

GCSE

PHYSICS

Paper 2 Higher Tier

Mark scheme Practice Paper Series – Set 1 SGC/S1/SP/2H

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/2H. 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 4.5–4.8. 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 11.3 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	$(M =) 2.0 \times 0.30$	an answer of 0.60 scores 2 marks allow 2.0×30 (distance in cm)	1	AO2 4.5.4 MS 3c
	$(M =) \mathbf{0.60}$	allow 60 if the unit is given as N cm	1	AO2 4.5.4 MS 3c
	N m / newton metre	allow Nm allow N cm only with a numerical answer of 60 do not accept J or N/m the unit mark is otherwise independent of the calculation	1	AO1 4.5.4
01.2	$0.60 = 3.0 \times d$ or $(d =) 0.60 \div 3.0$	an answer of 0.20 scores 2 marks allow ECF from an incorrect answer to 01.1 allow a correct use of the principle of moments: $2.0 \times 0.30 = 3.0 \times d$	1	AO2 4.5.4 MS 3b MS 3c
	$(d =) \mathbf{0.20}$ (m)	allow 20 cm if the unit is changed an answer of 20 with the unit unchanged (m) scores 1 mark	1	AO2 4.5.4 MS 3b MS 3c
01.3	the weight of the rule acts at the pivot / the centre of mass of the rule is at the pivot, so the (perpendicular) distance from the pivot is zero (and the weight has no moment)	allow the weight acts through the pivot, so it has no turning effect allow the rule balances on the pivot before the weights are added / the moments of the weight of the parts of the rule on either side of the pivot are equal and opposite ignore the rule is light	1	AO2 4.5.1.3 4.5.4
01.4	the force on the teeth of gear B (from gear A) is the same size as the force on the teeth of gear A (from gear B)	allow the same force acts on both gears where the teeth meet	1	AO1 4.5.4
	(but) the force on gear B acts at a greater distance from its axle / gear B has a larger radius, so the moment (force $\times$ distance) is greater	allow the moment on gear B is three times the moment on gear A because its radius is three times as large (it has three times as many teeth) ignore references to the speed of the gears	1	AO1 4.5.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(atmospheric pressure) decreases (as the height increases)		1	AO3 4.5.5.2
	by a smaller amount for each 2 km increase in height / the decrease is not linear e.g. it falls by 22 kPa from 0 to 2 km but by only 11 kPa from 6 to 8 km	allow the pressure decreases less steeply at greater heights / the rate of decrease gets smaller the pattern may be stated, or shown by comparing the falls over two intervals (e.g. 22 kPa from 0 to 2 km but 11 kPa from 6 to 8 km) values that show only that the pressure decreases (e.g. 101 kPa at 0 km and 36 kPa at 8 km) gain the first mark only	1	AO3 4.5.5.2
02.2	the atmosphere is less dense at greater heights / there are fewer air molecules in a given volume (1) so there are fewer collisions of air molecules with a surface each second (1) or there is less air above a surface at greater heights (1) so the weight of the air above the surface is smaller (1)	1 mark for a reason and 1 mark for its linked consequence two reasons with no consequence score 1 mark allow the air is thinner for less dense ignore references to gravity being weaker	2	AO1 4.5.5.2
02.3	$(p =) 150 \times 1030 \times 9.8$	an answer of 75 705 scores 4 marks	1	AO2 4.5.5.1.2 MS 3c
	$(p =) 1\,514\,100$ (Pa)	allow 1.5×10^6 (Pa)	1	AO2 4.5.5.1.2 MS 3c
	$(F =) 1\,514\,100 \times 0.050$	allow ECF from an incorrect pressure	1	AO2 4.5.5.1.1 MS 3b MS 3c
	$(F =) \mathbf{75\,705}$ (N)	allow 75 700 or 76 000 or 7.6×10^4 (N) allow 75 000 (N) from a pressure rounded to 1.5×10^6 Pa an answer of 80 755 or 81 000 (N) (atmospheric pressure added) scores 3 marks an answer of 30 282 000 (pressure $\div$ area) scores 2 marks	1	AO2 4.5.5.1.1 MS 3b MS 3c
