

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International Advanced Subsidiary and Advanced Level

## **MARK SCHEME for the October/November 2015 series**

### **9700 BIOLOGY**

**9700/41**

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 2015</b>	<b>9700</b>	<b>41</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 2015	9700	41

1 (a) ATP ;  
pyruvate ;  
NAD ;  
ATP synthase ;

[4]

(b) (i) 1980 ; ;  
Allow one mark for  $\frac{5.2 - 0.25}{0.25} (\times 100)$  or  $\frac{4.95}{0.25} (\times 100)$

[2]

(ii) ethanol evaporated ;  
other microorganism metabolises ethanol ;

[max 1]

**[Total:7]**

2 (a) *example:*  
penicillin / other named antibiotic ;

*explanation any two from:*  
substance made by a microorganism during stationary phase / AW ;  
**A** growth of microorganism has almost stopped

produced, when there is a shortage of nutrients / when population is under stress ;

not needed for normal metabolism (of microorganism) ;

[max 3]

(b) 1 wild-type bacteria, secretes / releases, delftibactin ; **I** produces

2 delftibactin makes soluble gold ions into insoluble gold ; **A** precipitates gold

3 insoluble gold is not toxic ; **ora**

4 insoluble gold, stays outside the bacteria / not in bacterial cytoplasm ;

5 (so) no / fewer, soluble gold ions enter bacterium (from solution) ;  
**A** *D. acidovorans* for wild-type  
**A** *Au* / *metallic gold* / *solid* / *gold particles* / *gold precipitate* for insoluble gold  
**A** *Au<sup>3+</sup>* / *gold ions* / *ions* for soluble gold

[max 3]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

(c) 1 without Au<sup>3+</sup> numbers of wild-type and mutants similar / AW ;

*support*

2 with Au<sup>3+</sup> fewer mutants than wild-type ; **ora**

3 with Au<sup>3+</sup> fewer mutants than without Au<sup>3+</sup> ; **ora**

4 with Au<sup>3+</sup> and (added) delftibactin more mutants than with Au<sup>3+</sup> alone ; **ora**

*does not support*

5 with Au<sup>3+</sup> and (added) delftibactin fewer mutants than without Au<sup>3+</sup> ; **ora**

6 only one set of data / no statistical analysis ; **A** no repeats [max 4]

(d) 1 grow the wild-type, bacterium / *D. acidovorans* ;

2 in fermenter ;

3 *ref. to* (fed) batch culture ;

4 *ref. to* sterilised ;

5 nutrients at start (batch) / nutrients at intervals (fed) ;

6 carbon / nitrogen, sources ;

7 *ref. to* aeration / provide oxygen ;

8 *ref. to* constant temperature / water jacket ; **A** environmental conditions kept constant

9 details of fermenter ; e.g. paddles / stirrers

10 harvest delftibactin / downstream processing ; [max 5]

**[Total:15]**

3 (a) 1 DNA, denatured / strands separated ;

2 *ref. to* adding primer ;

3 copies of genes / pieces of DNA, of different lengths produced ;

4 *ref. to* use of DNA polymerase ; **A** PCR

5 *ref. to* fluorescent dyes / radioactive probes ;

6 *ref. to* electrophoresis / detail ;

7 DNA / base, sequence, read / visualised ;

8 (DNA / base sequence), can be compared ; [max 4]

<b>Page 5</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – October/November 2015</b>	<b>9700</b>	<b>41</b>

- (b) 1 allopatric speciation ;  
2 (due to) geographic isolation ;  
3 different (winter), selection pressures / environments ;  
4 sympatric speciation ;  
5 (two) populations have different, features / behaviours ;  
6 (two) populations do not interbreed / mates within same population ;  
7 ref. reproductive isolation ;  
8 (over time populations) cannot breed (as different species) ;  
9 AVP ; e.g. different mating calls / mutation

[max 4]

**[Total:8]**

- 4 (a) 1 cross between, two wild grasses / einkorn and goat grass ;  
2 hybrid / offspring, sterile ;  
3 chromosome doubling ;  
4 due to nondisjunction ;  
5 formation of, tetraploid /  $4n$  / polyploid ;  
6 diploid /  $2n$ , gametes now formed ;  
7 new cross with a, diploid /  $2n$ , wild grass ;  
8 hybrid / offspring, sterile ;  
9 hybrid / offspring, triploid /  $3n$  ;  
10 chromosome doubling ;

