Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2005
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION B) BYB7/A
Unit 7 Section A Microbes and Disease

Friday 24 June 2005 1.30 pm to 3.45 pm

In addition to this paper you will require:
- Section B provided as an insert (enclosed);
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: The total time for Section A and Section B of this paper is 2 hours 15 minutes.

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in **Section A** in the spaces provided. All working must be shown.
- **Section A** and **Section B** will be marked by different examiners. You must ensure that any extra sheets are fastened to the appropriate question paper answer book.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for **Section A** is 50.
- Mark allocations are shown in brackets.
- You are reminded of the need for clear presentation in your answers. All answers should be in good English and should use accurate scientific terminology.
- You are advised to spend 1 hour on **Section A**.
- You are reminded that **Section A** requires you to use your knowledge of different parts of the specification as well as Module 7 in answering synoptic questions. These questions are indicated by the letter **S**.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
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4			
5			
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7			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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SECTION A

Answer **all** questions in the spaces provided.

1 (a) Describe how each of the following parts of the body is protected to prevent microorganisms entering living cells.

(i) Skin

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(1 mark)

(ii) Lungs

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(1 mark)

(iii) Eyes

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(1 mark)

(b) Describe how macrophages help to prevent the spread of microorganisms that enter the blood and other tissues.

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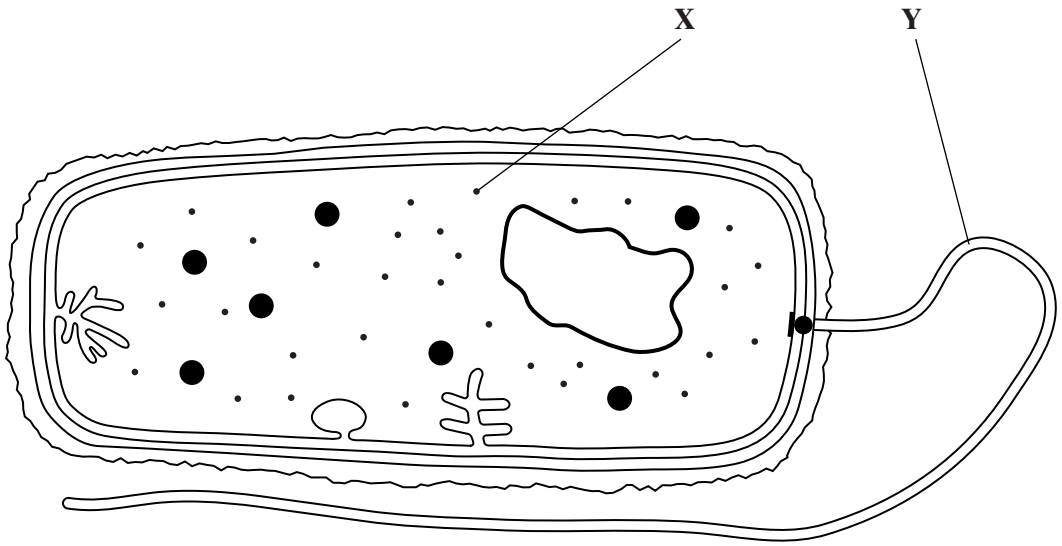
(2 marks)

5

2 The diagram shows a bacterium.



(a) Give the function of

(i) organelle **X**;

.....

(ii) organelle **Y**.

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(2 marks)

S (b) (i) Give **two** ways in which the structure of this bacterium is similar to the structure of a cell lining the human small intestine.

1 .....

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2 .....

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(2 marks)

(ii) Give **two** ways in which the structure of this bacterium differs from the structure of a cell lining the human small intestine.

1 .....

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2 .....

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(2 marks)

6

Turn over ▶

3 (a) With reference to typhoid fever and salmonella food poisoning, explain what is meant by infectivity.

