

**2805/04 Microbiology and Biotechnology**

**June 2005**

**Mark Scheme**

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

<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
1 (a) (i)	attached to an insoluble material / AW ;	1
(ii)	(micro)encapsulation / (trapped) in alginate beads ; adsorption / stuck onto, e.g. collagen / clays / resin / (porous) glass ; cross linkage <i>or</i> covalent / chemical bonding to, e.g. cellulose / collagen fibres ; gel entrapment / trapped inside gel e.g. silica (lattice / matrix) ; partially permeable membrane (polymer) microspheres ;	max 2
(iii)	urine can be processed / no problem of removing urine / AW ; pure / drinkable / useable, water produced ; <b>A</b> water recycled space saving / less water needs to be taken into space ; payload limit / weight reduction / AW ; no need to take more enzymes into space / enzymes reusable ; <b>A</b> enzymes recoverable no problem in separating enzyme from products / product not contaminated ; ref to longer shelf-life of enzyme ; AVP ; e.g. larger surface area of enzyme exposed, more stable at extremes, ref to ease of use (of bioreactor)	max 3
(b) (i)	adding / using, <u>water</u> ; breaking, bond / ester bond (in molecule) ; <b>A</b> breakdown into smaller molecules	2
(ii)	matrix, protects / stabilises, (immobilised) enzyme / lipase ; <i>allow once</i> so will function, at optimal rate / more efficiently (than soluble), at higher temperature / 45 °C ; <b>A</b> greater activity / AW ref to soluble lipase begins to denature (reducing activity) ; <i>ora</i> continues to work, at optimal rate / more efficiently, at <u>lower</u> pH ; ref to presence of fatty acids changing pH ; ref to ionic bonds breaking (in soluble lipase) ; <i>ora</i> AVP ; e.g. ref to industrial uses, ref to effect on R groups	max 4
<b>[Total:</b>		<b>12]</b>

Question	Expected Answers	Marks
2 (a)	<p><i>aseptic techniques</i> <span style="float: right;"><b>to max 4</b></span></p> <p>1 <u>sterile</u>, Petri dish / pipette / agar ; <b>A</b> <u>sterile</u> inoculating loop</p> <p>2 lift lid of dish, slightly / away at angle ; AW</p> <p>3 flame, neck of jar / bottle of, culture / (molten) agar ;</p> <p>4 ref to disinfectant ; e.g. discard pots, surfaces cleaned</p> <p>5 AVP other aseptic technique ; e.g. flamed forceps, use of spirit burner / Bunsen burner</p> <p><i>method to make seeded plates</i></p> <p><i>max 1 if ref to inoculate but inappropriate method to create lawn</i></p> <p>7 molten agar poured into plate (and set) / use prepared plate ;</p> <p>6 ref to inoculating ; e.g. add bacterial sample to surface using pipette</p> <p>8 ref to making lawn ; e.g. spread with glass / disposable spreader / (sterile) swab</p> <p><b>or</b></p> <p>6 ref to inoculating ; e.g. add bacterial sample to molten (cooled) agar</p> <p>7 mix contents ;</p> <p>8 pour plate (and set) ;</p> <p><b>or</b></p> <p>6 add bacterial sample to dish using pipette ;</p> <p>7 (then) molten agar poured in ;</p> <p>8 swirl plate (gently) to mix (and allow to set) ;</p> <p><i>method to add deodorant</i></p> <p><i>max 1 if deodorant added by e.g. one streak / drops (must be method to give comparison)</i></p> <p>9 dip filter paper disc into deodorant ;</p> <p>10 repeat with other deodorant ;</p> <p>11 place onto surface of agar ;</p> <p><b>or</b></p> <p>9 punch holes / make wells in agar ;</p> <p>10 add deodorant to well ;</p> <p>11 repeat with other deodorant ;</p> <p><i>incubation and results</i></p> <p>12 (partially) seal dish with, tape / parafilm ;</p> <p>13 incubate at 20 – 30°C ; <b>R</b> 37 °C</p> <p>14 for 2-5 days ;</p> <p>15 measure / compare size of, zone of inhibition ; AW</p> <p>16 larger zone more effective deodorant ; <b>R</b> ref. to colonies</p> <p>17 ref to replicates ;</p> <p>18 ref to variables controlled ; e.g. size of, discs / wells <i>and</i> volume of organism / agar</p> <p>19 AVP ;</p> <p>20 AVP ; e.g. further detail of, technique / procedure  detail of measuring, diameter / area  (Vernier) calipers  tracing onto acetate</p>	<b>max 8</b>
	<b>QWC – legible text with accurate spelling, punctuation and grammar ;</b>	<b>1</b>

