GCSE

BIOLOGY

Higher Tier Paper 1

Mark scheme Practice Paper Series – Set 2 SGC/S2/SB/1H

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This mark scheme is an original resource written for sciencegcse.co.uk to accompany the Set 2 practice paper SGC/S2/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
When a fixed number of responses is requested but extra responses are given, consider the whole list. Each incorrect response or contradiction cancels one otherwise available correct response, up to the mark limit; the score cannot fall below zero. Neutral material identified by **ignore** does not cancel a correct response. Do not apply this rule as a penalty for extra relevant detail in an extended answer.

3.2 Marking procedure for calculations
A correct final answer can receive the marks indicated in the question-specific scheme without every intermediate step being written. Do not award full marks if the working shown contradicts that answer. Where the question specifically requires a method, demonstration or working, apply that requirement. Credit correct stages when the final answer is wrong, including consequential steps where permitted. A printed unit may only be replaced by another unit when the numerical value is converted consistently.

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
Use an earlier incorrect value in a later part where ECF is allowed by the question-specific scheme. Within a calculation, credit later correct stages that use an earlier incorrect value consistently, subject to any stated limits. Do not repeatedly penalise the same error.

3.5 Phonetic spelling
Accept a misspelling when the intended scientific term is clear, including when a term is being recalled. Do not accept wording that could instead name a different scientific term.

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 03.3 and 09.2 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	(in the) tips of roots and shoots	allow root tip / shoot tip allow growing points	1	AO1 4.1.2.3
01.2	(adult) stem cells can only differentiate into **some** types of cell	allow bone marrow stem cells can only form blood cells allow most animal cells differentiate at an early stage	1	AO1 4.1.2.3
01.3	the stem cells have the **same genes** as the patient	allow the cells have the same antigens / proteins on their surface	1	AO2 4.1.2.3
	so they are not recognised as **foreign** by the immune system / white blood cells		1	AO2 4.1.2.3
01.4	any **one** from: • transfer of a viral infection • the cells may divide uncontrollably / form a tumour • rejection, if the stem cells come from a donor		1	AO1 4.1.2.3
01.5	one set of chromosomes is pulled to **each end** of the cell	allow the two copies of each chromosome separate ignore DNA replicates (this happens before mitosis)	1	AO1 4.1.2.2
	the **nucleus divides** (to form two identical nuclei)		1	AO1 4.1.2.2
01.6	diabetes **or** paralysis	allow other conditions where cells could be replaced, e.g. Parkinson's disease, sickle cell disease ignore cancer	1	AO1 4.1.2.3
		Total	**8**	
02.1	mitochondrion	allow mitochondria	1	AO1 4.1.1.2
02.2	(electron microscopes have a) higher **resolution**	allow higher magnification allow can see smaller structures (such as ribosomes) / more detail ignore clearer	1	AO1 4.1.1.5
02.3	36 ÷ 12 000 = 0.003 (mm)	an answer of 3 (µm) scores **2** marks	1	AO2 4.1.1.5 MS 1a, 3c
	0.003 × 1000 = **3** (µm)	allow 1 mark for 0.003 as the final answer	1	AO2 4.1.1.5 MS 1a, 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	3×10^{-6} (m)	allow an answer consistent with the student's answer to 02.3, correctly converted and in standard form	1	AO2 4.1.1.5 MS 1b (HT)
02.5	heart muscle cells need a lot of **energy** (to contract continuously)		1	AO2 4.1.1.2 4.4.2.1
	X / mitochondria are where **aerobic respiration** takes place, which releases energy	do not accept produce / make energy	1	AO2 4.1.1.2 4.4.2.1
02.6	any **two** from: • cell membrane • cytoplasm • ribosomes	allow DNA / genetic material ignore cell wall, nucleus, plasmids, mitochondria	2	AO1 4.1.1.1
		Total	**9**	
03.1	2^{15} = 32 768 so there were **15** divisions	an answer of 20 (minutes) scores **3** marks allow a correct sequence of successive doublings	1	AO2 4.1.1.6 MS 1a, 2a
	5 hours = 300 minutes		1	AO2 4.1.1.6 MS 1a, 2a
	300 ÷ 15 = **20** (minutes)	allow ECF from an incorrect number of divisions	1	AO2 4.1.1.6 MS 1a, 2a
03.2	so that **oxygen** can get into the dish		1	AO1 4.1.1.6 RP
	(this) prevents the growth of harmful **anaerobic** bacteria		1	AO1 4.1.1.6 RP