02.4	the pressure (in the water) increases with depth		1	AO1 4.5.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	so the pressure (and force) on the bottom of the submarine is greater than the pressure (and force) on the top , giving a resultant upward force	allow the water pushes up on the bottom surface with a greater force than it pushes down on the top surface	1	AO1 4.5.5.1.2
Total			10	
03.1	in a closed system , the total momentum before an event is equal to the total momentum after the event	allow isolated system for closed system allow (total) momentum before a collision or explosion = (total) momentum after ignore 'momentum is conserved' on its own	1	AO1 4.5.7.2
03.2	the card on glider A blocks / interrupts the light beam as it passes through the light gate and the data logger measures the time for which the beam is blocked	allow the data logger records how long it takes the card to pass through the gate	1	AO1 4.5.6.1.2
	velocity = length of the card ÷ time	allow the data logger calculates the velocity from the length of the card and the time	1	AO1 4.5.6.1.2
03.3	total momentum before = $(0.30 \times 0.50) - (0.20 \times 0.20) = 0.11$ (kg m/s)	an answer of 0.22 (m/s) to the right scores 3 marks the momentum of glider B must be subtracted, because it moves in the opposite direction	1	AO2 4.5.7.1 4.5.7.2 MS 3c
	$(v =) 0.11 \div (0.30 + 0.20) = \mathbf{0.22}$ (m/s)	allow ECF from an incorrect total momentum that combines the momenta of both gliders, divided by 0.50 an answer of 0.38 (the two momenta added) scores 1 mark for the calculation an answer of 0.30 (glider B ignored) scores 0 marks for the calculation	1	AO2 4.5.7.2 MS 3b MS 3c
	(direction:) to the right / the direction glider A was moving	this mark can be awarded for a correct direction from any positive total momentum	1	AO2 4.5.7.2
03.4	friction is an external force (on the gliders) or friction would slow the gliders down / reduce their momentum		1	AO3 4.5.7.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(so with very little friction) the system is (almost) closed , so the total momentum before and after the collision should be the same / the results can be used to test conservation of momentum	allow otherwise the velocity measured after the collision would be too low (and momentum would not appear to be conserved)	1	AO3 4.5.7.2
Total			8	
04.1	20 Hz to 20 kHz	if more than one box is ticked, no mark	1	AO1 4.6.1.4
04.2	(s =) 1500×0.80	an answer of 600 scores 3 marks allow $0.80 \div 2 = 0.40$ (s) for the first mark and 1500×0.40 for the second mark	1	AO2 4.6.1.5 MS 3c
	(s =) 1200 (m)	this is the distance travelled by the pulse to the sea bed and back	1	AO2 4.6.1.5 MS 3c
	(depth =) $1200 \div 2 = 600$ (m)	allow ECF from an incorrect distance an answer of 1200 scores 2 marks	1	AO2 4.6.1.5 MS 3c
04.3	the frequency (of the sound wave) does not change		1	AO2 4.6.1.2
	(wave speed = frequency $\times$ wavelength, so as the speed increases) the wavelength increases	this mark can be awarded without the first mark allow the wavelength increases in proportion to the speed	1	AO2 4.6.1.2
04.4	S-waves are not detected in a large region on the opposite side of the Earth from the earthquake (only P-waves are detected there)	allow there is a shadow zone for S-waves	1	AO3 4.6.1.5
	S-waves are transverse and cannot travel through a liquid		1	AO1 4.6.1.5
	so the S-waves cannot pass through the outer core, which shows that the outer core must be (a) liquid	allow P-waves are detected on the opposite side but S-waves are not, so the outer core transmits longitudinal waves but not transverse waves ignore P-waves travel through solids and liquids / P-waves are detected on the opposite side, on its own ignore references to the inner core	1	AO3 4.6.1.5
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$(\Delta v \Rightarrow) 30 - (-20) = 50 \text{ (m/s)}$ or change in momentum = $0.058 \times 50 = 2.9 \text{ (kg m/s)}$	an answer of 580 scores 3 marks the change in velocity must take the change in direction into account allow -50 (m/s) or -2.9 (kg m/s)	1	AO2 4.5.7.3 MS 3b MS 3c
