GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier Physics Paper 2

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

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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/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 section 6.5–6.7 (Paper 2 may also draw on section 6.1). 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 02.1 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>(at least two) concentric circles centred on the wire</td><td>circles must not touch each other or the wire
allow approximately circular</td><td>1</td><td>AO1
6.7.2.1</td></tr>
<tr><td></td><td>arrows anticlockwise on the circles</td><td>the direction mark depends on circles being drawn
at least one arrow is needed and all arrows must be anticlockwise
any clockwise arrow loses this mark</td><td>1</td><td>AO1
6.7.2.1</td></tr>
<tr><td>01.2</td><td>Q</td><td></td><td>1</td><td>AO2
6.7.1.2, 6.7.2.1</td></tr>
<tr><td></td><td>the field lines outside the solenoid point away from end Q</td><td>the reason mark depends on Q being chosen
allow the field lines go from Q to P outside the solenoid
allow the field inside the solenoid points towards Q</td><td>1</td><td>AO2
6.7.1.2, 6.7.2.1</td></tr>
<tr><td>01.3</td><td>the field lines (inside the solenoid) are parallel</td><td>allow straight lines in the same direction</td><td>1</td><td>AO1
6.7.1.2, 6.7.2.1</td></tr>
<tr><td></td><td>the field lines are equally spaced</td><td>allow the same distance apart</td><td>1</td><td>AO1
6.7.1.2, 6.7.2.1</td></tr>
<tr><td>01.4</td><td>iron core: the magnetic field becomes stronger</td><td>allow the solenoid becomes a stronger magnet</td><td>1</td><td>AO1
6.7.2.1</td></tr>
<tr><td></td><td>reversing the current: the direction of the magnetic field reverses</td><td>allow the poles swap / P becomes the north pole</td><td>1</td><td>AO1
6.7.2.1</td></tr>
<tr><td colspan="3">Total</td><td>8</td><td></td></tr>
<tr><td>02.1</td><td colspan="2"><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
6.6.2.2
RP</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	Indicative content • place the plates the same distance from the heater • switch on the heater • record the starting temperature of each plate • record the temperature of each plate at regular intervals, e.g. every minute • for the same time, e.g. 5 minutes • calculate the temperature increase of each plate • the plate with the greater temperature increase in the same time is the better absorber • use plates of the same metal, size and thickness • the plates should start at the same temperature • repeat, swapping the positions of the plates • do not touch the heater or the plates when they are hot To reach Level 3 the method must keep both plates the same distance from the heater (this may be implied by using the set-up shown in the figure), measure the temperature of each plate over the same time and compare the temperature increases.			
02.2	**A** / matt black		1	AO3 6.6.2.2 RP
	its temperature increased more than plate **B** in the same time, e.g. 14.0 °C compared with 4.4 °C in 5 minutes	the reason mark depends on **A** being chosen the reason must use data from the table allow a comparison of any pair of temperatures at the same time	1	AO3 6.6.2.2 RP
02.3	$\Delta E = 0.080 \times 900 \times 14.0 = 1008$ (J)	an answer of 3.36 (W) scores **3** marks	1	AO2 6.1.1.3, 6.1.1.4 MS 3c
	time = 5 × 60 = 300 (s)		1	AO2 6.1.1.3, 6.1.1.4 MS 3c
	P = 1008 ÷ 300 = **3.36** (W)	allow 3.4 (W) an answer of 201.6 (W) (time in minutes) scores **2** marks allow ECF from an incorrect energy	1	AO2 6.1.1.3, 6.1.1.4 MS 3c
02.4	as plate **A** gets hotter it transfers energy to the surroundings at a greater rate	allow it emits more (infrared) radiation as its temperature increases allow it loses more energy to the air ignore it absorbs less radiation	1	AO3 6.6.2.2 RP
