2012 Biotechnology

Higher

Finalised Marking Instructions

GENERAL MARKING ADVICE: BIOTECHNOLOGY

The marking schemes are written to assist in determining the 'minimal acceptable answer' rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

1. There are no **half marks**. Where three answers are needed for two marks, normally one or two correct answers gain one mark.

2. In the mark scheme, if a word is **underlined** then it is essential; if a word is (**bracketed**) then it is not essential.

3. In the mark scheme, words separated by / are **alternatives**.

4. There are occasions where the second answer negates the first and no marks are given. There is no hard and fast rule here, and professional judgement must be applied. Good marking schemes should cover these eventualities.

5. Where questions on data are in two parts, if the second part of the question is correct in relation to an incorrect answer given in the first part, then the mark can often be given. The general rule is that candidates should not be penalised repeatedly.

6. If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, candidates should not be penalised repeatedly.

7. Clear indication of understanding is what is required, so:

   - if a description or explanation is asked for, a one word answer is not acceptable
   - if the questions ask for **letters** and the candidate gives words and they are correct, then give the mark
   - if the question asks for a word to be **underlined** and the candidate circles the word, then give the mark
   - if the result of a calculation is in the space provided and not entered into a table and is clearly the answer, then give the mark
   - **chemical formulae** are acceptable eg CO_2, H_2O
   - contractions used in the Arrangements document eg DNA, ATP are acceptable
   - words not required in the syllabus can still be given credit if used appropriately eg metaphase of meiosis

8. Incorrect **spelling** is given. Sound out the word(s),

   - if the correct item is recognisable then give the mark
   - if the word can easily be confused with another biological term then **do not** give the mark eg ureter and urethra
   - if the word is a mixture of other biological words then **do not** give the mark, eg mellum, melebrum, amniosynthesis.

9. **Presentation of Data:**

- if a candidate provides two graphs or bar charts (eg one in the question and another at the end of the booklet), mark both and give the higher score
- if the question asks for a line graph and a histogram or bar chart is given, then do not give the mark(s). Credit can be given for labelling the axes correctly, plotting the points, joining the points either with straight lines or curves (best fit is rarely used)
- if the *x* and *y* data are transposed, then do not give the mark
- if the graph used less than 50% of the axes, then do not give the mark
- if 0 is plotted when no data is given, then do not give the mark (ie candidates should only plot the data given)
- no distinction is made between bar charts and histograms for marking purposes. (For information: bar charts should be used to show discontinuous features, have descriptions on the *x* axis and have separate columns; histograms should be used to show continuous features; have ranges of numbers on the *x* axis and have contiguous columns.)
- where data is read off a graph it is often good practice to allow for acceptable minor error. An answer may be given 7.3 ± 0.1.

10. **Extended response questions:** if a candidate gives two answers where there is a choice, mark both and give the higher score.

11. **Annotating scripts:**

- put a 0 in the box if no marks awarded – a mark is required in each box
- indicate on the scripts why marks were given for part of a question worth 3 or 2 marks. A 3or 7near answers will do.

12. **Totalling scripts:** errors in totalling can be more significant than errors in marking:

- enter a correct and carefully checked total for each candidate
- do not use running totals as these have repeatedly been shown to lead to more errors.

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Marking Scheme

Section A

1.	**C**	16.	**C**
2.	**D**	17.	**D**
3.	**A**	18.	**A**
4.	**D**	19.	**D**
5.	**B**	20.	**C**
6.	**A**	21.	**B**
7.	**B**	22.	**B**
8.	**C**	23.	**A**
9.	**B**	24.	**C**
10.	**A**	25.	**B**
11.	**B**	26.	**C**
12.	**D**	27.	**C**
13.	**A**	28.	**A**
14.	**C**	29.	**D**
15.	**D**	30.	**A**

