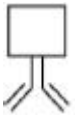
Mark schemes

Q1.

(a) 1. ‘Y’-shaped (antibody) linked to rectangle with exposed arms of ‘Y’;

For example



Accept ‘Y’ shape with 4 chains touching anywhere on the ‘constant’ region of the antibody.

2. Disulfide bridge/bond

OR

Antigen binding site

OR

Variable region

OR

Non variable/constant region

OR

Light chain

OR

Heavy chain

OR

Hinge region

OR

Polypeptide;

2

(b) ('Effective' ideas)

1. (ADC) removed (tumours) in 32/group 1 (patients)

OR

(ADC) is (cancer) cure in 32/group 1 (patients);

*For **four marks**, at least 'one effective' idea and at least one 'not effective' idea*

Accept people for patients

Accept not detectable or destroyed or digested for removed

2. (ADC) reduced (the size of tumours) in 40/group 2

OR

(ADC) reduced (the size of tumours) 72/group 1 and group 2;

Accept positive effect or is effective or works against for reduced

('Not effective' ideas)

3. Unknown effect (of ADC) in 28 patients

OR

(Suspect ADC) did not work in 28 patients;

4. Unknown effect (on tumours) after 3 months
OR

Don't know if (tumours) continue decreasing (in size) after 3 months
OR

Don't know if (tumours) grow (again) after 3 months;

5. No (information from a) control (group of patients)
OR

No placebo (drug used)
OR

No antibody alone (used);

Accept a description of placebo, eg non-active drug

Ignore fake drug for placebo

6. (Only) small sample size;

Ignore references to gender or age or other health issues

4 max

[6]

Q2.

(a) Correct answer within range of 7 to 7.5 = **2 marks**;;

Incorrect but shows division by 5500 = **1 mark**

OR

Answer shows correct number but incorrect decimal place eg 70 / 727 / 0.72 = **1 mark**;

2

(b) Correct answer of 3 / 2.5 / 2.52 × 10^{13} in any correct mathematical form = **2 marks**;;

Incorrect but shows 5250 in any correct mathematical form = **1 mark**

OR

Incorrect but answer shows first three numbers as 252 = **1 mark**;

2

(c) 1. Osmosis does not occur;

*Accept no **net** flow of water for osmosis.*

2. (Red blood) cells do not burst/lyse/shrink;

Accept crenation (of red blood cells).

Accept converse eg osmosis would occur and cells would burst/lyse/shrink.

Accept cells would be larger/smaller.

2

(d) 1. Binding/complex between antigen A and (antibody) anti-A;

Ignore reference to (antibody) anti-B in donor.

2. (Causes red blood) cells to join/clump;

Reject 'clot/clotting'.

2

(e) A, B, AB and O;

Accept all the blood groups.

1

[9]

Q3.

(a) 1. (Second antibody with) enzyme remains;

Accept any description of antibody with enzyme remaining eg 'not washed out'.

2. (So substrate converted to) coloured product;

2

(b) Antibodies (produced against syphilis and *B. burgdorferi*) are similar

OR

Antibodies (to syphilis) are complementary to antigens (of *B. burgdorferi*)

OR

Antigen(s) (of syphilis and *B. burgdorferi*) are similar (in structure);

1

(c) 1. Low concentration of antibodies (against *B. burgdorferi*)

OR

No/little antibody produced (during first two weeks);

2. (Only) primary response

OR

By plasma cells

OR

Plasma cells not produced

OR

B cells not divided/cloned;

2

(d) 1. For all symptoms higher percentage in PTLDS group;

2. Significant difference/increase (in intensity of all symptoms) in PTLDS group;

Reject 'results are significant'

Accept 'difference/increase in (all) results is significant'.

3. Most significant difference/increase (in intensity) in fatigue/joint pain/muscle pain symptoms in PTLDS group

OR

Less significant difference/increase (in intensity) in depression/fever symptoms in PTLDS group;

Reject 'results are significant'

If neither mp 2 or mp 3 is awarded accept for one mark 'there is less than a 5% or less than 0.05 probability of difference (in intensity of symptoms) being due to chance'.

