1. *Answers should be written in continuous prose. Credit will be given for biological accuracy, the organisation and presentation of the information and the way in which the answer is expressed.*

Read the following passage.

A potential new cancer treatment involves what are known as *magic bullets.* Cancer cells have cell-surface antigens which are not found on normal cells. Antibodies are produced to one of these antigens by the monoclonal antibody technique. Once the antibody molecules have been made, an enzyme is attached to them and the antibody-enzyme complex is injected into the patient. A drug, which causes cell lysis, is then injected in an inactive form.

(a)   Use the information in the passage to suggest how the drug kills only cancer cells.

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(3)

(b)   Explain the role of B-lymphocytes and T-lymphocytes in the defence of the body against a virus infection.

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(6)

(c)   Immunisation programmes may use either attenuated or dead microorganisms. Suggest why there might be problems for the patient when using these vaccines.
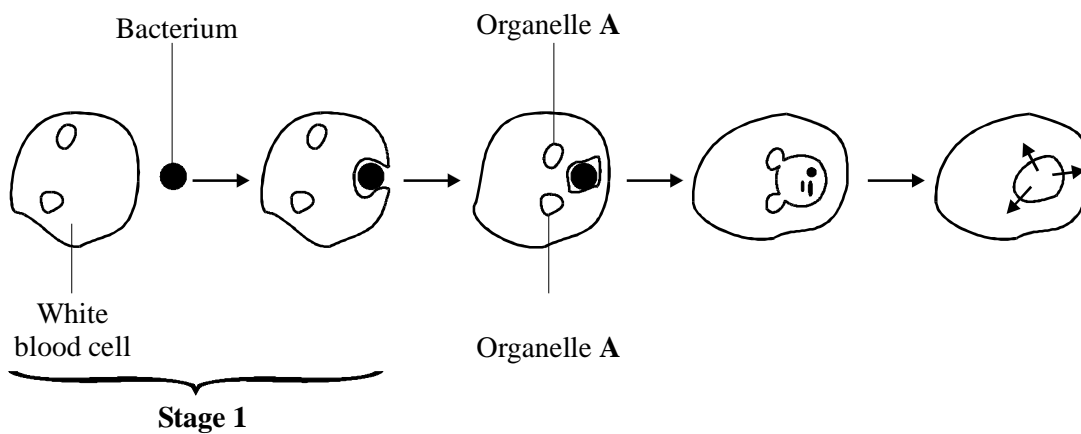
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(3)
(Total 12 marks)

2.   The diagram shows one way in which white blood cells protect the body against disease.

(a)   Describe what is happening during **Stage 1**.

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(2)

(b) (i) Name Organelle **A**.

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(1)

(ii) Describe the role of Organelle **A** in the defence against disease.

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(2)
(Total 5 marks)

3. MMR is the combined vaccine used against measles, mumps and rubella. It contains attenuated microorganisms.

(a) What is an attenuated microorganism?

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(1)