- (b) (i) increased sweat (in hot conditions) ;  
releasing more antibacterial substances ;  
bacteria divide more in hot conditions / AW ;   **R** bacteria grow more  
bacteria destroyed / growth inhibited ;  
(potential) pathogens prevented from infecting / AW ; **max 2**
- (ii) bacterial cell wall contains, murein / peptidoglycan ; **max 2**  
plant cells have cellulose cell walls ;  
animal cells no cell wall ;

**[Total: 13]**

<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
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3 (a)

<i>structural feature</i>	<i>virus</i>	<i>bacteria</i>
<i>outer coating</i>	envelope / protein / capsid / capsomeres	peptidoglycan / murein / lipopolysaccharide / capsule / slime layer ;
<i>cytoplasm</i>	none	present ;
<i>nuclear material</i>	<i>DNA or RNA</i>	DNA ; <b>A</b> chromosome

3

- (b) **A** - RNA ;  
**B** – glycoprotein (spikes) / protein (spikes) / gp 120 / antigen ;  
**C** – reverse transcriptase ;

3

- (c) **1** viral recognition (of host cell) ;  
**2** ref to named host cell ; e.g. T (helper) lymphocyte / cell , CD4 cell , macrophage , monocyte , Langerhans cell (skin) , glial cell, dendritic cell (CNS)  
**3** virus, adsorbs onto / attaches to / binds to, receptors (on membrane) ;  
**4** ref to entry into host cell ; e.g. fusion envelope with host cell surface membrane / taken in by endocytosis **R** injected  
**5** nucleocapsid in cell / AW ;  
**6** uncoating / capsomeres disassembled ; AW  
**7** (viral) DNA synthesised using reverse transcriptase ;  
**8** enters nucleus ;  
**9** integrates into (host) chromosome / DNA ; AW  
**10** (known as) provirus ;  
**11** lysogenic / latent (phase) ; **A** dormant *must be in context*  
**12** (progresses to) lytic cycle ; *must be in context*  
**13** (new) viral RNA synthesised ;  
**14** ref to other named viral components synthesised ; e.g. capsomeres, enzymes, spikes  
**15** host cell machinery used / AW ;  
**16** assembly (of new viruses) / AW ;  
**17** leave cell by budding / enclosed in cell membrane / AW ;  
**18** AVP ;  
**19** AVP ; e.g. specificity of recognition and binding to host cell receptors  
CD4 receptor, DNA polymerase used to make viral double stranded DNA  
latent infection in macrophages have newly made viruses in vacuoles  
provirus activated to initiate lytic cycle  
transcription of viral DNA to make viral RNA  
translation to make viral proteins

max 8

**QWC – clear, well organised, using specialist terms ;**

1

*award the QWC mark if four of the following are used in correct context*  
named host cell, fusion, receptors, endocytosis, nucleocapsid, capsid, capsomere, uncoating, reverse transcriptase, provirus, budding, polymerase, lysogenic / latent, lytic, transcription, translation

(d) *marking points can be taken from a labelled diagram*

binary fission ;

bacterial DNA / chromosome, attaches to, plasma membrane ; **A** mesosome

DNA replication ;

semi-conservative (replication) ;

ref to viral replication as host DNA replicates ;

cell elongation ;

growth between attachment points pushes, DNA / chromosomes, apart ;

cross wall / septum, forms ;

two daughter cells formed / AW ;

**max 4**

**[Total: 19]**

Question	Expected Answers	Marks
4 (a)	odd number of sets of chromosomes / AW ; homologous pairs not formed ; <b>A</b> ref to difficulties in pairing during meiosis ; <i>allow point if reference made to causing problems during meiosis</i> does not form seeds ;	<b>max 2</b>
(b)	ref to, sterile conditions / aseptic techniques ;  (small) piece of plant tissue removed ; <b>A</b> take cuttings ref to named tissue ; e.g. meristem, axillary / (apical) buds explant ;  <i>or</i>  leaf removed ; enzymes / cellulases / pectinases, to remove cell wall ; protoplasts formed ;  growth on nutrient medium ; plant growth regulators / named growth regulator ; <b>R</b> hormones rooting ; incubation in light ; plantlets ; subdivide ; handling, medium / sterile soil ;  AVP ; AVP ; e.g. remove wax from leaves callus culture / mass of undifferentiated cells forms ref. auxin to cytokinin ratio Murashige and Skoog (M & S) medium further detail of culture method / aseptic technique	<b>max 5</b>

