1 The human body responds to infection by viruses in a number of ways.

The non-specific response involves interferon. The specific immune response requires antigen presentation to the cells of the immune system.

(a) Explain the importance of interferon in the body's response to infection by viruses.

(2)

(b) Describe the role of antigen presentation in the body's specific immune response to infection by viruses.

(4)

(c) There is an 'evolutionary race' between some viruses, such as HIV, and their host.

Suggest how this could affect the body's specific immune response to infection by viruses. Give an explanation for your answer.

(3)

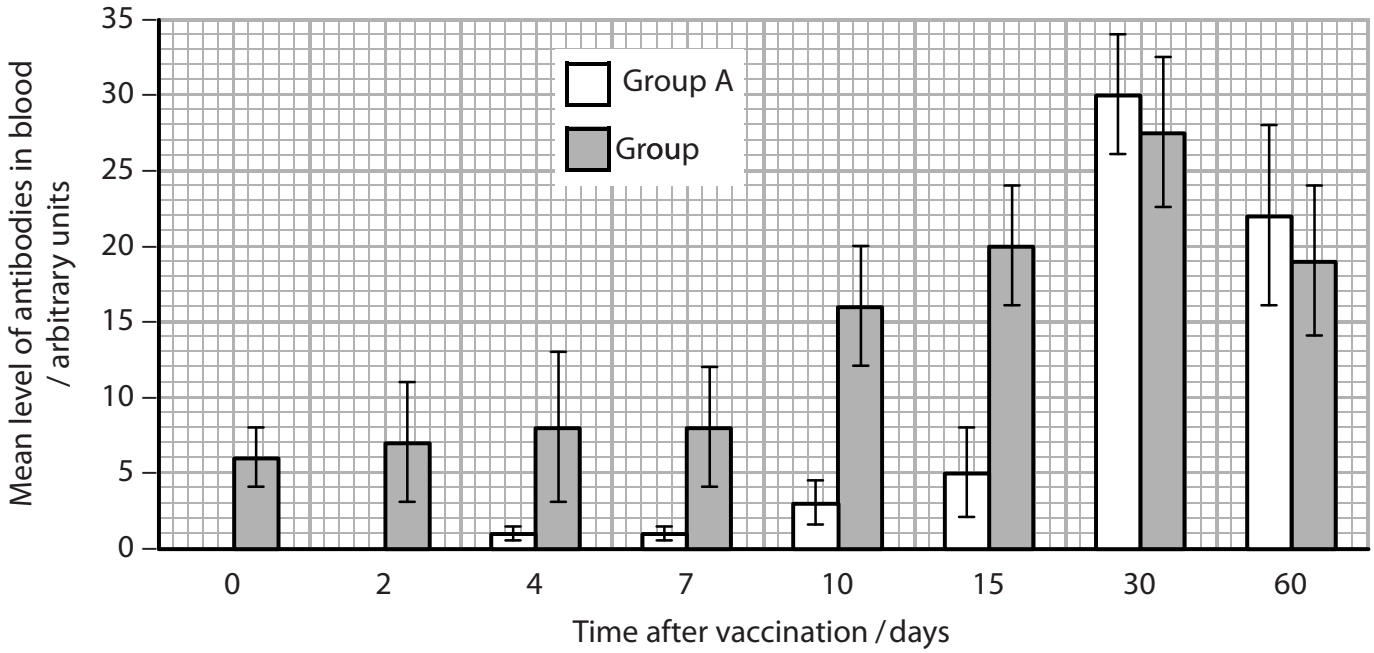
(Total for Question 1 = 9 marks)

2 Yellow fever is caused by a virus. Infection with this virus causes thousands of deaths every year in people who have not been vaccinated.

The graph below shows the mean levels of antibodies in the blood of two groups of people, group A and group B, after being vaccinated. The same vaccine was used each time.

Group A consisted of eight people. They were given a vaccination against yellow fever and their blood was analysed.

Group B consisted of nine people who had already been vaccinated against yellow fever. They were given a second vaccination and their blood was analysed.



(a) Place a cross ☒ in the box next to the term that describes the type of immunity that results from this vaccination against yellow fever.

(1)

☒ **A** artificial active

☒ **B** artificial passive

☒ **C** natural active

☒ **D** natural passive

(b) (i) Compare the changes in the mean levels of antibodies in these two groups of people in the first fifteen days after vaccination.

(2)

(ii) Explain why the mean levels of antibody in group B are different from group A in the first fifteen days.

(3)

(c) Using the information in the graph, explain the advantage of vaccinating people twice against yellow fever.

(2)

(d) Comment on the reliability of the data shown in the graph.

(3)

(Total for Question 2 = 11 marks)

3 Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

(2)

(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis,* are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

(2)

(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

(2)

(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

(3)

(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

(4)

(Total for Question 3 = 13 marks)

4 Bacteria and viruses can cause human diseases.

(a) Distinguish between the structure of bacteria and viruses

(3)

(b) Infection with a bacterium can result in the development of active immunity to that bacterium. This results in the production of antibodies by plasma cells.

(i) Describe how infection with a bacterium results in the production of plasma cells.

(4)

(ii) Explain how antibodies help a person to recover from an infection.

(2)

(iii) A person who has had an organ transplant has to take immunosuppressive drugs. This prevents the immune system from destroying the organ transplant. Some of these drugs work by inhibiting the production of cytokines.

Suggest what effect these drugs could have on a person infected with a bacterium or a virus.

(4)

(Total for Question 4 = 13 marks)