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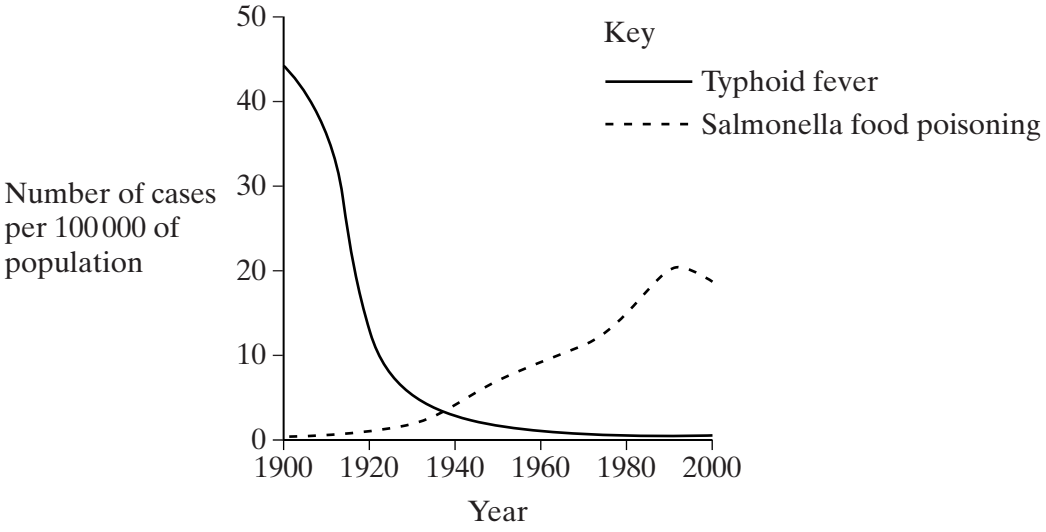
(2 marks)

(b) Typhoid fever is mainly a water-borne infection. Salmonella food poisoning is caused by contaminated food. The graph shows changes in the incidence of these diseases in the USA in the twentieth century.



Suggest an explanation for the overall trend in the number of cases of

(i) typhoid fever;

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(1 mark)

(ii) salmonella food poisoning.

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(1 mark)

4 Penicillin was first used to treat infections in the 1940s.

(a) Describe how penicillin prevents the growth of bacteria.

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(1 mark)

(b) The bacterium *Staphylococcus aureus* is a common cause of life-threatening infections. By the 1960s it had already become resistant to the antibiotic penicillin.

(i) Describe **one** mechanism of resistance to penicillin.

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(1 mark)

S (ii) Explain how *S. aureus* evolved resistance to penicillin.

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(3 marks)

(c) If a patient fails to respond to treatment with penicillin, another antibiotic, called vancomycin, may be used. In 2002 a patient was found to be infected with a strain of *S. aureus* containing a gene that made it resistant to vancomycin. The same gene was found to be very common in bacteria of the species *Enterococcus faecalis* from the gut of the patient. Suggest how some of the *S. aureus* bacteria came to contain the vancomycin-resistance gene.

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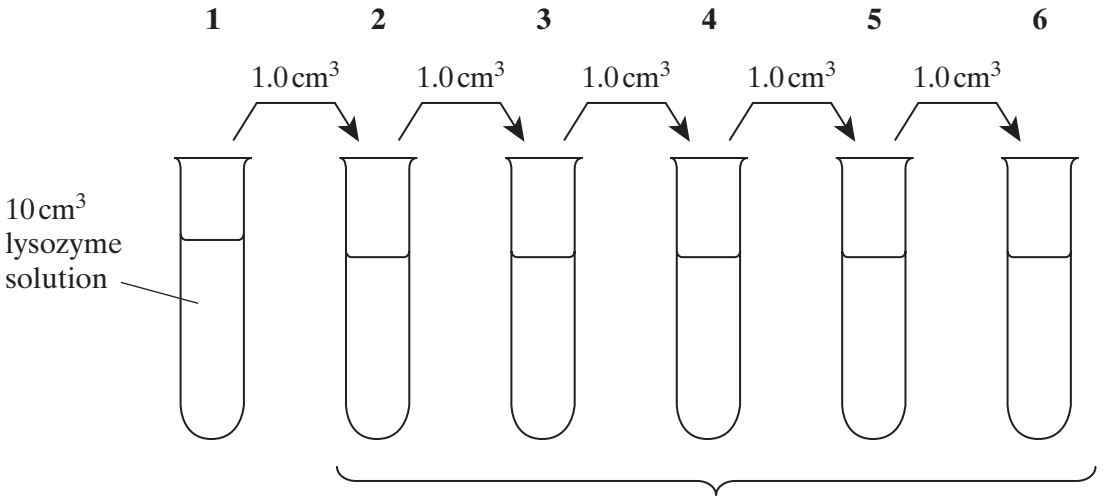
(2 marks)

