CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9700 BIOLOGY

9700/42 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.

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

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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 accepted)
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)

1 (a) label **L** to any thylakoid membrane **;**

label **R** to stroma **;** [2]

(b) to absorb, more / maximum, light **;**

to avoid damage by high light <u>intensities</u> **;** [2]

(c) 1 carbon dioxide **;** **A** CO_2

2 ATP **;**

3 reduced NADP **;**
mp 2 and mp3 in either order

4 acetyl CoA **;** [4]

[Total: 8]

2 (a) defective development / increased risk of miscarriage / mutation **;** [1]

(b) 1 *idea of* switch on gene / transcription **;**

2 detail of positional problem **;**
e.g. gene may insert in any of the chromosomes
e.g. gene may be within an, intron / non-coding DNA
e.g. gene may share promoter with host gene that does not get switched on in this cell [2]

(c) *assume metaphase I unless otherwise stated*

	metaphase I		metaphase II	
1	bivalents / homologous pairs, (line up)	**or**	single chromosomes (line up)	**;**
2	chiasmata	**or**	no chiasmata	**;**
3	46 / 2n / diploid (number of, chromosomes)	**or**	23 / n / haploid (number of, chromosomes)	**;**
4	undivided centromeres	**or**	dividing centromeres	**;**

accept from labelled diagram [max 3]

(d) *comparison - max 2*

1 greater total number of oocytes with r-hFSH **;**

2 greater number of, oocytes in metaphase II / secondary oocytes, with r-hFSH **;**

3 comparative figures **;** e.g. 763 v 407 / 634 v 323 / 83% v. 79%

explanation

4 r-hFSH purer / more concentrated **ora**
or
u-hFSH may have degraded **;** **ora** [max 3]

(e) (i) 1 results same for first three days **;**

2 higher concentration with r-hFSH from day 3 **;**

3 greatest difference is at day 12 **;**

4 highest concentration of u-hFSH at 3 nmol dm^{-3} **and** r-hFSH at 9 nmol dm^{-3}
or
r-hFSH highest concentration × 3 u-hFSH **;** [max 3]

(ii) 1 thickening of, endometrium / lining of uterus **;**

2 development of blood capillaries in, endometrium / lining of uterus
or
endometrium / lining of uterus, becomes more vascular **;**

3 inhibition of FSH, production / release / secretion **;** [max 2]

[Total: 14]

3 (a) 1 lots of pollen grains made
so more chance of pollination **;**

2 pollen grains, light / smooth / aerodynamic,
so easily transported **;**

3 no / small, petals / corolla / perianth,
so stamens / anthers / stigma, outside of flower **;**

4 long filaments
so anthers outside of flower **;**

5 anthers outside of flower / versatile anthers,
so pollen released **;**

6 long style
so stigma outside of flower **;**

7 stigma outside of flower / stigma has large surface area,
so traps pollen **;** [max 5]

(b) 1 not dependent on, external factors / wind **;**

2 other plants (for cross-pollination) may be at a distance **;**

3 maintains (hybrid) gene pool **;**

4 keeps advantageous (hybrid) characteristics in offspring **;** [max 3]

(c) can breed with parent species / not reproductively isolated from parent species **;** [1]

[Total: 9]

4 (a) 1 reduces likelihood of harmful recessive <u>alleles</u> coming together **;**

2 to prevent, inbreeding depression / reduced vigour **; ora**

3 increases ability (of population) to adapt to changing environment **; ora**

4 increases chances of survival when exposed to, pathogen / disease **; ora** [max 3]

(b) (i) *assume foothills unless otherwise stated*

1 frogs (in foothills) have low(er) body temperature **; ora**

2 (lower temperatures) slow down, metabolic / enzyme-catalysed, reactions **; ora**

3 because, kinetic energy / collision rate, is less
or
fewer ESCs **; ora** [max 2]

(ii) 1 *idea of* initially foothill populations have greater mass than lowland populations **;**

2 (foothill) max mass reached earlier **; ora**

3 (foothill) max mass greater **; ora**

4 paired comparative figures **;**
e.g. [mp2] 37 days v 45 days
[mp3] 420 mg v 375 mg
day 37 foothills 420 mg v lowland 370 mg

5 after day 37 foothills decreases and lowland continues to increase in mass **;** [max 3]

(iii) 1 kept in identical (environmental) conditions **;**

2 (so) genes must be / environment cannot be, causing the differences **;** [2]

(iv) 1 (foothill population) can cope with (the effect of) cool temperatures **;**

2 time period available for, growth / metamorphosis, shorter in the foothills **;**

3 more chance of metamorphosing before, autumn / cooler weather, arrives **;** [max 2]

(c) 1 tadpoles / adults, from lowlands unlikely to survive in the foothills / AW ;

2 ref. to genetic differences (between the two populations) ; [2]

[Total: 14]

5 **(a)** arrow downwards from cell body into long axon ; [1]

(b) **(i)** 1 active transport ;

2 ref. to sodium potassium pump ;

3 sodium ions out **and** potassium ions in ;

4 against their, concentration / electrochemical, gradient ;

5 ref. to, ion diffusion / ion leakage ; [max 3]

(ii) 1 enter, presynaptic knob / AW ;

2 causes vesicles ;

3 to, move to / fuse with, presynaptic membrane ;

4 (so) neurotransmitter released (into synaptic cleft) / exocytosis ; [max 3]

(iii) 1 restoring Na^+ gradient / 34% energy, (only) in dendrites ;

