Immunity

(Past Year Topical Questions 2010-2015)

May/June 2010 (21)/Q4

(d) Vaccinations are used to control infectious diseases. They were used as part of the programme to eradicate smallpox and as part of the continuing programmes against diseases such as polio and measles.

Smallpox was eradicated from the world in the 1970s. Polio is likely to be the next infectious disease to be eradicated. TB and malaria continue to be important diseases.

Explain how vaccination provides immunity as an important part of programmes to control and eradicate infectious diseases.

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May/June 2010 (22)/Q3

(d) A person who is confirmed as HIV-positive has tested positive for the presence of antibodies to HIV.

Outline the events that occur in a newly-infected person, which lead to the production of antibodies to HIV.

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May/June 2010 (23)/Q4

(b) Explain why it has been difficult to develop an **effective** vaccine for malaria.

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Oct/Nov 2010 (21)/Q4

A potential vaccine for choleragen was trialled on volunteers. Fig. 4.1 shows the concentration of antibodies against choleragen in the blood of a volunteer who received a first injection at week 0, followed by a booster injection at week 15.

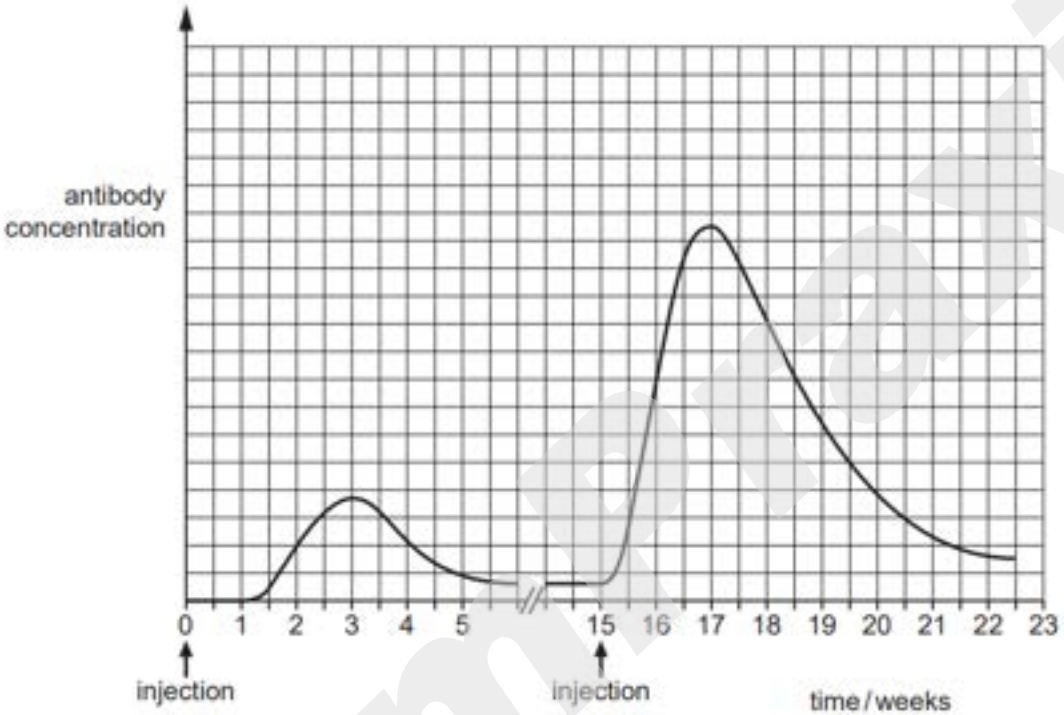

Fig. 4.1

(b) Using the information in Fig. 4.1, explain the differences between the responses to the first injection and the booster injection.

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Oct/Nov 2010 (22)

4 Fig. 4.1 is an incomplete flow chart showing some of the events of the primary immune response that occur after a person has been given a vaccine.

