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GCSE (9-1)

**Physics B (Twenty First Century Science)** 

J259/04: Depth in physics (Higher 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
<b>✓</b>	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
1	alternative and acceptable answers for the same marking point
<b>√</b>	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 B:

Assessment Objective
Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.
Demonstrate knowledge and understanding of scientific ideas.
Demonstrate knowledge and understanding of scientific techniques and procedures.
Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.
Apply knowledge and understanding of scientific ideas.
Apply knowledge and understanding of scientific enquiry, techniques and procedures.
Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.
Analyse information and ideas to interpret and evaluate.
Analyse information and ideas to interpret.
Analyse information and ideas to evaluate.
Analyse information and ideas to make judgements and draw conclusions.
Analyse information and ideas to make judgements.
Analyse information and ideas to draw conclusions.
Analyse information and ideas to develop and improve experimental procedures.
Analyse information and ideas to develop experimental procedures.
Analyse information and ideas to improve experimental procedures.

Q	uestio	n Answer	Marks	AO element	Guidance
1	(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

Q	Question		Answer	Marks	AO element	Guidance
2	(a)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 125(A) award 3 marks	3	2.1	<b>ALLOW</b> $V_1 \times I_1 = V_2 \times I_2$ <b>OR</b> 400 000 × 2000
			$V_1 \times I_1 = 25000 \times 2000 = 50\ 000\ 000\ \checkmark$ $I_2 = 50\ 000\ 000\ \div 400\ 000\ \checkmark$ = 125 A $\checkmark$			<b>ALLOW</b> $I_2 = I_1 \div 16$
	(b)	(i)	40000 (kWh) ✓	1	2.2	
		(ii)	Between 9.30 pm − 10.30 pm ✓	1	2.2	<b>ALLOW</b> 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.	6	2 × 1.1 2 × 2.2 2 × 3.2b	<ul> <li>AO1.1 – Demonstrates knowledge and understanding of advantages and disadvantages of electricity generation by fossil fuels and renewable sources</li> <li>For example: <ul> <li>Wind only generates electricity when the wind blows</li> <li>Solar panels only generate electricity during the day</li> <li>Fossil fuels are non-renewable, but work 24/7</li> <li>Hydroelectric generates only when the water level is high in a reservoir</li> </ul> </li> </ul>
			Level 2 (3-4 marks) Describes advantages and disadvantages of at least two different power stations. AND			<ul> <li>Wind/solar/hydroelectric are renewable</li> <li>Wind solar and hydroelectric Or the renewables cannot generate all the time Or depend on weather conditions.</li> </ul>

Question	Answer	Marks	AO element	Guidance
sta  The info evident stands and stands are stands and stands are stands and stands are stands and stands and stands are stands are stands and stands are stands are stands and stands are	tions can be used to meet electrical demand over a day.  ere is a line of reasoning with some structure. The formation presented is relevant and supported by some idence.  vel 1 (1-2 marks) escribes advantages and/or disadvantages of one or more personant of power station.  ere data from the table or graph to suggest how the power ations can be used to meet electrical demand over a day.  ere is an attempt at a logical structure with a line of assoning. The information is in the most part relevant.  Warks  or response or no response worthy of credit.			<ul> <li>AO2.1 – Applies knowledge and understanding of how energy is generated in relation to the details in the table and the graph</li> <li>For example:         <ul> <li>Fossil fuels have long start-up times so need to be left running</li> <li>Base load can be met by adding power of fossil fuels with one of the renewables</li> <li>Demand cannot be met by the renewables alone</li> <li>Show evidence of correct calculations</li> </ul> </li> <li>AO3.2b – Analyses information to make judgements and draw detailed and supported conclusions from the graph and the table</li> <li>For example:         <ul> <li>Hydroelectric power is the only reliable way of meeting demand as wind and solar are unreliable</li> <li>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</li> <li>Fossil fuels plus a combination of the renewables are needed to provide energy</li> </ul> </li> </ul>

