Exampro A-level Biology (7401/7402)

Name:

Class:

Immunology

Author:

Date:

Time: 115

Marks: 85

Comments: **These questions mix the different styles of questions. Short answers, practical techniques, experimental data analysis, extended answer and comprehension Work through these, the more you do the better you will become with your exam technique.**

Q1. (a) Phagocytes and lysosomes are involved in destroying microorganisms. Describe how.

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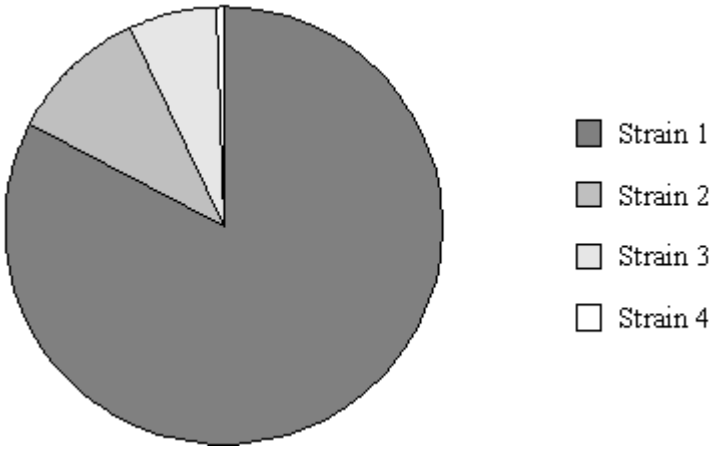
(3)

(b) The pie chart shows the proportions of people infected with four different strains of influenza virus early in 2004.



(i) A person may develop influenza twice within a short time. Use information from the pie chart to explain why.

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(2)

(ii) The information in the pie chart is valuable to companies who make influenza vaccines. Use your knowledge of antigens to explain why.

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(2)
(Total 7 marks)

Q2. (a) Describe how B-lymphocytes respond when they are stimulated by antigens.

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(4)

(b) The table gives information about some components of a red blood cell.

Component	Glycoprotein	Phospholipid	Haemoglobin
Location in cell	on outer surface of plasma membrane	within plasma membrane	in cytoplasm

Suggest which component of an intact red blood cell is most likely to act as an antigen during a blood transfusion. Explain your answer.

Component .....

Explanation .....

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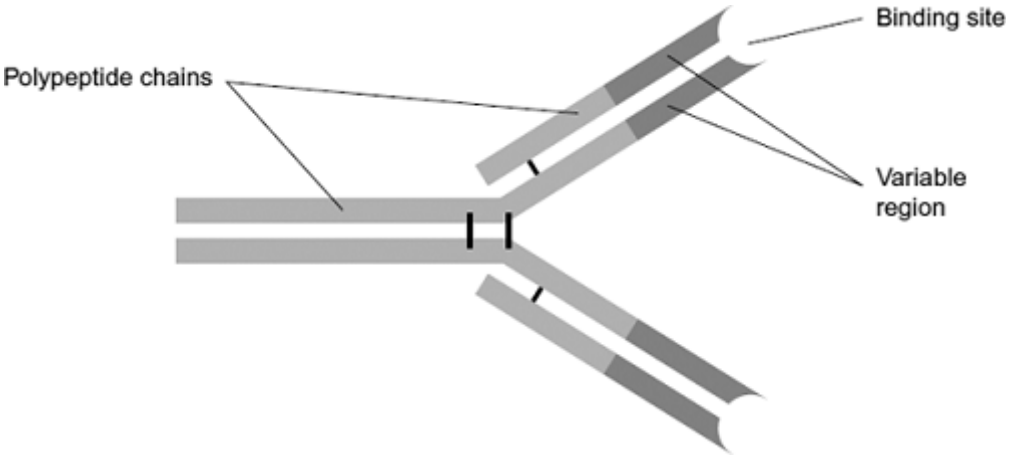
(2)
(Total 6 marks)