(c) *max 4 for either*

*advantages*

many plants ;  
genetically identical ;  
(so) all have desired, characteristics / genotypes / phenotypes ;  
no need for (artificial) selection ;  
can be obtained in short space of time / AW ;  
easy to, transport / store ; **A** ref to space saving  
easy to genetically engineer ;  
disease / virus, free ;

*disadvantages*

genetically identical, qualified in terms of disadvantage ;  
susceptible to disease ;  
loss in genetic diversity (as cloned plants are grown exclusively) ;  
farmers have to buy plants from suppliers / AW ;  
ref to economic problems for developing countries ; e.g. start up costs  
patented property ;

AVP ;

AVP ; e.g. no quarantine required, ref. to cost qualified, not labour intensive  
(advantages), genetically unstable (disadvantage)

**max 5**

**[Total: 12]**



Question	Expected Answers	Marks
5 (a)	<p>(i) temperature ;  concentration of, substrate / sugars / carbohydrates ;  concentration of yeast ;  pH / carbon dioxide concentration ;  oxygen availability ;  concentration of, alcohol / ethanol / toxic waste ;  AVP ;</p> <p>(ii) carbon dioxide ;     <b>A</b> CO<sub>2</sub></p>	<p><b>R</b> volumes / amounts  <b>R</b> volume / amount</p> <p style="text-align: right;"><b>max 3</b></p> <p style="text-align: right;"><b>1</b></p>
(b)	<p>(i) <i>one mark for slow, fast, slow / nothing</i></p> <p>initial gas production slow, ref to time ;  rapid rate, ref to time ;  little gas production, ref to time ;  ref to actual volumes ;</p> <p>any rate calculated ;</p> <p>(ii) ref to (aerobic / anaerobic) respiration ;</p> <p><i>slow gas production</i>  transport of glucose into yeast cells takes time ; <b>A</b> absorbed / taken up by yeast  detail ; e.g. ref to carriers</p> <p><i>rapid rate of respiration</i>  high substrate concentration in yeast cells ;</p> <p><i>rate slows</i>  substrate runs out ;  or other factor(s) / named factor, affect the rate ;</p> <p>AVP ; e.g. increase in number of yeast cells increases rate of respiration, qualified  ref to time taken for adjustment to conditions (in slow production)</p>	<p style="text-align: right;"><b>max 4</b></p> <p style="text-align: right;"><b>max 4</b></p>
(c)	<p><i>slower rate of respiration</i>  enzymes(s) to, metabolise / hydrolyse / digest / breakdown, maltose not present ;  genes switched on ;  time for enzymes to be synthesised ;  ref to, membrane transport / ease of passing through membrane ;  AVP ; e.g. facilitated diffusion</p>	<p style="text-align: right;"><b>max 2</b></p>

**[Total: 14]**

Question	Expected Answers	Marks
6 (a)	provides oxygen for <u>aerobic</u> respiration ; any detail, e.g. oxidative phosphorylation ; sterile to prevent contamination ; mixes fungus with substrate / prevents settling / bubbles help stirring / AW ;	2
(b) (i)	carbon – glucose / lactose ; nitrogen – amino acids / nitrate ions / ammonium ions / yeast extract ;  <b>A</b> corn steep liquor for either but not both	2
(ii)	water is for, cooling / removing excess heat ; maintains, constant / optimum, temperature ; respiration produces heat ; which would, denature enzymes / kill cells ; heat also produced by, stirrer / motor ;	max 3
(iii)	will affect, enzyme action / metabolic rate ; <b>A</b> denature enzymes addition of, buffer / acid / alkali / base ;	2
(c) (i)	96 hours ;	1
(ii)	<b>X</b> includes, rapid / exponential / main, growth phase ; <i>ora</i> when primary products are made / penicillin is a secondary metabolic product ; excess of nutrients in <b>X</b> <i>or</i> penicillin produced when nutrients, limited / depleted ;	3
(d)	filter (to remove fungus) ; fungus washed (to remove penicillin) ; continuous countercurrent / chemical extraction ; concentration ; addition of potassium ions ; precipitate crystals / (potassium) salts ; solvents used to purify penicillin ; AVP ; e.g. dried, some are chemically modified, 99.5% pure	max 3
(e)	can genetically engineer microorganisms ; ref to risk of infection ; e.g. CJD with GH avoids problem with, side effects / allergic effects ; <b>A</b> ref. to immune response large amount of product ; grow microorganisms in small, area / volume ; <b>A</b> less space required can be cultured anywhere in world ; ethical advantages, qualified ; ref to cost qualified ; e.g. <i>insulin</i> uses cheaper feedstock (than for rearing pigs) AVP ; AVP ; e.g. high replication / growth rate extraction of GH from brains slow process	max 4
	[Total:	20]