GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Physics Paper 1

Mark scheme Practice Paper Series – Set 2 SGC/S2/P/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/P/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 Combined Science: Trilogy (8464) specification, Physics section 6.1–6.4. 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 (question 01.1 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.

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>01.1</td><td>
<table>
<tr><td>Level 3
(5–6 marks)</td><td>The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.</td></tr>
<tr><td>Level 2
(3–4 marks)</td><td>The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.</td></tr>
<tr><td>Level 1
(1–2 marks)</td><td>The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.</td></tr>
<tr><td>0 marks</td><td>No relevant content.</td></tr>
</table>
</td><td></td><td>6</td><td>AO1
6.2.1.4
RP</td></tr>
<tr><td></td><td>Indicative content
• close the switch
• adjust the variable resistor to change the potential difference across the diode
• record the potential difference (voltmeter reading) and the current (ammeter reading)
• take readings over a range of potential differences, e.g. from 0 V to 0.8 V
• take small steps, e.g. 0.1 V, / more readings where the current starts to increase (0.4–0.8 V)
• reverse the diode (or the battery) and repeat to obtain readings in the reverse direction
• record the reverse readings as negative values
• the resistor protects the diode from too large a current
• open the switch between readings so the components do not heat up
• repeat the readings and calculate mean values
• plot a graph of current (y-axis) against potential difference (x-axis)
To reach Level 3 the method must change the potential difference with the variable resistor, record pairs of readings over a range and include either the reverse direction or plotting the characteristic graph.</td><td></td><td></td><td></td></tr>
<tr><td>01.2</td><td>there is no current / almost no current until the potential difference is about 0.4 V</td><td>allow no current up to 0.2 V
allow very little current below 0.5 V</td><td>1</td><td>AO3
6.2.1.4
RP</td></tr>
<tr><td></td><td>then the current increases rapidly / by larger and larger amounts as the potential difference increases</td><td>allow the current increases non-linearly
allow the current increases, but not in direct proportion to the potential difference</td><td>1</td><td>AO3
6.2.1.4
RP</td></tr>
<tr><td>01.3</td><td>0.70 = 0.0200 × R</td><td>an answer of 35 (Ω) scores 2 marks
allow R = 0.70 ÷ 0.0200</td><td>1</td><td>AO2
6.2.1.3
MS 3c</td></tr>
<tr><td></td><td>R = 35 (Ω)</td><td>an answer of 0.035 (Ω) scores 1 mark (current not converted to amperes)</td><td>1</td><td>AO2
6.2.1.3
MS 3c</td></tr>
<tr><td>01.4</td><td>It has a very high resistance in the reverse direction.</td><td>if more than one box is ticked, no mark</td><td>1</td><td>AO1
6.2.1.4</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	the current may be smaller than 0.1 mA / smaller than the resolution of the ammeter (so it is too small for this ammeter to measure)	allow the ammeter is not sensitive enough ignore the ammeter is faulty	1	AO3 6.2.1.4 WS 3.7
		Total	**12**	
02.1	the nucleus is very small and contains most of the mass of the atom		1	AO1 6.4.1.1, 6.4.1.3
	protons and neutrons are in the nucleus	allow protons have positive charge and neutrons have no charge	1	AO1 6.4.1.1, 6.4.1.3
	electrons are arranged in energy levels / shells around the nucleus	allow negatively charged electrons outside the nucleus	1	AO1 6.4.1.1, 6.4.1.3
02.2	**A** absorbed		1	AO1 6.4.1.1
	B emitted		1	AO1 6.4.1.1
02.3	it loses (one or more outer) electrons	do not accept it gains protons do not accept it gains electrons	1	AO1 6.4.1.2
02.4	$1.2 \times 10^{-10} \div 6.0 \times 10^{-15}$	an answer of 20 000 scores **2** marks	1	AO2 6.4.1.1 MS 1b
	= **20 000** (times)	allow 2×10^4 / 2.0×10^4 an answer of 5×10^{-5} scores 0 marks	1	AO2 6.4.1.1 MS 1b
		Total	**8**	
03.1	current in the 100 Ω resistor = 2.0 ÷ 100 = 0.020 (A)	an answer of 200 (Ω) scores **3** marks	1	AO2 6.2.1.3, 6.2.2 MS 3c
	potential difference across the thermistor = 6.0 − 2.0 = 4.0 (V)	alternative method for the second and third marks: total resistance of the branch = 6.0 ÷ 0.020 = 300 (Ω) (1), so R = 300 − 100 (1)	1	AO2 6.2.1.3, 6.2.2 MS 3c
