AQA GCSE Biology | 8461

SPECIFICATION POINT 4.1.1.6

Culturing microorganisms (biology only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**15**
Available paper years	**2008–2025**

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.

4.1.1.6 Culturing microorganisms (biology only)

Answer 01 · Mark scheme June 2008 | BLY3H | Original Q6 | Legacy

question	answers	extra information	mark
6(a)	any **five** from: description: • (at low protein conc / at first) increased protein gives increased growth / gives steep line • at medium protein conc rise is less steep • at high protein conc / later increased protein gives no change • appropriate use of number eg levels off at 16.4 (million bacteria per cm^3) **or** levels off at 5 (g per dm^3 protein) **or** 6 (million bacteria) at 0 protein conc. **or** 12-12.4 (million bacteria) **or** 0.8-1 protein conc. explanation: • protein is the limiting factor at low conc. / at first **or** not enough protein at low concentration • something else is limiting at high conc. / later **or** not enough named example at high concentration • growth rate equals death rate at high concentration / accept birth rate equals death rate • protein is used to make cell structures	if no reference to protein conc allow **1** mark for description of line in 2 or 3 stages eg goes up and levels off **or** goes up sharply, goes up less steeply and levels off allow between 16.3 and 16.5 accept named example: temperature / glucose / mineral element / etc do **not** accept growth unqualified	5

Question 6 continued on next page...

4.1.1.6 Culturing microorganisms (biology only)

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: June 2008

Question 6 continued...

question	answers	extra information	mark
6(b)	0.5–5 (g per dm^3)	allow any number in range	1
	below this – lower growth rate	allow most / greatest amount of bacteria at 5	1
	above 5 – no improvement in growth rate / waste of resources / waste of money **or** above 0.5 < 5 slower improvement in growth rate / waste of resources / waste of money	do **not** allow just 'graph levels off''	1
Total			**8**

4.1.1.6 Culturing microorganisms (biology only)

Answer 01 · Mark scheme

June 2008 | BLY3H | Original Q6 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: June 2008

4.1.1.6 Culturing microorganisms (biology only)

Answer 02 · Mark scheme

January 2009 | BLY3H | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	any **two** from: • sterilise / kill microorganisms • method of sterilisation eg apparatus / media sterilised in oven / autoclave • pass flask mouth / pipette tip / loop / test tube mouth through flame • work near a flame • minimise opening of flask / test tube **or** hold non-vertical	 ignore 'cleaning' / 'disinfect' ignore 'germs' allow pressure cooker / boiling water allow idea of sealing / covering **or** prevent entry of air	2
4(b)	any **two** from: • temperature • concentration / amount of nutrients / ions • type of nutrient • volume / amount of solution • amount of bacteria added • agitation **or** amount of oxygen	 ignore references to time / type of bacterium	2
4(c)(i)	7.5	accept in range 7.4 – 7.6	1
4(c)(ii)	use more pH values around / close to pH 7.5 / between 7 and 8		1
Total			**6**

4.1.1.6 Culturing microorganisms (biology only)

Answer 02 · Mark scheme

January 2009 | BLY3H | Original Q4 | Legacy

COMPONENT NUMBER: BLY3H

COMPONENT NAME: Biology

STATUS: Final

DATE: January 2009

4.1.1.6 Culturing microorganisms (biology only)

Answer 03 · Mark scheme June 2009 | BLY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	B		1
4(a)(ii)	any **one** from: • largest area of / most digestion (of lipid) • largest clear area	allow agar / jelly / mixture broken down / digested do **not** allow digestion of bacteria / lipase ignore digestion **by** bacteria	1
4(b)	any **two** from: • effect of pH / pH described • effect of temperature • effect on different types of lipid / fat • cost **or** allergic reactions **or** effect on skin / fabrics / **or** environment **or** interaction with other chemicals in powder **or** shelf life		2
4(c)	enzymes / named enzyme denatured / destroyed	allow active site(of enzyme) altered	1
Total			**5**

4.1.1.6 Culturing microorganisms (biology only)

Answer 03 · Mark scheme

June 2009 | BLY2H | Original Q4 | Legacy

BLY2H

4.1.1.6 Culturing microorganisms (biology only)

Answer 04 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	to kill (other) (micro) organisms (in the milk) / to sterilise	allow germs ignore viruses allow destroy ignore pasteurise	1
2(b)(i)	0.015	award **2** marks for correct answer irrespective of working allow answer or use of 1.5 for **1** mark allow **1** mark for $\frac{(y_1 - y_2)}{100}$ but incorrect answer y-values may be incorrect **or** use of 6.0 **and** 4.5 but incorrect answer	2
2(b)(ii)	running out of substrate / sugar / food **or** (acid / low pH) denatures enzymes / proteins / kills bacteria	accept stops / slows enzymes / metabolism allow (acid / low pH) stops / slows bacteria working / growing	1
2(c)	lactic acid	 if incorrect acid allow **1** mark	1 1
2(d)(i)	25		1
2(d)(ii)	pathogens / harmful bacteria (might) grow (at 35 °C)	do **not** accept viruses	1
Total			**8**

4.1.1.6 Culturing microorganisms (biology only)

Answer 04 · Mark scheme

January 2011 | BLY3H | Original Q2 | Legacy

BLY3H

4.1.1.6 Culturing microorganisms (biology only)

Answer 05 · Mark scheme

June 2011 | BLY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	any **one** suitable product: eg • penicillin / antibiotic / other named antibiotic • mycoprotein / described / quorn • lactic acid / yoghurt • enzymes • ethanol / alcohol / beer / wine • hormones / insulin / GH / somatotrophin • blood-clotting protein / factor VIII • methane / biogas • vaccines		1
6(b)(i)	otherwise too many colonies <u>to count</u> **or** too many bacteria <u>to count</u> **or** make it easier to count		1
6(b)(ii)	a colony is <u>many</u> bacteria **or** cannot see one bacterium each bacterium produces one colony		1 1

