OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **2805/04**

Microbiology and Biotechnology

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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Abbreviations, annotations and conventions used in the Mark Scheme	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	R	=	reject
	( )	=	words which are not essential to gain credit
	____	=	(underlining) key words which **must** be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Question			Expected Answers	Marks
1	(a)	(i)	*correct drawing on <u>each</u> cell, labelled = 1 mark* cell wall **;** ribosome(s) **;** *treat reference to size as neutral e.g. 70S / 80S* plasma / cell (surface), membrane **;** **A** plasmalemma	**1 max**
		(ii)	*drawings and labels should be on <u>Chlamydomonas</u>* *reject any structures that are labelled on both cells* *max 1 if more than three labels* nucleus / nuclear envelope **;** *must show two membranes* **A** nuclear membrane nucleolus / nucleoli **;** RER **;** SER **;** Golgi, body / apparatus / complex **;** lysosome / Golgi / secretory vesicle **;** mitochondrion **;** vacuole / tonoplast **;** cytoskeleton / microtubules / microfilaments **;** <u>80S</u> ribosomes**;** **A** <u>large(r)</u> ribosomes **;** linear chromosome(s) **;** chloroplast **;**	**3 max**
		(iii)	*two marks for correct answer* 3 μm **;;** *one mark if image length ÷ magnification correct e.g.* (8.9 – 9.1 x 10^{-2} m) ÷ 30 000 *or if not to nearest whole number*	**2**

Question			Expected Answers	Marks
1	(b)		*accept ora for all relevant points* improved / higher, <u>resolution</u> / <u>resolving power</u> **;** greater ability to distinguish between two close points **;** AW more detail / better clarity **;** smaller structures seen outside of range of light microscope **;** any two examples of ultrastructure seen **;;** e.g. *Chlamydomonas* nuclear envelope **R** nuclear membrane nuclear pores visible mitochondrial envelope / inner membrane / cristae ER visible ribosomes visible cytoskeletal structures / microfilaments / microtubules, visible *E.coli* ribosomes visible (circular) DNA AVP **;** e.g. SEM shows (external) surface detail resolution approx 1000 x better points closer than 0.5nm can be distinguished magnification / enlargement possible (with good resolution maintained) comparison of wavelength (electron v light)	**5 max**
	(c)	**(i)**	*any one from* not easily dissolved in cytoplasm **;** makes, (more) insoluble / less soluble **;** avoids osmotic problems **;** easier storage / less space required **;**	**1 max**
		(ii)	*glycogen* supplies C (for biosynthesis) **;** ref. energy / glucose, store **;** **A** can be, hydrolysed / broken down, to glucose *polyphosphate* *any one from* for membrane structure / phospholipids **;** nucleic acid / RNA / DNA structure **;** ATP (synthesis) **;** energy reserve / source **;**	**2 max**
	(d)		*synthesis / production of* human growth hormone **;** insulin / humulin **;** *accept other valid examples*	**2 max**
				[Total:16]

Question			Expected Answers	Marks
2	(a)	1	**partially permeable** membrane **;** **A** selectively	
		2	glucose **diffuses** through **;**	
		3	biological **recognition layer** **;**	
		4	**immobilised glucose oxidase** **;**	
		5	glucose / substrate, binds to, glucose oxidase / enzyme / **active site** / **enzyme-substrate complex** forms **;** AW	
		6	**gluconic acid** produced **;**	
		7	response detected by **transducer** **;** AW	
			or	
		6	reduces concentration of oxygen **;**	
		7	ref. to **platinum** (oxygen) **electrode** **;**	
		8	transducer produces electrical signal / current **;**	
		9	ref. to **amplifie**r **;**	**max 7**
		10	ref. to level related to glucose concentration **;**	
		11	AVP **;** e.g. binding, **specific** / **complementary** (shape) equation given	
			QWC – clear, well organised using specialist terms **;** *in bold above*	**1**
	(b)		*any two from*	
			quantitative measurement of blood glucose / AW **;**	
			rapid **;**	
			accurate / sensitive **;**	
			portable / can test anywhere / can test at home / no need to go to clinic / hospital **;**	
			ref. to ease of use **;**	
			using small volumes of blood **;**	
			allows correct dose of insulin to be calculated **;**	
			reusable **;**	
			ref. to reliability **;**	**2 max**
	(c)	**(i)**	hybridoma **;**	**1**
		(ii)	*2 max if the feature is not linked to the cell type*	
			B-, lymphocyte / cell produces antibody **;** AW	
			(but) division limited / short-lived **;**	
			unable to be maintained in culture / AW **;**	
			myeloma cell divides continuously **;** AW **A** can be cultured	
			R rapid *alone - needs idea of continuous division*	
			ref. to fusion allowing genomes of both cells to be present**;**	**3 max**
	(d)		protein / glycoprotein, on, the surface of virus / envelope **;**	
			(acts as) antigen **;**	
			complementary shape / specific tertiary structure (to antibody binding site) **;**	
			(antigen/ AW) attaches / binds, to (HIV) antibody **;**	
			AVP **;** e.g. ELISA technique	
			named protein / gp 120	
			normally binds to receptors on host cell	**3 max**
				[Total:17]

