AQA GCSE Biology | 8461

SPECIFICATION POINT 4.6.3.7

Resistant bacteria

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**10**
Available paper years	**2007–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

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Answer 01 · Mark scheme

March 2007 | BLY1A | Original Q6 | Legacy

Six	**A**	antibiotics	**1**
	B	natural selection	**3**
	C	pandemic	**4**
	D	resistance	**2**

	A	**B**	**C**	**D**

Answer 02 · Mark scheme

November 2008 | BLY1AP | Original Q9 | Legacy

Nine	**3**	**1**	**3**	**3**

Answer 03 · Mark scheme

March 2009 | BLY1AP | Original Q8 | Legacy

Eight	**2**	**3**	**3**	**3**

Answer 04 · Mark scheme

November 2011 | BLY1AP | Original Q9 | Legacy

Nine	**1**	**1**	**1**	**3**

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Answer 05 · Mark scheme

January 2013 | BL1FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	pathogens		1
3(b)(i)	A disease affecting people in many countries		1
3(b)(ii)	birds fly / migrate OR human contact with birds more likely OR there are more birds (than pigs)	accept converse birds not contained / difficult to control movement	1
3(c)(i)	antibiotics (only) kill bacteria OR antibiotics don't kill viruses	ignore flu is caused by a virus unqualified ignore virus resistant / immune	1
3(c)(ii)	painkillers	accept any correct named painkiller, eg aspirin or paracetamol allow antivirals / Tamiflu ignore medicine / tablets	1
3(c)(iii)	resistant bacteria	in this order	1 1
Total			7

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Answer 05 · Mark scheme

January 2013 | BL1FP | Original Q3 | Legacy

BL1FP

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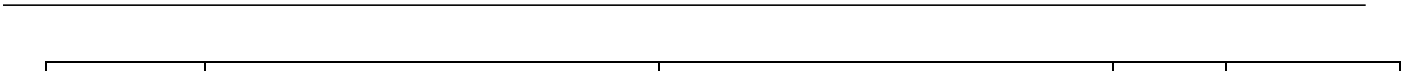
Answer 06 · Mark scheme June 2015 | BL1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	64		1	AO2 1.1
2(a)(ii)	36	allow e.c.f from (a)(i) i.e. 100 – answer given in (a)(i)	1	AO2 1.1
2(a)(iii)	any **one** from: • only considers 16-year-olds • only about some / 5 countries	ignore lack of evidence allow does not refer to all ages allow does not refer to all countries	1	AO3 1.1
2(b)	the more exercise done the healthier a person is	allow the more exercise done the higher the health rating allow the less exercise done the lower the health rating	1	AO3 1.1.1e
2(c)	having a high cholesterol level		1	AO1 1.1.1d
2(d)(i)	antibodies		1	AO1 1.1.2c/d/e
2(d)(ii)	antibiotics		1	AO1 1.1.2i
Total			**7**	

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Answer 06 · Mark scheme

June 2015 | BL1FP | Original Q2 | Legacy



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Answer 07 · Mark scheme June 2017 | BL1FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)		reason must be consistent with safety precaution mark together		AO2 1.1.2m
		ignore germs		
		ignore other safety precautions		
		do **not** allow viruses		
	either			
	Petri dish / culture medium sterile	allow agar sterile	1	
	so no other / harmful microorganisms grow		1	
	OR			
	Petri dish / lid secured (with adhesive tape) (1)			
	so microorganisms cannot leave (1)	allow so other / harmful microorganisms cannot enter ignore spread unqualified		
	OR			
	incubated at 25 °C (1)			
	to prevent / reduce growth of pathogens (1)			
5(b)(i)	any **one** from: • largest / larger area where no microorganisms are growing • most / more microorganisms killed	allow largest clear / white area	1	AO3 1.1.2h/i/j

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Answer 07 · Mark scheme

5(b)(ii)	*idea of* E may not be best on all / other (types of) microorganism eg tested on only one type of microorganism	allow antibiotics do not kill viruses allow (other) bacteria / microorganisms may be / become resistant (to E) allow deficiency diseases are not caused by microorganisms allow disease may be minor / not life threatening allow only tested once **or** not repeated allow (patient) may be allergic to E allow idea of investigation not carried out at body temperature	1	AO3 1.1.2h/i/j 1.1.1a
5(c)(i)	B **and** C **and** D	all three required in any order for mark additional letters will cancel the mark	1	AO2 1.1.2