Question 6 continues on the next page

Question 6 continued

question	answers	extra information	mark
6(c)	correct answer: 8 800 000 / 8.8 million / 8.8×10^6	correct answer gains **2** marks with or without 1st two lines if answer incorrect, 1 error in calculation eg 88 000 / 880 000 gains **1** mark **or** allow error carried forward from incorrect 1st line for **1** mark	2
6(d)(i)	on graph: line starts at x and decreases downward sloping s – shaped curve not reaching zero before 30 hours		 1 1
6(d)(ii)	(graph **A**) rises: because glucose <u>is used</u> for reproduction / growth / cell division / multiplication (graph **A**) falls: less / no glucose available **or** glucose is limiting causes some bacteria to die	 allow food for glucose must relate to previous point	 1 1 1
6(d)(iii)	method B counts living and dead bacteria / includes dead bacteria		1
Total			**12**

The AQA UMS Conversion Calculator is available on the **Results statistics** page of the AQA Website

4.1.1.6 Culturing microorganisms (biology only)

Answer 06 · Mark scheme

January 2013 | BL1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There is a brief description of at least one of the stages (pre-inoculation, inoculation, post-inoculation).	There is a simple description of at least two stages and an explanation of at least one of them.	There is a clear description of all three stages and an explanation of at least two of them.

examples of biology points made in the response:

Pre-inoculation

- Petri dish and agar sterilised before use
- to kill unwanted bacteria
- inoculating loop passed through flame / sterile swab
- to sterilise / kill (other) bacteria

Inoculation

- loop/swab used to spread/streak bacterium onto agar

allow other correct methods, eg bacterial lawns

- lid of Petri dish opened as little as possible
- to prevent microbes from air entering

Post-inoculation

- sealed with tape
- to prevent microbes from air entering
- incubate
- to allow growth of bacteria

Question 3 continues on the next page

BL1HP

Question 3 continued

question	answers	extra information	mark
3(b)(i)	bacteria killed / destroyed	ignore fights / attacks / stops growth / got rid of	1
3(b)(ii)	*Might be correct* largest area / space where no bacteria are growing	allow most bacteria killed	1
	Might not be correct (need more evidence as) D may be harmful to people / animals / surfaces	ignore ref to cost / dangerous or harmful unqualified	1
	or may work differently with different bacteria		
	or disinfectants may be different concentrations	ignore different amounts of disinfectant unless reference to different drop size	
	or may not last as long	ignore take longer to work allow reference to anomalous result or not repeated	
Total			**9**

4.1.1.6 Culturing microorganisms (biology only)

Answer 06 · Mark scheme

January 2013 | BL1HP | Original Q3 | Legacy

BL1HP

4.1.1.6 Culturing microorganisms (biology only)

Answer 07 · Mark scheme

June 2013 | BL1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	auxin	accept other named plant hormones	1
5(b)(i)	any **three** from: • no (fusion of) gametes / fertilisation • only one parent • no mixing of genetic material • no genetic variation **or** genetically identical offspring	 allow no meiosis **or** new cells only produced by mitosis allow not two parents allow clones	3
5(b)(ii)	more / many offspring / plants (produced from one parent plant)	allow less damage to parent plant ignore speed / cost	1
Total			**5**

4.1.1.6 Culturing microorganisms (biology only)

Answer 08 · Mark scheme

June 2018 | 8461/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	toxins / poisons (secreted by / from / in bacteria)		1	AO1 4.3.1.3
01.2	any **two** from: • wash hands after using toilet / being sick **or** wash hands before preparing / handling food **or** do not prepare food (whilst infected) • isolate yourself • disinfect clothes / surfaces • do not share utensils / cutlery / towels	ignore 'wash hands' unqualified ignore reference to coughing / sneezing allow examples of how isolation could be achieved	2	AO2 4.3.1.1
01.3	antibiotics	allow named examples of antibiotics	1	AO1 4.3.1.8
01.4	immune system is damaged / weakened **or** immune system doesn't function properly white blood cells cannot kill bacteria / *Salmonella* (as effectively)	allow immunocompromised allow lack of / no white blood cells allow no / fewer antibodies so bacteria not killed **or** less phagocytosis so bacteria not killed **or** no / fewer antitoxins to counter toxins	1 1	AO2 4.3.1.2

4.1.1.6 Culturing microorganisms (biology only)

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **one** from: • (give chickens) antibiotics • don't sell infected chickens / eggs • keep infected chickens isolated / indoors • slaughter the infected chickens	allow (give chickens) monoclonal antibodies allow don't sell the chickens / eggs ignore don't sell chickens / eggs allow keep the chickens indoors ignore keep chickens indoors ignore vaccination / chlorination / disinfection	1	AO1 4.3.1.3
01.6	(cleaning liquid) B **and** greater reduction in number of bacteria (after cleaning) in both locations	ignore few bacteria in both locations allow neither / both **and** idea of experimental error	1	AO3 4.1.1.6 4.3.1
01.7	radius (of area with no bacteria growing)	allow diameter (of the area with no bacteria growing) ignore πr^2 unqualified allow idea of placing agar plate onto graph paper and counting the squares not covered with bacteria	1	AO2 4.1.1.6