Question			Expected Answers	Marks
3	(a)		provides oxygen for respiration / for <u>aerobic respiration</u> **;** sterile, to prevent contamination / so no pathogens **;** mixes fungus with substrate / prevents settling / bubbles help stirring / AW **;**	**2 max**
	(b)	(i)	*carbon* glucose / lactose **;** *nitrogen* amino acids / nitrate ions / ammonium ions / yeast extract **;** **A** corn steep liquor for either but not both	**2 max**
		(ii)	water is for, cooling / removing (excess) heat **;** maintains, constant / optimum, temperature **;** respiration produces heat **;** (which would) denature enzymes **;** **A** kills cells / fungus **R** denatures cells / fungus heat also produced by, stirrer / motor **;**	**3 max**
		(iii)	will affect, enzyme action / metabolic rate / AW **;** **A** denature enzymes addition of, buffer / acid / alkali / base **;**	**2**
	(c)	(i)	96 hours **;** <u>±</u> 1.5 hours	**1**
		(ii)	**X** includes, rapid / exponential / main, growth phase **;** *ora* when primary, metabolites / products are made **;** penicillin is a secondary, metabolite / product **;** **A** antibiotics (*for penicillin*) excess of nutrients in **X** *or* penicillin produced when nutrients, limited / depleted **;**	**3 max**
				[Total:13]

Question			Expected Answers	Marks
4	(a)		*thioglycolate* to create anoxic / anaerobic conditions **;** **A** remove oxygen, qualified *resazurin* indicator of oxygen, presence / penetration (from broth surface) **;** **A** ref. to indicating aerobic / anaerobic conditions	2
	(b)		ref. to sterile / sterilising (equipment / broth) **;** **A** inoculating loop flamed disinfect surfaces **;** AW protective clothing / lab coat / goggles **;** spirit / Bunsen, burner **;** flame neck of jar of, broth culture / nutrient broth **;** lids, held / not placed on surfaces / lifted slightly / away from face **;** disinfectant discard pot **;** AW *max 4 for aseptic techniques OR if inoculating agar plate* idea of transfer, from broth culture to inoculate tube **;** use of named equipment e.g. pipette, inoculating / wire, loop, stab wire **;** **A** syringe, mounted needle	5 max
	(c)	1	ref. pink area indicator of, oxygen presence / aerobic conditions **;** ora *penalise once if no reference to growth i.e. reference made to presence organism D*	8 max
		2	grows only, at / slightly below, surface / where oxygen present **;** **A**	
		3	grows only at top <u>aerobic respiration</u> **;**	
		4	*organism E*	
		5	growth, throughout the tube / with oxygen and without oxygen / in aerobic	
		6	conditions and anaerobic conditions **;**	
		7	grows better, where oxygen available / in aerobic conditions **;** *idea of difference*	
		8	provides more energy for, growth / reproduction **;** (capable of) aerobic and anaerobic <u>respiration</u> **;** **A** respire with and without oxygen	
		9	<u>facultative</u> (aerobe / anaerobe) **;**	
		10	*organism F*	
		11	growth only in, anoxic / anaerobic, conditions / no oxygen / sensitive to oxygen	
		12	AW **;** **A** growth only at bottom *or a*	
		13	anaerobic respiration **;** **A** fermentation **;** strict / obligate, anaerobe **;** AVP **;** e.g. different microorganisms display different oxygen requirements (for growth) AVP **;** ref. **D**, obligate / strict, aerobe **;** **A** strictly aerobic	
			QWC – legible text with accurate spelling, punctuation and grammar ;	1
	(d)		*for each, award 1 mark for a valid reason for the match of organism to location* e.g. *vessel* **E** able to respire with and without oxygen / facultative anaerobe OR **F** anaerobic conditions (created in fermenter) **;** *skin surface* **D** exposed to air therefore aerobic **;** *digester* **F** anaerobic conditions in digester OR **E** initial aerobic, then anaerobic conditions **;**	3
				[Total:19]