Q	Question		Answer	Marks	AO element	Guidance
3	(a)		One normal line drawn at right angles at point of entry of light ray or point of departure of light ray ✓ Dispersion of light in the prism, and dispersion of light leaving the prism, with red and violet clearly identified ✓	2	1.2	
	(b)		(Yes)  Both red and violet light are refracted at a greater angle in the crystal prism AW✓  The crystal prism produces a wider spectrum/the difference between red and violet light is greater/difference between read and violet light is 4.6 ° compared to glass 1.7 ° ✓	2	2.1	

Q	uest	ion	Answer	Marks	AO element	Guidance
4	(a)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer L = 2.14W + 10 award 3 marks  m= evidence of working out gradient e.g. 15 ÷ 7 ✓ = 2.14 ✓	3	1.2	ALLOW m between 2.0 and 2.3
			<b>c</b> = 10 ✓			
		(ii)	<b>c</b> = (original) length of spring ✓ <b>m</b> = 1/spring constant ✓	2	2.1	
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.43(J) award 4 marks	4		
			Extension = 18 – 6 = 12cm ✓		2.1	
			12cm = 0.12m√		1.2	
			Energy stored = 0.5 x 60 x 0.12 <sup>2</sup> ✓		2 x 2.1	<b>ALLOW</b> a correct evaluation for an incorrect extension with no unit conversion for 1 mark and 2 marks with a correct unit conversion
			= 0.43(2) J ✓			
						<b>ALLOW</b> answer of 4.3 x 10 <sup>n</sup> for any incorrect unit conversion or no unit conversion for 3 marks
						<b>ALLOW</b> answer of 0.972 (use of 0.18m) or 0.108 (use of 0.06m) for 3 marks

C	Question		Answer	Marks	AO element	Guidance	
5	(a)		Closed circuit and Potential Difference ✓	1	2.1	Both required for 1 mark	
	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 360 C award 4 marks	4			
			Charge = current × time ✓ = 3 × 120 ✓ = 360 ✓ Unit = coulomb /C ✓		1.2 2 x 2.1 1.1	<b>ALLOW</b> an answer of 6 (no unit conversion for time) for 2 marks	
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE  If answer = 6(V) award 3 marks  potential difference = Work done ÷ charge  = 2160 ÷ 360 ✓  = 6 (V) ✓	3	1.2 2x2.1	ALLOW ecf. From b(i)	
	(c)		Wire C has the least resistance ✓ A lower resistance produces a greater power/higher current✓	3	2x3.1a		
			A justification that the power is greater using a calculation from information from circuit Fig. 5.1 or explanation of $P=I^2R$ or $P=V^2/R$		3.2a		
	(d)		(disagree with Amaya) Current increases ✓ More paths for charges to move (for same potential difference)✓ Total resistance reduced ✓	3	3.2b	ALLOW reading on ammeter increases	

C	uestion	Answer		AO element	Guidance	
6	(a)	(This causes a force) upthrust (directed upwards) ✓  If weight > upthrust mini-submarine will sink/resultant force directed downwards ✓  There is a greater pressure on the bottom surface than the top surface of the submarine ✓	3	2.1		
	(b)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 39/38.95 MPa award 4 marks  3.8 (km) = 3800 (m)   1025 x 10 x 3800   = 38 950 000 Pa   = 39/38.95 MPa   = 39/38.95 MPa	4	1.2 2 x2.1 1.2	ALLOW correct answer in Pa (correct conversion km to m) but incorrect conversion to MPa for 3 marks ALLOW 38950 for 2 marks (no conversion from km to m and no conversion to MPa) ALLOW 0.03895 for 3 marks (no conversion from km to m)	

