UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 question paper

9700 BIOLOGY

9700/04 Paper 4 (Theory 2), maximum raw mark 100

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UNIVERSITY of CAMBRIDGE International Examinations

A = accept
R = reject
AW = alternative wording
ora = or reverse argument

1 (a) P = 2.15 and R = 19 for 3marks ;;;

Allow one mark for working if incorrect answer(s) [3]

(b) / **(c)**

		unicell **P**	unicell **R**
kingdom		prokaryote	protoctista ; ***R*** *eukaryote alone*
features	1	0.5 – 5 μm	up to 40μm ;
	2	DNA circular *ignore plasmid*	DNA linear ;
	3	DNA, free / in cytoplasm ***R*** *no nucleus*	DNA in nucleus / AW ;
	4	DNA naked	DNA associated with protein / histones ;
	5	70s / 18nm, ribosomes	80s / 22nm, ribosomes ;
	6	No ER	ER ;
	7	few organelles	many types of organelle ;
	8	no organelles surrounded by membrane / no named organelle	organelles surrounded by membrane / named organelle ;

[5 max]

notes

look for pairings if not side by side and link with red line

give credit for two paired statements in same box

no credit for single statements

allow ecf if P and R kingdoms swapped

[Total: 9]

2 **(a)** 1 ref. variety of, species / organisms ;
2 genetic diversity within species / AW ;
3 genetic diversity between species ;
4 wide range of, habitats / ecosystems ; [3 max]

(b) 1 ref. rapid growth of plants / high rate of photosynthesis ;
2 large number of plant, species / types ;
3 flowers / fruit / leaves, (for animals) throughout the year ;
4 provides, niches / habitats ; [2 max]

(c) *allow up to two good examples for each role*

1 *ecological role*
e.g. ;; (nutrient cycling / climate)

2 *economic role*
e.g. ;; (food / medication / timber / ecotourism)

3 *ethical role*
e.g. ;; (indigenous people)

4 *AVP*
e.g. ;; (gene bank / interdependence of species) [4 max]

[Total:9]

3 (a) *any four from*

1 thick / dehydrated / sticky, mucus ;
2 builds up in, lung / gut / airways ; ***A*** *excess of mucus…..* ***R*** *blocks up*
3 infections in lungs ; ***A*** *named infection*
4 scar / damage, lungs ;
5 mucus, prevents secretion (of digestive enzymes) from pancreas / blocks pancreatic duct ;
6 malnutrition / inadequate digestion / inadequate absorption ; ***R*** *indigestion*
7 reduced, growth / development ;
8 excessively salty sweat / muscle cramps ;
9 mucus blocks sperm duct / males sterile ; *female neutral* [4 max]

(b) *gametes* BX bX BX BY bX bY ;

offspring genotypes see table ;

offspring phenotypes see table ; ***R*** *phenotypes if no gender*

probability of CF daughter 1in 8 offspring / 1 in 4 daughters / 12.5% / 0.125 ;

gametes	BX	BY	bX	bY
BX	BBXX normal female	BBXY normal male	BbXX normal/carrier female	BbXY normal/carrier male
bX	BbXX normal/carrier female	BbXY normal/carrier male	bbXX CF female	bbXY CF male

[4]

(c)

1 mutation alters DNA base sequence ;
2 triplet of bases / three bases,(in DNA) codes for an amino acid ; ***R*** *'codon' re DNA*
3 base substitution alters code ;
4 base, addition / deletion, produces frame shift / subsequent triplets have altered coding ;
5 ref. transcription ;
6 ref. translation ; [4 max]

(d) (i) E has, AAG / GAA / 2As and 1G, missing / ora ; [1]

(ii) E's polypeptide lacks one amino acid present in D's ;
different primary structure ;
may have different, secondary structure / tertiary structure / 3D shape ; [2 max]

[Total: 15]

4 (a) 1 maintains, constant / stable, internal environment ; ***R*** *normal*
2 a change in, some parameter / example of parameter ; *(like blood glucose or temperature)*
3 detected by a, sensor / receptor ;
4 brings about response via an effector / ref.corrective mechanism ;
5 ref. return to, norm / set point ;
6 named, receptor / effector ; [4 max]

