

## 2.4 CELL RECOGNITION AND THE IMMUNE SYSTEM 2 – MARKSCHEMES

### Q1.

- (a)
1. Person (infected with HIV) has HIV DNA (in their DNA);
  2. New HIV (particles) still made;
  3. (AZT) inhibits reverse transcriptase;
  4. (AZT) stops these (new HIV particles) from forming new HIV DNA;

**OR**

Slows / stops replication of HIV;

5. Stops destruction of more / newly infected T cells;
6. So immune system continues to work (and AIDS does not develop);

4. *Context is important*

4. *Allow slows / stops (re)production of HIV*

4. *Reject (AZT) prevents DNA replication*

4 max

- (b)
1. Slows / stops the development of AIDS;
  2. Because HIV **resistant to AZT** is damaged / destroyed / prevented from replicating (by other drugs);

**OR**

3. AZT continues to work as a drug;

4. Because HAART prevents the spread of AZT-resistant HIV to rest of the human population;

**OR**

5. No new HIV particles made;

6. Because HAART might interfere with viral protein synthesis;

*Mark in pairs.*

*Do not mix and match.*

2. *Neutral HIV killed*

2. *Accept other drugs prevent HIV resistant to AZT from infecting new / more cells*

6. *Accept blocks transcription / translation / synthesis of lipid envelope / aspect of viral structure*

4 max

- (c)
1. (Fewer mitochondria so) less (aerobic) respiration;
  2. (Muscles receive) less ATP (so waste);

1. *Ignore no respiration*

2. *Reject less energy produced*

2. *Ignore no ATP is made*

2

[10]

### Q2.

- (a)
1. (Anti-AQP4) antibody has a (specific) tertiary structure;
  2. Has binding site / variable region that only binds to / complementary to one antigen;

3. Antigen to this antibody (only) found on these nerve cells;
4. So, antibody (only) binds to / forms antigen-antibody complex with these nerve cells (causing damage);

*Reject "active site" (only penalise once if it occurs throughout)*

*3. / 4. Accept 'receptor' for antigen*

4

- (b)
1. Only 20 in the study;  
**OR**  
Only one study;
  2. For some concentrations of antibody there is a range in the number of vertebrae surrounding damaged nerve cells;
  3. No statistical test used;
  4. Correlation is weak;

1. *Accept small sample*
2. *Accept suitable use of data*
2. *Accept converse*

3 max

- (c)
1. The monoclonal antibody binds to nerve cell antigen so less / no anti-AQP4 can bind;  
**OR**  
The monoclonal antibody forms antigen-antibody complex with nerve cell antigen so less / no anti-AQP4 can bind;
  2. When monoclonal antibody binds it doesn't cause damage to nerve cell;

*It = monoclonal antibody*

1. *Reject "active site"*

*Ignore "competitive inhibitor"*

*Accept receptor for antigen*

*Do not credit responses in the context of enzymes*

2 max

[9]

### Q3.

- (a)
1. Antigen / epitope on surface of *N. meningitidis* / bacterium binds to surface protein / surface receptor on a (specific / single) B cell.  
*If answered in context of T cell, allow Antigen binds to (specific / single) T cell*
  2. (Activated) B cell divides by mitosis / produces clone;  
*If answered in context of T cell, allow (Activated) T cell releases cytokine.*
  3. (Division) stimulated by cytokines / by T cells;  
*If answered in context of T cell, allow (Cytokine) stimulates production of plasma cells;*
  4. B cells / plasma cells release antibodies;

5. (Some) B cells become memory cells;
6. Memory cells produce plasma / antibodies faster

6

- (b)
1. Mutation  
*Allow horizontal gene transfer*
  2. Results in Nm cell with allele for resistance to one antibiotic / to named antibiotic
  3. (This) cell survives and passes the allele for resistance to offspring;  
*2. and 3. If gene for resistance, penalise once*
  4. Process repeated with different genes conferring resistance to each of the other (two) antibiotics  
*If reference made to 'resistant gene', 2 max for MP2, 3 and 4*

4

(c) Any **five** contrasting statements, e.g.