C	uest	ion	Answer	Marks	AO element	Guidance
7	(a)	(i)	Any <b>one</b> from: Don't know the exact temperature change (room temp to boiling point of water) AW ✓ The power of the kettle may be variable (not always 1900W) AW ✓ Some of the heat being used to heat the kettle (not all heat going to water) ✓ Heat loss to the surroundings ✓	1	3.2a	
		(ii)	Any <b>one</b> from: Measure the temperature of the water with a thermometer (before heating and after)  Use an (immersion) heater and measure potential difference and current (to calculate the power)/measure potential difference and current of the kettle (to calculate the power)  Insulate kettle  Insulate kettle	1	3.3b	IGNORE any references to measuring the mass of the water IGNORE any references to repetition and mean calculation
	(b)		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 4275(J/kg °C) award 4 marks  60 x 3 = 180 ✓ E = 1900 × 180 = 342 000(J) ✓ c = Energy ÷(mass x temp.change) = 342 000 ÷ (1 x 80) ✓ c = 4275 (J/kg °C) ✓	4	1.2 3x2.1	ALLOW 3 marks for one incorrect conversion 4.275 (Energy=1.9 x180) or 71.25 (Energy=1900x3)
	(c)		(when temperature increases (heated)) increase in kinetic store/molecules vibrating or moving faster ✓ (At boiling point) temperature stays the same (although energy continues to be supplied) ✓ Causes increase in potential store as energy is required to change state/latent heat/overcome forces of attraction/break bonds ✓	3	3×1.1	ALLOW particles for molecules  DO NOT ALLOW reference to gravitational potential energy

Question	Answer Ma		AO element	Guidance
8 *	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)  Gives a detailed comparison of distance travelled (including calculations of distance travelled) from the graph.  OR  Gives a detailed comparison of her motion (including calculations of acceleration)  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)  Gives a comparison of her distance travelled (attempts at calculation of distance travelled) from the graph.  OR  Gives a description of her motion (attempts at calculation of acceleration) from the graph.  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)  Gives a brief comparison of her distance travelled and/or motion from the graph in terms of similarities or differences.  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	2x 1.2 2x2.1 2x3.1a	AO 1.2 – Demonstrates knowledge and understanding of velocity-time graphs/work done  For example:

Q	Question		Answer	Marks	AO element	Guidance
9	(a)	(i)	All 4 points (September to December) plotted correctly ✓	1	2.2	Plot points (17, 32), (13, 40), (10, 35) and (7, 41) <b>ALLOW</b> ½ square tolerance
		(ii)	Best fit line drawn ✓	1	2.2	An equal number of plotted points either side of their line of best
	(b)		Neither is fully correct as difficult to draw a line of best/points are too scattered/away from line of best fit AW ✓ (But) there a weak <u>negative</u> correlation (with increasing temp) ✓ Use of data to support their reasoning ✓	3	3.2a	

Question		on	Answer	Marks	AO element	Guidance
10	(a)	(i)	(Ali is correct because)	3		
			(Increasing the number of coils of wire) increases the strength of the magnetic field (of the solenoid) ✓		1.1	
			(So) a greater force (acting on the coil due to it being in the magnetic field of the permanent magnet) ✓		2x2.1	
			(And) this increases the amplitude of vibrations AW (of the plastic cup) ✓			
		(ii)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1400(Hz) award 5 marks	5		
			Recall and rearrange frequency = wave speed ÷ wavelength ✓		1.1	
			Conversion of wavelength = 0.24m 340 ÷ 0.24 ✓ = 1416(.666) (Hz) ✓		1.2 2.1 × 2	ALLOW (340/24 = ) 14.167 for 2 marks ALLOW any calculated value in mark point 4 to 2
			= 1400 (2 significant figures) ✓		1.2	s.f. (independent mark = one mark)
	(b)		Loudspeaker requires an alternating voltage/alternating current (whereas battery is DC) ✓	4	1.1	
			Current creates a magnetic <u>field</u> (in the coil)✓			
			AC creates <u>changing</u> (magnetic) field ✓			
			Field interacts with the field of the (permanent) magnet so generates a force/coil moves ✓			

Q	Question		Answer	Marks	AO element	Guidance
11	(a)		(When switch is closed current flows) A magnetic field is produced in coil 1 ✓ (Change in magnetic field) induces a potential difference in second coil <b>and</b> causes a current to flow✓ Current flows in opposite direction ✓ (Because) it opposes change in magnetic field✓	4	3.1a 3x2.1	IGNORE reference to a voltage being generated
	(b)		Magnetic field stops changing ✓ (So) potential difference no longer induced ✓	2	3.1a 2.1	

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