bacteria have a thick(er), cell wall / peptidoglycan layer (than Gram -ve) ;  
3 Gram +ve lack outer, lipid / lipopolysaccharide, membrane / layer ; **ora**  
4 crystal violet / iodine, stains, cell wall / peptidoglycan, blue / purple ;  
5 not washed away when, decolourising solution / alcohol / propanone, is added ;  
6 Gram -ve stains, red / pink ; **A** not blue  
*idea that*  
7 membrane is removed when, alcohol / acetone, is added so, crystal violet / iodine, does  
not remain ;  
8 wall is thinner so any, crystal violet / iodine, is washed out ;  
9 AVP ; [max 4]

[Total:11]

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- 2 (a) (i) glycosidic bond shown as forming between OH on C1 and OH on C4 ,  
and glucose residues rotated so that –O– in the rings are opposite each other ;
- bond formation may be shown diagonally between C1 and C4 or by rotating one of the  
glucose molecules so the OH groups are adjacent*
- water molecule formed ; [2]
- (ii) ( $\beta$  1-4,) glycosidic ; [1]
- (b) *similarities*
- 1 have –OH groups / both have more than one –OH group ;
  - 2 have an aldehyde group ; **A** both are aldoses ;
  - 3 have a ring structure / have an O in the ring ;
  - 4 can also be straight chains ;
  - 5  $\text{CH}_2\text{O}$  ;
  - 6 AVP ; [max 2]
- difference*  
(*ribose is*) pentose / 5C, ( $\beta$  glucose is) hexose / 6C ; **A**  $\text{C}_5\text{H}_{10}\text{O}_5$  ,  $\text{C}_6\text{H}_{12}\text{O}_6$  [1]
- (c) (i)
  - 1 compact ;
  - 2 insoluble ;
  - 3 osmotically, inactive / inert ;
  - 4 ref to water potential ;
  - 5 easily formed / easily recovered *or* mobilised ;
  - 6 ref to free ends ;
  - 7 ref to branching of amylopectin providing, free ends / easy mobilisation ;
  - 8 amylopectin ideal storage molecule ;
  - 9 ref to energy storage ; **A** respiratory substrate [max 4]
- (ii) more branching points allows fast, storage / mobilisation, of glucose ;  
*idea that may have arisen by mutation / evolutionary accident ;* [1]
- [Total: 11]**

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- 3 (a) all organisms share the same genetic code / AW ;  
**A** transcription is possible / promoters work in the same way [1]
- (b) (i) 1 *role of promoter is to switch on genes ;*  
2 ref to, transcription ; **A** described  
3 only in the rice endosperm ;  
4 not expressed anywhere else (would be a waste of energy / resources) ;  
5 in edible part of seed ; [max 2]
- (ii) 1 use restriction, enzyme / endonuclease ;  
2 cut plasmid / open plasmid ;  
3 sticky ends / complementary bases ;  
4 ref to hydrogen bonding / A - T / C - G ;  
5 role of ligase, in sealing sugar-phosphate backbone / AW ; [max 3]
- (iii) 1 can insert into plant DNA / carries other genes into plant genome ;  
2 ref to vector ;  
3 ref to, tumour inducing / Ti / genes concerned with insertion ; [max 2]
- (iv) microprojectile / biolistics / gene gun / micropipette ; [1]
- (c) 1 step (of several) with lowest rate ;  
2 slowing entire pathway / determines rate of rest of pathway / step that controls rate of other steps / AW ;  
3 step that controls rate at which product is made ; [max 2]
- (d) 1 increase expression of *psy* ;  
2 by genes from other sources ;  
3 by, better / different, promoter ;  
4 by more than one copy of gene ; [max 2]  
5 AVP ; e.g. increase rate of production of enzyme, ref to role of gene product
- (e) (i) 1 gene transfer to other rice ;  
2 contamination of other crop (e.g. ref to organic crop) ;  
3 gene transfer to wild relative ;  
4 gene transfer via bacteria or viruses with unknown effect ;  
5 recipient plant outcompetes others / ref to 'superweed' ;  
5 toxic to non pests ;  
6 AVP ; *must be something specific not a vague answer* [max 1]
- (ii) 1 allergy ;  
2 long term toxicity ;  
3 antibiotic resistance of gut bacteria if antibiotic marker used ;  
4 gene transfer to, virus to human cells / gut bacteria, with unknown effect ;  
*if idea not used in (i)*  
5 AVP ; [max 1]
- [Total: 15]**