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>03.3</td><td colspan="2"><table>
<tr><td>Level 3
(5–6 marks)</td><td>A logical and detailed plan that would give valid results. A range of concentrations is made by dilution with sterile water; discs soaked in each concentration (and a control) are placed on agar spread with bacteria using aseptic technique; the plates are incubated and the clear zones are measured; the lowest concentration tested that gives a clear zone is identified.</td></tr>
<tr><td>Level 2
(3–4 marks)</td><td>A plan that includes making different concentrations and the main steps of the disc method, but some detail is missing or the order is not fully logical. Some variables are controlled or some aseptic technique is described.</td></tr>
<tr><td>Level 1
(1–2 marks)</td><td>Simple statements about some relevant steps, for example put discs of mouthwash on agar. There is little or no indication of how different concentrations would be made or compared.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table></td><td></td><td>6</td><td>AO2
4.1.1.6
RP</td></tr>
<tr><td></td><td colspan="2">Indicative content
make a range of concentrations by diluting the mouthwash with sterile water, e.g. 100%, 50%, 25%, 12.5% and 6.25%
use a measuring cylinder / pipette to measure the volumes accurately
a control disc soaked in sterile water
pass the spreader or inoculating loop through a Bunsen flame (and let it cool) before use
spread the bacteria evenly over the surface of the agar
work near a Bunsen flame and lift the lid of the dish only slightly
soak discs of the same size in each concentration for the same time
place the discs on the agar, evenly spaced, using sterile forceps
secure the lid with tape (not sealed all round), label the dish and store it upside down
incubate at 25 °C (for about 48 hours)
look for a clear zone around each disc / measure the diameter of each clear zone
identify the lowest concentration tested that gives a clear zone; this does not establish an exact minimum inhibitory concentration in a liquid culture
repeat with more plates (and test concentrations between the last two if needed)
control variables: same bacteria culture and volume spread, same size of disc, same soaking time, same incubation temperature and time
To reach Level 3 the plan must include a dilution series, a control disc and a way of identifying the lowest concentration tested that produces a clear zone.</td><td></td><td></td></tr>
<tr><td colspan="3">Total</td><td>11</td><td></td></tr>
<tr><td>04.1</td><td>(162 − 72) ÷ 72 × 100</td><td>an answer of 125 (%) scores 2 marks</td><td>1</td><td>AO2
4.4.2.2
MS 1c, 4a</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	= **125** (%)	allow readings ± 1 beat per minute with a correct calculation (range 120 to 130%) allow 1 mark for 225 (%)	1	AO2 4.4.2.2 MS 1c, 4a
04.2	the muscles contract more so need more **energy**		1	AO2 4.4.2.2
	so the rate of (aerobic) **respiration** increases		1	AO2 4.4.2.2
	so more **oxygen** and glucose must be delivered (and more carbon dioxide removed) by the blood		1	AO2 4.4.2.2
04.3	(some) anaerobic respiration produced **lactic acid**	allow not enough oxygen reached the muscles	1	AO1 4.4.2.1 4.4.2.2
	the lactic acid built up and caused muscle **fatigue** (so the muscles contracted less efficiently)		1	AO1 4.4.2.1 4.4.2.2
04.4	5 (minutes)	allow 4.5 to 5.5 (minutes)	1	AO3 4.4.2.2 MS 4a
04.5	any **one** from: • the heart muscle is stronger, so it pumps more blood with each beat • less lactic acid / a smaller oxygen debt was produced • more capillaries / mitochondria in the muscles		1	AO3 4.4.2.2
		Total	**9**	
05.1	amino acids		1	AO1 4.2.2.1
05.2	A		1	AO3 4.2.2.1 WS 3.5