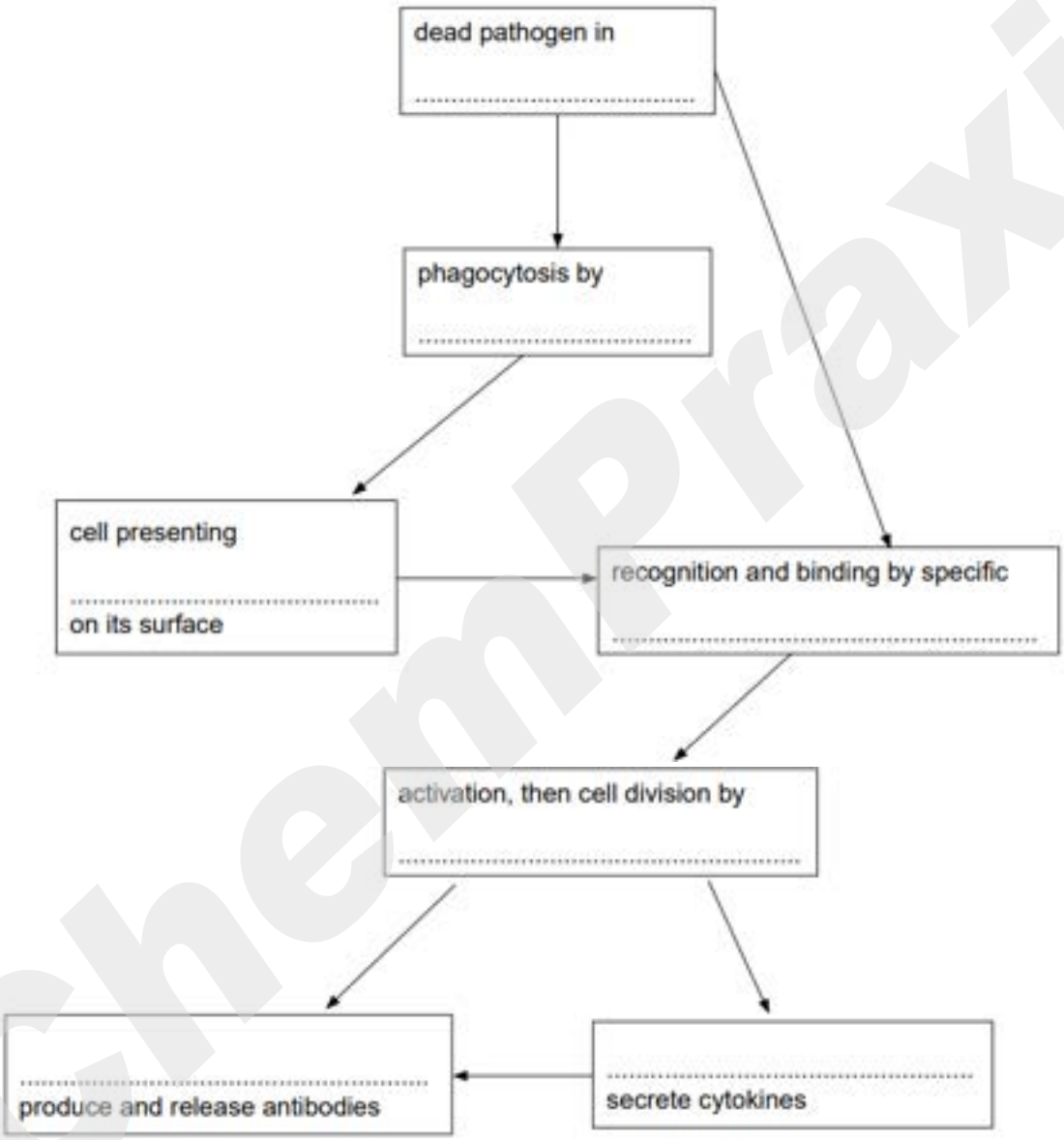

Fig. 4.1

(a) Choose the correct term from the list below to complete Fig. 4.1.

lymphocytes	**antigens**	**mitosis**	**vaccine**
T_h-lymphocytes	**plasma cells**	**macrophages**	

[3]

(b) Explain why the person is unlikely to become ill if they are infected by the same pathogen some months later.

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(c) Some parents decide that their children should not take part in a vaccination schedule.

Suggest how a country-wide vaccination schedule can give protection against infection to **unvaccinated** children.

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Oct/Nov 2010 (23)

4 **(a)** Outline the roles of the T-lymphocytes and B-lymphocytes in a primary immune response.

T-lymphocytes .....

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B-lymphocytes .....

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.....[4]

Fig. 4.1 shows how the concentration of antibody in blood plasma changes during the response to an antigen which is injected at day 0.

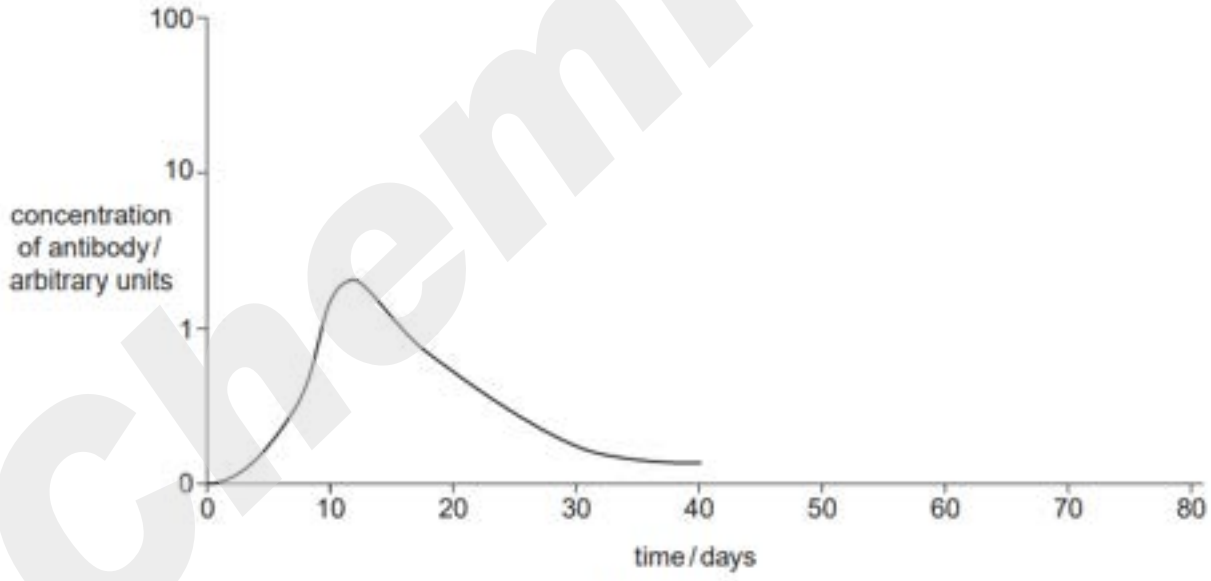

Fig. 4.1

(b) Explain why the concentration of antibody falls as shown in Fig. 4.1.

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(c) Draw on Fig. 4.1 how the antibody concentration would change if the same antigen entered the blood plasma on day 40. [3]

May/June 2011 (21)

6 Measles is a common viral infection. A vaccine has been available for measles since the 1960s. There are vaccination programmes for many diseases including measles. Babies are born with a passive immunity to measles so the vaccine is not given in the first few months after birth.

(a) Explain how active immunity differs from passive immunity.

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(b) Explain why the vaccine for measles is not given in the first few months of a child's life.

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The World Health Organization (WHO) publishes data on the vaccination programmes for infectious diseases. The WHO recommends vaccination rates of over 90% of children.

Each health authority in a country reports its success in vaccinating children in their district. The WHO uses these figures to estimate the percentage of districts in each country that vaccinate 90% of children against measles.

The WHO also collects statistics on death rates of children under the age of 5 from all causes, including infectious diseases.

Fig. 6.1 shows these statistics for 24 countries for the year 2007.

