

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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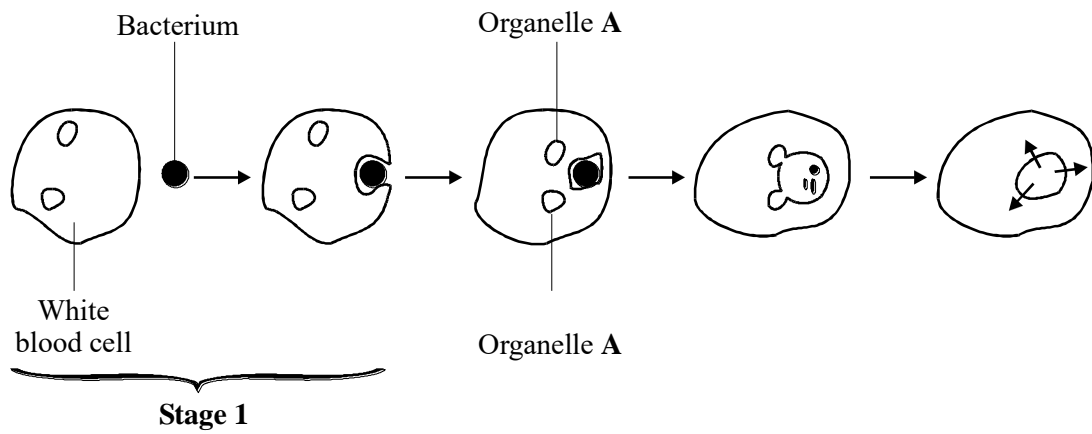
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(3)
(Total 12 marks)

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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(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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(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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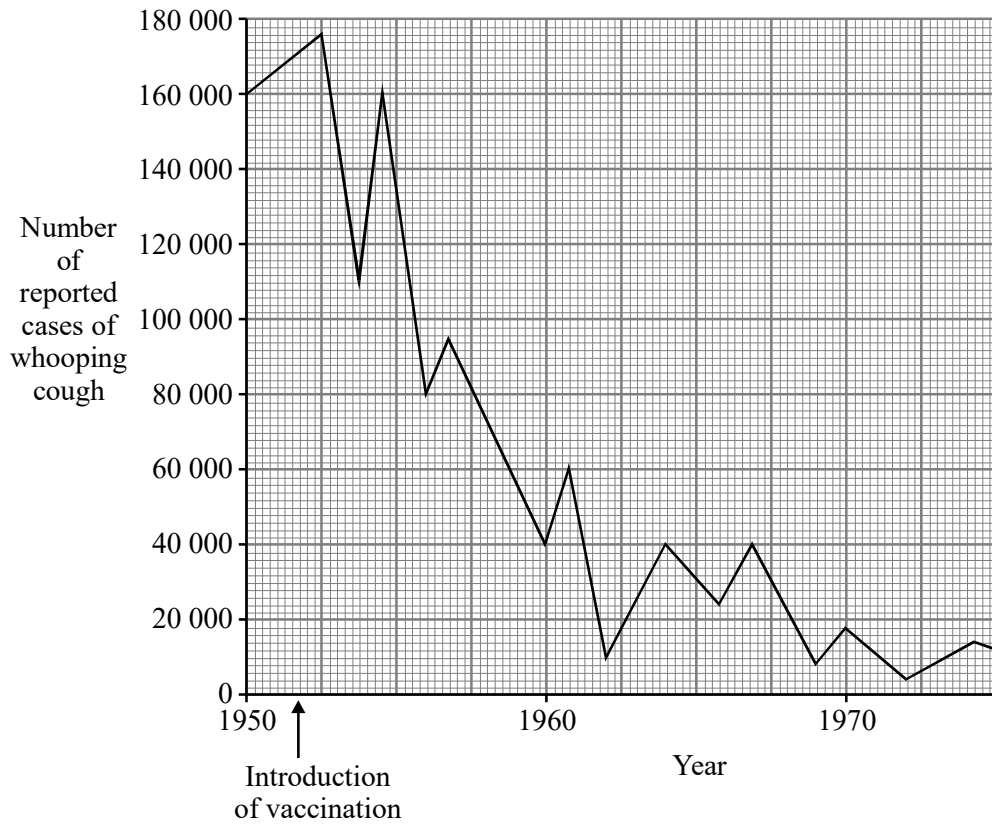
(1)

(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.

