

1 Antibiotics are used in the treatment of bacterial infections.

(a) (i) Cephalosporins are antibiotics that inhibit the production of bacterial cell walls.

Suggest why cephalosporins are **bactericidal** antibiotics.

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(ii) Quinolones are antibiotics that inhibit the synthesis of DNA in bacterial cells.

Suggest why quinolones are **bacteriostatic** antibiotics.

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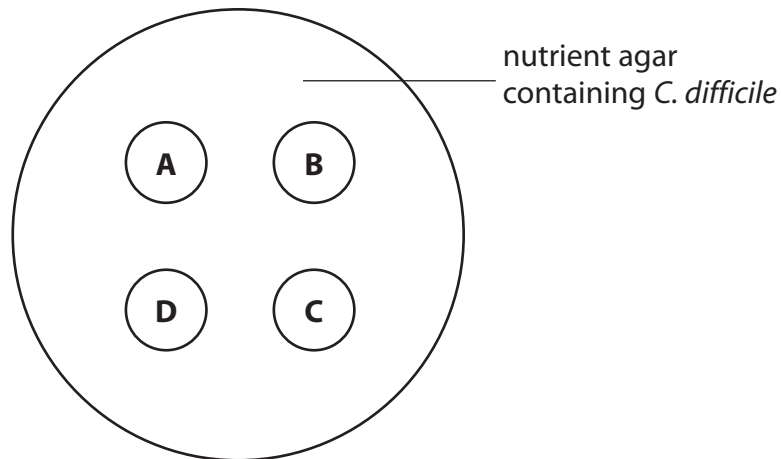
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(b) An investigation of the effectiveness of different antibiotics on *Clostridium difficile* was carried out by a hospital laboratory. Several nutrient agar plates, containing *C. difficile*, were prepared.

Four discs, A, B, C and D, were placed on the surface of each plate. Each disc contained the same concentration of a different antibiotic.

The diagram below shows the position of the four discs on each agar plate, before being incubated.



After incubation, the scientists in the laboratory concluded that *C. difficile* was completely resistant to antibiotics A and C. They also concluded that antibiotic D was more effective against *C. difficile* than antibiotic B.

(i) Explain how the appearance of the nutrient agar plates, after incubation, would have enabled the scientists to reach these conclusions.

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For each of the statements below, put a cross (☒) in the box next to the term that completes each statement.

(ii) In this investigation, several nutrient agar plates were used for (1)

- A** accuracy
- B** precision
- C** reliability
- D** validity

(iii) In this investigation, each disc had the same concentration of antibiotic for (1)

- A** accuracy
- B** precision
- C** reliability
- D** validity

(c) Hospital-acquired infections caused by bacteria can be a major problem for patients.

In a study in a London hospital, it was found that pillows contaminated with bacteria could spread infections between patients.

Suggest how this hospital could improve the prevention and control of the spread of infections.

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(Total for Question 1 = 12 marks)

- 2 (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.

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

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(Total for Question 2 = 10 marks)

3 Blood infection caused by the bacterium, methicillin-resistant *Staphylococcus aureus* (MRSA), has become a major concern in hospitals. This infection can be difficult to treat due to increasing resistance of MRSA to bacteriostatic and bactericidal antibiotics.

(a) Explain what is meant by the terms **bacteriostatic antibiotic** and **bactericidal antibiotic**.

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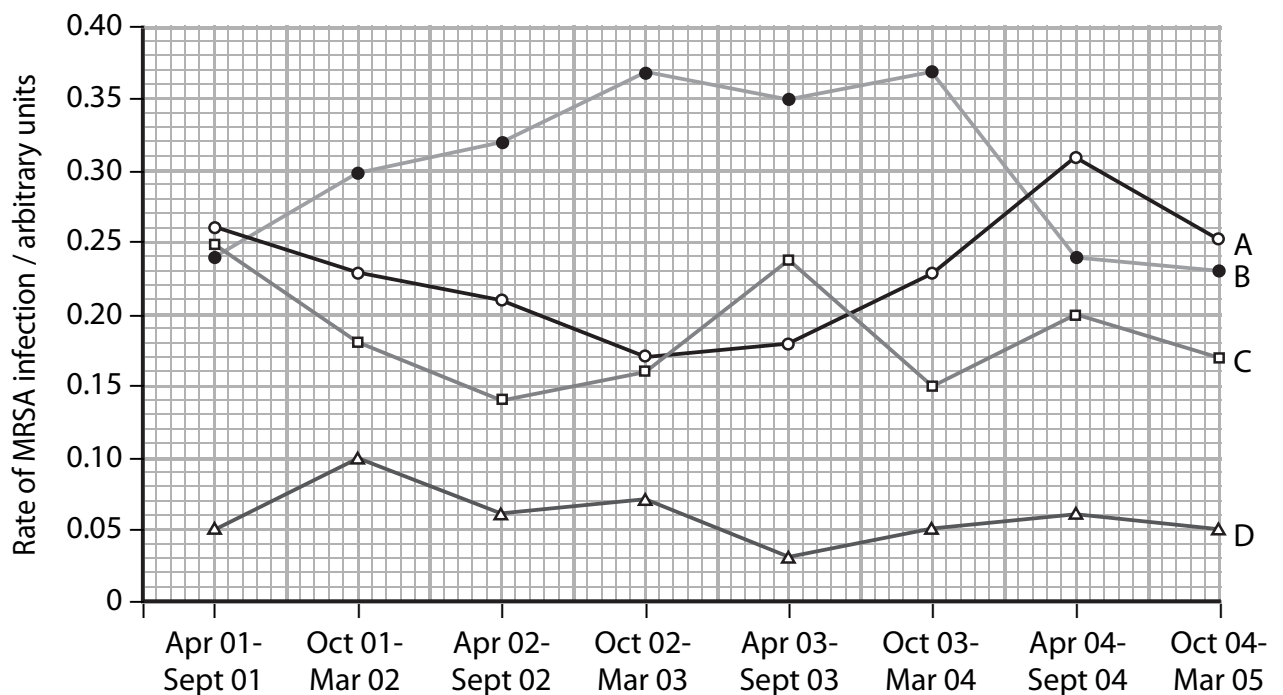
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(b) The graph below shows the occurrence of MRSA infection in four hospitals, A, B, C, and D for the period from April 2001 to March 2005. The rate of MRSA infection in each hospital during each six-month period was recorded.



Compare the rates of MRSA infection in hospital A with those in hospital B.

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(c) MRSA is present on the skin of approximately 1 in 3 of all patients entering hospitals for treatment.

(i) Describe the most significant difference between the rate of MRSA infection in hospital D compared with those of the other three hospitals.

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(ii) Suggest why the rate of MRSA infection in hospital D differs from the rates in the other hospitals.

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(Total for Question 3 = 10 marks)