Oxford Cambridge and RSA

F

GCSE (9–1)

Physics A (Gateway)

J249/01: Paper 1 (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for Autumn 2021

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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.

1. Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

2. 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

3. **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.

Overlap questions that are common to J249/03 are indicated by grey shading in the left-hand column.

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	1.1	
2			C ✓	1	1.2	
3			B ✓	1	1.1	
4			D ✓	1	1.1	
5			A ✓	1	1.1	
6			D ✓	1	2.1	
7			C ✓	1	1.1	
8			C ✓	1	1.1	
9			A ✓	1	2.1	
10			D ✓	1	2.1	
11			B ✓	1	1.2	
12			D ✓	1	2.1	
13			C ✓	1	1.2	
14			D ✓	1	2.2	
15			B ✓	1	2.1	

Question			Answer	Marks	AO element	Guidance
16	(a)		Arrow near X to the right	1	1.2	**ALLOW** an arrow near to X / top 3 field lines that points in the correct direction **IGNORE** any correct arrows on additional field lines **DO NOT ALLOW** any incorrect arrows on additional field lines
	(b)	(i)	At least 2 circles drawn ✓ Anticlockwise arrow on at least one circle ✓	2	1.2 2.2	
		(ii)	Increase current ✓	1	1.2	**ALLOW** Increase power/voltage/potential difference/pd
	(c)	(i)	Both points correctly plotted ✓✓ **OR** Any one point correctly plotted ✓ Best-fit line is a straight line passing through the origin ✓	3	3 x 2.2	+/- ½ square tolerance **DO NOT ALLOW** 'blobs' plotted with more than ½ square diameter
		(ii)	As the number of turns increases the number of paperclips picked up increases ✓ The number of paperclips picked up is (directly) proportional to the number of turns ✓	2	2 x 3.1a	**ALLOW** If the number of turns is doubled the number of paperclips picked up doubles
		(iii)	**Any two from:** Keep the core (of the electromagnet) the same ✓ Keep the current the same ✓ Keep the area of the coils the same ✓ Use identical paperclips ✓ Keep the distance between the electromagnet and the paperclips the same / AW ✓	2	2 x 3.3a	**ALLOW** Power/voltage/potential difference/pd

Question			Answer	Marks	AO element	Guidance
17			Correct symbol for a cell ✓ Cell connected correct way around (for current to flow) ✓	2	1.1 1.2	

Question			Answer	Marks	AO element	Guidance
18	(a)		energy ✓ speed ✓ pressure ✓	3	3 x 1.1	**ALLOW** energy and speed in either order
	(b)		**Any two correct calculations (one mark each):** 200 x 50 = 10 000 ✓ 250 x 40 = 10 000 ✓ 400 x 25 = 10 000 ✓ 1000 x 10 = 10 000 ✓ Comment that they are the same and therefore PV does equal a constant ✓	3	2 x 2.1 3.2b	
	(c)		Less air (molecules) as height increases / weight of air decreases with height / AW / ORA ✓	1	1.1	

Question			Answer	Marks	AO element	Guidance
19	(a)		2 ✓	1	1.1	
	(b)	(i)	B ✓ **Any one from:** A only goes up to 10 ✓ B has the best resolution (for 11N reading) ✓ Reading on B will be in the middle of the scale ✓ C goes up in 5N (increments)/ scale is too coarse✓	2	3.2a 2.2	
		(ii)	Elastic limit exceeded / spring no longer returns to original length ✓ Plastic deformation / spring permanently stretched ✓	2	2 x 2.2	**ALLOW** Newton-meter is broken / no longer works.
		(iii)	C ✓ Least extension (for same force) / AW ✓	2	3.2b 2.2	**ALLOW** spring is stiffer
	(c)		**Any two from:** It is not linear ✓ The extension is different when loading and unloading ✓ Force and extension are not proportional ✓ It does not obey/follow Hooke's law ✓	2	2 x 1.2	**ALLOW** It does not go up (or down) evenly
	(d)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.024 (J) award 3 marks** 4 cm = 0.04 m ✓ ½ x 30 x 0.04^2 ✓ 0.024 (J) ✓	3	 1.2 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
20	*		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed description of method(s), including relevant equipment and equation(s) **AND** Detailed comments about accuracy/precision. *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)** Description of method, including relevant equipment **OR** Description of method, including relevant equation(s) **AND** Basic comment about accuracy/precision. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	1x1.2 2x2.2 1x3.1b 2x3.3b	**AO1.2 Demonstrate knowledge and understanding of relevant equations:** • volume of cube = l x b x h or $(length)^3$ **OR** can use displacement for the regular block • density = mass / volume **AO2.2 Apply knowledge and understanding of techniques and procedures to describe methods of determining density** • relevant equipment to include e.g. ruler, balance, measuring cylinder, displacement can • mass of copper/iron measured using balance • measure length/side/edge of cube • place copper (in water) in measuring cylinder and record increase in volume (of water) **OR** place copper (in water) in displacement can and use a measuring cylinder to measure the volume of the displaced water **ALLOW** volume of cube measured using displacement method **AO3.1b / 3.3b Analyse information and ideas to evaluate and improve accuracy and precision of experimental procedures** • repeat readings and calculate the mean • make sure no zero error on balance • use equipment with a high resolution • read measuring cylinder at eye level / no parallax error • dry the objects before measuring mass

