**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

**9700/41** Paper 4 (A2 Structured Questions), maximum raw mark 100

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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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 as guidance) |

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**1** **(a)** 36 **;**;
*allow one mark for number not rounded up i.e. 35.7*
***or***
*allow working of* $\frac{X}{7} \times 100$ [2]

**(b)** 1. reduction in extent of ice sheet **;**
2. reduction in number of, seals / prey / food **or** increased competition for food **;**
3. idea of increased distance to travel to find food **;**
4. loss / destruction, of breeding sites **;**
5. result of named human activity **;** e.g. mining / drilling / killing / building / pollution
6. disease **;** [3 max]

**(c)** *applies to U. maritimus but accept ora*
1. DNA linear **;**
2. DNA in nucleus **or** has, nuclear membrane / nucleus **;**
3. DNA, associated with protein / in chromosomes **;**
4. ribosome, 22 nm diameter / 80s **;**
5. membrane bound organelles / named organelle **;**
6. no cell wall **;**
7. size up to 40μm **;** [3 max]

**[Total: 8]**

**2** **(a)** **(i)** *any one from* **;**
hot springs
sulphur springs
geysers
geothermals
marine vent
volcanic area
hot desert [1]

**(ii)** 1. each bacterium grows at a different temperature (range) **;**
2. (the heap) heats up **;**
3. idea of when temperature kills one species of bacterium others are still active
**or**
as temperature increases process can continue **;**
4. increased oxidation of heap **;**
5. more productive / enables increased yield of gold **;** [3 max]

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**(b) (i)** 1. *A. ferrooxidans* increases, oxidation of the ore / production of $Fe^{3+}$ ;
2. little difference in effect 0–5 days ;
3. greatest effect after 15 days ;
4. comparative figs for with and without *A. ferrooxidans* on a single day ; [3 max]

**(ii)** 1. cheaper (than other methods) ;
2. does not require energy input ;
3. does not require other chemicals to be purchased ;
4. does not require specialist equipment ;
5. can be done *in situ* ;
6. less labour needed ;
7. bacteria are self-replicating / AW ;
8. more environmentally friendly than other methods / no harmful emissions / AW ;
9. useful for extraction from, low grade ores / waste ; [3 max]

**(c)** *must have at least one D mark to score 4 marks*
D1 both strains give similar rate with and without arsenic ions ;
D2 both strains are arsenic-resistant ;
D3 strain 2, more active / higher oxidation rate, (than strain 1) ;
E4 arsenic acts as a selective, agent / pressure ;
E5 mutation / AW, produces resistant bacteria ;
E6 resistant bacteria survive / **ora** ;
E7 resistant allele passed on ;
E8 frequency of allele increases (in population) ; [4 max]

**[Total: 14]**

**3 (a)** 1. ref. hormone treatment ;
2. results in, superovulation / many oocytes / many follicles, maturing at same time ;
3. oocytes harvested ;
4. detail of harvesting ;
5. mixed with sample of sperm ;
6. in special medium ;
7. idea of, waiting for three days / wait until 6–8 cell stage ;
8. embryos placed in uterus ;
9. ref. maintenance of endometrium ;
10. sperm / sperm nucleus / sperm DNA, may be injected into oocyte ; [4 max]

**(b)** *one mark for a ✓ in the correct box*
*more than one ✓ in a row = no mark*
*ignore crosses*

*DNA* – colourless ;
*acrosome* – colourless ;
*mitochondria* – green ; [3]

**(c)** 1. (hydrolytic) enzymes may damage oocyte ;
2. (acrosome contents) affect development of fertilised oocyte ; [1 max]

**[Total: 8]**

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**4 (a)**

| | | | | |
|---|---|---|---|---|
| 1. | β cells detect glucose levels | **or** | no detection of blood glucose conc. | ; |
| 2. | β cells secrete insulin | **or** | no insulin released | ; |
| 3. | when blood glucose concentration rises | **or** | when blood glucose concentration rises | ; |
| 4. | (insulin causes) muscle cells / adipose tissue / liver cells | **or** | muscle cells / adipose tissue / liver cells | ; |
| 5. | to increase uptake of glucose from blood / increased membrane permeability to glucose | **or** | do not take up excess glucose | ; |
| 6. | (insulin causes liver cells) to convert glucose to glycogen | **or** | glucose not converted to glycogen (by liver cells) | ; |
| 7. | (insulin causes liver cells) to increase respiration of glucose | **or** | rate of respiration of glucose does not increase | ; |
| 8. | (if no β cells) no control of blood glucose levels / AW | **or** | no control of blood glucose levels / AW | ; |