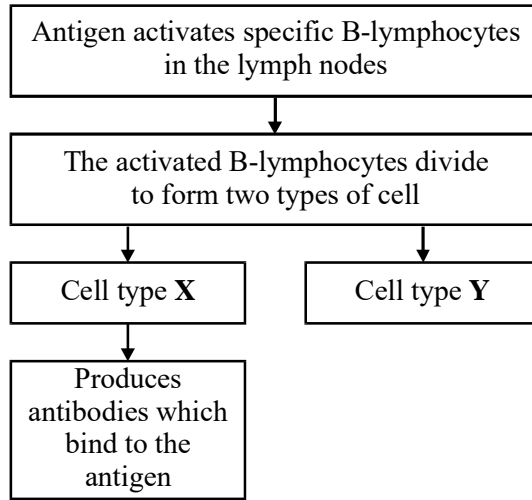
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(1)

(Total 7 marks)

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



(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. Immunity can be either active or passive.

- (a) The table shows some statements, which may be related to active immunity, to passive immunity or to both. Complete the table by placing a tick in the box if the statement is true or a cross in the box if the statement is not true.

| Statement | Active immunity | Passive immunity |
|--|-----------------|------------------|
| Antibodies produced if the body is re-infected by the same pathogen. | | |
| An antibody reacts with an antigen. | | |
| Antibodies received in breast milk. | | |
| Attenuated microorganisms used in the vaccine. | | |

(4)

- (b) If a pregnant woman becomes infected with the *Rubella* virus in the early stages of pregnancy, her developing embryo may become deaf, blind or brain damaged. Explain why it is recommended that:

- (i) girls are vaccinated against *Rubella* when they are young;

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- (ii) young boys are also vaccinated against *Rubella*.

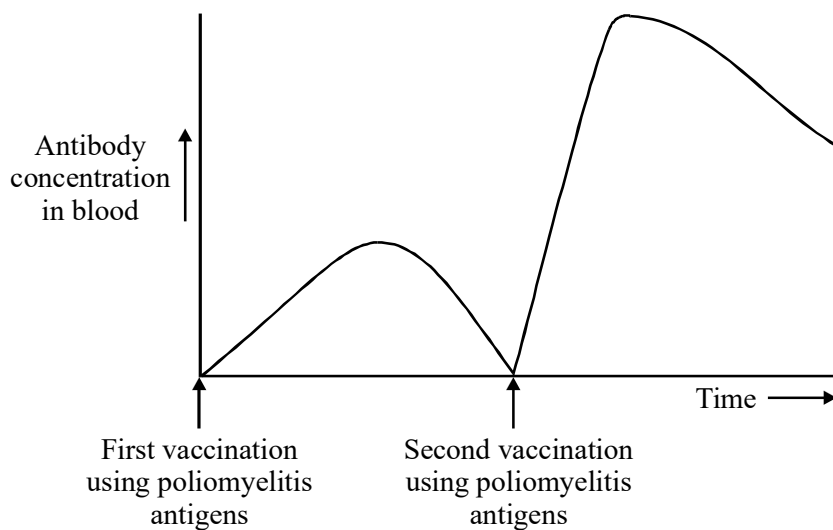
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(2)

(Total 6 marks)

6. 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)

7. (a) Explain how viruses cause damage to cells.

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(3)

Hepatitis A is a disease caused by a virus, which can permanently damage the liver and other organs, such as the pancreas.

