UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

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.

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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 excepted)
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)** allopatric **;** [1]

(b) 1. packs / populations, isolated from each other **;**
2. inbreeding / no interbreeding **;**
3. little mutation **;**
4. AVP **;** e.g. small population to start with / small gene pool to start with [2 max]

(c) 1. agriculture / buildings / AW **;**
2. *idea of* wolves dying **;**
3. hunting / trapping / AW **;**
4. hybridisation / infertility / change in (wolf) gene pool / loss of wolf alleles / AW **;** [4]

(d) 28(%) **;;** [2]
allow one mark for number not rounded up or incorrect answer but correct idea regarding working

[Total: 9]

2 **(a)** 1. only three colours (for positive reactions) / only a small range **;**
2. no measurement of actual concentration / no numerical value measured **;** [2]

(b) **(i)** peroxidase **;** [1]

(ii) 1. (catalyses breakdown of hydrogen peroxide) to produce oxygen **;**
2. chromogen, oxidised by / reacts with, (oxygen) **;**
3. produces range of colours **;**
4. more, peroxide / oxygen produced, = greater change / darker colour **;** [2 max]

(iii) 1. to keep out, proteins / enzymes / polymer / named large molecule **;**
R large molecules unqualified
2. to prevent interference (to reactions) **;**
3. to prevent loss of, enzyme / chromogen **;**
4. so still allowing reaction to occur **;** [2 max]

(c) **(i)** 1. **B** has diabetes and **A** does not **;**
2. **A**'s, values / peak, lower because he secretes insulin
or
B's, values / peak, higher because, no / little, insulin **;**
in A
3. (insulin affects), liver / muscle, cells **;**
4. increase in glucose uptake / increase in permeability of membranes (to glucose) **;**
5. increase in use of glucose in respiration **;**
6. (more) glucose converted to glycogen **;**
in B
7. because cells unresponsive to insulin **;** [4 max]
accept quoted values for lower and higher in mark point 2

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(ii) (the concentration of blood glucose), above which some glucose appears in the urine / AW **;** [1]

(iii) 1. (at first), glucose reabsorbed by proximal convoluted tubule **;**
2. ref. co transported with Na^+ / facilitated diffusion / protein carrier **;**
3. above 180mg ($100cm^{-3}$ glucose in blood) no further reabsorption **;**
4. because carriers (in PCT) saturated / AW **;** [3 max]

[Total: 15]

3 (a)

	male		female	
1	produces sperm	**or**	produces, oocyte	;
2	division of cytoplasm is equal	**or**	division of cytoplasm is unequal	;
3	four gametes produced	**or**	one gamete produced	;
4	no polar bodies	**or**	polar bodies	;
5	ref. maturation	**or**	no equivalent maturation stage	;
6	ref. meiosis completed	**or**	ref. incomplete meiosis	;

[3 max]

(b) 1. a ductless gland **;**
2. hormones in the blood **;**
3. ref. target, organ / tissues **;** [2 max]

(c) 1. (both), reduce / stop, secretion (of FSH and LH) **;**
2. (both) involve negative feedback **;**
3. to, anterior pituitary / hypothalamus **;**
4. both are, contraceptives / description **;** [3 max]

[Total: 8]

4 (a) 1. low oxygen (in water) results in anaerobic respiration **;**
2. (anaerobic respiration) produces alcohol **;**
3. rice tolerant to alcohol **;**
4. (because rice has) high levels of, alcohol dehydrogenase / enzyme that breaks down alcohol **;**
5. presence of, aerenchyma / described **;**
6. allows, oxygen / air, to reach roots (from aerial tissues) **;** [3 max]

(b) (i) 1. (immersion in water) stimulates production of ethene **;**
2. (concentration of) ethene produced increased with time (after submergence) **;**
3. very little difference in ethene production between T65 and C9285 **;**
4. use of figures **;** 2 values of ethene **plus** 2 values of time for **either** T65 **or** C9285 [2 max]

