

**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

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Mark scheme abbreviations:

<b>;</b>	separates marking points
<b>/</b>	alternative answers for the same point
<b>R</b>	reject
<b>A</b>	accept (for answers correctly cued by the question, or by extra guidance)
<b>AW</b>	alternative wording (where responses vary more than usual)
<b><u>underline</u></b>	actual word given must be used by candidate (grammatical variants accepted)
<b>max</b>	indicates the maximum number of marks that can be given
<b>ora</b>	or reverse argument
<b>mp</b>	marking point (with relevant number)
<b>ecf</b>	error carried forward
<b>I</b>	ignore
<b>AVP</b>	alternative valid point (examples given as guidance)

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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 intensities ; [2]

(c) 1 carbon dioxide ; **A** CO<sub>2</sub>  
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)	<b>or</b>	single chromosomes (line up)	;
2	chiasmata	<b>or</b>	no chiasmata	;
3	46 / 2n / diploid (number of, chromosomes)	<b>or</b>	23 / n / haploid (number of, chromosomes)	;
4	undivided centromeres	<b>or</b>	dividing centromeres	;

*accept from labelled diagram*

[max 3]

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(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  $3 \text{ nmol dm}^{-3}$  **and** r-hFSH at  $9 \text{ nmol dm}^{-3}$   
**or**  
r-hFSH highest concentration  $\times 3$  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]

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- (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 alleles 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]

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- (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<sup>+</sup> gradient/34% energy, (only) in dendrites ;  
 2 recycling transmitter **and** setting up Ca<sup>2+</sup> 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]

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(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 <sub>2</sub>
oxidative phosphorylation	NAD FAD water / H <sub>2</sub> O

⋮

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<sub>2</sub> produced divided by O<sub>2</sub> consumed / ratio of CO<sub>2</sub> produced to O<sub>2</sub> consumed;

ref. to volume / number of molecules / moles, of, CO<sub>2</sub> / O<sub>2</sub> ;

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]



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- 8 (a) (i) locus ; [1]  
(ii) having two identical alleles (of a gene) ; [1]

(b) *parental genotypes*

1  $C^B C^{CM}$  ;

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

*parental gametes*

3  $C^B$   $C^{CM}$   $C^{CH}$   $C^{CM}$  ;

*offspring genotypes*

4/5  $C^B C^{CH}$   $C^B C^{CM}$   $C^{CH} C^{CM}$   $C^{CM} C^{CM}$  ;; *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]

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- (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]

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- (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 chromogen (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]**