AQA GCSE Biology | 8461

SPECIFICATION POINT 4.3.2.1

Producing monoclonal antibodies

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**6**
Available paper years	**2018–2025**

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.

4.3.2.1 Producing monoclonal antibodies

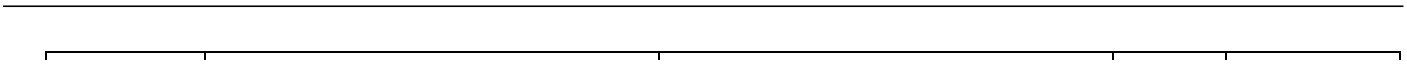
Answer 01 · Mark scheme June 2018 | 8461/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(mouthpiece) has pierced / entered the phloem **or** (the aphid) has been feeding from the phloem		1	AO2 4.2.3.2
05.2	yellow leaves due to lack of chlorophyll	ignore 'choroplasts' ignore magnesium is needed to make chorophyll	1	AO1
	(therefore) less / no light absorbed (by chlorophyll)		1	AO2
	(therefore) lower rate of / no photosynthesis	do **not** allow 'energy is produced by photosynthesis'	1	AO1
	(therefore) plant makes less / no sugar / glucose		1	AO1
	(therefore) plant converts less / no sugar / glucose into protein (for growth, so growth is stunted)	allow less glucose / sugar converted into cellulose (cell wall) allow less energy for protein synthesis	1	AO1 4.3.3.1 4.4.1.1 4.4.1.3
05.3	inject the protein / it into a mouse		1	AO1 4.3.2.1
	combine lymphocytes with tumour / cancer cells to make hybridoma (cells)	ignore white blood cells allow T or B lymphocytes ignore tumour unqualified	1	
	find a hybridoma which makes a monoclonal antibody specific to PVY		1	
	(the scientist) clones (the hybridoma) to produce many cells (to make the antibody)	do **not** allow cloning of original stem cells allow many rounds of cloning / mitosis	1	
Total			**10**	

4.3.2.1 Producing monoclonal antibodies

Answer 01 · Mark scheme

June 2018 | 8461/1H | Original Q5



4.3.2.1 Producing monoclonal antibodies

Answer 02 · Mark scheme June 2019 | 8461/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **one** from: • (chemical which) catalyses / speeds up reactions in living organisms • (chemical which) catalyses / speeds up biological reactions	allow biological catalyst allow reduces activation energy (of reactions) in living organisms	1	4.2.2.1 AO1
	idea of specificity **or** (is a) protein	allow made of amino acids	1	
08.2	salivary gland	ignore mouth ignore liver	1	4.2.2.1 AO1
	small intestine	allow duodenum / ileum ignore intestine unqualified do **not** accept large intestine	1	

4.3.2.1 Producing monoclonal antibodies

Answer 02 · Mark scheme June 2019 | 8461/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	reduced / no enzyme production / release (from pancreas)	allow named example of enzymes ignore reference to hormones	1	4.2.2.1 4.4.2.3 4.4.2.1 AO2
	food is not broken down fully **or** food is not digested fully	allow no food is broken down / digested allow example	1	
	plus any **one** of the following routes for max **2** marks:	mark as pairs		
	less glucose / sugar absorbed **or** less glucose / sugar passes into the blood(stream)		1	
	(so) less glucose available for respiration so more (body / stored) fat used up in metabolism / respiration **or** fewer amino acids absorbed **or** fewer amino acids pass into the blood(stream) (1) (so) fewer amino acids are available for making new protein for repair / replacement (1) **or** fewer fatty acids absorbed **or** fewer fatty acids pass into the blood(stream) (1) (so) fewer fatty acids available so less fat is stored in the body (1) **or** chemotherapy / radiotherapy causes nausea / loss of appetite (1) (so) less intake of food (1)	ignore glycerol ignore glycerol	1	

4.3.2.1 Producing monoclonal antibodies

Answer 02 · Mark scheme June 2019 | 8461/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(cancer) cells cannot divide **or** (cancer) cells are destroyed / killed	do **not** accept reference to the drug killing (cancer) cells	1	4.2.2.7 AO3
	(so) tumour doesn't grow / get bigger **or** tumour less likely to spread **or** tumour less likely to form secondary tumours	allow cancer cells less likely to spread / metastasise	1	
	(because) enzymes **A** and **B** are not working / active / effective / present **or** (because) enzymes **A** and **B** are inhibited	allow reference to both enzymes ignore enzymes unqualified	1	
08.5	(functional) enzyme **B** would still be made / present	allow enzyme **B** is not inhibited	1	4.2.2.7 AO3
	(therefore cancer) cells would still divide uncontrollably **or** (therefore cancer) cells would not be destroyed **or** (therefore) the tumour will (continue to) grow / get bigger / spread **or** the tumour will form secondary tumours		1	
08.6	any **two** from: • to avoid the patients thinking they feel better with the drug **or** to take into account a psychological effect • as a control / comparison • to avoid bias(ed results)	ignore to make it more valid unqualified ignore to provide an independent variable	2	4.3.1.9 AO2
08.7	testing on volunteers with the disease		1	4.3.1.9 AO1

4.3.2.1 Producing monoclonal antibodies

Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	monoclonal antibody is attached to radioactive substance / toxin / drug / chemical monoclonal antibody will (only) attach to / target (antigen on) cancer cells / tumour (so) radioactive substance / toxin / drug / chemical will (bind to cancer cells and) stop them growing / dividing	allow radioactive substance / toxin / drug / chemical will kill / destroy the cancer cells **OR** monoclonal antibody interrupts the cell cycle **or** monoclonal antibody aids immune response (1) monoclonal antibody will (only) target cancer cells / tumour (1) (so) action of monoclonal antibody stops cancer cells growing / dividing **or** (so) action of monoclonal antibodies helps immune system kill / destroy cancer cells (1)	1 1 1	4.3.2.2 AO1 AO1 AO1
Total			**19**	

4.3.2.1 Producing monoclonal antibodies

Answer 03 · Mark scheme

November 2020 | 8461/1H | Original Q7

The full source mark scheme begins on page 21. Follow original question 7 in that document.

