



**GCSE (9-1)**

**Physics B (Twenty First Century)**

Unit **J259F/01**: Foundation Tier – Breadth in physics

General Certificate of Secondary Education

**Mark Scheme for June 2018**

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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
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	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:

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
<b>AO3.2</b>	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.
<b>AO3.3</b>	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)		longitudinal ✓		1	1.1	electromagnetic <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">longitudinal</span> radio transverse
	(b)		<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = 336 (m/s) award 2 marks $0.84 \times 400$ ✓ = 336 (m/s) ✓		2	2.1 x2	ALLOW 340 (m/s)

Question			Answer		Marks	AO element	Guidance												
2	(a)	(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33.33%;">Wire</td><td style="width: 33.33%;">Connected to National Grid</td><td style="width: 33.33%;">Is at the same voltage as the ground</td></tr> <tr> <td>Live</td><td>✓</td><td></td></tr> <tr> <td>Neutral</td><td>✓</td><td></td></tr> <tr> <td>Earth</td><td></td><td>✓</td></tr> </table>	Wire	Connected to National Grid	Is at the same voltage as the ground	Live	✓		Neutral	✓		Earth		✓		2	1.1 x2	all 3 correct gets 2 marks. 2 correct gets 1 mark. No marks if only one correct.
Wire	Connected to National Grid	Is at the same voltage as the ground																	
Live	✓																		
Neutral	✓																		
Earth		✓																	
		(ii)	230 V ✓		1	1.1	0 V 12 V <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">230 V</span> 25000 V												
	(b)		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;"></td><td style="width: 25%;">True only for d.c</td><td style="width: 25%;">True only for a.c</td><td style="width: 25%;">True for both</td></tr> <tr> <td>Current always flows in the same direction.</td><td>✓</td><td></td><td></td></tr> <tr> <td>The domestic supply in the UK uses this.</td><td></td><td>✓</td><td></td></tr> </table>		True only for d.c	True only for a.c	True for both	Current always flows in the same direction.	✓			The domestic supply in the UK uses this.		✓			2	1.1 x2	
	True only for d.c	True only for a.c	True for both																
Current always flows in the same direction.	✓																		
The domestic supply in the UK uses this.		✓																	

Question			Answer				Marks	AO element	Guidance																		
3	(a)		1.2 m/s ✓				1	1.1	0.12 m/s <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">1.2 m/s</span> 12 m/s   120 m/s																		
	(b)		$\frac{36 \times 1000}{3600}$ ✓				1	2.1	$\frac{36 \times 60}{1000}$ $\frac{36 \times 1000}{60}$ $\frac{36 \times 3600}{1000}$ <span style="border: 1px solid black; border-radius: 50%; padding: 2px;">(36 \times 1000) / 3600</span>																		
	(c)	(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td></td><td style="text-align: center;">A</td><td style="text-align: center;">B</td><td style="text-align: center;">C</td><td style="text-align: center;">D</td></tr> <tr> <td>In which section does Sam have an average speed of 3.5 m/s?</td><td style="text-align: center;">✓</td><td style="text-align: center;"> </td><td style="text-align: center;"> </td><td style="text-align: center;"> </td></tr> <tr> <td>In which section does Sam slow down?</td><td style="text-align: center;"> </td><td style="text-align: center;"> </td><td style="text-align: center;">✓</td><td style="text-align: center;"> </td></tr> </table>					A	B	C	D	In which section does Sam have an average speed of 3.5 m/s?	✓				In which section does Sam slow down?			✓		2	2.2 1.2				
	A	B	C	D																							
In which section does Sam have an average speed of 3.5 m/s?	✓																										
In which section does Sam slow down?			✓																								
	(c)	(ii)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = $0.7 \text{ (m/s}^2)$ award 3 marks  Reading off the graph: change in speed = $(7 \text{ (m/s)} - 0)$ ✓  $7(\text{m/s}) \div 10 \text{ (s)}$ ✓  $= 0.7 \text{ (m/s}^2)$ ✓				3	1.2 2.1 2.1	<b>ALLOW</b> just 7 and/or just 10 for first marking point. <b>ALLOW</b> use of any data points from section A of graph eg $3.5 \div 5$ .																		

