OCR

RECOGNISING ACHIEVEMENT

2805 / 04 Microbiology and Biotechnology

January 2004

Mark Scheme

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 (½) 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.

Mark Scheme

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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
	___	= (underlining) key words which **must** be used to gain credit
	ecf	= error carried forward
	R	= reject
	A	= accept
	AW	= alternative wording
	ora	= or reverse argument

Question	Expected Answers	Marks

1 (a) 10^{-6} easy to count / 10^{-5} dilution too many colonies to count accurately;
10^{-7} dilution too few colonies to be representative;
10^{-6} numbers very similar / 10^{-6} more reliable / 10^{-5} more variable;

allow ecf If first dilution factor is wrong **max 2**

(b) method of calculating mean;
mean value is 97;
this represents numbers of individuals;
divide by the dilution factor (10^{-6}) / multiply by 10^{6};
this gives 97 000 000 (per sample);
original sample was 0.5 cm^{3} so double the figure to find number per cm^{3} /
      divide by 0.5; **4**

(c) lower number / less / no bacteria present / bacterial growth would be inhibited; **1**

(d)

	E. coli	*B. cerus*
capsule	absent	present;
lipopolysaccharide outer membrane	present	absent;
murein wall	present	present;
cell surface membrane	present	present;

4

[Total : **11**]

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Question	Expected Answers	
2 **(a)**	virus;	**1**

(b) **F -** head region / capsid;   **R** capsomere
    G - base plate;   **2**

1 (bacteriophage) tail fibres, attach to, host cell / receptor;
2 tail fibres bend and base plate is anchored (by pins);
3 tail sheath contracts;
4 hollow spike pushed into cell;
5 aided by enzymes;
6 nucleic acid injected;   **R** RNA injected
7 with, enzymes / viral proteins;
8 phage enzymes breakdown bacterial DNA;
9 phage DNA replicates;
10 codes for new viral proteins;
11 new phages assembled;
12 <u>lysozyme</u> (enzyme) made;
13 cell lysis / lytic cycle;
14 phages released;
15 AVP; (more detail) e.g. rolling circle DNA replication
16 AVP; ref to prophage / lysogenic life cycle   **max 8**

QWC – legible text with accurate spelling, punctuation and grammar;   **1**

(d) **(i)** genetic engineering;
        used as vectors;
        transferring genes / pieces of DNA;
        to bacteria;
        AVP;;   max 3

(ii) they destroy bacteria;
        ruin fermentation process (involving bacteria);
        loss of product;
        must be sure to use sterile techniques;
        escape of GM phage (into environment);
        consequence; e.g. pathogenic
        risk of introducing genes into wild bacteria;
        risk of 'superphage' killing bacteria unintentionally;
        AVP;;   max 3   **max 4**

                                                          [Total : 16]

Mark Scheme

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Question	Expected Answers	

3 (a) (i) heat exchanger;
respiration in fermenter produces heat;
cools the contents of the fermenter;   **max2**

(ii) carbon dioxide;
respiration;   **R** aerobic or anaerobic unqualified   **2**

(iii) oxygen / aerobic process / mixing / agitation;   **1**

(b) centrifuge / cyclone separation;
RNA reduction;
using enzymes;
filter;
steam;
to kill fungus / sterilisation;
named specific additive; e.g. egg white
purpose of additive; e.g. flavour, colour, shape, binder   **max 4**

(c) no / less, cholesterol;
less fat;
ref to containing protein;
(high) dietary fibre;
data quote making a comparison;   max 2

lower risk of heart disease;   **R** bad for heart
lower blood cholesterol;   **R** blocks arteries
easier to control body mass;
suitable for vegetarians;
AVP; e.g. advantages of dietary fibre   max 3   **max 4**
AVP;

[Total : 13]