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Mark scheme

June 2022 | 8461/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	any **one** from: • sexual contact / intercourse • exchange of body fluids	allow intercourse unqualified ignore kissing allow example of exchange such as (drug) users sharing needles **or** blood transfusion **or** passage from mother to foetus in uterus	1	AO1 4.3.1.1 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(number of cases) in women decreases then increases, then decreases (number of cases) in men increases then decreases	ignore use of figures allow **total** numbers (of men and women together) increase then decrease ignore reference to differences between men and women if no other marks awarded allow overall trend decreases in **both** for **1** mark	1 1	AO3 4.3.1.1 4.3.1.2

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	any **one** from: • better education (into prevention of spread of HIV) • condoms more widely available **or** condoms easier to source **or** condoms cheaper • new / better drugs (to prevent HIV infection / spread) • better / more testing / identification (of people with HIV)	allow increased awareness about HIV ignore contraception / protection unqualified allow PrEP / anti-retrovirals stop the virus being passed on ignore new treatments do **not** accept antibiotics allow less promiscuity ignore vaccination	1	AO3 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	$\frac{242}{1288}$		1	AO2 4.3.1.2
	0.1878…	allow a rounded answer	1	
	0.188 (:1)	allow a correctly rounded answer from student's incorrect division using numbers from **Table 8** do **not** accept if a unit is given	1	

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	any **one** from: • calculate as a percentage • give the numbers per 100 000 people	ignore calculate as a proportion allow any standard number eg 10 000 / 1000	1	AO3 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6		ignore reference to WBC unqualified		AO1 4.3.1.7 4.3.1.6 4.3.1.2
	inactive HIV / virus is injected (into bloodstream / muscle / body)	allow dead HIV / virus is injected (into bloodstream / muscle / body) allow (named) part of HIV / virus is injected (into bloodstream / muscle / body)	1	
	white bloods cells produce antibodies (against inactive virus)	allow lymphocytes produce antibodies (against inactive virus) do **not** accept phagocytes produce antibodies (against inactive virus)	1	
	(if infected with HIV) correct / specific antibodies are produced quickly		1	
	antibodies destroy the (active) virus / HIV	allow antibodies 'kill' the (active) virus / HIV	1	

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	HIV / antigen / protein injected into mouse	allow other correct small mammals eg rat	1	AO1 4.3.2.1
	extract / collect (mouse) lymphocytes that make a specific antibody to HIV / antigen / protein	allow extract specific lymphocytes from someone with HIV for **2** marks	1	
	lymphocytes are combined with a tumour cell to create a <u>hybridoma</u>	allow lymphocytes are combined with a myeloma / cancer cell to create a <u>hybridoma</u>	1	
	(hybridoma) <u>cloned</u> to create many cells that produce the antibody		1	
		alternative route HIV / antigen / protein injected into mouse (1) lymphocytes from mouse are combined with a tumour cell to create a <u>hybridoma</u> (1) the hybridoma that makes the specific / correct antibody is isolated (1) (hybridoma) <u>cloned</u> to create many cells that produce the antibody (1)		

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Mark scheme June 2022 | 8461/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8		allow 'the virus' for HIV throughout		AO3 4.3.2.1 4.3.2.2
	monoclonal antibody is complementary / specific to HIV antigen	allow correct description of complementarity	1	
	monoclonal antibodies attach to (all the) HIV antigens		1	
	(so) HIV cannot bind to (human) cell **or** (so) HIV genetic material cannot enter (human) cell	allow white blood cells **or** phagocytes identify (monoclonal) antibodies and engulf / destroy (antibody bound) HIV	1	
		alternative route monoclonal antibody is complementary / specific to HIV antigen (1) monoclonal antibody with (anti-retroviral) drug attached attaches to the HIV antigens (1) drug destroys the virus **or** drug destroys genetic material (1)		

Total Question 7		**19**

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Mark scheme

June 2023 | 8461/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.1	any **two** from: • *(effect)* muscle fatigue **or** oxygen debt occurs (1) *(reason)* caused by (build-up of) lactic acid (1) • *(effect)* (continued) heavy / deep / fast breathing (1) *(reason)* to provide the oxygen needed to break down (built-up) lactic acid (1) • *(effect)* (continued) increased heart rate (1) (*reason)* to provide the oxygen needed to break down (built-up) lactic acid (1) • *(effect)* fewer / weaker muscle contractions (1) *(reason)* (because) less energy is released / available (1)	mark as pairs allow muscle cramp ignore fatigue / cramp unqualified allow to repay the oxygen debt allow to repay the oxygen debt do **not** accept energy being produced / made / created	4	AO1 4.4.2.1 4.4.2.2

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Mark scheme

Question	Answers	Mark	AO / Spec Ref.
04.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3 4.4.2.2
	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	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	
	No relevant content.	0	
	Indicative content • test a group of athletes • use at least two different types / intensities of exercise • get each athlete to do all exercises **or** have a large (≥30) group doing each exercise • record heart rate for each athlete before and after exercise **or** calculate increase in heart rate for each athlete after exercise • calculate the mean increase in heart rates for each type / intensity of exercise • compare mean increase in heart rates for each type / intensity of exercise • control variables: o same (biological) sex **or** mix of sexes o same level of activity / exercise o same age o same caffeine / drug / medicine intake o same length of time for exercise o no health issues / illnesses o return to resting heart rate before each exercise		

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.3	(athlete is) faster / stronger	allow description of improved performance allow reference to increased stamina / endurance	1	AO2 4.4.2.1 4.4.2.2
	(because more muscle mass so) more / stronger muscle contractions		1	

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.4	hybridoma		1	AO1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.5	any **three** from: • (cell) is cloned • many (identical) cells are produced • all the cells make the same antibody • the antibody is (collected and) purified	ignore name of cell allow many clones are produced	3	AO1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.6	a monoclonal antibody only binds to the anabolic steroid		1	AO2 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.7	to show that the test is working	allow to prevent a false negative (result) ignore to show there are free / remaining monoclonal antibodies	1	AO3 4.3.2.1 4.3.2.2

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.8	*evidence* no blue / visible dye (in control area) *reason* (because) no (free) monoclonal antibodies bound to control area **or** (because) there were no (free) monoclonal antibodies on the end of the (test) strip	allow no line(s) (in control area) allow no colour change (in control area) allow the (free) monoclonal antibodies did not move up the test strip allow urine did not move up the test strip	1 1	AO3 4.3.2.1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
04.9	D		1	AO3 4.3.2.1 4.3.2.2

