CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9700 BIOLOGY

9700/41 Paper 4 (A2 Structured Questions), maximum raw mark 100

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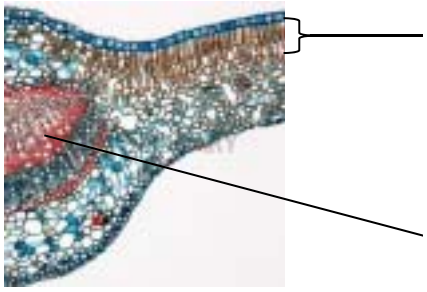
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Mark scheme abbreviations:

;	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)



P / palisade mesophyll (tissue) ;

X / xylem (tissue) ;

[2]

(b) *large surface area*
(to get) more, light / carbon dioxide ; **A** gas exchange **I** oxygen

thinness
small(er) / short(er) / reduced, diffusion distance for gases **OR**
fast(er) diffusion of gases ; **A** named gas, either CO_2 or O_2

1 mark only if both points made but not related to features in italics [2]

(c) (i) have chloroplasts / varying thickness of (cell) walls / no plasmodesmata ; [1]

(ii) water potential / Ψ, of (guard) cell(s), increases / becomes less negative ;

water leaves cell(s) ;

(by) osmosis / down a water potential gradient ; **I** diffuses

(guard cell) becomes, flaccid / less turgid / AW ; [max 3]

[Total: 8]

2 (a) has more than one polypeptide ; **A** FSH has 2 / α and β, polypeptides **R** has four

has, prosthetic group / non-protein part / carbohydrate / sugar ; [max 1]

(b) 1 produce / make, monoclonal antibodies specific to (u-h)FSH / anti(u-h)FSH monoclonal antibodies ;

2 ref. to column / framework, for, attachment / immobilisation ; **R** test strip

3 urine, added to / flows past / passed over, antibodies ;

4 (so) allowing, hormone / (h)FSH, to bind (to monoclonal antibodies) ;

5 treatment needed to release, hormone / (h)FSH (from monoclonal antibodies) ; **I** filtering
[max 3]

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(c) 1 sugars need to be added / glycosylation **;** **A** bacteria cannot modify protein

2 needs, Golgi body / rough endoplasmic reticulum **;** **A** bacteria lack, Golgi / rough endoplasmic reticulum

3 ref. to problems in bacteria with, introns / wrong promoter / secretion / **ora** **;** [max 1]

(d) *labels to correct recognisable structures*

(secondary) oocyte **;** **R** ovum

zona pellucida **;**

corona radiata / cumulus oophorus **;**

fluid-(filled space) / antrum **;**

granulosa / follicle / follicular, cells **;**

theca **;** [max 3]

(e) **(i)** *comparison*

1 more mature follicles with r-hFSH **;** **ora**

2 oestrogen (concentration), higher with r-hFSH **;** **ora**

3 comparative data quote **;** e.g. 13 v 8 mature follicles
OR 6.55 v 3.95 nmol dm^{-3} oestrogen concentration
OR manipulated figures
e.g. difference of 5 / 2.6 nmol dm^{-3} /
62.5% increase (r) follicles / 65.8% (r) oestrogen

explanation

4 (because) r-hFSH, purer / more concentrated / **ora**
OR
(some) u-hFSH, damaged by extraction technique / degraded **;** [max 4]

(ii) 1 difference / difference described, is significant **;**

2 not due to chance **;** **A** due to something other than chance

3 smaller than, critical value / value for significance of, 0.05 / 5% **;** [max 2]

[Total: 14]

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3 (a) *self-pollination* ***ora*** *for cross-pollination*

1 gametes / alleles / genes / DNA, come(s) from one parent **;**

2 gives, less genetic variation / more genetic uniformity **;**

3 results in inbreeding **;**

4 increases homozygosity / decreases heterozygosity **;** [max 3]

(b) anthers and stigma / stamens and carpels, closer together **;** [1]

(c) 1 range of flower size in original population **;**

2 genetic variation (affecting flower size) in original population **; I** mutation

3 change in environment / selection pressure,
is absence of, bees / insect pollination (in greenhouse) **;**

4 plants with small, flowers / petals, are,
selected for / reproduce / at a selective advantage **; ora**

5 <u>alleles</u> for small size passed to offspring **; ora I** gene

6 frequency of, advantageous / smallness, allele increases **; ora**

7 directional selection **;**

8 temperature / irrigation / space / competition, different in field and glasshouse **;**

9 small size explanation linked to factor in mp8 **;** [max 5]

[Total: 9]

4 (a) (i) 1 habitat loss / urbanisation / roads / agriculture **; R** deforestation