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(ii) 1. in T65 ethene does not affect internode elongation **but** in C9285 ethene promotes internode elongation **;**
2. in C9285, greater concentrations of ethene cause greater elongation **;**
3. use of comparative figures to support mark point 1 **or** mark point 2 **;** *both units at least once* [2 max]

(c) 1. *SK* genes present in C9285 / *SK* genes not present in T65 **;**
2. **increased** production of GA in C9285 / little or no increased production of GA in T65 **;**
3. GA stimulates, stem elongation / AW **;**
4. AVP **;** e.g. T65 has no receptors for ethene [3 max]

(d) (i) *SK2* more important **; ora**
O. nivara has mutated *SK2* and does not have deepwater response
or
O. glumaepatula has *SK2* but not *SK1* and does have deepwater response **;** [2]

(ii) 1. (addition / insertion), of a, base / nucleotide, to DNA / to a gene **;**
2. changes a, sequence of three bases / triplet / codon **;** *ignore ref. to frame shift*
3. (triplet) no longer codes for an amino acid **;** [2 max]

(iii) 1. breed deepwater variety with (high-yielding) non-deepwater variety **;**
2. identify / select, offspring with **both** deepwater response and high yield **;**
3. breed selected offspring (with **both** deepwater response and high yield) **;**
4. continue for many generations **;** [3 max]

[Total: 17]

5 (a) 1. caused by a single gene **;**
2. caused by a recessive allele **;**
3. delivery of, correct / dominant / normal, allele (could correct the condition) **;**
4. only need to get allele into a few cells **;**
5. ease of access to affected area **;**
6. serious so worth the risk **;**
7. AVP **;** e.g. only targets eye / no surgery needed [3 max]

(b) 1. virus no longer able to cause infections **;**
2. correct / dominant / normal, allele (of *RPE65*) added **;**
3. promoter added **;** [2 max]

(c) 1. ref. to safety / not known if the technique might have side effects **;**
2. rare condition **;**
3. expense **;**
4. AVP **;** e.g. trial to see if delivery method works [2 max]

[Total: 7]

6 (a) (i) <u>phosphorylation</u> **;** [1]

(ii) <u>lysis</u> **;** [1]

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(iii) dehydrogenation / oxidation ; *ignore reduction of NAD* [1]

(b) provides activation energy / AW ;
for it to split / AW ; [2]

(c) 1. decarboxylated / carbon dioxide given off ;
2. ethanal produced ;
3. ethanal reduced ;
4. by reduced NAD ;
5. to ethanol ;
6. dehydrogenase ; [4 max]

[Total: 9]

7

step	reason for step
obtain copies of gene with sticky ends	the gene codes for the synthesis of insulin
plasmid (used) ;	acts as a vector for the transfer of the gene into the host
use restriction endonuclease enzyme	to produce 'sticky ends' **or** cut at specific, site / sequence ;
mix vector and gene	gene inserts into, vector / plasmid **or** forms recombinant DNA / AW ; **A** detail of complementary base pairing
(use DNA) ligase ;	to seal the sugar-phosphate backbone
insert, plasmid / vector, into host / *E. coli / bacteria* ;	to obtain transformed host *E. coli* cells
screen for, and obtain, successfully transformed cells	so only recombinant host cells cultured / AW;
ref. batch / continuous, culture **or** fermenter **or** bacterial cloning / population growth ;	to obtain large amounts of insulin for extraction and purification

[7]

[Total: 7]

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8 **(a)** *any two from*
(cigarette) smoke **;**
named air pollutant **;**
animal fur / skin flakes / AW **;**
perfumes / aerosol / solvents **;**
dust / mites **;**
pollen / spores **;** [2 max]

(b) **(i)** high tensile strength / withstands pulling forces / fibrous / insoluble / forms fibrils / flexible **;** [1]

(ii) 1. inbreeding **;**
2. little genetic variation / small gene pool / small population **;**
3. many carried faulty allele / AW **;**
4. faulty / mutant, allele, could be dominant or recessive **;**
5. little phenotypic variation **;** [3 max]

[Total: 6]