Total Question 4	21

4.3.2.1 Producing monoclonal antibodies

Answer 06 · Mark scheme

June 2025 | 8461/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.1	(stem cells) can differentiate into any type of cell	allow (stem cells) can differentiate into liver cells ignore specialisation	1	AO1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.2	any **one** from: • (it is) destroying a (potential) life / embryo • embryo cannot give consent • (against) religious / cultural / personal beliefs	allow the embryo does not have a choice allow against (someone's) faith ignore against God's will ignore religion unqualified	1	AO2 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.3	**A** = lymphocyte (specific to the antigen) **B** = tumour (cell) **C** = hybridoma	ignore white blood cell allow myeloma allow other specific types of tumour (cell) ignore cancer (cell)	1 1 1	AO2 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.4	(the mouse is) injected with (liver) antigens	allow (by) injecting (the mouse) with liver cells do **not** accept (by) injecting (the mouse) with a pathogen	1	AO2 4.3.2.1

4.3.2.1 Producing monoclonal antibodies

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.5	monoclonal antibodies bind to (liver) antigens / cells	allow drug sticks to (liver) antigens / cells	1	AO2 4.2.2.3 4.3.1.6
	(because) monoclonal antibodies are complementary (in shape) to (liver) antigen	allow description of complementarity ignore reference to specificity do **not** accept (because) monoclonal antibodies are the same shape as (liver) antigen	1	4.3.2.1 4.3.3.2
	(so) antibodies released by white blood cells cannot bind to (liver) antigens / cells	allow (so) antibodies released by lymphocytes cannot bind to (liver) antigens / cells allow (so) phagocytes are unable to identify / detect cells to engulf do **not** accept (so) antibodies released by phagocytes cannot bind to liver antigens / cells	1	

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.6	any **one** from: • tests to detect pathogens	allow COVID tests **or** lateral flow tests **or** LFTs	1	AO1 4.3.2.2
	• tests to detect hormones / chemicals / drugs • to locate / identify (specific) molecules in a cell / tissue • to locate / detect cancer (cells) • to deliver (toxic) chemicals / drugs to cells	allow chemotherapy / immunotherapy allow to treat named disease ignore to diagnose / treat disease unqualified		

Question	Answers	Extra information	Mark	AO / Spec Ref.
07.7	gall bladder		1	AO1 4.2.2.1

4.3.2.1 Producing monoclonal antibodies

Answer 06 · Mark scheme

Question	Answers	Mark	AO / Spec Ref.
07.8	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5-6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1-2	AO1
	No relevant content.	0	4.2.2.1
	Indicative content • less / no bile produced (by liver) so less / no emulsification of fats o (so) fats not made into small(er) droplets o (so) surface area (of fat) not increased o (so) lipase cannot digest fat as quickly / much (due to smaller surface area) • less / no bile produced (by liver) so acid not neutralised o (because) bile is alkaline o (so) lipase **or** small intestine not at optimum pH o (so) lipase denatures o (so) lipase cannot digest fat as quickly / much (due to reduced / incorrect pH) For **Level 3**, there must be consideration of the effect on lipase activity and on both emulsification **and** the effects of pH.		

Total Question 7	**17**

4.3.2.1 Producing monoclonal antibodies

AQA

GCSE
BIOLOGY
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Paper 1 Higher Tier

Mark scheme

June 2020

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206G8461 1H/MS

4.3.2.1 Producing monoclonal antibodies

MARK SCHEME – GCSE BIOLOGY – 8461/1H – JUNE 2020

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.3.2.1 Producing monoclonal antibodies

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

4.3.2.1 Producing monoclonal antibodies

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

4.3.2.1 Producing monoclonal antibodies

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

4.3.2.1 Producing monoclonal antibodies

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	*before arrow* carbon dioxide **and** water *after arrow* glucose	allow correct chemical symbols ignore any attempt at balancing equation ignore light / chlorophyll either order ignore sugar / carbohydrate do **not** accept starch	 1 1	AO1 4.4.1.1
01.2	<u>light</u> (light) is captured / trapped / absorbed by chlorophyll / chloroplasts	ignore description of subsequent parts of the photosynthesis reaction allow sun<u>light</u> ignore sun allow (light) is used by chlorophyll / chloroplasts	 1 1	AO1 4.1.1.2 4.4.1.1
01.3	$\frac{18.5 + 19.3 + 19.5}{3}$ **or** $\frac{57.3}{3}$ 19.1 (cm^3/hour)	 allow an answer correctly calculated using only two correct values	1 1	AO2 4.4.1.2 RPA 6
01.4	a ring around 14.2	allow clear indication of correct result	1	AO3 4.4.1.2 RPA 6

4.3.2.1 Producing monoclonal antibodies

01.5	any **one** from: • scale / value was misread • there was air / oxygen in the syringe / measuring cylinder / apparatus • the lamp / light was moved • temperature changed • had different mass / length of pondweed • pondweed had not acclimatised	ignore human error ignore references to counting bubbles or time allow measurement error allow light intensity changed ignore different bulb / lamp unqualified	1	AO3 4.4.1.2 RPA 6
01.6	did not use it in calculation (of mean)		1	AO3 4.4.1.2 RPA 6
01.7	any **one** from: • light (intensity) • carbon dioxide (concentration) • pondweed size / amount • pondweed species	do **not** accept temperature ignore time allow distance / power / colour of lamp / light allow same (piece of) pondweed	1	AO3 4.4.1.2 RPA 6
01.8	enzyme(s) lose the shape of the active site	allow enzyme(s) (start to) denature allow enzyme(s) destroyed / damaged do **not** accept enzyme(s) killed	1	AO2 4.2.2.1

4.3.2.1 Producing monoclonal antibodies

01.9	y-axis labelled '(rate of) photosynthesis in cm^3/hour'		1	AO2 4.4.1.2 RPA 6
	suitable scale on y-axis	must take up half or more of grid provided	1	
	all points plotted to within ± ½ small square	allow 3 or 4 correct plots for **1** mark ignore any attempt to plot a point at 20 °C	2	
	correct curved line of best fit	ignore line joined point to point with straight lines ignore extrapolation	1	
Total			**16**	