Q3. 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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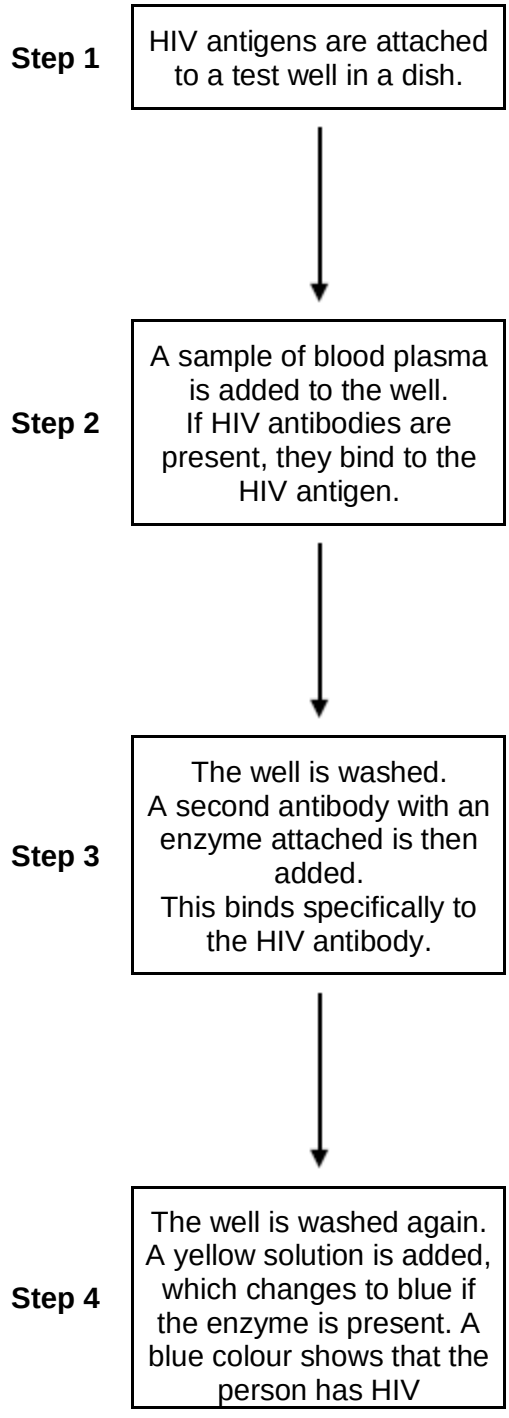
(3)
(Total 4 marks)

Q4. The figure below shows a test that has been developed to find out if a person has antibodies to the human immunodeficiency virus (HIV) antigen.



antibodies.

(a) This test only detects the presence of HIV antibodies. Give **two** reasons why it cannot be used to find out if a person has AIDS.

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2 .....

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(2)

(b) The solution will remain yellow if a person is **not** infected with HIV. Explain why.

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(2)

(c) A mother who was infected with HIV gave birth to a baby. The baby tested positive using this test. This does not prove the baby is infected with HIV.
Explain why.

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(2)

(d) A control well is set up every time this test is used. This is treated in exactly the same way as the test wells, except that blood plasma is replaced by a salt solution.

Use information from the figure above to suggest **two** purposes of the control well.

1 .....

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2 .....

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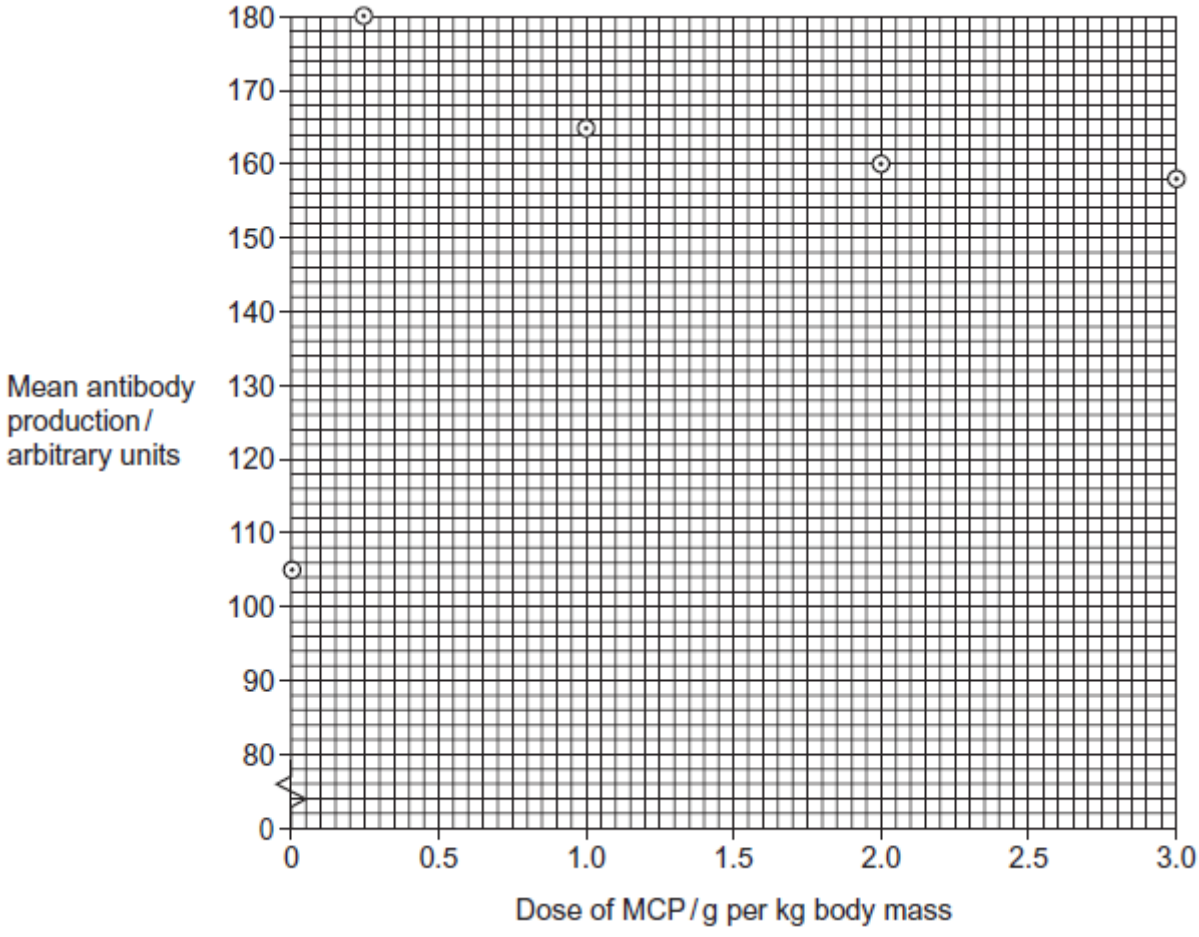
(2)
(Total 8 marks)