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Answer 07 · Mark scheme

5(c)(ii)	Healthy animals will produce a higher yield.		1	AO3 1.1.2
5(c)(iii)	Microorganisms become resistant to the antibiotic.		1	AO1 1.1.2h/i
5(d)(i)	white	allow phagocytes / lymphocytes / leucocytes do **not** allow other types of blood cell	1	AO1 1.1.2c/d
5(d)(ii)	These blood cells produce antibodies. These blood cells ingest pathogens.		1 1	AO1 1.1.2d
Total			**10**	

4.6.3.7 Resistant bacteria

Answer 07 · Mark scheme

June 2017 | BL1FP | Original Q5 | Legacy

4.6.3.7 Resistant bacteria

Answer 08 · Mark scheme

June 2023 | 8461/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.1	6000 (kJ/m^2/year)		1	AO2 4.7.5.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.2	$\frac{40}{16\,000} \times 100$ 0.25 (%)		1 1	AO2 4.7.5.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.3	cows move less indoors it is warmer indoors		1 1	AO1 4.7.5.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.4	cows are close(r) together	allow cows are in an enclosed space	1	AO2 4.7.5.2 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.5	any **one** from: • D • G • H		1	AO3 4.6.3.7 4.1.1.6 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.6	DNA		1	AO1 4.6.3.7

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Answer 08 · Mark scheme

June 2023 | 8461/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.7	reproduction		1	AO2 4.6.3.7 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.8	any **two** from: • many animals will become ill • resistant bacteria passed from animal to animal • animals cannot be cured (by the antibiotic) • animals may be less productive / efficient • farmer may lose profit / money	ignore reference to crops allow many animals may die allow disease passed from animal to animal **or** other animals infected allow antibiotic will not work allow less meat / milk produced allow less growth allow cannot sell infected produce / animals	2	AO2 4.3.1.1 4.6.3.7 4.7.5.2

Total Question 4	11

4.6.3.7 Resistant bacteria

Answer 09 · Mark scheme

June 2025 | 8461/1F | Original Q4

Question 4

Question	Answers	Mark	AO / Spec Ref.
04.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	AO1 4.1.1.6 RPA2
	No relevant content.	0	

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	Indicative content: *preparation of agar plate* • melt agar • pour agar into Petri dish • allow agar to cool / set *transfer of bacteria* • transfer bacteria to agar / Petri dish **or** spread bacteria on agar / Petri dish • transfer bacteria using (inoculating) loop **or** by pouring (liquid) bacterial culture *techniques to ensure sterile conditions (aseptic technique)* • wipe table with a disinfectant / antibacterial solution **or** sanitise hands using sanitiser gel • sterilise agar by heating **or** using autoclave / UV **or** pressure cooker • sterilise Petri dish by heating **or** using autoclave / UV **or** pressure cooker **or** ethanol • sterilise neck of agar / bacteria bottle by passing through a flame • only open lid of agar bottle minimally **or** only lift lid of Petri dish minimally • work next to a Bunsen flame • sterilise inoculating loop before use by dipping in alcohol / ethanol • sterilise inoculating loop before use by passing through a flame *growth of bacteria* • incubate Petri dish upside down • tape lid (correctly) • incubate at 25 °C **or** leave bacteria to grow For **Level 3**, a valid method must include preparation of the agar plate and transfer of the bacteria using sterile techniques. For **Level 2**, a method must include preparation of the agar plate and transfer of the bacteria.		

