1 Bovine respiratory diseases (BRD) are a major problem in cattle, causing serious economic losses. The causes of BRD are multiple and complex.
The most severe cases of BRD involve infections by both viruses and bacteria.

(a) The table below shows some features found in bacteria and viruses.
For each feature, place **one** cross ☒ in the appropriate box, in each row, to show whether it is found in bacteria only, in viruses only or in both bacteria and viruses.

(3)

Feature	Bacteria only	Viruses only	Both bacteria and viruses
Glycogen granules	☒	☒	☒
Nucleic acids	☒	☒	☒
Protein coat (capsid)	☒	☒	☒

(b) Mild cases of BRD can usually be treated using antibiotics.
The treatment of severe cases of BRD will involve the use of antibiotics and other medications.

(i) Suggest why medications, other than antibiotics, are needed to treat the most severe cases of BRD.

(2)

(ii) The table below shows the effectiveness of various antibiotics on three species of bacteria that can contribute towards severe cases of BRD.

Antibiotic	**Effectiveness of various antibiotics on three BRD bacterial pathogens (%)**		
	Mannheimia haemolytica	***Pasteurella multocida***	***Histophilus somni***
Danofloxacin	71	88	84
Enrofloxacin	83	93	95
Florfenicol	85	90	95
Oxytetracycline	56	70	55
Spectinomycin	72	76	67
Tilmicosin	61	64	93

A group of cattle has BRD but the bacteria pathogen has not been identified. Suggest which antibiotics would be the most suitable to use to treat these cattle.
Give reasons for your answer.

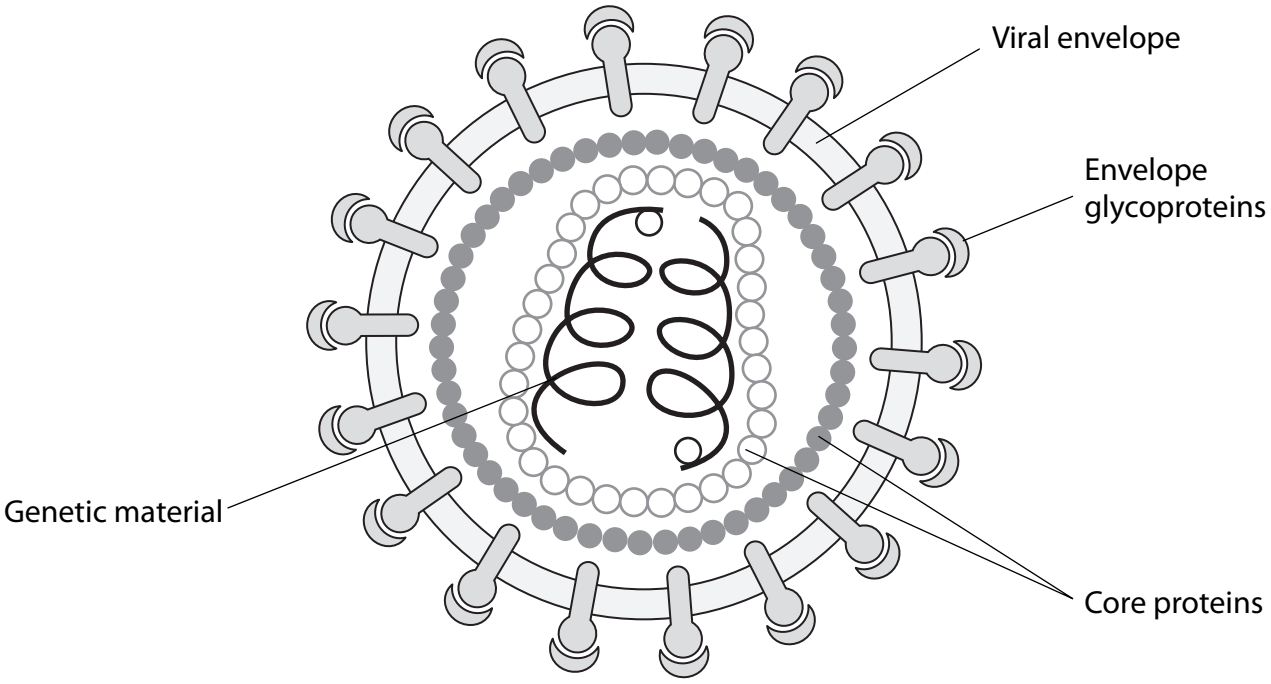
(3)

(iii) Suggest why it might be advisable to change the antibiotic being used, in the treatment of these cattle, once the pathogen has been identified.

(3)

(Total for Question 1 = 11 marks)

2 The diagram below shows the structure of Human Immunodeficiency Virus (HIV).



(a) State how the genetic material in HIV differs from the genetic material in the bacterium *Mycobacterium tuberculosis* that causes TB.

