

**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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<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – October/November 2014</b>	<b>9700</b>	<b>43</b>

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)

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- 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 natural selection ;

*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, allele ;

7 frequency of PKU allele 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]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- (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]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- (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/ $30.5 \text{ kJ mol}^{-1}$  ;

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

[max 3]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- (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<sup>6</sup> per cm<sup>3</sup> v 900 × 10<sup>6</sup> per cm<sup>3</sup>] **and** [490 × 10<sup>6</sup> per cm<sup>3</sup> v 410 × 10<sup>6</sup> per cm<sup>3</sup>] **or** manipulated figures
- for mp2*  
 [950 × 10<sup>6</sup> per cm<sup>3</sup> v 490 × 10<sup>6</sup> per cm<sup>3</sup>] **and** [900 × 10<sup>6</sup> per cm<sup>3</sup> v 410 × 10<sup>6</sup> per cm<sup>3</sup>] **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<sup>6</sup> per cm<sup>3</sup> v 460 × 10<sup>6</sup> per cm<sup>3</sup>] **and** [840 × 10<sup>6</sup> per cm<sup>3</sup> v 50 × 10<sup>6</sup> per cm<sup>3</sup>] **or** manipulated figures
- for mp2*  
 [840 × 10<sup>6</sup> per cm<sup>3</sup> v 50 × 10<sup>6</sup> per cm<sup>3</sup>] **or** [460 × 10<sup>6</sup> per cm<sup>3</sup> v 50 × 10<sup>6</sup> per cm<sup>3</sup>] **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]**

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- 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<sup>-3</sup>/except for 200 mg dm<sup>-3</sup> ;
- 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]**

6 (a)

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

[3]

(b) receptor/generator ; **A** threshold

[1]

(c) 1 high blood pressure in glomerulus ;

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

3 molecules pass through holes in (capillary) endothelium ;

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

5 less than 69 000 RMM ;

6 molecules pass between gaps in podocytes ;

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]



(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 concentration ; [3]

(c) (i) chlorophyll b **and** carotenoids ;

[1]

(ii) 1 absorb light (energy) ;

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

3 pass energy to, chlorophyll a/primary pigment ;

4 in reaction centre ; [max 3]

(iii) reflected ; [1]

(iv) action spectrum ; [1]

[Total: 15]

Page 10	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- 9 (a) 1 vitamin A found in aleurone layer of rice (seeds) ;
- 2 white rice does not contain, aleurone layer / vitamin A / carotenoids /  $\beta$  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*<sup>TM</sup> [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]

Page 11	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2014	9700	43

- 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]