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	movement / spreading out of molecules / particles	allow movement / spreading out of (named) substances / chemicals / gases / liquids ignore reference to membranes / cells	1	AO1 4.1.3.1
	from (an area of) high(er) concentration to (an area of) low(er) concentration	allow down / with the concentration gradient ignore along / across the concentration gradient do **not** accept movement from / to a concentration gradient	1	
02.2	increased carbon dioxide concentration in the air		1	AO2 4.1.3.1 4.2.3.2
	increased number of stomata that are open		1	

4.3.2.1 Producing monoclonal antibodies

02.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.1.3.1 4.2.2.2 4.2.2.3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	

	Indicative content
	• (many) alveoli
	  • provide a large(r) surface area (**:** volume)
	
	• capillaries are thin
	  or alveoli / capillary walls are thin **or** one cell thick
	  or capillaries are close to the alveoli
	  • which provides short diffusion path (for oxygen / carbon dioxide)
	
	• breathing (mechanism) moves air in and out
	or lungs are ventilated
	  • to bring in (fresh) oxygen
	  • to remove carbon dioxide
	  • to maintain a concentration / diffusion gradient
	
	• large capillary network (around alveoli)
	or good blood supply
	  • to remove oxygen(ated blood) quickly
	  • to bring carbon dioxide to the lungs quickly
	  • to maintain a concentration / diffusion gradient		

4.3.2.1 Producing monoclonal antibodies

02.4	osmosis	allow diffusion	1	AO1 4.1.3.1 4.2.3.2 4.1.3.2
02.5	active transport (because) energy is needed (to move nitrate ions) from a low(er) concentration (in the soil) to a high(er) concentration (in the root / cell)	 allow (to move nitrate ions) against / up the concentration gradient allow (because) there is a lower concentration (of nitrate ions) in the soil **or** (because) there is a higher concentration (of nitrate ions) in the root / cell ignore reference to amount / number of nitrate ions ignore along / across the concentration gradient do **not** accept if reference to molecules / atoms moving	1 1 1	AO3 AO2 AO2 4.1.1.3 4.2.3.2 4.1.3.3
Total			**14**	

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **two** from: (both have) • cytoplasm • (cell) membrane • DNA / genetic material • ribosomes	ignore reference to shape allow RNA ignore genetic information if no other mark awarded allow sub-cellular structures for **1** mark if no other mark awarded allow correct cellular process, e.g. respiration for **1** mark	2	AO2 4.1.1.1 4.1.1.2 4.1.2.1
03.2	any **three** from: • prokaryotic cell is smaller • prokaryotic cell has no mitochondria • prokaryotic cell has no nucleus **or** DNA is free in the cytoplasm **or** genetic material is free in the cytoplasm • prokaryotic cell has a single loop of DNA **or** prokaryotic cell has a single loop of genetic material • prokaryotic cell has plasmids	allow converse for eukaryotic cells allow reference to bacterium instead of prokaryotic cell ignore reference to features not shown in Figure **5** if neither mark awarded, allow prokaryotic cell has no membrane-bound organelles ignore genetic information ignore genetic information ignore circular / rings of DNA allow prokaryotic cells have smaller ribosomes	3	AO2 4.1.1.1 4.1.1.2 4.1.2.1

4.3.2.1 Producing monoclonal antibodies

03.3	1 µm = 0.001 mm **or** 1 mm = 1000 µm **or** 0.05 mm = 50 µm **or** 0.05 × 1000 (1:) 50	 do **not** accept if a unit is given	1 1	AO2 4.1.1.1 4.1.1.2
03.4	mitosis	correct spelling only	1	AO1 4.1.2.2
03.5	35%		1	AO2 4.1.2.2
03.6	 (stage 1) DNA / chromosomes replicate / duplicate mitochondria / ribosomes / sub-cellular structures increase in number **or** mitochondria / ribosomes / sub-cellular structures replicate (stage 2) one set of chromosomes is pulled / moved to each end of the cell (stage 3) the cytoplasm **and** cell membrane divides (to form two cells)	ignore names of the stages of the cell cycle ignore genetic material ignore DNA / chromosomes double / reproduce allow cytoplasm increases ignore cell grows unqualified allow one of each chromosome is pulled / moved to each end of the cell ignore nucleus divides allow cytoplasm divides **and** (new) cell membranes form ignore nucleus divides	 1 1 1 1 1	AO1 4.1.2.2
Total			**13**	

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	fatty acids glycerol		1 1	AO1 4.2.2.1 4.4.2.3
04.2	enzyme binds to the substrate because they are complementary (shapes) (so) substrate is broken down (into products) (so) products are released **or** enzyme is not changed	allow enzyme joins to the substrate because they fit together exactly allow enzyme joins to the substrate because the substrate fits the active site ignore reference to specificity do **not** accept same shape allow (so) substrate splits (into products) ignore products are formed, unqualified allow enzyme is not used up allow reference to activation energy for either marking point 2 **or** marking point 3	1 1 1	AO2 4.2.2.1
04.3	each active site has a specific shape (so only fits one type of lipid molecule)	allow each active site is a different shape do **not** accept reference to the substrate having an active site	1	AO2 4.2.2.1
04.4	add Benedict's (solution / reagent to the liquid) boil / heat (if glucose is present the blue) colour changes to yellow / green / orange / brown / (brick)red	 allow any temperature of 65 °C or above	1 1 1	AO1 4.2.2.1 RPA 4

4.3.2.1 Producing monoclonal antibodies

04.5	add iodine solution / reagent (to the liquid) (if starch is present) it changes colour to blue / black (from yellow / orange / brown)	allow add a drop of iodine ignore iodine unqualified	1 1	AO1 4.2.2.1 RPA 4
04.6	glucose from photosynthesis (excess) glucose converted to starch	do **not** accept starch made in photosynthesis allow (excess) glucose is stored as starch	1 1	AO2 4.2.2.1 4.4.1.1 4.4.1.3 4.4.2.3
04.7	starch (stores) have been converted to glucose (so the glucose can be) used for respiration / (named) metabolic reactions **or** (so the glucose can be) used to release energy (because) there is no light to make (new / more) glucose by photosynthesis	ignore reference to residual glucose from previous photosynthesis do **not** accept idea of energy being produced / created / made	1 1 1	AO3 4.4.1.1 4.4.2.1 4.4.1.3
04.8	any **one** from: • test roots / stems of plants (in the light and dark) • test other species of plant • measure the concentrations of glucose **and** starch • vary the time in the dark / light • test variegated leaves	do **not** accept reference to changing the independent variable allow test other parts of the plants allow test other types of plant ignore mass / amount allow any other valid extension ignore repeats	1	AO3 4.4.1.2 4.4.1.3
Total			**17**	

