

# GCSE

## BIOLOGY

### Paper 1 Higher Tier

**Mark scheme** Practice Paper Series – Set 1 SGC/S1/SB/1H

Version 1.1

This mark scheme is an original resource written for sciencegcse.co.uk to accompany the Set 1 practice paper SGC/S1/SB/1H. It is not an AQA mark scheme and has not been produced or endorsed by AQA. It follows the structure and conventions of AQA GCSE science mark schemes so that students and teachers can mark the practice paper in the same way that a real paper is marked.

Marking should be carried out using the Information to Examiners on the following pages. The paper has not been standardised, so raw marks should not be converted into grades using any published grade boundaries.

Specification references are to the AQA GCSE Biology (8461) specification, sections 4.1–4.4. AO = assessment objective; WS = working scientifically; MS = mathematical skills; RP = required practical.

## 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 answer(s) expected, including alternative acceptable wording, in the **Answers** column
- guidance on which answers are and are not creditworthy in the **Extra information** column
- the assessment objective (AO) and specification reference for each marking point.

Award marks positively. Do not deduct marks for incorrect additional material unless it contradicts a correct answer (see 3.1). Marks are awarded for what the student has written, not for what they might have meant.

### 2. Emboldening and underlining

2.1 Where a list of acceptable answers is given and more than one mark is available, **any two from** (or similar) is used, followed by the acceptable answers.

2.2 A bold **and** indicates that both parts of the answer are needed to gain the mark.

2.3 Alternative answers acceptable for the same mark are separated by **or**. Different words that are acceptable within a marking point are separated by a forward slash (/).

2.4 Words in bold in the Answers column are the essential words that must be present, or their equivalent, for the mark to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

For a question asking for a fixed number of responses, consider the whole answer, including extra responses. Each incorrect or contradictory response cancels one correct response; ignore neutral additions. Numbered answer lines do not limit marking to the first responses. This rule does not apply to extended answers.

#### 3.2 Marking procedure for calculations

Full marks can be awarded for a correct numerical answer without working, unless the question asks for working to be shown. If the answer is incorrect, marks may be awarded for the correct stages of working shown in the mark scheme. Anything shown in brackets in the Answers column (for example the unit) is not required for the mark.

#### 3.3 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.

#### 3.4 Errors carried forward

Any error in the answer to a structured question causes the loss of the mark(s) for that part only. Later parts should be marked on the assumption that the incorrect answer was correct, where the mark scheme indicates that error carried forward (ECF) applies.

#### 3.5 Phonetic spelling

Accept misspelled or phonetic scientific terms when the intended answer is clear, unless the spelling could be confused with a different technical term. This also applies when the question asks for the name of a process or structure.

#### 3.6 Brackets

Words shown in brackets in the Answers column are not required to gain the mark but help to set the context.

#### 3.7 Allow

Answers that are acceptable but which would not normally be expected are shown as **allow**.

#### 3.8 Ignore

Statements shown as **ignore** are neither creditworthy nor penalised. Mark the rest of the answer normally.

#### 3.9 Do not accept

Statements shown as **do not accept** are incorrect and, where they contradict or replace the expected answer, mean the mark is not awarded.

### 4. Level of response marking instructions

Extended-response questions (questions 06.3 and 11.2 in this paper) are marked using a level of response mark scheme. The scheme has three levels, each covering two marks, plus a level descriptor and indicative content.

**Step 1 – Determine a level.** Read the whole answer and decide which level descriptor best fits it. Use a 'best-fit' approach: an answer does not need to meet every part of a descriptor to be placed in that level, and a weak part of the answer need not prevent it from reaching the higher level if the overall quality matches the descriptor.

**Step 2 – Determine a mark within the level.** Award the higher mark in the level if the answer meets the descriptor fully and the points made are well linked; award the lower mark if the answer only just meets the descriptor or contains minor errors or omissions.

The indicative content is not a checklist: students need not include every point to reach the top level, and other relevant, correct points should be credited. An answer that lists points without linking them into a coherent answer should be placed in a lower level than one that develops and connects them.