Q5. Scientists tested a claim that modified citrus pectin (MCP) increased the production of antibodies by the immune system.

- They divided a large number of mice into five groups.
- They gave the mice in each group a different amount of MCP in their food.
- The scientists then stimulated antibody production in the mice. They did this by injecting them with a solution containing sheep red blood cells.

The results are shown in the graph.



(a) The data obtained in this investigation have been plotted on a graph. How would you join the points? Give a reason for your answer.

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(1)

(b) Use the graph to describe the effect of MCP on mean antibody production.

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(2)

(c) Calculate the percentage increase in antibody production from when there was no MCP in the diet to when the dose is 1.0 g per kg.

Answer .....%

(2)

(d) The dose of MCP given to the mice was calculated in g per kg body mass. Explain why the dose was calculated per unit mass.

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(1)

(e) Explain how antibodies were produced when the mice were injected with sheep red blood cells.

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(Extra space) .....

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(3)

(f) A newspaper suggested that these data show that taking MCP will give people increased resistance to disease. With reference to the data give **two** reasons why this conclusion may **not** be valid.

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2 .....

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(2)
(Total 11 marks)

Q6. In the early 1980s, before DNA analysis had been developed, scientists investigated the genetic variation of cheetahs living in captivity. They used skin grafts to do this. They carried out skin grafts on anaesthetised animals by

- removing a small piece of skin from one animal. This animal was the recipient.
- replacing the removed skin by a piece of skin taken from another animal. This animal was the donor.
- attaching the new piece of skin with stitches.

A graft may be accepted by the recipient. It will be rejected if the recipient's immune system recognises the antigens on the skin as foreign.

Scientists carried out skin grafts between cheetahs living in captivity and domestic cats. The table shows the data that they obtained.

Recipient of skin graft	Donor of skin graft	Relationship	Time taken for the graft to be rejected / days
Domestic cat 1	Domestic cat 2	Unrelated	13

Cheetah 1	Domestic cat 3	Unrelated	12
Cheetah 1	Cheetah 2	Sisters	No rejection after 52 days
Cheetah 3	Cheetah 4	Unrelated	49
Cheetah 5	Cheetah 6	Unrelated	No rejection after 78 days
Cheetah 7	Cheetah 8	Unrelated	No rejection after 41 days
Cheetah 9	Cheetah 10	Unrelated	No rejection after 24 days
Cheetah 11	Cheetah 12	Unrelated	No rejection after 14 days
Cheetah 13	Cheetah 14	Unrelated	No rejection after 44 days

The scientists also grafted skin from one area to another on the same animal. These grafts were not rejected.

(a) (i) The scientists grafted skin from a domestic cat to a cheetah. Suggest why.

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(1)

(ii) They also grafted skin from one area to another on the same animal. Explain why.

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(1)

(b) (i) Give **three** conclusions that you can make from the data in the table above about the time taken for rejection.

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2. .....

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3. .....

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(3)

(ii) Give **one** reason why these conclusions may **not** be reliable.