(b) Vaccines protect against disease by stimulating the production of memory cells. Describe how memory cells protect the body from disease.
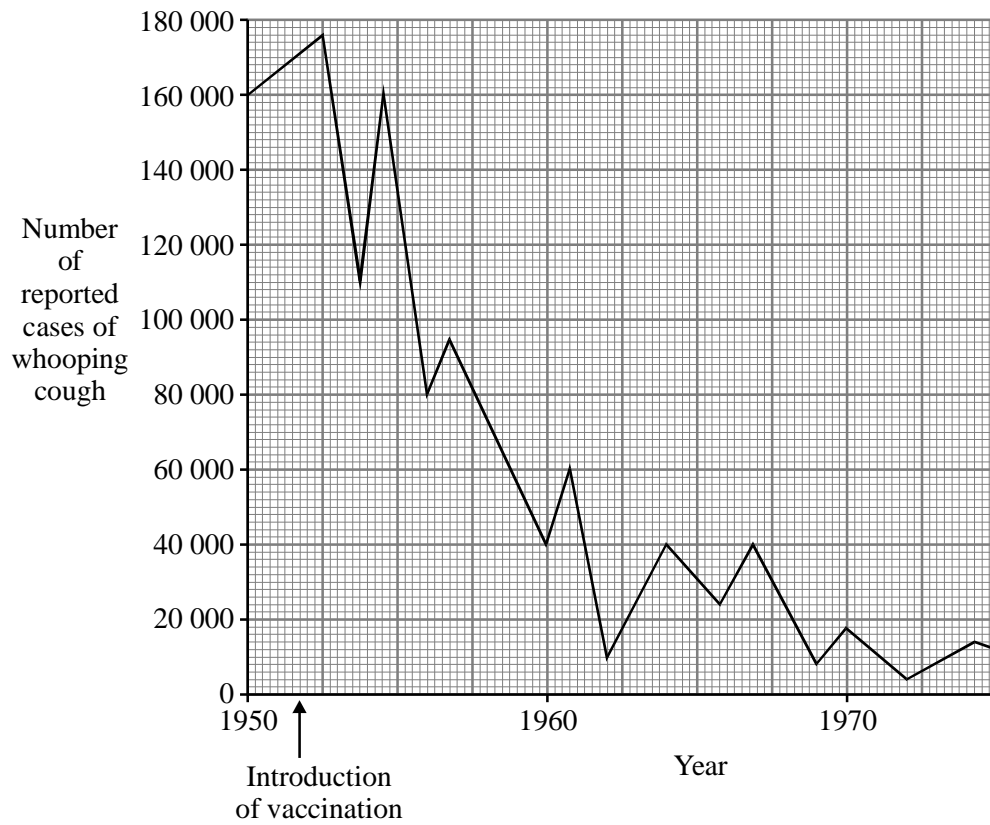
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(3)

(c)   The graph shows the number of reported cases of whooping cough during the period 1950 to 1975.

Describe and explain what the graph shows about the number of reported cases of whooping cough during the period 1952 to 1960.

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(2)

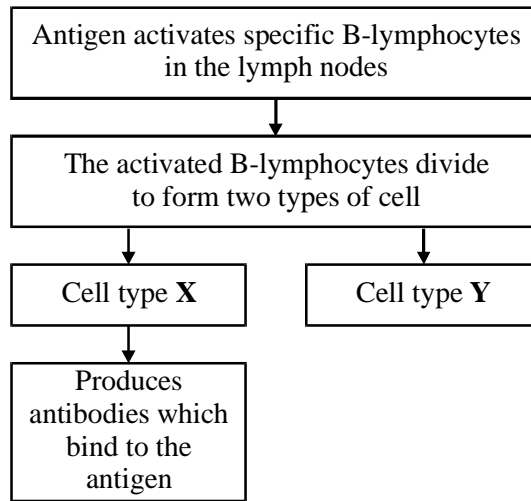(d)   The number of reported cases of whooping cough increased during the 1980s. Suggest **one** reason why.

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(1)
(Total 7 marks)

4.   The flow chart shows some of the stages involved in the immunological response to an antigen.

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┌─────────────────────────────────────┐
│ Antigen activates specific B-lymphocytes │
│         in the lymph nodes          │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│   The activated B-lymphocytes divide │
│        to form two types of cell    │
└─────────────────────────────────────┘
        │                     │
        ▼                     ▼
┌──────────────┐      ┌──────────────┐
│  Cell type X │      │  Cell type Y │
└──────────────┘      └──────────────┘
        │
        ▼
┌──────────────┐
│   Produces   │
│ antibodies which │
│  bind to the │
│    antigen   │
└──────────────┘
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(a)   What is an antigen?

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        (1)

(b)   Name

        (i)   Cell type **X** ....

        (ii)   Cell type **Y** ....

        (2)

(c)   Explain the importance of cell type **Y** in immunity.

