

GCSE

COMBINED SCIENCE: TRILOGY

Physics Paper 2 Higher Tier

Mark scheme Practice Paper Series – Set 1 SGC/S1/P/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/P/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 Combined Science: Trilogy (8464) specification, Physics sections 6.5–6.7. 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 (question 02.4 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	0.8 (s)	allow 0.80 (s)	1	AO2 6.5.4.3.2 MS 4a
01.2	(s =) 20×0.8	an answer of 16 scores 2 marks allow ECF from an incorrect answer to 01.1	1	AO2 6.5.4.3.1 MS 3c
	(s =) 16 (m)		1	AO2 6.5.4.3.1 MS 3c
01.3	(a =) $20 \div 4.0$	an answer of 5 scores 2 marks an answer of 4.2 ($20 \div 4.8$) scores 1 mark	1	AO2 6.5.4.1.5 MS 4a MS 4d
	(a =) 5.0 (m/s^2)	allow -5.0 (m/s^2)	1	AO2 6.5.4.1.5 MS 4a MS 4d
01.4	any two from: - a wet / icy road (surface) - worn brakes / brakes in poor condition - worn tyres / tyres with little tread - a greater speed (of the car) - a greater mass of the car (e.g. more passengers or a heavy load)	allow a slippery road / rain, snow or leaves on the road allow tyres in poor condition / under-inflated tyres allow a smaller braking force ignore bad weather unless it is linked to the road surface do not accept factors that affect only the thinking distance, e.g. tiredness, alcohol, drugs, distractions	2	AO1 6.5.4.3.3
01.5	work is done by the friction (force) between the brakes and the wheels	allow friction between the brake pads and the wheel / disc allow friction (in the brakes) causes heating	1	AO1 6.5.4.3.4
	(this) reduces the kinetic energy of the car or energy is transferred from the kinetic (energy) store of the car to the thermal (energy) store of the brakes	allow kinetic energy is transferred to thermal energy / internal energy (of the brakes) ignore heat is produced / energy is lost, without reference to kinetic energy	1	AO1 6.5.4.3.4
Total			9	
02.1	the resultant force on the trolley is zero	if more than one box is ticked, no mark	1	AO1 6.5.4.2.1
02.2	(size =) 4.9 (N)		1	AO1 6.5.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(direction =) upwards	allow vertically up / away from the bench do not accept downwards	1	AO1 6.5.4.2.3
02.3	(a =) $1.2 \div 0.50$	an answer of 2.4 scores 2 marks	1	AO2 6.5.4.2.2 MS 3b MS 3c RP 19
	(a =) 2.4 (m/s^2)	an answer of 0.6 (1.2×0.50) or 0.42 ($0.50 \div 1.2$) scores 0 marks	1	AO2 6.5.4.2.2 MS 3b MS 3c RP 19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	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 mass of the trolley is changed over a suitable range, how the force is kept constant and how valid (repeated) measurements of acceleration are obtained.	6	AO3 6.5.4.2.2 RP 19 WS 2.2
	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 force is kept constant.		
	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.		
	0 marks	No relevant content.		
	Indicative content • measure the mass of the trolley (using a balance) • keep the hanging mass the same, so that the (accelerating) force stays the same • release the trolley from the same starting position each time • the card on the trolley passes through the light gate and the data logger calculates the acceleration • add masses to the trolley to increase its mass, e.g. 0.10 kg at a time • use at least five different masses • repeat each measurement (at least three times) and calculate a mean acceleration • keep other variables the same, e.g. the same bench and surface, the same position of the light gate, the same length of string • plot a graph of acceleration against the mass of the trolley to find the relationship • safety: put something soft (e.g. a box with padding) under the hanging masses and keep feet clear; stop the trolley before it hits the pulley Credit other correct, relevant points, e.g. using two light gates, or a stopwatch and metre rule, to determine the acceleration. To reach Level 3 the plan must state that the hanging mass (force) is kept constant, and describe how the mass of the trolley is changed over a suitable range with repeat readings.			
Total			11	
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 6.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
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 6.5.4.1.2
	velocity = length of the card ÷ time	allow the data logger calculates the velocity from the length of the card and the time	1	AO1 6.5.4.1.2
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 6.5.5.1 6.5.5.2 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 6.5.5.2 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 6.5.5.2
03.4	friction is an external force (on the gliders) or friction would slow the gliders down / reduce their momentum		1	AO3 6.5.5.2
	(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 6.5.5.2
Total			8	
04.1	a vertical line drawn from the tip of the arrow to the horizontal (dashed) line, forming a right-angled triangle	allow a correct rectangle of components	1	AO2 6.5.1.4 MS 5a
	the length of the horizontal side read or measured and converted using 5 N per square	e.g. 8.7 squares $\times$ 5 N	1	AO2 6.5.1.4 MS 5a