| Question     | Answers                                                                                                                                                                                                                               | Extra information                                                                                                                                               | Mark     | AO / Spec. Ref.             |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------|
| 01.1         | A – (single loop of) <b>DNA or</b> chromosome                                                                                                                                                                                         | allow chromosomal DNA / genetic material<br>do not accept nucleus                                                                                               | 1        | AO1<br>4.1.1.1              |
|              | B – <b>plasmid</b>                                                                                                                                                                                                                    | allow (small) ring / loop of DNA                                                                                                                                | 1        | AO1<br>4.1.1.1              |
| 01.2         | (allows the cell to) <b>move</b> / swim                                                                                                                                                                                               | allow movement / propulsion<br>do not accept feeding / attachment                                                                                               | 1        | AO2<br>4.1.1.1              |
| 01.3         | any <b>one</b> from:<br><ul style="list-style-type: none"> <li>(bacterial cell) has <b>no nucleus or</b> the DNA is (a loop) free in the cytoplasm</li> <li>has plasmids</li> <li>has a cell wall</li> <li>is much smaller</li> </ul> | allow has no mitochondria / chloroplasts<br>allow has a flagellum<br>ignore 'is a prokaryote' without a structural difference                                   | 1        | AO1<br>4.1.1.1              |
| 01.4         | virus                                                                                                                                                                                                                                 | if more than one box is ticked, no mark                                                                                                                         | 1        | AO1<br>4.1.1.5              |
| 01.5         | 4 mm = 4000 $\mu\text{m}$ <b>or</b> 2 $\mu\text{m}$ = 0.002 mm                                                                                                                                                                        | an answer of 2000 scores <b>2</b> marks                                                                                                                         | 1        | AO2<br>4.1.1.5<br>MS 1b, 2h |
|              | (magnification =) <b><math>\times 2000</math></b>                                                                                                                                                                                     | an answer of 2 (units not converted) scores <b>1</b> mark<br>an answer of 0.0005 (inverted) scores <b>0</b> marks                                               | 1        | AO2<br>4.1.1.5<br>MS 1b, 2h |
| <b>Total</b> |                                                                                                                                                                                                                                       |                                                                                                                                                                 | <b>7</b> |                             |
| 02.1         | something that <b>increases the chance</b> / likelihood / probability of a person developing a disease                                                                                                                                | allow a factor linked to an increased rate of a disease<br>allow 'makes it more likely that you get a disease'<br>do not accept something that causes a disease | 1        | AO1<br>4.2.2.6              |
| 02.2         | $72 \div 2000 (\times 100)$                                                                                                                                                                                                           | an answer of 3.6 scores <b>2</b> marks                                                                                                                          | 1        | AO2<br>4.2.2.6<br>MS 1c     |
|              | (percentage of smokers =) <b>3.6 (%)</b>                                                                                                                                                                                              | an answer of 0.036 scores <b>1</b> mark                                                                                                                         | 1        | AO2<br>4.2.2.6<br>MS 1c     |
| 02.3         | 12 (times)                                                                                                                                                                                                                            | allow ECF from 02.2: answer to $02.2 \div 0.3$ , correctly calculated                                                                                           | 1        | AO2<br>4.2.2.6<br>MS 1c     |

| Question     | Answers                                                                                                                                                                                                                                                                                                                                                                                         | Extra information                                                                                                                                                            | Mark     | AO / Spec. Ref.          |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------|
| 02.4         | any two from: <ul style="list-style-type: none"> <li>other risk factors were not controlled, e.g. air pollution / genes / passive smoking</li> <li>a link / correlation alone does not prove a cause</li> </ul>                                                                                                                                                                                 | Allow other named, plausible confounding factors.<br><br>Ignore unequal group sizes or individual exceptions alone.<br><br>Do not accept smoking does not cause lung cancer. | 2        | AO3<br>4.2.2.6<br>WS 1.4 |
| 02.5         | benign tumour: (abnormal cells) <b>contained in one area or</b> does not invade other tissues / does not spread                                                                                                                                                                                                                                                                                 | allow usually within a membrane<br>allow the converse for malignant tumours                                                                                                  | 1        | AO1<br>4.2.2.7           |
|              | malignant tumour: <b>invades neighbouring tissues or</b> spreads to other parts of the body (in the blood) <b>or</b> forms secondary tumours                                                                                                                                                                                                                                                    | 'malignant tumours are cancerous' alone is insufficient<br>do not accept benign tumours are harmless                                                                         | 1        | AO1<br>4.2.2.7           |
| <b>Total</b> |                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                              | <b>8</b> |                          |
| 03.1         | to <b>kill</b> (unwanted) <b>microorganisms</b> / bacteria (that could contaminate the culture)                                                                                                                                                                                                                                                                                                 | allow to prevent contamination by other microorganisms<br><br>do not accept to clean / wash the dish                                                                         | 1        | AO1<br>4.1.1.6           |
| 03.2         | (at 37 °C) bacteria that are <b>harmful to humans</b> / pathogens are more likely to grow <b>or</b> 37 °C is human body temperature (so pathogens grow well)                                                                                                                                                                                                                                    | allow disease-causing bacteria for pathogens                                                                                                                                 | 1        | AO1<br>4.1.1.6           |
|              | (so incubating at 25 °C) <b>reduces the risk</b> to the student / is safer                                                                                                                                                                                                                                                                                                                      | ignore 'bacteria grow more slowly at 25 °C' on its own                                                                                                                       | 1        | AO1<br>4.1.1.6           |
| 03.3         | any <b>two</b> from: <ul style="list-style-type: none"> <li>sterilise the (inoculating) loop in a (Bunsen) flame before use (and allow it to cool)</li> <li>open the lid of the dish as little as possible / for as short a time as possible</li> <li>work close to a (Bunsen) flame <b>or</b> replace the lid quickly</li> <li>do not touch the agar with the loop handle / fingers</li> </ul> | allow sterilise the loop by heating it<br>allow 'flame the neck of the culture bottle'<br>ignore wash hands / wear gloves                                                    | 2        | AO1<br>4.1.1.6<br>RP 2   |
| 03.4         | (radius = 10 mm so) $3.14 \times 10^2$ <b>or</b> $3.14 \times 100$                                                                                                                                                                                                                                                                                                                              | an answer of 314 scores <b>2</b> marks                                                                                                                                       | 1        | AO2<br>4.1.1.6<br>MS 5c  |

