10. Infectious Diseases

10.2 Antibiotics

Paper 1

Question Paper

1 How does the antibiotic penicillin affect the metabolism of a bacterial cell?

A Penicillin reduces cell growth by preventing water uptake.

B Penicillin inhibits the formation of cross-links in the cell wall between peptidoglycan molecules.

C Penicillin inhibits the hydrolysis of peptidoglycan links in the cell wall during cell extension.

D Penicillin weakens the cell wall by digesting peptidoglycan molecules.

2 Scientists studied the multidrug-resistant bacterial infections in children caused by one type of bacteria between 2007 and 2015. The percentage of multidrug-resistant infections rose from 0.2% to 1.5%.

What was the percentage increase in multidrug-resistant infections between 2007 and 2015?

A 1.3% **B** 87% **C** 130% **D** 650%

3 An antibiotic inhibits the formation of cross-links between the molecules that form cell walls in bacteria.

Which statements explain why bacteria are killed by the antibiotic?

1 The bacterial cell is destroyed by osmotic lysis.

2 Cellulose molecules **cannot** form hydrogen bonds.

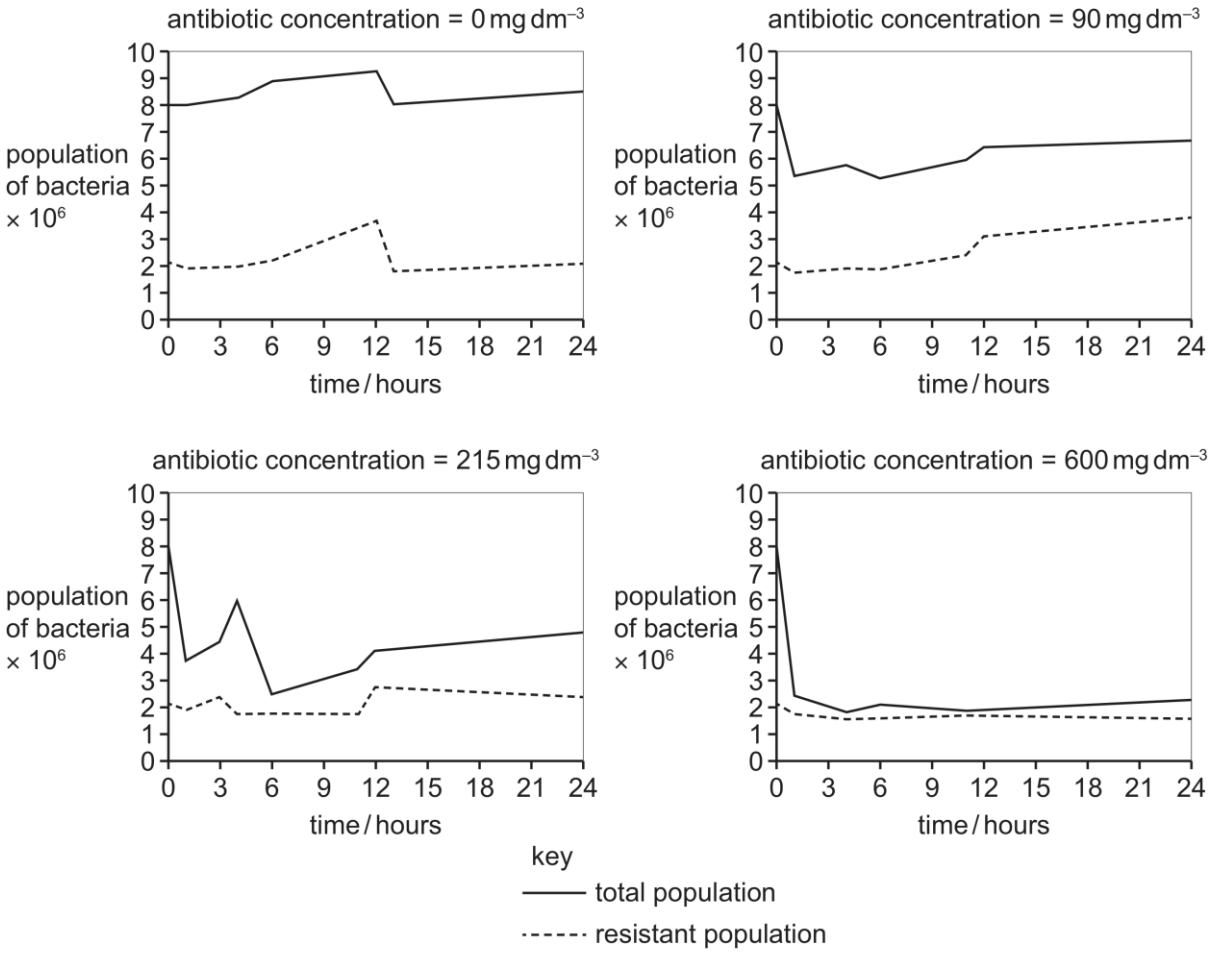
3 The cell wall is no longer partially permeable.

