Oxford Cambridge and RSA

F

GCSE (9–1)

Physics B (Twenty First Century Science)

J259/02: Depth in physics (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.

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

	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.

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Question			Answer	Marks	AO element	Guidance
1	(a)		B ✓	1	1.1	tick in 2nd box
	(b)		Spectrum ✓	1	1.1	word ringed
	(c)	(i)	Violet ✓	1	1.1	tick in 3rd box
		(ii)	Red ✓	1	1.1	tick in 1st box
		(iii)	Different colours have different wavelengths/ travel at different speeds (inside the glass) ✓	1	1.1	**ALLOW** correct change e.g. shorter wavelengths travel more slowly **DO NOT ALLOW** different frequencies

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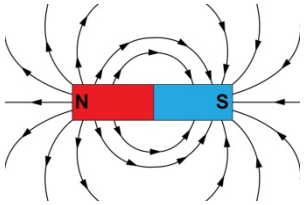
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th>Pole on first magnet</th><th>Pole on second magnet</th><th>Result</th></tr>
<tr><td>N</td><td>S</td><td>(Attract)</td></tr>
<tr><td>N</td><td>N</td><td>Repel</td></tr>
<tr><td>S</td><td>S</td><td>Repel</td></tr>
<tr><td>S</td><td>N</td><td>Attract</td></tr>
</table>
Attract correctly labelled ✓
Both Repel correctly labelled ✓</td><td>2</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Arrow heads on any four lines in correct direction ✓
 
</td><td>1</td><td>2.1</td><td>ALLOW extra correct field lines with arrow heads in correct direction.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Stronger ✓

Closer together ✓</td><td>2</td><td>2.1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>An induced magnet loses its magnetism when removed from a magnetic field ✓</td><td>1</td><td>1.1</td><td></td></tr>
</table>

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Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	Constant velocity / speed (downwards) **OR** zero acceleration ✓	1	1.1	
		(ii)	One arrow up and one arrow down drawn approximately the same length ✓ Weight (downwards) **AND** Air resistance /Friction due to air (upwards)✓	2	2.2	**ALLOW** *W* or *mg* for weight for any upward arrow **ALLOW** drag for air resistance for any downward arrow
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 600 (N) award 2 marks** = 60 x 10 ✓ = 600 (N) ✓	2	2.1	
	(c)	(i)	Velocity/Displacement ✓	1	1.1	**ALLOW** acceleration / momentum / force **ALLOW** any other vector quantity **DO NOT ALLOW** weight / distance
		(ii)	Vectors have direction **OR** scalars do not have direction ✓	1	1.1	

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Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	Points plotted correctly ((4, 6.0) and (5, 7.5)) ✓ Straight line drawn through all points ✓	2	1.2	**ALLOW** points to within half a square of correct co-ordinates.
		(ii)	The extension increases as weight increases/extension (directly) proportional to weight ✓	1	2.1	**ALLOW** as weight doubles extension doubles **ORA** **ALLOW** weight increases as extension increases / weight (directly) proportional to extension
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.67 (N/cm) award 3 marks** = 5 ÷ 7.5 ✓ = 0.666… ✓ = 0.67 (N/cm) ✓	3	 2 x2.1 1.2	**ALLOW ECF** from mis-plotted graph **ALLOW** any correct choice of pair of co-ordinates on the line and correctly calculated extension Answer to 2 s. f.
	(b)		Non-linear✓ Rubber band ✓	2	2.1	

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Question			Answer	Marks	AO element	Guidance
5	(a)		(Atom A – Number of Neutrons =) 6 (Atom C – Atomic number =) 7 ✓	1	2.2	
	(b)		Atom A **AND** Atom B ✓	1	2.1	Both ringed
	(c)		Beta particle✓	1	1.1	Ringed

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Question			Answer	Marks	AO element	Guidance
6	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 15.8 Ω award 4 marks**	4		**ALLOW** use of any point on the line. Correct answers will be in range 15.7 to 16.0 Ω
			= 6.0 ÷ 0.38 ✓		2.1	
			= 15.789…… ✓		2.1	**ALLOW** 15.78 i.e. answers that round to the correct answer to the required number of d.p.
			= 15.8 (1 decimal place) ✓		1.2	
			= 15.8 Ω ✓		1.1	**ALLOW** 1 mark for ohm(s) or Ω
	(b)		Constant *R* (for straight region of graph) ✓ *R* changes above 5.6 (±0.2) V ✓ *R* increases (for curved region of graph) ✓	3	3.1a	