| Question     | Answers                                                                                                                                                                                                                                                                               | Extra information                                                                                                          | Mark      | AO / Spec. Ref.         |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------|
|              | (area =) <b>314</b> (mm <sup>2</sup> )                                                                                                                                                                                                                                                | an answer of 1256 (diameter used as radius) scores <b>1</b> mark<br>allow 314.2 / 314.16                                   | 1         | AO2<br>4.1.1.6<br>MS 5c |
| <b>03.5</b>  | the larger the clear zone, the more effective the antibiotic <b>or B</b> is the most effective because it has the largest clear zone (kills the most bacteria)                                                                                                                        | allow the bacteria are most sensitive to B                                                                                 | 1         | AO3<br>4.1.1.6          |
|              | <b>C</b> is the least effective (smallest clear zone)<br><b>or</b> the order of effectiveness is B, A, C                                                                                                                                                                              | allow A is less effective than B but more effective than C<br>ignore references to W unless linked to it being a control   | 1         | AO3<br>4.1.1.6          |
| <b>03.6</b>  | 3 hours = 180 minutes <b>and</b> $180 \div 20 = 9$ divisions <b>or</b> $2^9$                                                                                                                                                                                                          | an answer of 512 scores <b>2</b> marks                                                                                     | 1         | AO2<br>4.1.1.6<br>MS 1a |
|              | (number of bacteria =) <b>512</b>                                                                                                                                                                                                                                                     | an answer of 256 or 1024 (one division out) scores <b>1</b> mark<br>an answer of 18 ( $9 \times 2$ ) scores <b>0</b> marks | 1         | AO2<br>4.1.1.6<br>MS 1a |
| <b>Total</b> |                                                                                                                                                                                                                                                                                       |                                                                                                                            | <b>11</b> |                         |
| <b>04.1</b>  | xylem                                                                                                                                                                                                                                                                                 |                                                                                                                            | 1         | AO1<br>4.2.3.1          |
| <b>04.2</b>  | any <b>two</b> from:<br><ul style="list-style-type: none"> <li>(cells are) dead / hollow <b>or</b> form (continuous) tubes</li> <li>no end walls (between cells) so water can flow through</li> <li>(walls) strengthened / thickened with lignin (so they do not collapse)</li> </ul> | allow thick walls<br>ignore 'long' / 'narrow'<br>do not accept living cells / sieve plates (phloem)                        | 2         | AO1<br>4.2.3.1          |
| <b>04.3</b>  | $54 \div 10$                                                                                                                                                                                                                                                                          | an answer of 5.4 scores <b>2</b> marks                                                                                     | 1         | AO2<br>4.2.3.2<br>MS 1a |
|              | (rate =) <b>5.4</b> (mm per minute)                                                                                                                                                                                                                                                   | an answer of 3.0 or 1.2 (wrong row used) scores <b>1</b> mark                                                              | 1         | AO2<br>4.2.3.2<br>MS 1a |
| <b>04.4</b>  | (moving air) <b>removes water vapour</b> / humid air from around the leaf / stomata                                                                                                                                                                                                   | allow blows away water molecules                                                                                           | 1         | AO2<br>4.2.3.2          |
|              | (so this) maintains / increases the <b>concentration gradient</b> (of water vapour) so evaporation / diffusion (of water from the leaf) is faster                                                                                                                                     | allow faster transpiration means more water is drawn up the shoot<br>do not accept the fan heats the leaf                  | 1         | AO2<br>4.2.3.2          |
| <b>04.5</b>  | (tissue) <b>phloem</b>                                                                                                                                                                                                                                                                |                                                                                                                            | 1         | AO1<br>4.2.3.1          |

