

GCSE

PHYSICS

Paper 1 Higher Tier

Mark scheme Practice Paper Series – Set 1 SGC/S1/SP/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/SP/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 Physics (8463) 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 08.4 and 11.1 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	electrons are transferred (by friction) from the cloth to the rod	do not accept protons / positive charges move	1	AO1 4.2.5.1
	(so) the rod gains electrons and becomes negatively charged and the cloth loses electrons and becomes positively charged	allow the rod has more electrons than protons	1	AO1 4.2.5.1
01.2	they repel (each other)	allow they push apart / move away from each other	1	AO1 4.2.5.1
01.3	(at least four) straight radial field lines, evenly spaced, starting at the surface of the sphere	lines must not cross	1	AO1 4.2.5.2
	arrows on the lines pointing towards the sphere	the direction mark can only be awarded if the lines are radial	1	AO1 4.2.5.2
01.4	at / close to the surface of the sphere	allow where the field lines are closest together	1	AO1 4.2.5.2
01.5	the electric field (between the sphere and the object) is strong enough to ionise the air / to pull electrons off the air molecules	allow the air becomes conducting / the field causes the air to break down	1	AO1 4.2.5.2
	(so) charge / electrons flow through the air (from the sphere to the earthed object) as the spark	allow a current flows through the air	1	AO1 4.2.5.2
Total			8	
02.1	any two from: - starting temperature of the water - volume / mass of water - thickness of the insulating material - type / size of beaker - time (10 minutes) - room temperature / place where the beakers were left	allow the same lid / no lid on each beaker ignore 'the material' (the independent variable)	2	AO2 4.1.2.1 RP 2 WS 2.2
02.2	bubble wrap	the justification mark can only be awarded if bubble wrap is chosen	1	AO3 4.1.2.1 RP 2
	(because) the temperature fell by the smallest amount : 18 °C compared with 22 °C (cotton wool), 30 °C (foil) and 34 °C (no insulation)	allow the water stayed hottest (62 °C) – a comparison with at least one data value is needed	1	AO3 4.1.2.1 RP 2
02.3	bubble wrap traps air (in the bubbles)		1	AO1 4.1.2.1
	air has a low thermal conductivity / is a poor conductor and trapped air cannot move, so energy is not transferred by convection	allow air is a good insulator	1	AO1 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$(\Delta E =) 0.20 \times 4200 \times 34$ or $0.20 \times 4200 \times (80 - 46)$	an answer of 28 560 scores 2 marks an answer of 67 200 (80 °C used) or 38 640 (46 °C used) scores 1 mark	1	AO2 4.1.1.3 MS 3c
	$(\Delta E =)$ 28 560 (J)	allow 28 600 or 2.9×10^4 (J)	1	AO2 4.1.1.3 MS 3c
02.5	$(P =) 28\,560 \div 600$	an answer of 47.6 scores 2 marks allow ECF from an incorrect answer to 02.4 an answer of 2856 (10 used as the time) scores 0 marks	1	AO2 4.1.1.4 MS 3c
	$(P =)$ 47.6 (W)	allow 48 (W)	1	AO2 4.1.1.4 MS 3c
Total			10	
03.1	the current is the same at all points in the circuit	if more than one box is ticked, no mark	1	AO1 4.2.2
03.2	$(4.0 + 8.0 =)$ 12 (Ω)		1	AO2 4.2.2 MS 1a
03.3	$(I =) 12 \div 12$	an answer of 1.0 scores 2 marks allow ECF from an incorrect answer to 03.2	1	AO2 4.2.1.3 MS 3b MS 3c
	$(I =)$ 1.0 (A)	allow 1 (A)	1	AO2 4.2.1.3 MS 3b MS 3c
03.4	$(V =) 1.0 \times 8.0$	an answer of 8.0 scores 2 marks allow ECF from an incorrect answer to 03.3	1	AO2 4.2.1.3 4.2.2 MS 3c
	$(V =)$ 8.0 (V)	allow 8 (V) an answer of 4.0 (V) (pd across the 4.0 Ω resistor) scores 1 mark	1	AO2 4.2.1.3 4.2.2 MS 3c