4.6.3.7 Resistant bacteria

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.2	to prevent growth of pathogens	allow to prevent growth of harmful bacteria / fungi / microorganisms	1	AO2 4.1.1.6 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.3	to show the effect of no antibiotics		1	AO2 4.1.1.6 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.4		ignore ring drawn around blank / water disc ignore shading / hatching within rings		AO3 4.1.1.6 RPA2
	larger ring drawn around antibiotic **A** than **B**		1	
	smaller ring drawn around antibiotic **C** than **B**	ignore no ring drawn around antibiotic **C**	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.5	none of the bacteria would have been killed		1	AO3 4.1.1.6 4.3.1.8

Total Question 4	11

4.6.3.7 Resistant bacteria

Answer 10 · Mark scheme

June 2025 | 8461/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	bases		1	AO1 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	3 / three		1	AO2 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	mutation		1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	*figures from graph* 40 and 1 *correct equation* $\frac{40 - 1}{12}$ *correct answer* 3.25 (cases per million people per year)	 allow $\frac{39}{12}$ 	 1 1 1	AO2 4.6.3.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	resistant		1	AO1 4.6.3.7

4.6.3.7 Resistant bacteria

Answer 10 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **one** from: • discovery of a new antibiotic / drug / treatment • vaccination • isolation of patients • better / improved education about MRSA • better hygiene	allow social distancing allow increased awareness of MRSA allow examples such as more / better hand washing (in hospitals)	1	AO2 4.6.3.7

Total Question 5	**8**

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Answer 08 · Examiner comments June 2023 | 8461/2F | Original Q4

Question 4

This question was about energy balances for cattle raised indoors and outdoors, and problems caused by the development of antibiotic resistance in bacteria that might cause disease in the cattle.

04.1 This was a simple sum that required selection of appropriate data from Table 3. Although many students used the data correctly, it was clear that many did not read the question or the table headings correctly, as a variety of answers such as '6002' (adding all the values) and '5900' (subtracting, rather than adding) were given instead of the required value: 6000.

Answer 08 · Examiner comments June 2023 | 8461/2F | Original Q4

04.2 Many students were able to substitute the correct values into the equation, thus gaining the first mark. However, when it came to giving a final answer, it was not uncommon for students to multiply the answer by 100 again, giving an answer of '25%', rather than 0.25%, thus showing a weak understanding of percentages. Fewer than half the students arrived at the correct answer.

04.3 Half the students were able to select both less movement indoors and it being warmer indoors as two reasons why it was more energy efficient to keep cattle indoors.

04.4 This question was generally well done with more than three-quarters of students stating that the cows were 'closer together' indoors and hence diseases would spread more rapidly. The idea of being 'in an enclosed space' was seen occasionally.

04.5 From Figure 7, it was evident to two-thirds of students that the antibiotic discs with no zone of inhibition (either D, G or H) were ones to which the bacterium was resistant.

04.6 The vast majority also understood that a change in a bacterium's DNA (rather than carbohydrate or lipid) was responsible for antibiotic resistance.

04.7 Most students also understood that a change in one bacterium could cause millions more to become resistant due to the bacteria having a high rate of reproduction.

04.8 The fact that antibiotic resistance in bacteria could become a problem to farmers was variously attributed to illness in the farmer's cattle, their productivity decreasing and them not being able to be cured of their illness by antibiotic treatment and hence the farmer's profits being decreased. Some students struggled to be able to express themselves sufficiently clearly in their answers and only one-quarter scored both of the available marks.

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Answer 09 · Examiner comments

June 2025 | 8461/1F | Original Q4

Question 4 (low and standard demand)

04.1 This was a levelled, extended response question based on a required practical. Students were asked to describe a method to grow bacteria on a sterile agar plate. Around 20% of responses were awarded a mark within Level 3, 50% in Level 2 and 15% in Level 1. Students achieving Level 1 gave one or more appropriate points from the indicative content, but these were insufficient to allow a valid outcome to their method.

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Answer 09 · Examiner comments

To enter Level 2, students had to make clear how an agar plate could be prepared to grow a sample of bacteria. This was the minimum requirement to match the Level 2 descriptor of 'identifying most steps in the method'.
To enter Level 3, students had to go further and give examples of aseptic techniques; by doing this, they were able to fulfil the other requirements of the question, including preparing a plate that was 'sterile' and growing a sample of 'uncontaminated' bacteria. Those students who matched the Level 3 criteria generally showed excellent knowledge and understanding of the steps involved. Their descriptions were detailed and appropriately sequenced. The responses of many students, however, remained in Level 2. They appreciated the fundamental steps of preparing and inoculating a plate but struggled to give clear mention of the aseptic techniques that should be followed. Reference to heating the inoculating loop (or some other, identifiable, description) was frequently seen but, without further points, Level 3 was not achievable. Other indicative content was often hinted at but was too vague to be considered. So, answers such as 'other bacteria from the air should be prevented from entering the plate', 'the rod should be sterilised' or 'the bench should be cleaned' were all insufficient as they did not describe how these steps should actually be carried out.