(2)

(b) One of the ways in which HIV may enter the blood is through the use of infected needles. Explain why unbroken skin is an effective barrier against HIV infection.

(2)

(c) The table below shows the changes in the number of CD4 T-lymphocytes in the blood of a person infected with HIV, during the first 10 weeks after infection.

Time after infection / weeks	CD4 T-lymphocyte count / cells per mm^3 of blood
0	1050
1	980
2	810
3	600
4	520
5	490
6	480
7	500
8	530
9	580
10	600

(i) Describe the change in numbers of CD4 T-lymphocytes during the first 6 weeks after infection with HIV.

(2)

*(ii) Explain the change in numbers of CD4 T-lymphocytes during the first 6 weeks after infection with HIV.

(5)

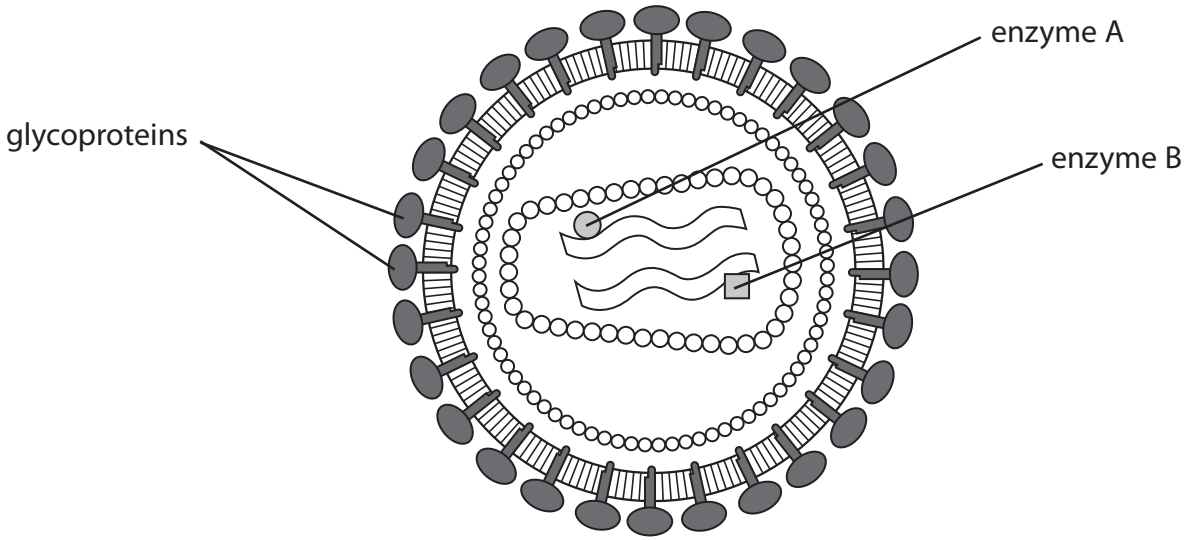
(iii) Suggest **one** effect that this change would have on one other component of the infected person's blood.

(1)

(Total for Question 2 = 12 marks)

3 Anti-viral drugs have been developed to treat patients infected with Human Immunodeficiency Virus (HIV).

The diagram below shows the structure of HIV.



(a) A glycoprotein has a carbohydrate attached to a protein molecule.
Describe the three-dimensional structure of a glycoprotein.

(3)

(b) Some anti-viral drugs prevent HIV entering the host cells.

Suggest how these anti-viral drugs could prevent HIV entering the host cells.

(3)

*(c) Describe how the enzymes shown in the diagram are involved in HIV infection.

(5)

(Total for Question 3 = 11 marks)

4 (a) The table below gives some of the features of bacteria and viruses.

Place **one** tick (✓) in each row to indicate whether the feature is found in bacteria only, viruses only or both bacteria and viruses.

(3)

Feature	Found in		
	Bacteria only	**Viruses only**	**Both bacteria and viruses**
Nucleic acid			
Cytoplasm			
Protein capsid			

(b) In human populations, the bacterium, *Helicobacter pylori*, is associated with the development of severe chronic atrophic gastritis (SCAG) in the stomach. SCAG is the first step that can lead to the most common form of stomach cancer.

The table below shows the reported new cases of stomach cancer in 2006 in the UK.

The mean rate of stomach acid secretion for each age group is also shown.

Age group / years	Mean acid secretion / mg hour^{-1}	New cases of stomach cancer
11–15	170	0
16–20	160	0
21–25	150	0
26–30	120	0
31–35	100	4
36–40	90	10
41–45	60	55
46–50	60	95
51–55	60	183
56–60	50	263
61–65	40	424
66–70	40	633

(i) Suggest why patients with SCAG may be given antibiotics as part of their treatment.

(2)

*(ii) Using the information about SCAG and the data, describe and suggest explanations for the trends shown in the table.

(5)

(Total for Question 4 = 10 marks)