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Basic description of method with some omissions. **AND** One relevant equation. **OR** Basic comment about accuracy/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.*			

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	Earth ✓ *g* is largest (*W* = *mg* and *m* is fixed) ✓	2	3.2a 1.1	
		(ii)	Mass ✓	1	1.1	**ALLOW** distance from another object
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2000 (N/m^2) award 3 marks** pressure = force / area ✓ 600 / 0.3 ✓ 2000 (N/m^2) ✓	3	 1.2 2.1 2.1	
		(ii)	Upwards arrow labelled as normal contact force ✓ Downwards arrow labelled as weight ✓ Arrows are equal length (by eye) ✓	3	3 x 1.1	**ALLOW** force exerted by ground **ALLOW** two upwards arrows, one per foot **ALLOW** force exerted by Earth If two upwards arrows, each should be half the weight

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 480 (J) award 3 marks** (0.6 kN =) 600 N✓ 600 x 0.8 ✓ 480 (J) ✓	3	 1.2 2.1 2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9.6 (s) award 3 marks** (Rearrangement) Time taken = work done / power ✓ 480 ÷ 50 ✓ 9.6 (s) ✓	3	 1.2 2.1 2.1	**ALLOW** ECF from (a)(i)
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.1 (A) award 4 marks** (Rearrangement) Current = power / potential difference or $I = P / V$ ✓ 50 / 24 ✓ 2.08(3) (A) ✓ 2.1 (A) (2 sig.fig) ✓	4	 1.2 2.1 2.1 1.2	**ALLOW** voltage for potential difference

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	450 m ✓	1	2.2	
		(ii)	350 s ✓	1	2.2	**ALLOW** 5 minutes 50 s
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.3 (m/s) award 3 marks** (Rearrangement) Speed = distance / time ✓ 450 / 350 ✓ 1.3 (m / s) ✓	3	 1.2 2.2 2.2	**ALLOW** ECF from (a)(i) and(ii) **ALLOW** 1.2857 (m/s) **ALLOW** s = d / t
		(iv)	Section E ✓ Steepest <u>gradient</u> or <u>slope</u> ✓	2	2.2 1.1	 **ALLOW** correct speeds calculated (1 m / s) and compared for sloped sections
		(v)	(The student) Stopped✓	1	1.1	**ALLOW** any sensible answer related to stopping
	(b)		(Time) Watch / stopwatch / stopclock / timer **AND** (Distance) trundle wheel / (measuring) tape ✓	1	2.2	**ALLOW** mobile (phone) <u>timer</u> **IGNORE** mobile (phone) **ALLOW** metre rule **ALLOW** tracking / fitbit app on mobile to measure distance **IGNORE** ruler

Question			Answer	Marks	AO element	Guidance
24	(a)		Ammeter B **AND** Ammeter B does not have a zero error / ammeter A has a zero error ✓ Ammeter B can read a current of 1 A / ammeter A cannot read up to a current of 1 A / only reads to 50 mA ✓	**2**	3.3b x 2	**ALLOW** ammeter A does not start at zero **ALLOW** Ammeter A does not read high enough **DO NOT ALLOW** higher degree of precision / digital
	(b)	**(i)**	(For a fixed resistor) *V* is (directly) proportional to *I* / *V=IR* ✓ And gives a straight-line graph through the origin ✓	**2**	3.2b x 2	**ALLOW** calculation of resistance of 10 Ω from the gradient of the graph for two different points for **1 mark** **ALLOW** constant gradient through the origin
		(ii)	**Any one from:** (Higher current) gives greater heating effect ✓ Apparatus was not left to cool between readings ✓	**1**	3.3b	 **ALLOW** the resistor / component had heated up **DO NOT ALLOW** random error
		(iii)	Ask **someone else** to repeat your experiment ✓ Repeat experiment using **different** equipment ✓	**2**	3.3b x 2	**IGNORE** just repeat experiment
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.5 (W) award 2 marks** 0.5^2 x 10 ✓ 2.5 (W) ✓	**2**	 2.1 2.1	

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk