



General Certificate of Education

Biology 6416

Specification B

BYB7/A Microbes and Disease

Mark Scheme

2007 examination - June series

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Question 1

- (a) (i) Time for synthesis of enzyme/protein/RNA/genes being expressed/
cells growing but little division; 1
- (ii) No limiting factor/optimum conditions/divide at rapid or exponential; 1
- (b) Release of CO₂/build up of acids; 1
- (c) (pH changes) breaks hydrogen/ionic bonds;
Changes tertiary structure/active site of enzymes/denaturation;
(Decrease in enzyme activity) decreases named process e.g.
respiration/reproduction/metabolism; 3

Total 6**Question 2**

- (a) (i) Maintains optimum conditions (for growth)/no limiting factors;
As continuous/frequent input of medium or nutrients/removal of
products;
- OR*
- Sterile medium/trap prevents entry of other microbes/contamination;
Prevents competition (with other microbes); 2 max
- (ii) Suitable suggestion and explanation
- For example:
Stirring mechanism;
Ensures microbes obtain optimum nutrient levels/prevents clumping/
even distribution of heat;
- OR*
- Add buffer to inflow;
To maintain optimum pH;
- OR*
- Water jacket/bath;
To remove heat from respiration/keep a constant or optimum
temperature;
- OR*
- Sparger/sterile air input;
To maintain optimum O₂/ supply O₂/prevent anaerobic conditions; 2

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- (b) (i) Suitable commercial advantage of continuous, explained;
- For example:
Reduces need to clean/reassemble, so less 'down time' of fermenter
or economic advantage/maintains exponential growth phase, so
products produced at maximum rate/requires smaller vessels so cheaper; 1
- (ii) Suitable commercial disadvantage of continuous, explained:
- For example:
Maintains optimum conditions/prevents any factor becoming limiting/
growth does not enter stationary phase, so no secondary metabolites
produced; 1
- Total 6**

Question 3

- (a) Two of **A, C, D**; 1
- (b) Structure, capsule/cell wall; 1
- (Cell wall/capsule) have polysaccharide/ sugar/ protein/ ligands;
That bind to host cells;
- OR*
- (Cell wall/capsule of Gram negative) breaks down when bacterium dies;
releasing endotoxin;
- OR*
- Capsule has fewer binding sites/receptor sites/antigens;
Less antibodies can bind/phagocytosis; 2 max
- OR*
- Capsule resistant to enzymes;
Protects from/reduces phagocytosis; 2 max
- (c) Reduced NAD gives electrons/H⁺;
Reference to electron transport chain;
ATP produced/energy released;
For active transport/uptake (of amino acids);
Without NADH, less ATP produced;
Reference to less carrier molecules for alanine; 3 max
- Total 7**
-

Question 4

(a) (i) $\frac{17}{0.004} = 4250 \text{ per mm}^3$

OR

$\frac{19}{0.004} = 4750 \text{ per mm}^3$; 2

(the principle of number divided by correct volume earns one mark)

(ii) Answer (17) = 4250×10^8 , 4.25×10^{11}
 Answer (19) = 4750×10^8 , 4.75×10^{11} ; 2

(the principal of the answer in (a)(i) $\times 10^5$ or 10^3 earns one mark)

- (b) Carry out serial dilution of culture medium/description;
 Add known volume to agar (plate);
 Incubate at suitable temperature/20-25°C;
 Count colonies;
 Multiply by dilution factor; 3 max

Total 7**Question 5**

- (a) What antibiotic affects; how this affects growth;

For example:

Binds to ribosomes/prevents RNA binding to ribosomes;
 So inhibits translation/protein synthesis/synthesis of enzymes;

OR

Inhibit nucleic acid/RNA/DNA synthesis;
 So prevents transcription/protein synthesis/synthesis of enzymes/cell division;

OR

Alters membrane permeability;
 Allows ions to leak out/prevents ions uptake; 2 max

- (b) (i) (Bacterial cell cytoplasm) has lower water potential (than outside);
 So water enters (down water potential gradient);
 Cell wall not strong enough to resist outward pressure/cell bursts; 3
- (ii) (Mammalian) cells have no cell walls/exist in isotonic medium; 1
- (c) Ampicillin not broken down by low pH/acids (in stomach); 1

Total 7

Question 6

- (a) Cuts DNA at CAGT/TGAC sequence;
Removes GT/TG (from end of DNA);
Forms sticky ends;
(HIV) DNA joins due to complementary base pairing/G to C and T to A;
- OR*
- Integrase recognises a specific a specific base sequence/CAGT/TGAC;
Due to complimentary/specific shape (of active site);
Forms sticky ends;
(HIV) DNA joins due to complimentary base pairing/G to C and T to A; 3 max
- (b) (i) Reverse transcriptase;
- OR*
- (viral) protease; 1
- (ii) Uses HIV RNA to make DNA;
- OR*
- Cuts viral proteins; 1
- (c) DNA strands separate/H bonds break/one (anti-sense) used as template;
RNA nucleotides bind to DNA;
By complementary base pairing/A to U/T or C to G;
Using hydrogen bonds;
RNA polymerase joins nucleotides (to form mRNA); 3 max

Total 8**Question 7**

- (a) Antigen presented by macrophages;
B lymphocyte with complementary antibody (on its surface) binds to antigen;
B lymphocyte divides by mitosis/forms clone;
Plasma cells secrete/release antibody (into blood);
Memory cells formed; 4 max
- (b) Proteins have specific tertiary structure/3D shape;
Complementary to/fits shape of receptor; 2
- (c) Sequence of bases codes for a sequence of amino acids/primary structure;
53 different amino acids/535 'bird flu' amino acids (in new protein);
New primary structure alters the tertiary structure/3D shape;
New shape binds more effectively to receptors (on cells of lungs and airways);
HA proteins can act as antigens;
New shape not recognised by antibodies/memory/Bcells; 3 max

Total 9