03.5	the current through the two resistors is the same (because they are in series)		1	AO2 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(and) potential difference = current $\times$ resistance, so for the same current the larger resistance has the larger potential difference	allow the potential difference is (directly) proportional to the resistance when the current is the same allow more work is done (per coulomb) pushing the charge through the larger resistance	1	AO2 4.2.2
03.6	(in parallel) there is more than one path for the current or the current through the two resistors adds together	allow the current splits between the resistors	1	AO2 4.2.2
	(so) the total current from the battery is larger for the same potential difference, so the total resistance ($= V / I$) is smaller or the total resistance is less than the smallest individual resistance	allow each resistor has the full 12 V across it, so the current through the 4.0 Ω resistor alone is already 3.0 A	1	AO2 4.2.2
Total			10	
04.1	$(E_p =) 500 \times 9.8 \times 20$	an answer of 98 000 scores 2 marks	1	AO2 4.1.1.2 MS 3c
	$(E_p =) \mathbf{98\ 000}$ (J)	allow 9.8×10^4 (J) or 98 kJ	1	AO2 4.1.1.2 MS 3c
04.2	$(E_k =) 98\ 000$ (J) or $\frac{1}{2} \times 500 \times v^2 = 98\ 000$	an answer of 19.8 or 20 scores 3 marks allow ECF from an incorrect answer to 04.1	1	AO2 4.1.1.2 MS 3b MS 3d
	$v^2 = (2 \times 98\ 000) \div 500 = 392$	an answer of 392 (square root not taken) scores 2 marks	1	AO2 4.1.1.2 MS 3b MS 3d
	$(v =) \mathbf{19.8}$ (m/s)	allow 20 (m/s) allow 19.79 to 19.80 (m/s)	1	AO2 4.1.1.2 MS 3b MS 3d
04.3	(the car does work against) friction / air resistance (as it moves along the track)	allow there is friction between the wheels and the track	1	AO3 4.1.2.1
	(so) some energy is transferred to the thermal energy store of the track / air / surroundings or some energy is dissipated, so less energy is transferred to the kinetic energy store of the car	allow not all the gravitational potential energy is transferred to kinetic energy do not accept energy is lost / used up without reference to where it goes	1	AO3 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	$(P =) 98\,000 \div 25$	an answer of 3920 scores 2 marks allow ECF from an incorrect answer to 04.1	1	AO2 4.1.1.4 MS 3c
	$(P =) \mathbf{3920}$ (W)	allow 3900 (W) or 3.9 kW	1	AO2 4.1.1.4 MS 3c
Total			9	
05.1	the resistance is directly proportional to the length	allow as the length doubles, the resistance doubles	1	AO3 4.2.1.3 RP 3 MS 4a
	(because) the graph is a straight line through the origin	both the straight line and the origin are needed	1	AO3 4.2.1.3 RP 3 MS 4a
05.2	(gradient =) 0.050 (Ω/cm) or 5.0 Ω per 100 cm or 1.5×5.0	an answer of 7.5 scores 2 marks	1	AO2 4.2.1.3 MS 4c
	(resistance =) 7.5 (Ω)		1	AO2 4.2.1.3 MS 4c
05.3	(when the circuit is on) the current heats the wire / the temperature of the wire increases		1	AO2 4.2.1.3 RP 3
	(and) the resistance of the wire increases with temperature , so the resistance readings would be affected or so that temperature is kept constant (as a control variable)	allow so the temperature does not affect the results allow to make it a fair test if temperature is mentioned	1	AO2 4.2.1.3 RP 3
05.4	the resistance of the thermistor decreases as the temperature increases	do not accept the resistance increases with temperature	1	AO1 4.2.1.4
	(so) the current in the circuit (or the potential difference across a component) changes , and when it reaches a set value the circuit switches the heater off	allow the change in current is used to operate a switch	1	AO2 4.2.1.4
05.5	any one from: - switching on (street / garden / security) lights automatically when it gets dark - a light meter (e.g. in a camera) - controlling a display brightness	ignore a light sensor without an application	1	AO1 4.2.1.4
Total			9	