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(1)

(iii) There are proteins on the skin of cheetahs that act as antigens. What do the data in the table suggest about these cheetah antigens?

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(1)

(iv) Antigens are proteins. Explain why a knowledge of antigens can show that animals are genetically similar.

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(2)

(Total 9 marks)

Q7. (a) What is vaccination?

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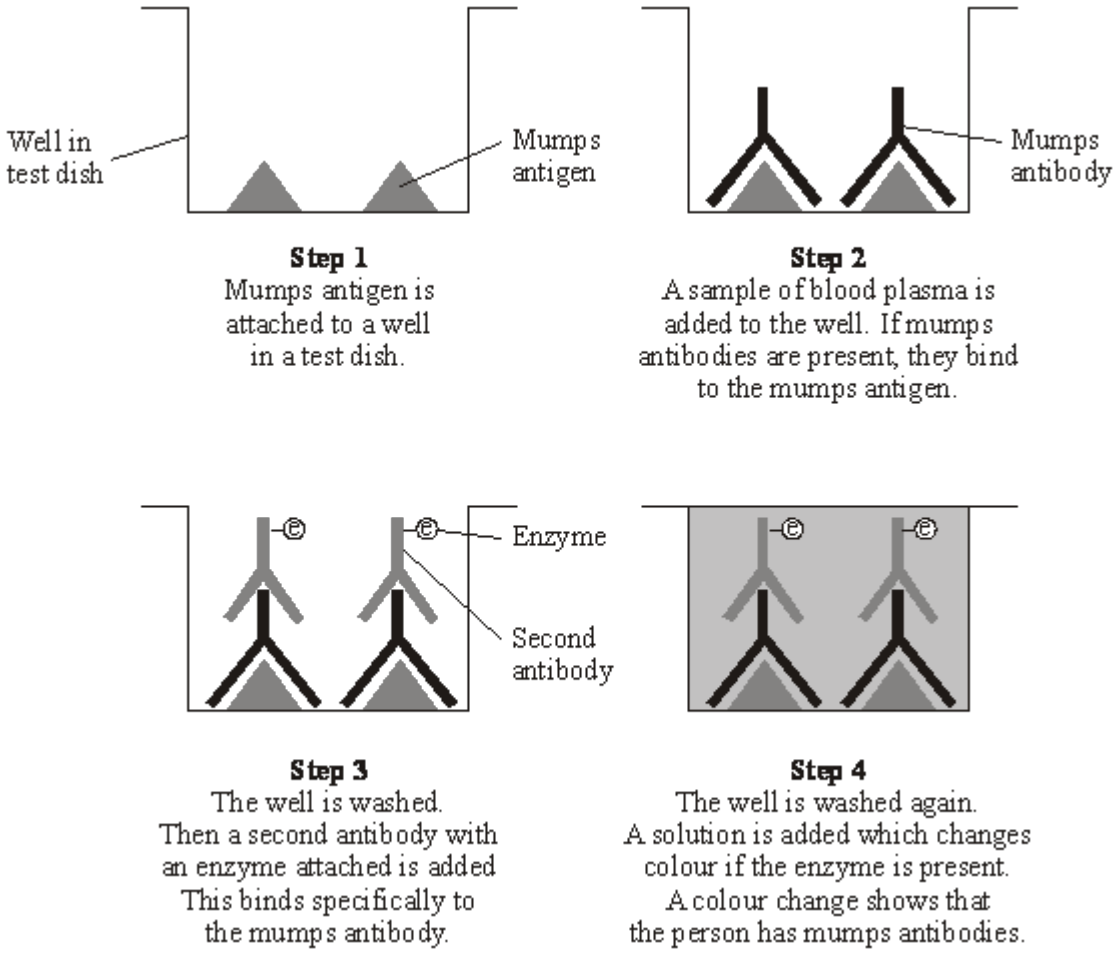
(2)

(b) A test has been developed to find out whether a person has antibodies against the

mumps virus. The test is shown in the diagram.



(i) Explain why this test will detect mumps antibodies, but not other antibodies in the blood.

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(1)

(ii) Explain why it is important to wash the well at the start of **Step 4**.

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(2)

(iii) Explain why there will be no colour change if mumps antibodies are not present in the blood.

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(2)
(Total 7 marks)

Q8. 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)

Q9.