	$(F \Rightarrow) 0.058 \times 50 \div 0.0050$ or $(F \Rightarrow) 2.9 \div 0.0050$	allow ECF from an incorrect change in velocity or from a mass not converted to kg	1	AO2 4.5.7.3 MS 3b MS 3c
	$(F \Rightarrow) \textbf{580 (N)}$	allow -580 (N) an answer of 116 (Δv taken as 10 m/s) scores 2 marks an answer of 580 000 (mass not converted to kg) scores 2 marks	1	AO2 4.5.7.3 MS 3b MS 3c
05.2	the airbag increases the time taken for the driver's head to stop / for the momentum of the head to become zero	allow the head slows down over a longer time	1	AO1 4.5.7.3
	the change in momentum (of the head) is the same , so the rate of change of momentum is smaller		1	AO1 4.5.7.3
	force = rate of change of momentum, so the force on the head is smaller	allow $F = m\Delta v/\Delta t$, and Δt increases, so F decreases, for this mark ignore the airbag is soft / cushions the head do not accept the airbag absorbs the force	1	AO1 4.5.7.3
Total			6	
06.1	(distance = area under the graph $\Rightarrow$) 50×20	an answer of 1000 scores 2 marks	1	AO2 4.5.6.1.5 MS 4f
	(distance $\Rightarrow$) 1000 (m)	allow 1 km	1	AO2 4.5.6.1.5 MS 4f
06.2	(air resistance = weight = $80 \times 9.8 \Rightarrow$) 784 (N)	allow 780 (N) an answer of 784 (N) with no reason scores 1 mark	1	AO2 4.5.1.3 MS 3c
	(reason:) the velocity is constant at 30 s / the skydiver is at terminal velocity, so the resultant force is zero (and the air resistance is equal to the weight)	allow the forces are balanced allow the gradient is zero at 30 s this mark can be awarded with an incorrect weight	1	AO2 4.5.6.2.1

Question	Answers		Extra information	Mark	AO / Spec. Ref.
06.3	Level 3 (5–6 marks)		A detailed and coherent explanation of the motion in all four stages (speeding up; falling at terminal velocity; slowing down after the parachute opens; falling at a lower terminal velocity). The changes in velocity are clearly linked to the size of the air resistance compared with the weight (the resultant force).	6	AO1 4.5.6.1.5 4.5.6.2.1
	Level 2 (3–4 marks)		An explanation of the motion in at least two of these stages, with some correct references to the forces, for example air resistance increasing with speed until it is equal to the weight. There may be gaps or some lack of linking.		
	Level 1 (1–2 marks)		Simple statements that describe the motion (for example speeds up, constant speed, slows down) or identify the forces, with little or no link between the forces and the motion.		
	0 marks		No relevant content.		
	Indicative content Description (from Figure 5) 0 to about 15 s: the velocity increases, but the gradient (acceleration) decreases - about 15 s to 40 s: constant (terminal) velocity of 50 m/s 40 s to about 45 s: the velocity decreases rapidly (deceleration) - after about 45 s: a constant, lower (terminal) velocity of 5 m/s Explanation - at 0 s the only force is the weight (there is no air resistance), so the acceleration is 9.8 m/s^2 - as the velocity increases, the air resistance increases - so the resultant force (weight – air resistance) decreases and the acceleration decreases - when the air resistance is equal to the weight, the resultant force is zero, so the skydiver falls at a constant (terminal) velocity - opening the parachute increases the surface area, so the air resistance increases and becomes greater than the weight - the resultant force is upwards, so the skydiver decelerates - as the velocity decreases, the air resistance decreases until it is equal to the weight again - the resultant force is zero again, so the skydiver falls at a new, lower terminal velocity Credit drag or friction for air resistance. To reach Level 3 the answer must explain the slowing down after the parachute opens in terms of the air resistance being greater than the weight. Do not credit statements that the skydiver moves upwards when the parachute opens.				