2 human damage (to plants) **;** e.g. trampling / camping / picking

3 climate change **;** e.g. drought / storms

4 soil erosion **;**

5 loss of pollinators **;**

6 use of herbicides **;**

7 competition with / eaten by, introduced species **;**

8 pollution **;** [max 2]

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(ii) 1 to maintain biodiversity **;**

2 to maintain, food chains / food webs / stability of ecosystems **;**

3 to maintain, genetic diversity / genetic variation / gene pool **;**

4 resources (for humans) **;** e.g. biofuel / food / medicines / wood

5 aesthetic reasons / (eco)tourism **;**

6 to maintain, nutrient cycle / soil structure / climate stability **;**

7 *idea of* ethical duty **;** [max 3]

(b) 1 gibberellin moves (from embryo) to aleurone layer **;**

2 gene, switched on / transcribed / used to make mRNA **;**

3 amylase produced **; I** released / stimulated

4 (amylase), hydrolyses / digests, starch to maltose **; I** breaks down / converts **/** glucose

5 for, respiration / ATP / energy **;**

6 for, growth / development / cell division / mitosis, in embryo **;**

7 AVP **;** e.g. role of, DELLA / PIF [max 4]

(c) (i) *survival:*

1 less risk of extinction (for high seed survival compared with low survival) **;**

germination percentage:
for low survival:

2 as % germination increases, risk of extinction decreases **;**

for high survival:

3 as % germination increases risk of extinction decreases until,
30–36 % germination, then risk of extinction increases **;**

4 use of paired figures **;** e.g. quote % germination and risk of extinction for each of:
high v low [mp1]
2 points on low survival line [mp2]
2 points on high survival line [mp3]
allow ± one grid square for figures [max 3]

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(ii) *yes*

1 (scraping) increases germination **;**

2 more germination lowers risk of extinction **; ora**

3 if seeds don't survive long / for low survival value seeds, scraping is good **;**

no

4 if seeds do survive long-term / for high survival value seeds, a store of seeds remains in soil **;**

5 (avoid risk of) all germinating at once and perhaps all dying **;** [max 3]

[Total:15]

5 (a) 1 two (complete) sets of chromosomes / diploid / 2n **;**

2 one of each chromosome, from each parent / maternal and paternal **;**

3 to allow (homologous) pairs to form during, meiosis / prophase 1 / reduction division **;** [max 2]

(b) most / high % / more than 70%, of females in **three** populations prefer calls from their own population **;**

less than half / 44%, of females in, **one** population / population 60, prefer calls from their own population **; ora** [2]

(c) *yes*

1 different chromosome numbers **;**

2 cannot interbreed to form fertile offspring / hybrids infertile **;**

3 (because) not all chromosomes will be able to pair in meiosis **;**

4 live in different, habitats / climatic regions
OR
geographical isolation **;**

5 (so) unlikely to interbreed / reproductively isolated **;**

6 most females prefer males from their own population **; ora**

7 differences in mating, call / behaviour **;**

no

8 some females, willing to mate with / prefer, males from other populations **;**

9 phenotypically / morphologically, similar **;** [max 4]

[Total: 8]

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6 (a) *toxin may*

1 bind to receptors on postsynaptic (membrane) **;**

2 (so) stops ACh binding / inhibits depolarisation / no action potentials / Na^+ ion channels stay shut **;**

3 (so) stimulates ACh receptors / causes (continuous) depolarisation / causes action potentials / opens Na^+ ion channels **;**

4 reduces / stops, release / recycling, of ACh (by presynaptic neurone) **;**

5 inhibits acetyl cholinesterase / AW **; R** denatures [max 3]

(b) 1 enter, presynaptic neurone / AW **;**

2 causes vesicles (containing ACh) **;**

3 to, move to / fuse with, (presynaptic) membrane **;**

4 (so) ACh released (into synaptic cleft) / exocytosis **;** [max 3]

(c) 1 ensure one-way transmission **;**

2 filter out infrequent impulses / temporal summation **; I** weak

3 allow, interconnection / integration, of, nerve (cell) pathways / many neurones **;**
OR
spatial summation / convergence of impulses / divergence of impulses **;**

4 ref. memory / learning **;**

5 idea of inhibitory effect **;** [max 2]

[Total:8]

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7 (a) 1 glucose phosphorylated by ATP **;**

2 (forms) hexose / fructose, bisphosphate **;**

3 raises energy level of / activates, glucose / sugar
OR
lowers activation energy of reaction **;**

4 breaks down to **two** TP **;**

5 6C → 2 × 3C **;**

6 hydrogen (atoms) removed / dehydrogenated / oxidised **;**

7 2 reduced NAD formed **; A** NADH / $NADH_2$

8 ref. to 4 ATP produced / net gain of 2 ATP **;**

9 pyruvate produced **;**

10 AVP **;** e.g. ref. to substrate level phosphorylation / dehydrogenase / phosphofructokinase / hexokinase [max 6]

(b)

	substrate level phosphorylation	oxidative phosphorylation	
enzymes are involved	✓	✓	
occurs in cytoplasm	✓	×	;
occurs in mitochondria	✓	✓	;
channel proteins are involved	×	✓	;