4.1.1.6 Culturing microorganisms (biology only)

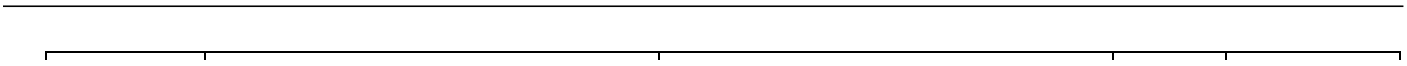
Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	repeat **and** look to see if results are similar	ignore repeat unqualified allow repeat **and** look to see if results are different allow repeat and see if there are anomalies ignore repeat and identify anomalies ignore repeat and compare unqualified	1	AO3 4.1.1.6
01.9	any **one** from: • toxicity / side / health effects • effect on other types of bacteria / pathogens • interaction with other cleaners • ease of use • dilution factor of each cleaner (vs. cost) • time cleaner is effective for	 ignore harmful / dangerous allow reference to allergies allow not tested on other types of bacteria ignore germs ignore concentration unqualified ignore how long the cleaner lasts for allow reference to odour of cleaning liquid ignore reference to cost unqualified ignore environmental effects / flammability	1	AO3 4.1.1.6
Total			**11**	

4.1.1.6 Culturing microorganisms (biology only)

Answer 08 · Mark scheme

June 2018 | 8461/1H | Original Q1



4.1.1.6 Culturing microorganisms (biology only)

Answer 09 · Mark scheme June 2019 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	same kingdom + phylum + class + order **or** same order **or** they have the top four groups the same	allow both Poales	1	AO3 4.6.4
05.2	**Rr / rR**	do **not** accept **RR** or **rr** ignore heterozygous do not accept homozygous	1	AO3 4.6.1.6 4.6.3.3
05.3	C^WC^W		1	AO3 4.6.1.6
05.4	parental genotypes / gametes correct for both parents: $C^R C^W$ $C^R C^W$ / C^R and C^W genotypes of offspring correctly derived in a Punnett square: C^RC^R C^RC^W C^WC^W correct identification of phenotypes from their cross: C^RC^R = red C^RC^W = pink C^WC^W = white	allow **R** and **W** throughout allow own symbols if defined allow correctly derived genotypes from incorrect gametes allow colours correctly identified from different offspring, only if pink and other colour(s) are given	1 1 1	AO2 4.6.1.6
05.5	answer correctly derived from Question **05.4** to match stated phenotypes	allow 50(%) if no offspring given in Question **05.4** allow to match genotypes if no phenotypes given	1	AO2 4.6.1.6

4.1.1.6 Culturing microorganisms (biology only)

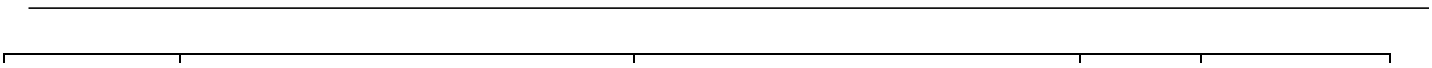
Answer 09 · Mark scheme June 2019 | 8461/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	*(several groups)* so many / several plants can be produced	allow each (group) will give a new plant	1	AO1 4.1.2.3 4.6.1.3 4.6.2.5
	(nutrients) for making protein / amino acids **or** for making chlorophyll **or for providing** energy **or for respiration**	allow other examples do **not** accept making energy ignore for growth	1	
	(add hormones) so differentiation occurs **or** so roots / shoots develop	allow for the formation of different tissues / organs / named allow to stimulate cell division	1	
	(sterile conditions) to prevent growth / entry of microorganisms / named type **or** prevent decay / disease	ignore to kill microorganisms ignore contamination unqualified	1	
	(temperature = 20 ^{o}C) so optimum / good growth	allow reference to enzymes working well ignore enzymes not denatured ignore reference to pathogens / microorganisms	1	
05.7	(all new plants have been) produced by asexual reproduction / mitosis **or** produced without (fusion of) gametes	ignore produced from one parent	1	AO2 4.1 4.1.2.2 4.6.1.1 4.6.2.5
	(so) all are genetically identical / clones **or** all are **C^RC^W /** heterozygous	allow all are the same genotype / alleles / genes / DNA	1	
Total			**14**	

4.1.1.6 Culturing microorganisms (biology only)

Answer 09 · Mark scheme

June 2019 | 8461/2H | Original Q5



4.1.1.6 Culturing microorganisms (biology only)

Answer 10 · Mark scheme

June 2019 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	**Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3–4	AO1 AO2
	Level 1: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		1–2	
	No relevant content		0	
	Indicative content • use of quadrat • (quadrat) of given area / dimensions – eg 0.25 m^2 or 1 m × 1 m • quadrats are placed randomly • method of obtaining randomness – eg random coordinates from a calculator **or** throw over shoulder **or** throw with eyes closed • suitable number of quadrats (10 or more **or** a large number) • count number of plants (in each quadrat) • calculation of mean per quadrat or per unit area • determination of area of field (length × width) • population = mean per m^2 × area of field			4.7.2.1
07.2	more bacteria so more divisions / reproduction (per unit time)		1	AO2 4.1.1.6
07.3	any **three** from: • add (more) sugar • add (more) amino acids / protein • add (more) oxygen • increase temperature • remove toxins / waste **or** maintain pH • stir the culture	if neither point given, allow add (more) nutrients allow in range 26 °C to 40 °C allow maintain optimum temperature if no other mark awarded allow **1** mark for add more food	3	AO3 4.1.1.6 4.4.2.3 4.7.2.3 4.7.4.3 4.7.5.4

