OCR
Oxford Cambridge and RSA

GCSE

Physics A

Unit **J249H/03**: Higher Tier – Paper 3

General Certificate of Secondary Education

Mark Scheme for June 2018

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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.

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

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:

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

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	variable resistor ✓	1	1.2	**ALLOW** rheostat **IGNORE** potentiometer
		(ii)	Control / change / vary / increase / decrease / AW the resistance / current in the circuit ✓	1	1.2	**DO NOT ALLOW** merely 'changes the voltage or changes p.d.' **BUT ALLOW**: changes the potential difference or voltage **across (component) X**
	(b)	(i)	(filament) bulb / lamp ✓	1	3.2a	
		(ii)	gradient / slope (of graph) changes (as potential difference / voltage changes) ✓ idea of increasing resistance (with more p.d.) / ORA ✓ idea of increasing temperature / AW ✓	3	3.1a 1.2 2.2	**ALLOW** 'graph / line / slope levels off' / non-linear Resistance increases with greater temperature ✓✓
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4 (V) award 2 marks** 0.25 x 16 ✓ 4 (V) ✓	2	 2.1 2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1 (W) award 3 marks** P = IV ✓ P = 0.25 x 4 ✓ P = 1 (W) ✓ **OR** $P = I^2R$ ✓ $P = 0.25^2 \times 16$ ✓ P = 1 (W) ✓	3	 1.2 2.1 2.1 1.2 2.1 2.1	**ALLOW e.c.f. from part ci**

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	Any three from: place the compass onto the card or near to the wire (and turn on the current) ✓ plot / observe the direction of the compass / needle ✓ repeat idea of tip-to-tail / plotting onto the card ✓ repeat at different distances from the centre ✓	3	3 x 1.2	
		(ii)	one or more circles around wire ✓ clockwise arrow(s) ✓	2	2 x 2.2	**DO NOT ALLOW** a spiral **BUT ALLOW** if clockwise direction shown by an arrow on the spiral
	(b)		**always** points to North / South ✓✓ **OR** Points to (magnetic) North / South ✓ line up with the magnetic field lines of the Earth ✓ **OR** Compass needle shows (an angle of) dip ✓ Dip (angle) changes (from equator) ✓	2	2 x1.1	**ALLOW** Points North / South wherever you are ✓✓

Question			Answer	Marks	AO element	Guidance
18	(a)		Rod **attracts** water ✓ • Opposite charges attract ✓ • water has both + and – charges / idea of polarisation / AW ✓	3	3 x 1.2	**IGNORE** positive electrons / movement of protons / ions for this answer. **ALLOW** Water bends or moves towards rod **OR** for candidates that have misinterpreted the diagram as repulsion of water then **ALLOW** Rod **repels** water / water bends or moves away from rod ✓ • Like charges repel ✓ • water has both + and – charges / idea of polarisation / AW ✓
	(b)	(i)	potential difference ✓ closed or complete circuit ✓	2	2 x 1.1	**IGNORE** ions / charge **ALLOW** voltage **ALLOW** higher level answers eg. must have delocalised electrons / electrons that are free to move
		(ii)	**FIRST CHECK THE ANSWERON ANSWER LINE** **If answer = 1500 (C) award 4 marks** Q = It ✓ t = 5 x 60 = 300 (s) ✓ Q = 5 x 300 ✓ Q = 1500 (C) ✓	4	1.1 2.1 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	as the length of the wire increases the resistance increases / proportional relationship / ORA ✓ **BUT** idea of **directly** proportional ✓ ✓	**2**	2 x 3.2b	**IGNORE** positive correlation Numerical answers must **USE** values rather than merely quoting values Eg. (approximately) doubling the length, doubles the resistance / ORA ✓ ✓ Eg. Increases by 7 to 8Ω per 25cm / 0.3Ω (allow 0.28 to 0.32) per cm ✓✓
		(ii)	mean for 25cm (is recorded to 3 decimal places) **and** it should be recorded to one decimal place ✓ mean for 50cm is incorrect **and** it should be 16.2Ω ✓	**2**	2 x 3.3a	Error **and** a solution required for each marking point. **ALLOW** answer in terms of sig. figs: Eg. mean for 25cm is recorded to 4 sig. figs. – it should be recorded to 2 sig. figs.
		(iii)	75cm attempt 3 or 18.7 (is an anomaly) ✓ it has not been included in the **mean** ✓	**2**	2 x 3.2a	
		(iv)	**straight** line **through the origin** scores ✓✓ **straight** line / linear relationship / proportional and not through origin scores ✓	**2**	2 x 3.1a	**ALLOW** answers shown on a diagram **ALLOW** directly proportional ✓✓ **DO NOT ALLOW** a curved line through origin **IGNORE** positive correlation (in written comments)