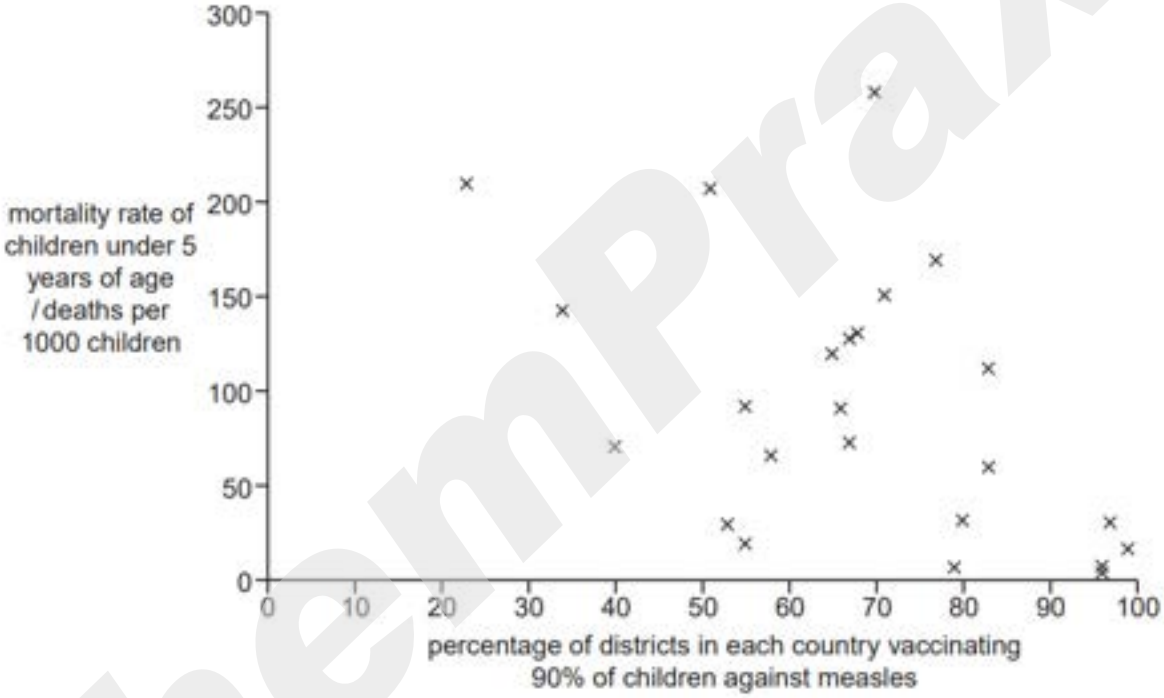

Fig. 6.1

(c) Use the information in Fig. 6.1 to explain why the WHO recommends immunisation of 90% of children.

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Oct/Nov 2011 (21)

6 Phagocytes and lymphocytes are part of the body's cellular response to infection by pathogens.

Fig. 6.1 shows the origin and maturation of phagocytes and lymphocytes.

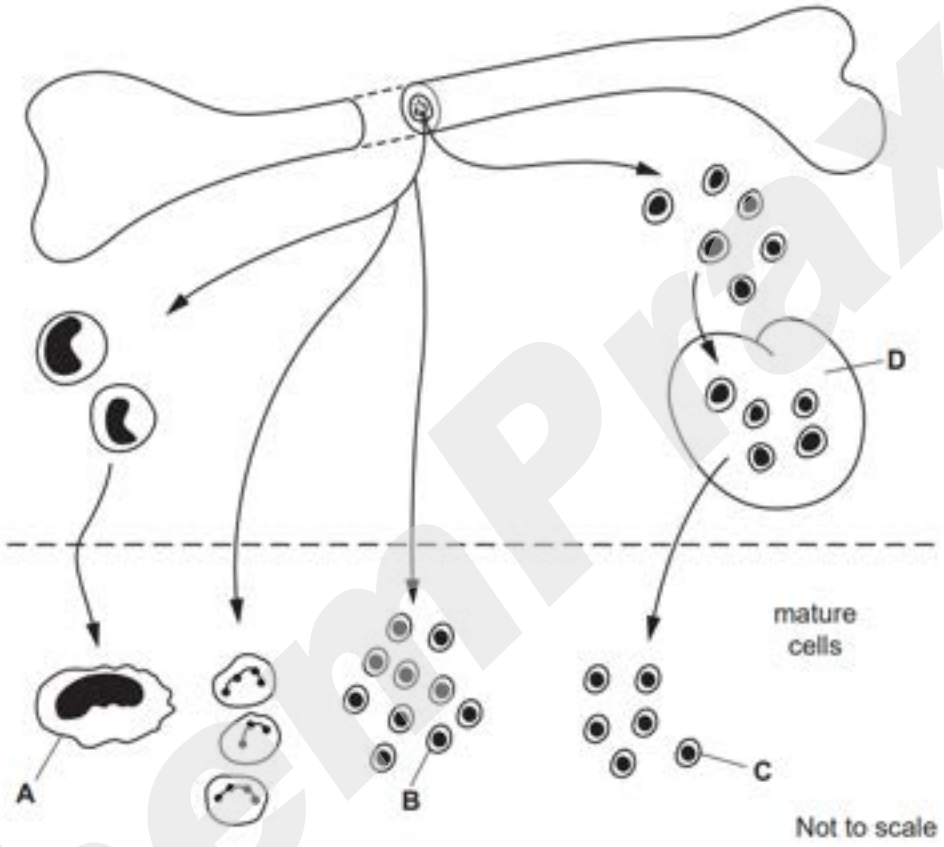

Fig. 6.1

(a) Name the site of origin of phagocytes and lymphocytes.

.....[1]

(b) Name:

(i) cells **A**, **B** and **C**

A .....

B .....

C ..... [3]

(ii) organ **D**.

..... [1]

(c) Explain the roles of the cells, **A**, **B** and **C** in an immune response.

In your answer use the terms *antigen* and *non-self*.

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Oct/Nov 2011 (22)

2 **(a)** White blood cells play an important role in defence.

State precisely the type of white blood cell that fits each of the descriptions given in **(i)** to **(iv)**.

(i) It is formed in the bone marrow and matures from a monocyte. It contains many lysosomes with hydrolytic enzymes.

.....[1]

(ii) It is formed, and matures in, the bone marrow. It contains a lobed nucleus and has the ability to ingest microorganisms by endocytosis.

.....[1]

(iii) When activated, it differentiates into a cell that secretes a chemical, which causes other cells to lyse (burst). It contains a large, spherical nucleus.

.....[1]

(iv) It is formed as a result of a primary immune response and remains in the body. On activation, it has the potential to produce antibodies during a secondary immune response.