Fewer answers remained in Level 1 and those that did were either very limited in content or made confused comments such as using the Bunsen burner to heat the plate after bacteria had been added. The statements students make in these extended response questions do not need to be long or complex and it is never necessary to include all the points listed in the indicative content on the mark scheme to achieve the highest level. Neither do responses have to be written in complete sentences - succinct bullet points often suffice and may even help students to organise their ideas more effectively. As is always the case with extended response questions, however, answers are considered holistically and always in a positive framework. It was pleasing here to see some students entering Level 3 and achieving high marks.

04.2 Few students (just under 10%) gave a correct answer to this question. The reference to temperature triggered lines of thought which were inappropriate and gained no credit such as:

- a higher temperature could lead to faster growth of bacteria and this could be dangerous.
- a higher temperature might be too high and cause the bacteria to be killed / enzymes to be denatured / the antibiotics not to work.
- a higher temperature might cause the agar to melt.

Answers which suggested that the higher temperature might cause the bacteria to 'become' dangerous were also not creditworthy.

04.3 65% of students were able to identify the purpose of the control disc in the investigation.

04.4 Some students struggled to appreciate that the *difference* in the effectiveness of each antibiotic had to be reflected in their answers and simply drew rings, as requested, around A and C but without any distinctions at all. Others gave a smaller ring around A

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Answer 09 · Examiner comments June 2025 | 8461/1F | Original Q4

but a larger one around C. Many, however, clearly understood this RPA and gave clear and correct answers. Students should be encouraged to use a pencil, at least in the first instance, when answering questions involving drawing. Answers often showed that students had changed their minds but were unable to erase and correct a first attempt. It was, therefore, difficult for examiners to appreciate their final intentions. Over 11% of students did not attempt this question and students are encouraged to check that all questions have been answered, particularly where no answer lines are provided.

Answer 10 · Examiner comments

June 2025 | 8461/2F | Original Q5

Question 5 (Low and Standard demand)

05.1
Almost 75% of students knew that A, C, G and T are called bases.

05.2
Only 40% of students correctly calculated that 3 amino acids were coded for by the section of DNA given. The most common wrong answers were 2, 4 and 9. Some students who gave 2 as their answer had highlighted the two copies of AGTA within the sequence.

05.3
Almost three quarters of students knew that a change in DNA is called a mutation.

05.4
Students were given a graph showing cases of MRSA in one country and asked to calculate the mean rate of increase for a period of 12 years. There was a lot of confusion about how to do this calculation and only 10% of students achieved full marks.
The most common incorrect answer was seen when students chose to add up the cases per million for each year from 1993 to 2003 and divide by either 12 (years) or 7 (number of readings). Although their list of readings from the graph would have included 1 and 40, MP 1 could only be awarded if the student went on to indicate that these were the relevant readings for this question.

There was a number of incorrect readings from the graph that could not gain credit for mark point 1 – but did not preclude the student from gaining subsequent mark points. Other common errors were forgetting to subtract the 1 or reading the graph as 1 million and 40 million rather than 1 and 40. Many students gained mark point 1 for the correct readings from the graph but then proceeded to do the wrong calculation. Some students gained mark point 1 for getting 39 by adding together the increase between each straight section of the graph; '5 + 5 + 2 + 6 + 6 + 15' rather than doing 40 – 1.
10% of students chose not to attempt this calculation.

05.5
Nearly 60% of students knew that the word resistant describes bacteria that are not killed by antibiotics.

05.6
Students were asked to suggest a reason for the decrease in MRSA cases after 2006. A pleasing 60% of students were able to do so with all bullet points seen across the range of responses. By far the most common correct answer was to do with vaccination. Many students also implied the discovery of a new antibiotic/drug by referring to one that works to kill the bacteria (as opposed to the current ones that do not). Some students missed out on the mark by just referring to 'a cure being found' – which was too vague.