Total				10	
07.1	one side of each wavefront reaches / enters the glass before the rest of the wavefront	allow references to the left-hand and right-hand sides of the wavefronts in Figure 6	1	AO1 4.6.2.2	
	that part of the wavefront slows down first, while the rest is still travelling faster in the air		1	AO1 4.6.2.2	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(so) the wavefront changes direction / the light bends towards the normal	ignore the light is attracted or pulled by the glass	1	AO1 4.6.2.2
07.2	an alternating current is induced / created in the aerial (or the receiver circuit)	allow a.c. for alternating current allow an alternating potential difference is induced allow the electrons in the aerial oscillate	1	AO1 4.6.2.3
	with the same frequency as the radio waves		1	AO1 4.6.2.3
07.3	96 MHz = 9.6×10^7 Hz	an answer of 3.1 scores 3 marks	1	AO2 4.6.1.2 MS 1b
	$(\lambda =) (3.0 \times 10^8) \div (9.6 \times 10^7)$	allow ECF from an incorrect conversion	1	AO2 4.6.1.2 MS 1b MS 3b
	$(\lambda =) \mathbf{3.1}$ (m)	allow 3.125 or 3.13 (m) an answer of 3 125 000 or 3.1×10^6 (m) (96 used as the frequency in Hz) scores 2 marks	1	AO2 4.6.1.2 MS 1b MS 3b
07.4	a correct comparison using the data, e.g. - the CT scan dose is 400 times the dose from a chest X-ray - the CT scan dose is about 3 times the yearly background dose / about 3 years of background radiation	allow the CT dose is much larger than a chest X-ray but similar to (a few) years of background radiation	1	AO3 4.6.2.3 MS 1c
	the increase in risk is small, and the benefit of the scan (e.g. diagnosing an illness so it can be treated) outweighs the risk	ignore the scan is safe	1	AO3 4.6.2.3
Total			10	
08.1	out of the page	if more than one box is ticked, no mark	1	AO2 4.7.2.2
08.2	5.0 cm = 0.050 m and 36 mN = 0.036 N	an answer of 0.30 scores 3 marks (the unit is marked separately)	1	AO2 4.7.2.2 MS 1b
	0.036 = $B \times 2.4 \times 0.050$ or $(B =) 0.036 \div (2.4 \times 0.050)$	allow ECF from incorrect conversions	1	AO2 4.7.2.2 MS 3b MS 3c
	$(B =) \mathbf{0.30}$	an answer of 0.003 (5.0 cm not converted) or 300 (36 mN not converted) scores 2 marks	1	AO2 4.7.2.2 MS 3b MS 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	T / tesla	allow N/(A m) the unit mark is independent of the calculation	1	AO1 4.7.2.2
08.3	there is a current in sides AB and CD in a magnetic field, so there is a force on each side (the motor effect)	allow the magnetic field of the current (in the coil) interacts with the field of the magnets (giving a force)	1	AO1 4.7.2.3
	the current in AB is in the opposite direction to the current in CD		1	AO1 4.7.2.3
	so the forces on AB and CD are in opposite directions (upwards on AB, downwards on CD)	allow one side is pushed up and the other side is pushed down allow the direction of the forces is given by Fleming's left-hand rule	1	AO1 4.7.2.3