		Total	**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	the total mass (of the trolley, the hanger and the masses) stays the same	allow the mass being accelerated is constant	1	AO1 6.5.4.2.2 RP
	so that the mass is a control variable / only the force changes	allow so that it is a fair test allow so that any change in acceleration is caused only by the change in force	1	AO3 6.5.4.2.2 RP
03.2	a = (0.70 − 0.40) ÷ 0.60	an answer of 0.50 (m/s^2) scores **2** marks	1	AO2 6.5.4.1.5 RP MS 3c
	a = **0.50** (m/s^2)	allow 0.5 (m/s^2) an answer of 1.2 (m/s^2) (0.70 ÷ 0.60) scores 0 marks	1	AO2 6.5.4.1.5 RP MS 3c
03.3	both points plotted correctly	allow ± half a small square	1	AO2 6.5.4.2.2 RP MS 4a, 4c
	a straight line of best fit passing through all the points	the line must not be forced through the origin	1	AO3 6.5.4.2.2 RP MS 4c
03.4	gradient = (0.90 − 0.10) ÷ (0.50 − 0.10) = 2.0	allow a gradient in the range 1.9 to 2.1 allow any correct pair of values read from the line	1	AO3 6.5.4.2.2 RP MS 4d
	total mass = 1 ÷ gradient	allow $F = ma$ so the gradient is 1 ÷ mass allow ECF from an incorrect gradient do not accept mass = force ÷ acceleration for a single result, e.g. 0.50 ÷ 0.90 = 0.56 kg	1	AO3 6.5.4.2.2 RP MS 3b
	total mass = **0.50** (kg)	allow 0.48 to 0.53 (kg) an answer of 0.50 (kg) scores **3** marks an answer of 2.0 (kg) (the gradient) scores 1 mark a gradient of 0.50 (change in force ÷ change in acceleration) used directly as the mass scores **2** marks max	1	AO3 6.5.4.2.2 RP MS 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	friction (acts on the trolley)	allow a force of about 0.05 N is needed to overcome friction before the trolley accelerates allow air resistance / friction in the pulley allow the bench was not tilted to compensate for friction ignore human error / zero error	1	AO3 6.5.4.2.2 RP
		Total	**10**	
04.1	X-rays are transmitted by / pass through soft tissue	allow skin / muscle / flesh for soft tissue	1	AO1 6.6.2.2, 6.6.2.4
	but are absorbed by bone	allow bones absorb more X-rays than soft tissue for **2** marks ignore bones show up on the image / X-rays can see bones	1	AO1 6.6.2.2, 6.6.2.4
04.2	X-rays are ionising radiation	allow X-rays can remove electrons from atoms	1	AO1 6.6.2.3
	ionisation can damage DNA / cause mutations, which can lead to cancer	allow changes to genes	1	AO1 6.6.2.3
	microwaves are non-ionising and transfer energy to the thermal energy store of tissue when absorbed	allow microwaves heat body tissue rather than directly ionising atoms	1	AO1 6.6.2.3
04.3	they travel at the same speed (in a vacuum)	allow both travel at 3×10^8 m/s	1	AO1 6.6.2.1
	infrared radiation has a shorter wavelength (than microwaves)		1	AO1 6.6.2.1
	wave speed = frequency × wavelength, so when the speed is the same a higher frequency means a shorter wavelength	allow wavelength is inversely proportional to frequency (for the same speed)	1	AO2 6.6.1.2
		Total	**8**	
05.1	$W = 0.050 \times 9.8$	an answer of 0.49 (N) scores **2** marks	1	AO2 6.5.1.3 MS 1a, 3c
	W = **0.49** (N)	an answer of 490 (N) (mass in g) scores 1 mark	1	AO2 6.5.1.3 MS 1a, 3c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	a = (5.0 − 3.9) ÷ 0.50	allow 1 mark for a change in speed of 1.1 m/s an answer of 0.38 (N) scores **5** marks	1	AO2 6.5.1.4, 6.5.4.1.5, 6.5.4.2.2 MS 3c
	a = 2.2 (m/s^2)		1	AO2 6.5.1.4, 6.5.4.1.5, 6.5.4.2.2 MS 3c
	resultant force = 0.050 × 2.2 = 0.11 (N)	allow ECF from an incorrect acceleration an answer of 0.11 (N) scores **3** marks	1	AO2 6.5.1.4, 6.5.4.1.5, 6.5.4.2.2 MS 3c
	air resistance = weight − resultant force = 0.49 − 0.11	allow ECF from 05.1	1	AO2 6.5.1.4, 6.5.4.1.5, 6.5.4.2.2 MS 3c
	air resistance = **0.38** (N)		1	AO2 6.5.1.4, 6.5.4.1.5, 6.5.4.2.2 MS 3c