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Question			Answer	Marks	AO element	Guidance
7	*		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)** Explains why Sarah's method is inaccurate with reference to error and calculations **AND** Suggests one detailed method that Sarah can use to measure speed of sound *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)** Explains why Sarah's method is inaccurate with reference to error **AND/OR** calculations **AND** Suggests one method to measure speed of sound *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)** Explains reasons why Sarah's method is inaccurate **OR** Suggests one sound method to measure speed of sound *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 2.1 2 x 3.1b 2x 3.3a	**AO 1.2 Demonstrates knowledge of speed equation** • Conversion of units **AO 2.1 Applies knowledge of speed equation and units** • Use of speed = distance ÷ time to calculate speed of sound approx.1000/4 = 250m/s or time of 2.9 s or distance of 1360 m **AO 3.1b Evaluates information and ideas** For example: • Compares approx. value to actual speed of sound • The values don't compare so method is suitable to measure the speed of sound • The method is not suitable as the time and distance is only an approximation • Not possible to take an average to reduce random error **AO 3.3a Makes developments to experimental procedure** For example: • Description may include a diagram of an alternative method which either only involves Sarah or involves another person, e.g. measuring the time taken for a sound to travel from a source to a detector (echo off a wall)/two microphones and a digital time or e.g. timing the time between lightning and thunder and determine the distance from a map.

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Question			Answer	Marks	AO element	Guidance
8	(a)		Condensation ✓ Sublimation ✓ Evaporation ✓	3	1.1	
	(b)		Same number of particles / mass is constant ✓ (But density decreases) in water vapour as same mass in greater volume / particles are further apart ORA✓	2	2.1	**ALLOW** greater mass per volume

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Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	3 ✓	1	2.2	
		(ii)	Lower slope /gradient or less steep (for 15 – 30 min) ORA for 30 - 45 min✓	1	2.2	time must be stated for reverse argument
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.6 (km/min) award 2 marks** = 6 ÷ 10✓ = 0.6 (km/min) ✓	2	2.2	**ALLOW** this gradient from distance time graph calculated using any pair of co-ordinates on the correct part of the line. **ALLOW** full marks for calculations with converted units and correct unit for speed. **ALLOW** one mark for conversion or partial conversion with incorrect units **ALLOW** 6 ÷ 600 **OR** 6000 ÷ 10 **OR** 6000 ÷ 600 **ALLOW** 10 m/s

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Question			Answer	Marks	AO element	Guidance
10	(a)	(i)	Similarity: More generated in summer months rather than winter✓ Difference: Individual months are not the same/ Amir has higher maximum value and/or lower minimum value ✓	2	3.1a	**ALLOW** any valid similarity **ALLOW** any valid difference
		(ii)	Any **two** from: Idea of weather conditions not always the same/AW✓ Company recorded average over several years – Amir over 1 year **OR** Amir only has small sample (1 year) **OR** For accurate data, a large sample of more than 1 year needed ✓ Repeated readings needed to reduce effect of outliers ✓	2	3.2a	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = £4815 award 3 marks** 3800 ÷ 350 (= 11) solar panels needed to produce minimum of 3850W ✓ 11 × 415 = 4565 ✓ 4565 + 250 = 4815 ✓	3	2.1	**ALLOW ECF** for 10 or 10.87 for a maximum of two marks. **ALLOW ECF** for incorrect cost of panels for including cost of battery for 1 mark
		(ii)	(Solar Panels because) Wind turbines required = 3800/1250 = 3.04 so 4 needed cost 4×1500 = £6000 (+£250 battery) **OR** so 4 needed cost 4×1500 (+£250) > £5000 ✓ Cannot buy enough with £5000 to deliver enough power ✓ **OR**	2	3.2b	Calculation of the number of wind turbines required (3800/1250 = 3.04) so 4 needed cost 4×1500 = £6000 **OR** > £5000 Conclusion based on candidate's calculated value using correct method.

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Question			Answer	Marks	AO element	Guidance
			Max number of wind turbines = £5000 (- £250) ÷ £1500 = 3.3 (or 3.2) so 3 is max number and max power = 3×1250 = 3750 ✓ Cannot get enough power from 3 wind turbines ✓			Calculation of number of wind turbines that can be bought with £5000 Conclusion based on candidate's calculated value using correct method. **ALLOW** comparison of wind turbine calculated value with solar panel value from **(bi)** = £4565 and conclusion based on candidate's values.