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	(horizontal component =) 43 (N)	allow 42 to 45 (N) an answer calculated with trigonometry ($50 \times \cos 30^\circ = 43.3$ N) with no construction on Figure 4 scores a maximum of 2 marks an answer of 25 (N) (the vertical component) scores 1 mark if the construction is correct	1	AO2 6.5.1.4 MS 5a
04.2	(constant speed in a straight line means) the sledge is not accelerating / its velocity is constant, so the resultant force on it is zero	allow reference to Newton's first law	1	AO1 6.5.4.2.1 6.5.1.4
	(so) the horizontal forces are balanced : the forward (horizontal) component of the pull equals the backward friction force	allow the forces in the direction of motion cancel out	1	AO1 6.5.4.2.1 6.5.1.4
04.3	($W =$) 43×15	an answer of 645 or 650 scores 2 marks allow ECF from an incorrect answer to 04.1	1	AO2 6.5.2 MS 3c
	($W =$) 645 (J)	allow 650 (J) from 43.3 N allow 630 to 675 (J) an answer of 750 (the whole 50 N used) scores 0 marks	1	AO2 6.5.2 MS 3c
Total			7	
05.1	a tangent drawn to the curve at 6.0 s		1	AO2 6.5.4.1.4 MS 4e
	gradient of the tangent calculated using values read from it, e.g. $(63 - 0) \div (10 - 3)$		1	AO2 6.5.4.1.4 MS 4e
	(speed =) 9.0 (m/s)	allow 8.0 to 10.0 (m/s) an answer of 4.5 ($27 \div 6.0$, the mean speed) scores 0 marks	1	AO2 6.5.4.1.4 MS 4e
05.2	the direction of the motorbike is (continuously) changing		1	AO1 6.5.4.1.3
	(so) its velocity is changing (and acceleration is the rate of change of velocity)	allow velocity is a vector, so a change of direction is a change of velocity allow there must be a resultant force (towards the centre), so the motorbike accelerates	1	AO1 6.5.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$20^2 - 8.0^2 = 2 \times a \times 140$	an answer of 300 scores 4 marks	1	AO2 6.5.4.1.5 MS 3b MS 3c
	(a =) $336 \div 280 = \mathbf{1.2}$ (m/s ²)		1	AO2 6.5.4.1.5 MS 3b MS 3c
	(F =) 250×1.2	allow ECF from an incorrect acceleration	1	AO2 6.5.4.2.2 MS 3c
	(F =) 300 (N)	an answer of 357 (u ² not subtracted: a = 1.43 m/s ²) scores 2 marks	1	AO2 6.5.4.2.2 MS 3c
Total			9	
06.1	(length of one loop =) $1.20 \div 4 = 0.30$ (m)	an answer of 0.60 scores 2 marks	1	AO2 6.6.1.2 MS 1a RP 20
	(wavelength =) $2 \times 0.30 = \mathbf{0.60}$ (m)	an answer of 0.30 scores 1 mark	1	AO2 6.6.1.2 MS 1a RP 20
06.2	(v =) 40×0.60	an answer of 24 scores 2 marks allow ECF from an incorrect answer to 06.1	1	AO2 6.6.1.2 MS 3c RP 20
	(v =) 24 (m/s)		1	AO2 6.6.1.2 MS 3c RP 20
06.3	8 (loops)	8 with no explanation scores 1 mark	1	AO3 6.6.1.2 RP 20
	wave speed = frequency $\times$ wavelength and the speed is constant, so doubling the frequency halves the wavelength (to 0.30 m)	allow the wavelength is inversely proportional to the frequency	1	AO3 6.6.1.2 RP 20
	(so) each loop is now 0.15 m long and $1.20 \div 0.15 = 8$ or twice as many half-wavelengths fit on the same length of string	allow ECF from an incorrect answer to 06.1	1	AO3 6.6.1.2 RP 20
Total			7	
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 7	1	AO1 6.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	that part of the wavefront slows down first, while the rest is still travelling faster in the air		1	AO1 6.6.2.2
	(so) the wavefront changes direction / the light bends towards the normal	ignore the light is attracted or pulled by the glass	1	AO1 6.6.2.2
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 6.6.2.3
	with the same frequency as the radio waves		1	AO1 6.6.2.3
07.3	96 MHz = 9.6×10^7 Hz	an answer of 3.1 scores 3 marks	1	AO2 6.6.1.2 MS 1b
	$(\lambda =) (3.0 \times 10^8) \div (9.6 \times 10^7)$	allow ECF from an incorrect conversion	1	AO2 6.6.1.2 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 6.6.1.2 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 6.6.2.3 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 6.6.2.3
Total			10	
08.1	out of the page	if more than one box is ticked, no mark	1	AO2 6.7.2.2
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 6.7.2.2 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 6.7.2.2 MS 3b MS 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	($B =$) 0.30	an answer of 0.003 (5.0 cm not converted) or 300 (36 mN not converted) scores 2 marks	1	AO2 6.7.2.2 MS 3b MS 3c
	T / tesla	allow N/(A m) the unit mark is independent of the calculation	1	AO1 6.7.2.2
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 6.7.2.3
	the current in AB is in the opposite direction to the current in CD		1	AO1 6.7.2.3
	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 6.7.2.3
	(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 6.7.2.3
Total			9	
TOTAL FOR PAPER			70	