7

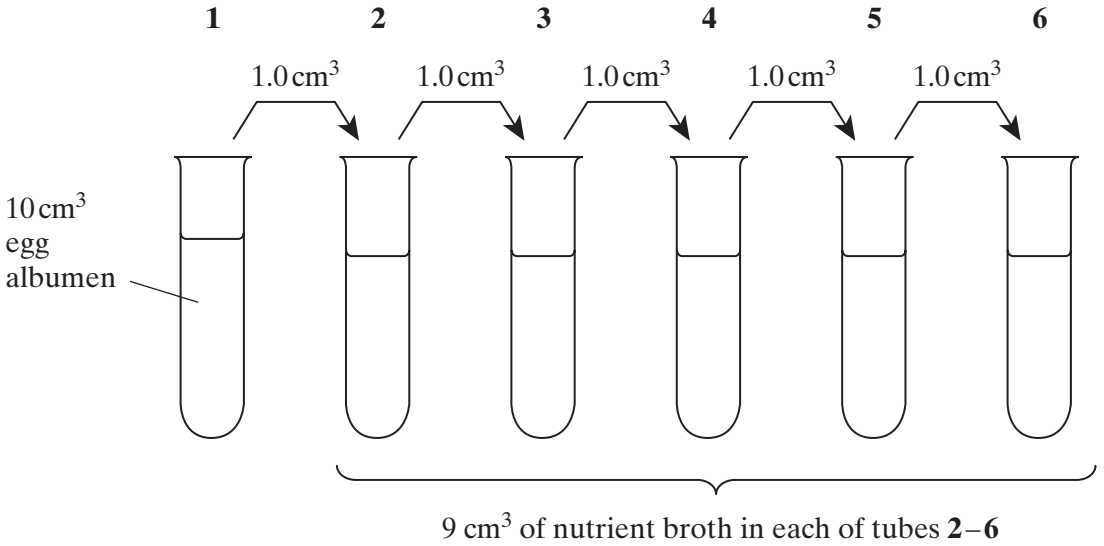
5 Egg albumen contains lysozyme which kills bacteria. The concentration of lysozyme in egg albumen can be determined by comparing the effect of serial dilutions of lysozyme solution and egg albumen on a bacterial culture. The diagram shows how the serial dilutions were made.

In series **A**, 10 cm^3 of lysozyme solution containing 35 $mg\,cm^{-3}$ was placed in tube **1**. Serial dilutions were made as shown. In series **B**, 10 cm^3 of egg albumen was placed in tube **1**. Serial dilutions were made as shown. All the tubes were then inoculated with 1 cm^3 of a bacterial culture and left in the same conditions for 30 minutes.

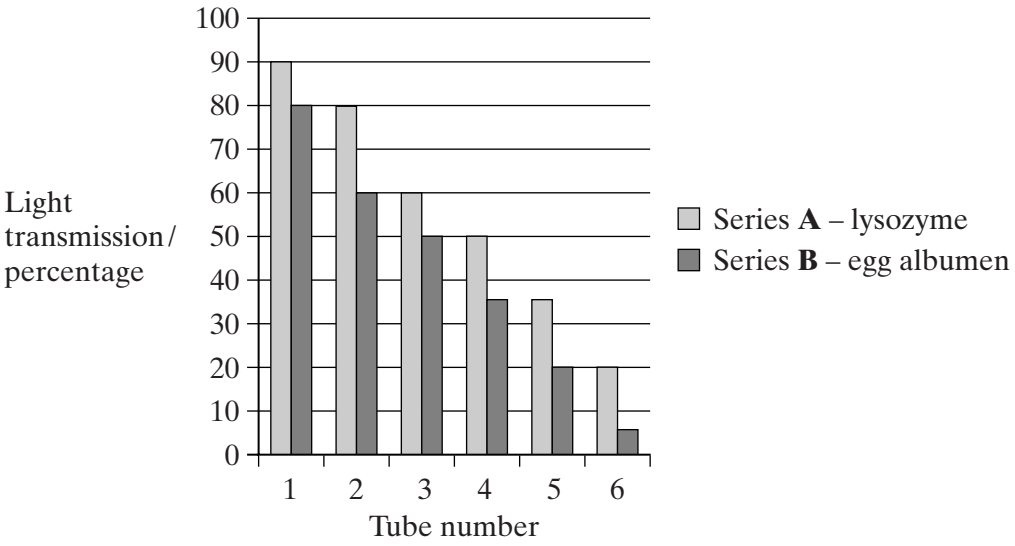
Series **A**



Series **B**



Light transmission through all the tubes was the same initially. The graph shows the light transmission through each tube after 30 minutes.



(a) Explain the effect of dilution on light transmission through the tubes in series **A**.