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Question			Answer	Marks	AO element	Guidance
11	(a)		Timer/stop watch ✓ Thermometer/digital thermometer ✓	2	1.1	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 432 000(J) award 3 marks** time = 180 (s) ✓ power = 2400W ✓ power × time = 2400 × 180 ✓ Energy = 432 000(J) ✓	4	 1.2 1.2 2.1 2.1	**ALLOW** 2 mark for 7.2 (J) **ALLOW** 3 marks for 432(J) OR 7200 **ALLOW ECF** for candidate's time and power **ALLOW ECF** for power and time conversions
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.48 award 2 marks** 345 600 / 432 000 ✓ = 0.8 ✓	2	2.1	**ALLOW ECF (b)** **ALLOW** answer given as %
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4320 award 2 marks** 345 600 / 1 × 80 ✓ = 4320 (J/kg°C) ✓	2	2.1	
	(d)	(i)	(Thermal) energy dissipated to the surroundings ✓	1	3.2a	**ALLOW** energy is lost to the surroundings **ALLOW** examples for surroundings e.g. element air
		(ii)	Any **one** from: Insulate kettle ✓ Shorter temperature change ✓ Shorter time ✓	1	3.3b	**IGNORE** repeat and calculate an average value

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Question			Answer	Marks	AO element	Guidance
12	(a)		Further ✓ More ✓ Red ✓ Wavelength ✓ Faster ✓	4	3.1a	4 marks for 5 correct 3 marks for 4 correct 2 marks for 3 correct 1 mark for 1 or 2 correct
	(b)		Why: To see if the work is accurate/correct/valid/well preformed ✓ How: The work is checked by other scientists/experts in the field ✓	2	1.2	**ALLOW** Answers for 'why' and 'how' transposed **IGNORE** reproducing/repeating or any form of doing experiments

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Question			Answer	Marks	AO element	Guidance
13	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 125(A) award 3 marks** $V_1 \times I_1$ = 25000 × 2000 = 50 000 000 ✓ I_2 = 50 000 000 ÷ 400 000 ✓ = 125 A ✓	**3**	**2.1**	**ALLOW** $V_1 \times I_1 = V_2 \times I_2$ **OR** 400 000 × 2000 **ALLOW** $I_2 = I_1 \div 16$
	(b)	**(i)**	40000 (kWh) ✓	**1**	**2.2**	
		(ii)	Between 9.30 pm – 10.30 pm ✓	**1**	**2.2**	**ALLOW** answers between 9.30 pm and 10.30 pm
		(iii)	4 pm ✓	**1**	**2.2**	
	(c)*		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)** Describes in detail the advantages **and** disadvantages of at least two different power stations. **AND** Uses data from the table **and/or** graph to make a valid conclusion of how the power stations can be used to meet electrical demand over a day. *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)** Describes advantages **and** disadvantages of at least two different power stations. **AND**	**6**	**2 × 1.1** **2 × 2.2** **2 × 3.2b**	**AO1.1 – Demonstrates knowledge and understanding of advantages and disadvantages of electricity generation by fossil fuels and renewable sources** For example: • Wind only generates electricity when the wind blows • Solar panels only generate electricity during the day • Fossil fuels are non-renewable, but work 24/7 • Hydroelectric generates only when the water level is high in a reservoir • Wind/solar/hydroelectric are renewable • Wind solar and hydroelectric Or the renewables cannot generate all the time Or depend on weather conditions.

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Question			Answer	Marks	AO element	Guidance
			Uses data from the table **or** graph to suggest how the power stations can be used to meet electrical demand over a day. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** Describes advantages **and/or** disadvantages of one or more types of power station. **OR** Uses data from the table or graph to suggest how the power stations can be used to meet electrical demand over a day. *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.*			**AO2.1 – Applies knowledge and understanding of how energy is generated in relation to the details in the table and the graph** For example: • Fossil fuels have long start-up times so need to be left running • Base load can be met by adding power of fossil fuels with one of the renewables • Demand cannot be met by the renewables alone • Show evidence of correct calculations **AO3.2b – Analyses information to make judgements and draw detailed and supported conclusions from the graph and the table** For example: • Hydroelectric power is the only reliable way of meeting demand as wind and solar are unreliable • Wind/solar energy may not be available at the same time so we cannot assume all the max. power is available at any one time • Fossil fuels plus a combination of the renewables are needed to provide energy

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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

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