06.1	the (gas) particles collide with the walls (of the cylinder)	allow the particles hit the walls	1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	each collision exerts a force on the wall; the total force (from all the collisions) per unit area is the pressure	allow the collisions produce a force at right angles to the wall	1	AO1 4.3.3.2
06.2	$p_1V_1 = p_2V_2$ or $1.2 \times 10^5 \times 0.050 = p_2 \times 0.020$	an answer of 3.0×10^5 or 300 000 scores 3 marks	1	AO2 4.3.3.2 MS 3b MS 3c
	$(p_1V_1 =) 6000 \text{ (Pa m}^3\text{)}$ or $p_2 = 6000 \div 0.020$	an answer of 4.8×10^4 (48 000, the volumes inverted) scores 1 mark	1	AO2 4.3.3.2 MS 3b MS 3c
	$(p_2 =) 3.0 \times 10^5 \text{ (Pa)}$	allow 300 000 (Pa) or 300 kPa	1	AO2 4.3.3.2 MS 3b MS 3c
06.3	the same number of particles are in a smaller volume / the particles are closer together		1	AO1 4.3.3.2
	(so) there are more collisions with the walls per second / per unit area, giving a larger force per unit area	allow the particles hit the walls more often do not accept the particles move faster	1	AO1 4.3.3.2
06.4	(pushing the piston in quickly) work is done on the gas (by the force on the piston)	allow energy is transferred to the gas mechanically	1	AO1 4.3.3.3
	(so) the internal energy of the gas increases / the kinetic energy of the particles increases, so the temperature rises	do not accept the particles rub together / friction between particles	1	AO1 4.3.3.3
06.5	the particles move randomly / in random directions with a range of speeds	allow the particles move quickly in all directions	1	AO1 4.3.3.1
	the temperature is related to the average kinetic energy of the particles: the higher the temperature, the higher the average kinetic energy / speed of the particles	allow the particles move faster at higher temperatures	1	AO1 4.3.3.1
Total			11	
07.1	(mass number =) 14		1	AO2 4.4.2.2
	(atomic number =) 7	numbers must be in the correct positions (mass number above the atomic number)	1	AO2 4.4.2.2
07.2	a neutron changes into a proton		1	AO1 4.4.2.1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(and) an electron is created (in the nucleus) and emitted / ejected from the nucleus (at high speed)	allow the beta particle is a high-speed electron ejected from the nucleus do not accept an electron from the outer shell is emitted	1	AO1 4.4.2.1 4.4.2.2
07.3	(the atomic number) increases by 1	do not accept it increases without the amount	1	AO1 4.4.2.2
07.4	$(24 \div 8.0 =) \mathbf{3}$ half-lives	an answer of 1 : 8 scores 3 marks	1	AO2 4.4.2.3 MS 1c MS 3c
	$1600 \rightarrow 800 \rightarrow 400 \rightarrow \mathbf{200}$ (Bq) or $1600 \times (\frac{1}{2})^3$	allow $1600 \div 8$	1	AO2 4.4.2.3 MS 1c MS 3c
	(ratio =) $200 : 1600 = \mathbf{1 : 8}$	an answer of 8 : 1 (the ratio inverted) scores 2 marks allow $\frac{1}{8}$ or 0.125 for 2 marks (not in the form asked for)	1	AO2 4.4.2.3 MS 1c MS 3c
07.5	it is not possible to predict when a particular nucleus will decay or which nucleus will decay next	allow each nucleus has the same chance of decaying in a given time	1	AO1 4.4.2.3
	(but) for a large sample the activity follows a predictable statistical decrease / the half-life is constant	do not accept a constant overall rate of decay / activity	1	AO1 4.4.2.3
Total			10	
08.1	any two from: - rocks / soil (radon gas) - cosmic rays (from space / the Sun) - food and drink - building materials - medical procedures (X-rays / tracers) - nuclear weapons testing / nuclear accidents / nuclear waste	allow the Sun ignore 'nuclear power stations' without reference to accidents or waste	2	AO1 4.4.3.1
08.2	(total dose =) $1.30 + 0.35 + 0.30 + 0.45 = 2.40$ (mSv)	an answer of 18.75, 18.8 or 19 scores 3 marks	1	AO2 4.4.3.1 MS 1a MS 1c
	$0.45 \div 2.40 \times 100$	allow ECF from an incorrect total	1	AO2 4.4.3.1 MS 1a MS 1c
	(percentage =) 18.75 (%)	allow 18.8 or 19 (%)	1	AO2 4.4.3.1 MS 1a MS 1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.							