Question			Answer				Marks	AO element	Guidance		
4			<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = 230 (N) award 3 marks  Recall: weight = mass × gravitational field strength ✓  $= 23 \text{ (kg)} \times 10 \text{ (N/kg)}$ ✓ $= 230 \text{ (N)}$ ✓				3	1.2 2.1 2.1			

Question		Answer	Marks	AO element	Guidance
5	(a)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 400 (N m) award 3 marks</b></p> <p>Recall: moment = force <math>\times</math> distance ✓</p> <p><math>200 \text{ (N)} \times 2(0) \text{ (m)} \checkmark</math>  <math>400 \text{ (N m)} \checkmark</math></p>	3	<p>1.2</p> <p>2.1</p> <p>2.1</p>	
	(b)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 1.6 (m) award 3 marks</b></p> <p>Moment of Max's weight (about pivot) = 400 (N m) ✓</p> <p><math>250 \text{ (N)} \times d = 400 \text{ (N m)} \Rightarrow d = 400 \text{ (N m)} \div 250 \text{ (N)} \checkmark</math>  <math>= 1.6 \text{ (m)} \checkmark</math></p>	3	<p>1.2</p> <p>2.1</p> <p>2.1</p>	<p>ECF incorrect answer to (a) or term for moment.</p> <p><b>ALLOW</b> ratio method eg, <math>250 \div 200 = 2 \div d</math></p>

Question		Answer	Marks	AO element	Guidance
6	(a)	<p>Ray from bulb continues in straight line to touch mirror ✓</p> <p>Reflected ray is straight line from point of reflection to face (anywhere between eye and chin) ✓</p>	2	1.2 2.2	Must be a solid line.
	(b) (i)	<p>water from the bath evaporates / changes to gas ✓</p> <p>water / steam then condenses / changes back to liquid when it touches the mirror ✓</p>	2	1.1 x2	ALLOW water changes to steam.
	(ii)	<p>the light is scattered / reflected / refracted by water droplets ✓</p> <p>all colours / all the light from light bulb / in all directions / diffuse /specular ✓</p>	2	1.1 x2	

Question		Answer	Marks	AO element	Guidance
7	(a) (i)	0.05 m ✓	1	1.2	0.05 m 0.15 m 0.25 m 0.35 m
	(a) (ii)	Recall and rearrange: spring constant = force ÷ extension ✓ $= 20 \div 0.050$ ✓ $= 400$ (N) ✓	3	1.2 2.1 2.1	<b>ALLOW ECF</b> from (a)(i) for first two marking points. <b>ALLOW</b> reverse argument. Must equal 400 (N) as this is 'show that'.
	(b)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> If answer = 0.5 (J) award 3 marks <b>EITHER:</b> select: $\frac{1}{2} k x^2$ ✓ energy stored = $0.5 \times 400 \times 0.050^2$ ✓ = 0.5 (J) ✓ <b>OR</b> Select: select: $\frac{1}{2} F x$ ✓ energy stored = $0.5 \times 20 \times 0.050$ ✓ = 0.5 (J) ✓	3	1.2 2.1 2.1	<b>ALLOW ECF</b> from extension value in (a)(i)
	(c)	(directly) proportional ✓	1	3.1a	<b>ALLOW</b> linear <b>ALLOW</b> doubling the force doubles the extension.
	(d)	<b>ANY 3 OF:</b> elastic (potential) energy (stored in spring) ✓ transfer to kinetic energy store as spring moves /oscillates ✓ transfer to gravitational energy store as spring oscillates / moves up ✓ energy dissipated as thermal energy store in spring / air/ surroundings ✓ energy is transferred, or work is done by friction /air resistance ✓	3	1.1 x3	

Question			Answer		Marks	AO element	Guidance			
8	(a)	(i)	95 ✓		1	1.1	95	241	241 + 95	241 - 95
	(a)	(ii)	241 - 95 ✓		1	1.1	95	241	241 + 95	241 - 95
	(b)	(i)	<b>EITHER:</b> Paper blocked (most of) the radiation / reduces count rate ✓ Alpha radiation is stopped by paper / Beta radiation passes through paper.✓ <b>OR</b> There is no difference in count rate between paper and aluminium. ✓ Beta radiation would be stopped by aluminium. ✓		2	3.1b x2				
	(b)	(ii)	Use lead (as blocking material) ✓ gamma radiation is absorbed by lead ✓		2	3.3a x2				
	(c)		<b>EITHER</b> (It is not dangerous because) Alpha radiation is not penetrating ✓ So is absorbed/ stopped by case of smoke alarm ✓ <b>OR</b> (It is not dangerous because) The amount of (gamma) radiation is very small / gamma is not very ionising ✓ So people in houses will absorb very little gamma radiation ✓		2	3.1b x2				

Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	correct symbol (circle containing V) connected in parallel with component Y ✓	1	2.2	
		(ii)	variable resistor / change resistance ✓ increase resistance to decrease current / ORA ✓	2	2.1 x2	
	(b)	(i)	<b>FIRST CHECK THE ANSWER IN TABLE</b> <b>If answer = 3.77 (<math>\Omega</math>) award 4 marks</b> Recall and rearrange: $R = V/I$ ✓ 6.0 / 1.59 ✓ 3.77 ( $\Omega$ ) (ignore s.f.) ✓ correct rounding to s.f. ✓	4	1.2 2.1 2.1 1.2	
		(ii)	as current increases, resistance increases ✓	1	3.1a	<b>ALLOW</b> positive correlation.
		(iii)	(filament) lamp / bulb / heating element / fuse ✓ resistance increases as it heats up ✓	2	3.2b x2	.

Question		Answer	Marks	AO element	Guidance	
10	(a)	(i)	<p>A <input checked="" type="checkbox"/> ✓</p> <p>B <input type="checkbox"/></p> <p>C <input type="checkbox"/></p>	1	1.1	
		(ii)	<p>A <input checked="" type="checkbox"/> ✓</p> <p>B <input checked="" type="checkbox"/> ✓</p> <p>C <input type="checkbox"/></p>	1	1.1	Both ticks required for the mark.
	(b)		<p><b>EITHER</b> bar magnet is permanent / does not lose magnetism / stays magnetic <b>OR</b> iron bar is induced magnet / will lose magnetism / will not stay magnetic ✓</p>	1	1.1	<b>ALLOW:</b> Iron bar is only magnetic / picks up paper clips when the magnet is there.
	(c)		<p><i>A compass will always point towards.....</i> <input type="checkbox"/> True <input checked="" type="checkbox"/> False</p> <p><i>The Earth's magnetic north pole is the same.....</i> <input type="checkbox"/> True <input checked="" type="checkbox"/> False</p> <p><i>The core of the Earth is magnetic.....</i> <input checked="" type="checkbox"/> True <input type="checkbox"/> False</p> <p><i>The compass points down because the surface.....</i> <input type="checkbox"/> True <input checked="" type="checkbox"/> False</p>	2	1.1 2.1 1.1 2.1	All 4 correct = 2 marks 2 or 3 correct = 1 mark 1 correct = 0 mark

Question		Answer	Marks	AO element	Guidance
11	(a)	<p><b>MAX 3 in total:</b>  <b>MAX 2 similarities:</b>  temperature increases (as time increases) / both graphs go up ✓    both graphs level off/increase less rapidly as time goes on ✓</p> <p><b>MAX 2 differences:</b>  black goes up quicker / graph is steeper (or reverse argument) ✓    black reaches higher temperature / silver reaches a lower temperature ✓    silver starts at lower temperature / black starts at a higher temperature ✓</p>	3	3.1a x3	<p><b>ALLOW</b> they both get hotter</p> <p><b>ALLOW</b> black has a higher temp / silver has a lower temperature as one difference (instead of one of the latter two, but not both)</p> <p><b>IGNORE</b> any attempt at explanation in this part.</p>
	(b)	<p><b>EITHER</b>  black absorbs more radiation/light/infrared than silver  ORA ✓  <b>OR</b>  silver reflects more radiation/light/infrared than black ORA ✓  so more <u>energy</u> transferred to black thermometer ORA ✓</p>	2	1.1 x2	<p><b>ALLOW</b> heat</p>
	(c)	<p><b>EITHER</b>  distance from lamp / intensity of radiation or light is not controlled / the same ✓  method to control this e.g. measure distance / use ruler / clamp thermometers, AW ✓  <b>OR</b>  initial temperature is not controlled / not the same ✓  method to control this e.g. use separate timers for each thermometer and start them at a specified temperature ✓</p>	2	3.3b x2	<p><b>ALLOW</b> Any valid weakness for first mark and any reasonable method for second mark.</p>