Section B

Question	Acceptable Answer	Mark	Unacceptable answer
1 (a) (i)	Part of cell – **nucleus** Name of Process – **transcription** Part of cell – **ribosome** Name of Process – **translation**	**1** **1**	
(ii)	Transfers/carries amino acids to the ribosome	**1**	
(b) (i)	Peptide bond	**1**	
(ii)	Fold into secondary structure held together by hydrogen bonds	**1**	
(c) (i)	Correct structure labelled	**1**	
(ii)	To process proteins (enzymes) for secretion	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
2 (a)	Capsid/protein coat	**1**	
(b)	Synthesis of viral protein coat Assembly of new viral particles	**1** **1**	
(c)	2.9 (nm)	**1**	
(d)	Production of vaccines/as cloning vectors	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
3 (a)	Krebs cycle	**1**	
(b)	Glycolysis/stage 1	**1**	
(c)	Cristae of mitochondrion	**1**	
(d)	Via a hydrogen carrier/NAD		
(e)	38 ATP	**1**	
(f)	Facultative anaerobe	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
4 (a) (i)	One mark for both axes correct and labelled One mark for each set of data correctly plotted	**3**	
(ii)	The optimum temperature for both organisms is 30°C/between 10°C and 30°C *Lactobacillus* cell mass increases more rapidly than *Candida*	**1**	
(iii)	1.725 hr/1 hr 43 ½ mins	**1**	
(b)	*Candida* – ethanol, CO_2 (and ATP) *Lactobacillus* – lactic acid (and ATP)	**1** **1**	
(c) (i)	Any 2 of – incubation time/pH/nutrient supply/any other reasonable answer	**2**	
(ii)	To ensure they are ready for reproduction/cell growth/that they are actively growing/lag phase is complete	**1**	
(d)	Repeat the experiment in a narrow temp range (1) taking measurements at closer intervals eg every 1 or 2 degrees (1)	**2**	

Question	Acceptable Answer	Mark	Unacceptable answer
5 (a)	Mannitol – differential Phenol red – differential Sodium chloride – selective **2 correct = 1 mark** **3 correct = 2 marks**	**2 correct =1 mark** **3 correct = 2 marks**	
(b) (i)	37 Justification – only *Staphylococcus* (ferment mannitol to) produce acid, which will turn the phenol red/indicator yellow	**1**	
(ii)	$37 = 37 \times 10 \times 10^6 = \underline{3.7 \times 10^8}$ (or calculation correct with answer from (i))	**1**	
(iii)	Because other species will be inhibited/will not grow on MSA	**1**	
(c)	Oxidase test	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
6 (a) (i)	Generic	1	
(ii)	Gloves and safety glasses	1	
(iii)	Autoclaving	1	
(b) (i)	1 in 20 dilution	1	
(ii)	To show it is the disinfectant which is causing the effect	1	
(iii)	Because total cell number would include dead cells	1	
(iv)	Biocidal Because number of living cells decreases which indicates cells are being killed	1 (for correct answer and reason)	

Question	Acceptable Answer	Mark	Unacceptable answer
7 (a)	Apical meristem	**1**	
(b) (i)	To remove microorganism/contamination/to sterilise	**1**	
(ii)	For energy production/any other reasonable answer	**1**	
(iii)	They have different proportions of plant growth substances/hormones/cytokinins and auxins	**1**	
(iv)	Buffer	**1**	
(c)	Mutation	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
8 (a) (i)	Miscanthus produces a greater biomass per acre of land (1) less land (or a smaller percentage of land) is required to produce the target volume of biofuel (1)	2	
(ii)	Corn produces more ethanol per ton of biomass	1	
(b) (i)	Site 3 : 14.5 × 91 = 1319.5 Site 1 : 11.9 × 91 = 1082.9 Difference <u>236.6 gallons</u>	1	
(ii)	Any 2 from difference in rainfall/nutrient content of soil/temperature/hours of sunlight Any other reasonable answer	1	
(c)	It would increase: reason – more area grown to meet target for biofuel production Or, it would decrease: reason – increasing population therefore more demand for food crops and less capacity for biofuel production/increased production from GM crops	1	
(d)	Cellulase	1	

Question	Acceptable Answer	Mark	Unacceptable answer
9 (a) (i)	Entrapment	1	
(ii)	Ease of separation of enzyme and product/ no contamination of product with enzyme	1	
(iii)	To produce maximum contact with beads/ maximum surface area for reaction between beads and milk	1	
(b)	Product continually made/fresh substrate continually supplied	1	
(c) (i)	Water jacket	1	
(ii)	To maintain optimum temperature for enzyme/enzyme may become denatured/ milk may coagulate at too high temperature *Page 13*	1	
(iii)	Rate milk is sprayed/yield of product/ exclusion of contaminants/flow rate/ technical specification/control systems for pH or fluid volume (any 2)	1 1	
(d)	Measure the activity of the enzyme before and after immobilisation/measure the activity of non-immobilised enzyme <u>and compare</u> with immobilised	1	