*allow mp2 or mp8 not both*  
*allow mp3 or mp10 not both*

[max 4]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

(b) gibberellin/gibberellic acid ; [1]

(c) (i) 1 gene would be present in every cell ;  
 2 (when gene expressed) mRNA is in large amounts ;  
 3 difficult to, isolate/identify/extract, gene ;**ora** for mRNA [max 2]

(ii) (*from day 3 to day 10*)

1 activity/SUT production, in seed decreases because darkness (of bands) decreases ;  
 2 activity/SUT production, in shoot increases because darkness (of bands) increases ;  
 3 activity/SUT production, remains constant in root because darkness (of bands) stays the same; [max 2]

(d) (i) 1 (fluorescent) antibody binds with, SUT/the sucrose transporter protein ;  
 2 view/photograph, tissues/sections, with a microscope ;  
 3 fluorescent areas indicate presence of SUT ; [max 2]

(ii) 1 presence of SUT in aleurone layer indicates sucrose moves (from aleurone layer to endosperm) ;  
 2 hydrolysis of starch, produces glucose or maltose/does not produce sucrose ; [2]

(iii) 1 active transport/pumping, of hydrogen ions out of companion cells ;  
 2 (at source sucrose) loaded, by cotransport/with hydrogen ions (into companion cells) ;  
 3 water moves into, companion cell/sieve tube (element) ;  
 4 by osmosis ;  
 5 idea of a hydrostatic pressure gradient ;  
 6 mass flow ; [max 3]

[Total:16]

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

- 5 (a) 1 diversity of, habitats / ecosystems ;
- 2 number of different species ;
- 3 genetic diversity within a species ; [max 2]
- (b) (i) 1 less choice of mates ;
- 2 could lead to inbreeding ;
- 3 inbreeding depression / decrease in hybrid vigour ;
- 4 decrease in, genetic variation / heterozygosity ; **A** smaller gene pool
- 5 *ref. to* possible difficulties in finding enough food ;
- 6 *idea that* small areas are more vulnerable to damage than larger ones ;
- 7 more easily exposed to danger outside area ; [max 3]
- (ii) 1 educate people about the gibbons ;
- 2 can research gibbons to find about their, behaviour / habitat requirements;
- 3 *ref. to* health care ;
- 4 adequate food ;
- 5 AVP ; e.g. fundraising for conservation projects in the wild / protection from predators or hunters [max 3]

**[Total:8]**

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

6 (a) *toxin (max 2)*

- 1 calcium ions do not enter presynaptic, neurone / knob ;
- 2 ACh / neurotransmitter, not released into synaptic cleft ;
- 3 sodium ions do not enter, neurone / axon ;
- 4 no depolarisation of (postsynaptic) membrane /  
no action potentials in (postsynaptic) neurone ;

*inhibitor (max 2)*

- 5 blocks / binds to, acetylcholinesterase ;
- 6 ACh / neurotransmitter, remains attached to receptors ;
- 7 continuous, depolarisation of postsynaptic membrane /  
action potentials in postsynaptic neurone ;
- 8 stops recycling of ACh / neurotransmitter / AW ;

[max 4]

(b) (i) convert / transduce, stimulus into a, nerve / electrical, impulse ; **A** named stimulus

[1]

(ii) receptor / generator, potential ;

[1]

(iii) 1 *idea that* the larger the intensity of stimulus  
the greater the frequency of action potentials ;

2 further detail ; e.g. *ref. to* all-or-nothing law / all action potentials have  
same p.d.

3 may involve more, receptors / neurones ;

[max 2]

[Total:8]



Page 9	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

- 7 (a) (i) carbon dioxide concentration / temperature ; [1]
- (ii) 1 stomata, number / size ;
- 2 number / size, of chloroplasts ;
- 3 leaf surface area / thinness of lamina ;
- 4 number / size, of intercellular airspaces ;
- 5 rubisco concentration ;
- 6 age / senescence ; [max 2]
- (iii) 1 respiration (rate) greater than photosynthesis (rate) ;
- 2 (so) overall there is a net production of carbon dioxide / AW ;
- 3 at **X**, idea that photosynthesis = respiration / compensation point ; [max 2]
- (b) (i) RuBP / ribulose biphosphate ; [1]
- (ii) 1 grana site of light-dependent stage ; [2]
- 2 ATP and reduced NADP produced ;
- (iii) (*without ATP and reduced NADP*)
- 1 less / no, GP converted to TP ;
- 2 less / no, RuBP / ribulose biphosphate, can be regenerated ;
- 3 light-independent stage / Calvin cycle, cannot occur (as much) ; [max 2]
- (c) chlorophyll a ;
- thylakoid ; I grana / granum
- reaction centre ;
- electron transport chain ; **A** ETC [4]