08.3	the detector also records background radiation, so the background count rate must be subtracted to find the count rate due to the source alone	allow so that the count rate from the source is not overestimated	1	AO1 4.4.3.1							
08.4	<table><tr><td>Level 3 (5–6 marks)</td><td>A clear evaluation that considers both the type of radiation and the half-life for the isotopes, links each to the requirements of the test (detection outside the body, a two-hour test, keeping the dose to the patient low), and reaches a justified choice of isotope B.</td></tr><tr><td>Level 2 (3–4 marks)</td><td>An evaluation that considers the type of radiation and/or the half-life for some of the isotopes, with some links to the requirements of the test. A choice may be made but is not fully justified.</td></tr><tr><td>Level 1 (1–2 marks)</td><td>Simple statements about one or two of the isotopes, for example that alpha radiation is dangerous, with little or no link to the use as a tracer.</td></tr><tr><td>0 marks</td><td>No relevant content.</td></tr></table> Indicative content Type of radiation - the tracer must emit gamma radiation because gamma radiation is penetrating enough to pass out of the body and reach the detector - gamma radiation is the least ionising, so it causes the least damage to cells while it is inside the body - isotope A emits alpha radiation, which has a very short range and would be absorbed inside the body, so it could not be detected outside the body - alpha radiation is highly ionising and would damage cells / tissue inside the body, so A is unsuitable Half-life - the half-life must be long enough for the tracer to remain active during the two-hour test, but short enough that the activity falls quickly afterwards so the patient does not receive an unnecessary dose - a half-life of 6 hours is long enough for the test (the activity falls by only about a fifth in two hours) and the tracer will have decayed to a very low activity within a day or two - isotope C has a half-life of 8 days, so the patient would remain radioactive / continue to be irradiated for weeks after the test, increasing the risk Conclusion: isotope B is the most suitable (gamma emitter with a half-life of 6 hours); C could be detected but gives an unnecessarily large dose; A is unsuitable. Credit other correct, relevant points. Do not credit statements that the half-life should be as long as possible, or that a shorter half-life is always safer without reference to the length of the test.	Level 3 (5–6 marks)	A clear evaluation that considers both the type of radiation and the half-life for the isotopes, links each to the requirements of the test (detection outside the body, a two-hour test, keeping the dose to the patient low), and reaches a justified choice of isotope B .	Level 2 (3–4 marks)	An evaluation that considers the type of radiation and/or the half-life for some of the isotopes, with some links to the requirements of the test. A choice may be made but is not fully justified.	Level 1 (1–2 marks)	Simple statements about one or two of the isotopes, for example that alpha radiation is dangerous, with little or no link to the use as a tracer.	0 marks	No relevant content.	6	AO3 4.4.3.2 4.4.3.3
Level 3 (5–6 marks)	A clear evaluation that considers both the type of radiation and the half-life for the isotopes, links each to the requirements of the test (detection outside the body, a two-hour test, keeping the dose to the patient low), and reaches a justified choice of isotope B .										
Level 2 (3–4 marks)	An evaluation that considers the type of radiation and/or the half-life for some of the isotopes, with some links to the requirements of the test. A choice may be made but is not fully justified.										
Level 1 (1–2 marks)	Simple statements about one or two of the isotopes, for example that alpha radiation is dangerous, with little or no link to the use as a tracer.										
0 marks	No relevant content.										