| Question     | Answers                                                                                                                                                                                                                                                                                                        | Extra information                                                                                                                              | Mark     | AO / Spec. Ref.           |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------|
|              | (process) <b>translocation</b>                                                                                                                                                                                                                                                                                 | do not accept transpiration                                                                                                                    | 1        | AO1<br>4.2.3.2            |
| <b>Total</b> |                                                                                                                                                                                                                                                                                                                |                                                                                                                                                | <b>9</b> |                           |
| <b>05.1</b>  | any <b>two</b> from: <ul style="list-style-type: none"> <li>(the root hair gives the cell a) <b>large surface area</b> (for absorption)</li> <li>(contains) <b>many mitochondria</b> (to release energy for active transport)</li> <li>thin cell wall / membrane <b>or</b> short diffusion distance</li> </ul> | allow large surface area to volume ratio<br>do not accept 'has a large surface' without reference to area<br>ignore references to chloroplasts | 2        | AO1<br>4.1.1.3<br>4.1.3.3 |
| <b>05.2</b>  | $(48 - 12) \div 48 \times 100$ <b>or</b> $36 \div 48 \times 100$                                                                                                                                                                                                                                               | an answer of 75 scores <b>2</b> marks                                                                                                          | 1        | AO2<br>4.1.3.3<br>MS 1c   |
|              | (percentage decrease =) <b>75</b> (%)                                                                                                                                                                                                                                                                          | an answer of 25 (the percentage remaining) scores <b>1</b> mark                                                                                | 1        | AO2<br>4.1.3.3<br>MS 1c   |
| <b>05.3</b>  | nitrate ions are absorbed by <b>active transport</b> <b>or</b> the ions are moved <b>against</b> the concentration gradient                                                                                                                                                                                    | allow from a dilute solution to a more concentrated solution<br>do not accept diffusion / osmosis for this mark                                | 1        | AO2<br>4.1.3.3            |
|              | (active transport) requires <b>energy</b> (from respiration)                                                                                                                                                                                                                                                   | allow uses energy released by respiration<br>do not accept energy is made / produced / created                                                 | 1        | AO2<br>4.1.3.3            |
|              | without oxygen there is less (aerobic) <b>respiration</b> so less energy is released (for active transport)                                                                                                                                                                                                    | allow respiration stops / cells respire anaerobically, releasing less energy                                                                   | 1        | AO2<br>4.1.3.3<br>4.4.2.1 |
| <b>05.4</b>  | any <b>one</b> from: <ul style="list-style-type: none"> <li>anaerobic respiration (still) releases some energy</li> <li>some oxygen remained (dissolved) in the solution / cells at first</li> </ul>                                                                                                           | allow some energy was already stored in the cells<br>ignore 'the cells were still alive'                                                       | 1        | AO3<br>4.1.3.3            |
| <b>Total</b> |                                                                                                                                                                                                                                                                                                                |                                                                                                                                                | <b>8</b> |                           |
| <b>06.1</b>  | lymphocyte                                                                                                                                                                                                                                                                                                     | allow B-lymphocyte / B cell<br>do not accept white blood cell alone                                                                            | 1        | AO1<br>4.3.2.1            |
| <b>06.2</b>  | (the antibody has a) <b>specific</b> shape <b>or</b> its shape is complementary to / fits only one antigen                                                                                                                                                                                                     | allow the antigen has a specific shape that only this antibody fits                                                                            | 1        | AO1<br>4.3.2.1            |
|              | (and) all the (monoclonal) antibodies are <b>identical</b> <b>or</b> they are produced by (clones of) a single cell                                                                                                                                                                                            | allow all made by the same hybridoma cell                                                                                                      | 1        | AO1<br>4.3.2.1            |

| Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                          | Extra information              | Mark                                                                                                                                                                                                                     | AO / Spec. Ref.                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------|--|---|--------------------------------------|
| 06.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <table><tr><td><b>Level 3<br/>(5–6 marks)</b></td><td>A clear, logical description of how monoclonal antibodies are produced, with the main steps in the correct order, <b>and</b> a clear explanation of why the treatment targets cancer cells rather than other body cells.</td></tr><tr><td><b>Level 2<br/>(3–4 marks)</b></td><td>A description of production that includes most of the main steps, possibly with some omissions or steps out of order, <b>and/or</b> a partial explanation of why cancer cells are targeted.</td></tr><tr><td><b>Level 1<br/>(1–2 marks)</b></td><td>Some relevant statements about production or use, for example that a mouse is used or that the antibodies bind to cancer cells, with little development.</td></tr><tr><td><b>0 marks</b></td><td>No relevant content.</td></tr></table> |                                                                                                                                                                                                                          | <b>Level 3<br/>(5–6 marks)</b> | A clear, logical description of how monoclonal antibodies are produced, with the main steps in the correct order, <b>and</b> a clear explanation of why the treatment targets cancer cells rather than other body cells. | <b>Level 2<br/>(3–4 marks)</b> | A description of production that includes most of the main steps, possibly with some omissions or steps out of order, <b>and/or</b> a partial explanation of why cancer cells are targeted. | <b>Level 1<br/>(1–2 marks)</b> | Some relevant statements about production or use, for example that a mouse is used or that the antibodies bind to cancer cells, with little development. | <b>0 marks</b> | No relevant content. |  | 6 | AO1 / AO2<br>4.3.2.1<br>4.3.2.2 (HT) |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Level 3<br/>(5–6 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A clear, logical description of how monoclonal antibodies are produced, with the main steps in the correct order, <b>and</b> a clear explanation of why the treatment targets cancer cells rather than other body cells. |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Level 2<br/>(3–4 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A description of production that includes most of the main steps, possibly with some omissions or steps out of order, <b>and/or</b> a partial explanation of why cancer cells are targeted.                              |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Level 1<br/>(1–2 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Some relevant statements about production or use, for example that a mouse is used or that the antibodies bind to cancer cells, with little development.                                                                 |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | No relevant content.                                                                                                                                                                                                     |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| <b>Indicative content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| <b>Production</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| <ul style="list-style-type: none"><li>• a mouse is injected with the antigen (found on the cancer cells) <b>or</b> the mouse is stimulated to make antibodies</li><li>• lymphocytes from the mouse produce the antibody</li><li>• the lymphocytes are collected (from the mouse's spleen)</li><li>• lymphocytes do not divide easily, so they are fused with (myeloma) tumour cells, which divide rapidly</li><li>• the fused cell is a hybridoma</li><li>• a single hybridoma cell that makes the required antibody is selected and cloned (divides many times)</li><li>• large amounts of the identical antibody are collected and purified</li></ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| <b>Treating cancer</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| <ul style="list-style-type: none"><li>• the antibody binds only to the antigen (on the surface of) the cancer cells</li><li>• the antibody can be attached to a radioactive substance / a toxic drug / a chemical that stops cells dividing</li><li>• so the substance is delivered directly to the cancer cells</li><li>• other body cells do not have the antigen, so the antibody does not bind to them and they are not harmed (fewer side effects than chemotherapy or radiotherapy)</li><li>• the antibodies can also trigger the immune system to attack the cancer cells / block receptors so the cells stop dividing</li></ul>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| Credit other correct, relevant points. Do not credit statements that the antibodies are made by the patient, or that the hybridoma cells are injected into the patient.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                                                          |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| 06.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | (far) fewer patients have severe side effects with the monoclonal antibody <b>or</b> 12% compared with 48% <b>or</b> four times fewer side effects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | allow the difference in the percentage of tumours that became smaller is small (45% compared with 50%)                                                                                                                   |                                | 1                                                                                                                                                                                                                        | AO3<br>4.3.2.2 (HT)            |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | because the (monoclonal) antibody binds only to the cancer cells, whereas chemotherapy (drugs) also damage healthy (dividing) cells                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | allow chemotherapy is not specific to cancer cells                                                                                                                                                                       |                                | 1                                                                                                                                                                                                                        | AO3<br>4.3.2.2 (HT)            |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                          |                                | 11                                                                                                                                                                                                                       |                                |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |
| 07.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | magnesium ions are needed to make <b>chlorophyll</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                          |                                | 1                                                                                                                                                                                                                        | AO1<br>4.3.3.1                 |                                                                                                                                                                                             |                                |                                                                                                                                                          |                |                      |  |   |                                      |

