H

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.

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 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.

Question			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

Question			Answer	Marks	AO element	Guidance
2	(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.

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

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	

Question			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 ✓ **c**= 10 ✓	**3**	**1.2**	**ALLOW** m between 2.0 and 2.3
		(ii)	**c**= (original) length of spring✓ **m** = 1/spring constant ✓	**2**	**2.1**	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.43(J) award 4 marks** Extension = 18 – 6 = 12cm ✓ 12cm = 0.12m✓ Energy stored = 0.5 x 60 x 0.12^2 ✓ = 0.43(2) J ✓	**4** **2.1** **1.2** **2 x 2.1**	**ALLOW** a correct evaluation for an incorrect extension with no unit conversion for 1 mark and 2 marks with a correct unit conversion **ALLOW** answer of 4.3 x 10^n for any incorrect unit conversion or no unit conversion for 3 marks **ALLOW** answer of 0.972 (use of 0.18m) or 0.108 (use of 0.06m) for 3 marks

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** Charge = current × time ✓ = 3 × 120 ✓ = 360 ✓ Unit = coulomb /C ✓	4	 1.2 2 x 2.1 1.1	 **ALLOW** 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✓ 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	2x3.1a 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

Question			Answer	Marks	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✓	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)

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	Any **one** 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 **one** 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 ✓	**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 ^{o}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 ^{o}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	Marks	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: • Acceleration is gradient of graph • Distance is area under graph • Acceleration = change in velocity ÷ time • Converting of units **AO 2.1 – Applies knowledge and understanding of velocity-time graphs** For example: • Correct calculations for acceleration for each training session • Correct calculation for deceleration • Correct distance calculated for each training session: Training session one total distance = 2700m, Training session two total distance = 3375m **AO 3.1 – Analyses information from a velocity-time graph to interpret the motion of an object** For example: • Comparison of motion in terms of accelerations and total distance travelled for each training session e.g. training session two covers greater distance in same time period etc.

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

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 **and** 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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