CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9700 BIOLOGY

9700/43 Paper 4 (A2 Structured Questions), maximum raw mark 100

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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 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)

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1 (a) (i) C (cytosine) is replaced by T (thymine) ;

GCC becomes GTC / GCT becomes GTT ; [2]

(ii) change in, active site / tertiary structure / 3D structure ; [1]

(b) 1 <u>natural selection</u> ;

in Europe

2 more, fungus / ochratoxin A ;

3 ochratoxin A / fungus, acts as selection pressure ;

4 heterozygotes / carriers, have advantage ; **AW**

5 (heterozygotes / carriers) survive / reproduce ; **A** selected for / less likely to develop renal cancer

6 pass on, advantageous / PKU, <u>allele</u> ;

7 frequency of PKU <u>allele</u> increases ;

8 *idea that* people with PKU are treated so also pass on recessive allele ;

*accept **ora** Sub-Saharan Africa* [max 5]

[Total: 8]

2 (a) 1 supplied with food ;

2 monitor health of the, mother / offspring ;

3 (sperm / eggs) stored / frozen ; **A** sperm bank

4 artificial insemination / in vitro fertilisation ; **A** AI / IVF

5 *ref. to* cloning / surrogacy / fostering (of young) ;

6 fertilised eggs incubated artificially ;

7 transfer of breeding partners between zoos ;

8 maintenance of records ;

9 maintains genetic diversity ;

10 protection from, predators / shooting / disease ; [max 4]

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(b) 1 no longer living in natural habitat **;**

2 stress **;**

3 behavioural changes **;**

4 *idea of* disruption to normal reproductive cycles **;**

5 reject mate **;** [max 2]

(c) 1 may find difficulty in moving around (due to previously been captive) **;**

2 *idea of* difficulty obtaining food / short of food / outcompeted for food **;**

3 difficulty integrating with others of members of their species **;**

4 disease **;**

5 *idea of* lack of survival skills **;** **A** lack of fear of, humans / predators [max 2]

(d) lead poisoning / lead is an enzyme inhibitor **;** [1]

[Total: 9]

3 **(a)** **(i)** **X** – reverse transcriptase **;** **R** RNA

Y – DNA polymerase **;** [2]

(ii) 1. large number of copies of mRNA readily available **;**

2. *idea of* mRNA is only from gene coding for insulin (being expressed) **;**

3. easier than, extracting / locating, gene from cell's DNA **;**

4. AVP **;** e.g. introns already removed / bacteria cannot remove introns [max 2]

(b) 1 in yeast cells promoters already present **;**

2 have RER / Golgi body **;**

3 so, insulin can be modified / insulin is in correct 3D conformation **;**

4 AVP **;** e.g. *ref. to* YAC holding more DNA than BAC [max 2]

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(c) 1 it is identical to human insulin / exact fit to receptor (cell surface membranes) ;

2 (more) rapid response ;

3 no / fewer, rejection problems / side effects / allergic reactions / immune response ;

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

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

6 less risk of, transmitting disease / infection ;

7 good for people who have developed tolerance to animal insulin ; [max 3]

[Total: 9]

4 **(a)** *ignore ref. to energy currency*

1 *idea of* synthesis of complex substances or synthesis of named large molecule / anabolic reactions;

2 transport of substances against concentration gradient / active transport ;

3 movement qualified ; e.g. muscle contraction / cilia movement / locomotion

4 AVP ; e.g bioluminescence, electrical discharge, temperature regulation [max 2]

(b) **(i)** *both answers required for one mark*

A adenine **R** adenosine

B ribose / pentose ; [1]

(ii) 1 small ;

2 water soluble ;

3 easily transported around the cell ;

4 easily hydrolysed (to release energy) ;

5 (so) relatively large quantity of energy released / 30.5 $kJ\,mol^{-1}$;

6 *idea of*, rapid turnover / small cellular ATP content is sufficient for cell's requirements ; [max 3]

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(c) (i) 1 less / decreased (aerobic respiration) **;**

