Higher

GCSE

Physics A Gateway

J249/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2022

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1.   Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.

2.   Make sure that you have read and understood the mark scheme and the question paper for this unit. These are available in RM Assessor.

3.   Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

MARKING

1.   Mark strictly to the mark scheme.

2.   Marks awarded must relate directly to the marking criteria.

3.   The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4.   If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the RM Assessor messaging system.

5.   Work crossed out:

      a.   where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

      b.   if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6.   Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7.   There is a NR (No Response) option. Award NR (No Response)

      -     if there is nothing written at all in the answer space

      -     OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')

      -     OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

      Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8.   The RM Assessor **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

      If you have any questions or comments for your Team Leader, use the phone, the RM Assessor messaging system, or email.

9.   Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response question on this paper is **18.**

11.   Annotations available in RM Assessor

Annotation	Meaning
✔	Correct response
✘	Incorrect response
⌃	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

12.   Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13.   **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives

- the question paper

- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9-1) in Physics A:

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

For answers to Section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	D ✓	1	2.1	
2	D ✓	1	1.2	
3	B ✓	1	2.1	
4	D ✓	1	1.1	
5	B ✓	1	1.1	
6	C ✓	1	1.2	
7	B ✓	1	2.1	
8	A ✓	1	2.1	
9	C ✓	1	1.1	
10	C ✓	1	2.1	
11	A ✓	1	1.2	
12	C ✓	1	2.1	
13	A ✓	1	2.1	
14	B ✓	1	1.1	
15	D ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)		**Any four from:** Mark two points (a distance apart / along the road) ✓ Measure distance (between those two points) ✓ Instrument to measure distance (between those two points) using tape measure / trundle wheel ✓ Measure time (between those two points) ✓ Instrument to measure time taken (between those two points) using a stopwatch / stop clock / timer / AW ✓	4	4 x 1.2	**ALLOW** set distance **IGNORE** ruler **ALLOW** metre rule **IGNORE** speed guns / camera **IGNORE** mobile phone on its own **IGNORE** light gates **IGNORE** calculations of mean speed
	(b)	(i)	A Because it has the steepest gradient / line / slope or greatest increase in speed in same time / smallest time for same increase in speed ✓	1	2.1	No mark for just A **ALLOW** A = 0.13 m / s² **and** B = 0.08 m / s² **ALLOW** velocity increases quicker
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.08 award 3 marks** Acceleration = gradient ✓ 2.0 / 25 ✓ 0.08 (m/s²) ✓	3	 1.2 2.1 2.1	**ALLOW** acceleration = change in velocity / time **ALLOW** any two suitable numbers from the graph **ALLOW** 2 marks for an answer of 0.13(33) – candidate mistakenly calculated acceleration of car A.
		(iii)	(Motor in Car A) is more powerful / transfers energy faster / has a motor which supplies a larger force / ORA ✓	1	1.2	**ALLOW** idea that there is more drag / friction (acting on car B) / (car A) is more streamlined / has tyres with better grip **ALLOW** (Car A has) a larger / different current / p.d. / (driving) force **ALLOW** ECF choice of car from (b)(i) **IGNORE** bigger battery

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.6 award 3 marks** current = potential difference / resistance ✓ 6.0 / 10 ✓ 0.6 (A) ✓	3	1.2 2.1 2.1	**ALLOW** p.d. / pd for potential difference
		(ii)	3 (V)	1	2.2	
	(b)	(i)	Current increases ✓ (Because total) resistance (in the circuit) decreases ✓	2	3.1a 2.2	**ALLOW** Current has alternative path / round the lamp / does not pass through lamp **ALLOW** lamp is short-circuited **ALLOW** p.d. across lamp has decreased **ALLOW** two marks for correct calculation of 1.2 A
		(ii)	Potential difference increases ✓ **Any one from:** (Because) current through the resistor has increased ✓ (Because) the p.d. from the cells is not split across two components / not shared with the lamp / AW ✓	2	3.1a 2.2	**ALLOW ECF** for current decreases in (b)(i) one mark for potential difference decreases and one mark for current in resistor has decreased
		(iii)	0 (V)	1	2.2	**ALLOW** 3 (V) if answer to (a)(ii) = 0 (V)

