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

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)** 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^{3+} */ gold ions / ions* for soluble gold [max 3]

(c) 1 without Au^{3+} numbers of wild-type and mutants similar / AW **;**

support

2 with Au^{3+} fewer mutants than wild-type **; ora**

3 with Au^{3+} fewer mutants than without Au^{3+} **; ora**

4 with Au^{3+} and (added) delftibactin more mutants than with Au^{3+} alone **; ora**

does not support

5 with Au^{3+} and (added) delftibactin fewer mutants than without Au^{3+} **; 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) 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]

(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]

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]

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]

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 bisphosphate **;** [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 bisphosphate, 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]

8 (a) (i) $\mathbf{C^R}$
$\mathbf{C^W}$ **;** *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) $\mathbf{C^WC^WHH}$ **;**
$\mathbf{C^WC^WHh}$ **;**

$\mathbf{C^RC^Whh}$ **;** [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]

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]

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]