Q1.

The human immunodeficiency virus (HIV) leads to the development of acquired immunodeficiency syndrome (AIDS). Eventually, people with AIDS die because they are unable to produce an immune response to pathogens.

Scientists are trying to develop an effective vaccine to protect people against HIV. There are three main problems. HIV rapidly enters host cells. HIV causes the death of T cells that activate B cells. HIV shows a lot of antigenic variability.

Scientists have experimented with different types of vaccine for HIV. One type contains HIV in an inactivated form. A second type contains attenuated HIV which replicates in the body but does not kill host cells. A third type uses a different, non-pathogenic virus to carry genetic information from HIV into the person's cells. This makes the person's cells produce HIV proteins. So far, these types of vaccine have not been considered safe to use in a mass vaccination programme.

Use the information in the passage and your own knowledge to answer the following questions.

(a) People with AIDS die because they are unable to produce an immune response to pathogens (lines 2-4).

Explain why this leads to death.

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(Extra space).....

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(3)

(b) Explain why each of the following means that a vaccine might **not** be effective against HIV.

(i) HIV rapidly enters host cells (lines 6-7).

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(2)

(ii) HIV shows a lot of antigenic variability (lines 7-8).

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(2)

(c) So far, these types of vaccine have not been considered safe to use in a mass vaccination programme (lines 14-15).

Suggest why they have **not** been considered safe.

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(Extra space).....

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(3)
(Total 10 marks)

Q2. (a) What is a pathogen?

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(1)

(b) When a pathogen enters the body it may be destroyed by phagocytosis. Describe how.

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(Extra space) .....

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(4)

(c) When a pathogen causes an infection, plasma cells secrete antibodies which destroy this pathogen.

Explain why these antibodies are only effective against a specific pathogen.

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(2)
(Total 7 marks)

Q3. Read the following passage.

Herpes viruses cause cold sores and, in some cases, genital warts. Scientists are well on the way to producing an antibody which will counteract herpes infection. This antibody works by sticking to the virus and blocking its entry into cells. It has proved very effective in animal tests.

One drawback with this approach, however, is that antibodies are at present produced using hamster ovary cells. This method is expensive and only produces limited amounts. A new technique is being developed to produce antibodies from plants. It involves introducing the DNA which codes for the required antibody into crop plants such as maize.

Use information from the passage and your own knowledge to answer the questions.

(a) (i) What is an antibody?

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(2)

(ii) Describe how antibodies are produced in the body following a viral infection.

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(6)

(b) Describe how the antibody gene could be isolated from an animal cell and introduced into a crop plant such as maize (lines 7-8).

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(4)

(c) Taking a course of these antibodies from plants to treat a herpes infection would not produce long-term protection against disease. Explain why.

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(2)

(d) Explain **one** advantage of using antibodies from plants to treat a disease, rather than antibodies produced in an experimental animal (lines 5-6).

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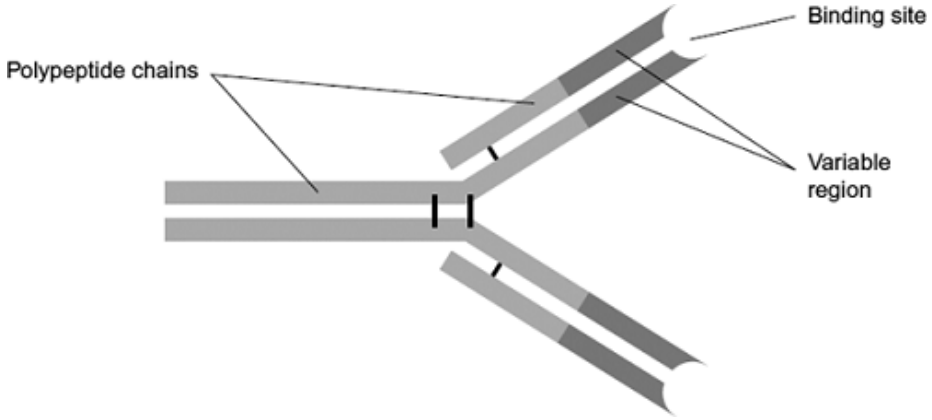
(1)

(Total 15 marks)

Q4. The diagram shows an antibody molecule.



(a) What is the evidence from the diagram that this antibody has a quaternary structure?

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(1)

(b) Scientists use this antibody to detect an antigen on the bacterium that causes stomach ulcers. Explain why the antibody will only detect this antigen.

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(*Extra space*) .....

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(3)
(Total 4 marks)

Q5. Read the following passage.

The life cycle of the malarial parasite consists of a number of stages. Some of these stages occur in humans and some occur in mosquitoes. At each stage, the parasite has different antigens on the surface of its cells. Attempts have been made to extract some of these antigens and use them to make vaccines to combat the disease. A trial has recently been carried out with one of these vaccines. An injection of the vaccine was given to a group of people chosen at random at the start of the trial. Another injection was given 30 days later.

Blood samples were taken at regular intervals throughout the trial. After the first injection, the concentration of antibody in the blood rose slowly then fell quickly. After the second injection, the concentration rose quickly. It reached a maximum concentration of approximately twice the concentration it reached after the first injection.

Use information from the passage and your own knowledge to answer the following questions.

(a) What is meant by *antigens* (line 3)?

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(2)

(b) (i) Use information from the passage to sketch a graph to show the effects of the two injections on the concentration of antibody in the blood.