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4 (a) (i) multipotent cells can differentiate into a limited number of cell types (but not into whole organism); [1]

- (ii) 1 external growth factors (first messengers) / mitogens / cytokines / AW ;  
 2 receptors on cell (surface) membrane ;  
 3 activate kinases ;  
 4 kinases phosphorylate enzymes (and alter their activity) ;  
 5 activate, transcription factors / promoters ;  
 6 increase production of cyclins ;  
 7 cyclins / kinases control stages of, cell cycle / mitosis ;  
 A ref to checkpoints during cell cycle [max 3]

- (iii) 1 each stem cell contains a complete genome ;  
 2 genes for all features required by different cell types ;  
 3 example of cell required in tendons ;  
 e.g. cells in wall of blood vessels , connective tissue cells, fibroblasts  
 4 cells will be in slightly different conditions ;  
 5 different genes will be expressed / AW, in different conditions ;  
 6 ref to role of gene product ;  
 7 gene expression alters the possibility of expression of further genes ;  
 8 influence of signals from adjoining cells ;  
 9 influence of signals from distant cells ; [max 3]

- (b) 1 diagram shows (TS) of, sarcomere / myofibril / thick and thin filaments ;  
 2 in relaxed muscle ;

*credit these points if they are on a diagram of LS sarcomere / thick and thin filaments*

- 3 Q shows, actin / thin, filaments, alone ;  
 4 R shows, myosin / thick, filaments alone ;  
 5 P is overlap between thick and thin filaments ;  
 6 Q is I band ;  
 7 P is (overlap region of) A band ;  
 8 R is H zone ;  
 9 if contracted muscle, then, no / little, I band and H zone ; [max 4]

(c) *at end of motor neurone to max 3*

- 1 neuromuscular junction / motor end plate ;  
 2 calcium ions enter / AW, when action potential arrives ;  
 3 stimulates vesicles to, move towards / fuse with, pre-synaptic membrane ;  
 4 further detail ; e.g. voltage gated channel proteins for calcium ions

*muscle to max 3*

- 5 impulse / action potential, in, sarcolemma / T-tubules, stimulates release of calcium ions from sarcoplasmic reticulum ;  
 6 calcium ions combine with troponin ;  
 7 movement of tropomyosin ;  
 8 exposing myosin binding sites on thin filaments ;  
 9 actin and myosin interact ;  
 10 further detail of role of calcium ions in muscle ;  
 11 when no action potential calcium ions pumped back into sarcoplasmic reticulum ; [max 5]

[Total: 16]

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- 5 (a) *flightless birds in New Zealand*
- 1 evolved from birds that could fly / flighted birds migrated to New Zealand ;
  - 2 ref to founder effect / rapid evolution on islands ;
  - 3 absence of mammals ;
  - 4 available niches ;
- credit ref to takahē as a ground-dwelling, herbivorous animal / grazer, occupying a niche that is associated with mammals elsewhere*
- 5 abundant, food / resources, on ground ;
  - 6 nesting sites available on the ground ;
  - 7 few / no, predators ;
  - 8 advantage in being flightless as flight requires considerable energy ;
  - 9 ref to (natural) selection ;
  - 10 AVP ; e.g. ref to non-flying, trait / allele(s) [max 4]
- (b)
- 1 humans introduced, predators / invasive species / domesticated species ;
  - 2 named example(s), e.g. stoats, rats ;
  - 3 habitat change as a result of environmental changes ;
  - 4 isolated / trapped, populations ;
- A geographical isolation or ref from passage about population on mountains
- 5 cannot fly to other areas ;
  - 6 ref to effects of inbreeding in small populations ;
  - 7 ref to, pathogens / disease ;
  - 8 ref to, habitat destruction by humans / other appropriate human influence(s) ;
  - 9 AVP ; [max 3]
- (c)
- 1 fundamental niche represents the possible range of a species ;
  - 2 realised niche may be less than ideal ;
  - 3 range restricted by limiting factors ;
  - 4 including interactions with other organisms ;
  - 5 e.g. interspecific competition / named example ;
  - 6 e.g. food availability ;
  - 7 e.g. presence of predators / disease ;
  - 8 realised niche has features of fundamental niche ;
  - 9 features must be identified before endangered species is transferred ;
  - 10 use of information about the fundamental niche of the takahē ;
  - 11 use of information about the realised niche of the takahē ;
  - 12 realised niche *now* may not be optimal as a result of changes in the past ;
  - 13 AVP ;