4. Only (investigated) for 2 weeks

OR

Short time period (for investigation);

5. Difficult to determine intensity of symptoms

OR

Determining intensity of symptoms is subjective;

Accept any description of determining symptoms eg, judging symptoms.

4 max

[9]

Q4.

(a) 1. (Cell-surface) membrane

2. Protein

Accept immunoglobulin or glycoprotein

Ignore tertiary

Ignore polypeptide

3. Antigen

Accept complementary/specific

Ignore identical

4. Plasma

5. Active

Ignore artificial

Ignore primary

6. Herd;;;

*6 correct = **3 marks***

*4–5 correct = **2 marks***

*2–3 correct = **1 mark***

*0–1 correct = **0 marks***

3 max

(b) 1. (High rate of) mutation;

*Accept antigenic variability **OR** descriptions of antigenic variability*

2. (High) genetic diversity;

3. HIV in cells could (still) spread infection;

4. HIV (DNA) embeds/inserts itself in **host DNA**;

5. Lack of funding/money (for research/development);

6. HIV causes fewer T cells, **so** immune response (to the vaccine) does not happen;

Accept 'HIV destroys/kills T cells' for 'HIV causes reduced T cells'

Accept 'so B cells not activated' for 'so immune response (to the vaccine) does not happen

Ignore immune cells destroyed

1 max

(c) **(Ciprofloxacin)**

1. (HIV) has RNA

OR

(HIV) does not have DNA;

Ignore any prefixes to RNA

Reject references to single stranded DNA

(Penicillin)

2. (HIV) has no cell wall

OR

(HIV) does not contain murein;

*Reject any references to incorrect viral structures, eg viruses have a cell membrane **OR** a cell wall made of chitin*

2

[6]

Q5.

(a) Capsid and attachment protein;

1

(b) 1. (DNA) helicase **and** (DNA) polymerase;

Accept (DNA) ligase for either enzyme.

2. (Helicase) breaks hydrogen bonds (to unwind DNA);

Reject 'hydrolyse hydrogen bonds'

3. (Polymerase) condensation reactions to join (adjacent) nucleotides

OR

(Polymerase) forms phosphodiester bonds between (adjacent) nucleotides;

Reject mp3 if polymerase forming hydrogen bonds or joining complementary base pairs

Accept (DNA) ligase joins DNA fragments.

Note: Incorrect/no enzymes named but both roles outlined = 1 mark

3

(c) Uncontrolled cell cycle/division/mitosis;

Reject meiosis Ignore growth

1

(d) For:

1. Needs to be given early (age 10-12) before exposure to HPV;

***Max 3** for mark points 1-5*

Accept 'Needs to be given before sexual activity'

2. Will reduce transmission to girls (for when they are older);

Accept 'spread' for 'transmission'

3. Boys can be infected with HPV

OR

(Vaccination) prevents HPV infection;

4. (Need boys) to ensure herd immunity

OR

(Need boys) to be above 50% vaccinated;

5. Boys can have increased risk of cancer (from HPV infection);

Against:

6. Boys at less risk of cancer (from HPV infection) than females

OR

Cervical cancer only affects females;

7. May be side effects from vaccine;

4 max

[9]

Q6.

(a) 1. Reduced surface area

OR

Fewer co-transport/carrier/channel proteins;

Ignore references to diffusion OR facilitated diffusion OR active transport

Ignore SA

Accept gut for ileum

2. Decreases water potential in ileum/lumen

OR

Increases water potential in cells;

Accept Ψ for water potential

Ignore WP

Accept reduces water potential gradient

3. (So) water moves out of cells/into ileum by <u>osmosis</u>

OR

(So) less/no water moves into cells/out of ileum by <u>osmosis</u>;

Accept lumen for ileum

Accept absorbed for moves

3

(b) 1. Anti-toxins/antibodies cause phagocytosis/ destruction/agglutination/neutralisation (of toxin);

For 'neutralised', accept idea of preventing toxin binding/damaging cells lining the ileum.

