

GCSE (9–1)

Physics B (Twenty First Century Science)

J259/01: Breadth in physics (Foundation 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.

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Annotations available in RM Assessor

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.

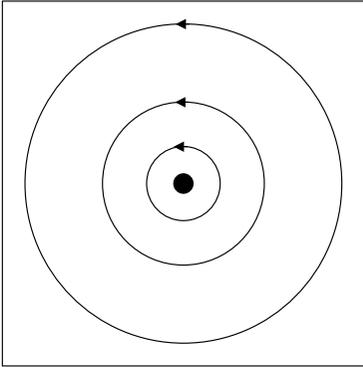
The breakdown of Assessment Objectives for GCSE (9-1) in Physics B:

	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)	The cell, to provide a potential difference AND The wires, to make a complete circuit ✓	1	1.1	Both required for one mark, 2 nd box ticked AND 4 th box ticked. ALLOW other clear methods of indicating answers.
	(b)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.2 (Ω) award 2 marks 3.3 \div 1.5 ✓ 2.2 (Ω) ✓	2	2.1 \times 2	
	(c) (i)	Amaya ✓ (The current is the same) everywhere in a loop / in a (series) circuit / either side of a component ✓	2	3.1a 2.1	DO NOT ALLOW the readings on the ammeter are the same. ALLOW the current in a (series) circuit cannot change.
	(ii)	Any one from: use different ammeters (and see if you get the same results) ✓ swap the ammeters round (and see if you get the same results) ✓ test the ammeters in the same circuit (to compare them) ✓ test the ammeters in a control circuit (one with known current) ✓	1	3.3b	

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	X-rays have a shorter wavelength than visible light ✓	1	1.1	3 rd box ticked. ALLOW other clear methods of indicating answer.
		(ii)	Our eyes can detect only a small range of frequencies ✓	1	1.1	Top box ticked. ALLOW other clear methods of indicating answer.
	(b)	(i)	$\frac{150\,000\,000}{300\,000} \checkmark$	1	2.1	Left most calculation. ALLOW other clear methods of indicating answer.
		(ii)	At the same time as visible light ✓	1	1.1	3 rd box ticked. ALLOW other clear methods of indicating answer.
		(iii)	Reason: (X-rays and visible light) travel at the same speed (in a vacuum / empty space) ✓	1	1.1	

Question		Answer	Marks	AO element	Guidance
3	(a)	10^{-10} m ✓	1	1.1	3 rd answer circled. ALLOW other clear methods of indicating answer.
	(b)	Any two from: gold foil experiment / alpha particle scattering ✓ most particles went straight through (in the gold foil experiment) ✓ (some) particles bounced back / reflected (in the gold foil experiment) ✓ discovery of electron / subatomic particles ✓	2	1.1 × 2	DO NOT ALLOW a description of the diagrams. ALLOW a description of the experiment. IGNORE electrons fired at atom
	(c)	The incorrect parts are: (the nucleus) is negative ✓ (the nucleus) contains electrons ✓	2	1.1 × 2	ALLOW corrected versions of the incorrect statements, ie; the nucleus is positive, the nucleus contains neutrons (and protons).
	(d) (i)	$20 + 12$ ✓	1	1.1	4 th sum circled. ALLOW other clear methods of indicating answer.
	(ii)	$10 - 6$ ✓	1	1.1	1 st sum circled. ALLOW other clear methods of indicating answer.

Question		Answer	Marks	AO element	Guidance	
4	(a)	<p>concentric circles around wire ✓</p> <p>anticlockwise arrow(s) ✓</p> <p>spacing of field lines increases with distance from wire ✓</p> 	3	1.1 × 3	<p>minimum 2 circles for first marking point,</p> <p>ALLOW answer drawn on Fig 4.1, if nothing on Fig 4.2.</p>	
	(b)	(i)	strength (of field) decreases with distance / further from wire ✓	1	1.1	ALLOW (magnetic) force decreases with distance
		(ii)	increase the current / pass the wire through the card more than once ✓	1	2.1	<p>DO NOT ALLOW more wire (unless it is clear that the wires are being doubled up).</p> <p>ALLOW more wires.</p> <p>IGNORE bigger wire</p>
	(c)	points to <u>magnetic</u> pole of Earth / Earth has <u>magnetic</u> field / Earth's core is <u>magnetic</u> / AW ✓	1	1.1	<p>IGNORE electromagnetism.</p> <p>DO NOT ALLOW gravity</p>	