	(the two forces) produce a turning effect , so the coil rotates (about its axle)	allow the split-ring commutator reverses the current in the coil every half turn so that the coil keeps turning in the same direction, for this mark ignore the magnets attract or repel the coil	1	AO1 4.7.2.3
Total			9	
09.1	(magnet held stationary:) the reading is zero / the needle returns to zero	allow there is no (induced) current	1	AO2 4.7.3.1
	(magnet pulled out:) the needle moves to the left / in the opposite direction (to when the magnet was pushed in)	ignore references to the size of the deflection	1	AO2 4.7.3.1
09.2	$230 \div 12 = 2300 \div n_s$ or $(n_s =) 2300 \times 12 \div 230$	an answer of 120 scores 2 marks	1	AO2 4.7.3.4 MS 3b MS 3c
	$(n_s =) \mathbf{120}$		1	AO2 4.7.3.4 MS 3b MS 3c
09.3	$230 \times I_p = 12 \times 2.3$ or $(I_p =) 12 \times 2.3 \div 230$	an answer of 0.12 scores 2 marks allow $(I_p =) 2.3 \times 120 \div 2300$ (using the turns ratio), with ECF from 09.2	1	AO2 4.7.3.4 MS 3b MS 3c
	$(I_p =) \mathbf{0.12}$ (A)	an answer of 44 (the potential differences inverted) scores 0 marks	1	AO2 4.7.3.4 MS 3b MS 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	a direct current produces a constant / unchanging magnetic field (in the iron core)	allow an alternating current produces a changing magnetic field, for this mark allow d.c. for direct current	1	AO1 4.7.3.4
	so the magnetic field through the secondary coil does not change, so no potential difference is induced across the secondary coil	allow a potential difference is only induced (in the secondary coil) when the magnetic field changes allow no current is induced in the secondary coil	1	AO1 4.7.3.4
Total			8	
10.1	(it expands to become a) red super giant	do not accept red giant	1	AO1 4.8.1.2
	(it explodes as a) supernova		1	AO1 4.8.1.2
	(it becomes a) neutron star or (if it is massive enough) a black hole	the stages must be in the correct order for 3 marks allow the core that remains collapses to form a neutron star or a black hole	1	AO1 4.8.1.2
10.2	the direction of the satellite is continuously changing	allow gravity provides a force towards the centre of the orbit	1	AO1 4.8.1.3
	so its velocity is changing / acceleration is the rate of change of velocity	allow the resultant force causes acceleration / changes velocity do not accept centrifugal force	1	AO1 4.8.1.3
10.3	X	the reason marks can only be awarded if X is chosen	1	AO3 4.6.3.2 MS 4a
	the peak (maximum intensity) of the curve for X is at a shorter wavelength	allow the peak for X is nearer the blue end of the visible spectrum	1	AO3 4.6.3.2 MS 4a
	X emits radiation of greater intensity at every wavelength / the peak intensity for X is higher	allow X emits more radiation from each square metre	1	AO3 4.6.3.2 MS 4a
10.4	the speed is (directly) proportional to the distance	allow when the distance doubles, the speed doubles allow speed ÷ distance is constant (22 km/s per million light years) ignore a positive correlation / the further away, the faster, on its own	1	AO3 4.8.2 MS 1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.						
