# 2010 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 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 CO2, H2O
   - 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 $7.3 \pm 0.1$.

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 ✓ or x near 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.

**2010 Biotechnology Higher**

**Marking Scheme**

**Section A**

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

**Section B**

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **1 (a)** | Escherichia coli | **1** | | |
| **(b)** | Hydrogen peroxide/$H_2O_2$ | **1** | | |
| **(c)** | Clostridium tetani<br>Produces spores (that are heat resistant) | **1** | | |
| **(d)** | <u>Only</u> E. coli would grow/would not be inhibited | **1** | | |
| **(e)** | Tube 1: Micrococcus luteus<br>Tube 2: Clostridium tetani<br>Tube 3: Escherichia coli/Staphylococcus epidermidis<br><br>**Three answers = 2 marks, two or one answers = 1** | **2** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **2 (a) (i)** | 16.66 (accept 16.7 or 16.67) | **1** | | |
| **(ii)** | Leu – asp – ser – ser – arg – lys | **1** | | |
| **(b)** | In nucleus exons and introns (**1**); in cytoplasm exons only (**1**) | **2** | | |
| **(c)** | X Y Z W | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **3 (a)** | Add sample of broth to plate (**1**) spread over whole surface of plate (**1**) with sterile spreader (**1**)<br>Three points = **2** marks; two points = **1** mark | **2** | | |
| **(b)** | To allow (valid) comparison between plates | **1** | To make the test fair | |
| **(c)** | 1 in 10/10 times | **1** | | |
| **(d)** | 5 : 3 | **1** | | |
| **(e)** | Does not kill bacteria but prevents growth/ growth arrested | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **4 (a)** | Number of cases declines to 1988/1989 then rises (**1**) Use of appropriate numbers (**1**) | **2** | | |
| **(b)** | 34.8/34.78 | **1** | | |
| **(c)** | 1980 – 1981 | **1** | | |
| **(d)** | 26.25%/26.3% | **1** | | |
| **(e)** | Via plasmid (or other plausible) | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **5 (a)** | Enzymes/detergent/grinding/homogenisation/ultrasound | **1** | | |
| **(b)** | Protein | **1** | | |
| **(c)** | Presence of <u>specific</u> DNA sequence/ <u>recognition</u> sequence | **1** | DNA sequence | |
| **(d)** | Positive **and** size | **2** | | |
| **(e)** | Complementary sequence (**1**). Single stranded (DNA/RNA)(**1**) Radioactive/chemiluminescent label(**1**) **Two from three** | **2** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **6 (a)** | 10g agar **and** 500cm$^3$ water | **1** | | |
| **(b) (i)** | Weighing agar: Face mask/gloves/lab coat/PPE | **1** | | |
| **(ii)** | Autoclaving: Loosen lids/check autoclave/ water level in autoclave/other acceptable | **1** | | |
| **(c)** | Brownes Tube/indicator strip | **1** | | |
| **(d)** | Medium that only allows growth of certain species | **1** | | |
| **(e)** | **Two of** not dry/not flat/not smooth/ contaminated | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **7 (a)** | W lag phase<br>X log/exponential phase | **1** | | |
| **(b) (i)** | Any time from 3 to 5 hours | **1** | | |
| **(ii)** | 2 hours | **1** | | |
| **(iii)** | Growth rate is faster in X than Y | **1** | | |
| **(iv)** | 375% | **1** | | |
| **(c)** | Build-up of waste toxins/(named) factor becomes limiting | **1** | | |
| **(d)** | Regulator makes repressor/Lactose binds repressor (**1**)/repressor can't bind operator (**1**)/ structural gene switched on/enzyme produced (**1**) lactose is inducer (**1**) **three points for three marks**. | **3** | Wrong point loses mark | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **8 (a) (i)** | **Two from**: Oxygen, temperature, pH, nutrient supply | **1** | Food supply | |
| **(ii)** | Scaling up | **1** | | |
| **(iii)** | To determine technical specification, containment of micro-organisms, maintenance of sterility, control systems.<br>Up to two points. | **2** | | |
| **(b) (i)** | Resistant to corrosion; steam sterilisation; strength | **1** | Easy to clean | |
| **(ii)** | **Two of**: Drains in floor/sump beneath floor/ raised doors and windows/sealed doors and windows | **2** | | |
| **(c)** | Extracellular enzymes can be separated from cells and purified from the media (**1**).<br>Isolation of intracellular enzymes require an additional step of breaking the cells open (**1**) | **2** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **(d) (i)** | Name – Adsorption. Description – enzyme attached by non-covalent bonds.<br>Name – Entrapment. Description – enzyme trapped in a jelly like matrix or capsule.<br>Name – Bonding. Description – covalently bonded to solid support. | **1** | | |
| **(ii)** | **Two of**: Ease of recycling/separation from product/can stabilise enzyme. Environmentally favourable. | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **9 (a)** | Scale and axes correct (**1**); plot and key correct (**1**) | **2** | | |
| **(b)** | **Two of**: Concentration of arsenic in the soil; time of exposure to arsenic/growth period; plants not previously exposed to arsenic; nutrients in soil/growth conditions identical. | **2** | | |
| **(c)** | Plants will have different masses | **1** | | |
| **(d)** | Plants from China and Poland have greater concentration in fronds than UK and India (**1**) Concentration in roots is same in plants from all regions (**1**) | **2** | | |
| **(e)** | Bioremediation | **1** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **10 (a) (i)** | Agrobacterium (tumifaciens) | **1** | | |
| **(ii)** | Transfers genes to plants/natural plant pathogen/ infects plants | **1** | | |
| **(b)** | Transformation | **1** | | |
| **(c)** | Plasmid gives resistance to antibiotic (**1**) only plants with plasmid will grow (**1**) | **2** | | |
| **(d) (i)** | Inoculate plant cells with untransformed bacteria/bacteria without plasmid | **1** | | |
| **(ii)** | To prove that plasmid has been taken up/to prove that transformation was successful | **1** | | |
| **(e)** | Plant tissue divided (**1**) and transferred to media with hormones/growth factors (to allow it to develop into a whole plant) (**1**) or grown on (**1**) and used as source of explants (**1**) | **2** | | |

