A-Level Biology

Immune System

Mark Scheme

Time available: 66 minutes
Marks available: 51 marks

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1.

(a) 1. Cell ingests/engulfs the antibody/ADC

OR

Cell membrane surrounds the antibody/ADC (to take it inside the cell);

Accept endocytosis for ingest/engulf

2. Lysosomes fuse with vesicle/phagosome (containing ADC);

3. Lysozymes breakdown/digest the antibody/ADC to release the drug;

Accept hydrolytic enzyme for lysozyme

3

(b) 1. ADC will bind to non-tumour/healthy cells;

Reject reference to active site

2. Cause death/damage of non-tumour/healthy cells

OR

Cause damage to other organs/systems;

2

(c) Correct answer for 2 marks, 9.2×10^{-5};;

Accept for 1 mark,

0.046 (correct mass injected into 23g mouse)

0.000092 (correct answer but not in standard form)

2

(d) Mice died

OR

Not ethical to continue;

1

(e) 1. Tested on other mammals to check for safety/side effects;

Accept named mammal, eg rat

2. Tested on (healthy) humans to check for safety/side effects;

Accept: Tested on (healthy) human tissue/cells to check for no side-effects

3. See if repeat doses stop the tumours regrowing (in Group J);

4. Investigate different concentrations of ADC to find suitable/safe dosage;

2 max

[10]

2.

(a) 1. Engulfs;

Accept endocytosis

OR

Description

Ignore 'taken in'

2. Forming vesicle/phagosome **and** fuses with lysosome;

3. Enzymes digest/hydrolyse;

Accept lysozymes for 'enzymes'

3

(b) 1. (Cells from) other organisms/transplants;

2. Abnormal/cancer/tumour (cells);

3. (Cells) infected by virus;

Accept 'own cells' if autoimmune response suggested

Accept APCs

Accept non-self

2 max

(c) 'X' written at either or both ends of Y shape;

1

(d) Joins two (different) polypeptides;

Accept holds/attaches

Accept 'prevents polypeptide chains separating'

1

[7]

3.

(a) 1. Mutation in the viral DNA/RNA/genome/genetic material;

Accept named examples mutations

2. Altered (tertiary structure of the) viral attachment protein;

Accept 'antigen' for 'attachment protein'

Accept causes antigenic variability

3. Allows it/attachment protein/virus to bind (to receptors of other species);

Accept descriptions of binding eg is complementary

2 max

(b) For **one** mark, accept any **two** of the following:

- The polymerase chain reaction
- Genetic/DNA fingerprinting
- (Gel) electrophoresis
- DNA/genome sequencing;

Accept PCR for polymerase chain reaction

Accept autoradiography

Accept DNA hybridisation

Accept compare DNA/base sequence for 'DNA sequencing'

Ignore compare mRNA base sequence

Ignore compare amino acid sequence

Ignore DNA probes

1

(c) 1. (The scientists) could identify proteins (that derive from the genetic code)

OR

(The scientists) could identify the proteome;

2. (They) could (then) identify potential antigens (to use in the vaccine);

Reject if answer suggests vaccine contains antibodies

2

(d) 1. B cell (antibody) binds to (viral) specific/complementary receptor/antigen;

Accept B cell forms antigen-antibody complex

2. B cell clones

OR

B cell divides by mitosis;

3. Plasma cells release/produce (monoclonal) antibodies (against the virus);

4. (B/plasma cells produce/develop) memory cells;

Accept B cell undergoes clonal selection/expansion

3 max

[8]

4. (a) (Antibodies with the) same tertiary structure

OR

(Antibody produced from) identical/cloned plasma cells/B cells/B lymphocytes;

Accept in context of single plasma/B cell/B lymphocyte

Reject: genetically identical antibody

1

(b) Accept any **one** suitable use, eg

Targets/binds/carries drug/medicine to specific cells/antigens/receptors
OR
Block antigens/receptors on cells;

Accept cancer/diseased cells (as a specific cell).

Ignore medical diagnosis/pregnancy/ PSA/ELISA test.

1

(c)

Ignore mixing of direct or indirect ELISA

Accept annotated diagram(s).

1. (First) antibody binds/attaches /complementary (in shape) to antigen;

2. (Second) antibody with enzyme attached is added;

3. (Second) antibody attaches to antigen;

   Accept (second) antibody attaches to (first) antibody (indirect ELISA test).

4. (Substrate/solution added) and colour changes;

   Only award if enzyme mentioned.

4

[6]

5. (a) 1. (Antivenom/Passive immunity) antibodies bind to the toxin/venom/antigen and (causes) its destruction;

For 'bind' accept 'attach', ignore 'attack'.

For 'destruction of toxin' accept agglutination or phagocytosis.

Ignore reference to antibodies 'neutralising toxin/stopping damage'

Reject reference to 'killing' toxin/venom.

2. Active immunity would be too slow/slower;

Accept 'passive immunity is fast er', not simply 'passive immunity is fast'.

2

(b) 1. May be different form of antigen/toxin (within one species)
OR
Snakes (within one species) may have different mutations/alleles;

2. Different antibodies (needed in the antivenom)
OR
(Several) antibodies complementary (to several antigens);

No mark points are available for answers related to collecting venom from different species of snake.

2 max

(c) 1. Horses **because** more antivenom/antibodies could be collected (as more blood collected);

2. 4550 (cm^3) v 26 (cm^3) (blood collected);

Accept 175 rabbits needed to (collect the volume of blood from) one horse.

2

(d) 1. (So) the animal does not suffer from the venom/vaccine/toxin;

2. (So) the animal does not suffer anaemia/does not suffer as a result of blood collection;

3. (So) the animal does not have pathogen that could be transferred to humans;

Accept 'To fulfil licence/legal requirements'.

Accept '(So) the animal does not have pathogen that could result in it producing other antibodies (not wanted in the antivenom)'.

For 'pathogen' accept correct form of pathogen.

1 max

(e) 1. B cells specific to the venom reproduce by mitosis;

Accept in context of primary or secondary immune response.

Credit idea of specificity if given once in relation to T or B cell.

Accept a description for specificity.

Accept 'clone' for 'reproduce by mitosis'.

'Clonal selection of B cells' = MP1.

2. (B cells produce) plasma cells and memory cells;

3. The second dose produces antibodies (in secondary immune response) in higher concentration **and** quickly

OR

The first dose must be small so the animal is not killed;

Accept 'a lot of antibody' for 'higher concentration of antibody'.

3

[10]

6.

(a) 1. Virus can't bind (to receptor)/ can't enter cells;
2. So can't be replicated/ multiply;

Accept can't reproduce

3. So, doesn't damage cell(s)/tissues (and cause symptoms);

Accept no toxins released

2 max

(b) 1. Antigen/glycoprotein on Ebola binds to/stimulates (a specific) B cell;

Accept correct reference to stimulation of B cells by T cells

2. (Binding causes) replication/cloning of B cell;

Accept replication/cloning of plasma cell;

3. Plasma cells/B cells release/produce antibodies;

2 max

(c) 1. Lots of antibodies (against Ebola) in recovered patient;
2. Transfusion/plasma contains antibodies;

Ignore reference to cells

3. Antibodies (specific so) will bind with (Ebola) antigen;
4. (In recipient) virus destroyed/cannot enter cell;

Antigen destroyed is insufficient

3 max

(d) 1. (High mutation rate leads to) antigens change/antigenic variability;

Accept (high mutation rate leads to) changes in base sequence coding for antigen;

2. Vaccine contains specific antigen;
3. Antibodies not complementary to (changed) antigen / won't bind to (changed) antigens;

3

[10]