5 Which statement about viruses is correct?

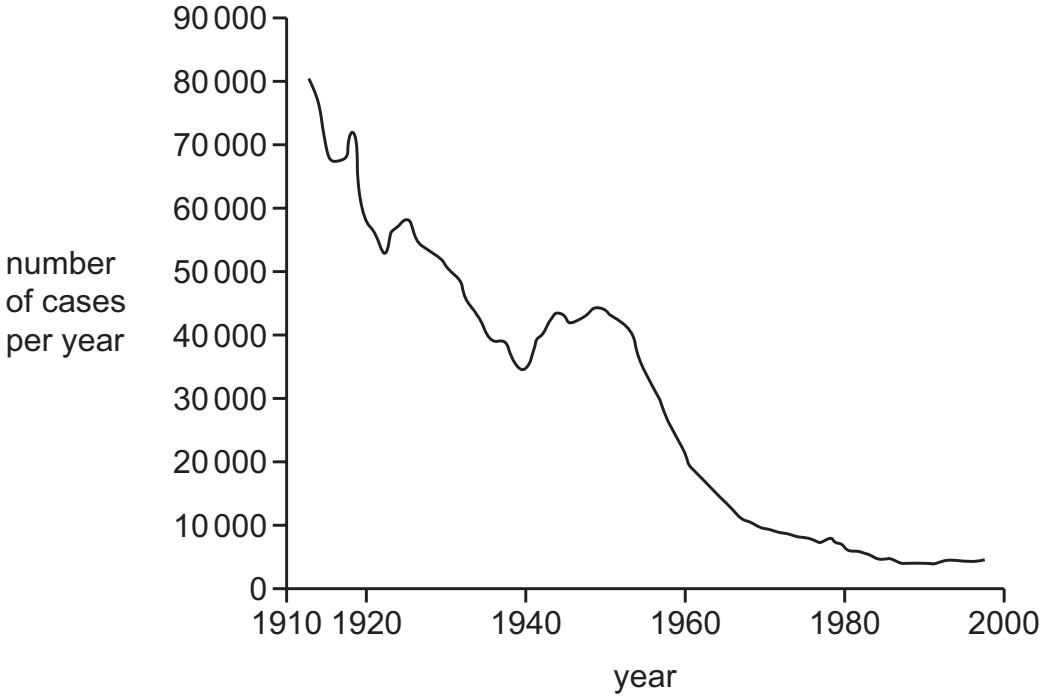
A They are cells with a capsid made of phospholipids.

B They are cells with a capsid made of protein.

C They are particles with a capsid made of phospholipids.

D They are particles with a capsid made of protein.

36 The graph shows the decrease in cases of tuberculosis (TB) in a country between 1910 and 2000.



Which factors could have contributed to the fall over this period?