[3]

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(c) *seeds soaked in water*

1 little / no, oxygen (in water) **;**

2 (mostly) anaerobic respiration **;**

seeds after 12 hours in the soil

3 (more) aerobic respiration / less anaerobic respiration **;**

4 mixture of substrates **;** e.g. 2 of carbohydrates, proteins and lipids

seedlings after 21 days

5 aerobic respiration **;**

6 substrate is, glucose / carbohydrate **;**

7 ref. to presence of leaves / photosynthesis **;** [max 6]

[Total:15]

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8 (a) gene mutation **;**

a change in the, base(s) / nucleotide(s) **;**
e.g. base, substitution / deletion / addition [2]

(b) *parental genotypes*
CC^aBb x C^hC^aBb ;

gametes
CB Cb C^aB C^ab x C^hB C^hb C^aB C^ab ; *allow on Punnett square*

offspring genotypes **; ;** *deduct one mark for each error*
max 1 ecf for offspring genotypes if only 4 given

offspring phenotypes **;**

phenotypes linked to genotypes **;**

	C^hB	**C^aB**	**C^hb**	**C^ab**
CB	**CC^hBB** full black	**CC^aBB** full black	**CC^hBb** full black	**CC^aBb** full black
Cb	**CC^hBb** full black	**CC^aBb** full black	**CC^hbb** full red	**CC^abb** full red
C^aB	**C^aC^hBB** Him black	**C^aC^aBB** albino black	**C^aC^hBb** Him black	**C^aC^aBb** albino black
C^ab	**C^aC^hBb** Him black	**C^aC^aBb** albino black	**C^aC^hbb** Him red	**C^aC^abb** albino red

[6]

[Total:8]

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9 (a) 1 obtain mRNA from β cells (of islets of Langerhans of pancreas) **;**

2 reverse transcriptase **;**

3 make (single-stranded) cDNA **;**

4 DNA polymerase used to make cDNA double stranded **;**

5 sticky ends created **; A** description

6 (obtain) plasmids **;**

7 cut with restriction, endonuclease / enzyme **; A** named e.g. EcoR1

8 ref. complementary sticky ends **;**

9 cDNA / insulin gene, mixed with plasmid **;**

10 DNA ligase **;**

11 seals nicks in sugar-phosphate backbone **; R** anneals [max 8]

(b) 1 (recombinant) plasmids mixed with bacteria **;**

2 (some) bacteria, take up plasmids / transformed **;**

3 heat shock / calcium chloride solution / Ca^{2+} ions / electroporation **;**

to identify bacteria containing plasmids

4 grow on, agar / medium, containing antibiotic (A) **; A** ampicillin

5 plasmid contains, antibiotic (A) / ampicillin, resistance gene(s) **;**

6 bacteria with plasmid survive **; ora**

to identify recombinant bacteria

7 replica plate **; A** description e.g. sponge / velvet pad / absorbent paper

8 (onto) agar / medium, containing second antibiotic (B) **; A** tetracycline

9 *(*tet^R / B / 2^{nd}) resistance gene inactivated (by insertion of new, DNA / gene) / AW **;**

10 (ID) colonies from, 1^{st} / ampicillin, plate that do not grow on, 2^{nd} / tetracycline, plate **;** [max 7]

[Total:15]

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10 (a) *batch / penicillin*

1 nutrients, decrease / run out ;

2 so, secondary metabolite / penicillin, made ;

3 fermenters can be used (after cleaning) for different process ;

4 if problem occurs only one batch affected ;

5 needs little, monitoring / attention (once set up) ;

continuous / mycoprotein

6 (fungus) kept in, exponential / log, phase (of growth) ;

7 (so) high, biomass / yield / production rate ;

8 little / no, downtime ;

9 small, vessels / space, required;

10 cost-effective ; [max 8]

(b) 1 mouse is injected with an antigen ;

2 wait for immune response to occur ;

3 clonal selection ; **A** description e.g. antigen binds to, specific / virgin, B cell

4 clonal expansion ; **A** description e.g. mitosis / division / cloning of B cells

5 B-lymphocytes / plasma cells, are extracted ;

6 from the mouse's spleen ;

7 fused with, cancer / myeloma / tumour, cells ;

8 hybridoma cells formed ;

9 hybridoma cells producing antibodies are identified ;

10 cultured on a large scale (to secrete monoclonal antibodies) ; [max 7]

[Total:15]

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