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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9700 BIOLOGY

9700/41 Paper 41 (Theory 2), maximum raw mark 100

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Section A

Question			Expected Answers	Marks
1	(a)	1	species threatened with extinction ;	
		2	numbers reduced to critical level / population too small ;	
		3	such low numbers that reproduction is affected ;	[2 max]
	(b)	1	(maintain colony) in zoo ;	
		2	captive breeding (programme) ;	
		3	assisted reproduction ; e.g. IVF	
		4	educate public ;	
		5	national parks / conservation areas ;	
		6	habitat protection ;	
		7	ban, hunting / poaching ;	[4 max]
				[Total:6]
2	(a)	1	population increases slowly at first / ref. lag phase ;	
		2	(because) adjusting to pond environment ;	
		3	(then) steep increase / log phase / exponential increase / rapid growth or reproduction phase ;	
		4	(because) abundant food source / named other factor ;	
		5	stationary phase ;	
		6	fall in population size / death phase / decline phase ;	
		7	(due to) predation / build up of waste ;	
		8	competition for named resource ; e.g. food shortage	
		9	idea of further increase and fall / ref. population size may be cyclic ;	[5 max]
	(b)		variation means the presence of different characteristics ;	
			resulting in different survival rates / AW ;	
			(leads to) reproductive, success / failure ;	[2 max]
				[Total: 7]

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3	**(a)**	**(i)**	so that, the bacteria were not killed / enzymes not denatured ;	[1]
		(ii)	1. bacteria put into (solution of) sodium alginate ; 2. place mixture in syringe ; 3. add drops of mixture to calcium chloride solution ; 4. calcium ions replace sodium ions (to form beads) ; 5. bacteria trapped in beads ;	[3 max]
	(b)	**(i)**	*note comparison between blue line and black line* *ignore references to red line - agar* 1. both increase up to, 18 / 24, hours ; 2. both similar, initially / up to 18 hours ; 3. biggest difference at 24 hours / rate of increase for immobilised cells greater than free cells between 18 and 24 hours ; 4. after 24 hours immobilised cells rate decreases while free cells rate continues to increase <u>or</u> after 39 hours free cells rate is greater than immobilised cells rate ; 5. free cells final concentration is still lower than highest value attained by immobilised cells ; 6. use of comparative figures ;	[4 max]
		(ii)	1. (could be) less surface area (to volume ratio) in cubes than beads ; 2. (could be) a greater diffusion distance to centre of cubes than beads ; 3. agar may be less permeable (to substrate) than alginate ; 4. something in agar may inhibit bacterial enzymes ; 5. some protease <u>adsorbed</u> by agar ;	[2 max]

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	(c)	**(i)**	82.14 / 82.1 / 82 (%) ; ; *allow one mark for suitable working if incorrect answer*	[2]
		(ii)	1. can use alginate (beads) many times ; 2. (reduces cost of), materials / energy / labour ; 3. fewer bacterial cultures needed / less time spent immobilising bacteria ; 4. more protease produced (per hour) (using alginate) ; 5. can run fermentation for longer time ; 6. less time wasted between fermentations ; *answers must imply comparison*	[3 max]
				[Total:15]
4	**(a)**		AABBCC ;	[1]
	(b)		*if doubling of chromosomes has not occurred*	
		1	chromosomes would not be able to pair ;	
		2	because chromosomes in the two sets are not homologous ;	
		3	during, prophase 1 / meiosis 1;	
		4	(therefore) gametes cannot be produced ;	[3 max]
	(c)	1	unable to, breed / reproduce ;	
		2	to produce fertile offspring ;	
		3	reproductively isolated ;	[2 max]
	(d)	1	species split into two populations by (geographical) barrier ;	
		2	different, selection pressures / (environmental) conditions, (on the two populations) ;	
		3	different features, selected / advantageous ;	
		4	change in, gene pools / allele frequencies ;	
		5	(over time) become unable to interbreed ;	[3 max]
				[Total: 9]

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5	**(a)**		ductless gland ; secretes (hormone) into blood ;	[2]
	(b)	**(i)**	1. follicle, develops / matures / grows ; 2. detail follicle ; e.g. antrum / corona / theca 3. (follicle) secretes oestrogen (and progesterone) ;	[2 max]
		(ii)	trigger ovulation / description ;	[1]
	(c)	1 2 3 4	to produce many (mature) <u>oocytes</u> at same time ; <u>superovulation</u> ; make harvesting easier ; IVF procedure has low success rate ;	[2 max]
	(d)	**(i)**	a change sets off events that counteract the change / AW / example described ;	[1]
		(ii)	oestrogen inhibition of, GnRH / FSH ;	[1]
	(e)	**(i)**	day 9 ;	[1]
		(ii)	prevent ovulation / so <u>oocytes</u> can be harvested ;	[1]
	(f)	1 2 3 4	very little difference in percentage of pregnancies resulting in live birth ; standard (slightly) more oocytes (per cycle) ; ora standard (slightly) more embryos (per cycle) ; ora comparative figs ;	[3 max]
	(g)	1 2 3	(promoter needed) to ensure genes are, expressed / switched on ; to produce, correct product / correct hormone / FSH ; ref. human / eukaryote, gene in, bacteria / prokaryote ;	[2 max]
				[Total: 16]