1 pasteurisation of milk

2 the provision of new housing to reduce overcrowding

3 removing large pools of stagnant water

4 identification of contacts of people infected with TB

A 1, 2 and 4 **B** 1 and 3 **C** 1 and 4 only **D** 2, 3 and 4

38 How does penicillin affect bacteria?

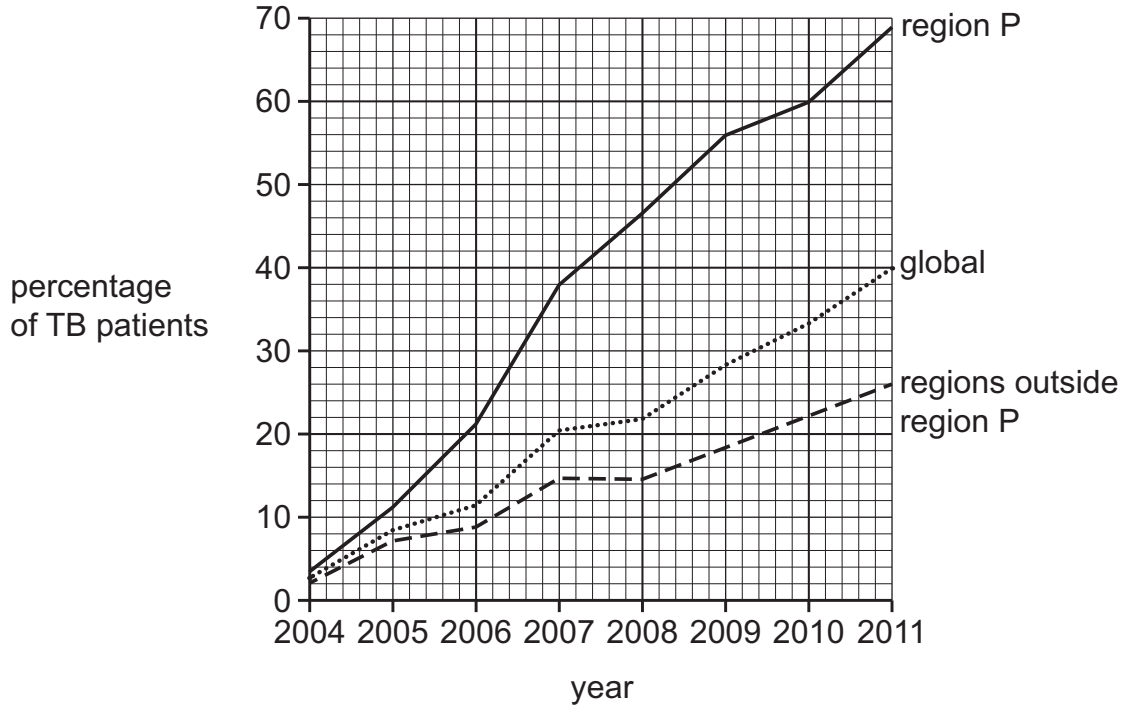
A It inhibits DNA replication by binding to nucleotides.

B It inhibits translation by preventing tRNA binding to ribosomes.

C It is a competitive inhibitor of an enzyme in cell wall synthesis.

D It is a competitive inhibitor of an enzyme in protein synthesis.

38 The graph shows the percentage of tuberculosis (TB) patients who were also known to be infected with HIV, from 2004 to 2011.



Which statement about the graph is correct?

A From 2004 to 2010, the percentage of TB patients with HIV infection in region P increased from 3% to 69%.

B From 2005 to 2011, the percentage of TB patients with HIV infection increased more rapidly in region P than in regions outside region P.

C From 2006 to 2011, the percentage of TB patients with HIV infection in regions outside region P doubled.

D From 2007 to 2011, the percentage of TB patients with HIV infection globally increased from 20% to 30%.

37 Scientists investigated the sensitivity and resistance of a bacterium called *Clostridium difficile* to four antibiotics. Colonies of bacteria were grown on agar plates for 24 hours, after which a different antibiotic was added to each plate. The number of bacterial colonies that died, stopped growing and continued growing were then counted. A bacterial colony is a group of bacterial cells that have multiplied from one bacterium.

Which antibiotic would be the best to treat a person infected with *Clostridium difficile*?

	antibiotic	number of colonies that died	number of colonies that stopped growing	number of colonies that continued growing
A	ampicillin	2	5	13
B	clindamycin	4	8	6
C	metronidazole	13	6	1
D	cefoxitin	9	5	4

6 **(a)** Alveolar macrophages are phagocytes found in the human gas exchange system. They produce hydrolytic enzymes, such as lysozyme, to digest pathogens entering the alveolus.

(i) State the term used to describe the sequence of nucleotides in the DNA of the alveolar macrophage that codes for a protein, such as lysozyme.

..... [1]

(ii) Synthesis of lysozyme occurs in two stages. The first stage occurs in the nucleus using one strand of DNA to synthesise mRNA.

State the name of the strand of DNA that is used to synthesise mRNA.

..... [1]

(iii) Name the organelle where the translation of mRNA takes place to produce lysozyme.

..... [1]

(iv) Lysozyme destroys bacterial cells by hydrolysing bonds in peptidoglycan.

Explain how the hydrolysis of bonds in peptidoglycan leads to the destruction of bacterial cells.

.....

.....

.....

..... [2]

(b) (i) Alveolar macrophages are found in contact with squamous epithelial cells in the walls of alveoli.

Explain how the cells lining the alveoli are adapted for gas exchange.

.....

.....

.....

..... [2]

(ii) Describe the role of elastic fibres in the wall of an alveolus.

.....

.....

.....

..... [2]

[Total: 9]

4 Bacteria can be classified according to the type of cell wall they have.

Gram-negative bacteria have a cell wall with an outer layer known as the outer membrane.

Gram-positive bacteria do not have an outer membrane, but have a much thicker peptidoglycan layer than Gram-negative bacteria.

Fig. 4.1 is a diagram of a section through the cell wall of a **Gram-negative** bacterium.