[4 max]

**(b) (i)** 1. (yes) more people with infection have CFRD than those without infection **;**
2. use of 'with CFRD' comparative figs **;**
***either*** *using number of people* – 44 / 52 / 96 (**no** infection)
against 106 / 121 / 227 (with infection)
***or*** *using* $FEV_1$ *values* – 71.1 / 53.6 / 124.7 (**no** infection)
against 49.0 / 42.0 / 91.0 (**with** infection)
**or** 28.5% males against 35.8% females (**no** infection)
**or** 38.9% males against 50.05% females (**with** infection)
3. AVP **;** e.g. we do not know how the sample was chosen (so this may not be a valid conclusion) [2 max]

**(ii)** $\frac{2.2}{71.4} \times 100$ **;** = 3.08 / 3.1 **;**
**or**
$\frac{2.2}{73.6} \times 100$ **;** = 2.99 / 3.0 **;** [2]

**(iii)** 1. more lung damage in females (with CFRD) than in males **;**
2. females (with CFRD) have lower $FEV_1$ than males **;**
3. use of figures **;** e.g. males $FEV_1$ 49 whereas female $FEV_1$ 42
**or** female $FEV_1$ 1.16 times lower than male $FEV_1$ [3]

**(c)** 1. CFTR protein acts as chloride channel (in cell membranes) **;**
*with CF*
2. faulty (CFTR) gene **;**
3. faulty / non-functional, (CFTR) protein produced **;**
4. chloride ions not able to move out (of cell) **;**
5. by active transport **;**
6. so less water passes out (of cell) **;**
7. down water potential gradient **;** **A** by osmosis
8. mucus secreted contains less water **;** [4 max]

**[Total: 15]**

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**5** **(a)** 1. (either feature) reduces water loss by, transpiration / evaporation **;**
2. reduction in, number of stomata / surface area, (for, transpiration / evaporation) **;**
3. rolling leaves traps moist air **;**
4. idea of reduced, diffusion / water potential, gradient (between leaf and trapped air) **;**

[3 max]

**(b)** **(i)** cooked protein more digestible than raw protein **;**
use of figures **;** *accept any **named** comparison between cooked and raw* [2]

**(ii)** *cooked*
1. cooking breaks cross-links (in kaffirin) **; A** bonds
2. ref. to named bond **;** e.g. hydrogen / ionic / disulphide / covalent
3. tertiary / 3D / quaternary, structure disrupted / AW **;**
4. protease can now bind, more / easier, with polypeptides **;**
5. <u>enzyme-substrate complexes</u> can form **;**
6. so more protein is digested to amino acids **;** [3 max]

**[Total: 8]**

**6** **(a)** enzyme acts on only one substrate **;**
shape of active site is complementary to substrate **;**
AVP **;** e.g. substrate held by temporary bonds / ES complex [2 max]

**(b)** symbols (must be of same letter) **;**
parental genotypes **and** gametes **;**
offspring genotypes **and** phenotypes **linked ;** [3]

**(c)** 1. insulates axon (membrane) **;**
2. depolarisation occurs only at nodes (of Ranvier) / AW **;**
3. <u>local circuits</u> **;**
4. saltatory conduction / AW **;**
5. speeds transmission of, action potential / impulse **;**
6. AVP **;** e.g. speed increases up to 50 times / $100ms^{-1}$ [3 max]

**[Total: 8]**

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**7** **(a)** active transport **;**
ribose **;**
water **;**
hydrolysis **;** **A** dephosphorylation
heat **;** [5]

**(b)** **(i)** (converted to) glycogen / lipid **;**
(used in) glycolysis / respiration **;** [1 max]

**(ii)** *anaerobic*
1. less ATP / only 2 ATP **;**
2. per mol glucose **;**
3. lactate still contains energy / only glycolysis involved / stages other than glycolysis not involved **;**
4. not sustainable / cannot go on indefinitely / AW **;** [2 max]

**(iii)**

| process | precise location |
|---|---|
| glycolysis | cytoplasm / cytosol **;** |
| link reaction | mitochondrial matrix **;** |
| Krebs cycle | mitochondrial matrix **;** |
| oxidative phosphorylation | inner mitochondrial membrane / cristae **;** |