1. Bacterial cell is much smaller than a human cell;
2. Bacterial cell has a cell wall but human cell does not;
3. Bacterial cell lacks a nucleus but human cell has a nucleus;
4. Bacterial cell lacks membrane-bound organelles but human cell has membrane-bound organelles;  
*Accept any named membrane-bound organelle*
5. Bacterial ribosomes smaller than human ribosomes / bacteria have 70S ribosomes whereas humans have 80S ribosomes;
6. Bacterial DNA is circular but human DNA is linear;
7. Bacterial DNA is 'naked' whereas human DNA is bound to histones / proteins  
*Since contrast is required, both parts of each statement must be present to gain the mark.*

5 max

[15]

#### Q4.

- (a) Regulator protein.  
*Accept regulator protein antigen*  
*Reject regulator protein receptor*  
*Ignore regular protein*

1

- (b)
1. Lipid soluble / hydrophobic
  2. Enters through (phospholipid) bilayer

**OR**

3. (Protein part of) LDL attaches to receptor
4. Goes through carrier / channel protein.
  4. *Accept by facilitated diffusion or active transport*
  4. *Reject active transport through channel protein*

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein  
*Do not award MP1 if reference to active site.*
2. Binds to / forms complex with (regulator protein)  
*"It" refers to monoclonal antibody in MP1 and MP2*
3. (So regulator protein) would not fit / bind to the receptor / is not complementary to receptor  
*3. Reject receptor on LDL*

2 max

(d) 1. Injection with salt solution

*1. Accept inject placebo in salt solution*

2. Otherwise treated the same.

2

[7]

**Q5.**

(a) (To diagnose AIDS, need to look for / at)

1. (AIDS-related) symptoms;
2. Number of helper T cells.

*Neutral: 'only detects HIV antibodies' as given in the question stem*

2

(b) 1. HIV antibody is not present;

*Accept HIV antibodies will not bind (to antigen)*

2. (So) second antibody / enzyme will not bind / is not present.

2

(c) 1. Children receive (HIV) antibodies from their mothers / maternal antibodies;

2. (So) solution will always turn blue / will always test positive (before 18 months).

*Allow 1 mark for the suggestion that the child does not produce antibodies yet so test may be negative*

2

(d) (Shows that)

1. Only the enzyme / nothing else is causing a colour change;
2. Washing is effective / all unbound antibody is washed away.

2

**Q6.**

- (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]

**Q7.**

- (a) 1. Antibody has tertiary structure;  
2. Complementary to binding site on protein.
- 2
- (b) 1. Prevents false negative results;  
2. (Since) shows antibody **A** has moved up strip / has not bound to any *Plasmodium* protein.
- 2
- (c) 1. Person is infected with *Plasmodium* / has malaria;  
2. Infected with (*Plasmodium*) *vivax*;

3. Coloured dye where antibody **C** present;
4. That only binds to protein from *vivax* / no reaction with antibody for *falciparum*.

*Person is infected with P. vivax / Plasmodium vivax  
= 2 marks (MP1 and MP2)*

4

[8]

**Q8.**

- (a)
  1. Outside of virus has antigens / proteins;
  2. With complementary shape to receptor / protein in membrane of cells;
  3. (Receptor / protein) found only on membrane of nerve cells.

*Accept converse argument*

3

- (b)
  1. No more (nerve) cells infected / no more cold sores form;
  2. (Because) virus is not replicating.

2

- (c) Prevents replication of virus.

1

- (d) MicroRNA binds to cell's mRNA (no mark)
  1. (Binds) by specific base pairing;
  2. (So) prevents mRNA being read by ribosomes;
  3. (So) prevents translation / production of proteins;
  4. (Proteins) that cause cell death.