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

4 Scientists investigated the effect of increasing concentrations of an antibiotic on the development of antibiotic resistance in bacteria.

The scientists grew four groups of bacteria and added a different concentration of antibiotic to each group. The number of resistant bacteria and the total population of bacteria were measured at intervals for 24 hours for each group.

The graphs show the results.



Which statements are correct conclusions that can be made from the results of this investigation?

1 Increasing the concentration of antibiotic decreases the population of non-resistant bacteria at the end of 24 hours.

2 The proportion of antibiotic-resistant bacteria increases with increasing concentrations of antibiotics.

3 Increasing the concentration of antibiotic always increases the number of resistant bacteria.

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

5 Which structures or compounds are present in a typical cell that can be killed by penicillin?

1 circular DNA

2 cytoplasmic DNA

3 70S ribosomes

4 peptidoglycan

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 2 only

D 4 only

6 Which statements are correct for penicillin?

1 It is harmful to prokaryotic cells.

2 It disrupts cell wall synthesis.

3 It becomes less effective with regular use.

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

7 Some of the processes which result in the formation of a population of bacteria that are resistant to a new antibiotic are listed.

1 change in reproductive success of bacteria

2 increase in frequency of the resistance allele in the population

3 increase in genetic variation within the population

4 random mutation occurs in bacterial DNA

What is the correct order of these processes?

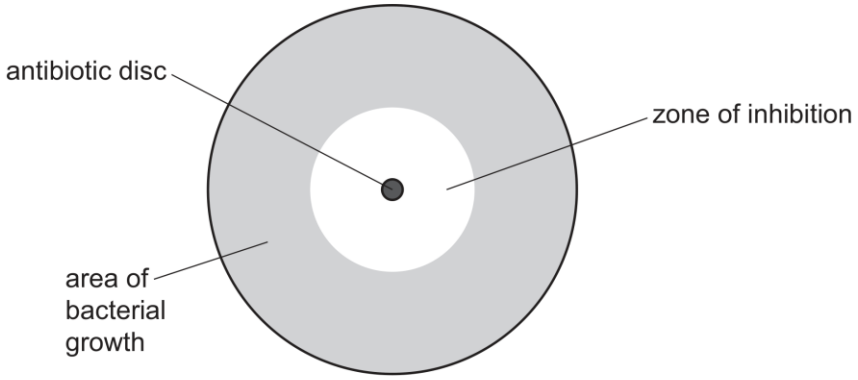
A $1 \rightarrow 3 \rightarrow 2 \rightarrow 4$

B $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

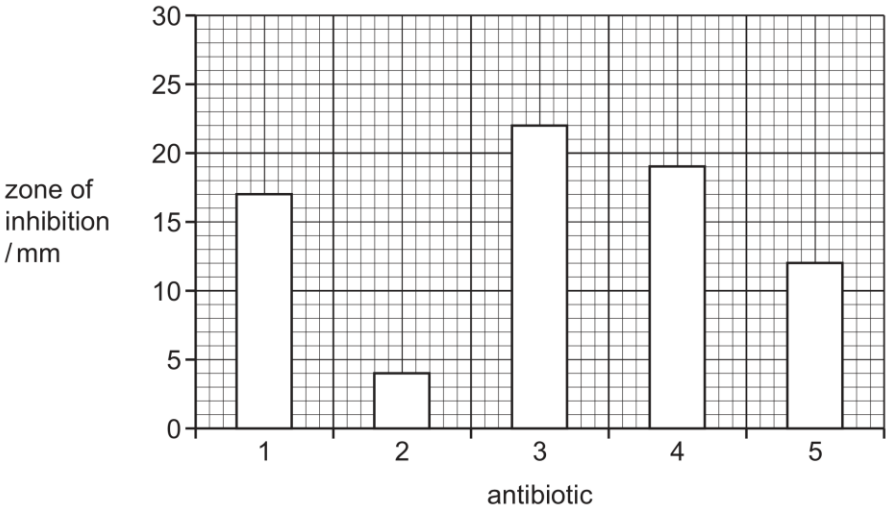
C $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

D $4 \rightarrow 3 \rightarrow 1 \rightarrow 2$

8 When bacteria are grown in a Petri dish containing discs with antibiotics, there will be zones of inhibition of bacterial growth.