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Question	Expected Answers	
4 (a) 1	starter culture added;	
2	speeds up souring / AW;	
3	lactose-fermenting bacteria;	
4	e.g. *Streptococcus lactis / S. cremoris*;	
5	produces lactic acid;	
6	pH falls;	
7	this gives the cheese its flavour;	
8	gas producing bacteria;	
9	e.g. *Leuconostoc lactis*;	
10	release carbon dioxide;	
11	this gives the cheese its texture;	
12	rennet / rennin added;	
13	chymosin and pepsin;	
14	coagulates, casein / protein;	
15	lactic acid bacteria inhibited when ripening;	
16	*Lactobacillu*s multiply;	
17	lactose converted to lactic acid;	
18	proteins converted to peptones and amino acids / fats to fatty acids and glycerol;	
19	amines / aldehydes / ketones produced, flavouring;	
20	AVP; e.g. named example of fungi to produce blue cheese	
21	AVP; 2 named examples of enzymes	**max 8**

QWC – clear well organised using specialist terms;   **1**
must use four specialist terms

(b) (i) purity / less contamination;
identical to natural enzyme;
no need to kill animals;   **R** 'ethical reasons' unless qualified
cheese acceptable to, vegetarians / vegans;   **max 2**

(ii) gene identified;
gene, extracted / isolated;
ref to, restriction enzyme / ligase (in correct context);
placed in, vector / plasmid;
ref to recombinant DNA;
added to yeast / microorganism;
cloned / cultured;
credit ref to, transcription / translation;   **max 5**

[Total : 16]

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Question	Expected Answers	
5 **(a)**	*look for links between aspects of protein structure and variation in shape of antibody* different, primary structures / sequences of amino acids; 20 types of amino acids; ref to secondary structure; helix / pleat ; tertiary structure, linked to 3D shape; globular shape; ref to 4 polypeptides / quaternary structure;	**max 3**
(b)	mouse is immunised by / injected with antigen; AW immune response / mouse produces B lymphocytes; **A** B cells mouse cells / B cells / plasma cells, produce antibody; spleen removed; lymphocytes separated from other cells; fused with, tumour cells / myeloma cells; forming hybridomas; hybridomas screened for antibody production; hybridomas, cloned / mass produced / 'fermented'; monoclonal antibodies harvested;	**max 5**
(c) **(i)**	human chorionic gonadotrophin / hCG; **A** human chorionic hormone only present in urine of pregnant woman; non-invasive technique / can be done at home / AW;	**max 2**
(ii)	attached to hormone (and keeps it on the dipstick);	**1**
(iii)	enzyme only attached to dipstick if HCG present;	**1**
(iv)	blue colour only appears if, HCG present / woman pregnant / positive test;	**1**
(d)	mouse antibodies are recognised as foreign; destroyed by the immune system / ref immune response / AW; removed from host before they can have their effect; immune complexes damage kidney;	**max 2**

[Total : 16]

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Question	Expected Answers	
6 **(a)** **(i)**	petrol; **R** gas	**1**
(ii)	cane sugar / sucrose; starch; cellulose;	**max 2**
(b) **(i)**	attached to, insoluble / inert, material; **R** solid base	**1**
(ii)	collagen matrix / gel entrapment / polymer microspheres / alginate beads / cellulose fibres; description of method;	**2**
(iii)	enzyme can be recovered / reused; product not contaminated / purer product; enzyme more stable; tolerant to changes in pH and temperature; cost effective;	**max 3**
(iv)	do not need to, start with / isolate, a pure enzyme(s); **A** ref to intracellular enzymes less expensive; cell will produce enzyme; cell may, divide / grow; no need to replace enzymes; more than one step may be involved / more than one enzyme is involved;	**max 5**
(c) **(i)**	larger surface area : volume ratio; rate of, diffusion / facilitated diffusion, greater; substrate / sugar, absorbed faster; product / ethanol, released / produced, faster;	**max 3**
(ii)	greater tolerance to high alcohol concentration; greater tolerance to pH difference; greater tolerance to temperature difference; AVP; e.g. faster growth rate / enzymes optimum rate at lower temperatures	**max 2**

[Total :   19]