.....[1]

(b) In 1980, it was announced that the highly infectious viral disease, smallpox, had been eradicated. This was mainly due to a worldwide vaccination programme planned by the World Health Organization (WHO).

Attempts have been made to control other diseases, such as measles, sickle cell anaemia and cholera, without the same success as smallpox.

(ii) Describe two features of the vaccine that contributed to the success of the smallpox eradication programme.

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2. .....

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(iii) Discuss the reasons why vaccination has **not** eradicated cholera **and** sickle cell anaemia.

cholera .....

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sickle cell anaemia .....

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May/June 2012 (21)

1 Name as precisely as you can the structure described in each of the following statements.

(b) The cell that ingests and digests cell debris and bacteria in the lungs.

.....[1]

(c) The cell that secretes antibodies.

.....[1]

May/June 2012 (21)/Q3

(d) Vaccination is used to control the spread of diseases, such as measles.

Explain why vaccination cannot be used to prevent sickle cell anaemia.

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.....[2]

May/June 2012 (22)/Q2

(b) An activated B-lymphocyte divides repeatedly by mitosis to produce many identical plasma cells.

(i) Explain why it is important that many identical plasma cells are produced.

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.....[3]

May/June 2012 (23)

5 Malaria is a disease caused by the parasite, *Plasmodium*. The parasite has a complex life-cycle, part of which involves development within the gut of the female mosquito which is responsible for the transmission of the disease.

Fig. 5.1 shows part of the life-cycle of the malarial parasite.

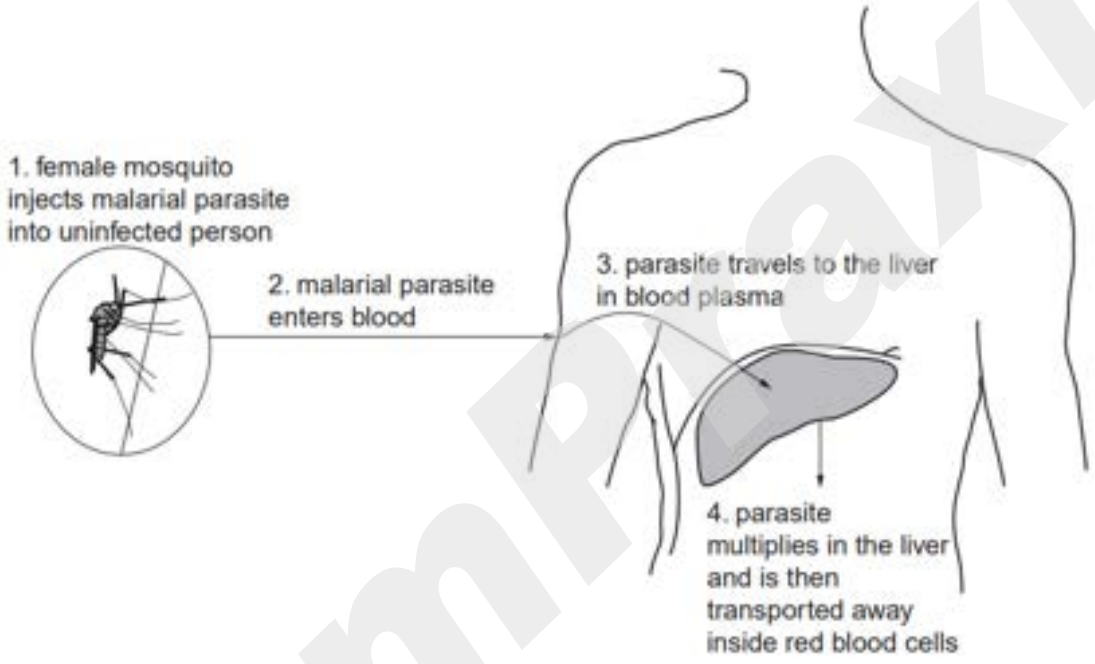

Fig. 5.1

Research has been directed towards the development of a malarial vaccine. Much of this research relies on the fact that *Plasmodium* has different forms in its life cycle.

During trials of a malarial vaccine, the parasites were killed using radioactivity and then injected into volunteers. This method provided some protection against malaria.

(c) The volunteers who were injected with the killed parasites produced antibodies, which provided some protection against the disease.

Outline the events that occur following injection of the parasites, which lead to the production of antibodies.

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.....[5]

Oct/Nov 2012 (21)/Q3

(c) During an immune response, cells divide by mitosis.

Describe how mitosis is involved in an immune response.

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(d) Describe the modes of action of T-lymphocytes during an immune response.

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Oct/Nov 2012 (22)/Q4

(b) Typhoid is an example of an infectious disease.

Some features of typhoid include:

- caused by a bacterium that can only infect humans
- caused by the ingestion of contaminated food and water
- can be treated with drugs
- can be prevented by a vaccine.

(iii) Child vaccination programmes against typhoid in some countries have had considerable success. The numbers contracting the disease have decreased, not only in the vaccinated children, but also in other age groups that were not part of the programme.

Suggest explanations for this observation.

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(c) After infection, the ingested typhoid bacteria are engulfed by phagocytes.

(i) Explain why the phagocytes act only against the bacteria and not against human cells.

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(ii) Unlike other bacteria, the typhoid bacteria are able to survive and multiply within the phagocytes.

Suggest an explanation for this observation.

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May/June 2013 (21)/Q2

(b) Antibodies against measles are produced by plasma cells during an immune response.

Fig. 2.1 shows a diagram of an antibody molecule.

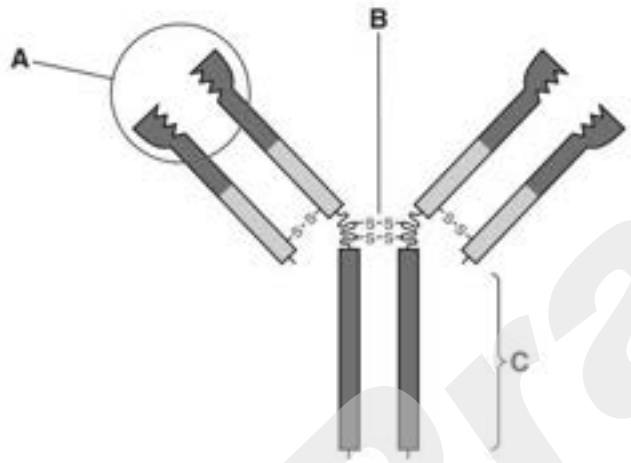

Fig. 2.1

Explain the functions of the parts labelled **A**, **B** and **C**.