4.1.1.6 Culturing microorganisms (biology only)

Answer 10 · Mark scheme

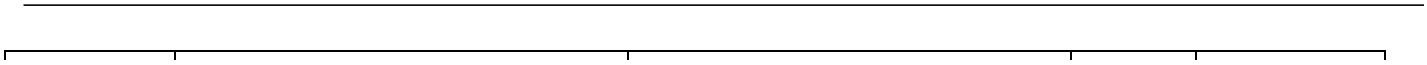
June 2019 | 8461/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		an answer in the range of 2.9 to 3.4 scores **4** marks an answer in the range of 2.08 to 3.77 scores **3** marks		AO2 4.1.1.6 4.6.2.4
	tangent drawn to the curve at 12 hours	do **not** accept if there is an incorrect tangent at 7 hours	1	
	calculation of rate at 7 hours $\frac{\Delta y}{\Delta x}$	allow an answer that correctly rounds to a value in range 10.0 to 11.7	1	
	calculation of rate at 12 hours $\frac{\Delta y}{\Delta x}$	allow an answer that correctly rounds to a value in range 3.1 to 4.8	1	
	3.3	allow in range 2.9 to 3.4 if both rates are in the correct ranges	1	
07.5	can use the glyphosate / weed killer to kill weeds but not kill / affect crop	allow **only** kills weeds	1	AO1 4.6.2.4 4.7.1.3 4.7.5.4
	(so) less competition for light / water / minerals / ions	allow less competition for nutrients ignore food / carbon dioxide / space	1	AO2
	(so) crops have high(er) yield	allow crops grow better / well	1	AO1
Total			**15**	

4.1.1.6 Culturing microorganisms (biology only)

Answer 10 · Mark scheme

June 2019 | 8461/2H | Original Q7



4.1.1.6 Culturing microorganisms (biology only)

Answer 11 · Mark scheme November 2021 | 8461/1H | Original Q2

02.1	any **two** from: • sterilise equipment / surfaces (before use) • (use) sterilised agar • secure lid of the Petri dish with (adhesive) tape • only lift lid of Petri dish a little (when setting up plate) **or** lift lid of Petri dish at an angle (when setting up plate)	ignore 'clean' unqualified ignore wash hands allow description of how to sterilise equipment allow description of how to sterilise agar	2	AO1 4.1.1.6 RPA2
02.2	B **and** it kills the fewest bacteria **or** it has the smallest area where no bacteria were growing	 allow it has the smallest clear / white area	1	AO3 4.1.1.6 RPA2

02.3	*(correct measurement)* r = 1.1 (cm) **or** r = 11 (mm) *(recall of the equation)* πr^2 *(calculation/substitution)* 3.14 x 1.1^2 **or** 3.14 x 11^2 = 3.799(4) (from 3.14 x 1.1^2) **or** = 379.9(4) (from 3.14 x 11^2) *correct unit* (3.7994) cm^2 **or** (379.94) mm^2	an incorrect answer for one step does not prevent allocation of marks for subsequent steps ignore calculation and subtraction of filter paper disc area from total area allow d = 2.2 (cm) **or** d = 22 (mm) allow a tolerance of ±1 mm allow correct calculation / substitution using an incorrect measurement allow 3.8 allow 380 do **not** accept unit with no attempt at working / answer	1 1 1 1 1	AO2 4.1.1.6 RPA 2
02.4	any **one** from: • repeat **and** calculate a mean • repeat **and** eliminate anomalies • use a control disc • use different types of bacteria	 allow description of control disc e.g. disc with water / nothing ignore set up a control	1	AO3 4.1.1.6 RPA2
Total			**9**	

4.1.1.6 Culturing microorganisms (biology only)

Answer 11 · Mark scheme

November 2021 | 8461/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	any **two** from: • (same volume of) water • (same) temperature • (same) species / type of plant • (same) age of shoot	allow (same amount of) water allow (amount of) minerals / ions / salts ignore (same) time ignore (same) height of shoot ignore carbon dioxide (concentration) do **not** accept light	2	AO3 4.5.4.1 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	**B** shows response (in **A**) is due to light (as **B** has no light)	allow **B** gives a comparison between no light and (one-sided) light ignore **B** shows the effect of no light	1	AO2 4.5.4.1 RPA8
	C shows response (in **A**) is due to one-sided light (as **C** has light from all sides)	allow **C** gives a comparison between all-round light and one-sided light ignore **C** shows the effect of light from all sides	1	

4.1.1.6 Culturing microorganisms (biology only)

Answer 12 · Mark scheme

June 2022 | 8461/2H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3		ignore reference to auxin ignore reference to left and right sides		AO3 4.5.4.1 RPA8
	growth / elongation occurs (just) behind / below / at the tip	allow no growth **or** very little growth at the base ignore shoot is taller	1	
	bending occurs (just) behind / below / at the tip **or** more growth on the side away from the light		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	phototropism / phototropic	allow positive phototropism ignore tropism do **not** accept negative phototropism do **not** accept phototrophic / phototrophism	1	AO1 4.5.4.1 RPA8

4.1.1.6 Culturing microorganisms (biology only)

Answer 12 · Mark scheme

June 2022 | 8461/2H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5		ignore references to **D** and **E** ignore references to left and right sides unless at least one is identified as side nearer to or further from the light		AO3 4.5.4.1
	in **F** there is more auxin in the side furthest from the light		1	
	in **G** there is the same mass of auxin in each side		1	
	in **F** auxin can move through the shoot but in **G** the glass prevents this		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	all four (blocks) have (approximately) the same mass of auxin	allow examples such as mass of auxin in **D** / **E** is (about) the same as in **F** / **G** **or** those in light have same mass of auxin as those in dark	1	AO3 4.5.4.1

Total Question 9		11

4.1.1.6 Culturing microorganisms (biology only)

Answer 13 · Mark scheme

June 2023 | 8461/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.1	(bacteria) release / produce toxins	allow (bacteria) release / produce poisons ignore toxins unqualified	1	AO1 4.3.1.3 4.3.1.1