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	**Any two from:** (extra resistance due to) connecting leads too long / too thin ✓ (extra) resistance of the croc clips / connections ✓ croc clip is not at 0cm / the end of the ruler / length of resistance wire **longer** than intended / AW ✓ Heating effect of wires ✓	**2**	2 x 3.1b	**DO NOT ALLOW** idea of less resistance Eg. Crocodile clips rusted / poor conductor / bad or loose connections **IGNORE** crocodile clips in wrong place unless qualified correctly. Eg. croc clips too far apart **ALLOW** Parallax error on meter (if it is analogue) / meter not calibrated (so resistance higher)
		(ii)	**Any one from:** make the connecting wires as short as possible ✓ keep croc clips clean / solder connections ✓ place croc clip exactly at the end of the ruler / at 0cm / AW✓	**1**	3.3b	Solution needs to be consistent with an error identified in part i. OR a new specified error **ALLOW**: use **thicker** connecting wires **ALLOW** let wire(s) cool between readings / Securely fix croc clip / calibrate meter / avoid parallax error

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	All three points correctly plotted ✓✓ **OR** two points correctly plotted ✓	**2**	2 x 2.2	Points should be + / - ½ square or less (by eye)
		(ii)	straight line up to 0.04, 8 **and** curved line consistent with points plotted past this point ✓	**1**	3.1a	**ALLOW ecf from part ai for misplotted points** **ALLOW** straight part of graph drawn without ruler. **DO NOT ALLOW** dot-to-dot for curve **Single** line should be **thin** (less than ½ square thick) and **continuous** to gain the mark.
		(iii)	Initially the **extension** increases steadily / linearly / uniformly / (directly) proportionally / elastically / AW ✓ (then the) wire reaches its **elastic limit** ✓ the extension increases plastically / by more for each (2N) weight added (past this point) / AW ✓	**3**	3.1a 1.2 3.1a	**ALLOW** gradient is steady up to 8N **ALLOW** initially obeys Hooke's law **IGNORE** limit of proportionality (as this is an AO3 answer for an AO1 question) **ALLOW** Hooke's law not obeyed after 8N
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 200 (N/m) award 3 marks** k = F ÷ x ✓ k = 6 ÷ 0.03 ✓ (or equivalent correct expression from 0 to 6N) k = 200 (N/m) ✓	**3**	 1.2 2.1 2.1	 **IGNORE** F=kx Substitution into correctly rearranged formula ✓✓

Question			Answer	Marks	AO element	Guidance
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.16 (J) award 2 marks**	**2**		**ALLOW** ecf from part b
			$E = 0.5 \times 200 \times 0.04^2$ ✓		1.2	**ALLOW** area under graph method: 0.5 x 8 x 0.04 ✓
			E = 0.16 (J) ✓		2.1	**BUT** area under graph method used to calculate 0.16 scores ✓✓