(i) **A** .....

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..... [2]

(ii) **B** .....

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..... [1]

(iii) **C** .....

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..... [1]

May/June 2013 (22)/Q5

(c) Some disease-causing organisms undergo frequent mutation, changing their surface antigens and making the disease much more difficult to control with a vaccination programme.

(i) Explain why existing vaccines may no longer be effective when the surface antigens of a disease-causing organism change.

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..... [2]

(ii) State precisely the type of immunity gained by a person who has been vaccinated.

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(d) The virus causing measles is said to be antigenically stable as it rarely mutates. Measles vaccination programmes have been successful in preventing epidemics in many areas.

Outline **two** reasons why measles is still common in many parts of the world, even though the vaccine is available.

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..... [2]

Oct/Nov 2013 (22)

6 (a) Nicotine, in cigarette smoke, is highly addictive. A nicotine vaccine has been developed to try and reduce the effects of addiction. The vaccine stimulates an immune response to produce antibodies that bind to the nicotine molecule. Fig. 6.1 is a diagram of an antibody molecule.

On Fig. 6.1:

- label **three** structural features that enable an antibody molecule to carry out its function.
- next to each label, state the function of the feature.

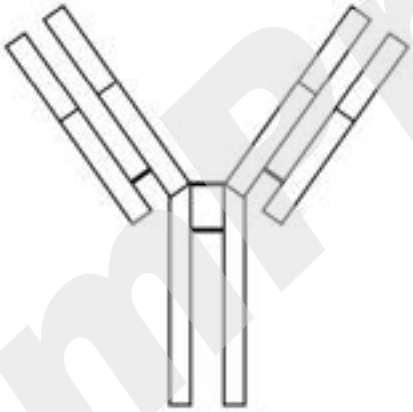

Fig. 6.1

[3]

Oct/Nov 2013 (23)

1 Fig. 1.1 is a diagram of an antibody molecule.

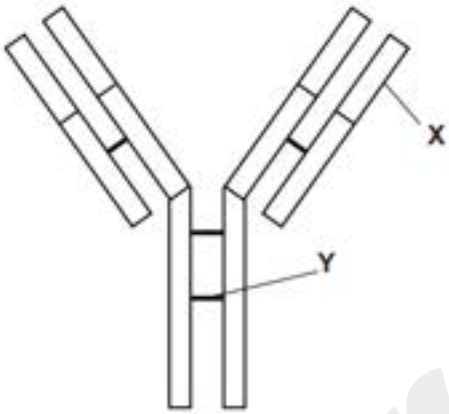

Fig. 1.1

(a) (i) Name the part labelled **X**.

..... [1]

(ii) Name the bond labelled **Y**.

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(b) When a pathogen enters the body, a primary immune response occurs. This response includes the production of antibodies.

Describe the stages in the immune response that lead to antibody being produced against a specific antigen.

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(c) Vaccination was used in the eradication of smallpox.

Explain, in terms of antigens, why it has not been possible to do the same for malaria.

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May/June 2014 (21)

4 B-lymphocytes respond to the presence of a non-self antigen by dividing as shown in Fig. 4.1.

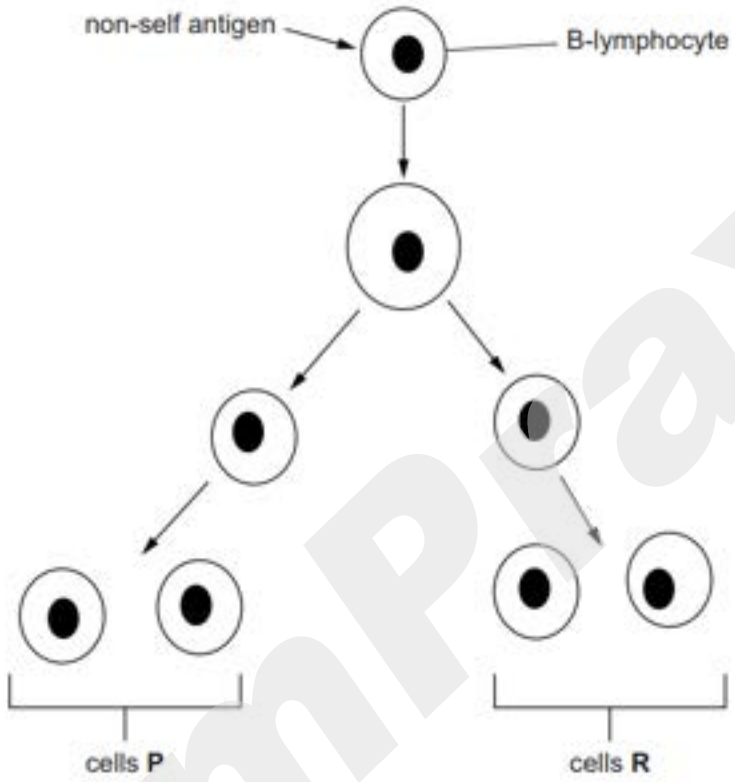

Fig. 4.1

(a) (i) Explain what is meant by the term *non-self antigen*.

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(ii) Outline how B-lymphocytes recognise non-self antigens.

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The cells labelled **P** on Fig. 4.1 continue to divide to give rise to many cells that differentiate into short-lived plasma cells. The plasma cells release antibody molecules.

(b) (i) Outline how plasma cells produce antibody molecules.

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..... [4]

(ii) Describe how antibody molecules are released from the plasma cell.

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(c) The cells labelled **R** on Fig. 4.1 divide to give more cells that do not differentiate into plasma cells. These cells have an important role in the immune system.

Explain the role of these cells.

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..... [3]

May/June 2014 (22)/Q4

(ii) Suggest **and** explain how the destruction of **memory** T_h cells will contribute to a lowered **secondary** immune response.