The chart shows the size of the zones of inhibition when a species of bacteria was incubated on five different plates of agar, each containing a disc with a different antibiotic.



Which conclusions can be made about the most and least effective antibiotics on this species of bacteria?

	most effective antibiotic	least effective antibiotic
A	3	2
B	4	3
C	3	1
D	2	3

9 The statements refer to the disease tuberculosis (TB).

1 The pathogen is **not** accessible to the immune system.

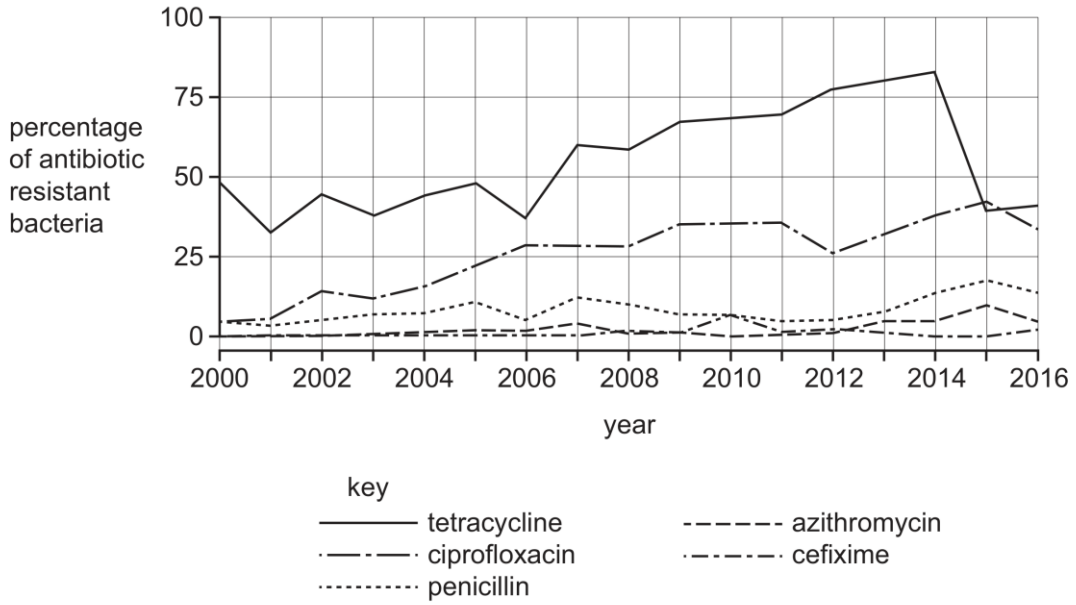
2 The bacterial pathogen reproduces slowly.

3 The pathogen is **not** very sensitive to antibiotics.

Which statements explain why antibiotic treatment for TB takes a long time?

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

10 The graph shows changes in the antibiotic resistance of a species of bacterium between 2000 and 2016 in one country. Samples of bacteria were collected every year from 48 hospitals. The bacteria were tested to see if they showed resistance to five different antibiotics.



What can be concluded from the data in the graph?

A Overuse of ciprofloxacin has caused antibiotic resistance to increase by more than 20% between 2000 and 2016.

B Percentage resistance to three of the antibiotics was at a peak in 2015.

C Changes in treatment guidelines have caused resistance to some antibiotics to decrease from 2015 to 2016.

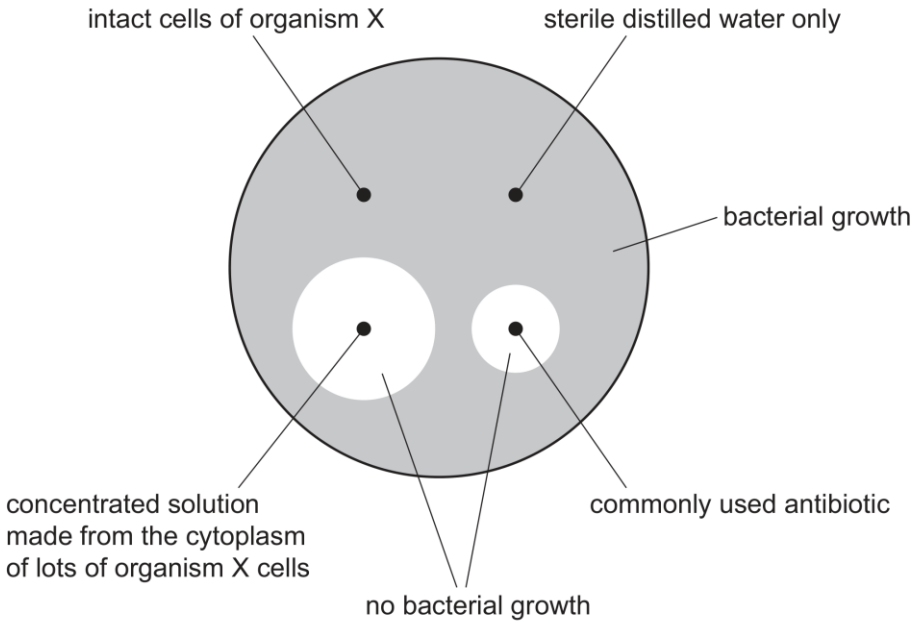
D The percentage of resistant bacteria is higher in 2016 than 2000 for all antibiotics.