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	mechanical	allow physical allow structural	1	AO3 4.3.3.2
05.2	any **one** from: • to deter herbivores • to prevent animals damaging it	ignore to injure animals, unqualified allow to deter animals eating it do **not** accept to deter predators	1	AO2 4.3.3.2
05.3	chemical		1	AO3 4.3.3.2

4.3.2.1 Producing monoclonal antibodies

05.4	any **two** from : • lack of magnesium (ions) (1) (so) not enough chlorophyll for (efficient) photosynthesis (1) (so) not enough glucose to make proteins for growth **or** not enough glucose to release energy for growth (1) • infection by pathogen / bacteria / virus / fungus (1) (so) leaves become discoloured / yellow so less photosynthesis (1) (so) not enough glucose to make proteins for growth **or** not enough glucose to release energy for growth (1) • infected by aphids (1) (which) remove sugars from phloem (1) (so) not enough glucose to make proteins for growth **or** not enough glucose to release energy for growth (1) • lack of (available) light (1) (so) chlorophyll breaks down (1) (so) not enough glucose to make proteins for growth **or** not enough glucose to release energy for growth (1)	allow (so) lack of chlorophyll produced causes yellow leaves (1), (so) not enough photosynthesis to produce glucose which is used to make proteins for growth (1) allow correctly named pathogen allow has rose black spot / TMV allow other symptoms of named pathogens / disease award once only award once only award once only	5	AO2 4.3.3.1 4.3.1.1 4.3.1.2 4.3.1.4 4.4.1.1 4.4.1.2 AO1 4.4.2.3 4.4.1.3

4.3.2.1 Producing monoclonal antibodies

05.5	(bacteria) obtain glucose / sugar (from the plant) (glucose used) for respiration **or** (glucose used) for making other named substances	 allow (glucose used) to release energy	1 1	AO3 AO2 4.2.3.2 4.4.1.3
05.6	(gorse plant) obtains nitrate (ions) needed for amino acids / proteins	 allow needed to make chlorophyll / DNA	1 1	AO2 4.1.3.3 4.4.2.3 AO1 4.3.3.1
05.7	willow bark		1	AO2 4.3.1.9
Total			**13**	

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any **two** from: • BMI / morphology / obesity level • smoking habits • diet • medication • family history of liver disease • fitness levels • ethnicity • area of UK they live in	ignore genetic factors allow mass / weight **and** height allow previous drinking habits allow medical conditions allow drug use allow level of exercise allow race	2	AO3 4.2.2.6
06.2	2.55 – 1.60 (= 0.95) $\left(\frac{0.95}{2.55} \times 100 = \right)$ 37 (.2549019608…) (%)	allow 1.60 – 2.55 (= –0.95) allow value for with meals in range 1.60 to 1.65 (for 1.60) allow answer correctly calculated from values in ranges 1.60 to 1.65 and 2.50 to 2.60 allow – 37(.2549019608...)(%)	1 1	AO2 4.2.2.6
06.3	12 × 2 × 7 = 168 (g/week) 1.8	 allow in range 1.8-1.9 allow correct reading from a calculation that omits the 2 **or** the 7 do **not** accept if a unit is given	1 1	AO2 4.2.2.6

4.3.2.1 Producing monoclonal antibodies

06.4	any **two** from: • consuming alcohol increases the RR (with / without meals) **and** supporting data • consuming less than 50 g/week of alcohol with meals does not increase the RR • even (small amounts of alcohol at) 25 g/week increases the RR if not with meals	allow risk for RR throughout allow data in terms of number of glasses of wine allow increasing alcohol consumption increases the RR at an increasing rate allow any value between 35 and 60 g/week	2	AO3 4.2.2.6
06.5	any **two** from: • large number in survey • long term / 15 year survey • well controlled	allow 800 000 in survey if neither mark awarded allow large study allow many controls	2	AO3 4.2.2.6
06.6	any **one** from: • people underestimate / overestimate alcohol consumption • people may change (lifestyle / drinking) habits over time • some people may drink all their weekly alcohol at once	allow people lie about alcohol consumption **or** people lie about other named control variables ignore survey only tested women	1	AO3 4.2.2.6

4.3.2.1 Producing monoclonal antibodies

06.7	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4	AO2 4.4.2.3 4.2.2.1
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2	AO1 4.4.2.2 4.2.2.6 4.2.2.5 4.5.3.3
	No relevant content	0	
	Indicative content Responses may refer to either total or partial liver failure • no bile made (in the liver) ○ fats / lipids are not emulsified ○ surface area of fats / lipids not increased ○ pH of small intestine will not be alkaline / neutralised ○ enzymes (in small intestine) will not work effectively **or** (named) food not digested / absorbed ○ so may lose weight • lactic acid not broken down / oxidised ○ accumulation of lactic acid in blood / body ○ lactic acid is toxic **or** body will be poisoned ○ oxygen debt higher / prolonged ○ so muscle pain / fatigue • proteins / amino acids will not be broken down (in liver) ○ (amino acids) not deaminated ○ amino acids not made into urea **or** will not form ammonia ○ (however) any ammonia formed is toxic ○ so accumulation of amino acids in blood / body • liver does not break down / remove other toxins (like alcohol) ○ toxins accumulate in blood / body ○ body will be poisoned ○ so pain **or** jaundice **or** swollen liver **or** portal hypertension occurs • glycogen stores will not be formed ○ cannot control blood glucose ○ so hyperglycaemia / hypoglycaemia / diabetes / coma may occur		