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.....[3]

May/June 2014 (22)

5 B-lymphocytes have antibodies located on their external surface. When B-lymphocytes become plasma cells they then secrete antibodies.

Fig. 5.1 shows how the enzyme papain digests an antibody to obtain three fragments.

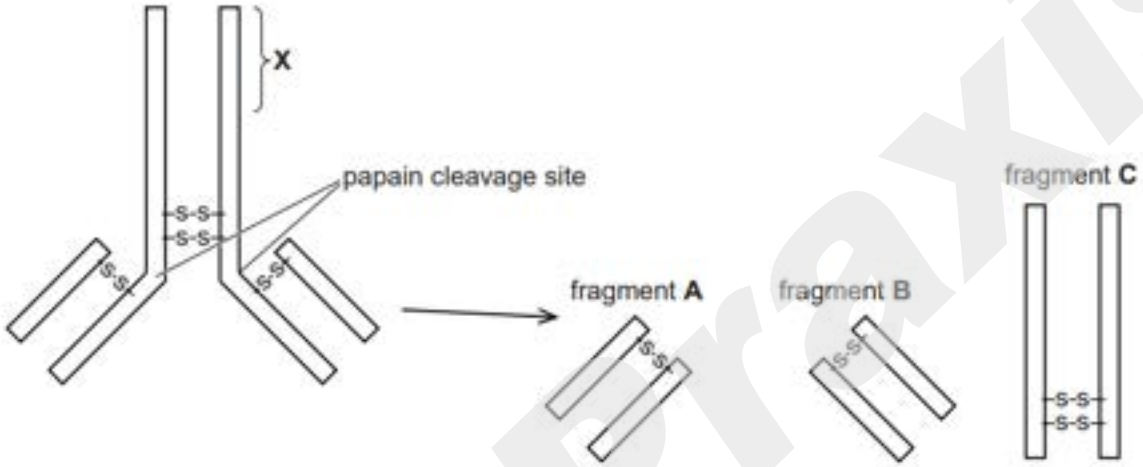

Fig. 5.1

(a) Fig. 5.1 shows the location of the region where papain acts.

State **one** role of this region in the intact antibody molecule.

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.....[1]

(b) The three fragments, **A**, **B** and **C** still retain their ability to function.

State the function of:

(i) fragments **A** and **B**

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.....[1]

(ii) fragment **C**.

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.....[1]

May/June 2014 (23)

2 Vaccination can protect against the infectious disease tuberculosis (TB).

(a) Define the terms:

(i) *vaccination*

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.....[2]

Oct/Nov 2014 (21)/Q2

Fig. 2.1 is a flow chart that shows the four different ways that a person can become immune to an infectious disease.

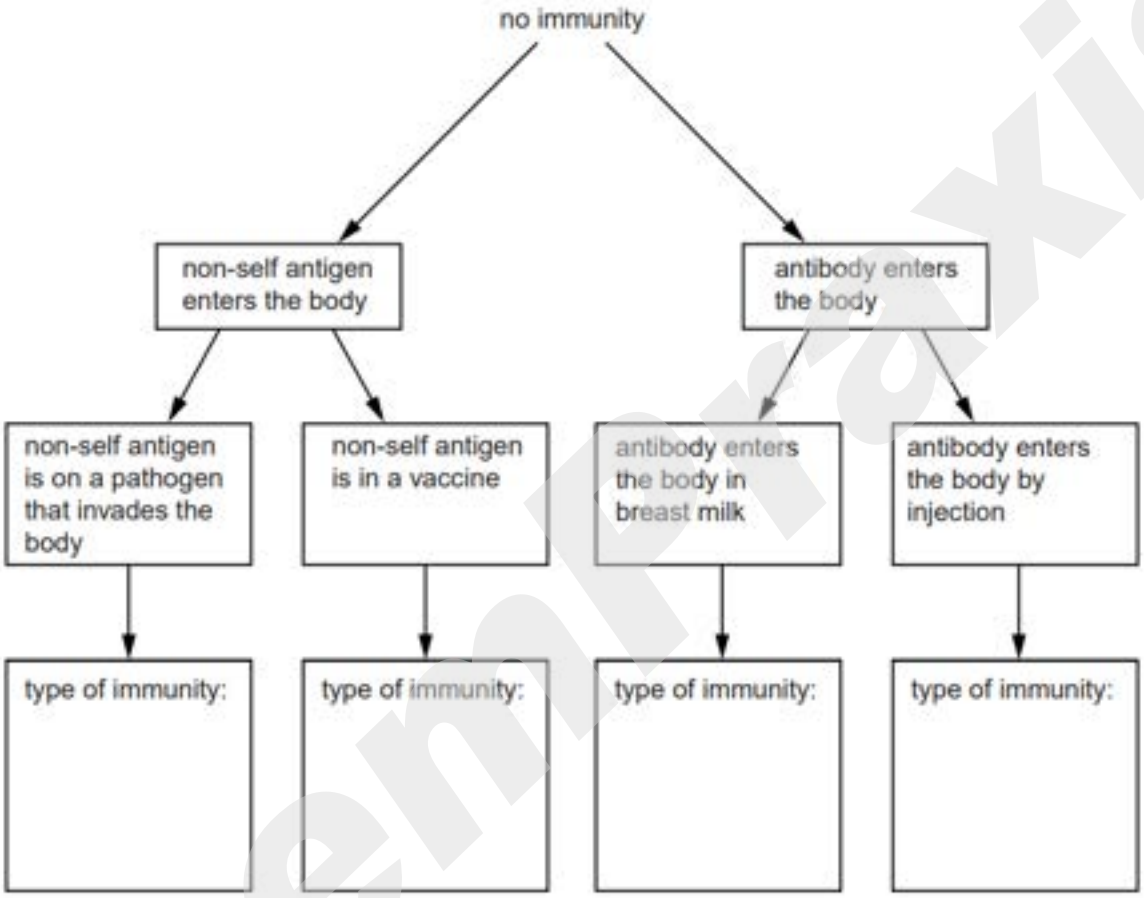

Fig. 2.1

(b) Complete Fig. 2.1 by writing in the boxes provided the four types of immunity described. [4]

Oct/Nov 2014 (22)/Q4

(b) Vaccination helps to prevent the spread of infectious diseases by stimulating an immune response in individuals against specific pathogens, such as Morbillivirus, the virus that causes measles.