2 recycling transmitter **and** setting up Ca^{2+} gradient / 6% energy, only in axons ;

3 so more mitochondria in dendrites as more energy required for processes ; **ora** [max 2]

[Total: 9]

6 **(a)** 1 humans (as selective agent) ;

2 shorthorn and Brahman bred together ;

3 offspring with ideal characteristics chosen to mate ;

4 repeated over many generations ;

5 allele frequency for ideal characteristics increases ;

6 directional selection ; [max 3]

(b) *any two from*
docility / AW ;

ref. to milk production ;

high fertility ;

hornlessness ;

ref. to meat production ;

disease resistance ; [max 2]

(c) 1 inbreeding depression / lack of hybrid vigour ;

2 more chance that harmful recessive alleles may be expressed ;

3 decrease in heterozygosity / increase in homozygosity ;

4 less genetic variation ; [max 3]

[Total: 8]

7 **(a)** **(i)** adenine ; [1]

(ii) ribose ; [1]

(b) 1 loss of phosphate / hydrolysis, leads to energy release ;

2 small packets of energy ;

3 small / water-soluble, so can move around cell ;

4 immediate energy donor ;

5 link between energy-yielding and energy-requiring reactions / AW ;

6 high turnover ; [max 3]

(c)

stage	products
glycolysis	pyruvate reduced NAD
Krebs cycle	reduced NAD reduced FAD carbon dioxide / CO_2
oxidative phosphorylation	NAD FAD water / H_2O

;;;

6 correct = 3 marks
4/5 correct = 2 marks
2/3 correct = 1 mark [3]

(d) *lipids*

1 more C-H bonds / more reduced / more hydrogen ;

2 produces more reduced NAD ;

3 produces more ATP per, gram / unit mass ;

4 more, aerobic respiration / oxidative phosphorylation / chemiosmosis ;

5 fats **only** broken down aerobically ; [max 2]

(e) (i) CO_2 produced divided by O_2 consumed / ratio of CO_2 produced to O_2 consumed;

ref. to volume / number of molecules / moles, of, CO_2 / O_2 ;

in the same time / per unit time ; [max 2]

(ii) *carbohydrate* = 1.0 ;

lipid = 0.7 ; [2]

(iii) becomes greater than 1 ; [1]

[Total: 15]

8 (a) (i) locus ; [1]

(ii) having two identical alleles (of a gene) ; [1]

(b) *parental genotypes*
1 C^BC^{CM} ;

2 $C^{CH}C^{CM}$;

parental gametes
3 C^B C^{CM} C^{CH} C^{CM} ;

offspring genotypes
4/5 C^BC^{CH} C^BC^{CM} $C^{CH}C^{CM}$ $C^{CM}C^{CM}$;; *deduct one mark for each error*

offspring phenotypes
6 black black chocolate cinnamon ; *must link phenotypes with genotypes*

penalise once for wrong symbol then ecf throughout [6]

[Total: 8]

9 (a) 1 ref. to VNTR (sequences) ;

2 quantity of DNA increased by PCR ;

3 DNA fragmented by, restriction enzyme(s) / endonuclease(s) ;

4 loaded (into wells) in agarose gel ;

5 (at) negative end / cathode end ;

6 ref. to buffer / electrolyte ;

7 direct current applied ;

8 phosphate groups of DNA give negative charge ;

9 (negatively charged) DNA attracted to, anode / positive electrode ;

10 short pieces / smaller mass, move further / move faster ; **ora**

11 (pieces) transferred to, membrane / nylon / nitrocellulose / absorbent paper
or
Southern blotting ;

12 heated to separate strands ;

13 probes / fluorescent dye, added ;

14 X-ray film / UV light / lasers ;

15 pattern of stripes / ref. banding pattern ; [max 9]

(b) 1 it is identical to human insulin **;** **ora**

2 (more) rapid response **;** **ora**

3 no / fewer, immune response / side effects / allergic reactions **;** **ora**

4 ref. to ethical / moral / religious, issues **;** **ora**

5 cheaper to produce in large volume / unlimited availability **;** **ora** **R** cheap to produce

6 less risk of, transmitting disease / infection **;** **ora**

7 good for people who have developed tolerance to animal insulin **;** **ora** [max 6]

[Total:15]

10 (a) *description*

1 enzyme mixed with sodium alginate (solution) **;**

2 placed in syringe **;**

3 added drop by drop **;**

4 to (solution of) calcium chloride **;**

5 beads (with enzyme) formed **;**

6 beads separated from calcium chloride **;**

7 wash with water **;**

advantages

8 (enzyme) can be re-used **;**

9 product, uncontaminated / enzyme-free **;**

10 (so) purification not needed / less downstream processing **;**

11 reduces cost **;**

12 works at higher temperature / thermostable **;**

13 works in changed pH **;**

14 reaction, can be fast(er) / have high(er) yield **;** [max 9]

(b) 1 glucose oxidase immobilised **;**

2 stuck onto, pad / (dip)stick **;**

3 dip stick lowered into, body fluid / blood / urine **;**

4 oxidises glucose (in body fluid) **;**

5 (changes glucose to) gluconic acid **;** **A** gluconolactone

6 hydrogen peroxide produced **;**

7 (peroxide) reacts with <u>chromogen</u> (on pad) **;**

8 produces, colour / named colour **;**

9 darkness of colour / range of colours, is proportional to concentration of glucose **;**

10 AVP **;** e.g. peroxidases catalyse reaction / ref. to importance of fixed time to observe colour change [max 6]

[Total: 15]