OCR
Oxford Cambridge and RSA

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GCSE (9–1)

Physics A (Gateway)

J249/01: Paper 1 (Foundation Tier)

General Certificate of Secondary Education

Mark Scheme for November 2020

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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.

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Annotations

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

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

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

Grey shading in column 1 (questions 22 & 23) indicates an overlap question also found on J249/03

Question			Answer	Marks	AO element	Guidance
16	(a)		Positively ✓ Negatively ✓ Neutrons ✓ Nucleus ✓	4	1.1 x 4	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 997 (kg/m^3) award 2 marks** 9970 ÷ 10 ✓ = 997 (kg/m^3) ✓	2	 2.1 2.1	
		(ii)	C B A	1	1.1	Correct order only
		(iii)	**Any one from:** C has more/the most particles (for the same volume) ✓ A has fewer/the least particles (for the same volume) ✓	1	1.1	**ALLOW** C has particles closest together/least spread out/most tightly packed **ALLOW** A has particles furthest apart/most spread out/least tightly packed **ALLOW** correct identification of C = solid, (B = liquid,) A = gas

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	Correct symbol for a voltmeter ✓ Voltmeter is in parallel with the lamp ✓	2	1.1 2.2	 **ALLOW** voltmeter in parallel with lamp and ammeter
		(ii)	Mistake: Units for current are missing ✓ Correction: Add A/amps/amperes/mA (for the unit) ✓ Mistake: Current is not recorded to correct number of decimal places / 1d.p. Correction: Current should be recorded to 1 d.p./1.0A ✓	4	3.2a 3.2b 3.2a 3.2b	 **ALLOW** Current at 1.0 V is recorded to 4 significant figures **ALLOW** current should be recorded to 2 sig figs
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.25 (Ω) award 3 marks** Rearrange to give resistance = potential difference ÷ current ✓ 4(.0) ÷ 3.2 ✓ = 1.25 (Ω) ✓	3	 1.2 2.1 2.1	**ALLOW** 1.3 (Ω) ✓✓✓ (**ALLOW** *R*) = *V* ÷ *I* Choice of *V*, I for wrong data point loses this mark but can get mp1 for equation and mp3 for evaluation ecf. Mp3 may depend on units chosen for current in (a)(ii).
	(b)	(i)	Point 1,1 correctly plotted within ½ small square ✓ Suitable curved line of best-fit drawn ✓	2	2.2 x 2	 Should be within 1 small square of each point. May not be extrapolated to (0,0,)
		(ii)	Current increases as potential difference increases/AW ✓ Rate of increase reduces/current increases more slowly with potential difference/AW ✓	2	3.1a 3.1a	**IGNORE** it is a straight line **ALLOW** (they are) not proportional / not linear **ALLOW** resistance increases as current goes up/filament gets hotter
		(iii)	Change lamp for a (fixed) resistor ✓ Measure current for different potential differences/AW ✓	2	1.2 x 2	 **ALLOW** repeat the experiment
		(iv)	Straight line (through the origin)/ current is (directly) proportional to voltage ✓ Resistance is constant./not changing/ fixed✓	2	1.2 x 2	 **ALLOW** obeys Ohm's Law

Question			Answer	Marks	AO element	Guidance
18	(a)		Any one set of readings from the graph multiplied together to give a correct number ✓ Any second set of readings from the graph multiplied together to give the same constant ✓	2	3.1b x 2	e.g. 5×500 = 10×250 = 20×125 = 25× 100 = 2500
	(b)		Doubled ✓ Doubled ✓	2	1.1 x 2	
	(c)		**Any two from:** As temperature increases, pressure increases / AW✓ Linear /straight line relationship ✓ Higher temperature means more (frequent) collisions (between particles and container) / AW✓	2	1.1.x 2	**ALLOW** higher temperature means bigger pressure **DO NOT ALLOW** *T* & *P* in wrong order **DO NOT ALLOW** (directly) proportional relationship **ALLOW** pressure goes up at the same rate as temperature **IGNORE** idea of more collisions with other particles

Question			Answer	Marks	AO element	Guidance
19	(a)		**Any two from:** Speed is a scalar ✓ Velocity is a vector ✓ Speed does not take direction into account / AW ✓ Velocity does take direction into account / AW ✓ Speed is calculated using distance ✓ Velocity is calculated using displacement ✓ Displacement depends on direction from start point / displacement takes into account direction ✓ Distance does not depend on direction from start point / distance does not take into account direction ✓	**2**	**1.1 x 2**	
	(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 20 (N) award 2 marks** 5 x 4 ✓ = 20 (N) ✓	**2**	**2.1** **2.1**	
		(ii)	**Any one from:** Not all energy is transferred to motion ✓ (Air) resistance ✓ Drag ✓ Friction ✓	**1**	**3.2a**	**ALLOW** Energy losses

Question			Answer	Marks	AO element	Guidance
19	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1500 (J) award 2 marks**	**2**		
			30 x 50 ✓		**2.1**	
			= 1500 (J) ✓		**2.1**	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 20 (W) award 3 marks**	**3**		**ALLOW** ecf from (c)(i)
			work done ÷ time ✓		**1.2**	**ALLOW** P = WD ÷ t
			1500 ÷ 75 ✓		**2.1**	
			= 20 (W) ✓		**2.1**	

