**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Pre-U Certificate**

# MARK SCHEME for the May/June 2014 series

## 9790 BIOLOGY

**9790/01** Paper 1 (Structured), 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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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**Notes:**
The following abbreviations may be used in mark schemes:

| | |
|---|---|
| / | alternative and acceptable answers for the same marking point |
| **;** | separates marking points |
| allow / accept / A | answers that can be accepted |
| AVP | any valid point – marking points not listed on the mark scheme but which are worthy of credit |
| AW / owtte | credit alternative wording / or words to that effect |
| ecf | error carried forward |
| ignore/I | statements which are irrelevant – applies to neutral answers |
| not/reject/R | answers which are not worthy of credit |
| ORA | or reverse argument |
| (words) | bracketed words which are not essential to gain credit |
| <u>words</u> | underlined words must be present in answer to score a mark |

**Section A**

| *Question Number* | *Key* |
|---|---|
| 1 | **C** |
| 2 | **1, 3, 5** |
| 3 | **B** |
| 4 | **D** |
| 5 | **A** |
| 6 | **A** |
| 7 | **D** |
| 8 | **C** |
| 9 | **C** |
| 10 | **A** |
| 11 | **B** |
| 12 | **B** |
| 13 | **B** |
| 14 | **B** |
| 15 | **C** |
| 16 | **B** |
| 17 | **B** |
| 18 | **C** |
| 19 | **C** |
| 20 | **D** |

**Section B**

**21 (a) (i)** *for any one time period*

1 comparative / manipulated, data quote for decrease in number of (different) seed species (during the drought) **;**
*manipulated data June 77 to Dec 77 = 5 species*

2 comparative / manipulated, data quote for decrease in (seed) abundance (during the drought) **;**
*manipulated data June 77 to Dec 77 = 0.58 $cm^3 m^{-1}$*
*units to be given for abundance once*

*for mps 1 and 2 allow data for pre-drought to during drought if sampling dates indicated*
*March 76 / pre-drought, to June 77 = 4 species 6.49 $cm^3 m^{-1}$*
*March 76 / pre-drought, to Dec 77 = 9 species 7.07 $cm^3 m^{-1}$*

*if mps 1 and 2 not gained, allow one mark for*
1 / 2 number of (different seed) species and seed abundance decreased **;**

**[2]**

**(ii)** *any one relevant e.g.*
ref. to easier / faster, than counting **;**
**A** more difficult / too small, to count
numbers do not indicate, size of seed / biomass / ORA **;**
**A** seeds can be of different sizes
more useful indication of, food / energy, availability **;**

**[max 1]**

**(iii)** 1 time of year (to collect samples) **;**
**A** ref. to seasonal changes
2 (aim to) sample, within a short time period **;**
**A** take samples at the same time
**A** take samples during same weather conditions
3 ref. suitable, sampling area / sample size **;**
4 sampling method, random / systematic **;**
**A** described
5 qualified / further detail **;**
e.g. computer-generated random locations
choose representative areas on island
description of avoiding particular areas, e.g. craters / lakes
use of belt transects (for systematic)
detail of quadrats (for systematic / random, sampling)
6 correct identification of / use key to identify, seed species **;**
7+8 AVP **; ;**
e.g. (repeat) samples to be taken at appropriate time intervals
collect comparative data (from other years / non-drought years)
relevant suggestion ref. seed collection / making estimates

**[max 4]**

**(b) (i)**

| | | | | |
|---|---|---|---|---|
| **percentage change** | +6.71 | | +5.73 | |

*both correct = 1 mark*

**[1]**

**(ii)** directional (selection) **;** **[1]**

**(c)** *accept birds or ground finches for G. fortis throughout*

1 ref. scarce food supply, limits population size / causes decrease in population size **;**

2 variation in phenotype / phenotypic variation
*or*
(individuals show) differences / variation, in mass
*or*
(individuals show) differences / variation, in bill, size / length / depth / width **;**
*mp 2 must be as a general statement*

3 selection pressure(s) operating / environmental change is selective pressure **;**

4 selective pressure, named / described **;**
e.g. drought / seed supply / seed type (e.g. larger / tougher, seeds most commonly available)