	R = 4.0 ÷ 0.020 = **200** (Ω)	allow ECF from an incorrect current or potential difference allow (4.0 ÷ 2.0) × 100 = 200 (Ω) for **3** marks	1	AO2 6.2.1.3, 6.2.2 MS 3c
03.2	the resistance of the thermistor decreases		1	AO1 6.2.1.4
	so the current in the thermistor and the 100 Ω resistor increases	allow the thermistor takes a smaller share of the 6.0 V / the potential difference across the thermistor decreases	1	AO2 6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	so the potential difference across the 100 Ω resistor increases: the voltmeter reading increases	allow ($V = IR$ and) R is fixed, so the reading increases a bare statement that the reading increases scores 1 mark; 'the thermistor's resistance decreases so the reading increases' scores 2 marks	1	AO2 6.2.2
		Total	**6**	
04.1	the energy needed to change 1 kg of ice from solid to liquid / to melt 1 kg of ice	allow the energy needed to change 1 kg of a solid into a liquid do not accept change of state without reference to melting	1	AO1 6.3.2.3
	with no change in temperature	allow at its melting point / at 0 °C	1	AO1 6.3.2.3
04.2	$E = 40 \times 300 = 12\,000$ (J)	an answer of 300 000 (J/kg) scores **3** marks	1	AO2 6.1.1.4, 6.3.2.3 MS 3b, 3c
	$12\,000 = 0.040 \times L$	allow ECF from an incorrect value of E	1	AO2 6.1.1.4, 6.3.2.3 MS 3b, 3c
	L = **300 000** (J/kg)	allow 3.0×10^5 (J/kg)	1	AO2 6.1.1.4, 6.3.2.3 MS 3b, 3c
04.3	energy from the (warmer) surroundings / the room also melted some of the ice	allow the ice gained energy from the air	1	AO3 6.3.2.3 WS 3.7
	so the mass of ice melted was greater than the mass melted by the heater alone, and $L = E \div m$ gives a value that is too small	allow the mass used in the calculation was too large for the energy supplied by the heater	1	AO3 6.3.2.3 WS 3.7
04.4	any **one** from: • set up an identical funnel of ice with no heater (or with the heater switched off) for the same time and subtract the mass of water it collects • insulate the funnel	allow do the experiment in a room at 0 °C ignore repeat the experiment	1	AO3 6.3.2.3 WS 2.7
		Total	**8**	
05.1	$E_e = 0.5 \times 320 \times 0.150^2$	an answer of 3.6 (J) scores **2** marks	1	AO2 6.1.1.2 MS 3c
	E_e = **3.6** (J)	an answer of 3 600 000 (J) (compression in mm) scores 1 mark	1	AO2 6.1.1.2 MS 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$E_k = 0.75 \times 3.6 = 2.7$ (J)	an answer of 9.5 (m/s) scores **3** marks allow ECF from 05.1	1	AO2 6.1.1.2, 6.1.2.2 MS 3b, 3c
	$2.7 = 0.5 \times 0.060 \times v^2$	allow $v^2 = 90$	1	AO2 6.1.1.2, 6.1.2.2 MS 3b, 3c
	v = **9.5** (m/s)	allow 9.49 (m/s) an answer of 11 (m/s) (75% not used) scores **2** marks	1	AO2 6.1.1.2, 6.1.2.2 MS 3b, 3c
05.3	doubling the compression makes the elastic potential energy four times greater	allow E_e is proportional to e^2 allow a correct calculation, e.g. E_e = 14.4 J	1	AO2 6.1.1.2
	so the kinetic energy of the ball is four times greater	allow E_k = 10.8 J	1	AO2 6.1.1.2
	E_k is proportional to v^2, so the speed doubles (√4 = 2): the student is correct	allow a calculated speed of 19 m/s, which is twice 9.5 m/s allow ECF: a calculated speed that is twice the student's answer to 05.2 the conclusion must be supported by reasoning to score this mark	1	AO2 6.1.1.2
05.4	any **one** from: • (work is done against) friction between the ball and the tube • air resistance • the spring and the plate also gain kinetic energy • (some energy is transferred as) sound	allow energy is transferred to the thermal energy store of the ball / the tube / the surroundings ignore energy is lost	1	AO1 6.1.2.1
		Total	**9**	
06.1	0 (top number) and −1 (bottom number)		1	AO1 6.4.2.2
	e	allow β	1	AO1 6.4.2.2
06.2	beta radiation would be absorbed by the outer layers of the food / by the boxes, so it would not reach the bacteria inside	allow beta radiation has a short range in the food do not accept beta is absorbed by (thin) plastic packaging	1	AO1 6.4.2.1
	gamma radiation is very penetrating, so it passes through the boxes and the whole of the food	allow gamma reaches all of the bacteria	1	AO1 6.4.2.1