| Question | Acceptable Answer | Mark | Unacceptable answer | Negates |
|---|---|---|---|---|
| **11 (a)** | Colour intensity depends on concentration of bound antibody/enzyme (**1**).<br>Concentration of enzyme/bound antibody depends on concentration of protein in tube (**1**) | **2** | | |
| **(b)** | To ensure that all available antigen was bound | **1** | | |
| **(c)** | To remove unbound antibodies | **1** | | |
| **(d) (i)** | Fuse <u>B lymphocyte</u> with <u>cancer cell</u> (**1**). <u>Select</u> those producing specific antibody (**1**) | **2** | | |
| **(ii)** | Pregnancy testing/tissue typing/identifying infectious agents/therapeutic/research tool | **1** | | |

**Section C**

**1 A** Give an account of microbial fermentation under the following headings:

**Production of ATP and its role in the cell**

1 Method of transferring chemical energy
2 ADP + Pi to produce ATP
3 Named use

**Maximum 2 marks**

**Aerobic respiration**

4 Glucose to pyruvic acid is glycolysis
5 Pyruvic acid to acetyl CoA
6 Acetyl CoA combines with 4 carbon intermediate to form 6 carbon/citric acid (tricarboxylic acid)
7 6 carbon/citric acid converted (in steps) to 4 carbon intermediate with release of $CO_2$
8 Production of hydrogen which combines with NAD/FAD/coenzyme
9 Carried to cytochrome system/ETC
10 Electrons/hydrogen passed along carriers/chain producing ATP
11 Final hydrogen acceptor is oxygen (and water is produced)

**Maximum 6 marks**

**Anaerobic respiration**

12 Only glycolysis/no Krebs and cytochrome system
13 Less/2 ATP produced
14 Final product lactic acid/ethanol

**Maximum 2 marks**

**Section C**

**1 B** Discuss unicellular and multicellular fungi under the following headings:

**Structure**

1 all eukaryotes
2 unicellular – single cell and multicellular – many cells
3 filamentous/hyphal
4 form a mycelium
5 membrane bound organelles/named organelles
6 have nucleus
7 may be multinucleate
8 has cell wall

**Maximum 5 marks**

**Reproduction**

9 unicellular/yeast reproduce by asexual/budding
10 multicellular reproduce by sexual and asexual
11 asexual produce spores/sporangium
12 sexual produce zygospores

**Maximum 3 marks**

**Uses**

13 yeast – ethanol/brewing/baking
14 multicellular – enzymes
15 multicellular – antibiotics/named antibiotic

**Maximum 2 marks**

**Section C**

**2 A** Discuss the use of batch and continuous flow processes in biotechnology.

**Batch**

1 closed system
2 nutrient depleted
3 waste products accumulate
4 production of secondary metobolites/penicillin
5 and 6 advantages (**accept two only**):
short fermentation time
ease of control
allows all stages of growth

**Continuous**

7 Fresh medium supplied
8 Product removed throughout
9 Optimum conditions (pH/temperature) maintained
10 Production of metabolites such as lactic acid/vitamin C
11 Advantage: increased productivity/continuous supply

**Maximum 8 marks**

**1 mark for relevance and 1 mark for coherence = 10 marks**

**Coherence**

1 The writing must be under sub-headings (batch and continuous) or divided into paragraphs.
2 Related information must be grouped together.
Batch grouped together/continuous grouped together.
3 At least **five** relevant points made.

**All** must apply for the coherence mark.

**Relevance**

1 No more than **two** irrelevant points eg description of fermenter etc for relevance mark.
2 At least **five** relevant points made – at least 2 from batch and 2 from continuous.

**Both** must apply for the coherence mark.

**Section C**

**2 B** Describe the new techniques used for animal breeding.

1 Embryo manipulation
2 Egg bisected at two cell stage and each half transplanted
3 Doubles reproductive rate
4 Embryo cloning
5 Many genetically identical copies/conserves desired features
6 Egg from donor grown to blastocyst stage
7 Undifferentiated cells isolated
8 Nuclear transfer
9 Cultured to blastocyst stage and transplanted into surrogate
10 Somatic cell cloning
11 Nuclear transfer from adult

**Maximum 8 marks**

**1 mark for relevance and 1 mark for coherence = 10 marks**

**Coherence**
1 The writing must be under sub-headings or divided into paragraphs.
2 Related information must be grouped together – embryo manipulation/embryo cloning/somatic cell cloning with at least **five** relevant points made.

**Both** of these must apply for the coherence mark.

**Relevance**
1 Essay should contain no more than **two** irrelevant points.
2 At least **five** relevant points

**Both** of these must apply for relevance mark.

[END OF MARKING INSTRUCTIONS]