[Total:14]

Page 10	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

8 (a) (i)  $C^R$   
 $C^W$ ; *must have same upper case letter plus different superscript (upper or lower)*  
h  
H; *accept any lower case followed by upper case of same letter* [2]

(ii)  $C^WC^WHH$  ;  
 $C^WC^WHh$  ;  
 $C^RC^Whh$  ; [3]

(b) *artificial selection – accept **ora** for natural selection.*

- 1 humans, act as selection pressure / choose parents ;
- 2 reduced genetic variation / smaller gene pool ;
- 3 inbreeding depression ;
- 4 loss of hybrid vigour ;
- 5 faster ;
- 6 for benefit of humans / not for benefit of animals ;
- 7 increased homozygosity / decreased heterozygosity ;
- 8 increased chance that harmful recessive alleles will, come together / be expressed ;

[max 4]

[Total:9]

Page 11	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

- 9 (a)
- 1 synthetic hormones used ;
  - 2 as they do not get broken down quickly/ act for longer ;
  - 3 oestrogen/ progesterone, concentrations remain high ;
  - 4 inhibits secretion of, FSH/LH/ GnRH ; I stops
  - 5 from anterior pituitary gland ;
  - 6 *ref. to* negative feedback ;
  - 7 inhibits ovulation/ no ovulation ;
  - 8 alters cervical mucus to stop sperm ;
  - 9 prevents implantation/ effect on endometrium ;
  - 10 AVP ; e.g. taken daily for 21 days/ stops for 7 days to allow menstruation (or) taken daily throughout month. [max 6]

(b) *biological – negative*

- 1 rise in blood pressure/ increased chance of blood clots ;
- 2 nausea/ headaches ;
- 3 increased risk of breast cancer ;
- 4 increase in STDs ;

*biological – positive*

- 5 regular/ no menstruation ;
- 6 reduced risk of developing, ovarian cysts/ ovarian cancer/ uterine cancer ;
- 7 reduced risk of uterine infections ; **A** pelvic

*social/ethical – negative*

- 8 (sexual freedom has led to) more marriage breakdowns ;
- 9 (so more) single parent families ;
- 10 increase in promiscuity ;
- 11 religious/ cultural, objection ;

*social/ethical – positive*

- 12 reduction in, unwanted pregnancies/ abortions ;
- 13 women have control over their fertility ; **A** 'bodies'
- 14 *ref. to* population control ; [max 9]

[Total:15]

Page 12	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9700	41

- 10 (a)**
- 1 lots of pollen grains made ;
  - 2 pollen grains, small/light ;
  - 3 pollen grains, smooth/aerodynamic ;
  - 4 (so), easily carried by the wind/more chance of pollination ;
  - 5 anthers are, versatile/loosely attached/attached at one point (to filaments) ;
  - 6 anthers/stamens/androecium, on long filaments/hang out (of flower)/exposed ;
  - 7 to release pollen (into, wind/air) ;
  - 8 stigmas hang out (of flower)/exposed ;
  - 9 stigmas, large surface area/hairy/feathery/branched ;
  - 10 to catch pollen ;
  - 11 no/small, petals/corolla/calyx/perianth/sepals ;
  - 12 no, nectar/scent, produced ;
  - 13 so no energy wasted ; [max 9]
- (b)**
- 1 *ref. to* outbreeding ;
  - 2 increased genetic variation/increased genetic diversity/larger gene pool ;
  - 3 increased heterozygosity/decreased homozygosity ;
  - 4 less likely that harmful recessive alleles will, come together/be expressed ;
  - 5 (increased) hybrid vigour ;
  - 6 decreased/no, inbreeding depression ;
  - 7 ability to, adapt to/survive in, changing (environmental) conditions ;
  - 8 reduced susceptibility to, disease/pests ;
  - 9 AVP ; e.g. positive effect on insects [max 6]

**[Total:15]**