



Subject: Microbiology and Biotechnology
Code: 2805/04

Session: January Year: 2002

Mark Scheme

MAXIMUM MARK	90
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ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

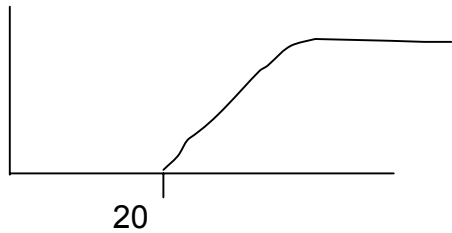
1. Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point 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.

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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 () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument
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Question	Expected Answers	Marks
1 (a) (i)	correct order : virus, prokaryotae, protoctista; DNA / RNA + absent (x); DNA + absent (x); DNA + present (✓);	4
(ii)	virus;	1
(b) (i)	A – bud; B – nucleus of bud; C – mitochondria; D – vacuole;	4
(ii)	<i>award two marks for the correct answer if no working shown</i> accurate measurement (45 mm); divided by the magnification (0.0125 mm); converted to μm (12.5 μm);	2
(c)	contact with host cell; role of cell surface receptors; host cell type; genetic material enters; detail of entry (endocytosis); RNA converted to DNA; reverse transcriptase; double strand of DNA made; DNA polymerase; (viral) DNA incorporated into host DNA; viral components produced; detail of protein synthesis; assembly of viral components; lysis / virus released from cell; transmission to another host;	7 max
	Q - clear well organised answer using specialist terms;	1
		8 max
		[Total: 19]

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Question	Expected Answers	Marks
2 (a)	<p><i>batch</i> nutrients added only at the beginning; periodic harvesting; small fermenter size;</p> <p><i>continuous</i> nutrients added during the process; continuous harvesting; large fermenter size;</p>	3
(b) (i)	fungus;	
(b) (ii)	<p><i>max 2 for problem</i> <i>problem</i> viscous / thick / tangle of cells; difficult to get oxygen to cells; reduce production;</p> <p><i>solution</i> aerate using airlift fermenter; stirrer will damage cells; use a sensor;</p>	3 max
(c)	lactose / sucrose / glucose; <i>NOT starch</i>	1
(d)	yeast extract / amino acids / hydrolyses protein;	1
(e)	begin line on x axis at 20 hours; line drawn up and flattening;	
	 <p>The graph shows a curve on a coordinate system. The x-axis has a tick mark at 20. The curve starts at the origin (0,0), remains at zero until the x-axis value is 20. At x=20, the curve begins to rise, following a concave-down path until it reaches a peak, after which it becomes a horizontal line extending to the right.</p>	2
(f)	graph shows if nutrient level high, microorganism grows; until growth stops no penicillin produced; excess nutrients always present during continuous fermentation; no secondary metabolites produced if excess nutrients present;	3 max

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Question	Expected Answers	Marks
3 (a)	restriction enzyme; cuts, bacterial chromosome / DNA; into separate (DNA) fragments; apply gene probe; detail; electrophoresis; detail; cut identified DNA from gel / Southern blotting; purify; concentrate gene / clone gene / PCR;	
	A correct route from mRNA or amino acid sequence	6 max
(b)	can not penetrate; cellulose cell wall; needs Ca ²⁺ ; pili not present; plasmids will only move from one bacterium to another;	
		2 max
(c)	genetically modified microorganisms produce light; only the activity of labelled population measured; results obtained quickly (2 hours); more sensitive; quantitative; does not require removal of cells from soil; cheap / reference to cost of technique;	
		2 max
		[Total: 10]

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Question	Expected Answers	Marks
4 (a)	<p>area of grid is $0.2 \times 0.2 = 0.04 \text{ mm}^2$; depth is 0.1mm so <u>volume</u> is 0.004 mm^3; cell count 8; in 1 mm^3 there would be $8/0.004 = 2000$ cells;</p> <p><i>for correct answer award 4 marks</i> <i>if the answer is incorrect check the working</i> <i>do not carry error forward</i></p>	4
(b)	<p>mix culture; put into cuvette; use colorimeter; detail; measure the amount of light not absorbed; this is the optical density of the culture; more organisms the greater optical density; take sample with known number of cells; relate optical density to cell number / calibrate; repeat / take several samples / replicates;</p> <p>Q – legible text with accurate spelling punctuation and grammar;</p>	6 max 1 7 max
(c) (i)	<p>calibration needed to find numbers present / affected by presence of particles / affected by the colour of the solution;</p>	1
(ii)	<p>includes dead cells; includes harmless bacteria; which are no threat; counts all species / does not identify harmful bacteria / does not count viruses;</p>	3 max
		[Total: 15]

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Question	Expected Answers	Marks
5 (a) (i)	plasma cell / B lymphocyte / B cell;	1
(ii)	lymphocyte is short lived; does not divide in culture;	2
(b)	antibody produced by descendants of specific B cell / produced by one type of B cell; one type of antibody produced for one type of, antigen / epitope;	2
(c)	immunisation of mammal with pure antigen; to stimulate antibody production; obtain plasma cells / B cells; by splenectomy / from spleen; fusion with myeloma cell; hybridoma; cell now capable of division; cloning; selection; culture in airlift fermenter; extraction of antibodies in solution; filter to remove cells; purify;	6 max
(d)	human chorionic gonadotrophin / HCG;	1
(e) (i)	hormone combines with mobile (monoclonal) antibodies; which diffuse up the strip; the complex combines with the immobilized (monoclonal) antibodies / both antibodies join; mobile antibodies can move no further; blue latex particles stay still in large window;	3 max
(ii)	to prove that the mobile monoclonal antibodies have moved to the top of the strip or past the large window / proves viability or activity of antibodies;	1
[Total: 16]		

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Question	Expected Answers	Marks
6 (a) (i)	remove / kills (some) microorganisms;	1
	(ii) collagen matrix; alginate beads; silica gel; cellulose fibres; partially permeable membrane; microcapsules;	
	<i>A other correct method</i>	2 max
	(iii) enzyme can be, recovered / reusable; can use continuous processing; product is not, contaminated / pure; enzyme is more stable; reference to economics / cost (qualified);	3 max
	(iv) low yield first time through fermenter; product fed back into fermenter; to remove more lactose; possible to use a smaller fermentation vessel;	2 max
(b)	<i>too hot</i> hydrogen bonds broken; globular shape of protein changed; shape of the active site changed; substrate / lactose, will not fit into the active site; reaction stops; denaturation of the enzyme; <i>too cold</i> low kinetic energy; substrate molecules move slowly; <i>reject reference to enzyme movement</i> few collisions; few enzyme/substrate complexes; slow rate of reaction;	5 max

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- (c) selectively permeable membrane only allows sugar to pass through;
to a biological recognition layer;
detail e.g. enzyme / antibody / membrane component / organelle / cell;
specific to sugar to be identified;
link between sugar and recognition layer causes physical or chemical
change;
transduction / produces an electrical signal;
quantitative / signal strength relates to the amount of sugar present; **3 max**

[Total: 16]