Oxford Cambridge and RSA

H

GCSE (9–1)

Physics A (Gateway Science)

J249/03: Paper 3 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2019

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

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	40 (g) ✓	1	3.2b	
		(ii)	Mass before = mass after / Mass is conserved AW ✓ Explanation in terms of particle rearrangement / conservation of numbers of particles✓	2	1.1 x2	**ALLOW** no mass is lost **ALLOW** matter for mass **ALLOW** atoms/molecules for particles
	(b)		**Any one from:** Original properties return if change is reversed for physical changes ✓ Chemical change can't be reversed (easily) OR physical change easily reversible✓ The substance after the change is the same as the substance before the change for physical changes ORA ✓	1	1.1	 **ALLOW** in a chemical change particles join together in a different way
	(c)	(i)	**Any three from:** Measure start/initial temperatures ✓ Turn on the heaters / heat water ✓ Measurements to determine energy or mass of water ✓ For a set time✓ Measure the final/end temperatures ✓	3	2.2 x3	**IGNORE** put thermometer or heater in beaker Initial can be implied **ALLOW** for a fixed temperature change **ALLOW** for a fixed temperature change, measure time
		(ii)	**Any one from:** Beakers are different sizes OR different volumes /mass of liquid in A and B ✓ Beakers are not insulated / no lids✓	1	3.3a	 **ALLOW** Heater is not fully in the water

Question			Answer	Marks	AO element	Guidance
		(iii)	**Any two from:** Use beakers of the same size / same volume✓ Use same mass or volume of liquid✓ Stir water / keep distance from thermometer to heater fixed✓ Insulate the beakers or put the beakers on an insulating material ✓ Put a lid on the beakers ✓ Make sure the heater is fully inserted into the liquid ✓	2	3.3b	

Question			Answer	Marks	AO element	Guidance
17	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.28 (A) award 4 marks**	4		
			Rearrange equation current = power ÷ potential difference/ I = P ÷ V ✓		1.2	
			I = 65 ÷ 230 ✓		2.1	
			I = 0.2826086 ✓		2.1	**NOTE** If answer not to 2 sig figs max 3 marks
			I = 0.28 (A) ✓		1.2	**ALLOW** one mark for any calculated answer to 2sf
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 117000 (or 116000) (J) award 4 marks**	4		**ALLOW ECF** from **(a)**
			E = P x t ✓		1.2	E = Q x V or I x t x V
			Unit conversion 30 minutes = 1800 seconds ✓		1.2	
			E = 65 x 1800 ✓		2.1	E = 0.28 × 1800 × 230 **ALLOW ECF for incorrect time conversion** **ALLOW** three marks for 1950 (J)
			E = 117000 (J) ✓		2.1	E = 116000 (J) ✓

Question			Answer	Marks	AO element	Guidance
18	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 25 (N/m) award 3 marks**	3		
			Recall and rearrange: spring constant = force exerted by a spring ÷ extension ✓		1.2	
			= 5 ÷ 0.2 ✓		2.1	**ALLOW** any other correct pair of points from the graph – points to be read to ±½ a small square
			= 25 (N/m) ✓		2.1	Final answer between 24 and 26 (N/m) scores three marks
	(b)		Line curves and gradient decreases ✓ Point at the end of the linear section of the line labelled 'elastic limit' ✓	2	2x1.2	**IGNORE** poorly drawn curves/thick lines **DO NOT ALLOW** curve with negative gradient at any point
	(c)			3	3x2.2	**DO NOT ALLOW** labels pointing to apparatus
			A downwards arrow labelled weight/load ✓			**ALLOW** gravity/gravitational force **DO NOT ALLOW** mass
			An upwards arrow labelled tension ✓			**ALLOW** force from spring
			<u>Two</u> equal length arrows (by eye), one vertically up and one vertically down ✓			**NOTE** this mark may not be scored if more than two arrows are drawn

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	LED / cells connected the wrong way around OR ✓ Voltmeter is across the battery/cells OR voltmeter should be across the LED ✓	2	2x3.2a	**ALLOW** diode **IGNORE** voltmeter in wrong place
		(ii)	**Any one from:** Control/change/alter the current (in the circuit) ✓ Control/change/alter the potential difference/voltage (across the LED) ✓	1	1.2	**DO NOT ALLOW** to vary the resistance
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 100 (Ω) award 3 marks** Resistance = potential difference ÷ current / R = V ÷ I ✓ R = 3.0 ÷ 0.03 ✓ R = 100 (Ω) ✓	3	 1.2 2.1 2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4.5 (C) award 4 marks** Charge flow = current × time / Q = I × t ✓ t = 2.5 minutes = 150 seconds ✓ Q = 0.03 x 150 ✓ Q = 4.5 (C) ✓	4	 1.2 1.2 2.1 2.1	**ALLOW** 3 marks for an answer of 0.075 (C) (time not converted to seconds) ✓✓✓
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 13.5 (J) award 2 marks** E = 4.5 x 3.0 ✓ E = 13.5 (J) ✓	2	 2.1 2.1	**ECF** from**19(b)(ii)** **ALLOW** 14(J)

Question			Answer	Marks	AO element	Guidance
20	(a)*		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)** Detailed explanation about how a transformer works. **AND** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. *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)** Simple explanation of how a transformer works. **AND** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. **OR** Detailed explanation about how a transformer works. **AND** A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*	6	1.1x3 3.1a x2 3.2ax1	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to give an explanation of how a transformer works** For example: • Alternating current / ac / voltage / potential difference • (induces) (alternating) pd / current in secondary • Linking different numbers of coils to changing potential differences (or currents) • More secondary coils = bigger output potential difference • Alternating current in primary coil induces alternating magnetic field in the iron core • Alternating magnetic field in the iron core induces alternating potential difference in the secondary coil • An alternating current flows if the output is connected to a circuit • Ratio of potential differences depends on ratio of coils • Step up transformers increase potential difference and have more secondary coils ORA **AO3.1a Analyse information and ideas to interpret – quantitative** • Correct equation selected from data sheet • Data from table processed • For A and C expect secondary pd of 24 V • For B and D expect secondary pd of 6 V