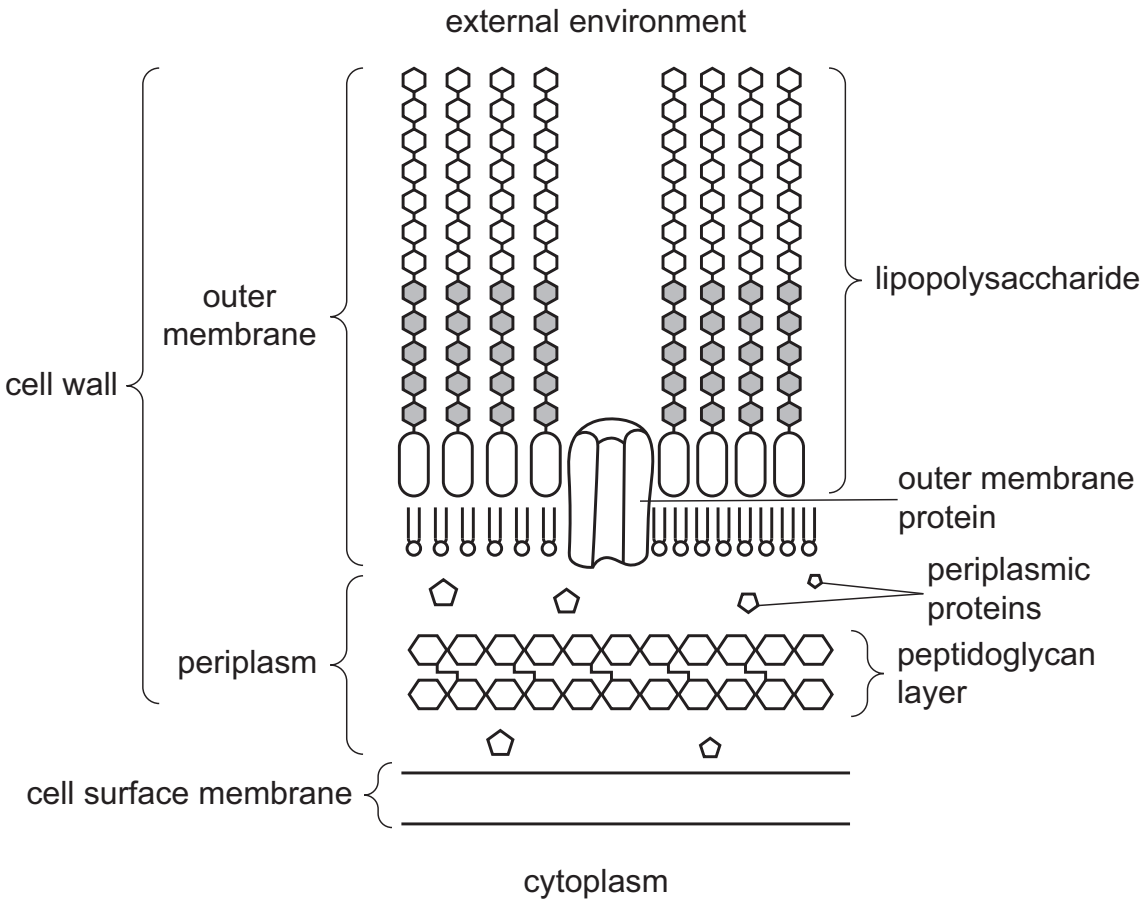


Fig. 4.1

(a) With reference to Fig. 4.1, outline the similarities **and** differences between the outer membrane of a Gram-negative bacterial cell and the cell surface membrane of a **eukaryotic** cell.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Pathogenic and non-pathogenic Gram-negative bacteria can produce extracellular vesicles. Fig. 4.2 summarises how two types of extracellular vesicle, OMVs and O-IMVs, are formed.

O-IMVs are formed from the outer membrane and the cell surface membrane. O-IMVs can contain ATP and DNA.