Question			Expected Answers	Marks
5	(a)		wort ;	1
	(b)		health food / yeast extract / 'Marmite' / used as, cattle / animal, feed / used to inoculate brew in whisky distilleries ;	1
	(c)		15°C ; **A** 12 - 20°C moisture / water ; **A** humid, damp oxygen / aeration ; removal CO_2 ;	2 max
	(d)	1 2 3 4 5 6 7 8	water enters seed / AW ; gibberellin / gibberellic acid, synthesised / produced / released ; (gibberellin) stimulates / AW, aleurone layer ; (cells) synthesise / produce amylase ; (some) starch, hydrolysis / converted to maltose ; proteases / proteolytic enzymes ; proteins to, peptides / amino acids ; AVP ; e.g. entry of water via micropyle idea of embryo, stimulated / stored enzymes, activated glucanase / cell wall degrading enzymes 'switching on' genes coding for enzymes increased, transcription / translation diffusion of gibberellin / enzymes from site of production to site of action protein matrix (of endosperm) broken down (large) starch granules (in endosperm) released some hydrolysis of starch to dextrins increased respiration embryo / root / shoot, growth ref. to a link between new products and growth e.g. sugar production for ATP / energy for growth / amino acids to make proteins / enzymes reference to conditions created in malt house e.g. switch to anaerobic respiration in steeps with long immersion periods abrasion of seeds / use of a seed cleaner to speed up germination addition of gibberellic acid by maltsters	4 max

Question			Expected Answers	Marks
5	(e)		prevents all sugars being used up (in respiration) / AW **;** *ora* prevents, growth of embryo / seedling being produced / AW **;** *ora* **A** plant growth sugars required for, brewing process / fermentation **;** further detail of above e.g. yeast, respiration / alcohol production **;**	**2 max**
	(f)	**(i)**	low moisture content makes enzymes less sensitive (to high temperature) **;** ref. to structure making enzymes heat stable / extra bonds **;** **R** ref. to thermophilic AVP **;** e.g. ref. to insufficient time (for all molecules to denature)	**1 max**
		(ii)	sugars / amino acids / nutrients (from grist), dissolve better **;** AW provides optimum conditions for / reactivates, enzymes / amylases / proteases **;** increased / additional, hydrolysis of, starch / dextrins **;** AW	**1 max**
		(iii)	for yeast / *Saccharomyces*, metabolism / growth / reproduction / population growth **;** *increased monosaccharides* increased (anaerobic), respiration / fermentation **;** (results in) increased amount of alcohol **;** *increased amino acids* increased protein **;** hence increased alcohol **;** *allow once only* AVP **;** e.g. increased aerobic respiration (initially) for population growth AVP **;** e.g. increased enzymes (synthesised) more CO_2 produced	**4 max**
				[Total:16]

Question			Expected Answers	Marks
6	(a)		remove, pathogens / AW **;** removes, specific component e.g. organic material / solids / smells / industrial contaminant **;** prevents river water becoming turbid / avoids reduced light levels in water **;** AW prevents eutrophication / fall in oxygen levels / rise in BOD, in river **;** AW	**2 max**
	(b)		ref. to aerobic conditions created / oxygen present / aeration **;** aerobic, respiration / digestion, occurring **;** increase population of, microorganisms / named microorganism types / nematodes **;** ref. to digestion of organic material / production, inorganic compounds / ions **;** floc formation **;** named microorganism **;** e.g. *Zoogloea*, *Nitrosomonas*, *Nitrobacter* ref. to food webs / interactions within tank **;** AVP **;** e.g. ions made available for recycling example of digestion occurring	**4 max**
	(c)	**(i)**	anaerobic **;** temperature above 15 ^{0}C **;** **A** up to 30 ^{0}C pH between 6 – 8 **;**	**2 max**
		(ii)	*treat as neutral – energy source / gasohol / produce energy / biogas any one relevant e.g.* fuel source / power sewage works / heats, digester / buildings / AW **;** **R** fuel for cars / power for power station	**1**
				[Total: 9]

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