05.3	as the speed (of the parachute) increases, the air resistance increases	allow drag for air resistance throughout	1	AO1 6.5.4.1.5, 6.5.4.2.1
	until the air resistance is equal to the weight	allow the forces become balanced	1	AO1 6.5.4.1.5, 6.5.4.2.1
	so the resultant force is zero (and the acceleration is zero)	allow the parachute has reached terminal velocity for this mark only if the resultant force is zero is implied do not accept air resistance is greater than the weight	1	AO1 6.5.4.1.5, 6.5.4.2.1
		Total	**10**	
06.1	the acceleration decreases	allow the acceleration decreases to zero (at 20 s) do not accept the train decelerates / slows down	1	AO3 6.5.4.1.5 MS 4a
	because the gradient of the graph decreases	allow the line gets less steep the reason mark depends on the first mark	1	AO3 6.5.4.1.5 MS 4a
06.2	distance = area under the graph (between 0 and 20 s)	allow evidence of counting squares	1	AO2 6.5.4.1.5 MS 4f
	1 small square represents 1 m	allow 1 large square represents 25 m	1	AO2 6.5.4.1.5 MS 4f

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	distance = **213** (m)	an answer in the range 205 to 220 (m) scores **3** marks an answer in the range 200 to 204 (m) or 221 to 225 (m) scores **2** marks an answer of 160 (m) (area of a triangle) scores 1 mark	1	AO2 6.5.4.1.5 MS 4f
06.3	deceleration = 16 ÷ 20 = 0.80 (m/s^2)	an answer of 1.6×10^5 (N) scores **3** marks	1	AO2 6.5.4.1.5, 6.5.4.2.2 MS 1b, 3c, 4d
	$F = 2.0 \times 10^5 \times 0.80$	allow ECF from an incorrect deceleration	1	AO2 6.5.4.1.5, 6.5.4.2.2 MS 1b, 3c, 4d
	F = **1.6×10^5** (N)	allow 160 000 (N) ignore a minus sign	1	AO2 6.5.4.1.5, 6.5.4.2.2 MS 1b, 3c, 4d
		Total	**8**	
07.1	0 (kg m/s)	allow zero	1	AO1 6.5.5.2
07.2	momentum of **B** = 0.80 × 0.60 = 0.48 (kg m/s)	allow total momentum after = 0 an answer of 0.40 (m/s) scores **3** marks	1	AO2 6.5.5.1, 6.5.5.2 MS 3b, 3c
	$1.2 \times v = 0.48$	allow momentum of **A** = momentum of **B** allow ECF from an incorrect momentum of **B**	1	AO2 6.5.5.1, 6.5.5.2 MS 3b, 3c
	v = **0.40** (m/s)	ignore a minus sign or a direction	1	AO2 6.5.5.1, 6.5.5.2 MS 3b, 3c
07.3	momentum is conserved, so the total momentum after the plunger is released is still zero		1	AO1 6.5.5.2
	so the momentum of **A** must be equal in size and opposite in direction to the momentum of **B**	allow the trolleys exert equal and opposite forces on each other (1) so they accelerate in opposite directions (1)	1	AO2 6.5.5.2
		Total	**6**	
08.1	the motor effect		1	AO1 6.7.2.2
08.2	the force is (directly) proportional to the current	allow as the current increases the force increases for 1 mark	1	AO3 6.7.2.2 MS 1c

Question	Answers	Extra information	Mark	AO / Spec. Ref.
	use of data, e.g. doubling the current from 2.0 A to 4.0 A (approximately) doubles the force from 19.8 mN to 40.0 mN	allow force ÷ current is (approximately) constant / about 10 mN per amp zero current giving zero force on its own does not demonstrate proportionality	1	AO3 6.7.2.2 MS 1c
08.3	F = 0.0400 (N)	an answer of 0.020 (m) scores **3** marks	1	AO2 6.7.2.2 MS 1a, 3b, 3c
	0.0400 = 0.50 × 4.0 × l	allow l = 0.0400 ÷ (0.50 × 4.0) allow ECF from an incorrect conversion of the force	1	AO2 6.7.2.2 MS 1a, 3b, 3c
	l = **0.020** (m)	allow 0.02 (m) an answer of 20 (m) (force in mN) scores **2** marks	1	AO2 6.7.2.2 MS 1a, 3b, 3c
08.4	the reading decreased to less than 84.36 g	allow it decreased to less than the reading with no current allow it fell below 84.36 g by the same amount as it had risen above it do not accept it returned to 84.36 g / to the original reading	1	AO2 6.5.4.2.3, 6.7.2.2
	the force on the wire reverses, so the (equal and opposite) force on the magnet is now upwards	allow the force on the magnet reverses / acts upwards allow reference to Newton's third law for 'equal and opposite' (on its own it does not score)	1	AO1 6.7.2.2
		Total	**8**	
		TOTAL FOR PAPER	**70**	