

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 6: MICROBIOLOGY AND PATHOGENS
ANTIBIOTIC RESISTANCE

SCORE

/32

PERCENTAGE

%

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Q1.

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 <i>E.coli</i> isolated from animals reared for food (%)			Mean percentage of resistant <i>E.coli</i> 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.

(4)

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(Total for question = 8 marks)

Q2.

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)

Q3.

There are drugs that can be taken to reduce the reproduction of HIV.

Explain why a patient is usually given several different drugs at the same time.

(2)

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(Total for question = 2 marks)

Q4.

Salmonella can cause severe vomiting and diarrhoea.

Public health laboratories use the Salmonella Rapid Culture technique to confirm a *Salmonella* infection.

This can accurately identify *Salmonella* as purple stained colonies within 48 hours.

Previous methods for the identification of *Salmonella* infections took four days.



Explain the advantages of using this technique in public health laboratories.

(3)

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Q5.

A student read that more than half of raw chickens on sale in supermarkets are contaminated with bacteria from the genus *Campylobacter*.

Some species of *Campylobacter* cause food poisoning in humans.

The student carried out an experiment to test the effectiveness of various antibiotics against *Campylobacter*.

The photograph shows the student's agar plates at the end of the experiment.

Q6.

Antibiotics have been developed to control bacterial infections.

(a) Name **one** bacterium which causes symptoms of infection by producing exotoxins.

(1)

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(b) Explain how an antibiotic has a bacteriostatic effect on bacteria.

(2)

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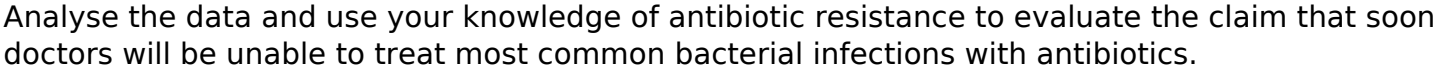
*(c) Bacterial resistance to common antibiotics is an increasingly serious problem facing doctors treating a wide range of infections.

The graph below shows the percentage of resistant bacteria in patients being treated with antibiotics for *Streptococcus pneumoniae* infections.

Group A had never been given antibiotics.

Group B had been previously treated with other antibiotics.

Group C had been previously treated with the named antibiotic.

[illegible]

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(Total for question = 12 marks)

Q7.

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.

(5)

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(Total for question = 5 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	- number of chicken and cattle with resistant <i>E.coli</i> (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 bacteria in the animals reared for food (1) (idea not entirely supported because) the bacteria in wild animals are 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 (so data 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)

Q2.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: - antibiotics are only prescribed if the illness could be caused by bacteria / 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 / exposure of bacteria to antibiotics} ACCEPT a description e.g. presence of antibiotic won't be a selective advantage DO NOT ACCEPT immune	(2)

Q3.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following: - HIV mutates (1) - resistance to one drug but not to {all / others} (1)		(2)

Q4.

Question Number	Acceptable Answer	Additional guidance	Mark
	An explanation that makes reference to the following: <i>Salmonella</i> food poisoning can spread easily (1) - therefore early identification means quicker treatment and containment of infection (1) - so that the correct antibiotic can be used to help prevent spread of infection and prevent antibiotic resistance if wrong antibiotic used (1)		(3)

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An answer that makes reference to the following: <u>Evaluation</u> judgment clearly stated and supported by an argument (1) AND at least one from each argument for 4 marks		

	<u>For</u> - antibiotic H is the most effective therefore spraying might help to reduce food poisoning (1) - which could prevent wider spread of infection or contamination of other products (1) <u>Against</u> - bacteria may be inside the chicken so unaffected by spraying (1) - possibility of promoting antibiotic resistance / effects on gut flora of consumers (1) - experimental results may not be {valid due to molecular size and diffusion / reliable due to lack of replicates} (1) - experiment used harmless strain of <i>Campylobacter</i> so results may not apply to { pathogenic strain / other bacteria that also cause food poisoning } (1)		(5)
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Q6.

Question Number	Correct Answer	Additional guidance	Mark
(a)	<i>Staphylococcus</i> spp.		(1)

Question Number	Correct Answer	Additional guidance	Mark
(b)	An explanation that makes reference to the following: - the number of living bacteria does not increase (1) - because cell division is prevented (1)	Accept more sophisticated answers that give details of how cell division is prevented	(2)

Question Number	Indicative content	
*(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Candidates are expected to reach a decision/conclusion on whether the development of bacterial resistance is so serious and rapid that antibiotics will become ineffective in the treatment of the majority of bacterial infections. • Prior use of antibiotics increases the percentage of resistant bacteria, supported by quantitative data • Prior use of the named antibiotic has the greatest effect, supported by quantitative data • Increasing use of antibiotics increases selection pressures so more resistant strains • Shows understanding that resistance mechanisms are inherited by sexual means and lateral gene transfer, e.g. via plasmids and this means they can spread rapidly and in some cases across species • Bacteria have high reproduction rates and mutations more likely within a short time • Understands current methods used to limit increase in resistant strains such as strict controls on antibiotic prescribing, problems of ensuring patients complete course of treatment when symptoms disappear, limit use of antibiotics in animal husbandry etc. • Comments on difficulties of developing new drugs • Methods of preventing spread of resistant strains especially hospital infection • Movement of humans means that transfer of resistant strains will spread to	
Level	Mark	Descriptor
	0	No rewardable material
Level 1	1-3	Provides little or no reference to a range of scientific ideas, processes, techniques and procedures. Scientific argument may be attempted, but fails to link biological concepts and/or ideas in order to support decision/conclusion. Limited attempt to address the question.
Level 2	4-6	Scientific reasoning occasionally supported through the linkage of a range of scientific ideas, processes, techniques and procedures. Scientific argument is partially developed. Attempts to synthesise and integrate relevant knowledge with linkages to biological concepts and/or ideas, leading to a notional scientific argument or decision/conclusion based on evidence.
Level 3	7-9	Scientific reasoning supported throughout by sustained linkage of a range of scientific ideas, processes, techniques or procedures. Scientific argument is well developed and logical. Demonstrating throughout the skills of synthesising and integrating relevant knowledge with consistent linkages to biological concepts and/or ideas, leading to nuanced and balanced scientific argument or decision/conclusion based on evidence.

Q7.

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)