1 The Human Immunodeficiency Virus (HIV) infects cells of the human immune system.

(a) (i) Place a cross (☒) in the box next to the name of the type of cell in the human immune system that is infected by HIV.

(1)

☒ **A** B effector cell

☒ **B** B memory cell

☒ **C** T helper cell

☒ **D** T killer cell

(ii) Place a cross (☒) in the box next to the name of the enzyme used to produce DNA from viral RNA in an infected cell.

(1)

☒ **A** DNA polymerase

☒ **B** RNA polymerase

☒ **C** restriction endonuclease

☒ **D** reverse transcriptase

(b) An antibody, known as 2G12, has been isolated from the blood of an HIV patient.

(i) State **two** characteristic features of antibodies.

(2)

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*(ii) The antibody 2G12 is produced in response to part of a glycoprotein found on the surface of HIV. Synthetic molecules have been made that resemble this part of the glycoprotein. The antibody 2G12 binds to these synthetic molecules.

Using the information, suggest how this may enable scientists to develop a means of producing **active** immunity to HIV infection.

(5)

(c) The table below shows some data about groups of people with HIV infection, in the United Kingdom in 2010.

Group	Numbers in the United Kingdom
People newly-diagnosed with HIV infection	6 630
People unaware of their HIV infection	21 625
People receiving treatment for HIV infection	65 000

Some of the figures shown in the table are estimates.

Suggest why data about HIV infections are often estimates.

(2)

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(Total for Question 1 = 11 marks)

2 Histamine and the proteins interferon and lysozyme are involved in the non-specific responses to infection.

(a) (i) Describe how the production and action of interferon differs from the production and action of lysozyme.

(3)

(ii) Suggest why the protein structure of lysozyme is important to the way in which it acts against pathogens.

(4)

(b) Following a bite by an insect, the area around the bite may show signs of inflammation as histamine is released.

(i) Explain why an insect bite, which breaks the surface of the skin, may lead to inflammation around the injury.

(3)

(ii) In order to reduce inflammation, a cream containing antihistamines might be applied to the skin, around an insect bite.

Suggest why applying this cream might be better than taking tablets containing antihistamines.

(3)

(Total for Question 2 = 13 marks)

3 In the immune response, antibodies are produced that are specific to the antigens of the pathogen causing the infection.

(a) Place a cross ☒ in the box next to the type of cell that produces antibodies as part of the immune response.

(1)

☒ **A** erythrocyte

☒ **B** macrophage

☒ **C** plasma cell

☒ **D** thrombocyte

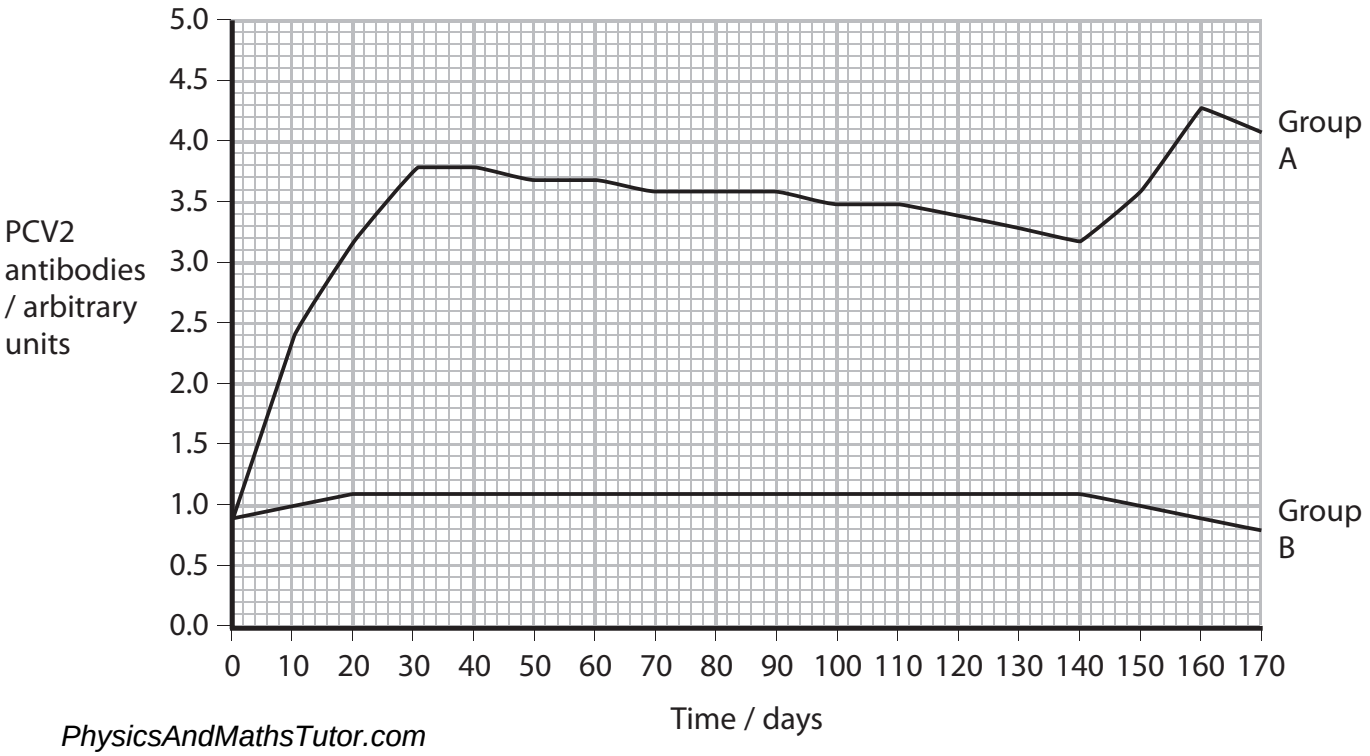
(b) In pigs, the disease known as post-weaning multisystematic syndrome (PWMS) is caused by the PCV2 virus. Common symptoms of PWMS include weight loss, breathing difficulties and enlargement of the lymph nodes. Most pigs diagnosed with PWMS will have to be destroyed.