Total			**15**

4.3.2.1 Producing monoclonal antibodies

Question	Answers	Extra information	Mark	AO / Spec.Ref.
07.1		ignore add mAbs and dye to slide (unbound)		AO2 4.3.2.2
	bind fluorescent dye to mAbs		1	
	put (bound) fluorescent mAbs on the slide (and rinse off)		1	
	mAbs will bind to Candida albicans / pathogens and show up under the microscope	allow mAbs will bind to Candida albicans / pathogens and show up under UV (lamp)	1	
07.2	more Candida albicans / pathogens will be engulfed / killed by phagocytes / white blood cells	allow Candida albicans / pathogens will be engulfed / killed by phagocytes / white blood cells more quickly do **not** accept white blood cells produce antibodies do **not** accept lymphocytes engulf Candida albicans	1	AO2 4.2.2.3 4.3.1.6 4.3.1.7
	therefore less damage to cells / tissues / organs	ignore less toxin released (by Candida albicans)	1	

4.3.2.1 Producing monoclonal antibodies

07.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		4-6	AO1 4.3.1.9
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1-3	
	No relevant content		0	
	Indicative content • given first to healthy volunteers ○ at (very) low dose ○ to test it is safe **or** to test for toxicity **or** to check for any side effects • then to some patients (with the disease) **or** people with the disease ○ to test for the correct / optimum dose ○ to check for any side effects ○ to test for efficacy **or** to test if it works ○ in a double blind trial ○ where neither patients nor doctors know who has the mAbs and who has a placebo (or alternative treatment) • reference to large trial **or** long duration **or** control variables			
07.4	any **one** from: • (the body will) not reject the mAbs **or** (the body is) less likely to reject the mAbs • mouse mAbs are (more likely to be) rejected • the human lymphocytes have already responded to that infection / cancer cell so they are known to work against the disease	do **not** accept idea of rejection of cells	1	AO3 4.3.2.2 4.3.2.1 4.3.1.6
Total			**12**	

4.3.2.1 Producing monoclonal antibodies

Answer 01 · Examiner comments

June 2018 | 8461/1H | Original Q5

Question 5 (standard, standard / high & high demand)

05.1 Many students recognised the relevance of the phloem, although some of these simply stated that the phloem carries sugars, without linking this to feeding by the aphid.

Some students continued the theme from the previous question and linked 'high concentration' in the question to diffusion, osmosis or active transport.

05.2 Although many students showed some understanding of the reason for stunted growth, most did not go on to achieve three or four marks.

The lack of magnesium was often linked to chlorophyll deficiency, causing yellow leaves, although chloroplasts were sometimes confused with chlorophyll. The fact that reduced chlorophyll would lead to a reduction in light absorption was frequently omitted as students moved directly to a reduction in photosynthesis and in turn, reduced glucose production.

However a lack of glucose was only rarely linked to a shortage of protein or cellulose, but more commonly to a lack of energy which was insufficient. Many students were able to describe much of the process that happens when magnesium is not deficient but did not answer the question by stating that none of this would happen in the case of magnesium deficiency.

05.3 This was a new area of the specification and although many students knew that something had to be injected, most were confused either as to the organism receiving the injection or to the contents of the syringe.

At the next step the need for lymphocytes, cancer cells and the production of a hybridoma was not understood by many. Although many knew the term 'hybridoma' most answers described the wrong components. Specificity was only mentioned on very rare occasions, as was the need for the scientists to clone the hybridoma. Many students did know some details, but clarity of detail and explanation was frequently lacking.

4.3.2.1 Producing monoclonal antibodies

Answer 03 · Examiner comments November 2020 | 8461/1H | Original Q7

Question 7 (standard/high & high demand)

Many students unnecessarily explained how monoclonal antibodies were produced for **07.1**, and very few scored marks on this question. Many students misunderstood the context of the question, and indicated that the mAbs would be injected into the slide. Some students thought that the mAbs were made of lymphocytes. In **07.2**, several students incorrectly stated that the mAbs themselves or lymphocytes would engulf the pathogen.

In **07.3**, many students were able to access Level 2, however, a number of students made blanket statements about clinical trials that applied to all participants. Several students were unable to clarify the difference between patients and healthy volunteers, with some using confusing terminology such as ‘healthy patients’.

4.3.2.1 Producing monoclonal antibodies

Concluding Remarks

Generally, the standard of this paper was broadly comparable to previous years. Students generally scored well on simple recall of knowledge questions (AO1) and the topics of cell structure, photosynthesis and movement across membranes were well answered. Most students were able to apply their knowledge effectively in straightforward questions (AO2), but some found application of knowledge to new situations more difficult. Many student's understanding of the structure and function of enzymes is limited and a lack of clear knowledge meant that some students articulated answers poorly on paper. Many students struggle to answer AO3 questions, particularly where complex data needs to be analysed or improvements to practical techniques need suggesting. A lack of precision when quoting, plotting or describing data is common.

As in previous years, details of the Benedict's test for sugar and iodine solution test for starch had not been recalled well, indicating that many students understanding of this practical activity was below expectations. Students continue to find the role of the liver in the human body a challenge.

4.3.2.1 Producing monoclonal antibodies

Mark Ranges and Award of Grades

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

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Examiner comments June 2022 | 8461/1H | Original Q7

Question 7 (Standard, standard/high and high demand)

07.1 Over 90% of students answered correctly, although occasional vague answers such as 'physical contact' were seen. References to sex or sexual contact / intercourse were the most commonly seen responses, but sharing needles or exchange of body fluids was also frequently seen. Some students talked about 'contraception' but did not qualify this as being a barrier method, which was not creditworthy.

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Examiner comments June 2022 | 8461/1H | Original Q7

07.2 Nearly 80% of students gained one mark in this question, either for referring to the number of cases increasing and then decreasing in men, or, for the fall-back mark of an overall decrease. A surprising number of students failed to read the figures correctly and suggested that cases in both men and women were decreasing or increasing until 2014. Several students identified a trend but failed to attribute it to men, women or both. Some did not attribute an overall decrease to **both** men and women or that the **total** number increased then decreased. Many compared the numbers of men and women, particularly saying that the number of cases in men was higher than in women, which was not incorrect, but not creditworthy. Several described the increase in 2014 as an anomaly. Students should be reminded to check the number of marks available for each question and to take care to consider each column of the table separately.

07.3 Just over half of students grained credit in his question. Those who fell short of the mark often gave vague answers such as 'education' or' contraception' without reference to an improvement, such as 'more', 'greater' or 'better'. Reference to vaccines was very common, which was the most common answer for zero marks, as well as several suggesting the development of herd immunity.