(i) Suggest two reasons why measles vaccination programmes may fail to prevent epidemics.

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(ii) Outline the response produced by **B-lymphocytes** on exposure to Morbillivirus in an individual **who already has immunity** to measles.

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Oct/Nov 2014 (23)

3 Measles is an infectious disease for which vaccines have been developed.

The commonly used vaccine consists of an attenuated (weakened) form of the virus.

The measles vaccine is normally given to children when they are about one year old, followed by a booster dose when they are about four years old.

(a) Explain how this vaccine can provide long-term immunity against measles.

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..... [5]

Fig. 3.1 shows the number of reported cases of measles and the percentage of the population vaccinated worldwide between 1980 and 2002.

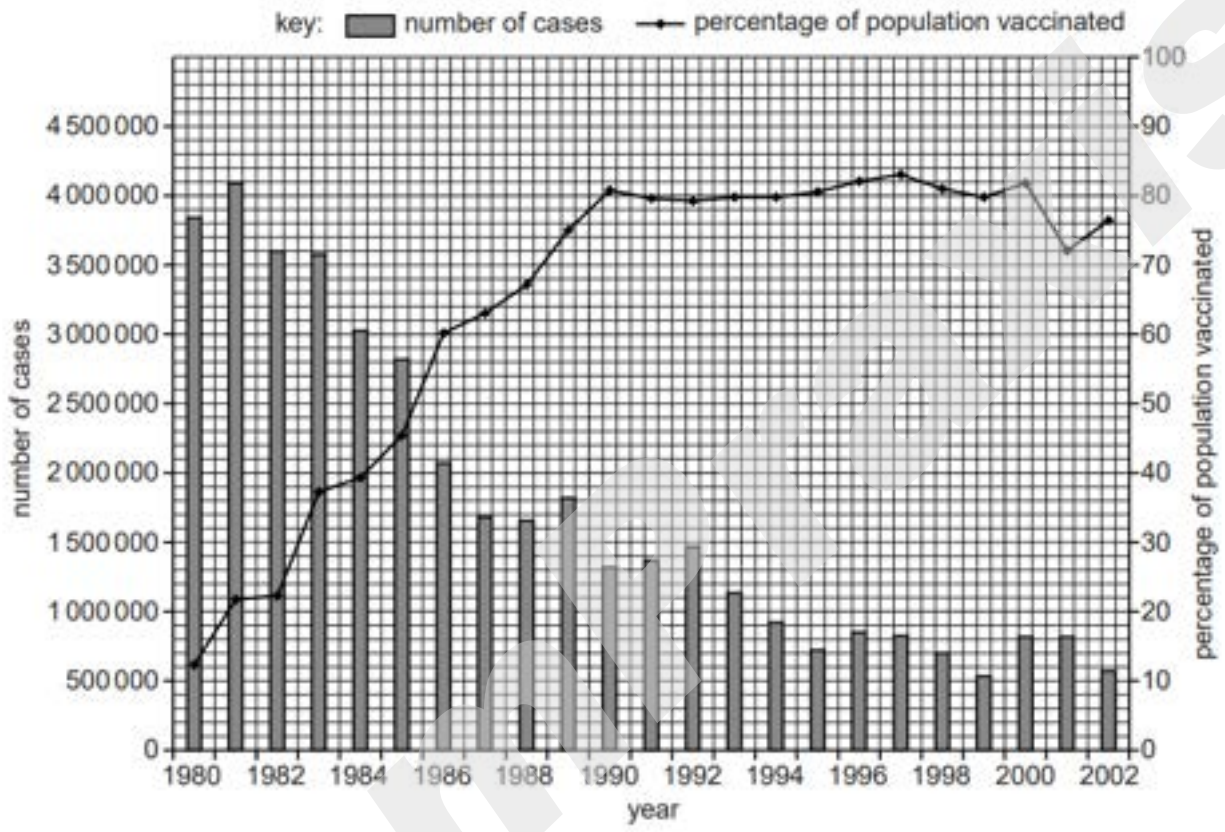

Fig. 3.1

(b) Describe the trends shown in Fig. 3.1:

between 1980 and 1990

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between 1990 and 2002.

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May/June 2015 (21)/Q2

Fig. 2.2 shows part of the immune response to the first infection by a bacterial pathogen that has entered the body through the lining of a bronchiole. **J** and **K** are stages in the immune response.