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        (2)

(d)   Influenza and measles are diseases caused by viruses. The viruses have antigens on their
       surface. Use your knowledge of antigens and antibodies to suggest why a person may
       have influenza several times, but usually has measles only once.
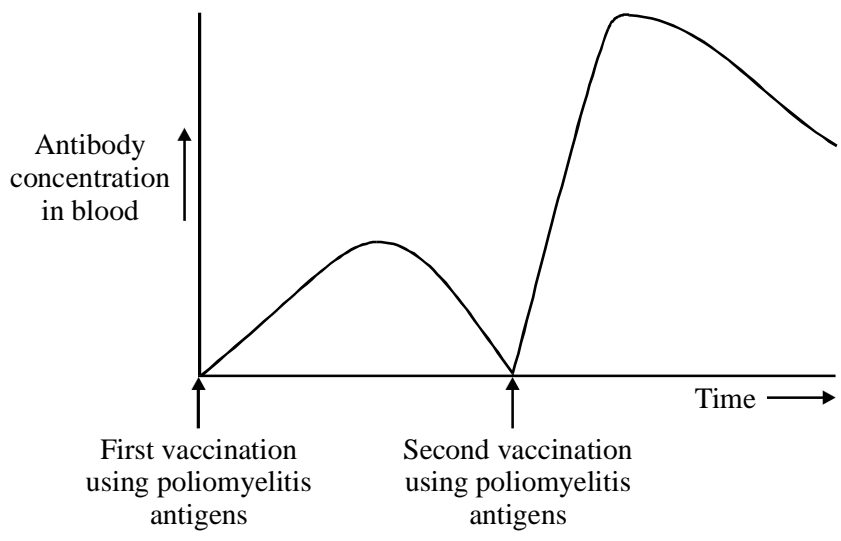
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(3)
(Total 8 marks)

5.   A child was given two vaccinations consisting of antigens from the virus which causes
       poliomyelitis. The graph shows the concentration of antibodies resulting from these
       vaccinations.

(a) What is a poliomyelitis antigen?

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(2)

(b) Describe and explain the difference in the child's response to the two vaccinations shown in the graph.

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(3)
(Total 5 marks)

6. (a) (i) What is an *antigen*?

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(2)

(ii)   Myeloid leukaemia is a type of cancer. Monoclonal antibodies are used in treating it. A monoclonal antibody will bind to an antigen on a myeloid leukaemia cell. It will not bind to other types of cell. Explain why this antibody binds only to an antigen on a myeloid leukaemia cell.

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(2)

(b)   Calichaemicin is a substance which is very toxic and kills cells. Scientists have made a drug by joining calichaemicin to the monoclonal antibody that attaches to myeloid leukaemia cells. Explain why this drug is effective in treating myeloid leukaemia.

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(2)
(Total 6 marks)

7.   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
5   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
10   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)

8. A vaccine has recently been developed against malaria. A trial of this vaccine was carried out in South America. The graph shows some of the results of this trial.
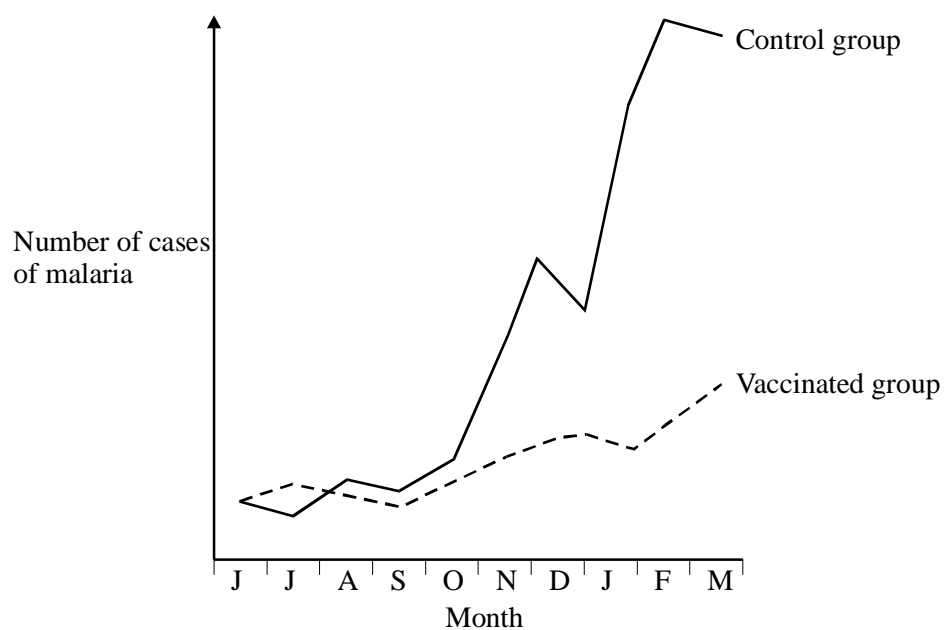
(a) (i) Suggest how the control group should have been treated.