[Total: 11]

- 6 (a) award one mark for each feature plus its adaptation. Some features have the same adaptation.

	features	adaptations
1	wide / large cross sectional area / large diameter	transport large volume of water / low resistance to flow ;
2	lack of cross walls / continuous columns	low resistance to flow / allows continuous flow of water ;
3	empty / no cytoplasm / AW	low resistance to flow ;
4	pits R 'gaps'	permit lateral movement / AW ; allows movement around cavitation ;
5	thickening of (secondary) wall A lignification	provides mechanical support / strengthens wall to prevent collapse under tension ; R strength unqualified / rigid R resisting positive pressure
6	annular / spiral, thickening	allows xylem vessels to stretch during growth without collapsing ;
7	lignin in walls	waterproofing wall (so water remains inside lumen) ;
8	AVP ; e.g. hydrophilic nature of cellulose	e.g. ref to adhesion of water to walls of xylem vessels

R adhesion of water to lignin as it is hydrophobic

R refs to capillarity

[max 4]

- (b) (i) *loblolly pine*

- 1 comparative descriptive comment ;  
e.g. time delay between high rates of transpiration and water absorption
- 2 comparative data quote (transpiration and water absorption) ;
- 3 environmental conditions promote stomatal opening and loss of water vapour ;
- 4 *idea that* transpiration drives water absorption ;
- 5 transpiration sets up a water potential gradient ;
- 6 ref to cohesion-tension from leaf to root ;
- 7 water enters roots ;

*rate of transpiration decreases after 1400 hours*

- 8 reaches water stress at 1400 hours ;
- 9 stomata close ;
- 10 stated environmental conditions change after 1400 hours ;

- 11 AVP ;

[max 4]

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- (ii) 1 prickly pear / *Opuntia ficus indica*, is a xerophyte ;  
2 example of xeromorphic feature ;  
3 very low rate of transpiration / data quote ;  
4 rate of transpiration peaks at 1800 hrs, after hottest part of the day ;  
5 (suggests that) prickly pear / *Opuntia ficus indica*, is a CAM plant ;  
6 stomata closed during the day / only open at night ;

[max 3]

[Total:11]

- 7 (a) (i) (theca of) follicle (in ovary) ;  
A adrenal cortex

[1]

- (ii) 1 increase in concentration of  $17\beta$ -oestradiol (during first half of cycle) ;

*oestrogen /  $17\beta$ -oestradiol*

- 2 acts on endometrium ;  
3 to stimulate, repair / cell division / growth of blood vessels / growth of glands ;  
4 thickening ;  
5 AVP ;

[max 3]

- (b) 1 hormones act by negative feedback on, anterior pituitary / hypothalamus ;  
2 decrease release of gonadotrophin-releasing hormone / GnRH ;  
3 decrease release of FSH, so development of follicles inhibited ;  
4 no oestrogen for positive feedback which would release (surge) of LH (mid cycle) ;  
5 no, ovulation / release of oocyte ;  
6 stimulates thickening of cervical mucus ;  
7 prevents thickening of endometrium / AW ;

[max 3]

- (c) *woman may be infertile because of high concentration of oestrogen / failure of negative feedback control of oestrogen secretion*

- 1 clomiphene, interacts with / blocks, oestrogen receptors ;  
2 *acts as a* competitive oestrogen receptor antagonist on, gonadotrophin-secreting cells in anterior pituitary / GnRH secreting cells in hypothalamus ;  
3 reduces negative feedback effect of oestrogen ;  
4 gonadotrophin-releasing hormone / GnRH, secreted from hypothalamus ;  
5 increases secretion of, FSH / LH, from anterior pituitary ;

[max 3]

[Total: 10]