OCR
Oxford Cambridge and RSA

GCSE (9-1)

Physics B (Twenty First Century)

Unit **J259F/02**: Foundation Tier – Depth 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.

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

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)	(i)	0.2 (seconds) ✓	1	2.2	± 0.01 s
		(ii)	0.57 (seconds) ✓	1	2.2	± 0.01 s
		(iii)	0.37 (seconds) ✓	1	2.1	**ECF** values from ai and aii
	(b)		Recall: v=s/t ✓ Realises that you have to double the distance / half the time ✓	2	1.2 2.1	**ALLOW** in words
	(c)		His value of time was inaccurate ✓ Did not have accurate clock/computer ✓	2	3.1b 3.2b	**ALLOW** other valid suggestion **ALLOW** 'did not have the technology'

Question			Answer	Marks	AO element	Guidance
2	(a)		Refraction ✓ Speed ✓ Absorption ✓	3	1.1 x3	
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 0.3(0) (m/s) award 2 marks** = 2.5 (Hz) × 0.12 (m) ✓ = 0.3(0) (m/s) ✓	2	2.1 x2	
		(ii)	**Any two from:** Shows the waves slowing down / changing speed. ✓ Shows the wavelength becoming smaller (entering glass or shallow water **ORA**). ✓ Shows the change in direction ✓ (Which) shows refraction ✓ Shows that light is a wave (because it does the same thing). ✓	2	3.1a x2	**ALLOW AW** for changing direction

Question			Answer	Marks	AO element	Guidance
3	(a)		Alternating means changing/swapping direction/**AW** ✓ Direct means constant/always the same way/**AW** ✓	2	1.1 x2	**ALLOW** annotated diagram
	(b)	(i)	**FIRST CHECK THE ANSWER IN THE ANSWER BOX.** **If answer = 300 000 (A) award 3 marks** output current = input p.d. × input current / output p.d. ✓ Output current = 230 000 × 300/230 (A) ✓ = 300 000 (A) ✓ **OR** 230 000 × 300 (A) = 230 × output current (A) ✓ 69 000 000 = 230 × output current output current = 69 000 000 / 230 (A) ✓ Output current = 300 000 (A) ✓	3	1.2 2.2 x2 1.2 2.2 2.2	Give full credit for use of inverse proportion, e.g. 'voltage gets 1000 × smaller, so current gets 100 × bigger'
		(ii)	Recall: Power = p.d. × current ✓ = 23 000 (V) × 3000 (A) = 69 000 000 (W) ✓ = 69 (MW) (so > 60 MW) ✓	3	1.2 2.1 x2	**NOT** 230 000 (V) × 300 (A)
		(iii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 6900 award 2 marks** Number = total output power/10 (kW) ✓ = 69 000 000 (W)/ 10 000(W) = 6900 ✓	2	2.2 x2	**ECF** 3bii

Question			Answer	Marks	AO element	Guidance
	(c)		Energy is dissipated as current heats the power cables ✓ **Any one from:** Current is smaller in the power cables ✓ Smaller current means less heat/smaller energy dissipated ✓	**2**	**1.1** **3.1a**	**ALLOW** 'energy loss' in place of energy dissipated **ALLOW** 'power' in place of 'energy' **ALLOW** example: e.g. for 230 000 V instead of 23 000 V current = 300 A instead of 3 000 A

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 40 award 2 marks** Number = 1400 (MW)/35(MW) ✓ = 40 ✓	**2**	**2.2 x2**	
		(ii)	**Any two from:** Does not work at night ✓ Days are shorter in winter ✓ Less power generated in cloud/rain ✓ Early morning/late evening the Sun is very low ✓ Panels get dirty / rays blocked by objects (e.g. trees) ✓	**2**	**2.1 x2**	**ALLOW** 1 max for idea that there is not always enough sunlight **ALLOW** Sunlight not always directly on them
	(b) *		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Describes some advantages and disadvantages of **BOTH** solar farms **and** gas-burning power stations, showing an understanding of non-renewable and renewable energy resources. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	**6**	**1.1 x2** **3.2b x4**	**AO1.1 Demonstrates knowledge and understanding of renewable vs. non-renewable energy resources** For example: • Gas is non – renewable so will run out • Solar is renewable • A renewable energy resource will not run out