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(1)

(ii) Explain why it was necessary to have a control group.

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(1)

The table shows some more data collected during this trial. It shows the total number and percentage of people in different age groups who caught malaria during the first year of the trial.

Age group/ years	Vaccinated group		Control group	
	Total number	**Percentage**	**Total number**	**Percentage**
1 – 4	3	0.07	13	0.32
5 – 9	32	0.44	43	0.58
10 – 14	36	0.57	58	0.75
15 – 44	68	0.62	83	0.57

(b) Explain the advantage of giving the percentage of people who caught malaria as well as the total number.

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(2)

(c)   From the data concerning the percentage of people catching malaria, the researchers concluded that the vaccine was most effective with people 1-4 years old.

    (i)   Explain the evidence from the table that supports this conclusion.

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(1)

    (ii)   Suggest why the vaccine was most effective with people in this age group.

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(2)

(d)   Explain how B-lymphocytes, plasma cells and memory cells help to protect the body from disease.

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(5)
(Total 12 marks)

9. (a) Antibodies are protein molecules. Explain why protein molecules are particularly well suited to carry out the role of antibodies.

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(2)

(b) Give **two** factors which affect the ability of bacteria to cause a disease.

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2. ....

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(2)

(c) Diarrhoeal diseases cause the death of over three million people annually. These diseases may be caused by certain types of bacteria in contaminated drinking water. More than 1000 bacteria per 100 cm^3 water are needed to produce symptoms. The incidence of diarrhoeal diseases can be reduced by using solar water disinfection which uses solar radiation to kill pathogenic microorganisms. The treatment consists of filling transparent containers with water and exposing them to full sunlight. In cloudy weather the exposure time needs to be up to 2 days longer to be effective.

The graph shows the effect that exposure time has on the number of bacteria present in a sample.
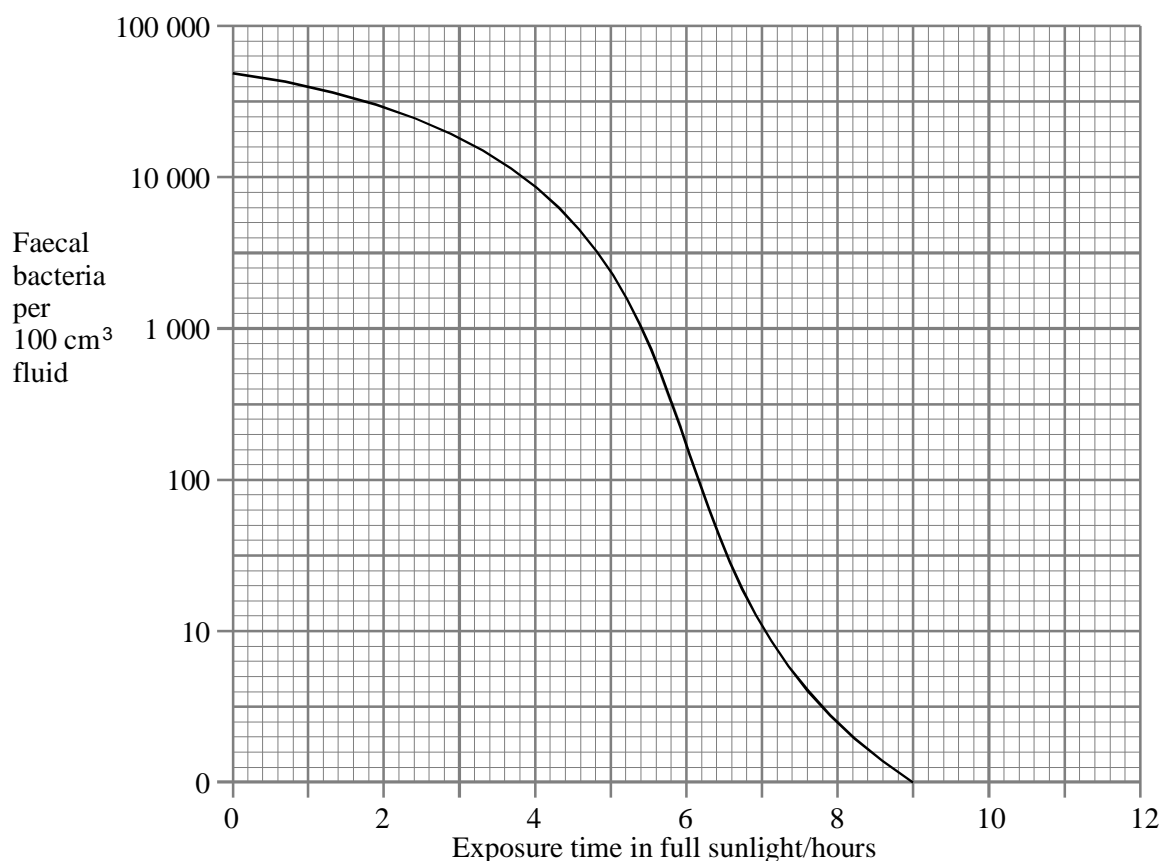
(i) Use the graph to estimate how long the sample of water must be exposed to full sunlight to make sure that it will not cause diarrhoea.