| Question     | Answers                                                                                                                                                                                                                                                        | Extra information                                                                     | Mark     | AO / Spec. Ref.           |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------|---------------------------|
|              | (so) less chlorophyll is made so the leaves are yellow / chlorosis (and less photosynthesis occurs)                                                                                                                                                            | allow chlorophyll is the green pigment, so with less chlorophyll leaves are not green | 1        | AO2<br>4.3.3.1            |
| <b>07.2</b>  | nitrate ions are needed to make <b>amino acids</b> / <b>proteins</b>                                                                                                                                                                                           | allow nitrogen for nitrate ions                                                       | 1        | AO1<br>4.3.3.1<br>4.4.1.3 |
|              | (and) proteins are needed for growth / to make new cells                                                                                                                                                                                                       | allow proteins are needed to make enzymes / cell structures                           | 1        | AO2<br>4.3.3.1            |
| <b>07.3</b>  | any <b>two</b> from: <ul style="list-style-type: none"> <li>• use a gardening manual / (gardening) website</li> <li>• take (infected) plants to a laboratory to identify the pathogen</li> <li>• use a testing kit containing monoclonal antibodies</li> </ul> | allow ask an expert / plant pathologist<br>ignore 'look at the plants'                | 2        | AO1<br>4.3.3.1            |
| <b>07.4</b>  | (the aphids) remove <b>sugars</b> / sap (from the phloem)                                                                                                                                                                                                      | allow remove dissolved sugars / glucose / sucrose                                     | 1        | AO2<br>4.3.3.1            |
|              | (so) less sugar is available (to the plant) for <b>respiration</b> / to make new cells / for storage <b>or</b> aphids may transmit viruses / disease to the plant                                                                                              | allow less energy is released for growth<br>do not accept less photosynthesis         | 1        | AO2<br>4.3.3.1            |
| <b>07.5</b>  | any <b>one</b> from: <ul style="list-style-type: none"> <li>• (tough / waxy) cuticle (on leaves)</li> <li>• cellulose cell walls</li> <li>• bark (layers of dead cells around the stem)</li> </ul>                                                             | do not accept thorns / hairs (mechanical) or poisons (chemical)                       | 1        | AO1<br>4.3.3.2            |
| <b>Total</b> |                                                                                                                                                                                                                                                                |                                                                                       | <b>9</b> |                           |
| <b>08.1</b>  | pulmonary vein                                                                                                                                                                                                                                                 | if more than one box is ticked, no mark                                               | 1        | AO1<br>4.2.2.2            |
| <b>08.2</b>  | (in the wall of the) <b>right atrium</b>                                                                                                                                                                                                                       | allow upper right chamber<br>do not accept right ventricle / left atrium              | 1        | AO1<br>4.2.2.2            |
| <b>08.3</b>  | (an electrical device that) sends <b>electrical impulses</b> / signals to the heart (muscle)                                                                                                                                                                   | allow stimulates the heart muscle to contract<br>ignore where the device is placed    | 1        | AO1<br>4.2.2.2            |
|              | (so that) the heart beats <b>regularly or</b> at the correct rate <b>or</b> to correct the irregular heartbeat                                                                                                                                                 | allow controls the heart rate<br>do not accept makes the heart beat faster            | 1        | AO1<br>4.2.2.2            |
| <b>08.4</b>  | less blood <b>or</b> less <b>oxygen</b> (and glucose) reaches (part of) the heart muscle                                                                                                                                                                       | allow the heart muscle cells do not get enough oxygen                                 | 1        | AO2<br>4.2.2.4            |