07.4 Over two thirds of students achieved full marks on this calculation question. Those that scored two marks often had the numerator and denominator reversed in their division or failed to round their answer to three significant figures, with the most common incorrect answer given being 0.19. The majority of students achieved 3 marks for a correct answer, sometimes given without any working shown and sometimes when the method of calculation was not clearly apparent. Some gave the figures as a ratio and did no calculation. Others gave the figures as a ratio but then produced figures which indicated that they had divided them. Many divided both numbers by 2, for no apparent reason. It was apparent that some students didn't have calculators, although some still managed a correct calculation.

07.5 Less than half of students gained this mark, with the most common incorrect answer being graphing the data to visually compare. It was also suggested frequently that the same number of men and women should be tested, considering this as a controlled investigation rather than gathered statistics. A significant number suggested presenting the results as a ratio, or presenting the total number, rather than just new cases.

07.6 A significant number of students were muddling the terms antibodies and antigens in their answer to this question about the process of vaccination. There was also some confusion around antibodies and antitoxins, and some suggesting the vaccine itself contained the antibodies. The most commonly achieved mark was mark point 1, although some students forgot to mention that the inactive virus needed to be injected into the body in some way. For MP2, some students failed to gain credit because they referred to the 'body' or 'immune system' producing the antibodies, which was not specific enough. For MP3, most students did not articulate the idea of specificity, just that antibodies were produced more quickly. There was occasionally confusion between white blood cells, lymphocytes and antibodies, with students saying that specific lymphocytes were produced, rather than specific antibodies. For this mark point, correct / specific antibodies could be inferred if it was stated that specific antibodies had been produced for MP2, and that these were produced on

4.3.2.1 Producing monoclonal antibodies

Answer 04 · Examiner comments June 2022 | 8461/1H | Original Q7

infection. A few students talked about monoclonal antibodies suggesting they may have returned to this question after looking at questions 07.7 and 07.8. Surprisingly, MP4 was the least credited, as most students ended their account at the production of antibodies and failed to make any reference to what the antibodies do. Where there were references to the virus being destroyed / killed, this was equally likely to be in the context of the dead / inactive virus. There were also many references to preventing infection or 'fighting off', 'dealing with', 'tackling the virus' or other similar imprecise statements. There were frequent references to vaccination of a large proportion of the population providing herd immunity.

07.7 Many students were confident in describing the need for the mouse to be injected and understood that lymphocytes are combined with a tumour cell to create a hybridoma, however, many students went on to suggest that the antibodies were fused to the tumour cell, rather than the lymphocytes. The combination of ideas of extraction of lymphocytes and that these must be ones that produce specific antibodies to HIV was less well described. The most challenging part was that these hybridoma cells are then cloned to create many cells, and that it is these cells that produce the monoclonal antibodies. Vague references to 'injecting disease' were occasionally seen. The 'allowed' idea that specific lymphocytes were extracted from someone with HIV was not seen. Another common misconception highlighted by this question was the idea that the hybridoma is the monoclonal antibody. There were some very interesting attempts at spelling hybridoma in student answers.

07.8 Just over 50% of students scored marks on this question, with many not using the figure to scaffold their answer. Several answers referring to the idea of reducing the speed of spread of the virus resulting in less damage to the immune system (and therefore meaning that the patient's own immune system is better able to fight the virus for longer, reducing the chance of the viral load getting high enough to result in AIDs) were seen.
Most students missed mark point 1, and for those who did attempt it, many omitted to reference the idea that the shapes of the antibody and antigen were complementary, rather just giving the key word 'specific'.
There was further evidence of the misconception seen in question 07.7 regarding the hybridoma being given to people as the treatment (rather than isolating the antibodies), or that the hybridoma is the monoclonal antibody.
A number of students made references to the antigen or antigen binding site shape being changed which may be evidence of confusion with enzyme biology. There were also a lot of students describing the antigen being destroyed so that the HIV could not bind to the human cell. A reasonably sized group of students clearly do not understand the process of viral infection and talked about the antigen binding site allowing the human cell to take in the HIV DNA and 'learn it' so that they can produce antibodies to fight it off.
In some responses it appeared that students were identifying the human cell from the figure as a white blood cell which 'remembers' HIV, whilst others mistook the human cell for the monoclonal antibody. For the final mark point, many students thought that it was the monoclonal antibodies which engulfed / destroyed the HIV, or that the antibodies destroyed infected cells once the HIV genetic material had entered. Some thought that it was the human cell, or the antigen binding sites on it, that were doing the engulfing when invaded by HIV.

4.3.2.1 Producing monoclonal antibodies

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.

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Examiner comments June 2023 | 8461/1H | Original Q4

Question 4 (Standard, standard/high and high demand)

04.1 Students were asked to explain two effects of anaerobic respiration on the body. Over 87% of students scored some marks on this question but only around 12% managed to score full marks. Many students mentioned lactic acid and were able to put this in the context of oxygen debt or muscle fatigue, though some answers were vague and referred to pain, aches or stitch which were not deemed sufficient to gain credit at this level. Lots of students gave increased breathing and heart rate as effects but less were able to relate this to the reason of needing the oxygen to break down lactic acid. Oxygen debt was frequently referred to but only gained credit as an explanation if reference was made to it being repaid in this context. While a significant number of students referred to 'less energy' being available, very few students correctly linked this idea to 'weaker muscle contractions'.

04.2 This levelled response question required students to design an investigation to show the effects of different exercise on heart rate. Most students attempted an answer, seemingly familiar with such an investigation. Over 16% of students were successful at entering level 3, with around 32% reaching level 2. The main barrier to students achieving higher marks seemed to be using just one athlete for the investigation which then limited the maximum mark achievable, as this would not lead to a valid outcome. Most understood the importance of measuring heart rate before and after exercise, although some students forgot about measuring the initial heart rate first, which again would not lead to a valid outcome. There were many references to technology such as heart rate monitors or watches to measure heart rate, which was creditworthy as long as heart rate was recorded before and after exercise. Students were generally very competent at describing control variables for their investigation.

4.3.2.1 Producing monoclonal antibodies

Answer 05 · Examiner comments June 2023 | 8461/1H | Original Q4

04.3 Nearly 58% of students managed to gain the first marking point about anabolic steroids making athletes faster or stronger, or gave specific descriptions of improved performance or enhanced stamina. Only 6% of students also gained the second marking point, and were able to develop this and explain that the increased muscle mass caused more or stronger muscle contractions. Students must take care not to repeat information in the question stem without adding value to this; thus, an answer stating that anabolic steroids improve performance was insufficient.