5 (intraspecific) competition **;**

6 detail of effect **;**
e.g. bigger bills able to break open large, fruits / seeds
larger *G. fortis* more able to compete for food
*G. fortis* with small bills unable to obtain sufficient food

7 *idea of* differential survival **;**
e.g. *G. fortis* with, higher mass / bigger bills, selected for / (better adapted to) survive / AW
(most) *G. fortis* with smaller, mass / bills, selected against / (more likely to) die

8 ref. those selected for / surviving, able to, reproduce / pass on (advantageous) alleles / ORA **;**

9 measurable change over time in phenotype / frequency in population of large, size / beak, increases over time **;**

10 AVP **;** e.g. different set of selection pressures operating when food abundant
not all small *G. fortis* died as able to feed on, other food sources / insects / nectar / pollen
post-drought selection of mates based on similar (large) size

**[max 6]**

**[Total: 15]**

**22 (a)** endocytosis / phagocytosis / pinocytosis **;**
further detail **;** e.g. membrane, invaginates / AW
membrane fusion
vacuole / vesicle, formed

*or*

diffusion **;**
**R** facilitated diffusion
further detail **;** e.g. across phospholipid bilayer
across hydrophobic core / AW
from a high to a low concentration
down a, diffusion / concentration, gradient

**[2]**

**(b) (i)** initial / primary, RNA transcripts have, exons and introns / coding and non-coding portions **;**
introns removed **;**
**A** non-coding / AW, sections / regions, removed

exon splicing / AW **;**
ref. spliceosomes / ribozymes / appropriate enzymes **;**

**[max 2]**

**(ii)** 1 if (translation on) free ribosomes, remain in cell / AW **;**
2 (if translation on ribosomes on RER) cytokines / AW, can be exported from cell **;**
3 polypeptide enters (lumen of) RER (as synthesis occurs) **;**
4 RER involved in, polypeptide / protein / cytokine, transport (through RER) / (post-translational) modification **;**
**A** description of modification
5 ref. (RER) formation of vesicle to transport to Golgi **;**
6 (transport to) Golgi body for, modification / processing / packaging **;**
**A** description e.g. folding, glycosylation
7 secretory / Golgi, vesicles transported to cell surface membrane for exocytosis / AW **;**
8 AVP **;** e.g. signal sequence (of amino acids) / signal sequence recognition protein (SRP), allows attachment to ER membrane

**[max 3]**

**(c) (i)** 1 Langerhans cell / keratinocyte / macrophage, as, antigen-presenting cell / APC **;**
**A** displaying hapten *in context of recognition*

2 ref. T-cells and, recognition / binding **;**
**A** clonal selection
**A** T-cells have complementary receptors / specific T-cells

3 activation / sensitisation / described **;**

4 proliferation / mitosis **;**
**A** clonal expansion

5 T (cytotoxic and helper), memory cell formation **;**

6 description of T-cytotoxic cell action **;**

7 explanation of faster response for second and subsequent contacts **;**
e.g. increased number of (specific) T-cells increases chance of coming across APC
more T-cytotoxic cells present to destroy, skin cells / keratinocytes, with hapten

8 T-helper cells secrete cytokine to stimulate, T-cytotoxic cell response / macrophages **;**

9+10 AVP **; ;**
e.g. ref. cytokine production by keratinocytes attract, macrophages / T-cells, to area
ref. rash linked to effect e.g. pus in blisters = dead, cells / macrophages
suggestion of no initial reaction by T-cells because of short life span of keratinocytes

**[max 6]**

**(ii)** *any one relevant e.g.*
immunocompromised / described **;**
may not have, specific T-cells / T-cells with, quinone / hapten, receptors **;**
may have T-cells but low in number and not come across APC **;**
may need several doses to build up sufficient numbers of T-cells **;**
inability of cells to convert urushiol **;**

**[max 1]**

**(d)** urushiol more rapidly acted upon by, enzyme / catechol oxidase, only / AW **;**
ref. (enzyme) inhibitor linked to red wine / red wine contains an inhibitor **;**
use of comparative data to support **;**
**A** comparative description of $V_{max}$
further detail of inhibition **;** e.g. competitive inhibition
similar shape to, substrate / urushiol
competes with substrate for active site
fewer enzyme-substrate complexes formed
increasing substrate concentration decreases inhibition

