F

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
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.

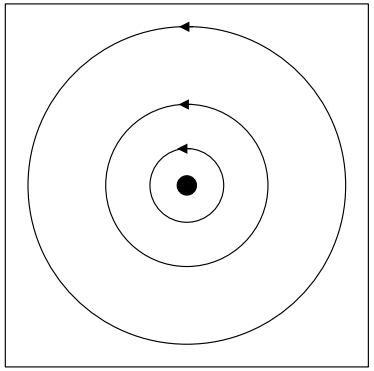
The breakdown of Assessment Objectives for GCSE (9-1) in Physics B:

	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, 2nd box ticked **AND** 4th 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 ÷1.5 ✓ 2.2 (Ω) ✓	2	2.1 × 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	3rd 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)	$\frac{150\ 000\ 000}{300\ 000}$ ✓	1	2.1	Left most calculation. **ALLOW** other clear methods of indicating answer.
		(ii)	At the same time as visible light ✓	1	1.1	3rd 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	3rd 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	4th sum circled. **ALLOW** other clear methods of indicating answer.
		(ii)	10 – 6 ✓	1	1.1	1st sum circled. **ALLOW** other clear methods of indicating answer.

Question			Answer	Marks	AO element	Guidance
4	(a)		concentric circles around wire ✓ anticlockwise arrow(s) ✓ spacing of field lines increases with distance from wire ✓ 	3	1.1 × 3	minimum 2 circles for first marking point, **ALLOW** answer drawn on Fig 4.1, if nothing on Fig 4.2.
	(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	**DO NOT ALLOW** more wire (unless it is clear that the wires are being doubled up). **ALLOW** more wires. **IGNORE** bigger wire
	(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	**IGNORE** electromagnetism. **DO NOT ALLOW** gravity

Question			Answer	Marks	AO element	Guidance
5	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 690 000 (N) award 3 marks** Conversion 23 000 (kPa) = 23 000 000 (Pa) ✓ 23 000 000 × 0.030 ✓ = 690 000 (N) ✓	**3** **1.2** **2.1 × 2**		**ALLOW** ECF for incorrect or no conversion, eg, 2 marks for answer of 690.
	(b)	**(i)**	**Any two from:** (pressure caused by) particles colliding ✓ (particles colliding) with walls ✓ (when the volume increases) particles travel further between collisions or vice versa ✓ (when the volume increases there are) fewer / less /more likely (frequent) collisions (so lower pressure) or vice versa ✓	**2**	**1.1 × 2**	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 34.5 (dm^3) award 2 marks** 23 000 × 15 (= 345 000) ✓ (345 000 / 10 000 =) 34.5 (dm^3) ✓	**2**	**2.1 × 2**	

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

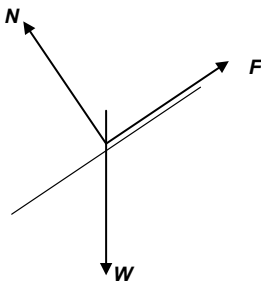
Question			Answer	Marks	AO element	Guidance
7	(a)		need more than one force /needs two forces ✓ (Sundip is pulling) at both ends / in opposite directions ✓	2	1.1 2.1	**IGNORE** reference to gravitational force.
	(b)	(i)	does not return to original shape (when force removed) ✓	1	1.1	
		(ii)	**Any one from:** (force meter) would give different results each time ✓ (force meter) could only be used once ✓ (force meter) would give incorrect values ✓	1	3.1b	
	(c)	(i)	force and extension are proportional / extension goes up in equal steps ✓	1	1.1	**DO NOT ALLOW** correlation, or as force goes up extension goes up.
		(ii)	3 or 4 (N) ✓ use of data, e.g. goes up in steps of 2.5 (cm) up (to 3.0 N), spring constant = 0.4 (N/cm) (to 3.0 N), different steps for higher forces ✓	2	3.2b × 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)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 320000 (J) award 3 marks** 90-20 = 70 ✓ 1.1 × 4200 × 70 = 323400 (J) ✓ = 320,000 (J) to 2sf ✓	**3**	**2.2 × 3**	
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2420 (W) award 3 marks** recall power = current^2 × resistance ✓ 11^2 × 20 ✓ = 2420 (W) ✓	**3**	 **1.2** **2.1 × 2**	
	(c)	**(i)**	(measure the temperature with a) thermometer ✓ (measure the time with a) stopclock ✓	**2**	**2.2 × 2**	 **ALLOW** timer
		(ii)	**Any one from:** 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 ✓	**1**	**3.3a**	

Question			Answer	Marks	AO element	Guidance
10	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 80 (J) award 3 marks** recall kinetic energy = 0.5 × mass × speed^2 ✓ 0.5 × 1.6 × 10^2 ✓ = 80 (J) ✓	3 **1.2** **2.1 × 2**		
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5 (m) award 3 marks** rearrange equation height = GPE ÷ (mass × g) ✓ 120 ÷ (2.4 × 10) ✓ = 5 (m) ✓	3 **1.2** **2.1 × 2**		
	(b)	(i)	chemical store ✓	1	1.1	1st box ticked. **ALLOW** other clear methods of indicating answer.
		(ii)	kinetic store ✓	1	1.1	3rd box ticked. **ALLOW** other clear methods of indicating answer.
		(iii)	**Any two from:** (impact) speed is high for low heights and/or large heights. ✓ at low heights, (rate of) change of speed is high / gradient steeper at high heights, (rate of) change of speed is low / shallow gradient. ✓ (impact) speed minimum at height between 0.4 – 0.6 m ✓ minimum speed is between 4 and 5 m/s.✓ data point read correctly from graph ✓	1 1	3.1a × 2	

Question			Answer	Marks	AO element	Guidance
11	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6680 (J) award 3 marks** Select equation: energy to cause a change of state = mass × specific latent heat ✓ Conversion 20 g = 0.020 kg ✓ 334 000 × 0.020 = 6680 (J) ✓	**3**	 **1.2** **1.2** **2.1**	**ALLOW** 6.68 x 10^3 / 6700 / 6.7 x10^3 If the conversion is missing or incorrect, max 2 marks available.
	(b)		**Any two from:** (time to melt depends on) rate of (thermal) energy transfer ✓ energy is transferred to the ice cube ✓ (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 ✓	**2**	**2.1 × 2**	 **ALLOW** the ice is heated/heating **Not just** heat is transferred to the ice **ALLOW** some materials are better insulators or conductors than others **ALLOW** thermal energy is transferred in the least time by aluminium because it is the best conductor (2 marks)
	(c)	**(i)**	put ice in container and wrap the container in material / AW ✓ measure temperature / use a thermometer / put (all equipment) in freezer ✓	**2**	**3.3b × 2**	**ALLOW** AVP e.g. use solid CO_2 that sublimes rather than melts / wrap the ice-cube in cling film/ use waterproof paper / laminate / cover in a thin layer of plastic
		(ii)	use smaller ice cubes / put the ice cubes on a warm surface / put each ice cube under a lamp ✓	**1**	**3.3b**	**ALLOW** put in a warmer environment / break up the ice

Question			Answer	Marks	AO element	Guidance
12	(a)	(i)	arrow perpendicular to surface, upwards and left labelled N ✓	1	2.1	 Perpendicular and parallel by eye. **ALLOW** in **(a)(ii)** one mark for missing or incorrect labels for both parts of the question **ALLOW** arrows anywhere on diagram
		(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	**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 **ALLOW** second mark for 'every action has an equal and opposite reaction'
		(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 ionising 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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