[4]

**(iv)**
1. cannot pass through phospholipid bilayer **;**
2. too big to fit through (glucose's) protein channel **;**
3. no specific transport protein **;**
4. AVP **;** e.g. used up as soon as it is made [2 max]

**(v)** oxygen debt **;** [1]

**[Total:15]**

**8** **(a)** *north island*
1. fewer / less abundant, hedgehogs allow increase (in both lapwing and redshank) **;**
2. breeding pair figs for either bird for 1983 and 2000 **or**
% change in population over that time for either bird **;**

*south island*
3. presence of hedgehogs causes decrease (in both lapwing and redshank) **;**
4. breeding pair figs for either bird for 1983 and 2000 **or**
% change in population over that time for either bird **;** [3 max]

**(b)**
1. (oystercatchers have) less competition **;**
2. hedgehogs mostly eat lapwing and redshank eggs / hedgehogs don't eat oystercatcher eggs **;**
3. (oystercatcher) eggs are, too large / camouflaged / inaccessible / distasteful
***or***
oystercatchers defend their, nests / eggs **;** [2 max]

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**(c)** 1. idea of geographical isolation ;
2. no interbreeding / gene flow, between <u>populations</u> ;
3. mutations occur ;
4. different, selection pressures / environmental conditions ;
5. genetic change / AW ;
6. genetic drift ;
7. (eventually) reproductive isolation ;
8. <u>allopatric</u> speciation ; [4 max]

**[Total: 9]**

**9 (a)** *endocrine*
1. hormones ;
2. chemical messengers ; **A** chemicals that transfer information
3. ductless glands / (released) into blood ;
4. target, organs / cells ;
5. ref. receptors on cell membranes ;
6. example of named hormone and effect ;

*nervous*
7. impulses/ action potentials ; **R** electrical, signals / current
8. along, axon / neurones / nerve fibres ; **R** nerves **R** across
9. synapse (with target) / neuromuscular junction ;
10. ref. receptor / sensory neurones ;
11. ref. effector / motor neurones ;

*differences – endocrine*
12. slow effect / ora ;
13. long lasting effect / ora ;
14. widespread effect / ora ;
15. AVP ; e.g. extra detail of synapse / hormone changes triggered within cells [8 max]

**(b)** 16. IAA / plant growth regulator ; **R** plant hormone
17. synthesised in, growing tips / apical buds / meristems ; **R** root tip
18. moves by diffusion ;
19. moves by active transport ;
20. from cell to cell ;
21. also, mass flow / in phloem ;
22. stimulates cell elongation ; **R** cell enlargement
23. inhibits, side / lateral, buds / growth ; **A** inhibits branching
24. plant grows, upwards / taller ; **A** stem elongates
25. auxin not solely responsible or interaction between auxin and other plant growth regulators ;
26. AVP ; e.g. role of ABA and lateral bud inhibition
27. AVP ; e.g. cytokinins antagonistic to IAA / gibberellins enhance IAA [7 max]

**[Total: 15]**

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**10 (a)** 1. photosystem I (PI) **and** photosystem II (PII) involved **;**
2. light harvesting clusters **;**
3. light absorbed by accessory pigments **;**
4. primary pigment is chlorophyll a **;**
5. energy passed to, primary pigment / chlorophyll a **;**
6. electrons, excited / raised to higher energy level **;**
7. (electrons) taken up by electron acceptor **;**
8. (electrons) pass down electron carrier chain *(to produce ATP)* **;**
9. PII has (water splitting) enzyme **;**
10. water split into protons, electrons and oxygen **;** **A** equation
11. photolysis **;**
12. electrons from PII pass to PI / electrons from water pass to PII **;**
13. to replace those lost **;** *give either in relation to PI or PII*
14. protons and electrons combine with NADP *(to produce reduced NADP)* **;**

*can award these marking points from a diagram* [9 max]

**(b)** 15. RuBP combines with carbon dioxide **;**
16. rubisco **;**
17. forms unstable 6C compound **;**
18. produces two molecules of, GP / PGA **;**
19. GP / PGA, converted to TP **;**
20. by reduced NADP and ATP **;**
21. from light dependent stage **;**
22. TP used to regenerate RuBP **;**
23. using ATP **;**
24. TP can form, hexose / fatty acids / acetyl CoA [6 max]

**[Total: 15]**

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