(b) 1 enzyme immobilised (in biosensor) ;
2 H^+ ions released (from gluconic acid) ;
3 give positive charge ;
4 current flows ;
5 size of current proportional to concentration of, H^+ / glucose ;
6 low reading (when blood tested) indicates, hypoglycaemia / low blood glucose concentration ; ***A*** *ora* [4 max]

alternative points
2 platinum electrodes ;
3 detects oxygen concentration ;

[Total: 8]

5 (a) (i) as temperature increases, rate / CO_2 used, increases then decreases ;
2 paired figs / peak at 18°C ; [2]

(ii) 1. (rises due to) increased kinetic energy of molecules ;
2. increased number of collisions / increase in enzyme activity ;
3. enzymes become (partly) denatured above, 18°C / optimum ;
4. (affects) rate of, light independent reaction / Calvin cycle / dark stage ;
5. stoma close as temperature rises ;
6. because of increased transpiration rate ;
7. which decreases carbon dioxide availability ;
8. more carbon dioxide available as temperature increases ;
9. faster diffusion rate ;
10. CO_2 / light / other factor, becomes limiting ; [2 max]

(b) (i) 1. maize has greater rate of photosynthesis (at all temperatures) / ora ;
2. optimum for maize is 23°C while optimum for wheat is 18°C ;
3. steeper increase for maize as temperature increases to optimum / ora ;
4. 2 paired figs (comparing wheat and maize) ; [2 max]

(ii) 1. bundle sheath cells (surround, vascular bundle / vein) ;
2. CO_2 accumulation / maintains higher CO_2 concentration than air outside ;
3. light-independent stage takes place here ;
4. (bundle sheath cells) kept away from air spaces (by mesophyll cells) ;
5. limits, loss of CO_2 / uptake of O_2 ;
6. avoids photorespiration / competition between CO_2 and O_2 for, RuBP / rubisco ;
7. plasmodesmata between bundle sheath cells and mesophyll ;
8. relevant comment on stomata ; [3 max]

(iii) lamellae / membranes, needed for light dependent reaction ;
as less chlorophyll to absorb light / less surface area exposed to light ; [2]

(c) **(i)** endosperm ; [1]

(ii) 1. total of oil and starch lower in maize than in sorghum / ora ;
2. 66.9% and 73.9% dry mass / ora ;

3. maize contains less energy than sorghum / ora ;
4. but overall not much difference in energy ;

(because)
5. oil provides more energy than starch (per unit mass) ;
6. maize has more oil but not enough to outweigh the greater starch content in sorghum / AW ; [3 max]

[Total: 15]

6 **(a)** 1 ovulation stimulated by, FSH / hMG (human menopausal gonadotrophin) / GnRH / clomiphene ; ***R*** *hCG*
2 oocytes collected ;
3 use of fine tube / laparoscopy ;
4 oocytes placed (in dish) with, motile sperm / AW ;
5 inspected, after three days for embryos / when reaches 6-8 cell stage ;
6 (more than one) embryos selected and placed into uterus ;
7 ref. sperm DNA injected into oocyte ;
8 (hCG given to) maintain endometrium ;

R *ova or eggs once* [4 max]

(b) **(i)** *(lower success rate in older women because)*
any two from

1. eggs may be less viable ;
2. more chromosome abnormalities in eggs ;
3. less eggs ;
4. hormones secreted less effective ;
5. hormones secreted in smaller quantities ; [2 max]

(ii) *any two from*

1. success rate is low ;
2. success falls off with age ;
3. takes money away from other services ;
4. reduces number of adoptions ;
5. social / ethical / religious, reasons ; [2 max]

[Total: 8]

7 **(a)** 1 provides, H^+ / protons / protons and electrons ; ***A*** *hydrogen* ***R*** H_2 ***R*** *produce* H^+
2 forms, reduced NAD / reduced FAD ; ***A*** *NAD / FAD, accepts* H^+
3 passed to ETC / cytochromes ;
4 oxidative phosphorylation ;
5 cytochrome oxidase ;
6 forms water (with oxygen) ; [3 max]

(b) **(i)** (initial) steep rise up to 40 (μmol) Al ;
2 paired figs ;
ref. plateau above 40 (μmol) Al ; [2 max]