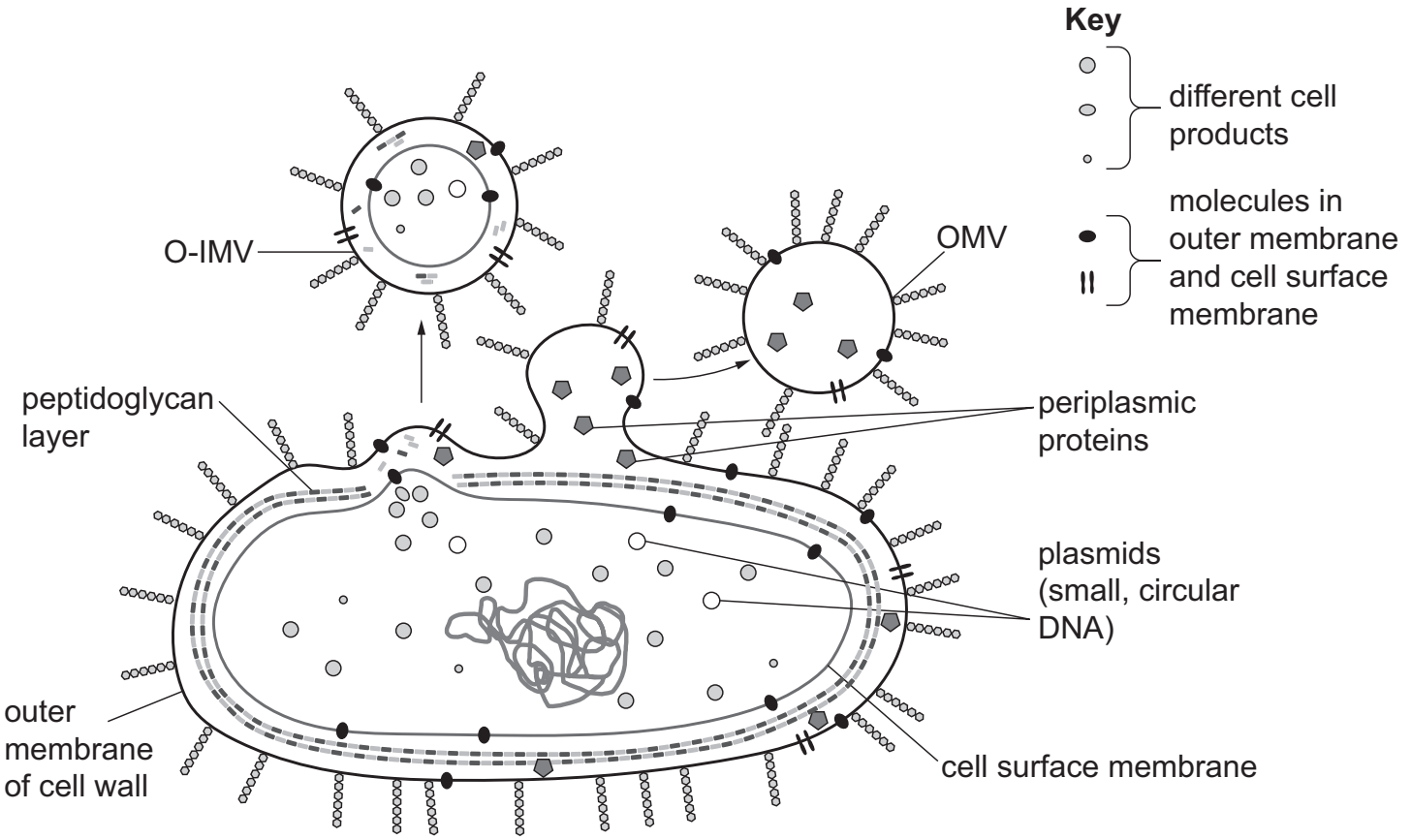


Fig. 4.2

(i) With reference to Fig. 4.2, suggest why fewer O-IMVs are formed than OMVs.

.....

..... [1]

(ii) Suggest why ATP is found within O-IMVs but **not** in OMVs.

.....

..... [1]

(iii) Suggest **and** explain why the discovery that O-IMVs contain DNA has implications for antibiotic resistance.

.....

.....

.....

.....

..... [2]

[Total: 7]

2 Compounds containing nitrite ions (NO_2^-) are present in many foods eaten by humans.

Scientists tested the effect of different concentrations of nitrite ions on the population growth of 5 species of bacterium. All 5 species are pathogenic and can infect the human digestive system.

For each species of bacterium, the scientists placed suspensions of the bacteria in a microwell plate. A microwell plate is a plastic plate containing 96 wells, which are similar to small test-tubes.

In each well, the scientists added:

- a suspension of the bacterial species
- a solution containing nitrite ions
- nutrient broth.

The scientists incubated the microwell plate at 37 °C for 24 hours. After 24 hours, the scientists estimated the number of bacteria in each well by measuring optical density, using a microwell plate reader.