	the stomach is acidic / contains hydrochloric acid **and** A works best at pH 2 / at a low pH	this mark is dependent on choosing A	1	AO3 4.2.2.1 WS 3.5
05.3	pH 4 is far below the **optimum** pH of B (pH 8)		1	AO2 4.2.2.1
	the shape of the **active site** changes / the enzyme is denatured	do not accept the enzyme is killed	1	AO2 4.2.2.1
	so the protein no longer **fits** into the active site	allow fewer enzyme–substrate complexes form	1	AO2 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	kills (most) bacteria / pathogens (in food)		1	AO1 4.2.2.1 4.3.1.6
	provides the low pH that the stomach protease needs to work best		1	AO1 4.2.2.1 4.3.1.6
		Total	**8**	
06.1	area = $3.14 \times 0.15^2 = 0.07065$ (mm^2)	an answer of 130 scores **3** marks	1	AO2 4.2.3.2 MS 2a, 5c
	$9 \div 0.07065 = 127.4$		1	AO2 4.2.3.2 MS 2a, 5c
	= **130** (per mm^2) (to 2 significant figures)	allow 1.3×10^2 if the diameter is used as the radius, an answer of 32 scores **2** marks	1	AO2 4.2.3.2 MS 2a, 5c
06.2	(most stomata on the lower surface) **reduces water loss**		1	AO3 4.2.3.2
	because the lower surface is shaded / cooler / not in direct sunlight, so less water evaporates	allow the lower surface is next to the air spaces of the spongy mesophyll for gas exchange	1	AO3 4.2.3.2
06.3	guard cells **open and close** the stomata	allow guard cells become turgid to open the stoma and flaccid to close it	1	AO1 4.2.3.2
	closing the stomata (at night / when water is short) reduces the water vapour lost from the leaf		1	AO1 4.2.3.2
06.4	any **one** from: • humidity • light intensity • air movement / wind		1	AO1 4.2.3.2
		Total	**8**	
07.1	any **two** from: • stunted growth • spots on leaves • areas of decay / rot • growths • malformed stems or leaves • discolouration • presence of pests		2	AO1 4.3.3.1
07.2	fewer chloroplasts / less chlorophyll so **less photosynthesis**	allow less light absorbed	1	AO2 4.3.3.1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	so less **glucose** is made for respiration / to make new cells or proteins (for growth)		1	AO2 4.3.3.1 4.4.1.3
07.3	the higher up the tree, the lower the percentage of leaves with spines	allow converse	1	AO3 4.3.3.2 WS 3.5
07.4	spines stop deer eating the leaves / are a mechanical defence		1	AO3 4.3.3.2 WS 3.5
	leaves below about 2 m can be reached by deer, so spines help them survive; above 2 m leaves are not eaten, so fewer have spines	allow spines use resources, so are not produced where they give no protection	1	AO3 4.3.3.2 WS 3.5
07.5	any **one** from: • antibacterial chemicals • poisons (to deter herbivores)		1	AO1 4.3.3.2
07.6	butterflies do not lay eggs on leaves that seem to have eggs on them already, so fewer caterpillars eat the leaves	allow mimicry deters butterflies from laying eggs	1	AO2 4.3.3.2
		Total	**9**	
08.1	pulmonary artery		1	AO1 4.2.2.2
08.2	(vena cava →) **right atrium** → **right ventricle**	allow atrium → ventricle on the right side	1	AO1 4.2.2.2
	(right ventricle →) **pulmonary artery** (→ lungs), passing through valves		1	AO1 4.2.2.2
08.3	the left ventricle pumps blood all around the **body**	allow the right ventricle pumps blood only to the lungs	1	AO1 4.2.2.2
	so it needs to produce a **higher pressure**	allow needs more force / stronger contraction	1	AO1 4.2.2.2
08.4	a mechanical valve lasts more than 25 years, so the 35-year-old will need fewer replacement operations		1	AO3 4.2.2.4 WS 1.4
	a biological valve (10 to 15 years) is likely to last for the rest of the 75-year-old's life		1	AO3 4.2.2.4 WS 1.4
	so the older patient avoids taking anticoagulants for life and the risk of bleeding	allow older patients are at greater risk from bleeding / from more surgery	1	AO3 4.2.2.4 WS 1.4
		Total	**8**	
09.1	cells from the malignant tumour **invade** neighbouring tissues		1	AO1 4.2.2.7