4

[10]

**Q9.**

- (a) (i) Protein on (surface of) chlamydia;

That initiates an immune response (in mice) / causes antibody production;

*Neutral "foreign protein"*

*Do not accept glycoprotein.*

*2. Accept description of initiating immune response.*

2

- (ii)
  1. Antibodies / memory cells against chlamydia (protein / antigen) are present;
  2. Protein on heart (muscle) similar to chlamydia protein / antigen so T cells / antibodies (attack heart muscle cells);
    - 2. Look for idea that both proteins are similar*
    - 2. Detail of what is attacking the heart muscle cells*

2

- (b) **FOR**

1. Prevents / reduces heart disease / attacks;
2. Cheaper to vaccinate than treat heart disease;

**AGAINST**

3. Vaccination costly;
4. Don't know frequency of chlamydia infection;
5. Research in mice might not be replicated in humans / humans might have a different protein;
6. Vaccine could cause heart disease or immune response against heart (muscle);

*2 max for arguments against  
Accept other valid answers*

3 max

[7]

**Q10.**

- (a) (i) Many people do not go to the doctor;

1

- (ii) 36000;

*No marks awarded for working here as calculation is very straightforward*

1

- (b) Same sugars / antigens on bacteria / nerve cells;

*Do not accept references to same shape as equivalent to complementary.*

Bind with antibody / form antigen-antibody complex;

*Reject react*

Have complementary shape / fit binding site;

*Reject active site*

3

- (c) Diaphragm will not move down / flatten / contract;

*Ignore references to breathing out*

Thoracic cavity / lung volume not increased so cannot breathe in;

2

[7]

**Q11.**

- (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;

Less / no competition so (*Clostridium*)  
reproduces / replicates / multiplies / increases in number;

*Reference to bacteria being 'immune' negates first marking point.*

*Reference to mitosis negates second marking point.*

2

- (ii) Immune system less effective / more likely to have other infections / been in hospital;

*Accept: 'Weak / lower' immune system'.*

1

- (b) Attaches to active site (of enzyme);  
(Methicillin) is a competitive inhibitor / prevents monomers / substrate attaching (to enzyme);

*'Competes for active site' = 2 marks.*

*Neutral: 'Prevents monomers joining / attaching to each other'.*

*Allow one mark max for answers relating to non-competitive inhibitor changing active site / preventing substrate attaching.*

*Do not penalise Methicillin forms an enzyme / substrate complex.*

2

- (c) (i) Have other illness / medical condition / 'weak' immune system / disease / infection;

*Reject: Due to 'other factors', 'are smokers', 'are obese' unless related to disease or illness.*

1

- (ii) Increase up to 2006 / 20 (per 100 000) then decreases;

1

- (iii) Correct answer in range of 52 – 59.1% = two marks;

Incorrect answer but shows change as between 4.8 – 5.2 / shows

correct subtraction giving this change e.g. 14 – 9 = one mark.

2

[9]

## Q12.

- (a) 1. Phagocyte attracted to bacteria by chemicals / recognise antigens on bacteria as foreign;
2. Engulf / ingest bacteria;
3. Bacteria in vacuole / vesicle;
4. Lysosome fuses with / empties enzymes into vacuole;
5. Bacteria digested / hydrolysed;

*1. Accept names chemical e.g. toxin*

- 2. Allow description of engulfing
- 3. Accept: bacteria in phagosome
- 5. Neutral: Break down
- 5. Accept digestive enzymes destroy bacteria
- 5. Do not accept "destroy bacteria" as it is in question stem

4 max

- (b)
1. Microvilli provide a large / increased surface area;
  2. Many mitochondria produce ATP / release or provide energy (for active transport);
  3. Carrier proteins for active transport;
  4. Channel / carrier proteins for facilitated diffusion;
  5. Co-transport of sodium (ions) and glucose or symport / carrier protein for sodium (ions) and glucose;
  6. Membrane-bound enzymes digest disaccharides / produce glucose;
    1. Reject villi on epithelial cells
    1. Accept brush border
    2. Accept large SA:vol ratio
    3. Need idea of "lots"
    4. Reject: energy produced
    5. Accept Na<sup>+</sup>K<sup>+</sup> pump
    6. Neutral: Channel proteins
    7. Accept named example

6

[10]

**Q13.**

- (a) (Micro)organism that causes disease / harm to body / an immune response;