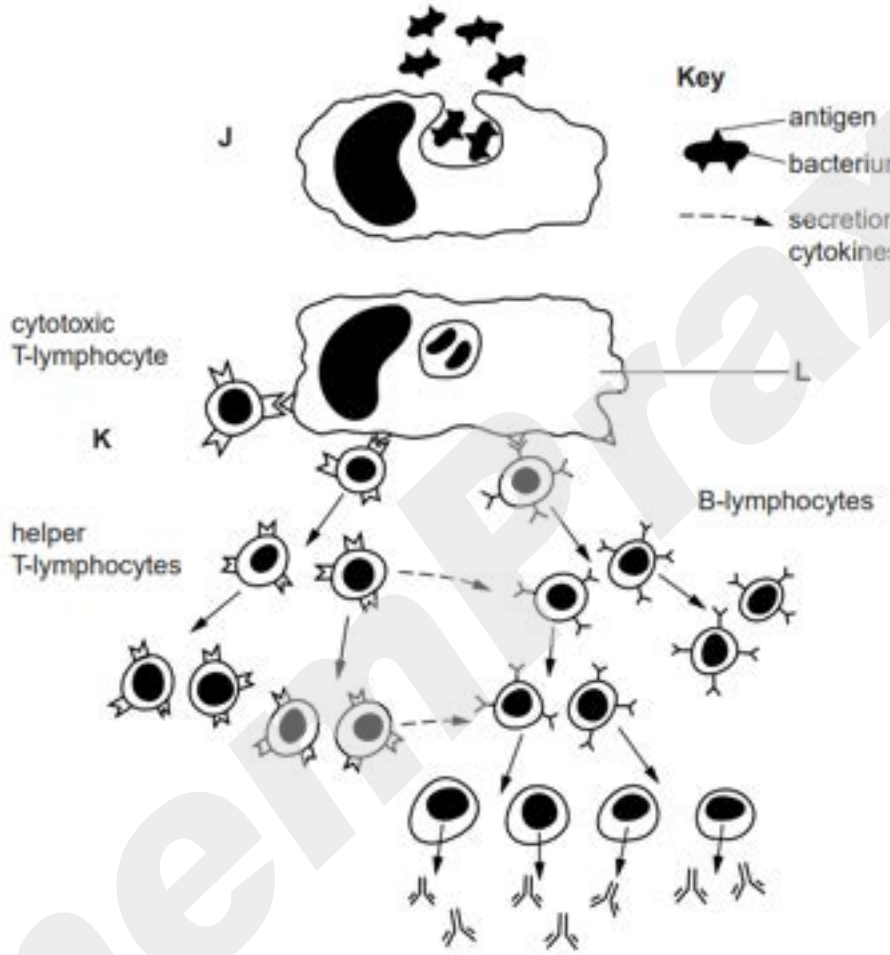

Fig. 2.2

(b) (i) State what is happening at stage **J**.

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.....[1]

(ii) Explain the role of cell **L** at stage **K** in the immune response.

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(c) With reference to Fig. 2.2, explain how the response to a second infection by this bacterial pathogen differs from the first.

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(d) There are various ways in which the effectiveness of immune responses can be reduced.

Suggest how each of the following reduces the effectiveness of an immune response.

(i) The number of T-lymphocytes is reduced in a person with HIV/AIDS.

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.....[1]

(ii) Some pathogens are covered in cell surface membranes from their host.

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.....[1]

(iii) B-lymphocytes do not mature properly and do not recognise any antigens.

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.....[1]

May/June 2015 (22)

5 (a) Natural immunity and artificial immunity can both be acquired in a passive or in an active manner.

Table 5.1 shows information about immunity acquired by two individuals, **P** and **Q**.

Complete Table 5.1.

Table 5.1

description of event	outcome for the individual	production of memory cells / yes or no	type of immunity acquired by individual
individual **P** is injected with a live, weakened disease-causing organism	individual P does not become ill from the disease and has long-lasting protection from the disease	.....	....
individual **Q** is injected with antibody against a specific disease-causing organism	individual **Q** does not become ill from the disease but is ill with the disease a year later	.....	....

[2]

Fig. 5.1 is a light micrograph of a sample of blood. Cell **X** is a phagocyte.

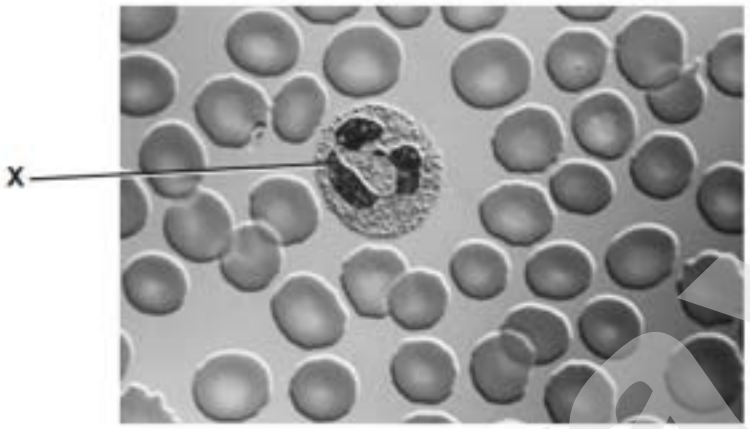

Fig. 5.1

(b) State the origin of the blood cell labelled X.

.....[1]

(c) Phagocytes play an important role when an immune response is initiated against cancerous tumour cells.

(i) Suggest how phagocytes can recognise the difference between healthy body cells and cancerous tumour cells.

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.....[2]

May/June 2015 (23)/Q3

(d) When a person received the smallpox vaccine, the numbers of plasma cells specific for the smallpox pathogen were measured from blood samples taken over a period of 35 days.

Fig. 3.2 shows how the numbers of smallpox-specific plasma cells changed during 35 days after vaccination.

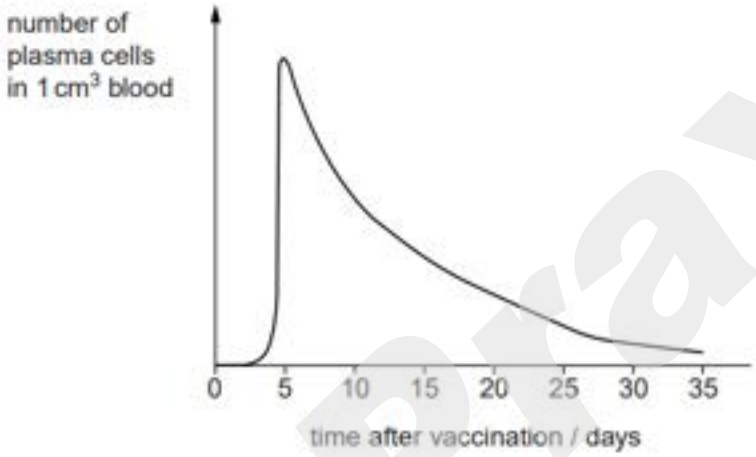

Fig. 3.2

Fig. 3.2 shows that the number of smallpox-specific plasma cells increases and then decreases within 35 days of vaccination.

Explain how a single dose of this vaccine can provide immunity for up to 10 years when the plasma cells are short-lived.

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(e) State two reasons why the vaccination programme was successful in eradicating smallpox.

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(f) State the type of immunity provided by the smallpox vaccine.

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Oct/Nov 2015 (21)/Q5

(e) The outer part of the measles pathogen contains an antigen called the H-protein. This antigen appears on the surface of cells infected with the measles pathogen.

Describe the role played by T-lymphocytes in a primary immune response to an infection by the measles pathogen.

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Oct/Nov 2015 (23)/Q1

(c) The genes responsible for antibody production are found on different chromosomes, such as chromosomes 2 and 14 in humans.

Explain how one antibody molecule is the product of more than one gene.

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(d) Describe **and** explain how the structure of an antibody molecule is related to its functions.

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