Question	Acceptable Answer	Mark	Unacceptable answer
10 (a) (i)	Flocculation/precipitation/filtration/ centrifugation	**1**	
(ii)	Solvent extraction	**1**	
(b)	Extracellular	**1**	
(c) (i)	Fermenter 1 – 35mm (or 30mm) ± 1mm Fermenter 2 – 20mm (or 15mm) (± 1mm must be consistent)	**1**	
(ii)	7 : 4 (or 2 : 1) must be consistent with answer for (i)	**1**	
(d)	Because Gram positive have more peptidoglycan in the cell wall which is the target for penicillin	**1**	
(e)	Stainless steel	**1**	
(f) (i)	To prevent contaminants entering	**1**	
(ii)	Filamentous fungi would become tangled in the paddles	**1**	

Question	Acceptable Answer	Mark	Unacceptable answer
11 (a) (i)	They are undifferentiated/can develop into adult tissues	**1**	
(ii)	Treat disease/organ production (or named example)	**1**	
(b)	Conserve desired features Produce (genetically) identical individuals	**1** **1**	
(c) (i)	Nuclear transfer	**1**	
(ii)	Surrogate	**1**	

Section C

1 A Discuss the applications of the following organisms in agriculture:

(a) Agrobacterium tumefaciens **(5)**
(b) Bacillus thuringienis **(5)**

(a) Used to produce transgenic plants (GMOs).
The bacterium carries a plasmid.
Foreign genes for desired characteristics can be inserted into the plasmid.
Plant protoplasts incubated with bacteria carrying the plasmid.
Protoplasts cultured on selective medium.
Only plant cells which have taken up the DNA will grow.
Any reasonable example of an application e.g. frost resistance.

any 5 of 7

(b) Produces a toxin.
(toxin is) a crystalline protein.
Only when the bacteria sporulate.
It is selectively toxic (to some species of caterpillar).
The bacteria can be sprayed on the crops.
The toxin can be sprayed on the crops.
Can insert the gene for toxin into plant cells.
Plants are then protected against/kill the insects.

any 5 of 8

10 marks

Section C

1 B Describe the production and uses of transgenic animals under the following headngs:

(a) Production of transgenic animals (2)
(b) Use of transgenic animals to produce medical products (3)
(c) Advantages and disadvantages over the use of microorganisms (5)

(a) Foreign DNA inserted by microinjection.
Or viral infection.
Into a fertilized egg.

any 2 of 3

(b) Transgenic animals with genome altered.
By recombinant DNA technology.
Gene inserted close to genes for milk production.
Secretion of product in milk.
Any reasonable example eg AAT or interferon.

any 3 of 5

(c) Advantages
– less downstream processing.
– GMOs more cost effective.
– no need for expensive culture vessels.
– no need for continuous monitoring or maintenance.
– animals can process eukaryotic proteins/add sugar residues.
– ability to secrete product passed on to next generation.

any 4 of 6

Disadvantages – social and ethical concerns over use of animals. **1**

10 marks

Section C

2 A Give an account of the similarities and differences between bacterial cell and a yeast cell.

Similarities
– both single-celled organisms
– cell membrane structure (phospholipid/protein)
– ribosomes for protein synthesis
– cytoplasm for chemical reactions/contains enzymes
– genome is double stranded DNA.

Differences
– cell wall is peptidoglycan in bacteria, chitin in yeast
– chromosome single circular in bacteria, multiple linear in yeast
– membrane bound nucleus in yeast not present in bacteria/bacteria are prokaryote, yeast is eukaryote
– other membrane bound organelles only in yeast
– binary fission in bacteria, budding in yeast
– only bacteria motile/have flagella, have plasmids, have capsule (max 2).

any 8 of 11

1 mark for coherence – must be under subheading or paragraphs, at least 2 points in each section, related information grouped together

1 mark for relevance – at least 5 relevant points, no more than 2 irrelevant points, at least 2 similarities and 2 differences.

Section C

2 B Give an account of the cells of the immune system and their functions in innate and acquired immunity.

– macrophages in innate immunity
– engulf pathogens (bacteria/viruses) by phagocytosis
– contain many lysosomes (to breakdown pathogens)

at least 1 of 3

– B-lymphocytes (B cells)
– produce antibodies in response to antigens
– antibodies bind to specific antigens
– this is the humoral response
– T-lymphocytes (T cells)
– activate other cells of the immune system
– attack foreign cells/antigens directly
– cell-mediated response
– both T and B lymphocytes part of the acquired immune response.

max 7 of 9

Coherence – information must be grouped under subheadings or in paragraphs, related information together (innate/acquired)

Relevance – at least 5 relevant points, no more than 2 irrelevant points.

[END OF MARKING INSTRUCTIONS]