2 oxygen, is the final electron acceptor / needed for ETC **;**

3 oxidative phosphorylation decreased / chemiosmosis decreased **;**

4 regeneration of NAD / Kreb's cycle / link reaction, decreased **;**

5 ATP synthesis decreases / ATP synthetase activity decreased **;** [max 2]

(ii) more ATP produced (for population growth) **;** [1]

(d) (i) 1 HB8 always does better than mutant HB8 **;**

2 HB8 and mutant HB8 both do better in aerobic than in anaerobic conditions **;**

3 data quote to support **;**

for mp1
[950×10^6 per cm^3 v 900×10^6 per cm^3] **and** [490×10^6 per cm^3 v 410×10^6 per cm^3] **or** manipulated figures

for mp2
[950×10^6 per cm^3 v 490×10^6 per cm^3] **and** [900×10^6 per cm^3 v 410×10^6 per cm^3] **or** manipulated figures [max 2]

(ii) 1 both grow better in aerobic compared to anaerobic **;**

2 *ref. to* significant difference found in mutant HB8 (aerobic compared to anaerobic) **;**

3 data quote to support **;**

for mp1
[880×10^6 per cm^3 v 460×10^6 per cm^3] **and** [840×10^6 per cm^3 v 50×10^6 per cm^3] **or** manipulated figures

for mp2
[840×10^6 per cm^3 v 50×10^6 per cm^3] **or** [460×10^6 per cm^3 v 50×10^6 per cm^3] **or** manipulated figures [max 2]

(iii) *idea that* HB8 is a better competitor than mutant HB8 **; ora**

in mutant HB8 activity of, enzyme / nitrate reductase, is reduced **;** [max 1]

[Total: 14]

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5 (a) (i) 1 performed in an open fermenter / nutrients added at a steady rate throughout **;**

2 products harvested throughout **;**

3 pH / temp / oxygen concentration, controlled throughout **;**

4 *ref. to* input = output / constant volume **;** [max 2]

(ii) 1 organisms maintained in exponential phase **;**

2 faster rate of enzyme production **;**

3 no build-up of toxins **;**

4 no down time / AW **;**

5 small vessels can be used **;**

6 cost effective **;** [max 3]

(b) (i) 1 percentage breakdown (of azo-dye) increased, between 7 and 10 days / after 10 days **;**

after 7 days

2 percentage breakdown (of azo-dye) increased with increasing concentration of azo-dye, up to 150 mg dm^{-3} / except for 200 mg dm^{-3} **;**

3 two breakdown percentages at two dye concentrations to support mp2 **;**

after 10 days

4 percentage breakdown (of azo-dye) decreased with increasing concentration of azo-dye **;**

5 two breakdown percentages at two dye concentrations to support mp4 **;** [max 4]

(ii) 1 time is not taken for enzymes to leave white-rot fungal cells **; ora**

2 lower concentration of enzymes from white-rot cells **; ora**

3 AVP **;** e.g. possible inhibitory effect of azo-dye on white-rot cells / ESCs formed more quickly [max 2]

(c) 1 enzyme can be, re-used / recovered after use **;**

2 enzyme does not contaminate water / no purification needed **;**

3 *idea of* enzymes being thermostable **;**

4 *idea that* enzymes able to withstand pH changes **;**

5 *ref. to* increased shelf-life of enzyme **;** [max 3]

[Total: 14]

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6 (a)

ion	role	type of cell
Fe^{2+}	oxygen transport / haemoglobin structure ;	red blood cell
Na^{+}	co-transport in the kidney	proximal convoluted tubule / epithelial ;
Ca^{+}	synaptic transmission / described ;	neurone

[3]

(b) receptor / generator ; **A** threshold [1]

(c) 1 high blood pressure in <u>glomerulus</u> ;

2 (due to) greater diameter of afferent vessel ; **ora**

3 molecules pass through holes in (capillary) <u>endo</u>thelium ;

4 <u>basement membrane</u> selectively permeable / only small molecules pass through <u>basement membrane</u> / large molecules unable to pass through <u>basement membrane</u> ;

5 less than 69 000 RMM ;

6 molecules pass between gaps in <u>podocytes</u> ;

7 enter renal capsule ; [max 4]

[Total: 8]