Question		Answer	Marks	AO element	Guidance
5	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 690 000 (N) award 3 marks</p> <p>Conversion $23\,000\text{ (kPa)} = 23\,000\,000\text{ (Pa)}$ ✓</p> <p>$23\,000\,000 \times 0.030$ ✓ $= 690\,000\text{ (N)}$ ✓</p>	3	1.2 2.1 × 2	ALLOW ECF for incorrect or no conversion, eg, 2 marks for answer of 690.
	(b)	(i)	2	1.1 × 2	
		(ii)	2	2.1 × 2	

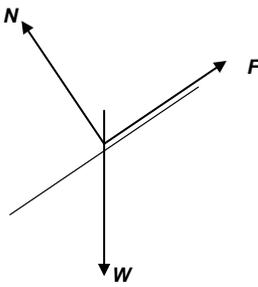
Question		Answer	Marks	AO element	Guidance			
6	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 10.8 (cm) award 2 marks</p> <p>$32.5 \div 3 \checkmark$ $= 10.8 \text{ (cm)} \checkmark$ (Answer must be to 3 sf to gain the second mark)</p>	2	2.1 × 2	<p>ALLOW ecf for second mark, e.g. $32.5 \div 2 = 16.3$ award 1 mark $32.5 \div 4 = 8.13$ award 1 mark $32.5 \div 5 = 6.50$ award 1 mark $32.5 \div 6 = 5.42$ award 1 mark</p> <p>DO NOT ALLOW 2 s.f. answer for second mark, e.g. $32.5 \div 5 = 6.5$ award zero marks</p>			
	(b)	(i)			<p>(the vibration is) perpendicular / at right angles \checkmark</p> <p>to the direction of travel / propagation \checkmark</p>	2	1.1 × 2	<p>ALLOW particles move up and down. ALLOW vibration/oscillation up and down ALLOW has peaks and troughs.</p>
		(ii)			<p>Any two from: sound waves are longitudinal \checkmark</p> <p>vibration is parallel (to direction of travel) \checkmark</p> <p>sound wave can travel through gases / wave on the string can only travel on the string \checkmark</p> <p>sound wave travels slower than the wave on the string \checkmark</p>	2	1.1 × 2	<p>ALLOW reference to compressions and rarefactions. ALLOW sound waves can travel through air.</p>

Question		Answer	Marks	AO element	Guidance
7	(a)	need more than one force /needs two forces ✓ (Sundip is pulling) at both ends / in opposite directions ✓	2	1.1 2.1	IGNORE reference to gravitational force.
	(b)	(i)	1	1.1	
		(ii)	1	3.1b	
	(c)	(i)	1	1.1	DO NOT ALLOW correlation, or as force goes up extension goes up.
		(ii)	2	3.2b x 2	

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	Similarity turbines / generators ✓ Any one from: Difference wind power uses moving air ✓ fossil fuels are burnt ✓ fossil fuels use steam ✓ wind power uses a kinetic store ✓ fossil fuels use a chemical store ✓	2	1.1 × 2	IGNORE references to pollution/renewability.
		(ii)	Any two from: nuclear reaction ✓ fusion reaction ✓ hydrogen (fuses) to form helium ✓ mass converted to energy (of radiation) ✓	2	1.1 × 2	
	(b)	(i)	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 62.5(%) award 3 marks recall efficiency = useful energy transferred / total energy transferred ✓ (150 ÷ 240) × 100 ✓ = 62.5 (%) ✓	3	1.2 2.1 × 2	ALLOW 2 s.f. 63(%) DO NOT ALLOW 0.625(%), 0.63(%) unless the % is crossed out on the answer line.
		(ii)	Any two from: Charger B is more efficient for the same cost ✓ Charger B is more efficient so it will cost less to run ✓ Charger B will charge the battery faster / more energy transferred per second ✓ Charger A will be less hot ✓ Use of numerical data from table to justify statement. ✓	2	3.2a × 2	ALLOW ECF from (c)(i) for comparison of efficiencies.