Question			Answer	Marks	AO element	Guidance
20	*		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)** Circuit A identified as a parallel circuit and having the brightest lamps **AND** Detailed explanation of why A has the brightest lamps **AND** Identification of control variables *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)** Circuit A identified as a parallel circuit and having the brightest lamps **AND** An explanation of why A has the brightest lamps **OR** Identification of control variables *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Circuit A identified as having the brightest lamps. **OR** Identification that circuit A is in parallel. **OR** Identification of control variables *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant***.** **0 marks** *No response or no response worthy of credit.*	**6**	**1.2 x 2** **2.2 x 2** **3.2b x 1** **3.3a x 1**	**AO1.2 Demonstrate knowledge and understanding of series and parallel circuits** For example: • circuit A is parallel • circuit B is series • both circuits have one cell **AO2.2 Apply knowledge and understanding of series and parallel circuits** For example: • resistance is lower in circuit A / ORA • more current flows in circuit A / ORA **AO3.2b Analyse information and ideas to draw conclusions** For example: • lamps in circuit A are brighter / ORA **AO3.3a Analyse information to develop experimental procedure by identifying control variables** • same (number of) lamps • same (number of) cells

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.5 (N/cm) award 3 marks** (Spring constant =) force ÷ extension ✓ 2.0 ÷ 4.0 ✓ = 0.5 (N / cm) ✓	3	 1.2 2.1 2.1	**ALLOW** 3 marks for 50 N/m Needs algebraic or arithmetic rearrangement for this m.p. Choice of *F*, *ext* for wrong data point loses mp2 but can get mp3 for evaluation ecf.
		(ii)	**Any two from:** Repeat readings and calculate a mean/average ✓ Use more forces ✓ Plot data on a graph (and use a line of best fit) ✓ Use equipment with a higher resolution✓ Repeat experiment with different equipment (and compare results) ✓	2	3.3b x 2	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.8 (J) award 2 marks** ½ x 40 x 0.2^2 ✓ = 0.8 (J) ✓	2	 2.1 2.1	**ALLOW** 3.8 (J)
	(c)	(i)	(moment of 2N weight) = 80 (N cm) ✓ (moment of 3N weight) = 150 (N cm) ✓	2	2.1 2.1	**ALLOW** 1 mark if answers are reversed
		(ii)	Anti-clockwise (as anti-clockwise moment is larger than the clockwise moment) / left hand side goes down / AW✓	1	3.1b	**ALLOW** indication of rotation by an arrow on the diagram

Question			Answer	Marks	AO element	Guidance
22	(a)	(i)	(Ruler has) equal numbers of protons and electrons / ORA✓ So (effects of positive charges and negative charges) cancel out / AW / ORA ✓	2	2 x 1.1	**ALLOW** equal numbers of positive and negative charges/opposite charges / ORA **ALLOW** ruler has not lost/gained electrons / ORA **ALLOW** ruler is **/** atoms are neutral unless they lose/gain electrons / ORA **ALLOW** if the ruler had been charged, movement of electrons (to/from the air) would discharge it **ALLOW** overall/net charge is zero/neutral / ORA **IGNORE** just charge is neutral
		(ii)	Electrons are transferred (from/to the ruler or from/to the cloth) / ORA ✓ **And any one from:** Charges are no longer equal / AW ✓ Different numbers of protons and electrons / AW ✓ Effects no longer cancel out / AW ✓	2	2 x 1.1	**ALLOW** electrons are lost/gained **DO NOT ALLOW** protons/positive charges move **ALLOW** ruler becomes negative/positive with correct movement of electrons ✓✓
	(b)	(i)	They must be opposite/unlike charges / one is positive and one is negative / one is a proton and one is an electron ✓ **And any two from:** They are being attracted ✓ The arrows show a force on the positive (charge)/(charge) B ✓ Forces / field (lines) go from positive to negative ✓ (Charge) A is negative **AND** (charge) B is positive✓	3	3 x 1.2	**ALLOW** A is positive and B is negative for this mark only **ALLOW** forces / field (lines) go from B to A **ALLOW** maximum of 1 mark if described as positive and negative poles

Question			Answer	Marks	AO element	Guidance
22	(b)	(ii)	**Any one from:** North and South (poles) (replace positive and negative charges) ✓ The arrows/field lines go from North to South (as opposed to positive to negative) ✓ They have similar shape field (patterns) ✓ Closeness of field lines represents strength of field (in each case) ✓ Opposite <u>poles</u> (and opposite charges) attract ✓ Both show direction of field (lines) / forces ✓	1	1.1	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5(.00) (C) award 3 marks** **(**Rearrange equation) Charge = energy transferred / potential difference ✓ (charge =) 200 / 40 ✓ = 5 (C) ✓	3	 **1.2** **2.1** **2.1**	

Question			Answer	Marks	AO element	Guidance
23	(a)		Tape measure / metre rule(r)/stick **AND** Stop clock/watch✓	1	1.2	**IGNORE** just ruler **ALLOW** light gates
	(b)	(i)	Mean = 2(.00) ✓ Median = 2.02 ✓ Mode = 2.08 ✓	3	1.2 x 3	**ALLOW** 2.04 for mean (for ignoring 1.84) **ALLOW** 2.06 for median if 2.04 calculated for the mean
		(ii)	(They have a) wide spread/range / AW ✓	1	3.2a	**ALLOW (**they are) not all close together / don't have a small difference / not similar / AW **ALLOW** they are too different / have a big gap / not concordant / 0.24 gap **IGNORE** not consistent
		(iii)	Improvement must be linked to error Error: Reaction time / difficulty in starting/stopping timer at exact time / AW ✓ Improvement: Video/record the drop (and replay using timings from the recording) / use an electronic timing method / light gates / A/W ✓ **OR** Error: Not dropping ball from exact height / AW Improvement: Indication of marking the point from where it should be dropped / A/W	2	3.3b 3.3a	Marks can be awarded for errors/improvements in either section **IGNORE** difficulty in timing without reason **IGNORE** human error unless qualified **ALLOW** use larger distances (so that % error in time is reduced)

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