11 Organism X produces molecule Y, which blocks the activity of 70S ribosomes.

An experiment was carried out to investigate the effect of Y on bacterial cells.

An agar plate with bacteria growing all over its surface had four wells cut into the agar. Different substances were added to each well and the agar plate with bacteria was incubated for a week.

The diagram shows the results after a week.



Which conclusions can be made from these results?

	molecule Y functions as an antibiotic	molecule Y cannot be released from cells of organism X	molecule Y would also affect the synthesis of proteins from nuclear DNA in a human cell
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = can be concluded
✗ = cannot be conclude

12 A patient has had repeated infections from the same pathogen over a few months. The patient has been treated with the same antibiotic on each occasion.

Which treatment could prevent an increase in the antibiotic resistance of the pathogen?

A a narrow spectrum antibiotic to treat a non-cellular pathogen

B a repeat prescription for the same antibiotic at a higher dose

C a specific antibiotic after testing for the pathogen

D a wide spectrum antibiotic to treat different strains of the pathogen

13 What will reduce the rate at which bacteria become resistant to antibiotics?

1 prescribing two antibiotics with different modes of action

2 prescribing different antibiotics for the same bacterium

3 finishing a prescribed course of antibiotics

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

14 Penicillin is an antibiotic used to treat infections caused by bacteria.

Which events explain how bacteria become resistant to penicillin?

1 The number of bacteria with the allele for resistance to penicillin increases.

2 Resistance to penicillin is the result of a mutation in a bacterium.

3 Bacteria with the allele for resistance to penicillin pass the allele to their daughter cells.

4 The mutation for resistance to penicillin is always caused by the presence of penicillin.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 4 only

D 2 and 3 only

15 What is the initial mechanism by which bacteria become resistant to antibiotics?

A genetic mutation

B overuse of antibiotics

C natural selection

D patients not finishing a course of antibiotics

16 What has contributed to the increase in antibiotic resistance in bacteria?

1 increased use of vaccines for animal diseases

2 mutations in bacterial DNA

3 patients not completing their antibiotic treatment

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

17 Which description of multiple drug resistance in bacteria is correct?

A Bacteria have DNA with resistant genes for several different types of antibiotic.

B Different species of bacteria have DNA with resistant genes for one type of antibiotic.

C Large numbers of one species of bacteria are immune to several different types of antibiotic.

D Many different species of bacteria are immune to one type of antibiotic.

18 The antibiotic teixobactin was discovered in January 2015. Teixobactin kills some bacteria such as *Staphylococcus* and *Mycobacterium*.

Most antibiotics work by binding to proteins. Teixobactin binds to lipids that are used in the synthesis of bacterial cell walls. This means that it is unlikely that bacteria will quickly develop resistance to teixobactin.

Which statements explain why bacteria are unlikely to quickly develop resistance to teixobactin?

1 A mutation in the gene coding for a protein allows selection for resistance.

2 Teixobactin binds to a lipid rather than to a protein.

3 The structure of a lipid is not encoded by DNA.

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

19 The table compares total antibiotic use (X) and the percentage of antibiotic-resistant pneumonia cases (Y) in five countries.

country	(X) total antibiotic use / defined dose per 1000 people per day	(Y) percentage of penicillin-resistant pneumonia cases
Austria	13	10
Denmark	11	4
Iceland	17	15
Spain	30	50
USA	24	33

What is supported by the data?

A When X decreases there is an increase in Y.

B When X increases there is an increase in Y.

C When X increases it causes an increase in Y.

D There is no relationship between X and Y.

20 Which statement about the development of resistance to antibiotics in bacteria is correct?

A All mutations in bacteria result in resistance to antibiotics.

B Antibiotics increase the rate of mutation in bacteria.

C Mutations leading to antibiotic resistance only occur when antibiotics are used to treat pathogenic bacteria.

D The proportion of antibiotic-resistant bacteria in a population only increases if the antibiotic is used.