*Accept: named microorganism that causes disease*  
*Allow infection*

1

- (b)
1. Phagocyte attracted by a substance / recognises (foreign) antigen;
 

*Accept named substance eg chemical / antigen*
  2. (Pathogen)engulfed / ingested;
 

*Accept: description*
  3. Enclosed in vacuole / vesicle / phagosome;
  4. (Vacuole) fuses / joins with lysosome;

5. Lysosome contains enzymes;  
*Accept named example of enzyme*
6. Pathogen digested / molecules hydrolysed;  
*Neutral: Destroyed*

4 max

- (c)
1. Antigens (on pathogen) are a specific shape / have specific tertiary / 3D structure;  
*1 / 3 Structure alone is insufficient*
  2. Antibody fits / binds / is complementary to antigen / antibody-antigen complex forms;  
*Reject - active site*

**OR**

3. Antibodies are a specific shape / have specific tertiary / 3D structure;
4. Antigens (on pathogen) fit / bind / are complementary to antibody / antibody-antigen complex forms;

2

[7]

**Q14.**

- (a)
- (i) protein / immunoglobulin;  
specific to antigen;  
idea of 'fit' / complementary shape;
  - (ii)
    1. virus contains antigen;
    2. virus engulfed by phagocyte / macrophage;
    3. presents antigen to B-cell;
    4. memory cells / B-cell becomes activated;
    5. (divides to) form clones;
    6. by mitosis;
    7. plasma cells produce antibodies;
    8. antibodies specific to antigen;
    9. correct reference to T-cells / cytokines;

2 max

6 max

- (b)
1. antibody gene located using gene probe;
  2. cut using restriction enzyme;
  3. at specific base pairs;
  4. leaving sticky ends / unpaired bases;
  5. cut maize / DNA / vector using same restriction enzyme;
  6. join using DNA ligase;
  7. introduce vector into maize / crop / recombinant DNA into maize;

4 max

- (c)
- passive / person is not making own antibodies / antibodies not replaced;  
memory cells not produced;

- (d) fewer ethical difficulties / less risk of infection; 2
- 1
- [15]

**Q15.**

- (a) Nucleus; 1
- (b) Enables organism to remain in area (of food source) / prevent its removal;

*Q 'To attach' is not sufficient unless qualified* 1

- (c) (i) Correct answer of 222(%);;
- Incorrect answer that clearly identifies difference in number of cases as 5800 –1800 or 5.8 – 1.8;
- Correct answer gains two marks* 2

- (ii) More water-related activities / more 'organisms' with increased temperature;
- Q Allow any reference to growth or replication of 'organisms'. Do not penalise reference to bacteria.*
- Q Do not allow increase in water consumption.* 1

- (d) (i) All have same shape / only binds to *Giardia* / one type of / specific antigen; 1

- (ii) Has complementary (shape) / due to (specific) tertiary structure / variable region (of antibody);
- Q Binds / fits not sufficient unless qualified;* 1

- (iii) Enzyme / second antibody would remain / is removed by washing;
- Enzyme can react with substrate (when no antigen is present); 2

[9]

**Q16.**

- (a) Virus / fungus / protozoan;
- Neutral: named example* 1

- (b) Produces toxins;
- Neutral: infects / colonises / invades cells*

Damages cells / tissues / example given e.g. cell lysis;

2

- (c) (i) (Antibodies) produced from a single clone of B cells / plasma cells;

*Accept: hybridoma cell line instead of B cell / plasma cell*

*Reject: idea that antibodies are cloned*

**OR**

(Antibodies) produced from the same B cell / plasma cell;

1

- (ii) (Specific) primary structure / order of amino acids;

(Specific) tertiary / 3D structure;

(So) Only binds to / fits / complementary to one antigen;

*Reject: 'active site' for either point 2. or 3. only once*

3

- (d) (Rapid) treatment of carriers / infected cattle / disease;

*Neutral: reference to rapid identification of infected cattle*

Can isolate / cull carriers / infected cattle / infected (dairy) products not sold / consumed / tracked;