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(2 marks)

(b) (i) Use the graph to find the concentration of lysozyme in the egg albumen in tube **2**. Explain how you obtained your answer.

Concentration ..... $mg\,cm^{-3}$

(2 marks)

(ii) Calculate the mass of lysozyme in an egg containing $50\,cm^3$ of egg albumen. Show your working.

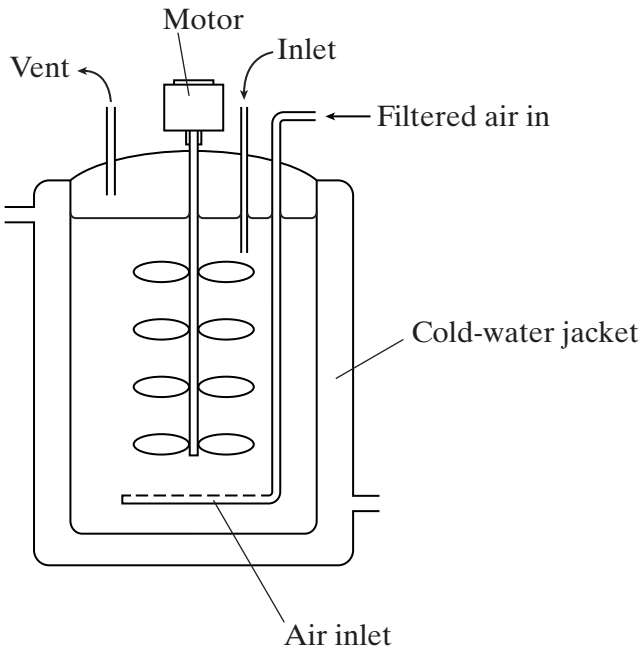
Mass ..... mg

(2 marks)

6

Turn over ▶

6 The diagram shows a fermenter used to produce penicillin from *Penicillium* fungus.



(a) (i) Explain why the air is filtered before it enters the fermenter.

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(2 marks)

(ii) Explain why the cold-water jacket is necessary.

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(2 marks)

S (b) The culture medium for the *Penicillium* includes lactose (a sugar), potassium phosphate and ammonia.

Explain why each of these is provided in the medium.

(i) Lactose

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(1 mark)

(ii) Phosphate

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(1 mark)

(iii) Ammonia

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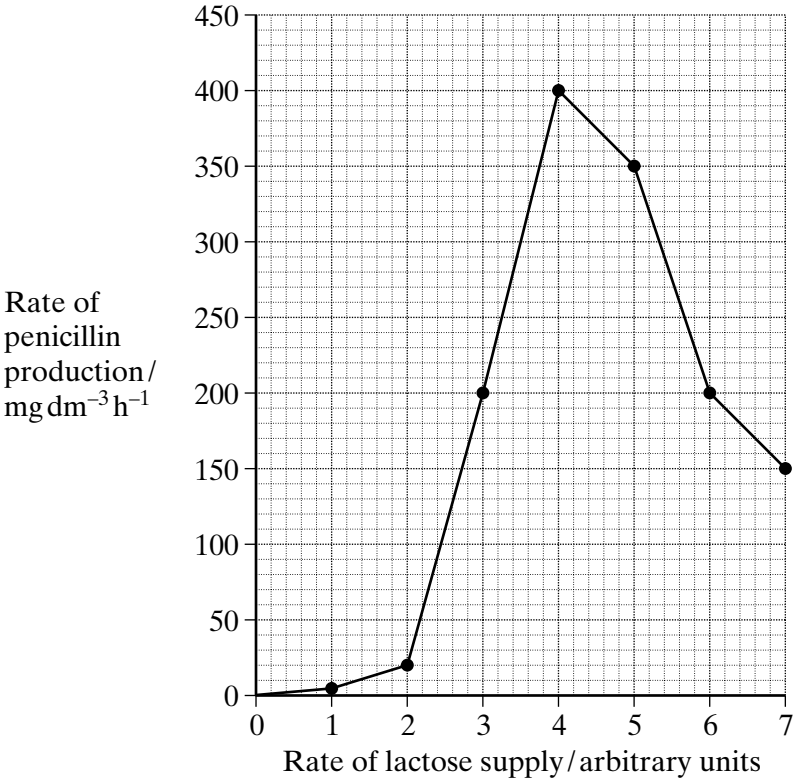
(1 mark)

QUESTION 6 CONTINUES ON THE NEXT PAGE

(c) Penicillin is usually produced by batch culture. An investigation was done to find out whether continuous culture could be used. Lactose solution was supplied to the fermenter at different rates and the rate of penicillin production was determined. The graph shows the results.