The hepatitis A virus is an RNA virus usually transmitted by drinking water contaminated with the faeces of infected people. It exists as a single immunological type. Heating the virus to 100 °C for five minutes inactivates its infectivity.

(b) Suggest why the virus causes damage only to some types of human cell.

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(1)

(c) Suggest why effective vaccines cannot be produced using hepatitis A viruses that have been heated to 100 °C.

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(1)

(d) Explain what is meant by hepatitis A virus existing as a *single immunological type*.

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(2)

(Total 7 marks)

8. (a) Describe how Koch's postulates could be used to show that a particular bacterium is responsible for causing a particular disease.

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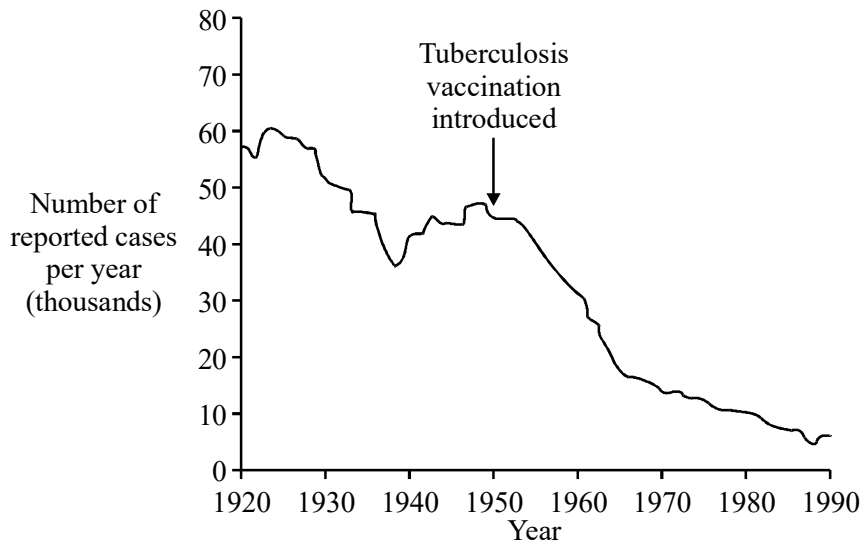
- (b) *Mycobacterium tuberculosis* is a bacterium that causes tuberculosis in humans. The gas-exchange system is at high risk from infection by *Mycobacterium tuberculosis*. Suggest why.

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(1)

- (c) The graph shows information about the number of reported cases of tuberculosis in the UK during the period 1920 to 1990.



- (i) It was not only vaccination that was responsible for the decline in the number of reported cases of tuberculosis. Give **one** piece of evidence from the graph to support this statement.

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(1)

- (ii) Suggest **one** reason, other than vaccination, for the decline in the number of reported cases of tuberculosis during the period shown.

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(1)

(Total 7 marks)

9. (a) (i) What is a pathogen?

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(1)

- (ii) What is an *attenuated* microorganism?

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(1)

- (b) Research by the World Health Organisation (WHO) has shown that a population is protected from a pathogenic disease when 95% of children are vaccinated against that disease. Explain why there is a low risk of a disease spreading when vaccination levels reach 95%.

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(2)

(c) The table shows information about vaccination levels against measles in 1997 and 2000.

| | Year | |
|---|------|------|
| | 1997 | 2000 |
| Percentage of children vaccinated against measles | 92 | 88.4 |

(i) Explain **one** advantage of recording the percentage of children vaccinated rather than the number of children vaccinated.

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(1)

(ii) For every 100 000 children born, calculate how many fewer children were vaccinated in the year 2000. Show your working.

Answer.....

(1)

(d) Give **two** ways in which passive immunity differs from active immunity.

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(2)

(Total 8 marks)

10. (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)

11. 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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(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.