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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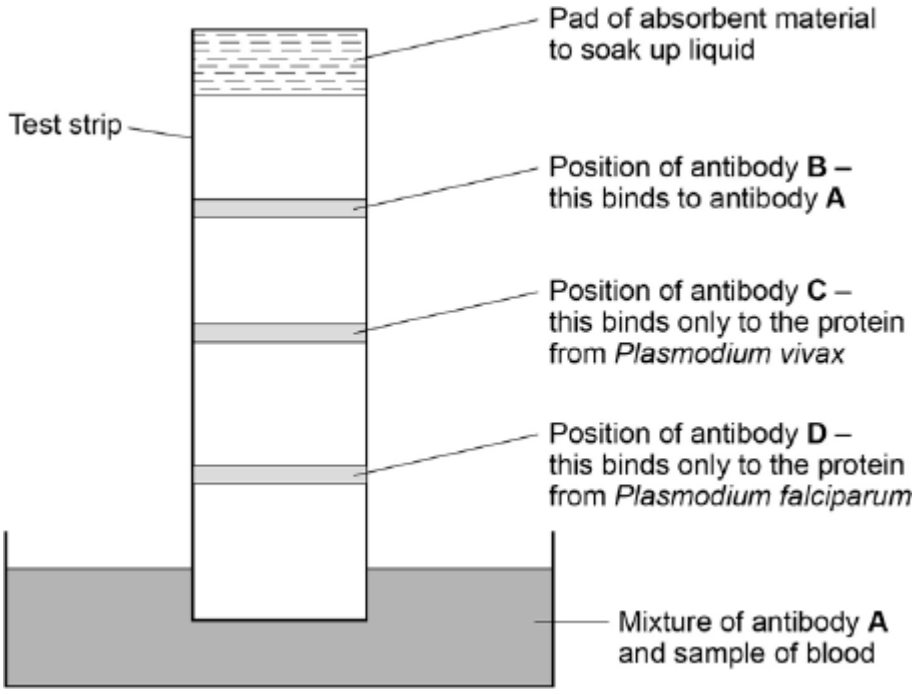
(3)
(Total 10 marks)

Q10. Malaria is a disease caused by parasites belonging to the genus *Plasmodium*. Two species that cause malaria are *Plasmodium falciparum* and *Plasmodium vivax*.

A test strip that uses monoclonal antibodies can be used to determine whether a person is infected by *Plasmodium*. It can also be used to find which species of *Plasmodium* they are infected by.

- A sample of a person's blood is mixed with a solution containing an antibody, **A**, that binds to a protein found in both species of *Plasmodium*. This antibody has a coloured dye attached.
- A test strip is then put into the mixture. The mixture moves up the test strip by capillary action to an absorbent pad.
- Three other antibodies, **B**, **C** and **D** are attached to the test strip. The position of these antibodies and what they bind to is shown in **Figure 1**.

Figure 1



(a) Explain why antibody **A** attaches only to the protein found in species of *Plasmodium*.

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(2)

(b) Antibody **B** is important if this test shows a person is not infected with *Plasmodium*.

Explain why antibody **B** is important.

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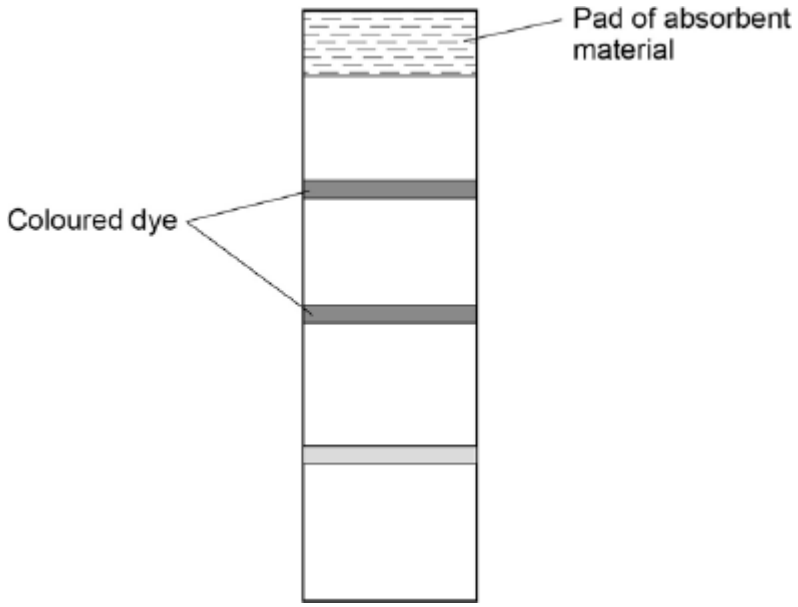
(2)

(c) One of these test strips was used to test a sample from a person thought to be infected with *Plasmodium*. **Figure 2** shows the result.

Figure 2



What can you conclude from this result?

Explain how you reached your conclusion.

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(4)
(Total 8 marks)