Question	Answers	Mark	AO / Spec Ref.
03.2	**Level 2**: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3-4	AO2
	Level 1: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1-2	AO1 4.3.1.3 4.3.1.7
	No relevant content	0	
	Indicative content: *Vaccination of animal* • (animal's) white blood cells / lymphocytes produce antibodies (against *Salmonella* / vaccine / antigens) • antibodies are specific / complementary / correct to *Salmonella* / antigens • (specific) antibodies bind to *Salmonella* / antigens *Secondary response in animal* • if infected (specific) antibodies are produced quickly **or** in large numbers • (so) white blood cells **or** antibodies would kill (live) *Salmonella* • (so) fewer / no bacteria / pathogens / *Salmonella* in animals **or** in animal products (meat / milk / eggs) *Prevention of food poisoning in humans* • (so) fewer / no bacteria / pathogens / *Salmonella* eaten **or** in (named) food • (so) number of bacteria never reaches a high enough level for infection to develop • (so) fewer toxins produced (in humans). For **Level 2** students must link immune response in animals to prevention of an outbreak in humans.		

4.1.1.6 Culturing microorganisms (biology only)

Answer 13 · Mark scheme

June 2023 | 8461/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.3	any **two** from: • disinfect hands / work surface • sterilise Petri dish **or** culture medium (before use) • pass inoculating loop / forceps through a flame (before use) • work near a flame **or** work in a fume cupboard • tilt lid (of Petri dish) when placing discs on agar (to minimise contact with air / breath) • secure lid of Petri dish with adhesive tape	allow alternative descriptions of sterilising equipment such as UV light ignore clean / wash surfaces / hands / equipment allow sterilise agar (before use) ignore sterilise equipment allow example of other method to minimise contact with air / breath ignore store dish upside-down	2	AO1 4.1.1.6 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.4	(37 °C) 37 °C is human / body temperature *Salmonella* / bacteria grows best / better at 37 °C (25 °C) 25 °C reduces / prevents the growth of bacteria that are harmful to humans / students	 allow (so) bacteria grow best / better at human body temperature allow because it is too low for growth of human pathogens	 1 1 1	AO2 4.1.1.6 4.3.1.3 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.5	(acts as a) control	allow for comparison allow to show that the results are not due to the paper disc allow to show that the results are due to the antibiotic ignore to show the effect / effectiveness of the antibiotic do **not** accept as a control variable	1	AO2 4.1.1.6 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.6	(they) killed the most bacteria	allow prevented most bacteria growing / replicating allow largest zone of inhibition (of bacteria) ignore largest clear area unqualified ignore antibiotic **B** killed the most bacteria	1	AO2 4.1.1.6 RPA2

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.7	measure the diameter / radius of each clear area **or** calculate / measure the area of each clear area	allow measure the diameter / radius of each region where the bacteria are killed allow calculate the area of each region where the bacteria are killed	1	AO3 4.1.1.6 RPA2

4.1.1.6 Culturing microorganisms (biology only)

Answer 13 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.8	bacteria must be resistant (to antibiotic **B**)	do **not** accept bacteria must be immune	1	AO3 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec Ref.
03.9	water enters the (bacterial) cell		1	AO2 4.3.1.8 4.1.3.2 4.1.1.1
	(water enters) by osmosis	allow (water enters) by diffusion through a partially / selectively / semi permeable membrane do **not** accept if description of concentrations is incorrect	1	
	(so) damaged / incomplete / no cell wall cannot withstand pressure (of water)	allow (so remaining) cell membrane cannot stretch further	1	

Total Question 3	**17**

Answer 14 · Mark scheme

June 2024 | 8461/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.1	penicillin	allow other named antibiotics ignore penicillium	1	AO1 4.3.1.3 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.2	the bacterium is killed (by antibiotic **C**)	allow there is a zone of inhibition (around antibiotic **C**)	1	AO2 4.3.1.8 4.1.1.6 RPA2
	if the bacterium was resistant, bacteria would be right up to the (edge of the) antibiotic disc	allow resistance means that the bacterium is not killed (by antibiotic(s)) allow if the bacterium was resistant there would be no zone of inhibition ignore no white area	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.3	any **two** from: • current / available antibiotics do not kill (certain) bacteria • diseases become more common **or** there will be some diseases that cannot be cured / treated • new antibiotics need to be developed which takes time / money	allow current / available antibiotics have no effect on (certain) bacteria ignore more people become ill allow some diseases become more difficult to treat	2	AO2 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.4	viruses **only** exist / reproduce inside (living) cells	allow viruses **need** (living) cells to exist / reproduce allow viruses exist / reproduce inside (living) cells **and** agar is not made of cells ignore names of cell types	1	AO2 4.3.1.8 4.3.1.1

4.1.1.6 Culturing microorganisms (biology only)

Answer 14 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.5	(these) drugs (can) damage (body) cells / tissues **or** it is hard to get (these) drugs into (living) cells	allow viruses often / frequently mutate (giving resistance to these drugs)	1	AO1 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec Ref.
06.6	AIDS		1	AO1 4.3.1.2

Total Question 6	8

4.1.1.6 Culturing microorganisms (biology only)

Answer 15 · Mark scheme

June 2025 | 8461/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.1	bacterial cells are prokaryotic and yeast cells are eukaryotic		1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.2	any **two** from: • nucleus • vacuole • mitochondria	allow chromosomes allow large ribosomes if no other mark awarded allow **1** mark for membrane bound sub-cellular structures	2	AO3 4.1.1.1 4.1.1.2