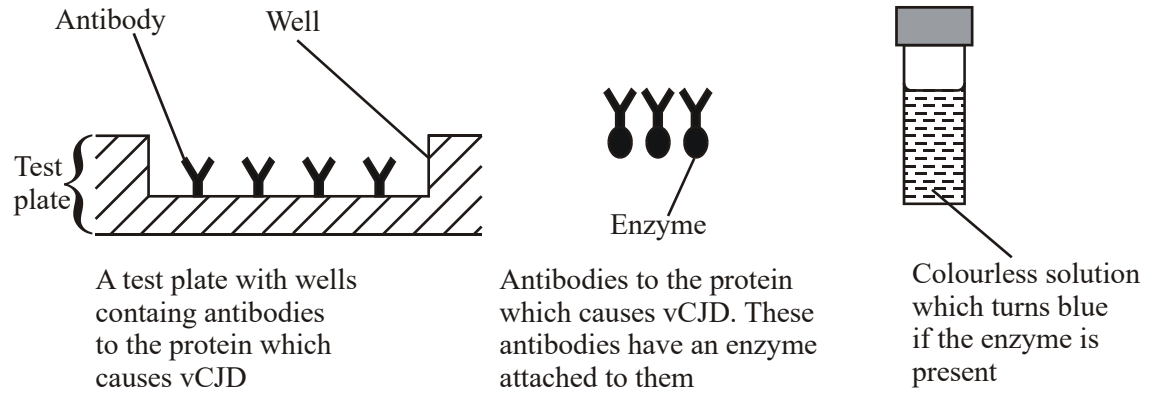
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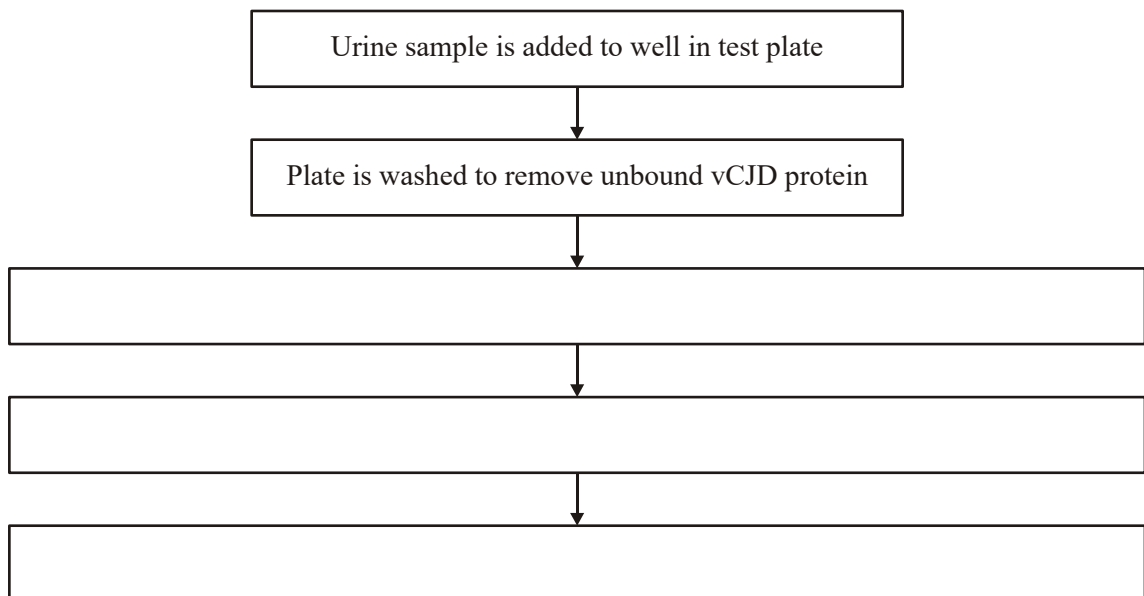
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12. A test has been developed to determine if a person is infected with variant CJD (vCJD), the human form of BSE (mad cow disease). The test detects the protein which causes vCJD in a urine sample.

