



JANUARY 2003

ADVANCED GCE UNIT

## MARK SCHEME

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MAXIMUM MARK: 90

**Syllabus / Component: 2805/05**

**Options in Biology:  
Microbiology and Biotechnology**

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Paper Set Date: 30/01/03

**ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS**

1. Please ensure that you use the **final** version of the Mark Scheme.  
You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ( $\frac{1}{2}$ ) should never be used.
3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.  

x	= incorrect response (errors may also be underlined)
^	= omission mark
bod	= benefit of the doubt (where professional judgement has been used)
ecf	= error carried forward (in consequential marking)
con	= contradiction (in cases where candidates contradict themselves in the same response)
sf	= error in the number of significant figures
4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.
5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.
6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.
8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

<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
	( )	= words which are not essential to gain credit
	—	= (underlining) key words which <b>must</b> be used to gain credit
	ecf	= error carried forward
	A	= accept
	R	= reject
AW	= alternative wording	
ora	= or reverse argument	

Question	Expected Answers	Marks
1 (a)	A – envelope / lipoprotein / membrane; B – capsomeres / capsid protein / protein core; C – DNA / RNA / genetic material / AW;	3
(b)	DNA <u>or</u> RNA; circular DNA / (only) DNA; 20 -300 nm; <b>A</b> any value within this range none / absent, and present / AW; both correct for mark <b>A</b> ref to 70S ribosomes for bacteria	max 4
(c) (i)	binary fission;	1
(ii)	binary fission faster; no nuclear division / mitosis is just nuclear division; (mitosis followed by) cytokinesis / cytoplasmic division / septum divides cell (in binary fission); no spindle formed / chromatids not pulled apart by spindle; cell membrane / mesosomes, used for bacterial chromosome attachment; circular DNA involved / not (linear) chromosomes;	max 3
(d)	identical genotype; identical phenotype; constant nature of the environment; less variation of phenotype / AW / beneficial characteristics still present; max. number of offspring; improves chance of finding new host; does not need to find a mate / single parasite can colonise a host;	max 3
<b>[Total: 14]</b>		

Question	Expected Answers	Marks
2 (a)	attached to, insoluble material / inert material / suitably named material; <b>R</b> description of immobilised	1
(b) (i)	hydrogen bonds broken; tertiary structure / globular shape altered / 3D shape altered; <u>active site</u> altered; denatured;	max 3
(ii)	up to 50°C no effect; above 50°C free enzyme, rate / activity, decreased; <b>R</b> 'works better' 50 – 60°C immobilised enzyme rate increases;	3
(iii)	<i>look for one of these ideas</i>  enzyme molecule does not move about as much; more support for enzyme; hydrogen or ionic bonding with substrate; <b>R</b> 'not denatured' / forms barrier / protects enzyme	max 1
(c)	reusable, qualified; e.g. no need for more expensive enzymes product is enzyme free, qualified; e.g. less downstream processing more cost effective, explained; AVP;  <b>R</b> advantage not qualified, e.g. reusable not qualified	max 2
		<b>[Total: 10]</b>

Question	Expected Answers	Marks
3 (a)	(i) fungus / <i>Fusarium</i> ;	1
	(ii) small vessel used; greater productivity; product always available; <b>R</b> produced continuously growth maintained in, exponential / log, phase;	max 2
	(iii) difficult to monitor all environmental factors; all product wasted if it, breaks down / is contaminated; product contaminated with unused raw materials; described practical problem; e.g. clumping of cells which blocks outlets	max 2
(b)	filtered / cyclone / centrifuge, separation of fungus; steam used to kill fungus; RNA reduction / use of ribonuclease; mycoprotein paste plus binder (egg white); add, vegetable flavours / colouring; make a dough / AW;	max 3
(c)	1 use transfer chamber / work near a Bunsen burner; 2 flame inoculating loop; 3 remove lid of tube; 4 do not put it down; 5 flame neck of tube; 6 dip cooled loop into culture; 7 flame neck again and replace lid; 8 raise lid, of agar / culture dish, <u>slightly</u> ; 9 streak; 10 incubate; 11 disinfect bench;	max 7
	<b>QWC – clear, well organised, using specialist terms;</b>	1
		<b>[Total: 16]</b>