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6	**(a)**	**(i)**	same band of DNA as, first / affected, child ;	[1]
		(ii)	1. father and mother, have normal and mutant alleles / are heterozygous ; 2. mutant / CF, DNA is, shorter / lighter ; 3. therefore travels further ;	[2 max]
	(b)	1 2 3 4 5 6	outcome of test needs explanation / counsellor gives advice on options ; already have one affected child to care for or problems / cost, of care ; ref. termination ; life expectancy increasing with improved drugs ; gene therapy, not as yet successful / likely to be temporary ; possibility of, pre-implantation genetic diagnosis (PGD) / artificial insemination by donor sperm (AID), on another occasion ;	[4 max]
				[Total: 7]
7	**(a)**		*allele* different / alternative, form of a gene ; **A** variety of a gene *dominant* (allele) that always expresses itself in the phenotype when present / (allele) which influences the phenotype even in the presence of an alternative allele / AW ;	[2]
	(b)		parental phenotype ; e.g. striped / long x striped / long **A** wild x wild parental genotype ; e.g. AaBb x AaBb gametes ; e.g. AB Ab aB ab offspring genotypes ;; offspring phenotypes ; *must be linked to genotypes*	[6]
			accept other symbols if key used *penalise once for no key but only if genetic cross works*	

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(c) (i)

	phenotypes of *Drosophila melanogaster*			
	grey body long wing	grey body vestigial wing	ebony body long wing	ebony body vestigial wing
observed number (O)	207	79	68	30
expected ratio	9	3	3	1
expected number (E)	216	72	72	24
O – E	–9	7	–4	6
$(O - E)^2$	81	49	16	36
$\frac{(O-E)^2}{E}$	0.38	0.68	0.22	1.50

[3]

(ii) 2.78 ; *apply ecf* [1]

(iii) χ^2 value represents probability of > 0.05 ;

no significant difference ;

(probability shows) differences due to chance ; [2 max]

[Total:14]

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8	**(a)**	**(i)**	*at low light intensity* 1. rate of photosynthesis increases as light intensity increases ; 2. light <u>intensity</u> is limiting factor ; *at higher light intensity* 3. graph, levels off / forms a plateau / rate becomes constant ; 4. CO_2 / some other factor, becomes limiting ;	[3 max]
		(ii)	1. above light intensity of 1 rate is always higher for expt. 2 ; 2. plateau reached at lower light intensity for expt. 1 ; 3. maximum / plateau, rate is double for expt. 2 ; 4. expt 2 has much more CO_2 (conc) (compared to expt 1) ; 5. CO_2, no longer limiting after 4.2 in expt.2 / is limiting in expt. 1 up to 2.8 ;	[3 max]
	(b)	1	enzymes, denatured / active site changes shape ;	
		2	rubisco / enzyme in cyclic photophosphorylation ;	
		3	Calvin cycle affected / description ;	
		4	less photolysis ;	
		5	less ATP produced ;	
		6	increased rate of respiration ;	
		7	respiration rate faster than photosynthesis rate / ref. compensation point ;	
		8	increased rate of transpiration ;	
		9	stomatal closure ;	
		10	less CO_2 uptake ;	[5 max]
				[Total:11]

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Section B: only one question to be answered.

9	**(a)**	1	(glucose) phosphorylated by ATP ;	
		2	raises energy level / overcomes activation energy ;	
		3	hexose bisphosphate ;	
		4	lysis / splitting, of, glucose / hexose ; **R** sugar splitting	
		5	breaks down to two TP ; **A** GALP / GADP / G3P / PGAL	
		6	6C → 2 x 3C ;	
		7	dehydrogenation / description ;	
		8	2 NAD reduced formed (from each TP to pyruvate formed) ;	
		9	4 ATP produced / net gain of 2 ATP ;	
		10	pyruvate produced ;	
		11	reduced NAD → oxidative phosphorylation / redox ; *accept flow diagram*	[7 max]
	(b)	12	nucleotide ;	
		13	adenine + ribose / pentose + three phosphates ;	
		14	loss of phosphate leads to energy release / hydrolysis releases 30.5 kJ ;	
		15	ADP + Pi ↔ ATP (reversible reaction) ;	
		16	synthesised during, glycolysis / Krebs cycle / substrate level phosphorylation ;	
		17	synthesised, using electron carriers / oxidative phosphorylation / photophosphorylation ;	
		18	in, mitochondria / chloroplasts ;	
		19	ATP synthase / ATP synthetase ;	
		20	chemiosmosis / description;	
		21	used by cells as immediate energy donor ;	
		22	link between energy yielding and energy requiring reactions / AW ;	
		23	active transport / muscle contraction / Calvin cycle / protein synthesis ;	[8 max]
				[Total: 15]

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10	**(a)**	1	strong stimulus in receptor / AW ;	
		2	action potential / impulses, along sensory neurone ;	
		3	dorsal root of spinal nerve ;	
		4	into spinal cord ;	
		5	synapse with intermediate neurone ;	
		6	(then) motor neurone ;	
		7	action potential / impulses, to effector ;	
		8	action potential / impulses, to brain ;	
		9	response ; e.g. knee jerk *5 max can be on diagram*	
		10	fast / immediate ;	
		11	stops / limits, damage / danger ;	
		12	automatic / no conscious thought ;	
		13	innate / stereotyped / instinctive ;	[7 max]
	(b)	14	Schwann cells ;	
		15	wrap around axon ;	
		16	sheath mainly lipid ;	
		17	(sheath) insulates axon (membrane) ;	
		18	Na^+ / K^+, cannot pass through sheath / can only pass through membrane at nodes ;	
		19	depolarisation (of axon membrane) cannot occur where there is sheath / only at nodes of Ranvier ;	
		20	local circuits between nodes ;	
		21	action potentials 'jump' between nodes ;	
		22	saltatory conduction ;	
		23	increases speed / reduces time, of impulse transmission ;	
		24	up to 100 ms^{-1} ;	
		25	speed in non-myelinated neurones about 0.5 ms^{-1} ;	[8 max]
				[Total: 15]

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