(ii) (initially) Al is, activator / cofactor / coenzyme ;
detail of shape change of enzyme ;
enzyme / substrate, limiting, after 40 (μmol) Al / high conc Al ; ***A*** *end product inhibition after 40 (μmol) Al* [2 max]

[Total: 7]

8 **(a)** C – depolarisation / inside (membrane) more positive ;
sodium ions / Na^+, flow in ;

D – repolarisation / inside (membrane) more negative ;
potassium ions / K^+, flow out ;

E – hyperpolarisation / refractory period ;
more negative than resting potential ; [6]

(b) *for A (ora for B)*
(generator / receptor) potential (difference) ;
does not overcome threshold ; [2]

[Total: 8]

9 **(a)** ref. mosquitoes, are vectors / carry malaria ;
conditions in those areas suitable for mosquitoes / ora ; [2]

(b) 1. areas of SCA and malaria incidence match / AW ;
2. homozygous, recessive / for SCA allele, die of SCA ;
3. homozygous, dominant / for normal allele, susceptible to / die of , malaria ;

4. heterozygous have, SCA symptoms / sickle cell trait ;
5. but are resistant to malaria ;
6. have selective advantage / survive ;
7. pass on, recessive / sickle cell, allele ;

8. SCA no advantage outside of malarial areas ;
9. SCA and malaria both act as selection pressures ; [4 max]

[Total: 6]

Section B

Question		Expected Answers	Marks
10	(a)	1 arranged in light harvesting clusters ; ***A*** *system*	
		2 primary pigments / chlorophyll a ;	
		3 at reaction centre ;	
		4 P700 / P1, absorbs at 700(nm) ;	
		5 P680 / P11, absorbs at 680(nm) ;	
		6 accessory pigments / chlorophyll b / carotenoids ; *ignore ref to chlorophyll a*	
		7 surround, primary pigment / reaction centre / chlorophyll a ;	
		8 absorb light ; *linked to 6*	
		9 pass energy to, primary pigment / reaction centre / ; chlorophyll a ;	
		10 P700 / PI, involved in cyclic photophosphorylation ;	
		11 (light absorbed results in) electron excited / AW ;	
		12 emitted from chlorophyll ;	
		13 chain of electron carriers / ETC ;	
		14 ATP synthesis ;	
		15 electron returns to, P700 / P1 ;	[9 max]
	(b)	16 photolysis of water ;	
		17 releases H^+ ; ***R*** *H / hydrogen atoms*	
		18 by, P680 / PII ;	
		19 e^- released ;	
		20 by, P700 / PI ;	
		21 both combine with NADP ;	
		(reduced NADP)	
		22 reduces, GP / PGA ;	
		23 to TP ;	
		24 ATP used ;	
		25 NADP, regenerated / oxidised ;	[6 max]
			[Total: 15]

11 (a)

1 chiasma / crossing over ;
2 between non-sister chromatids ;
3 of, homologous chromosomes / bivalent ;
4 in <u>prophase 1</u> ; *linked to 1*
5 exchange of genetic material / AW ; ***R*** *genes unqualified*
6 linkage groups broken ;
7 new combination of alleles ;

8 <u>independent assortment</u> ; ***R*** *random assortment*
9 <u>metaphase 1</u> ; *linked to 8*
10 detail of independent assortment ;

11 possible mutation ;
12 random mating ;
13 random fusion of gametes ; [7 max]

(b)

14 phenotypic variation results from interaction of genotype and environment / VP = VG + VE ;

15 environment may limit expression of gene(s) / AW ;
16 e.g. for size / mass / height ;
17 because, food / nutrients / ion, missing / malnutrition ;
18 named, nutrient / ion / mineral, missing ;

19 environment may, trigger / switch on, gene ;
20 ref. low temperature and change in animal colour ;
21 ref. high temperature and, curled wing in *Drosophila* / gender in crocodiles ;
22 ref. <u>UV</u> light and melanin production ;
23 ref. wavelength of light and, flowering / germination / fruit colour ;
24 other named trigger plus example ;

25 environment effect usually greater on polygenes / ora ;
26 environment may induce mutation affecting phenotype ; [8 max]

[Total: 15]