9 **(a)** *dominant*
(allele) that always expresses itself (in the phenotype) when present
or
(allele) which influences the phenotype even in the presence of an alternative allele **;**

gene
length of DNA / sequence of nucleotides, coding for a (specific) polypeptide **;** **A** protein [2]

(b)

parental phenotypes	man without TSC	woman with TSC	
parental genotypes	**tt**	**Tt**	
gametes	**all t**	**T or t**	**;**
offspring genotypes	**Tt**	**tt**	
offspring phenotypes	**TSC**	**normal**	**;**
probability of child having TSC	**50% / 0.50 / 1in 2 ;**		

[3]

(c) 1. spontaneous / random / chance **;**
2. mutation of, gene / allele **;**
3. AVP **;** e.g. named mutagen / detail of mutation [2 max]

[Total: 7]

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10 (a) 1. ground substance / stroma ;
2. for, light independent stage / Calvin cycle ;
3. contains enzymes / named enzyme e.g. rubisco ;
4. also, sugars / lipids / starch / ribosomes / DNA ;
5. internal membrane system ;
6. for, light dependent stage ;
7. fluid-filled sacs / thylakoids ;
8. grana are stacks of thylakoids ;
9. (grana) hold (photosynthetic) pigments ;
10. (grana) have large surface area for (maximum) light absorption ;
11. (pigments are arranged in), light harvesting clusters / photosystems ;
12. primary pigment / reaction centre / chlorophyll a, surrounded by accessory pigments ;
13. (accessory pigments) pass energy to, primary pigment / reaction centre / chlorophyll a ;
14. different photosystems absorb light at different wavelengths ;
15. membranes hold, ATP synthase / electron carriers ;
16. for, photophosphorylation / chemiosmosis ; [9 max]

(b) 17. grind leaf with solvent ;
18. example of solvent ; e.g. propanone
19. leaf extract contains mixture of pigments ;
20. ref. concentrate extract ;
21. further detail ; e.g. pencil line drawn / extract placed on chromatography paper / repetitive spotting / drying between spots
22. paper placed (vertically) in jar of (different) solvent ;
23. solvent rises up paper ;
24. each pigment travels at different speed ;
25. pigments separated as they ascend ;
26. distance moved by each pigment is unique ;
27. Rf value ;
28. two dimensional chromatography ;
29. better separation of pigments ; [6 max]

[Total: 15]

11 (a) 1. axon phospholipid bilayer impermeable to K^+ / Na^+ ;
2. sodium – potassium pump ;
3. detail of sodium-potassium pump ; e.g. transmembrane / globular / ATP binding site
4. active process / ATP used / energy needed ;
5. 3 Na^+ (pumped) out / 2 K^+ (pumped) in ;
6. K^+ <u>diffuse</u> out / Na^+ <u>diffuse</u> in ;
7. through, protein channels transport proteins ;
8. more K^+ channels open than Na^+ channels ;
9. therefore, membrane more permeable to K^+ **or** more K^+ leave than Na^+ enter (axon) ;
10. inside relatively more negative than outside ;
11. –65mV ; **A** –70mV
12. *idea of* leaking K^+ responsible for resting potential / AW ;
13. electrochemical gradient ;
14. voltage-gated channels closed ; [9 max]

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(b) *general*

15. respond to stimuli / AW **;**
16. (some) receptors are the ends of sensory neurones **;**
17. (some) receptors are cells **;**
18. they are energy transducers **;**
19. stimulus causes sodium ion channels to open **;**
20. sodium ions enter cell **;**
21. depolarisation **;**
22. receptor / generator, potential **;**
23. if (receptor potential) greater than threshold then action potential generated / all or nothing principle described **;**
24. increased stimulus strength leads to increased frequency of action potentials **;**

examples – allow any two below

receptor	form of energy detected
rods / cones	light **;**
taste buds / olfactory cells	chemical **;**
Pacinian \ Meissner's, corpuscle	pressure / touch **;**
Ruffinis endings	heat **;**
proprioreceptors	mechanical displacement **;**
hair cells in semicircular canals	movement **;**
hairs cells in cochlea	sound **;**

[max 2]

[6 max]

[Total: 15]

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