| Question     | Answers                                                                                                                                                                                                                         | Extra information                                                                                               | Mark      | AO / Spec. Ref.             |
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|              | (so) less (aerobic) <b>respiration</b> or less energy is released (in the muscle cells)                                                                                                                                         | allow the cells respire anaerobically (producing lactic acid)<br>do not accept energy is made / produced        | 1         | AO2<br>4.2.2.4              |
|              | (so) the muscle cells cannot contract (properly) <b>or</b> the cells die <b>or</b> the person has a heart attack                                                                                                                | allow the heart cannot pump blood properly                                                                      | 1         | AO2<br>4.2.2.4              |
| <b>Total</b> |                                                                                                                                                                                                                                 |                                                                                                                 | <b>7</b>  |                             |
| <b>09.1</b>  | sugar(s) / maltose / glucose                                                                                                                                                                                                    |                                                                                                                 | 1         | AO1<br>4.2.2.1              |
| <b>09.2</b>  | the iodine (solution) no longer turns blue-black <b>or</b> the iodine stays orange / brown                                                                                                                                      | allow the drop stops going black<br>do not accept the mixture turns blue-black                                  | 1         | AO1<br>4.2.2.1<br>RP 5      |
| <b>09.3</b>  | 120 (s) identified as anomalous / excluded                                                                                                                                                                                      | an answer of 55 scores 2 marks                                                                                  | 1         | AO2<br>4.2.2.1<br>MS 2b     |
|              | $(60 + 50) \div 2 = 55$ (seconds)                                                                                                                                                                                               | an answer of 76.7 (all three values used) scores <b>0</b> marks                                                 | 1         | AO2<br>4.2.2.1<br>MS 2b     |
| <b>09.4</b>  | mean time at pH 6 = $(90 + 80 + 100) \div 3 = 90$ (s) or $1 \div 90$                                                                                                                                                            | an answer of 0.011 scores <b>2</b> marks                                                                        | 1         | AO2<br>4.2.2.1<br>MS 2b, 2c |
|              | (rate =) <b>0.011</b> ( $s^{-1}$ )                                                                                                                                                                                              | an answer of 0.0111 (not 2 significant figures) scores <b>1</b> mark                                            | 1         | AO2<br>4.2.2.1<br>MS 2b, 2c |
| <b>09.5</b>  | pH 8 is above the <b>optimum</b> (pH 7) (for amylase)                                                                                                                                                                           | allow pH 7 is the optimum                                                                                       | 1         | AO2<br>4.2.2.1              |
|              | (so at pH 8) the enzyme (starts to) <b>denature</b> <b>or</b> the shape of the <b>active site</b> changes                                                                                                                       | do not accept the enzyme is killed                                                                              | 1         | AO2<br>4.2.2.1              |
|              | (so) the substrate / starch does not fit (the active site) as well <b>or</b> fewer enzyme–substrate complexes form (so the reaction is slower)                                                                                  | allow fewer successful collisions between enzyme and substrate                                                  | 1         | AO2<br>4.2.2.1              |
| <b>09.6</b>  | any <b>one</b> from:<br><ul style="list-style-type: none"> <li>temperature</li> <li>volume / concentration of amylase solution</li> <li>volume / concentration of starch solution</li> <li>volume of buffer solution</li> </ul> | allow time between taking samples<br>do not accept pH (independent variable) or time taken (dependent variable) | 1         | AO2<br>4.2.2.1<br>WS 2.2    |
| <b>Total</b> |                                                                                                                                                                                                                                 |                                                                                                                 | <b>10</b> |                             |
| <b>10.1</b>  | a disease that <b>cannot be passed</b> from one person (organism) to another                                                                                                                                                    | allow is not caused by a pathogen / is not infectious                                                           | 1         | AO1<br>4.2.2.5              |

| Question     | Answers                                                                                                                                                                                                                                                                                                                                                                                                            | Extra information                                                                                                                                                                 | Mark      | AO / Spec. Ref.          |
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| 10.2         | as the amount of alcohol drunk <b>increases</b> , the number of people with liver disease <b>increases</b>                                                                                                                                                                                                                                                                                                         | allow positive correlation                                                                                                                                                        | 1         | AO3<br>4.2.2.6<br>MS 2g  |
|              | the increase is (much) larger at higher amounts of alcohol, e.g. from 21 to 45 per 1000 between 29–42 units and more than 42 units <b>or</b> the number more than doubles between the top two groups                                                                                                                                                                                                               | data from <b>Table 6</b> required for this mark<br>allow any correct comparison of two values                                                                                     | 1         | AO3<br>4.2.2.6<br>MS 2g  |
| 10.3         | $45 \div 2 = 22.5$ (times)                                                                                                                                                                                                                                                                                                                                                                                         | allow 22 or 23                                                                                                                                                                    | 1         | AO2<br>4.2.2.6<br>MS 1c  |
| 10.4         | any <b>two</b> from: <ul style="list-style-type: none"> <li>a correlation / link does not prove a cause</li> <li>other factors were not controlled, e.g. diet / obesity / infection by hepatitis viruses / genes</li> <li>the amount of alcohol drunk was reported by the people themselves and may be inaccurate</li> <li>the groups are wide ranges <b>or</b> the size of each group is not known</li> </ul>     | allow other lifestyle factors could cause liver disease<br>do not accept 'alcohol does not cause liver disease'                                                                   | 2         | AO3<br>4.2.2.6<br>WS 1.4 |
| 10.5         | any <b>two</b> from: <ul style="list-style-type: none"> <li>affects / damages brain function <b>or</b> damages brain cells</li> <li>harms an unborn baby <b>or</b> affects the development of a fetus</li> <li>addiction</li> </ul>                                                                                                                                                                                | allow increased risk of (some) cancers<br>ignore 'makes you drunk'                                                                                                                | 2         | AO1<br>4.2.2.6           |
| 10.6         | any <b>two</b> from: <ul style="list-style-type: none"> <li>defects in the immune system make a person more likely to suffer from infectious / communicable diseases</li> <li>viruses living in cells can trigger cancer(s)</li> <li>immune reactions caused by a pathogen can trigger allergies, e.g. skin rashes / asthma</li> <li>severe physical ill health can lead to depression / mental illness</li> </ul> | allow named examples, e.g. HPV can cause cervical cancer; HIV damages the immune system so other infections develop                                                               | 2         | AO1<br>4.2.2.5           |
| <b>Total</b> |                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                   | <b>10</b> |                          |
| 11.1         | the diffusion / movement of <b>water</b> from a dilute solution to a (more) concentrated solution through a <b>partially permeable membrane</b>                                                                                                                                                                                                                                                                    | allow from a high water concentration to a low water concentration<br>allow semi-permeable for partially permeable<br>'movement of water across a membrane' alone is insufficient | 1         | AO1<br>4.1.3.2           |