	(the more distant galaxies are moving away faster, which shows that) the universe / space is expanding		1	AO3 4.8.2						
	so (going back in time) the universe must have begun from a very small region that was extremely hot and dense	allow all the galaxies (all the matter) were once at the same point ignore there was an explosion, on its own	1	AO1 4.8.2						
Total			11							
11.1	a ray from the top of the object parallel to the principal axis , refracted at the lens so that it passes through F on the right-hand side	the rays may change direction at the centre line of the lens arrows on the rays are not needed	1	AO2 4.6.2.5 MS 5a MS 5c						
	a ray from the top of the object passing through the centre of the lens without changing direction	allow a ray from the top of the object through F on the left-hand side that leaves the lens parallel to the principal axis, for either of the first two marks	1	AO2 4.6.2.5 MS 5a MS 5c						
	the image drawn as an (inverted) arrow from the principal axis to where the rays meet: 6 squares to the right of the lens and 2 squares below the principal axis	the image must be drawn where two correct rays meet allow $\pm\frac{1}{2}$ square for the position of the image	1	AO2 4.6.2.5 MS 5a MS 5c						
11.2	the mirror is (very) smooth , so the light is reflected in a single direction (specular reflection)	allow all of the light is reflected at the same angle	1	AO1 4.6.2.6 RP 9						
	the paper is rough (on a small scale), so the light is scattered in many different directions (diffuse reflection)	allow the light is reflected in different directions by different parts of the surface do not accept the paper absorbs (all) the light	1	AO1 4.6.2.6 RP 9						
11.3	<table><tr><td>Level 3 (5–6 marks)</td><td>A detailed and coherent plan covering all the major steps is given. The steps are set out in a logical order that another person could follow to obtain valid results. The plan describes how the path of the ray through the block is recorded, how the angles are measured from the normal, and how the angle of incidence is changed over a suitable range with repeat readings.</td></tr><tr><td>Level 2 (3–4 marks)</td><td>The main steps of a method are given, with some relevant detail. The plan may not be in a completely logical order, or may be missing some detail, for example how the normal is drawn or how the path of the ray inside the block is found.</td></tr><tr><td>Level 1 (1–2 marks)</td><td>Simple statements about some relevant steps are made. The response lacks a logical structure and would not lead to valid results.</td></tr></table>	Level 3 (5–6 marks)	A detailed and coherent plan covering all the major steps is given. The steps are set out in a logical order that another person could follow to obtain valid results. The plan describes how the path of the ray through the block is recorded, how the angles are measured from the normal, and how the angle of incidence is changed over a suitable range with repeat readings.	Level 2 (3–4 marks)	The main steps of a method are given, with some relevant detail. The plan may not be in a completely logical order, or may be missing some detail, for example how the normal is drawn or how the path of the ray inside the block is found.	Level 1 (1–2 marks)	Simple statements about some relevant steps are made. The response lacks a logical structure and would not lead to valid results.		6	AO3 4.6.1.3 4.6.2.2 RP 9 WS 2.2
Level 3 (5–6 marks)	A detailed and coherent plan covering all the major steps is given. The steps are set out in a logical order that another person could follow to obtain valid results. The plan describes how the path of the ray through the block is recorded, how the angles are measured from the normal, and how the angle of incidence is changed over a suitable range with repeat readings.									
Level 2 (3–4 marks)	The main steps of a method are given, with some relevant detail. The plan may not be in a completely logical order, or may be missing some detail, for example how the normal is drawn or how the path of the ray inside the block is found.									
Level 1 (1–2 marks)	Simple statements about some relevant steps are made. The response lacks a logical structure and would not lead to valid results.									

Question	Answers		Extra information	Mark	AO / Spec. Ref.
	0 marks	No relevant content.			
	Indicative content - place the glass block on the white paper and draw around it with the pencil - draw a normal (at 90° to the surface) at the point where the ray will enter the block - in a darkened room, use the ray box to shine a narrow ray of light at the point where the normal meets the block - mark the path of the incident ray and of the ray leaving the block with small crosses (at least two on each ray) - remove the block and join the crosses with a ruler; join the point of entry to the point of exit to show the ray inside the block - use the protractor to measure the angle of incidence and the angle of refraction from the normal - repeat for a range of angles of incidence, e.g. 10° to 70° in steps of 10° repeat each angle of incidence (on a fresh sheet of paper) and calculate a mean angle of refraction - keep the same glass block and the same ray box (colour of light) - plot a graph of the angle of refraction against the angle of incidence - safety: the ray box lamp gets hot, so do not touch it while it is switched on Credit a correctly labelled diagram. To reach Level 3 the plan must state that both angles are measured from the normal and describe how the angle of incidence is changed over a suitable range. Do not credit measuring the angles from the surface of the block.				
Total				11	
TOTAL FOR PAPER				100	