Question	Answers	Mark	AO / Spec Ref.
08.3	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3-4	AO3 4.1.1.6
	Level 1: Relevant features are identified and differences noted.	1-2	
	No relevant content.	0	
	Indicative content: • all three antibiotics have similar / no effect in the first 4 / 5 hours *antibiotic **A*** • **A** is least / less effective o because **A** starts to reduce the number of bacteria latest o because **A** reduces the number of bacteria the slowest o because the (maximum) number of bacteria using **A** is the highest o because **A** does not reduce the number of bacteria as much as **C** and / or **B** o because with **A** there is still a (much) larger number of bacteria left at 16 hours *antibiotic **B*** • **B** is more effective than **A** • **B** is less effective than **C** o because **B** starts to reduce the number of bacteria after **C** o because **B** starts to reduce the number of bacteria before **A** o because **B** reduces the number of bacteria more than **A** o because **B** reduces the number of bacteria quicker than **A** o because **B** reduces the number of bacteria slower than **C** *antibiotic **C*** • **C** is most / more effective o because **C** starts to reduce the number of bacteria soonest o because **C** reduces the number of bacteria the fastest o because the (maximum) number of bacteria with **C** is the lowest o because **C** is the (only) antibiotic to reduce the number of bacteria to zero For **Level 2**, all three antibiotics must be compared.		

4.1.1.6 Culturing microorganisms (biology only)

Answer 15 · Mark scheme

June 2025 | 8461/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec Ref.
08.4	dilute each sample and count the number of bacteria (using a microscope) find the mean number of bacteria and scale / multiply up	 allow find the mean number of bacteria and multiply by 50 allow find the total number of bacteria and multiply by 5	1 1	AO1 4.1.1.6 4.2.2.5

Total Question 8	9

Answer 08 · Examiner comments

Question 1 (standard demand)

01.1 A correct answer had to refer to toxins or poisons, which are the cause of symptoms of a *Salmonella* infection. Though it was not required, if a source was given for the toxins or poisons, it had to be correct. Thus, an answer which referred to 'toxins from the virus' was not awarded the mark.

Other students who did not achieve this mark often referred vaguely to *Salmonella* interacting with the stomach or intestine.

01.2 The most common response from students which received no credit was simply 'washing hands'. A little more than this was required for a mark to be awarded ie **when** hands should be washed to help prevent the spread of the bacteria to other people eg after using the toilet.

Another common misconception was that the *Salmonella* bacteria are spread by droplet infection and hence an answer suggesting covering your nose or mouth when coughing and sneezing was not creditworthy.

Many students achieved credit for the suggestion of isolation as a method of preventing the spread of the pathogen between people. Many of these students suggested how this isolation could be achieved eg keeping away from other people.

01.3 The correct answer, 'antibiotics' was very well known with 94% of students achieving this mark.

01.4 The first mark required the idea that the immune system is not functioning correctly in a person with AIDS. This could be expressed in a variety of ways, such as the immune system being weakened.

The second mark was awarded for a reason the person with AIDS does not recover as quickly which could, for example, be achieved by explaining that white blood cells can't kill the bacteria.

More students gained the first marking point than the second one eg they knew that AIDS weakens the immune system but then did not go on to explain fully why this meant recovery from the *Salmonella* infection would take longer. A common misconception was the idea that the immune system would be too busy with AIDS, so unable to deal with the *Salmonella* infection.

Answer 08 · Examiner comments

01.5 The question required students to suggest what the farmer could do to prevent the spread of the transmission of *Salmonella* bacteria from chickens to humans. It was not what a person could do to avoid contracting the bacteria.

Despite vaccination already having been described in the question stem as one method, many students gave this as their response. This highlights the importance to students of reading every question stem very carefully.

Answers that simply referred to 'chickens' being (for example) isolated were not given credit, as it was not clear if students were referring to the infected chickens or to the healthy ones. Suggestions of improved hygiene or disinfecting were ignored. 46% of students correctly suggested killing or isolating the infected chickens.

01.6 Students needed to study the figure carefully and give a full answer if they were to achieve this mark. It was insufficient for them to refer loosely to liquid B 'killing more bacteria', or simply to the numbers of bacteria present after use of the liquids, as there are situations where this is not true. Further qualification was necessary, with a reference to both surfaces.

01.7 Many students made good and correct use of the term 'zone of inhibition'. This question was answered well with 57% of students correctly quoting either 'radius' or 'diameter'.

A number of students misinterpreted the question and gave answers explaining how to calculate the area rather than what measurement had to be made. Some students gave the formula πr^2 and did not explain that r was the radius of the area with no bacteria growing.

01.8 Many students did not show an understanding of the term 'repeatable' as stated in the AQA science subject vocabulary. They answered by suggesting that another scientist should carry out the investigation or that different bacteria or a different temperature should be used.

Some students just said 'repeat' or 'repeat and compare', neither of which were sufficient as the question also needed a reference to the idea of seeing **if** the results were similar.

01.9 Most students who achieved this mark did so by referring to possible toxicity of the cleaning liquid. Answers such as 'checking if it is harmful' were insufficient.

Students who had followed the theme of the question through also often referred to the effect on other types of microorganism. Students who did not achieve the mark often gave the factor that had already been investigated, the extent to which the liquid kills the (Salmonella) bacteria or referred to 'cost', despite having been told that the liquids cost the same per dm^3.

4.1.1.6 Culturing microorganisms (biology only)

Answer 11 · Examiner comments — November 2021 | 8461/1H | Original Q2

Question 2 (standard demand)

Many students were able to demonstrate the mathematical skills and understanding assessed in **02.3**. Generally, the accuracy of the measurement of the radius (or equivalent) was good, however, some students used the Pi button on their calculator in their calculation, despite being given a value to use. A number of students calculated the area of the paper disc and subtracted this from their calculated value, which is neither required nor correct.