Question		Answer	Marks	AO element	Guidance
9	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 320000 (J) award 3 marks</p> <p>90-20 = 70 ✓ $1.1 \times 4200 \times 70 = 323400$ (J) ✓ = 320,000 (J) to 2sf ✓</p>	3	2.2 × 3	
	(b)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2420 (W) award 3 marks</p> <p>recall power = current² × resistance ✓</p> <p>$11^2 \times 20$ ✓ = 2420 (W) ✓</p>	3	1.2 2.1 × 2	
	(c) (i)	<p>(measure the temperature with a) thermometer ✓</p> <p>(measure the time with a) stopclock ✓</p>	2	2.2 × 2	ALLOW timer
	(ii)	<p>Any one from:</p> <p>heat in microwave for the same time_✓ heat in microwave ovens at the same power_✓ leave to cool for the same time ✓ same temperature of environment ✓ same initial temperature ✓ same mass of heat pack ✓</p>	1	3.3a	

Question		Answer	Marks	AO element	Guidance
11	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 6680 (J) award 3 marks</p> <p>Select equation: energy to cause a change of state = mass × specific latent heat ✓</p> <p>Conversion 20 g = 0.020 kg ✓</p> <p>$334\,000 \times 0.020 = 6680$ (J) ✓</p>	3	1.2 1.2 2.1	<p>ALLOW 6.68×10^3 / 6700 / 6.7×10^3</p> <p>If the conversion is missing or incorrect, max 2 marks available.</p>
	(b)	<p>Any two from: (time to melt depends on) rate of (thermal) energy transfer ✓</p> <p>energy is transferred to the ice cube ✓</p> <p>(which depends on) thickness of material / conductivity of material / foil is a good conductor / carpet is an insulator / carpet is thick / foil or paper are thin /AW ✓</p>	2	2.1 × 2	<p>ALLOW the ice is heated/heating Not just heat is transferred to the ice</p> <p>ALLOW some materials are better insulators or conductors than others</p> <p>ALLOW thermal energy is transferred in the least time by aluminium because it is the best conductor (2 marks)</p>
	(c)	(i)	2	3.3b × 2	<p>ALLOW AVP e.g. use solid CO₂ that sublimates rather than melts / wrap the ice-cube in cling film/ use waterproof paper / laminate / cover in a thin layer of plastic</p> <p>put ice in container and wrap the container in material / AW ✓</p> <p>measure temperature / use a thermometer / put (all equipment) in freezer ✓</p>
		(ii)	1	3.3b	<p>ALLOW put in a warmer environment / break up the ice</p> <p>use smaller ice cubes / put the ice cubes on a warm surface / put each ice cube under a lamp ✓</p>

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	arrow perpendicular to surface, upwards and left labelled N ✓	1	2.1	 <p>Perpendicular and parallel by eye.</p> <p>ALLOW in (a)(ii) one mark for missing or incorrect labels for both parts of the question</p> <p>ALLOW arrows anywhere on diagram</p>
		(ii)	arrow parallel to surface AND upwards and right labelled F ✓	1	2.1	
	(b)	(i)	if A exerts a force on B then B exerts a force on A ✓ forces are <u>equal</u> and <u>opposite</u> ✓	2	1.1 × 2	<p>ALLOW (an interaction) pair of forces (that are the same type) that act on different objects e.g. book pushes on table, table pushes on book NOT if only one object</p> <p>ALLOW second mark for 'every action has an equal and opposite reaction'</p>
		(ii)	(equal and opposite force) acts on the Earth ✓	1	2.1	ALLOW the Earth is attracted to Jamal / there is a force pulling the Earth upwards.

Question		Answer	Marks	AO element	Guidance
13	(a)	contamination effect ✓ (because the isotope/source/it) is inside/on the body ✓	2	1.1 × 2	
	(b)	it emits <u>ionising</u> radiation (which mutates DNA / cells) ✓	1	1.1 × 1	DO NOT ALLOW 'causes cancer / radiation sickness' on its own
	(c)	Any two from: (If radium is chosen) emits alpha so it is (most) ionising ✓ absorbed by bones so stays in body/not excreted ✓ least penetrating so radiation emitted is absorbed by tissue ✓ long half-life so stays in body/stays radioactive for a long time ✓ (If technetium is chosen) short half-life so lots of radiation in a short time / so high dose/exposure ✓ (If plutonium is chosen) absorbed by bones so stays in body/not excreted ✓ long half-life so stays in body ✓	2	3.2a × 2	ALLOW converse ALLOW alpha to identify radium and vice versa etc. ALLOW least penetrating so stays in body

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