**[max 3]**

**(e)** passes through, epidermis / named leaf cells / cuticle **;**
to, vascular tissue / phloem **;**
translocated / mass flow **;**
symplastic movement **;**
**A** if in context of via leaf cells to phloem
from, leaf / source, to sink **;**
AVP **;** e.g. detail of mass flow
detail of symplast pathway

**[max 3]**

**[Total: 20]**

**23 (a)** (light-dependent stage) provides NADPH and ATP / ORA **;**
further detail **;**
e.g. NADPH provides, electrons / reducing power, for GP to TP
ATP required for, GP to TP / regeneration of RuBP

**[2]**

**(b)** 2 molecules of, GP / TP, leave the cycle / AW **;**
*allow idea of 6 carbons with reference to GP / TP*
further detail **;**
e.g. for synthesis of glucose (phosphate)
for synthesis of , fatty acids / amino acids

**[2]**

**(c)** endosymbiosis **;**
qualified **;**
e.g. chloroplasts were small prokaryotes that, lived in host cells / were parasites / were prey
mutually beneficial relationship

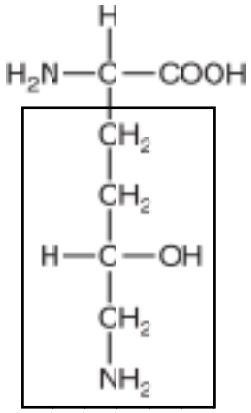
**[2]**

**[Total: 6]**

**24 (a)** 1 (glycine) amino acid with, smallest / H, R-group / side chain **;**
2 run along the, interior / central, axis of the helical polypeptide / AW **;**
3 allow the, triple helix / three polypeptides, to be, closely associated / tightly packed together / AW **;**
*look for idea of three compact helices*
**I** ref. to alpha helices
4 allows H-bonds to form between polypeptides (for strength) **;**
5 further detail **;**
e.g. bond forms between the amide (-C(=O)NH-) hydrogen atom of glycine in one polypeptide chain and the carbonyl oxygen atom of X in an adjacent polypeptide chain

**[max 3]**

**(b) (i)**




*box drawn around R group* **;** **[1]**

**(ii)** OH and H on carbon, 1 reversed / AW **;**
OH and H on carbon 4 reversed / AW **;**
*accept from annotations on Fig. 24.3*

**[max 1]**

**(c) (i)** *any one relevant e.g.*
no risk of transmissible disease **;**
(possibility of) large-scale production **;**
enables production where animal sources are more scarce **;**
allows (genetic) manipulation to obtain different collagen types **;**
to avoid, allergy / immune response, problems with, animal products / foreign proteins **;**
**A** reduced inflammatory response

**[max 1]**

**(ii)** cannot carry out post-translational modification **;**
do not have RER / Golgi **;**
**A** do not have necessary, cellular structures / organelles
do not have the necessary, genes / enzymes **;**

**[max 1]**

**(d)** *collagen structure:*

1 unable to hydroxylate, proline / lysine ;
2 hydrogen bonds not formed ;
3 no glycosylation for hydoxylysine (without the OH-) ;
4 further detail ; e.g. lack of stability / compromised structure, of triple helix
polypeptide chains more easily separated
weaker links between molecules to form collagen fibrils

*collagen function:*

5 ref. collagen, as a structural protein / high tensile strength ;
6 important in, connective tissue for wound healing / strong gums ;
7 ref. to presence in, tunica externa / tunica media / sub-endothelial layer, of, arteries / veins ;
8 weakened blood vessel wall may cause, blood leakage / bursting (hence symptoms) ;
9 ref. role of collagen in blood vessels ; e.g. in artery walls to resist high blood pressure

**[max 5]**

**(e) (i)** (rat cDNA probe binds to a) complementary (single-stranded) sequence in the sample being analysed / AW ;
(rat cDNA) probe binding to human DNA indicates region of similar nucleotide sequence exists ;
sufficient similarity to support idea of a gene that has lost expression / AW ;
if rat cDNA probe did not bind then would suggest no gene ;