Answer 12 · Examiner comments — June 2022 | 8461/2H | Original Q9

Question 9

This question was about investigations involving phototropism and the redistribution of auxin.

09.1 The amount of water given, the temperature and the type of plant were common correct answers for control variables in the investigation shown in **Figure 13**. 'Light' was an inappropriate suggestion as this was different in each of the three experiments. 'Time' was not rewarded as this was given as 12 hours in the diagram. More than three-quarters of students were able to suggest at least one correct control variable, with almost one third giving two.

09.2 Most responses to this question were very weak, with only one in eight scoring any marks. Most answers simply described experiments **B** (in the dark) and **C** (with all-round light) rather than stating these could be compared with experiment **A** (one-sided light) to show that light caused the effect in experiment **A** and that this light had to come from one side.

09.3 Careful inspection of **Figure 13** was necessary to answer this question – which showed the ink marks just behind the tip of the shoot were further apart in all three seedlings after 12 hours and that this region was also the part that bent towards the light in experiment **A**. Hence growth and response/bending occurred in this region. Both points were evident to only one in 20 students.

09.4 Nearly three-quarters of students knew that the response shown by seedling **A** was called *phototropism*. There was the inevitable confusion with the term 'phototropism', and 'tropism' unqualified was considered inadequate. Some correctly used the term 'positive phototropism' but the qualification 'negative' cancelled what would otherwise have been worth the mark.

09.5 This question, and the next, examined the ability to select appropriate information from **Figure 14** about the distribution of auxin in shoot tips under different light regimes. Most answers (two-thirds of students) correctly referred to shoot tip **F** which showed that a higher amount of auxin had moved into the agar beneath the side receiving less light. Far fewer students chose to compare this with the situation in shoot tip **G** where auxin was prevented from moving sideways through the shoot by the thin sheet of glass and thus resulted in equal amounts of auxin in the agar beneath the shaded and the illuminated sides. Many made inappropriate references to the results from the shoot tips kept in the dark (**D** and **E**).

4.1.1.6 Culturing microorganisms (biology only)

Answer 12 · Examiner comments

09.6 The hypothesis that light causes the breakdown of auxin was easily refuted by the observation that all four blocks of agar, whether beneath shoot tips in the light or in the dark, contained approximately equal amounts of auxin. Only one fifth of students made relevant observations about the shoot tips in the light compared with those in the dark, while many simply focused on the results for shoot tip **G** and did not gain credit.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Question 3 (Standard, standard/high and high demand)

03.1 A little over half of students correctly stated how *Salmonella* bacteria cause the symptoms of vomiting and diarrhoea. While the word 'toxin' was commonly used, many students failed to gain credit as they didn't refer to toxins being released or produced which was essential for the mark, but there was some confusion between the terms excrete and secrete.

03.2 This levelled response question required students to make links between the immune response in an animal (following vaccination), and the prevention of a food poisoning outbreak in humans. The high demand required to enter level 2 resulted in less than 6% of students making the leap, with just under 62% of students failing to even enter level 1, thus gaining no credit.
For many students lack of adequate technical language was a barrier to gaining credit with vague statements eg the body or immune system makes antibodies or the body can react faster when the bacteria re-infects. Common errors included poor understanding of what memory cell specifically are – suggesting they act as antibodies, or that antibodies make white blood cells. There appeared to be less confusion about the difference between antibodies, antitoxins and antigens than in previous years. The 2% minority of students who were able to answer both parts of the question skilfully gained full marks in level 2.

03.3 It was encouraging to read that most students had experience of the practical, allowing over 70% of students to gain 1 or more marks. Although many students gave precise answers, 'sterilise equipment' or 'flame equipment' was deemed too vague at this level.

03.4 This question proved a challenge for the majority of students, with only 1% gaining the full 3 available marks, and just under 43% gaining no marks at all. Very few students identified 37°C as being human body temperature, perhaps thinking this was unnecessary or assumed. Some responses identified the potential growth of harmful bacteria but did not specify that it may be harmful to humans in relation to the 25°C being used in school laboratories.

03.5 Generally well answered with around 66% of students gaining the mark. The incorrect term 'control variable' was not infrequent.

03.6 75% of students gave a correct answer here. Where students failed to gain this mark, it was often due to a lack of precision in their response, with a lack of a comparative term or weak description of the area where bacteria had been killed. Some students were unsuccessful as they referred to just one of the antibiotics, and the question clearly asks why should either A or B be prescribed so both had to be included in the response.

4.1.1.6 Culturing microorganisms (biology only)

Answer 13 · Examiner comments

June 2023 | 8461/1H | Original Q3

03.7 Generally well answered with most students being able to make an attempt at the answer, and around 56% of students gaining credit. Where students failed to gain this mark, it was often due to a lack of precision, for example simply referring to the circle rather than the clear area or the area where bacteria had been killed.

03.8. It was pleasing to see over 66% of students giving correct responses as they were clear on the idea of developing resistance. Numerous students muddled resistance and immunity and some commented that animals become immune to antibodies and as such could not be credited. Sadly, some students correctly described the development of resistance but went on to negate the mark with comments such as 'now the bacteria are immune to the antibiotic'.

03.9 This high demand question was not accessible to most students, and indeed over three quarters of students failed to gain any marks. Many students simply rewrote information from the stem of the question without saying that this was due to pressure from water and linking it to the impact this had on either the cell wall or cell membrane. A sizeable minority thought that the antibiotic entered the bacteria by osmosis causing it to burst. As anticipated some students negated correct detail on water movement, by giving incorrect definitions of osmosis, and in particular incorrect references to water potential or diffusion gradients. If water concentration is not specified, it is assumed that solute concentration is being described and this often results in an incorrect answer (for example, 'water moves from an area of high concentration to an area of low concentration' is not correct). We continue to also see confusion regarding the role of the cell wall and cell membrane in a cell, as well as lack of understanding around the role antibiotics play in bacterial infections.