A new vaccine has been developed to give gilts (female pigs having their first pregnancy) active immunity against PWMS. To test this vaccine, gilts were divided into two groups, A and B.

Group A gilts were vaccinated against PWMS on day 0, at the start of pregnancy. A second vaccination was given on day 20. A final vaccination was given on day 140, approximately 20 days before they were due to give birth.

Group B gilts were given no vaccine.

The graph below shows the results of blood tests to measure the concentration of PCV2 antibodies in these two groups.



(i) Describe how the vaccine gives **active immunity** against PWMS.

(3)

(ii) Apart from having no vaccine, suggest how group B should be treated during the test. Give reasons for your answer.

(3)

(iii) Compare the changes in concentrations of PCV2 antibodies in the blood of the two groups of gilts during pregnancy.

(3)

(iv) The table below shows the concentration of PCV2 antibodies detected in the piglets produced by the two groups of gilts, during the first 40 days after birth.

Age of piglets / days	Concentration of PCV2 antibodies / arbitrary units	
	Group A piglets	Group B piglets
0	3.9	0.7
10	3.2	0.8
20	3.0	2.6
40	2.9	2.9

Suggest reasons for the changes in the concentrations of PCV2 antibodies in group A and group B piglets.

(3)

(Total for Question 3 = 13 marks)

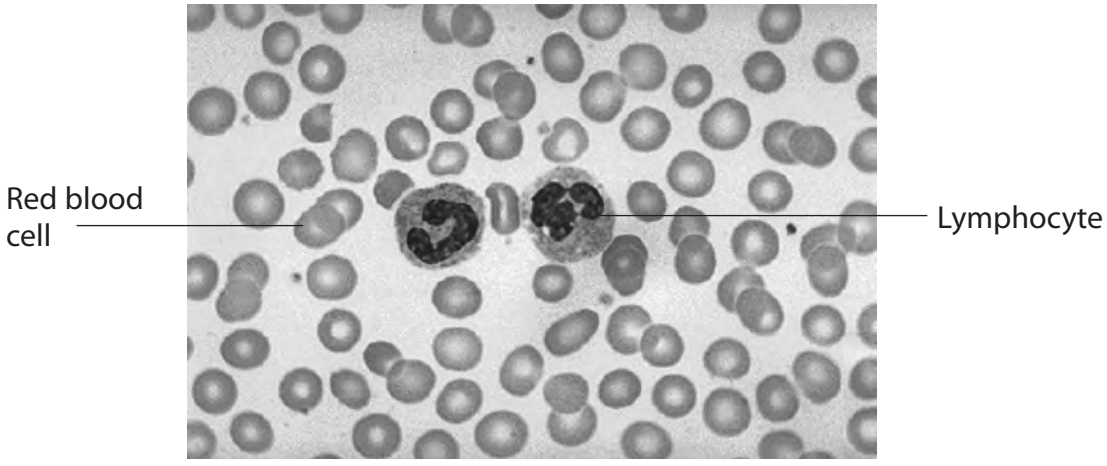
4 (a) The table below describes some features of the lymphocytes that are involved in the immune system.

Place a tick (✓) in the appropriate column to indicate whether the description is true or false.

(4)

Description	True	False
B and T cells are formed in the bone marrow		
B cells stimulate T cells to produce clones of memory cells		
T helper cells produce chemicals that destroy pathogens		
B and T cells are able to form clones by mitosis		

(b) A sample of blood was taken from a person with a bacterial infection.
The photograph below shows some of the cells in this blood sample.



Suggest **two** reasons why the bacteria that caused the infection are not visible in the photograph.

(2)

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(c) Suggest how a further sample of blood, taken a few days later, might differ from the one shown in the photograph, in each of the following circumstances. Give a reason for each answer.

(i) If the person is treated with antibiotic drugs.

(2)

(ii) If the person is given a placebo.

(2)

(Total for Question 4 = 10 marks)