7 (a) *gene*
length / section, of DNA
or
sequence of, bases / nucleotides ;

coding for a, polypeptide / protein ;

allele
different / alternative, form of a gene ; **A** variety of a gene

occupying same, locus / position (on homologous chromosomes) ; [4]

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(b)

individual	phenotype	genotype	
1	**B**	$I^B I^o$	;
2	**A** or **B**	$I^A I^o$ or $I^B I^o$	;
3	**B** or **A**	$I^B I^o$ or $I^A I^o$	;
4	**A**	$I^A I^o$	;

Individuals 2 and 3 ***must*** *have different phenotypes and genotypes* [4]

[Total: 8]

8 (a) **X** pointing to chloroplast ;

Y pointing to cell wall ;

Z pointing to any membrane ; [3]

(b) (i) rate on *y*-axis **and** light intensity on *x*-axis ;

all points plotted accurately ;

line of best fit ; [3]

(ii) 1 at low light intensity light is the limiting factor ;

2 at high light intensity other factors become limiting ;

3 such as, temperature / carbon dioxide <u>concentration</u> ; [3]

(c) (i) chlorophyll b **and** carotenoids ; [1]

(ii) 1 absorb light (energy) ;

2 at <u>wavelengths</u> not readily absorbed by, chlorophyll a / primary pigment ;

3 pass <u>energy</u> to, chlorophyll a / primary pigment ;

4 in reaction centre ; [max 3]

(iii) reflected ; [1]

(iv) <u>action spectrum</u> ; [1]

[Total: 15]

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9 (a) 1 vitamin A found in aleurone layer of rice (seeds) ;

2 white rice does not contain, aleurone layer / vitamin A / carotenoids / β carotene ;

3 genes coding for vitamin A production extracted ;

4 from, bacteria / *Erwinia uredovora* / *Pantoea ananatis* ;

5 (and) daffodils / maize ;

6 inserted into plasmids / plasmid used as a vector ;

7 promoters added ;

8 plasmids put into *Agrobacterium tumefaciens* ;

9 *Agrobacterium tumefaciens* mixed with rice embryos ;

10 (some embryos) take up bacteria and vitamin A gene ; **A** gene gun

11 grow into adult plants ;

12 produce seeds with, vitamin A / carotene ;

13 in endosperm ;

14 AVP ; e.g. *ref. to* Golden Rice™ [max 8]

(b) 1 GM seed could be difficult for farmers in developing countries to obtain ;

2 high cost of (buying) GM seed / cannot use own seed ;

3 too expensive for, people to buy / farmers to sell ;

4 might reduce efforts to relieve poverty ;

5 may not grow well in all conditions (as other traits not selected for) ;

6 *ref. to* possible, allergic reactions in humans / toxicity of more herbicide left after use / adverse effects on the immune system ;

7 under-developed countries becoming more dependent on other countries ;

8 cross-pollination with, wild plants / organic crops ;

9 new more resistant weeds / "superweeds" ;

10 *ref. to* loss of traditional varieties ;

11 loss of genetic diversity ;

12 harm to other species ; e.g. effect on rest of food chain [max 7]

[Total: 15]

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10 (a) 1 *ref. to* hormone treatment ;

2 results in, superovulation
or
many oocytes / many follicles, maturing at same time ;

3 oocytes harvested ;

4 detail of harvesting ;

5 mixed with sample of, sperm / male gametes ;

6 in special growth medium ;

7 wait, for three days / until 4–8 cell stage ;

8 embryos placed in uterus ;

9 *ref. to* maintenance of endometrium ; e.g. progesterone treatment

10 if sperm count very low ICSI used ;

11 sperm / sperm nucleus / sperm DNA, may be injected into oocyte ; [max 8]

(b) 1 'not natural' / technological process ;

2 *ref. to* multiple births ;

3 (possible) birth defects ;

4 cost to health service / only wealthy can access IVF ;

5 some embryos discarded ;

6 unknown effects of freezing embryos for storage ;

7 issues regarding use of stem cells ;

8 issues regarding selection of gender etc. ;

9 issues regarding, single people / gay people, having children by this method ;

10 extending age of conception of women past menopause ;

11 issues regarding, egg donation / surrogate mothers ;

12 *ref. to* psychological effects ; [max 7]

[Total: 15]

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