The test kit contains the following components.



- (a) Complete the flow chart to describe how this test would be used.



(3)

- (b) Explain why this test would detect vCJD, but not other antigens in the urine.

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(2)

(Total 5 marks)

13. 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.

- 5 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)

14. The box jellyfish produces a poison (venom) which enters the blood when a person is stung. A person who has been stung can be treated with an injection of antivenom. This antivenom is produced by injecting small amounts of venom from box jellyfish into sheep, then extracting antibodies from the sheeps' blood. These antibodies are then injected into the person who has been stung.

- (a) If a sheep is injected with the box jellyfish venom on more than one occasion a higher yield of antivenom is obtained. Explain why.

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(2)

- (b) Injecting antivenom does not give a person lasting protection against the venom of box jellyfish. Explain why.

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(2)

- (c) Suggest **one** possible problem in injecting people with antivenom made in this way.

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(1)

(Total 5 marks)

15.S A medical officer investigated the effectiveness of five different types of influenza vaccine. A total of 1350 people agreed to be vaccinated. The medical officer divided these into five groups. The number who suffered from influenza in the following year was recorded. The results are shown in the table.

| Type of influenza vaccine | Number of people vaccinated | | | |
|---------------------------|-----------------------------|-------------------------------|-------|-------------------------------------|
| | Suffered from influenza | Did not suffer from influenza | Total | Proportion suffering from influenza |
| I | 43 | 237 | 280 | 0.15 |
| II | 52 | 198 | 250 | 0.21 |
| III | 25 | 245 | 270 | 0.09 |
| IV | | | 260 | 0.18 |
| V | 57 | 233 | 290 | 0.20 |

(a) Complete the spaces in the table for the people vaccinated with type IV vaccine.

(1)

(b) The medical officer used a statistical test to assess the effectiveness of the five different vaccines.

(i) What would be the null hypothesis?

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(1)

(ii) The statistical test gave a probability of less than 0.05. What conclusion can be drawn from this?

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(c) It was suggested that the raw data showed that the type III vaccine was the most effective. Give **two** reasons why this conclusion may not be reliable.

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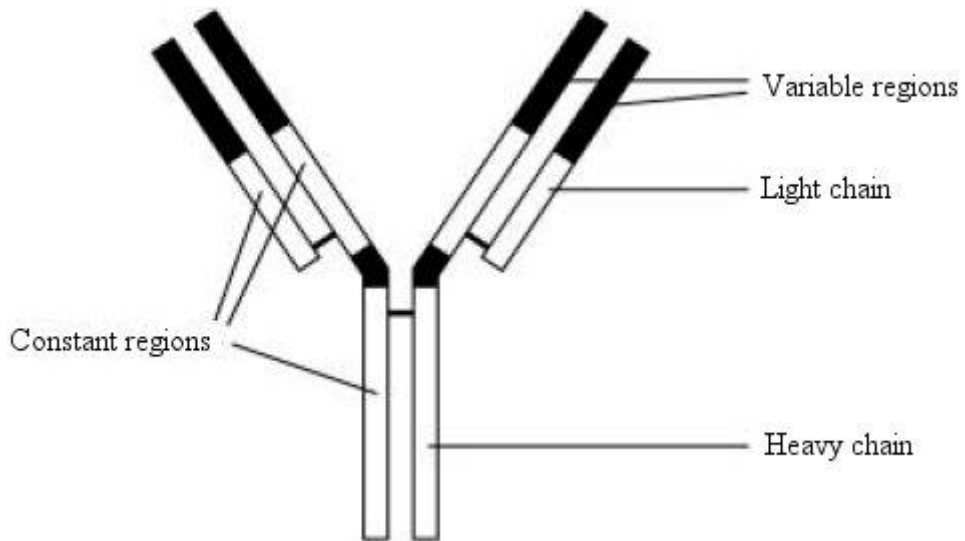
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(2)

(Total 5 marks)

16. 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)