Question		Answer	Marks	AO element	Guidance
12	(a)	<p><b>Any two from:</b></p> <p>planets are not all made of rock / some are made of gas ✓</p> <p>planets do not orbit in perfect circles / in ellipses ✓</p> <p>not all planets have moons (e.g. Venus, Mercury) ✓</p> <p>moons not all rocky/may be icy (e.g. Enceladus) [even though they may all have rocky cores] ✓</p>	2	1.1 x2	<p><b>ALLOW</b> specific correct examples, e.g. Jupiter not made of rock / made of gas, Venus does not have a moon, Saturn has moon(s) of ice</p> <p><b>ALLOW</b> a correctly identified statement quoted or identified from the report</p> <p>If more than two examples given apply list rule</p> <p><b>IGNORE</b> attempts to qualify a correctly identified statement with an incorrect example</p>
	(b)	<p>dust and gas ✓</p> <p>pulled together by gravity ✓</p>	2	1.1 x2	<p><b>ALLOW</b> dust / gas / matter / nebula</p> <p>Only give credit for responses that describe the formation of the solar system</p>
	(c)	mass is converted into energy (of radiation) ✓	1	1.1	<p>e.g. quoting <math>E = mc^2</math></p> <p><b>ALLOW</b> mass is lost in the form of energy</p> <p><b>ALLOW</b> mass is transferred/turned into energy</p>

Question		Answer	Marks	AO element	Guidance
13	(a)	(transferred by) electric current / electrically / electrical working ✓	1	1.1	<b>ALLOW</b> by a flow of electrons / current / electricity / <b>IGNORE</b> references to National Grid / wires /cables /transformers
(b) (i)		<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 864 (J) award 3 marks</b></p> <p>recall <b>and</b> rearrange equation: energy = p.d. × charge ✓</p> <p>substitution <math>2 \times 1.2 \times 360</math> ✓</p> <p>= 864 (J) ✓</p>	3	1.2 2.1 2.1	<p>Equations used to calculate energy must have energy as the subject (accept W for E).  <b>ALLOW</b> <math>E = ItV</math> <b>and</b> <math>Q = It</math> / <math>E = Pt</math> <b>and</b> <math>P = VI</math> and <math>Q = It</math> / <math>360 \times 1.2</math> seen</p> <p>Correct substitutions gain m.p 1 also</p> <p><b>DO NOT ALLOW</b> bald '86400' or '1728' or '432'. Credit can only be given for working</p>
(b) (ii)		<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 3.0 (A) award 4 marks</b></p> <p>Recall <b>and</b> rearrange: current = charge / time ✓</p> <p>Convert 2 minutes = 120 s ✓</p> <p>= <math>360 / 120</math> ✓</p> <p>= 3.0 (A) ✓</p>	4	1.2 2.1 2.1 2.1	<p><b>ALLOW</b> 3 marks for 180 (unit conversion omitted)</p> <p><b>ALLOW</b> '3 (A)'</p>

Question		Answer	Marks	AO element	Guidance
14	(a)	<b>FIRST CHECK THE ANSWER</b> <b>If answer = 720 000 (J) award 2 marks</b>  substitution $4.5 \times 1600 \times (120-20)$ ✓  $= 720\ 000\ (J)$ ✓	2	2.1 2.1	<b>ALLOW</b> 20 or 120 for $\Delta T$ to give 144 000 or 864 000  Does not need comparison with 700 000 for the mark
	(b)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 480 (s) award 3 marks</b>  recall <b>and</b> rearrange: time = energy / power ✓  substitution $720\ 000 / 1500$ ✓  $= 480\ (s)$ ✓	3	1.2 2.1 2.1	<b>ECF</b> (a) or energy = 700 000 (J)  <b>ALLOW</b> for 2 marks '48' or '4800' as a transcription error.
	(ii)	energy transferred to the metal radiator / in the wires ✓	1	1.1	<b>ALLOW</b> 'energy is lost to the surroundings' <b>IGNORE</b> it heats up the room / ignore efficiency arguments <b>DO NOT ALLOW</b> 'loss' on its own

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