1 The skin has an important role in protecting the body from infection by pathogenic bacteria. Human skin has a community of microorganisms, called the skin flora, living on it. Most of these microorganisms are harmless bacteria that feed on dead skin cells and secretions.

(a) (i) State **two** ways in which the skin flora can help to protect a person from infection by pathogenic bacteria.

(2)

1 .....

.....

2 .....

.....

(ii) Place a cross ☒ next to the part of the skin that forms a physical barrier against infection by pathogenic bacteria.

(1)

☒ **A** Epidermis

☒ **B** Erector pili

☒ **C** Malpighian layer

☒ **D** Sebaceous gland

(b) Influenza (flu) is caused by a virus.
Sometimes antibiotics are used as part of the treatment for a person with influenza.

Suggest why antibiotics may be used as part of the treatment for influenza.

(2)

.....

.....

.....

.....

.....

.....

(c) The overuse of antibiotics is causing concern.
The table below shows the number of prescriptions for antibiotics per 10 000 population in the USA, given during treatment for influenza, from 2000 to 2006.

Year	Number of prescriptions per 10 000 population
2000	226
2002	164
2004	172
2006	142

(i) Calculate the overall percentage reduction in the number of prescriptions per 10 000 population in the USA from 2000 to 2006.
Show your working.

(2)

Answer ..... %

(ii) The target set by health authorities in the USA for the number of prescriptions per 10 000 population by 2012 is 128, an overall reduction of 43.4% since 2000.

Suggest whether this target will be achieved.
Give an explanation for your answer.

(3)

.....

.....

.....

.....

.....

.....

.....

(iii) Suggest why health authorities in the USA are encouraging the reduction in the number of prescriptions of antibiotics.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 1 = 12 marks)

2 Human immunodeficiency virus (HIV) causes the condition known as acquired immunodeficiency syndrome (AIDS) in humans.

(a) Complete the following table by placing a tick (✓) in the correct column next to each statement to show whether it is true or false.

(3)

Statement	True	False
HIV infects b-lymphocytes in the human immune system		
The genetic material in HIV is a form of RNA		
The enzyme, reverse transcriptase, is used by HIV		

(b) Following infection by HIV, the genetic material will be copied as the virus reproduces. A single virus reproduces at a very fast rate giving rise to billions of viruses in just one day.

During reproduction of HIV, many genetic mutations are produced. This means that many new strains of HIV can develop quickly within an infected person.

(i) Explain what is meant by the term **genetic mutation**.

(2)

.....

.....

.....

.....

(ii) Suggest why effective treatment of HIV in human populations will require the continual development of a mixture of many new drugs.

(4)

(Total for Question 2 = 9 marks)

3 A white blood cell is an example of a typical eukaryotic animal cell.

(a) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) In eukaryotic cells, two organelles with a double membrane are

(1)

☒ **A** the nucleus and smooth endoplasmic reticulum

☒ **B** a nucleus and a mitochondrion

☒ **C** a mitochondrion and a ribosome

☒ **D** a mitochondrion and smooth endoplasmic reticulum

(ii) White blood cells, plant cells and prokaryotic cells all contain

(1)

☒ **A** a nucleus

☒ **B** Golgi apparatus

☒ **C** ribosomes

☒ **D** smooth endoplasmic reticulum

(iii) A structure present in prokaryotic cells but not present in a white blood cell is

(1)

☒ **A** a cell wall

☒ **B** a centriole

☒ **C** a ribosome

☒ **D** rough endoplasmic reticulum

(b) There are several types of stem cell found in humans.

The table below shows some features of two types of stem cell. If the feature applies to the stem cell place a tick (✓) in the box and if it does not apply, place a cross (✗) in the box.

(2)

Features	Totipotent stem cell	Pluripotent stem cell
Can give rise to totipotent stem cells		
Can give rise to differentiated cells		

*(c) Human bone marrow contains stem cells that can give rise to various types of blood cell including white blood cells.
Suggest how a stem cell in the bone marrow can become a differentiated blood cell.

(4)

(Total for Question 3 = 9 marks)

4 (a) Some of the ways by which a person may acquire antibodies to become immune to a disease are listed below.

A - artificial active

B - artificial passive

C - natural active

D - natural passive

Complete the table below by writing the letter of the most appropriate form of immunity shown in the list.

(2)

Source of antibodies	Form of immunity
Passed across placenta to fetus from mother	
Injected from another individual	
Produced as a result of suffering from the disease	
Produced following vaccination using antigen	

(b) Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium. When it enters the blood it can stimulate the production of several different clones of plasma cells. These produce a variety of antibodies (polyclonal antibodies).
Suggest an explanation for this.

(4)

(c) In the laboratory, it is possible to produce clones of special cells that only produce one type of antibody (monoclonal antibodies). These monoclonal antibodies can be used to detect the presence of antigens in the blood.

Suggest the advantage of using monoclonal antibodies, rather than polyclonal antibodies, in the detection of antigens in the blood.
Give reasons for your answer.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 4 = 9 marks)