Question	Answer	Marks	AO element	Guidance
18	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Comparisons between the two sets of data and with the manufacturer's data in terms of accuracy **AND** comparison in precision of the two sets of data. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Comparisons between the accuracy of the two sets of data or with the manufacturer's data **AND** a simple comparison in precision of the two sets of data **OR** A comparison between the accuracy of the two sets of data or with the manufacturer's data **AND** comparison in precision of the two sets of data *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	1 x 3.1a 1 x 3.1b 2 x 3.2a 2 x 3.2b	**AO3.1a/3.1b Analyse information to interpret and evaluate the accuracy and precision of the data.** For example • P has taken 3 readings, but Q has taken 5 readings • Different lengths of wire have been used • P lengths recorded to nearest cm; Q lengths recorded to nearest mm or different sig figs /decimal places • Resistance data has been recorded to different numbers of sig figs/decimal places • Both sets of data have repeat readings and calculated the mean **AO3.2a Analyse information to make judgements about the accuracy and precision of the data.** For example • P has unequal intervals / Q has equal intervals (10cm) between the readings • P has small range (9cm), Q has large range (50cm) • P has recorded their resistance data to zero decimal places • Q has repeat resistance readings closer together • For Q, resistance per length are similar • Reading for P 15 cm mean resistance is more than for 19 cm

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) There is a simple comparison between the two sets of data or with the manufacturer's data **OR** a simple explanation is given about accuracy or precision *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*			**AO3.2b Analyse information to draw conclusions about the accuracy and precision of the data.** For example: • Q is more accurate since resistance per unit length is closer to the true value of 1.2 Ω / cm • Q is more accurate as Q used longer lengths of wire (which reduces the heating effect) • Q's readings are more precise as the repeat readings are closer together

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	**Any three from:** small / tiny nucleus ✓ positively charged nucleus ✓ mass is concentrated in the nucleus ✓ most of atom is empty space ✓	3	3 x 1.1	**IGNORE** reference to electrons **ALLOW** maximum 2 marks for implying nucleus but not stating nucleus **ALLOW** atom has empty space
		(ii)	Previous models could not explain new observations / new evidence disproves old model / AW ✓	1	1.2	**ALLOW** (idea of) previous/plum pudding/Thomson's model did not fit with these observations **ALLOW** shows there is a nucleus / empty space **IGNORE** reference to neutrons (1932)
	(b)	(i)	(3 x 8 x 8 =) 192 (m³) ✓	1	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.3 / 2.30 / 2.304 award 3 marks** mass = density x volume ✓ 0.012 x 192 ✓ 2.3 / 2.30 / 2.304 (kg) ✓	3	 1.2 2.1 2.1	Possible ECF from 19(b)(i) Correct re-arrangement Correct substitution

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	Equal / 30N ✓ Opposite (direction) ✓	2	2 x 1.1	 **IGNORE** backwards
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (-)0.6 (m/s²) award 3 marks** $a = F / m$ ✓ 30 / 50 ✓ 0.6 (m / s²) ✓	3	 1.2 2.1 2.1	 Correct rearrangement of equation Correct substitution of numbers **IGNORE** sign **ALLOW** one mark for 0.75 (incorrect mass)
	(b)	(i)	Zero / 0 (kgm/s)	1	2.1	**IGNORE** units
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 80 (kg m / s) award 2 marks** = 40 x 2 = 80 (kg m / s)	2	2 x 2.1	 **IGNORE** sign
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = (-)1.6 award 3 marks** Momentum before = momentum after ✓ 80 = 50 V_B ✓ 1.6 (m/s) ✓	3	 1.2 2.1 2.1	**ALLOW** ECF from (b)(ii) but not from (b)(i) **ALLOW** $0 = (40 \times 2) + 50\ V_B$ **or** $0 = 80 + 50\ V_B$ **ALLOW** $V_B = -80/50$ **IGNORE** sign

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	force (exerted) on the wire / coil ✓ **or** interaction between the magnetic field around the wire and the (permanent) magnet / AW ✓	1	1.1	
		(ii)	clockwise ✓ (Fleming's) left hand rule ✓	2	2.2 1.2	**ALLOW** <u>left</u> hand side up / <u>right</u> hand side down
	(b)		**Any two from:** increase the current (in the coil) ✓ increase the number of coils ✓ increase the length of the coil (in the magnetic field) ✓ increase the strength of the magnet / magnetic field ✓	2	2 x 1.2	**ALLOW** increase potential difference / p.d. / voltage **IGNORE** size of magnet **IGNORE** (soft) iron core