Total			12								
09.1	neutron		1	AO1 4.4.4.1							

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	the nucleus (absorbs the neutron and) becomes unstable		1	AO1 4.4.4.1
	(the nucleus) splits into two smaller nuclei (of roughly equal size)	allow the nucleus splits into two daughter nuclei	1	AO1 4.4.4.1
	two or three neutrons are emitted and energy is released (as kinetic energy of the fragments and/or gamma radiation)	allow neutrons are released and energy is released	1	AO1 4.4.4.1
09.3	the neutrons released can be absorbed by other uranium nuclei , causing further fissions (which release more neutrons)	allow each fission can cause more than one further fission	1	AO1 4.4.4.1
	control rods absorb neutrons so that (on average) only one neutron from each fission goes on to cause another fission / so the reaction continues at a steady rate	allow the control rods are moved in or out to change the number of neutrons available ignore moderator	1	AO1 4.4.4.1
09.4	two light nuclei join (fuse) to form a heavier nucleus	allow hydrogen nuclei join to form helium	1	AO1 4.4.4.2
	some of the mass (of the nuclei) is converted into energy (released as radiation)	allow the products have less mass than the original nuclei and the difference is released as energy	1	AO1 4.4.4.2
09.5	the nuclei are (both) positively charged so they repel ; at very high temperatures the nuclei have enough kinetic energy to overcome the repulsion and get close enough to fuse	both the repulsion and the need for high kinetic energy / speed are needed for the mark	1	AO1 4.4.4.2
Total			9	
10.1	$40\,000 \times 300 = 12\,000\,000$ (W)	an answer of 12 scores 2 marks an answer of $12\,000\,000$ (W) or 1.2×10^7 (W) (not converted) scores 1 mark	1	AO2 4.1.1.4 MS 1b MS 1c
	(maximum power output =) 12 (MW)		1	AO2 4.1.1.4 MS 1b MS 1c
10.2	the output depends on the intensity of the sunlight : it is lower when it is cloudy / when the Sun is low in the sky and zero at night	allow the panels only give their maximum output in bright, direct sunlight	1	AO1 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	advantage – any one from: - reliable / gives a constant output day and night, whatever the weather - a very large output from a single site / much less land needed	allow the fuel has a very high energy density do not accept no carbon dioxide while generating electricity as an advantage over solar	1	AO1 4.1.3
	disadvantage – any one from: - produces radioactive waste that stays hazardous for a very long time (and must be stored safely) - risk of an accident releasing radioactive material - very expensive to build and to decommission - the fuel (uranium) is non-renewable	ignore 'dangerous' without a reason	1	AO1 4.1.3
Total			5	

Question	Answers		Extra information	Mark	AO / Spec. Ref.
11.1	Level 3 (5–6 marks)	A clear, logically ordered method with a correct circuit (ammeter in series with the lamp, voltmeter in parallel with the lamp, a means of varying the potential difference), readings of current and potential difference taken over a range including reversed polarity, and a description of how the results are processed.		6	AO1 4.2.1.4 RP 4
	Level 2 (3–4 marks)	A method with a mostly correct circuit and a description of the readings taken, but with some detail missing (for example no range, no reversed readings or an error in the meter positions).			
	Level 1 (1–2 marks)	Simple statements, for example connect an ammeter and a voltmeter and take readings, with little detail of the circuit or the method.			
	0 marks	No relevant content.			
	Indicative content - connect the power supply, switch, variable resistor, lamp and ammeter in series - connect the voltmeter in parallel with (across) the lamp - use the variable resistor (or a variable power supply) to change the potential difference across the lamp and the current through it - record the current and the potential difference for each setting - take readings for a range of potential differences (e.g. at least six, from 0 V up to the rated potential difference of the lamp) reverse the connections to the power supply (or to the lamp) and repeat, to obtain readings for negative potential differences and currents repeat each reading and calculate a mean / check for anomalies - switch off between readings so the lamp does not overheat / do not exceed the rated potential difference of the lamp plot a graph of current (y-axis) against potential difference (x-axis) and draw a smooth curve Credit a correctly drawn circuit diagram. Do not credit a voltmeter in series or an ammeter in parallel, or a method that measures resistance directly with an ohmmeter.				
11.2	a curve (through the origin) whose gradient decreases as the potential difference increases or the current increases less and less steeply (an S-shaped curve when negative values are included)	allow the line is not straight / flattens out at higher potential differences do not accept a straight line through the origin		1	AO1 4.2.1.4
Total				7	
TOTAL FOR PAPER				100	