(i) Describe the effect of the rate of lactose supply on the rate of penicillin production.

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(2 marks)

(ii) Suggest an explanation for the rate of penicillin production at the highest rates of lactose supply.

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(2 marks)

7 (a) Describe the structure of a human immunodeficiency virus (HIV).

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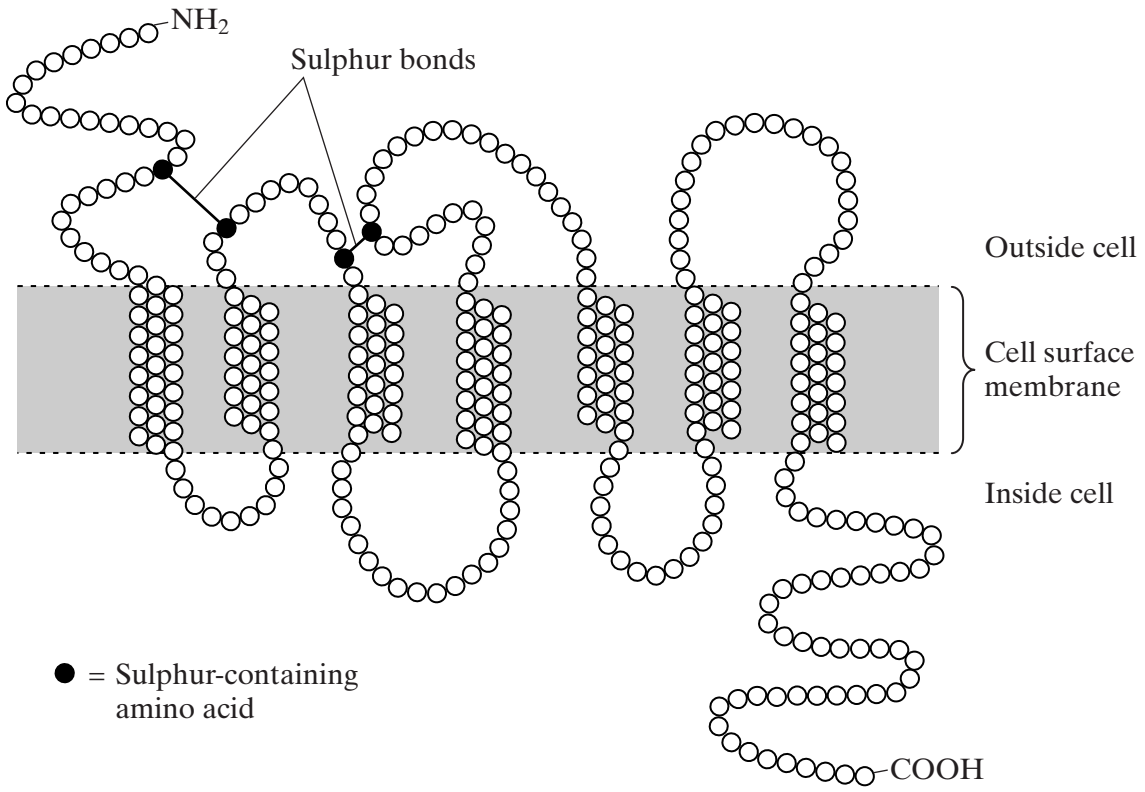
(2 marks)

S (b) HIV enters blood cells via CCR5 receptor molecules in the cell surface membranes. The diagram shows a CCR5 receptor, which is a protein.



Using information from the diagram, describe the structure of the CCR5 molecule in terms of its primary, secondary and tertiary structure.

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(3 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ▶

S (c) Some people carry a mutant form of a gene which results in a different form of the CCR5 protein. This interferes with the ability of HIV to infect human cells.

(i) Give **one** way in which the mutant gene may differ from the normal gene.

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(1 mark)

(ii) Suggest how the mutant form of the gene results in protection from HIV.

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(3 marks)

S (d) Smallpox is a viral disease that has been eradicated by mass vaccination. The smallpox virus uses the same receptors as HIV to enter cells of the immune system. People vaccinated against smallpox are much more resistant to HIV than unvaccinated people. Using the information given above, suggest an explanation for this.

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(2 marks)

11

END OF SECTION A

SECTION B IS PROVIDED AS AN INSERT

Question 7 Samson M, Libert F et al. *Nature* 382 (6593) p722 1996