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td></td><td>cells spread in the blood to other parts of the body and form secondary tumours</td><td></td><td>1</td><td>AO1
4.2.2.7</td></tr>
<tr><td>09.2</td><td colspan="2"><table>
<tr><td>Level 3
(5–6 marks)</td><td>A detailed and coherent description of several non-specific defences, linked to how each stops pathogens entering, and of all three ways that white blood cells destroy pathogens.</td></tr>
<tr><td>Level 2
(3–4 marks)</td><td>A description of some non-specific defences and some of the ways that white blood cells destroy pathogens. The links between the points are not always clear.</td></tr>
<tr><td>Level 1
(1–2 marks)</td><td>Simple statements about one or two defences, for example skin is a barrier or white blood cells kill bacteria.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table></td><td>6</td><td>AO1
4.3.1.6</td></tr>
<tr><td></td><td colspan="2">Indicative content
Stopping pathogens entering
• the skin is a physical barrier
• the skin produces antimicrobial secretions
• hairs and mucus in the nose trap particles that may contain pathogens
• the trachea and bronchi secrete mucus, which traps pathogens
• cilia move the mucus up to the throat, where it is swallowed
• the stomach produces hydrochloric acid, which kills pathogens that are swallowed
White blood cells
• phagocytosis: white blood cells engulf and digest pathogens
• white blood cells produce antibodies
• antibodies are specific to the antigens on a pathogen and help to destroy it
• white blood cells produce antitoxins, which neutralise the toxins made by bacteria
To reach Level 3 the answer must cover both stopping entry and all three white blood cell defences (phagocytosis, antibodies, antitoxins).</td><td></td><td></td></tr>
<tr><td>09.3</td><td>(8.0 − 1.0) ÷ 8.0 × 100</td><td>an answer of 87.5 (%) scores 2 marks</td><td>1</td><td>AO2
4.3.1.7
MS 1c</td></tr>
<tr><td></td><td>= 87.5 (%)</td><td>allow 88 (%)
allow 1 mark for 12.5 (%)</td><td>1</td><td>AO2
4.3.1.7
MS 1c</td></tr>
<tr><td>09.4</td><td>the girls vaccinated from 2008 (aged 12 to 13) were only 18 to 19 years old in 2014 / were not yet in the 20 to 24 age group</td><td></td><td>1</td><td>AO3
4.3.1.7
WS 3.5</td></tr>
<tr><td></td><td>cancer of the cervix takes many years to develop after infection with HPV</td><td>allow women aged 20 to 24 in 2014 had not been vaccinated</td><td>1</td><td>AO3
4.3.1.7
WS 3.5</td></tr>
<tr><td colspan="3">Total</td><td>12</td><td></td></tr>
<tr><td>10.1</td><td>lymphocytes make the (specific) antibody</td><td>allow lymphocytes cannot keep dividing indefinitely in culture</td><td>1</td><td>AO1
4.3.2.1 (HT)</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	tumour cells **divide rapidly** (so the hybridoma cell can be cloned to make large amounts of the antibody)		1	AO1 4.3.2.1 (HT)
10.2	hCG binds to the **mobile antibodies** (carrying the coloured beads)		1	AO2 4.3.2.2 (HT)
	the antibodies fixed at the test line bind to the **hCG** (attached to the mobile antibodies)		1	AO2 4.3.2.2 (HT)
	so the coloured beads collect at the test line; without hCG the mobile antibodies are not held there (and move on to the control line)	allow without hCG there is nothing for the fixed antibodies to bind to	1	AO2 4.3.2.2 (HT)
10.3	Strip 1: positive / pregnant Strip 2: negative / not pregnant Strip 3: the test has not worked (no control line)	three correct = **2** marks two correct = **1** mark	2	AO2 4.3.2.2 (HT)
10.4	after 10 days the concentration of hCG (20 units per dm^3) is **below** the concentration the test can detect (25 units per dm^3)	do not accept false negative unless explained	1	AO3 4.3.2.2 (HT) WS 3.5
	repeat the test a few days later / at least 14 days after fertilisation	allow have a blood test at a doctor	1	AO3 4.3.2.2 (HT) WS 3.5
		Total	**9**	
11.1	a pair of distances is identified where the distance doubles, e.g. 10 to 20 cm	allow 15 to 30 cm or 20 to 40 cm alternative: calculate rate × $distance^2$ at two distances for this mark	1	AO2 4.4.1.2 MS 3a (HT)
	the rate falls to a quarter for that pair, e.g. 64 to 16 bubbles per minute, as predicted by the inverse-square relationship	allow 28 to 7 or 16 to 4 for the corresponding pair alternative: show that the two products are approximately equal (about 6400) a complete numerical demonstration with one suitable pair scores **2** marks	1	AO2 4.4.1.2 MS 3a (HT)
11.2	as the distance increases the **light intensity** decreases		1	AO1 4.4.1.2
	light is the **limiting factor**, so less energy is available for photosynthesis	allow less light is absorbed by the chlorophyll	1	AO1 4.4.1.2
11.3	at 15 °C, **temperature** is the limiting factor		1	AO3 4.4.1.2 (HT) WS 3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	the enzymes that control photosynthesis work **slowly** at 15 °C, so extra carbon dioxide cannot be used much faster	allow increasing the temperature to 25 °C as well as the carbon dioxide gives a much larger increase	1	AO3 4.4.1.2 (HT) WS 3.5
11.4	extra profit calculated for D: (9.0 − 4.0) × 20 − 55 = £45	allow B = −£7 and C = £0 calculated	1	AO2 4.4.1.2 (HT) MS 1a, 2c
	condition D (with correct supporting calculation)	D with no working scores 0	1	AO2 4.4.1.2 (HT) MS 1a, 2c
11.5	any **one** from: • heating the greenhouse would cost more in winter (because it is colder outside) • light intensity is lower in winter, so light would limit the rate and the extra heat and carbon dioxide would not increase it much		1	AO3 4.4.1.2 (HT)
		Total	**9**	
		TOTAL FOR PAPER	**100**	