21 Species X is a single-celled eukaryote.

Species X has been genetically modified to produce penicillin, which does not harm the cell walls of species X.

What may be concluded from this information?

1 The cell walls of species X are chemically different from those of bacteria.

2 The cell walls of species X are made of peptidoglycan.

3 The cell walls of species X are made of cellulose.

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

22 Which statements about the use of antibiotics could cause an increase in antibiotic-resistant bacteria?

1 Patients do not always complete the course of antibiotics.

2 Patients keep unused antibiotics from previous prescriptions and take them at a later date in smaller doses than prescribed.

3 Antibiotics are used in farming to prevent infections.

4 Doctors prescribe narrow spectrum antibiotics that only kill a few types of bacteria.

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

23 Which use of antibiotics helps to reduce the spread of resistance in bacteria?

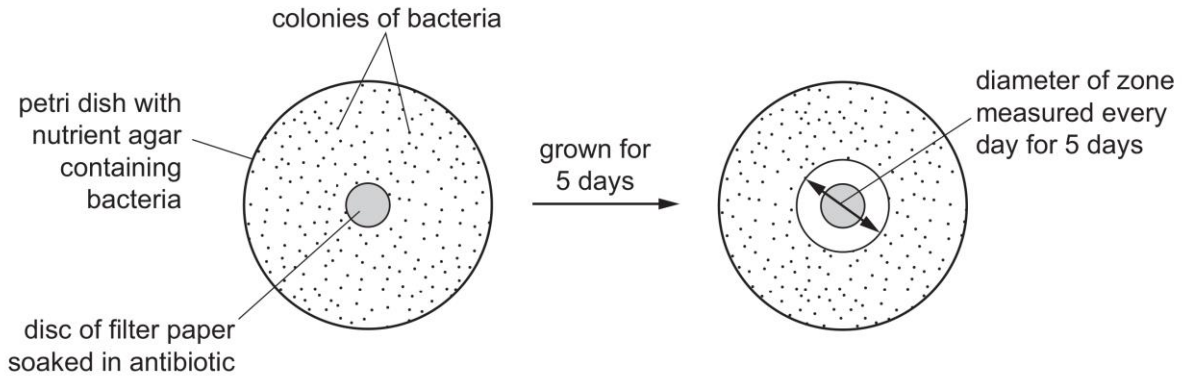
A using high concentrations of the antibiotic to kill all the bacteria

B giving routine preventative antibiotics to people who are having an operation

C regularly changing the type of antibiotic used to treat particular bacterial infections

D giving antibiotics to treat low level infection caused by a bacterium

24 The diagram shows one way of testing the effect of an antibiotic on bacteria.



The table shows the results of testing five different types of bacteria.

Zones of less than 13.0 mm show the presence of resistant bacteria.

type of bacteria	diameter of zone / mm				
	day 1	day 2	day 3	day 4	day 5
1	24.1	21.9	19.0	17.6	14.3
2	18.6	15.4	12.2	9.0	2.0
3	17.9	12.8	12.4	11.1	10.9
4	19.4	15.3	13.2	8.1	2.0
5	22.0	21.0	20.5	20.4	20.4

Which statement can be supported by this data?

A All the types of bacteria become resistant to antibiotics over time.

B Only types 2, 3 and 4 of the bacteria show resistance to the antibiotic.

C The antibiotic can be used to treat types 1 and 3 only.

D Type 5 of the bacteria can never become resistant to the antibiotic.

25 Some animals have genes that code for small peptides called cathelicidins. These peptides kill a wide range of bacteria by attaching to lipids in bacterial membranes, so weakening or disrupting them.

Scientists have produced a synthetic version of the cathelicidin that kills bacteria that are resistant to a number of antibiotics such as tetracycline.

Which pair of statements explain how this synthetic cathelicidin might help with the problem of antibiotic resistance?

1 It is synthetic so bacteria can never become resistant to it.

2 It could be used instead of tetracycline, allowing tetracycline resistance to be reduced.

3 The only way a bacterium could develop resistance to it is by altering all the lipids in its membranes.

4 It could be used to kill multidrug-resistant strains of bacteria for which there is no effective antibiotic.

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

26 The antibiotic tetracycline binds to the small subunit of bacterial ribosomes, stopping protein synthesis.

Bacteria have become resistant to tetracycline due to the effect of mutations.

Which effect could produce resistance to tetracycline?

A preventing tetracycline from binding to the bacterial cell wall

B preventing tetracycline from entering the bacterial cell

C preventing tetracycline from inhibiting transcription

D preventing the production of tetracycline by ribosomes