2. Anti-toxin/antibody prevents/reduces (chance of) diarrhoea

OR

(*C difficile*) patients with no diarrhoea have high(est) (concentration of) anti-toxin/antibody

OR

(*C difficile*) patients with diarrhoea have low(est) (concentration of) anti-toxin/antibody;

Accept people for patients

Ignore symptoms for diarrhoea

3. (Offered to *C. difficile*) patients with diarrhoea

OR

(Offered to) patients with low (concentrations of) anti-toxin/antibody;

Accept people for patients

Accept 'passive immunity offered' for 'antibody offered'

3

(c) 1. Peptide bonds hydrolysed;

Ignore named structures in the digestive system

2. Endopeptidase(s) break internal (peptide) bonds;

Accept 'bonds within' OR 'bonds in middle' for internal

3. Exopeptidase(s) break terminal (peptide) bonds;

Accept 'external bonds' OR 'bonds at ends' OR 'penultimate bonds' for terminal

4. (Membrane-bound) dipeptidase(s) break dipeptides to amino acids;

2, 3 and 4 Accept 'act on' OR 'affect' OR 'hydrolyse' for break

Accept between 2 amino acids for dipeptides

Ignore stomach acid

3 max

[9]

Q7.

(a) 1. Antigen (at T and substrate);
Reject antigen in blood

2. Enzyme-substrate complex (produces a line/colour change)

OR

Enzyme (binds) with substrate (produces line/colour change);
Accept colourless dye for substrate
Accept ES complex in this instance

2

(b) Blood/sample has moved/diffused (above T in the test);
Accept Blood/sample and anti-human antibody have moved (in the test)

1

(c) 1. (Cancer/fused cells) divide/replicate rapidly/uncontrollably;
Accept mitosis OR reproduce for divide
Accept hybridoma for 'fused cell'

2. B cells produce (monoclonal) antibody;
Accept 'plasma cells' OR 'memory cells' for 'B cells'
Accept secrete OR make for produce

2

(d) Harmful **but** not killed
OR

Harmful **but** only used once

OR
Harmful **but** stops human suffering

OR

Harmful **but** produces (useful) medicine/drugs

OR

Not harmed **but** injected (with a substance);
*Must have idea 'for' **and** idea 'against'*
Accept stressed OR exploited OR mistreated OR abused for harmed
Accept illness OR infection OR death for suffering

1

(e) *Max 2 from 4, 5 and 6*

Accept ELISA test for new test

1. Better than current at detecting early but not as good as lab-based;

   Accept reference to day(s) in range of 1 to 4 days for early

2. New/current test better than lab-based from 5 days

   OR

   New test as good as current from 5 days;

   1 and 2 Accept higher proportion for better

   Accept identifies OR finds OR spots for detects

   1 and 2 Accept 'more accurate' OR 'identifies more' OR 'finds more' OR 'detects more' OR 'is more successful' OR 'is more effective' for "better than" and the converse of these statements for "not as good as"

   Accept after 4 days

3. New test and lab-based better **total** (of) positives than current

   OR

   New test **total** (of) positives not (quite) as good as lab-based;

   1, 2 and 3 Accept correct comparative figures from the table OR calculations (some examples in table below)

4. New test (likely to be) quicker;

   Accept 'more efficient' for quicker

5. New test (likely to be) cheaper;

6. Limited/inaccessible labs

   OR

   Limited training of people to use labs;

3 max

(f) 1. Increases water potential of blood/capillary

OR

Decreases water potential of tissue fluid;

Accept Ψ for water potential

Ignore WP

Accept reduces water potential gradient

2. (So) less <u>water</u> returns to blood/capillaries (by osmosis)

OR

(So) more <u>water</u> leaves blood/capillaries (by osmosis);

Ignore tissue fluid

Accept 'no' for less

2

[11]

Q8.

(a) 1. Pathogens

Reject toxins

OR

Cells from an organism of a different species;

Accept named examples of pathogens

Accept bacteria/fungi

Ignore viruses

2. Cells from other organisms of the same species;

Ignore B cells/T cells

Accept named appropriate cells from other organisms of the same species

3. Abnormal body cells;

Ignore B cells/T cells

Accept cancer cells

Accept cell infected with virus

4. Antigen-presenting cells;

2 max

(b) As a control (experiment), to show that it is OXA affecting the (immune) response

OR

As a control (experiment), to show that (olive) oil is **not** affecting the (immune) response