Question	Expected Answers	Marks
4 (a) (i)	restriction sites identified in at least one strand; both chains split correctly;  <i>award one mark if</i> only top strand split / both strands cut correctly for one enzyme	2
(ii)	produce staggered cut; overlapping strand of DNA / single strand / unpaired nucleotides; sticky ends; use same enzyme on DNA and vector; easier to link together / produce recombinant DNA; insert gene in right order / AW; ora	max 3
(iii)	(DNA) ligase;	1
(iv)	DNA from <u>two sources</u> joined together; R genes / chromosomes joined	1
(b) (i)	substitution only alters one triplet; affects only one amino acid in the protein; A could be part of intron / non-coding part of gene  OR  triplet code is degenerate / described; thymine is last base of triplet code; not important in coding / any base produces the same code / new base sequence still codes for same amino acid;	max 2
(ii)	first base of next triplet now used in code / frame shift occurs; all subsequent triplets are different; all subsequent amino acids are different; <i>idea of</i> (globular) shape of protein changes;	max 2

- (c) yeast with the new gene can use cheaper substrates;  
make better use of the carbohydrates in existing substrates e.g. starch;  
no need to treat starch with enzymes before yeast can use it;  
yield of alcohol greater;  
taste may be different;  
AVP;  
AVP; e.g.  
low carbohydrate diet beer can be produced;  
without having to use extra enzymes after fermentation;  
any other sensible advantage of using this type of yeast;

**max 4**

**[Total: 15]**

Question	Expected Answers	Marks
5 (a) (i)	use bacteria / <i>Agrobacterium tumefaciens</i> ; containing plasmids with gene for resistance;	max 2
(ii)	growth medium contains herbicide so will destroy non-resistant tissue / cells without gene will die; all offspring contain herbicide resistant gene; <b>R</b> cells are clones	max 2
(b)	1 leaf used; 2 de-waxed; 3 using detergents; 4 incubated (for 12 hours); 5 with cellulase; 6 and pectinase; 7 removes walls; 8 (10%) mannitol added; 9 to maintain water potential / idea; 10 centrifuge; 11 resuspend in mannitol; 12 protoplast, cells without walls; 13 placed in nutrient medium; 14 AVP; e.g. callus development, incubate in light, fused cells called a 15 AVP; heterokaryon 16 AVP;	max 8
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	1
(c)	hybrids / polyploids, may be sterile; method of reproducing <u>favourable</u> genotype and phenotype plants produced are clones; identical genetically; disease free; no quarantine needed; quicker, related to cost; large numbers; fewer staff; quality control / AW; AVP;	max 4
(d)	contamination with, bacteria / fungi; cells of plant divide more slowly / outgrown by contaminants / competition;	2





Question	Expected Answers	Marks
6 (a) (i)	bacteria / <i>E. coli</i> ; yeast / fungi;	2
(ii)	temperature; pH; nutrient concentrations; sterility / AW; oxygen concentration / aeration; carbon dioxide concentration; AVP;	max 3
(iii)	cheap; high productivity; small quantity of insulin in each animal; no animals destroyed; less risk of disease; human protein; less risk of, allergenic / immune, problems; R likely to reject it	max 4
(b) (i)	cells express, DNA / gene; transcription; detail; translation; detail; protein synthesis; antigen is a protein;	max 3

- (ii) *accept any suitable advantages or disadvantages and credit further development of points*

e.g.

*advantages*

plants eaten;  
medical staff not needed;  
bananas grow in places where vaccines are needed;  
so no injection necessary;  
cheaper to produce;  
no need to refrigerate;

**R** easier to store / transport

**R** easier to store if unqualified

*disadvantages*

edible part may not contain antigen;  
need to encourage edible part of plant to produce antigen;  
antigen is protein so may be digested when eaten;  
less effective than traditional vaccines / difficult to control dose;

AVP;

e.g. much downstream processing required if plant not eaten;

**max 4**

**[Total: 16]**