For each species of bacterium, the scientists repeated the experiment with several different concentrations of solution containing nitrite ions.

The scientists determined the lowest nitrite concentration at which no bacterial population growth had occurred after 24 hours.

(a) The scientists standardised temperature, pH (pH 4.8) and time in the investigation.

State **two other** variables that the scientists should standardise in this investigation.

1 .....

2 .....

[2]

(b) The results of the investigation are shown in Fig. 2.1.

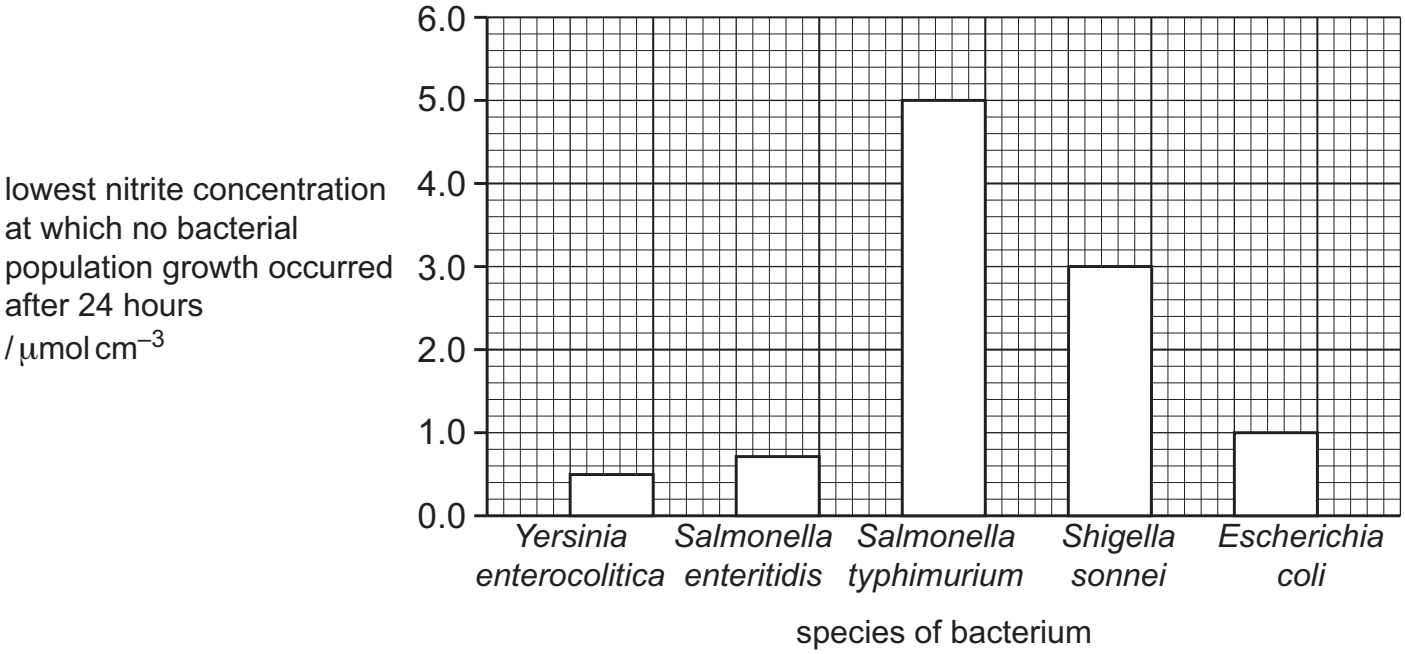


Fig. 2.1

(i) State the type of **data** represented by the species of bacterium and the lowest nitrite concentration in Fig. 2.1.

species of bacterium .....

lowest nitrite concentration .....

[2]

(ii) The 2 species of *Salmonella* shown in Fig. 2.1 are closely related.

Calculate the percentage difference between the results shown in Fig. 2.1 for the 2 species of *Salmonella*.

Show your working.

.....%

[3]

(iii) Use Fig. 2.1 to state:

- the species of bacterium that is most affected by nitrite ions
- the species of bacterium that is least affected by nitrite ions.

most affected .....

least affected .....

[1]

(c) A student looked at the results and stated:

Consuming a lot of nitrites would improve the health of people because it would help to prevent diseases in the digestive system caused by pathogenic bacteria.

Suggest **four** reasons why this conclusion might **not** be valid.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

[Total: 12]