Questions

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Bacteria are becoming increasingly resistant to antibiotics.

Controlling the spread of antibiotic resistance is necessary.

Many types of bacteria are resistant to penicillin and tetracycline.

(i) Which row of the table shows the part of a bacterial cell affected by these antibiotics?

(1)

		Penicillin	Tetracycline
☐	**A**	cell wall	cell wall
☐	**B**	cell wall	ribosome
☐	**C**	ribosome	cell wall
☐	**D**	ribosome	ribosome

(ii) Which row of the table describes the action of penicillin and tetracycline?

(1)

		Penicillin	Tetracycline
☐	**A**	bactericidal	bactericidal
☐	**B**	bactericidal	bacteriostatic
☐	**C**	bacteriostatic	bactericidal
☐	**D**	bacteriostatic	bacteriostatic

(Total for question = 2 marks)

Q2.

Bacteria are becoming increasingly resistant to antibiotics.

Controlling the spread of antibiotic resistance is necessary.

In an investigation, *E.coli* bacteria were isolated from animals reared for food and from some wild animals.

The mean percentage of the *E.coli* isolated from each type of animal that were resistant to different types of antibiotics was determined.

The table shows the results of this investigation, where n is the number of each type of animal.

Antibiotic	Mean percentage of resistant *E.coli* isolated from animals reared for food (%)			Mean percentage of resistant *E.coli* isolated from wild animals (%)	
	Broiler chicken n = 45	Village chicken n = 45	Cattle n = 12	Bat n = 13	Rodent n = 35
Ampicillin	50.00	8.89	8.33	0.00	8.57
Cephalothin	14.29	8.89	8.33	20.00	14.58
Chloramphenicol	46.43	0.00	0.00	0.00	0.00
Neomycin	50.00	2.22	25.00	0.00	5.71
Tetracycline	95.86	55.56	25.00	0.00	2.86

(i) Calculate the ratio of tetracycline-resistant *E.coli* in all the chickens to tetracycline-resistant *E.coli* in cattle.

(2)

Answer .....

(ii) There was a total of 2×10^8 *E.coli* isolated from cattle and 6×10^9 *E.coli* isolated from rodents.

Calculate how many more *E.coli* are resistant to cephalothin in rodents than in cattle.

(2)

Answer .....

(iii) Antibiotics can be added to animal feed.

It is thought this use of antibiotics has contributed to the spread of antibiotic resistance. Evaluate the extent to which the results of this investigation support this idea.

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(Total for question = 8 marks)

Q3.

Bacteria are becoming increasingly resistant to antibiotics.

Controlling the spread of antibiotic resistance is necessary.

One method of controlling the spread of antibiotic resistance is to avoid unnecessary prescriptions of antibiotics.

The table shows some illnesses and whether a prescription for antibiotics is recommended.

Illness	Antibiotic prescription
Bronchitis	may be recommended
Ear infection	may be recommended
Influenza	not recommended
Fluid in the ear	not recommended
Strep throat	recommended
Urinary tract infection	recommended

Explain why these recommendations could reduce the spread of antibiotic resistance.

(2)

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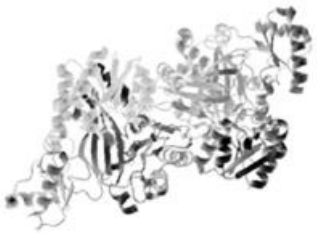
(Total for question = 2 marks)

Q4.

Acetyl CoA is produced in the link reaction when pyruvate is broken down.

The photograph shows a molecule of the enzyme acetyl CoA carboxylase.



This enzyme is involved in the conversion of acetyl CoA into fatty acids.

The enzyme is activated by citrate.

Citrate does not bind at the active site.

Citrate is produced in the Krebs cycle.

The enzyme is inhibited by long chain fatty acyl CoA molecules.

Fatty acyl CoA molecules have a longer carbon chain than acetyl CoA.

The enzyme acetyl CoA carboxylase has a different structure in bacteria.

The enzyme in bacteria is made of several polypeptide subunits whereas in humans, the enzyme is one large polypeptide.

Inhibitors of the bacterial enzyme are being developed to treat bacterial infections.

Explain why inhibitors of the bacterial enzyme may be useful when treating bacterial infections.

(2)

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(Total for question = 2 marks)

Q5.

Cysteine proteases are enzymes found in fruits such as pineapples.

When a protease enzyme is added to fat-free skimmed milk, the milk turns from cloudy to clear.

Cysteine proteases are also found in the predatory bacterium *Bdellovibrio bacteriovorus* (BvB).

These bacteria are harmless to humans but prey on Gram negative bacteria.

(i) Give two differences between Gram negative and Gram positive bacteria.

(2)

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(ii) The cell of the predatory BvB is 1µm in length and can swim 100 times its length per second.

Calculate the swimming speed of this bacterial cell in mm s^{-1}.

(2)

Answer .....

(iii) The BvB bacteria have been described as 'living antibiotics'.

Explain why the BvB bacteria might be useful in the future for treating bacterial infections.

(2)

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(Total for question = 6 marks)

Q6.

Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

The table shows information about five antibiotics.

Antibiotic	Year discovered	Time for first resistant strain of bacteria to be detected / years	Number of different types of each antibiotic that exist today
Penicillin	1928	1	>18
Tetracycline	1945	3	>16
Vancomycin	1953	27	1
Linezolid	1978	1	1
Daptomycin	1985	2	1

Analyse the data to comment on the number of types of each antibiotic that exist today.

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(Total for question = 5 marks)

Q7.

Antibiotics are widely used to treat infections.

Some antibiotics are bactericidal.

State what is meant by the term bactericidal.

(1)

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(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	**The only correct answer is B** *A is incorrect because tetracycline targets the ribosomes* *C is incorrect because tetracycline targets the ribosomes and penicillintargets the cell wall* *D is incorrect because penicillin targets the cell wall*		(1)
(ii)	**The only correct answer is B** *A is incorrect because tetracycline is bacteriostatic* *C is incorrect because tetracycline is bacteriostatic and penicillin isbactericidal* *D is incorrect because penicillin is bactericidal*		(1)

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	• number of chicken and cattle with resistant *E.coli* (1) • ratio given (1) **OR** • mean percentage of resistant bacteria in chickens calculated (1) • ratio given (1)	Example of calculation: (43 + 25) 68 chickens and 3 cattle 22.67 : 1 / 22.7 : 1 / 23 : 1 / 1 : 0.04 (95.86 + 55.56) ÷ 2 = 75.71 (75.71 : 25.00 =) 3.03 : 1 / 3 : 1 **ACCEPT** 1 : 0.33 / 1 : 0.3 / 1 : 1 **NB** correct answer with no working gains two marks {6.06 : 1 / 6.1 : 1 / 6 : 1 / 1 : 0.17 / 1 : 0.2} = 1 mark	(2)

Question Number		Additional Guidance	Mark
(ii)	• mean number of resistant bacteria for cattle or rodents calculated (1) • answer (1)	Example of calculation: 8.33% of $2 \times 10^8 = 16.66 \times 10^6$ **OR** 14.58 % of $6 \times 10^9 = 87.48 \times 10^7$ 53 / 52.5 / 52.51 (times more) 8.6×10^8 / 8.58×10^8 / 858 140 000 etc (more bacteria) correct answer with no working gains two marks	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to four of the following: • (idea supported because) overall there are more resistant bacteriain the animals reared for food (1) • (idea not entirely supported because) the bacteria in wild animalsare more resistant to cephalothin (1) • the number of animals in each group is very small (1) • the number of different types of {animal / antibiotic} is limited (sodata may not be representative) (1) • no standard deviations shown so spread of data is unknown (1)	**ACCEPT** other quoted data to illustrate exception **ACCEPT** validity of data	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • antibiotics are only prescribed if the illness could be caused bybacteria / antibiotics not prescribed if the illness is caused by viruses only (1) • because antibiotics acts as a selection pressure for resistant bacteria (1)	**ACCEPT** reduces the {use of antibiotics / exposureof bacteria to antibiotics} **ACCEPT** a description e.g. presence of antibioticwont be a selective advantage **DO NOT ACCEPT** immune	(2)

Q4.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of thefollowing: • an inhibitor of the bacterial enzyme may not affect thehuman one (1) • description of effect of treatment eg fatty acids not madeso {less respiration / bacteria die} (1) • so that there will be fewer side effects if used as atreatment for infections (1)	Allow enzymes are specific Allow is an effective antibiotic	(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to two of the following: • Gram positive bacteria have more peptidoglycan than Gram negative bacteria (1) • Gram positive stains {purple / blue} (with Gram stain), but Gram negative do not stain {purple / blue} (with Gram stain) (1) • Gram positive contains {teichoic acid / lots of murein} but Gram negative do not (1) • Gram positive have no {periplasmic space /outer membrane} but Gram negative do (1)	Allow Gram positive have a thicker cell wall thanGram negative Allow Gram positive stains {purple / blue} (withGram stain), but Gram negative stain red (with Gram stain) Allow Gram positive have low {lipid / phospholipid} content but Gram negative havehigh {lipid / phospholipid} content	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • conversion of micrometres to mm (1) • calculation of speed (1)	Example calculation 1µm = 0.001 mm 0.001 x 100 = 0.1 (mm s^{-1}) Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • BvB can kill gram negative bacteria (1) • without side effects for humans (1) • therefore could be useful when treating resistant bacterialinfections (1)	Allow bacteria cannot become resistantto BvB	(2)

Q6.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • there are more types of {penicillin / tetracycline / older antibiotic} (1) • because there has been more time for resistant strains to appear (1) • vancomycin has only one type (1) • because it has taken {a long time / 27 years} for the resistant strains to appear (1) • there is one type of {linezolid / daptomycin / younger antibiotic} (1) • because there has been less time for resistant strains to appear (1)	**Do not accept** immune	(5)

Q7.

Question Number	Answer	Additional Guidance	Mark
	{kills / destroys} bacteria	**Do not accept** causes lysis / affects cell wall synthesis	**(1)**