4.1.1.6 Culturing microorganisms (biology only)

Answer 14 · Examiner comments

June 2024 | 8461/1H | Original Q6

Question 6 (standard, standard/high demand and high demand)

06.1 83% of students were able to name an appropriate antibiotic. Commonly seen incorrect answers included aspirin, ibuprofen and paracetamol.

06.2 65% of students scored one mark on this question, with the majority achieving the first marking point. 6% of students scored two marks.

The vast majority of responses referenced a zone of inhibition, rather than a description of an area where the bacteria had been killed, both of which were creditworthy. However, references to a 'clear' or 'white' area were not. A number of students missed out on the mark, however, for offering vague references to bacteria 'not growing' rather than describing the effect the antibiotic had on them. For marking point 2, the majority of students went on to simply repeat what they had said for marking point 1 in a different way; that because the bacteria were killed, or because there was a zone of inhibition, they cannot be resistant, rather than what would happen if the bacteria *were* resistant. Frequently, reference to the antibiotic being resistant was seen.

06.3 74% of students scored zero marks on this question, largely due to not accurately articulating their ideas. The most commonly seen response related to marking point 3, regarding the difficulty of developing new antibiotics in terms of cost or time, with nearly a quarter of students achieving one mark. Some students began a sentence about the difficulty of developing new antibiotics, but offered no further clarification and therefore could not be awarded a mark. For marking point 2, many students began to try to express the idea that diseases would become more common and/or diseases would be more difficult to treat. However, they struggled to articulate themselves in a way that was creditworthy, with the emphasis on (individual) illnesses or infection, rather than diseases generally.

06.4 36% of students were awarded the mark in this question. The majority of students were aware that viruses only exist inside living cells although many had difficulty expressing this clearly enough to gain the mark. The most commonly seen correct response referred to viruses needing cells to reproduce, rather than viruses *only* reproducing inside cells.

06.5 43% of students achieved the mark in this question. A significant number of students understood that drugs used to destroy viruses would also damage the body cells, with vastly fewer recognising that it was hard to get these drugs into cells. Those who did not gain credit for this idea often stated that 'antibiotics only kill bacteria', 'viruses are small, so are difficult to find' or 'it is hard/expensive to research and develop new drugs'.

Those student who referenced mutation usually did not gain credit because they described viruses mutating 'more' or 'faster', rather than frequently. Often, students used the term 'they' in their answer as referring to 'the drugs', when in fact 'they', in the context of the question, refers to 'the scientists'. Students should be encouraged to look at the subject of the question before answering in terms of 'they' or 'it' for example, or better still, not use such terms in their answer.

06.6 84% of students correctly identified AIDS as a viral disease that damages white blood cells.

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4.1.1.6 Culturing microorganisms (biology only)

Answer 15 · Examiner comments

June 2025 | 8461/1H | Original Q8

Question 8 (standard/high demand and high demand)

08.1 90% of students achieved the mark in this question.

08.2 This question was answered well with 82% of students achieving 2 marks and less than 2% scoring zero. All three of the possible answers were seen, with vacuole sometimes being correctly qualified as 'large' or 'permanent'. The most common uncreditworthy

Answer 15 · Examiner comments

answer was 'ribosome' not being qualified with 'large'. Some students also gave chloroplasts as an uncreditworthy answer, with a few stating 'cell wall'.

08.3 This was a levelled response question with the command word compare. In comparison to question 03.1 where students struggled to evaluate, the vast majority were able to make valid comparisons in this question. The majority of students (59%) gained 2 marks as there were many routes to achieve more than the minimum requirement to enter Level 1 without giving enough detail to enter Level 2. Those who were able to enter Level 2 most commonly had given enough supporting evidence to gain 4 marks (11% of students). Most students were able to identify A as the least, and C as the most effective antibiotic and give supporting evidence from the graph for those comparisons. They often also stated or implied that the effectiveness of B was 'in between' but were limited to Level 1 because they did not give any explicit evidence for this, most commonly just describing the line for B, without including comparisons with A and / or C. 16% of students gained zero marks. These students had usually misinterpreted the graph completely, getting the comparative order the wrong way around. Others did no comparisons, but just described the three lines, and so students should be reminded to pay attention to the command word in the question. A few disqualified themselves by contradicting statements they had made by using the wrong letter for the antibiotic, possibly by accident. This may have been corrected if they had read their answer back through. There were some answers that were very difficult to read due to illegible handwriting at this late stage of the paper, but the majority of students found the answer space sufficient, not needing to use additional pages.

08.4 57% of students scored no marks in this question and, of those that did, the majority achieved MP2 only**.** Very few students realised the need to dilute the samples in order to be able to count the bacteria and therefore, MP1 was awarded very rarely. Students were more successful with MP2, with both routes to carry out the calculation seen. Many students gave a method to calculate the mean (which was not necessary for the mark to be awarded), and also the correct multiplier for the mean. Some students referred to scaling up the individual counts and then calculating a mean. This is a valid way of getting the correct answer, so was also creditworthy. The most common reason for students not to be awarded MP2 was the counting of just one sample and then scaling that up. Some students referred to multiplying by 50^3, presumably assuming that volume was important in some way, and a few more referred to measuring the area of the bacteria rather than the number, presumably confusing this question with the required practical and questions in previous years.

4.1.1.6 Culturing microorganisms (biology only)

Mark Ranges and Award of Grades

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