**[max 3]**

**(ii)** 1 frameshift (mutation) ;
2 from insertion site onwards new sequence of codons read / AW ;
3 leads to new sequence of amino acids specified (from point of mutation) ;
*needs idea of more than one amino acid changed*
4 altered primary stucture alters, tertiary structure / folding, of polypeptide ;
5 further detail ; e.g. loss / change of shape, of active site, so loss of function
6 change in codons may lead to a nonsense mutation / produce a stop codon ;
7 (so) shortened polypeptide / polypeptide produced may not function ;
*in context of premature stop codon*
8 AVP ; e.g. ref. more drastic effect if insertion early on in sequence

**[max 4]**

**(f)** (no need to synthesise as) able to obtain sufficient vitamin C, in the diet / from exogenous source ;
**A** relevant named foods

**[1]**

**[Total: 20]**

**25 (a)** *oestrogen / oestradiol:*
repair / thickening, of endometrium / uterine lining **;**
ref. low / decreased, concentrations of, FSH / LH **;**
**A** negative feedback effect on, FSH / LH
(higher concentrations) stimulate / AW, secretion / release, of LH (from anterior pituitary) **;**
**A** positive feedback effect on LH
**A** LH surge

*progesterone:*
stimulates growth / maintenance / increases vascularisation / AW, of, endometrium / uterine lining **;**
inhibits release of FSH / LH / (anterior) pituitary hormones **;**
**A** idea of inhibition by oestrogen released from corpus luteum

*FSH / follicle stimulating hormone:*
development of follicles **;**
stimulates, production / secretion, of oestrogen **;**

*LH / luteinising hormone:*
stimulates follicle growth (together with FSH) **;**
(high / increasing, levels bring about) ovulation **;**
stimulates development of corpus luteum (from empty Graafian follicle) **;**

**[max 5]**

**(b) (i)** metaphase I **;** **[1]**

**(ii)** *award marks on annotated diagrams*
1 condensation of chromosomes / described (e.g. coiling and supercoiling of DNA) **;**
2 ref. to random orientation of chromosomes **;**
3 homologous chromosomes pair up / synapsis / AW **;**
4 detail **;** e.g. along length, held by proteins
5 crossing over **;**
6 described **;** e.g. exchange between non-sister chromatids of sections of DNA
7 ref. separation of chromosomes, still held together in places **;**
8 chiasmata **;**
9 attachment of, kinetochores / centromeres, to spindle / microtubules / spindle fibres **;**
10 homologous pair / bivalent, movement towards, spindle equator / metaphase plate **;**

**[max 4]**

**(c)**

| cell type | timing | number of chromosomal DNA molecules per cell |
|---|---|---|
| oogonium | newly-formed | 46 |
| oogonium | late interphase immediately prior to onset of meiosis | 92 ; |
| primary oocyte | shortly before puberty begins | 92 ; |
| secondary oocyte | at ovulation | 46 ; |
| ovum | after binding of a sperm, but before the sperm nucleus enters the cell | 23 ; |

**[4]**

**[Total: 14]**

**26** *assume herbivore unless stated otherwise, look for ORA*
*response must include ref. to small and large intestine to score max*

1 have a, larger / developed, caecum ;
2 ref. to, most / much, digestion occurring in caecum ;
3 have, functioning / AW, appendix ;
4 (so can carry out) hindgut fermentation ;
5 ref. to (mutualistic) bacteria / gut flora / AW ;
6 for cellulose breakdown / have cellulase ;
7 microorganism metabolism / AW, releases volatile fatty acids ;
8 detail of benefit to herbivore ; e.g. fatty acids for energy
heat for thermoregulation
9 longer, small intestine / large intestine / digestive system ;
10 (as) need more, surface area / time, for digestion / absorption ;
11 AVP ;
e.g. little absorption of digested food in small intestine (on first time round)
longer intestines as, little digestion in stomach (compared to carnivores)
longer / developed, large intestines / colons, to extract water from fibre

**[max 5]**

**[Total: 5]**