Reduces spread of disease / no need to kill / prevents the death of non-infected animals;

*Neutral: ethical arguments*

3

[10]

**Q17.**

- (a) Hydrolysis (reaction);

*Accept phonetic spelling*

1

- (b) 1. Too big / wrong shape;

*Wrong charge - neutral*

*Accept insoluble*

2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);

3. Carrier / channel protein;

*Accept carrier / channel protein not present*

3

- (c) Foreign / (act as) antigen / non-self;

*Reject foreign cells*

1

- (d) 1. Dose to be given;  
*Accept: interaction with other drugs*
2. No (serious) side effects;
3. How effective;
4. Cost of drug;

2 max

[7]

**Q18.**

- (a) Phagocytes engulf / ingest pathogens / microorganisms / bacteria / viruses;  
Phagocytes destroy pathogens / microorganisms / bacteria / viruses;  
Lung diseases are caused by pathogens / microorganisms / bacteria / viruses;

*Q Allow description of process of engulfing*

2 max

- (b) (i) Alveoli / lungs will not inflate / deflate fully / reduced lung capacity;

Breathing out particularly affected / no longer passive;

2

- (ii) Alveolar walls thicken;

Longer diffusion pathway;

Scarred / fibrous tissue;

Reduces surface area (for gaseous exchange);

*Q Diffusion is essential for 2<sup>nd</sup> point and surface area for 4<sup>th</sup> point.*

4

- (c) (i) Cancer develops 20 – 30 years after exposure (to asbestos);

1

- (ii) Smoking / air pollution / specified industrial source;

1

[10]

**Q19.**

1. Vaccines contain antigens / dead / weakened pathogens / antigens dead / weakened pathogens are injected;

*Ignore references to T or B cells.*

2. Memory cells made;
3. On second exposure memory cells produce antibodies / become active / recognise pathogens;  
*3. Idea of memory cells responding.*
4. Rapidly produce antibodies / produces more antibodies;  
*4. Production of antibodies must be qualified for mark. Underlined ideas essential.*
5. Antibodies destroy pathogens;  
*5. Accept bacteria / viruses etc but not disease*

[5]

**Q20.**

- (a)
1. Vaccine contains antigen from pathogen;
  2. Macrophage presents antigen on its surface;
  3. T cell with complementary receptor protein binds to antigen;
  4. T cell stimulates B cell;
  5. (With) complementary antibody on its surface;
  6. B cell secretes large amounts of antibody;
  7. B cell divides to form clone all secreting / producing same antibody.

5 max

- (b)
1. Active involves memory cells, passive does not;
  2. Active involves production of antibody by plasma cells / memory cells;
  3. Passive involves antibody introduced into body from outside / named source;
  4. Active long term, because antibody produced in response to antigen;
  5. Passive short term, because antibody (given) is broken down;
  6. Active (can) take time to develop / work, passive fast acting.

5 max

[10]

**Q21.**

- (a)
- (i) Molecule/protein/glycoprotein;  
Stimulates immune response;  
(That causes) production of antibodies;  
  
2 max
  - (ii) Antigens on HIV are different (shape);  
So, antibody will not 'fit'/not complementary (to antigen);  
Receptor sites on antibody specific to one antigen;  
  
2 max
  - (iii) (Has site with) same shape as salmonella antigen so binds to anti-gal antibodies;  
(Has site with) same shape as receptor molecule so that HIV will bind;

Binds to both molecules;

2 max

- (b) Salmonella pathogen has specific antigen on surface;  
Salmonella pathogen engulfed by macrophage;  
T-cells activate B-cells;  
B-cell with complementary/specific receptor antibody activated/  
clonal selection;  
B-cells divide/form clone/clonal expansion;  
Plasma cells make antibodies;  
Specific to antigen/bind to salmonella bacterial antigen;  
*Accept macrophage presents antigen to T/B cells;*  
*Accept T-cells release factors;*

6 max

- (c) (i) HIV binds to specific receptor;  
Only present on certain cells / T-cells;