04.4 Over 92% of students correctly identified 'hybridoma' as the type of cell created when a mouse lymphocyte and tumour cell combine.

04.5 The process of creating monoclonal antibodies is clearly well known by some students, though others have varied misconceptions including that the lymphocyte or monoclonal antibodies are cloned, rather than the hybridoma. Just under 3% of students were able to get the full 3 marks as a result.
Many students spent a lot of their answer describing that a hybridoma is formed when a mouse lymphocyte and tumour cell combine, but this gained no credit as it had been assessed in the previous question, and so wasted time and answer space. Very few described that the hybridoma is cloned (simply dividing by mitosis was frequently stated but gained no credit). Additionally, very few were able to describe that all the cells produced made the same antibody. The most common point made that gained credit was that monoclonal antibodies need to be purified after collection. This question was set at high demand and required correct use of terminology, which very few students were able to do; consequently, almost 59% of students scored zero marks.

04.6 Almost 90% of students were able to correctly identify that a monoclonal antibody only binds to the anabolic steroid.

04.7 Around 47% of students were able to correctly suggest the purpose of the control area in a test strip, and suggested that it was to show that the test had worked. Some were distracted into giving other irrelevant details of the test process here and discussed the complementary nature of monoclonal antibodies, rather than focus on the question posed.

04.8 Many students were able to give correct evidence with 58% gaining 1 mark. Sadly, less were able to suggest a possible reason for the evidence they had selected and consequently, only around 26% of students successfully gained both available marks. Some students referred to other processes involved in the test when discussing the reason, rather than focussing on the idea of monoclonal antibodies not binding to, or reaching, the control area. Lots of students described the test not being used properly, or the urine not having any steroids in it as their reason, neither of which gained credit.

04.9 Just over 75% of students correctly identified athlete D as testing positive for anabolic steroids.

4.3.2.1 Producing monoclonal antibodies

Answer 06 · Examiner comments

June 2025 | 8461/1H | Original Q7

Question 7 (standard, standard/high demand and high demand)

07.1 Nearly 60% of students were able to use the correct terminology to achieve the mark in this question. Common incorrect answers included referring to the process of differentiation as 'specialisation' or describing undifferentiated cells turning into specialised cells.

07.2 47% of students achieved the mark in this question, with the most common correct answer being the idea of embryos or a potential life being destroyed or killed. A smaller proportion of students achieved credit for the idea that embryos are unable to give consent but very few were able to articulate ideas about beliefs clearly enough to be awarded the third bullet point in the mark scheme. Incorrect responses were often less biological or were emotive in nature e.g. 'it's murder', 'a baby is killed', 'embryos are a potential life', and 'it would have grown into a baby', that did not answer the question.

07.3 62% of students scored full marks in this question, with a further 17% scoring 2 marks, and 9% scoring 1 mark. The majority were able to identify and spell hybridoma (for MP3) correctly, but credit could not be awarded for reference to cancer, rather than tumour cell (for MP2), and white blood cell rather than lymphocyte (for MP1). A small number of students incorrectly named cell A as 'spleen cell' and cell B as a dead or weakened pathogen.

07.4 42% of students scored the mark for this question with most referring to injection of antigens rather than liver cells. Incorrect answers were almost always related to injecting the mouse with a pathogen or disease, confusing this context with that of vaccination against infectious disease.

07.5 Around 30% of students scored a mark on this question with only 11% scoring 2 marks and 1% scoring full marks. MP1 was most frequently scored, with the statement that monoclonal antibodies bind to antigens (on liver cells). A common incorrect response was that the monoclonal antibody would bind to white blood cells to stop them rejecting the liver cells. MP3 was scored infrequently, mostly with the idea that antibodies made by the patient's white blood cells would be blocked from binding to the liver antigens, after MP1 had already been scored. A few students did correctly describe that phagocytes could not detect the liver cells as the monoclonal antibodies

4.3.2.1 Producing monoclonal antibodies

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were bound to the antigens on their surface. MP2 was very rarely scored. Whilst most students had attempted this question using some correct terminology, the responses were often confused and either showed that the information provided in the stem of the question had not been used, or that the student had misunderstood the nature of the monoclonal antibody treatment for liver disease. It was very common to see the idea that if the monoclonal antibody was bound to the liver cell antigens, that the white blood cells would not produce antibodies at all.

07.6 This question was well-answered by most students with 67% scoring the mark. A range of answers was seen, although responses relating to cancer detection and treatment were most common. Drug and COVID testing were also seen frequently. Most incorrect answers were due to students not fully qualifying their responses for example 'treat diseases' or 'fighting cancer'.

07.8 This was a levelled response question about the function of the liver during liver failure. The majority of students attempted the question, but 43% of students achieved no marks. Level 2 responses were the most common with 24% of students achieving marks. 11% of students achieved Level 3 and 20% Level 1. The majority of Level 2 responses that did not match the criteria for Level 3, were due to an omission to refer to the role of lipase, or to distinguish that the rate of breakdown of fats would be slow*er* with liver disease. In addition, students were limited to Level 2 if they only described the effect on emulsification **or** on the neutralisation of acid.

In Level 1, the majority of students did not develop their answers, scoring 1 mark for reference to the effect on emulsification and neutralisation, but with no further detail, or scoring 2 marks for a linked idea about either emulsification or neutralisation. Common misconceptions included lipase being made in the stomach, fat *molecules* being broken down by the process of emulsification (rather than by lipase action), the liver producing lipase and bile neutralising acid in the stomach. Other incorrect answers included the idea that there would be no digestion of fat without bile, that lipase is found within bile, that bile is an enzyme and that lipase engulfs fats. The context of many students' responses related to the usual role of bile in a healthy liver, whilst mentioning less bile production in patients with liver disease. Some students scored no marks for this approach as they did not reference the disease causing less bile production, or said that the patient had *difficulty* producing bile, which was not creditworthy. Occasionally, some students did not mention bile at all, despite it being in the stem of the question. A few students thought that the diseased liver would stop producing enzymes or lipase which is why digestion of fat was difficult.