Question			Answer	Marks	AO element	Guidance
21 (*)	(a)		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)** **A detailed explanation of experimental procedure AND detailed discussion about accuracy** *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)** **EITHER** **a detailed explanation of the experimental procedure OR** **detailed discussion about accuracy OR** **a brief explanation of the experimental procedure and simple discussion about accuracy** *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)** **Brief explanation of the experimental procedure OR** **simple comment about accuracy** *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**	2 x 2.2 2 x 3.3a 2 x 1.2	**AO1.2 and AO2.2 Applies knowledge and understanding of how to use the equipment to find specific latent heat of water. For example:** • Measure the initial mass / weight of beaker • Turn on the heater • Start timing • Use the voltmeter, ammeter and stopclock to calculate the energy supplied (E=VIt) • Turn off the heater • Stop timing • Use a balance to measure the mass of the beaker and melted ice • Subtract the original mass of the beaker to find the mass / weight of the melted ice / calculate mass / weight of melted ice • Calculate specific latent heat by dividing energy by **mass** **AO3.3a Analyses information and ideas to develop experimental procedures and consider accuracy of the experiment**. **For example:** • Make sure that the heater is always covered with ice • Insulate / put lid on the funnel to reduce heat losses • Make sure that the mass of water produced is sufficiently large – run the experiment for long enough • Repeat the experiment to minimise (random) errors

Question			Answer	Marks	AO element	Guidance
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 380 000 (J) award 3 marks**	**3**		
			SLH = E ÷ m ✓		**1.2**	Rearranging equation 95 ÷ 250 or 0.38 scores ✓ (evidence of rearranged formula)
			= 95000 ÷ 0.25 ✓		**2.1**	95 000 ÷ 250 = 380 scores ✓✓ Or 95 ÷ 0.25 = 380 ✓✓ Or 380 ✓✓
			= 380000 (J/kg) ✓		**2.1**	

Question			Answer	Marks	AO element	Guidance
22	(a)		momentum ✓ **kinetic** energy or **KE** ✓	2	2 x 1.1	**IGNORE** mass conserved If more than two answers mark the first two answers (unless one of them is mass). Eg 'KE, mass, momentum ✓✓ Eg. PE, KE, momentum ✓
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINES** **If answers = 8.4 (kgm/s) and 6.75 / 6.8 (kgm/s) award 3 marks**	3		
			2 x 4.2 2.5 x 2.7 ✓		1.2	
			A: 8.4 (kgm/s) ✓		2.2	
			B: 6.75/6.8 (kgm/s) ✓		2.2	8.4 and 6.7 scores ✓✓ (incorrect rounding of one of the values)
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3.4 (m/s) award 3 marks**	3		
			(8.4 + 6.75) ÷ 4.5 ✓		2.2	ECF for momentum values eg. (A + B) ÷ 4.5
			3.37 / 3.366666667 (m) ✓		2.2	
			3.4 (rounding to 2 sf) ✓		1.2	Wrong answer but evidence of correct rounding ✓ Eg. 6.75 to 6.8 ✓

Question			Answer	Marks	AO element	Guidance
23	(a)	(i)	initial speed is zero **and** • either acceleration due to gravity = 10 • or g = 10 ✓ use a = (v-u) ÷ t to find the final speed / v ✓ use $v^2 - u^2 = 2as$ to find s ✓	3	3 x 1.1	**IGNORE** the idea of echoes and speed of sound **ALLOW** answers using g = 9.8 or 9.81 **ALLOW** v = u + at ✓ **ALLOW** credit for higher level answers: Eg. three marks for answer in terms of $s = ut + \frac{1}{2}at^2$
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 22 (m/s) award 2 marks** 10 = v (- 0) / 2.2 OR uses idea that stone gains 10m/s each second ✓ V = 22 (m/s) ✓	2	2 x 2.1	**ALLOW** 21.56 or 21.58 or 21.6 (if g=9.8 or 9.81) ✓✓

Question	Answer	Marks	AO element	Guidance
(b)	**only** 2 arrows drawn or directions of the two forces described – one upwards and one downwards ✓ Correctly names weight **and** air resistance / drag ✓ downward arrow longer than upward arrow / forces are unbalanced / resultant / net / overall force downwards ✓ so object accelerates / gets faster / increases velocity or speed ✓	**4**	2.1 1.1 2.1 1.1	Award marks for answer points given in diagrams or prose. **ALLOW** force of gravity or mg or gravitational pull for weight **BUT DO NOT ALLOW** merely 'gravity' **IGNORE** upthrust for this marking point only  Drag / air resistance (3 marks) Weight or force of gravity

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