2

- (ii) Antibiotics stop metabolism, viruses don't have metabolism;  
Viruses hide in cells, antibiotics can't reach;

Two suitable cell components antibiotics work against that  
viruses don't have;

e.g. some antibiotics work against ribosomes, that viruses don't have

2

- (d) (i) Adaptor molecule binds to HIV;  
(This) prevents the HIV binding to the receptor;  
Therefore few HIV available to infect cells;

2 max

- (ii) Would need to be complementary to MRSA (antigens);  
MRSA has different antigens;  
But would still need to have binding site for anti-gal;

2 max

[20]

## Q22.

- (a) 1. Infected by / susceptible to (other) pathogen(s) / named disease  
caused by a pathogen (from environment);

*Context is where immune system cannot prevent or  
stop these events*

*Allow attack / kill*

2. Pathogen(s) reproduce / cause disease (in host);

*MPs not given in context of HIV*

3. Damage cells / tissues / organs;

4. Release toxins;

3 max

- (b) (i) 1. (HIV enters cells) before antibodies can bind to / destroy

it;

*Ignore SAFETY comments*

*1. and 2. Relate to antibodies*

2. Antibodies cannot enter cells (to destroy HIV) / stay in blood;

**OR**

3. (Enters cells) before (secondary) immune response caused / before memory cells have time to respond;  
*3. and 4. Relate to virus*

4. So no antibodies present (to attack HIV);

**OR**

5. Vaccine taken up too quickly to cause immune response;  
*5. and 6. Relate to vaccine*

6. So no antibodies / memory cells formed;

**2 max**

- (ii)
1. Antigen (on HIV) changes;  
*Accept mutates*
  2. (Specific) antibody / receptor no longer binds to (new) antigen;  
*Ignore SAFETY comments*

**OR**

3. Many different strains of HIV / many antigens present on HIV;
4. Not possible to make a vaccine for all antigens / vaccine may not stimulate an antibody for a particular antigen;

**2 max**

- (c) 3 suitable suggestions;;;

*QWC ignore reference to HIV cells*

E.g.

1. Inactive virus may become active / viral transformation;
2. Attenuated virus might become harmful;
3. Non-pathogenic virus may mutate and harm cells;
4. Genetic information / protein (from HIV) may harm cells;
5. People (may) become / test HIV positive after vaccine used;  
*Vaccinated people may develop disease from a*

*different strain to that in the vaccine*

6. This may affect their work / life;  
*May continue high risk activities and develop or pass on HIV*

3 max

[10]

**Q23.**

- (a) Girls are not sexually active / not likely to carry HPV / vaccine may not work if already infected / few girls sexually active (at this age);

*Neutral: girls are not sexually mature*

*Neutral: to provide better protection*

*Accept: provides immunity before sexually active*

*Neutral: girls are less likely to have 'it' as could mean the vaccine from the question stem*

1

- (b) Other (HPV) types have different antigens;

No memory cells for other types / memory cells not activated / antibodies cannot attach to antigen / correct antibodies not produced / antibodies are not complementary;

*Accept: refs. to antigenic variability*

*Accept: B cells for memory cells*

*Accept: memory cells cannot recognise antigen for 'not activated'*

*Accept: examples of memory cell activation*

2

- (c) More antigen;

More memory cells;

So more antibodies produced / antibodies produced quicker (if infected);

*Accept: 'many' / 'enough' instead of 'more'*

*Neutral: primary / secondary response*

*Accept: T cells / B cells / plasma cells instead of 'antibodies'*

*Reject: the idea that vaccines contain antibodies*

**Q** *Reject: antibodies 'fight' / 'antibiotics'*

2 max

- (d) Cancer takes years to develop / develops later in life;

Takes time for females to become sexually active / females must become sexually active to obtain data;

Few people / only teenagers vaccinated;

*Neutral: will take time to vaccinate 80% of young*

girls

Accept: do not develop cancer instantly

2 max

- (e) (Cervical cancer) can be caused by other types of HPV / other factors / example given;

**OR**

(Some) women may have been infected (with HPV) before receiving the vaccine;

**OR**

(As a precaution) in case vaccine does not work / a way of monitoring if the vaccine has worked;

Accept: 'caused by other types of HPV' in the context of mutation

Neutral: to check for abnormal cells / that they are immune to the virus

1

- (f) Virus cannot replicate / is destroyed / is not carried (in vaccinated people);

Non-vaccinated people more likely to contact vaccinated people;

Neutral: 'do not spread virus' as in question stem

Must be in context of the individual and not the population as in question stem

Q Do not allow 'disease is destroyed'

Neutral: 'herd effect' as given in the question stem

2

[10]

## Q24.

- (a) add antibodies / enzyme;  
wash to remove unbound antibodies;  
add (colourless) solution;

(mark correct responses sequentially)

3

- (b) antibodies specific / shape only fits one antigen;  
other antigens different shape and would not bind to antibodies;

2

[5]

## Q25.

- (a) (i) Substance that causes an immune response / production of antibodies;

Ignore foreign / non-self

1

- (ii) 1. Not lipid soluble;
- 2. Too large (to diffuse through the membrane);
- 3. Antigens do not have the complementary shape / cannot bind to receptor / channel / carrier proteins (in membranes of other epithelial cells);

2 max

- (b) 1. (Vaccine contains) antigen / attenuated / dead pathogen;  
*1. Reject if in context of injection of vaccine*
- 2. T-cells activate B-cells;
- 3. B-cells divide / form clone / undergo mitosis;
- 4. Plasma cells produce antibodies;
- 5. Memory cells produced meaning more antibodies / antibodies produced faster in secondary response / on reinfection;

5

[8]

**Q26.**

- (a) (i) 1. (Scientists) can't show bias / influence / may have a vested interest / work for the company developing the vaccine;  
*Relates to the scientists*
- 2. (Volunteers) can't show psychological / mental effects / 'placebo effect' / expectations;  
*Relates to the volunteers*  
*Accept: reduces the 'Hawthorne effect' / demand characteristics*  
*Neutral: so they have no idea what they are taking*

2

- (ii) Any **two** suitable suggestions, eg  
*Neutral: refs. to age and health*
- 1. Amount of nicotine in cigarettes;  
*Neutral: different types of cigarette / different ways / frequency of smoking*
- 2. Amount inhaled / absorbed / time since last cigarette;  
*Neutral: absorption by gut / digestion*  
*Accept: absorption by mouth*
- 3. (Different) amounts excreted / metabolism / rate of binding (of nicotine) to protein;  
*Accept: broken down (differently)*
- 4. (Different) blood volumes;

*Neutral: different body masses*

5. Nicotine from passive smoking / other smokers / other sources;
6. Some volunteers received the vaccine / placebo;  
*Accept: some volunteers would have / would not have the antibodies*

2 max

- (b) (i)
1. Antibodies to nicotine produced / antibodies bind to nicotine;  
**Q Reject:** *vaccine contains / produces antibodies*  
**Q Neutral:** *antibodies digest / kill / fight nicotine*
  2. (So) nicotine does not bind to protein / does not reach the brain;  
**Q Reject:** *any reference to 'active site'*  
*Neutral: idea that the antibodies bind to the protein*
  3. (So) cigarettes / smoking does not satisfy addiction / reward smokers / release (reward) chemicals;

3

(ii) **(Agree):**

1. People choose to smoke / know the risks;
2. Should spend this money on education / preventing people from starting to smoke / treating other health problems / vaccines are expensive;

**(Disagree):**

3. Unethical not to treat;
4. Less money needed to treat the effects of smoking / cancer / smokers pay taxes so are entitled to treatment;

3 max

- (c)
1. High antibody responders have a high % to stop smoking / are more likely to stop smoking;  
*'People producing a high concentration of antibodies' is equivalent to 'high antibody responders'*  
*Accept: reference to values from the table*
  2. Only a few may be high antibody responders / no numbers on how many are high / medium / low antibody responders;  
*Neutral: not all people are high antibody responders*
  3. Percentage who stopped smoking is similar for placebo group and low / medium responders / some / % of placebo group (still) stopped smoking / placebo has the lowest value / % to

stop smoking;