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	**Any one from:** extensions / readings are close to the smallest measurement the ruler can make / AW ✓ rulers can only measure to the nearest mm ✓	1	3.3a	**ALLOW** extensions / readings are very small ✓ **ALLOW** difficult to measure extensions accurately with a ruler ✓
		(ii)	Use a larger mass / weight / force (to increase the extension) ✓	1	3.3b	**ALLOW** bigger for larger (BOD) **ALLOW** use springs with smaller <u>spring constant</u>s
	(b)	(i)	Correct point identified / point at 4 springs ✓ Correct new point plotted at (4, 0.6) ✓	2	3.2a 1.2	
		(ii)	As number of springs increases, extension decreases ✓ **or** extension is inversely proportional to the number of springs ✓✓	2	2 x 3.1a	**ALLOW** As the number of springs doubles, the extension halves ✓✓
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 50 award 5 marks** Correct reading from the graph of 1.6 cm ✓ Correct conversion to 0.016 m ✓ Spring constant = force / extension ✓ 0.8 / 0.016 ✓ 50 (N / m) ✓	5	 2.2 1.2 1.2 2.2 2.2	 **ALLOW ECF** 0.012 m for reading 1.2 cm from graph Correct rearrangement of equation **ECF** 0.8 / 0.012 **ALLOW** 4 marks for 0.5 or 5 or any other power of ten error **ALLOW ECF** 4 marks for 67 **ECF ALLOW** 3 marks for 0.67 or 6.7 or any other power of ten error
	(d)		R **and** As it requires the least force or weight to compress it (by a metre) / lowest spring constant✓	1	3.2b	No mark if S or T chosen **ALLOW** less stiff

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	1.12 (s)	1	1.2	
		(ii)	(Mistake) Mean for metal / 0.4444✓ (Correction) Calculate mean to two significant figures / 0.44 ✓	2	3.2a 3.3b	**ALLOW** correct reference to significant figures or decimal places **ALLOW** decimal places for significant figures **ALLOW** three significant figures / 0.444
		(iii)	No, as no-one else has completed the experiment / AW ✓	1	3.2b	**ALLOW** has not repeated the experiment with <u>different equipment</u> or <u>different techniques</u>
		(iv)	**Any one from:** Reduce random errors ✓ To see if the experiment was repeatable ✓ To check for anomalies / outliers ✓ To increase precision ✓	1	3.2a	**ALLOW** reduce errors **IGNORE** accurate / reliable / valid
	(b)	(i)	(1.12 ÷ 0.44) = 2.5 ✓	1	2.1	**ALLOW ECF** from (a)(i) **ALLOW** any number which rounds to 2.5 **ALLOW** 2.55
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.7 award 4 marks** (Mean) speed = distance / time ✓ = 1.2 / 0.44 ✓ = 2.73 ✓ = 2.7 ✓	4 1.2 2.1 2.1 1.2		**ALLOW ECF** for use of time = 1.12 s **ALLOW** 1.07 for two marks **ALLOW** 1.1 for three marks Correct re-arrangement **ALLOW** 1.2 / 0.444 or 1.2 / 0.4444 **ALLOW** 2.702 or 2.7002 or 2.$\dot{7}$ or 2.$\dot{7}\dot{2}$ or 2.72 **DO NOT ALLOW** 2.$\dot{7}$

Question			Answer	Marks	AO element	Guidance
	(c)		**Any three from:** falling magnet produces a changing magnetic field ✓ magnetic field / magnet induces a potential difference / current (in the copper / tube) ✓ magnetic field due to current in copper is produced✓ this magnetic field due to the current opposes the original magnetic field of the magnet✓	**3**	**3 x 1.2**	**IGNORE** copper becomes a magnet
	(d)		Forces are equal ✓ Magnet is travelling at a constant speed / terminal velocity / magnet is not accelerating ✓	**2**	**2 x 2.1**	**ALLOW** resultant force is zero **ALLOW** balanced **IGNORE** equilibrium

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