| Question | Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Extra information                                                                                                                                                                                                                                                                                                                                                               | Mark | AO / Spec. Ref.                       |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------|
| 11.2     | <b>Level 3 (5–6 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A clear, logical plan that could be followed to obtain valid results and that explains how the concentration of the potato cells would be found from the results. The plan includes a range of concentrations, control of the important variables, steps to make the measurements accurate (for example blotting, repeats) and the use of a graph of percentage change in mass. | 6    | AO2<br>4.1.3.2<br>WS 2.2, 2.3<br>RP 3 |
|          | <b>Level 2 (3–4 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A workable plan with the main steps (cutting, weighing, soaking in different concentrations, reweighing), but with some detail missing, for example few control variables, no repeats, or no clear way of finding the concentration from the results.                                                                                                                           |      |                                       |
|          | <b>Level 1 (1–2 marks)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Simple statements about some of the steps, for example put potato in sugar solutions and weigh it, with little detail of how to make the results valid or accurate.                                                                                                                                                                                                             |      |                                       |
|          | <b>0 marks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No relevant content.                                                                                                                                                                                                                                                                                                                                                            |      |                                       |
|          | <b>Indicative content</b><br><b>Method</b> <ul style="list-style-type: none"><li>• use the cork borer to cut potato cylinders of the same diameter and trim them to the same length</li><li>• blot the cylinders dry and measure the initial mass of each with the balance</li><li>• put one cylinder into each of a range of sugar solutions, e.g. 0 (distilled water), 0.2, 0.4, 0.6 and 0.8 mol/dm<sup>3</sup>, using the same volume of solution</li><li>• leave for the same time in each solution, e.g. 30 minutes / overnight</li><li>• remove the cylinders, blot them dry in the same way and reweigh them</li><li>• calculate the percentage change in mass for each cylinder</li></ul> <b>Accuracy and validity</b> <ul style="list-style-type: none"><li>• repeat with at least three cylinders at each concentration and calculate a mean</li><li>• use cylinders from the same potato; keep the temperature the same; use a balance reading to 0.01 g; blot consistently</li></ul> <b>Finding the concentration</b> <ul style="list-style-type: none"><li>• plot percentage change in mass against concentration and draw a line of best fit</li><li>• the concentration where the line crosses 0% change (no net movement of water) is the concentration of the potato cells</li></ul> Credit other correct, relevant points. A plan that measures length instead of mass is acceptable if the rest of the method is valid. Do not credit plans that use only one concentration of sugar solution. |                                                                                                                                                                                                                                                                                                                                                                                 |      |                                       |
| 11.3     | a straight line of best fit drawn through / close to the five points                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | the line must extend across the 0% line<br><br>do not accept a line joining the points dot to dot                                                                                                                                                                                                                                                                               | 1    | AO2<br>4.1.3.2<br>MS 4c               |
|          | (concentration =) <b>0.32 to 0.36</b> (mol/dm <sup>3</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | allow 0.33<br><br>allow a value correctly read from the candidate's own line of best fit (ECF)                                                                                                                                                                                                                                                                                  | 1    | AO2<br>4.1.3.2<br>MS 4c               |

| Question               | Answers                                                                                                 | Extra information                                                                                      | Mark       | AO / Spec. Ref.         |
|------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------|-------------------------|
| 11.4                   | the cylinders had different starting masses, so percentage change allows (fair) comparison between them | allow change in mass depends on the initial mass of the cylinder<br>ignore 'it is more accurate' alone | 1          | AO3<br>4.1.3.2<br>MS 1c |
| <b>Total</b>           |                                                                                                         |                                                                                                        | <b>10</b>  |                         |
| <b>TOTAL FOR PAPER</b> |                                                                                                         |                                                                                                        | <b>100</b> |                         |