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(1)

(ii) Suggest **one** disadvantage of 'solar water disinfection'.

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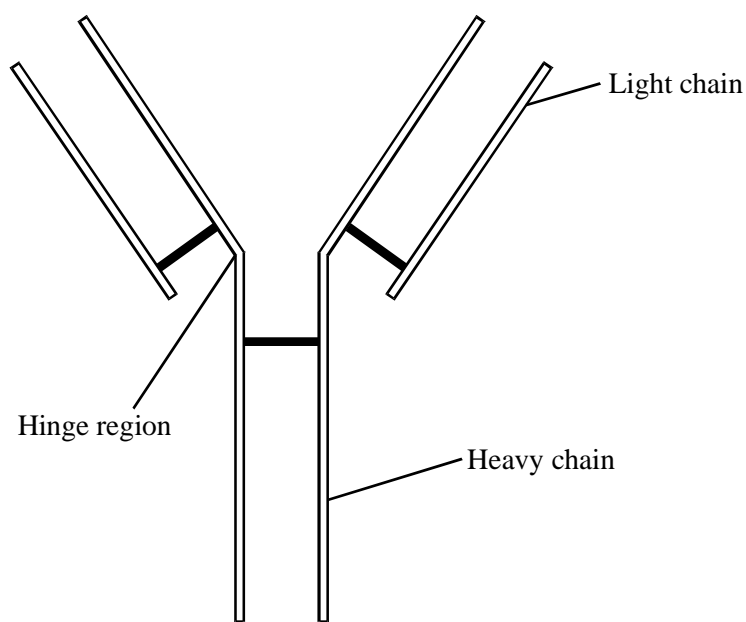
(1)

PMT

(d)   Salmonella infections are more likely to be contracted from contaminated food than from contaminated water. Suggest a reason for this.

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(1)
(Total 7 marks)

10.   The diagram shows an antibody.

S   (a)   Each heavy and light chain is made up from one type of monomer. Name the type of monomer in each chain.

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(1)

(b)   Write **X** on the diagram to show where an antigen may form a complex with this antibody.

(1)

(c)   Each antibody can form a complex with only one type of antigen. Explain why.

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(1)

(d)   The hinge region of the antibody allows both ends to pivot and rotate in relation to one another. Suggest how this action assists the role of antibodies in agglutination.

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(1)
(Total 4 marks)

11.   (a)   An antigen in a vaccine leads to the production of antibodies. Describe the part played by B lymphocytes in this process.

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(4)

S (b) Hepatitis B vaccine contains a viral antigen produced by genetically modified bacteria. Describe how the isolated gene that codes for a protein in the virus's coat could be transferred to the bacterial cells.

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(3)
(Total 7 marks)