06.3	no radioactive material / cobalt-60 atoms get into or onto the food (it is not contaminated)	allow the food does not touch the source	1	AO1 6.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	gamma rays do not make the nuclei of the atoms in the food unstable	allow gamma rays do not change / affect the nuclei of the atoms in the food ignore the food is only exposed to radiation (repeats the question)	1	AO1 6.4.2.4
06.4	$6.4 \times 10^{13} \div 4.0 \times 10^{12} = 16$	an answer of 21.2 (years) scores **3** marks	1	AO2 6.4.2.3 (HT) MS 1b, 1c
	$16 = 2^4$, so the activity halves 4 times / 4 half-lives	allow $6.4 \times 10^{13} \rightarrow 3.2 \times 10^{13} \rightarrow 1.6 \times 10^{13} \rightarrow 8.0 \times 10^{12} \rightarrow 4.0 \times 10^{12}$ for the first two marks	1	AO2 6.4.2.3 (HT) MS 1b, 1c
	time = 4 × 5.3 = **21.2** (years)	allow 21 (years) allow ECF from an incorrect number of half-lives	1	AO2 6.4.2.3 (HT) MS 1b, 1c
		Total	**9**	
07.1	both points plotted correctly: (20, 196.6) and (40, 214.6)	allow ± half a small square	1	AO2 6.3.1.1 RP MS 4a, 4c
	a straight line of best fit through or close to all the points	extend the line to the mass axis for 07.2	1	AO3 6.3.1.1 RP MS 4a, 4c
07.2	178 (g)	allow a value from 177 to 179 (g) allow the intercept of the student's line on the mass axis allow 176 (g) (intercept corrected for the 2.0 g zero error)	1	AO3 6.3.1.1 RP MS 4a, 4d
07.3	gradient of the line, e.g. (224.0 − 178.0) ÷ 50	an answer of 920 (kg/m^3) scores **3** marks allow the change in mass ÷ the change in volume between any two points on the line or any two results	1	AO2 6.3.1.1 RP MS 4d, 1a
	= 0.92 (g/cm^3)	allow a value from 0.90 to 0.94 (g/cm^3)	1	AO2 6.3.1.1 RP MS 4d, 1a
	× 1000 = **920** (kg/m^3)	allow a value from 900 to 940 (kg/m^3) allow ECF from an incorrect gradient correctly converted an answer of 4.48 or 4480 (total mass ÷ volume) scores 0 marks	1	AO2 6.3.1.1 RP MS 4d, 1a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	every mass reading was 2.0 g too high, so the line is moved up by 2.0 g	allow all the readings have the same (systematic) error	1	AO3 6.3.1.1 RP WS 3.7
	the gradient of the line (the density) does not change / only the intercept changes	allow the density depends only on the increase in mass, so the 2.0 g cancels out	1	AO3 6.3.1.1 RP WS 3.7
		Total	**8**	
08.1	thicker insulation reduces the rate of energy transfer	allow the energy has to pass through more material	1	AO1 6.1.2.1
	a lower thermal conductivity reduces the rate of energy transfer (by conduction)	ignore heat is trapped	1	AO1 6.1.2.1
08.2	reduction in power = 1.6 − 1.3 = 0.30 (kW)	an answer of (£)0.65 scores **3** marks	1	AO2 6.1.1.4, 6.2.4.2 MS 1a, 3c
	energy saved each day = 0.30 × 8.0 = 2.4 (kWh)	allow (1.6 × 8.0) − (1.3 × 8.0) = 12.8 − 10.4	1	AO2 6.1.1.4, 6.2.4.2 MS 1a, 3c
	money saved = 2.4 × 27 = 64.8 (p) = (£)**0.65**	allow (£)0.648 allow 65p if the unit is changed to pence allow 1.6 × 8.0 × 27 = 345.6 (p) and 1.3 × 8.0 × 27 = 280.8 (p) for 2 marks allow ECF from an incorrect energy	1	AO2 6.1.1.4, 6.2.4.2 MS 1a, 3c
08.3	a renewable energy resource is (being) replenished as it is used / will not run out	allow wood can be regrown / trees can be replanted	1	AO1 6.1.3
	a non-renewable energy resource will run out / cannot be replaced (once it has been used)	allow it is a finite resource / it takes millions of years to form	1	AO1 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	any **two** from: • the temperature of the water fell by less for jacket **B** (14 °C) than for jacket **A** (20 °C), which seems to support the conclusion • but the starting temperatures were different, so it was not a fair test • hotter water (a bigger temperature difference with the surroundings) transfers energy faster, so jacket **A** would be expected to show a bigger decrease • the temperature of the room may have been different on the two days **plus** • a conclusion justified by these points, e.g. the family's conclusion is not valid / jacket **A** may be the better insulator / the test should be repeated with the same starting temperature	1 mark for each of up to two points 1 mark for the justified conclusion max **2** marks if there is no justified conclusion a conclusion that jacket **B** is the better insulator does not score the conclusion mark	3	AO3 6.1.2.1 WS 3.5
		Total	**10**	
		TOTAL FOR PAPER	**70**	