(3)

(ii) Suggest **one** reason why it was necessary to give two injections of the vaccine (line 6).

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(1)

(iii) Although this vaccine is made from antigens from malarial parasites, it does not cause malaria. Explain why this vaccine does not cause malaria.

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(2)

(c) The blood from those taking part in the trial was also examined under the microscope at the beginning of the trial. Explain how this would enable those who had malaria to be identified.

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(1)
(Total 9 marks)

Q6. (a) Vaccines protect people against disease. Explain how.

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(*Extra space*) .....

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(5)

(b) Oral rehydration solutions (ORS) are used to treat diarrhoeal disease. What does an ORS consist of and how does it work?

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(*Extra space*) .....

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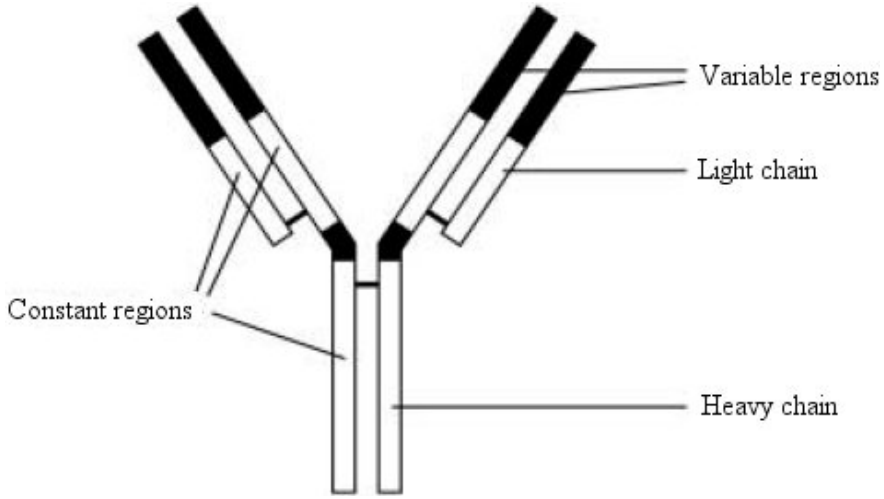
(5)
(Total 10 marks)

Q7. Antibodies are proteins. The diagram shows an antibody.



(a) Name

(i) the monomers that form the heavy and light chains

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(ii) the chemical bonds that join these monomers.

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(2)

(b) The specificity of an antibody depends on its variable regions. Explain how.

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(2)

(c) In a pregnant woman, some antibodies cross the placenta from the mother to the fetus. These antibodies only provide short-term immunity for newborn babies. Explain why these antibodies only provide short-term immunity.

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(2)
(Total 6 marks)

M1. (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 diease (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;

5. Vaccinated people may develop disease from a different strain to that in the vaccine

6. This may affect their work/life;

6. May continue high risk activities and develop or pass on HIV

3 max

[10]

M2. (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;

1. accept named substance eg chemical / antigen

2. (Pathogen)engulfed / ingested;

2. Accept: description

3. Enclosed in vacuole / vesicle / phagosome;

4. (Vacuole) fuses / joins with lysosome;

5. Lysosome contains enzymes;

5. Accept named example of enzyme

6. Pathogen digested / molecules hydrolysed;

6. 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]

M3. (a) (i) protein/immunoglobulin;
specific to antigen;
idea of 'fit'/complementary <u>shape</u>;

2 max

(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;

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;

2 max

(d) fewer ethical difficulties/less risk of infection;

1

[15]

M4. (a) Has more than one / four polypeptide chains / made up of polypeptide chain<u>s</u>;

1

(b) 1. Antibody / variable region has specific amino acid sequence / primary structure;

2. The shape / tertiary structure of the binding site;
2 Do not accept active site for this point.

3. Complementary to / fits / binds with these antigens;
3 Accept active site for this point.

4. Forms complex between antigen and antibody;

3 max

[4]

M5. (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]

M6. (a) 1. Vaccines contain antigens / antigens are injected;

Ignore references to T or B cells.

2. Dead pathogens / weakened pathogens;

2. Accept bacteria / viruses etc but not disease

3. Memory cells made;

4. On second exposure memory cells produce antibodies / become active / recognise pathogens;

4. Idea of memory cells responding.

5. Rapidly produce antibodies / produces more antibodies;

5. Production of antibodies must be qualified for mark. Underlined ideas essential.

6. Antibodies destroy pathogens;

6. Accept bacteria/viruses etc but not disease

7. Herd effect / fewer people to pass on disease;

5 max

(b) 1. Contains glucose / starch / carbohydrate / sugar;

1. Candidates may be aware of food based ORS. Accept appropriate carbohydrate sources such as rice/maize flour.

2. Sodium / salt;

3. Co-transport / symport;

4. Sodium and glucose taken up (from lumen);

5. Lowers water potential in cells/ increases water potential gradient;

5. Accept Ψ

5 Do not accept converse argument.

6. Water taken up by osmosis;

Water + correct direction + osmosis essential for this mark point.

5 max

[10]

M7. (a) (i) Amino acids;

1

(ii) Peptide;

1

(b) Contains specific sequence of amino acids;
Complimentary shape enables attachment to antigen;

2

(c) (Maternal antibodies) are antigens;
Destroyed by (fetal) antibodies / lymphocytes;

Q *Do not credit marks where source of antigens or antibodies/lymphocytes is ambiguous.*

2

[6]