Question			Answer	Marks	AO element	Guidance
			Level 1 (1–2 marks) Simple explanation of how a transformer works. **OR** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. **OR** A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. *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.*			**AO3.1a Analyse information and ideas to interpret - qualitative** For example: • Double the number of secondary coils (compared to primary) and the output potential difference is doubled (compared to input) • Halve the number of secondary coils (compared to primary) and the output potential difference is halved (compared to input) • In transformer A the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer B the number of coils decreases by 50% and the voltage decreases by 50%/AW • In transformer C the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer D the number of coils decreases by 50% and the voltage decreases by 50%/AW **AO3.2a Analyses information and ideas to make judgements** • Data supports the expected output voltages • Energy losses in A and C • B and D are efficient **ALLOW** voltage for potential difference and vice versa

	(b)	(i)	**Incorrect word** (A) **resistance** (is induced across the ends of the wire) ✓ **Corrected sentence** (A) potential difference/voltage (is induced across the ends of the wire) ✓ **OR** **Incorrect word** (A microphone is similar to a) **motor** ✓ **Corrected sentence** (A microphone is similar to a) generator ✓	2	2.1 x2	**ALLOW** current is induced **ALLOW** dynamo
		(ii)	Loudspeaker/speaker/headphones ✓	1	1.1	**IGNORE** phone

Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	Both points correctly plotted ✓ Smooth curve correctly drawn ✓	2	1.2	**ALLOW** within ½ small square for plotting **DO NOT ALLOW** straight lines between data points **IGNORE** any line drawn for <10°
		(ii)	Increase in angle of ramp increases speed (at bottom ramp) ORA✓ Increase is not linear/doubling angle does not double final speed / AW ✓ Reference to quantitative data for two calculations, for example, increase from 10˚ to 20˚ the speed increases by 0.76 whilst 20˚ to 30˚ the speed increases by 0.54 ✓	3	3.1a 3.1a 3.1b	**IGNORE** correlation **ALLOW** Not directly proportional / Not constant increase **NOTE comparison of two increases required** **NOTE** Speed increase from 0˚ to 10˚ is 1.81 and speed increase from 30˚ to 40˚ is 0.40
		(iii)	(Increase in angle) increases potential energy of the trolley/more work is done raising trolley to that point on the ramp ✓ This **increases** the / **more** kinetic energy at the bottom of the ramp ✓	2	1.1x2	 **ALLOW more** PE is transferred to KE
		(iv)	Attempt 1 at 30˚ (is only recorded to 1 decimal place)/ 3.1 ✓ Student should record data to a consistent number of decimal places or 2 dp / the reading should by recorded as 3.10 / AW ✓	2	3.3a 3.3b	**ALLOW** only recorded to 2 significant figures **ALLOW** should be recorded to 3 significant figures **NOT** same accuracy

Question			Answer	Marks	AO element	Guidance
		(v)	**Any two from:** Reproducible means that the results can be reproduced by someone else ✓ Only one student has collected this data ✓ The experiment is repeatable (as the repeated readings are close together) ✓	2	2.2x2	**NOT** experiment can be repeated
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6.16 (m/s^2) award 5 marks** $v^2 - u^2 = 2as$ (no mark – on formula sheet) u = 0 ✓ $a = v^2 \div 2s$ ✓ $a = 3.51^2 \div (2x1.0)$ ✓ a = 6.16005 (m/s^2) ✓ a = 6.16 (m/s^2) (2 decimal places) ✓	5	 2.1 1.2 2.1 2.1 1.2	 NOTE must be rearranged **ALLOW** Any number which rounds to 6.16 **ALLOW** one mark for any calculated answer to 2dp
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9 (J) award 3 marks** kinetic energy (J) = 0.5 x mass (kg) x (speed (m/s))^2 / KE = ½ mv^2 / KE = 0.5mv^2 ✓ KE = 0.5 x 2.0 x 3.0^2 ✓ KE = 9 (J) ✓	3	 1.2 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
22	(a)		Pressure is inversely proportional to volume OR *pV* = constant for a particular gas OR for any of the gases calculation of p x V ✓ For gas B: 10 x 0.4 = 4 <u>and</u> for gas C: 20 x 0.2 =4 OR Pressure of C is double the pressure of B <u>and</u> volume of C is half the volume of B ✓ B and C ✓	3	3.2b 3.1a 3.2b	**NOTE** could be written next to table
	(b)		For an increase in temperature / heating of gas: gas particles / molecules / atoms have a higher (average) speed / more (kinetic) energy ORA✓ They collide more frequently / often with the walls (of container) / container AW✓ Bigger force (over same area) equals greater pressure ✓	3	3x1.1	**Direction of temperature change must be clear** **ALLOW** move faster for higher (average) speed **ALLOW** linked to increase/decrease of KE if temperature change not explicit **ALLOW** bigger change in momentum
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5500 (Pa) award 3 marks** pressure due to a column of liquid (Pa) = height of column (m) x density of liquid (kg/m^3) x g (N/kg) / P = hρg (no mark – on formula sheet) g = 10 (N/kg) ✓ P = 0.5 x 1100 x 10 ✓ P = 5500 (Pa) ✓	3	 1.1 2.1 2.1	**ALLOW** three marks for 5390 Pa if g=9.8 N/kg or 5395.5 Pa if g=9.81 N/kg is used **ALLOW** 9.8(1) N/kg

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