*Accept: reference to values from the table*

4. Large sample size / double blind **so** reliable / representative;
5. Antibody levels peak at / drop after 5 months / boosters may be needed at / after 5 months;
6. May start smoking again after 5 / 6 months / do not know the percentage who stopped smoking after 5 / 6 months;
7. Nicotine is not the only factor responsible for making people smoke;

*Must mention nicotine*

*Do not accept: correlation does not mean causation  
/ could be due to other factors*

5 max

[15]

**Q27.**

- (a) Injection of antigens / toxoids;

(Antigen from) attenuated microorganism / non-virulent microorganisms / dead

microorganisms / isolated from microorganism;

Stimulates the formation of memory cells;

max 2

- (b) (i) Antibodies are specific to mumps antigen;  
2nd antibodies specific to mumps antibody;

1

(ii) Removes unbound 2<sup>nd</sup> antibodies;  
Otherwise enzyme may be present / may get colour change anyway / false positive;

2

(iii) No antibodies to bind (to antigen);  
Therefore 2<sup>nd</sup> antibody (with the enzyme) won't bind / no enzyme / enzyme-carrying antibody present (after washing in step 4);

2

[7]

**Q28.**

- (a) molecule (on cell surface);  
that triggers immune response;

2

- (b) (i) axes right way round and labelled;  
2nd peak drawn higher;

- steeper gradient on second rise; 3
- (ii) because one dose does not give a high enough level of antibody to be effective / because the antibody falls after a while; 1
- (iii) antigens are only single molecules / part of parasite; do not actually cause disease; 2
- (c) malaria sufferers would have parasites in red blood cells; 1
- [9]**

**Q29.**

- (a) (i) **(Whole-cell vaccine),**  
*Accept converse statements for other vaccine*  
*Reject references to the vaccine being alive or the disease reproducing etc*
1. Heat(ing) supposed to kill bacteria;
  2. Some might be alive / active / viable;  
*Accept active pathogens present*
  3. (If so) bacteria could reproduce;
  4. Bacterium makes or contains toxin;
  5. Toxin might not be affected / all destroyed by heat;
  6. Bacteria or toxins attacking / killing person's cells;
- 3 max**
- (ii) **(Whole-cell vaccine),**  
*Ignore references to more / greater antigens unqualified. It is the variety of antigens that matters*
1. (Contains) many different / greater range of antigens;
  2. Each antigen causes its own immune response / production of / has a specific (type of) antibody;
- 2**
- (b) 1. Only patients who had whooping cough have toxin / antibody / immune response;  
*Accept converse e.g. those without antibody had another disease*
2. Toxin is an antigen and is (only) produced by this bacterium;
  3. Leading to presence of specific antibody / only 4% had this antibody / 13% did not have antibody;

3

- (c) 1. There may not be large rises;
2. Might be the result of wrong diagnosis / reference to difference in figures / 13% diagnosed with whooping cough didn't have it;  
*Ignore reference to new strains or antigenic variability*

2

[10]

**Q30.**

- (a) Presence of resistant and non-resistant varieties / mutation produces resistant variety;  
Resistant ones survive / non-resistant ones killed by treatment;  
These will reproduce and produce more resistant parasites / pass on resistance allele;

3

- (b) Likelihood of being infected (by strain resistant to both drugs) is less;  
 $1/500 \times 1/500/1/250\ 000$ ;  
Drug has longer effective life;

max 2

- (c) (i) As comparison / to show that nothing else in the treatment was responsible;

1

- (ii) Given injections of saline / injection without SPf66;  
(otherwise) treated the same as experimental group;

2

- (d) (i) 100%;

1

- (ii) 10%;

1

- (e) (i) Different lengths of DNA have different base sequences / cut at specific sequence;  
Results in different shape / different shape of active site;  
Therefore (specific sequence) will only fit active site of enzyme;

3

- (ii) Recognition sites contain only AT pairs;  
Which would occur very frequently;

2

[15]