OR

To use as a control/standard/reference/starting point, to compare with (after) OXA (exposure);

Reject

'control/controlled variable'

1

(c) 1. Labelled axes correct way round, linear scale and units;

Reject if line graph drawn

Reject if Y-axis does not cover at least half of the grid

Reject if bars not of equal width

Accept a dual bar chart drawn

Reject if bars are touching (except dual bars)

Accept interruption drawn on the y axis

2. Mean points plotted correctly;

Allow all plots to the nearest half cm

3. SD bars correctly plotted above and below the peak of each bar;

Allow all plots to the nearest half cm

3

(d) **Cellular response**

1. Female to female no significant difference in cellular response as SD overlap;

2. Male to male no significant difference in cellular response as SD overlap;

3. Significant **increase** in cellular response in autoimmune male compared with autoimmune female as SD do not overlap

Humoral response

4. Male to male no significant difference in humoral response as SD overlap;

5. Female to female significant **increase** in humoral response as SD do not overlap;

6. Significant **increase** in humoral response in autoimmune female compared with autoimmune male as SD do not overlap

***Max 2** for answers only relating to the cellular response **or** humoral response*

Accept '(ear) thickness' for cellular response, and 'concentration of anti-OXA/antibody' for humoral response

*If **no** other marks awarded, accept **1 principle mark** for the idea that if SD overlap there is no significant difference or the converse*

1, 2 and 4 Accept difference (likely) due to chance for no significant effect

3, 5 and 6 Accept increase not (likely) due to chance for significant increase

Allow 'error bars' for 'SD'

3 max

(e) **Supporting**

1. (Oestrogen) increases the humoral response that produces antibody;

2. More antibodies could increase progression of SLE;

3. (Oestrogen) decreases the cellular response that produces T_C cells;

4. Fewer T_C cells could decrease/slow progression of RA;

5. Mice and humans are both mammals, so likely to have similar effects in both;

Against

6. Increase in response might mean quicker production of antibody (not more)

   OR

   Decease in response might mean slower production of T_C cells (not fewer);

7. Decrease in cellular response could (also) mean fewer antigen-presenting cells (and not just T_C cells);

8. (Investigation) done in mice/not humans;

9. **Table 2** does not state which type of autoimmune disease the mice had

   OR

   Mice might not suffer from SLE/RA;

***Max 3** for reasons supporting or against*

4 max

(f) **No – no mark**

1. Mice with autoimmune disease will be unlikely to reproduce/survive

OR

Mice with autoimmune disease will be selected against;

2. Will not pass on allele (for autoimmune disease)

OR

Allele frequency (for autoimmune disease) will reduce/change;

Yes – no mark

3. As long as the autoimmune disease did not affect the mice's ability to reproduce/survive;

4. The allele frequency will remain constant/not change;

*Award as mark points 1 and 2, **OR** 3 and 4*

2 max

[14]

Q9.

(a) 1. Fetal blood has more oxygen

OR

Fetal blood has less carbon dioxide;

Accept converse for references to mother's pulmonary artery

Accept fetal blood is oxygenated

Accept high for 'more' OR low for 'less'

Ignore affinity

2. (Because) gas exchange occurs in the placenta

OR

Gas exchange does **not** occur in (fetal) lungs;

2

(b) 1. (IgG) antibodies (from mother) are complementary/bind specifically;

Accept Antibodies bind with antigens / antigen-antibody complex

2. To pathogens/antigens **crossing** the placenta;

3. Giving passive immunity (in fetus)

OR

Stopping symptoms forming (in fetus)

OR

Giving immediate/rapid protection (in fetus);

3

(c) (Against measles)

1. (To achieve) herd immunity to reduce spread;

Accept 'herd effect' for herd immunity

(Against tetanus)

2. No herd immunity

OR

Skin wounds are common (in children);

Accept Only protects the individual

2

(d) Reduced vaccination (in children)

OR

virus has mutated;

Accept 'more unvaccinated individuals entering the country/ population'

Reject disease mutated

1

(e) 1. (Production of more) memory cells;

2. (So) higher concentration of antibodies (in blood)

OR

(So) more rapid production of antibodies (on further infection);

Accept More antibodies (in blood)

2

Ignore active immunity

[10]