Question			Answer	Marks	AO element	Guidance
			Level 2 (3–4 marks) Describes some <u>advantages</u> of **BOTH** solar farms **and** gas-burning power stations, showing an understanding of non-renewable and renewable energy resources. **OR** Describes some <u>disadvantages</u> of **BOTH** solar farms **and** gas-burning power stations, showing an understanding of non-renewable and renewable energy resources. **OR** Describes some advantages **and** disadvantages of **BOTH** solar farms and gas-burning power stations. *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)** Describes some advantages **and** disadvantages of gas-burning power stations <u>ONLY</u>. **OR** Describes some advantages **and** disadvantages of solar farms <u>ONLY.</u> **OR** Describes some advantages **or** disadvantages of <u>BOTH</u> solar farms and gas-burning power stations. **OR** Shows an understanding of non-renewable and renewable energy resources. *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.*			**AO3.2b Draws a conclusion describing advantages and disadvantages** For example: Advantages – solar farm • A solar farm can be used for grazing animals • Less pollution produced when generating electricity • solar power stations don't produce CO_2 (once built) Advantages – gas-burning power station • More power produced than solar farms • Gas is not reliant on weather conditions/light levels Disadvantage – solar farm • maximum solar output is 40 × smaller than gas [**ECF** part **(a)**] • Reliant on the weather conditions • Solar panel production is polluting • Looks ugly • Solar farms take up space Disadvantage – gas-burning power station • CO_2 contributes to global warming • Gas produces CO_2 • which damages the environment

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	U has A = 234 ✓ U has Z = 92 ✓	2	2.2 x2	
		(ii)	Alpha particles cannot penetrate a thin sheet of paper ✓ The aluminium in the case is thicker and denser than thin paper ✓	2	1.1 2.1	1st and 4th boxes
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 10 (%) award 3 marks** = 1.6 (kWh) / 16 (kWh) **OR** 0.1 ✓ = 0.10 x 100 (%) ✓ = 10 (%) ✓	3	3.1b 1.2 x2	**ALLOW** 1 mark for 90%
		(ii)	18(kWh) ÷ 1.6(kWh) ✓ = 11.25 (hours) (which is more than 10 h) ✓	2	2.2 3.1a	**ALLOW** 1.6 (kWh) × 10 (h) = 16 (kWh) Which is less than 18 (h) **AW**
	(c)		25 (km/h) × 4 (h) = 100 (km) ✓ Straight diagonal line from [0,0] ✓ Stopping at [100,4] ✓ horizontal line from [100,4] to [100,14] ✓	4	1.2 2.2 x3	May be shown by the correct graph **ALLOW ECF** from mp3

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 1.6 (J) award 3 marks** ∆g.p.e. = *mgh* ✓ = 0.80 (kg) × 10 (N/kg) × 0.20 (m) ✓ = 1.6 (J) ✓	**3**	**1.2** **2.1** **2.1**	
		(ii)	Air resistance is very small. ✓ There is not much friction acting on the trolley. ✓	**2**	**3.1a** **2.1**	1st and 5th box
		(iii)	1.3 m ✓	**1**	**2.2**	3rd box
	(b)	**(i)**	If trolley has not fallen any distance, there is no potential energy to transfer to kinetic energy. ✓	**1**	**1.1**	**ALLOW** (At the start) trolley has not moved and so KE and distance are both 0 AW
	(b)	**(ii)**	All three points correctly plotted {± 1 a small division} ✓ Best-fit smooth curve ✓	**2**	**2.2 × 2**	**ECF** own misplotting
	(c)		More energy, goes further /positive correlation ✓ Less increase in distance at higher energies ✓	**2**	**3.1a x2**	**ALLOW ECF** their plotted graph

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	**D** ✓	1	2.1	
		(ii)	**B** ✓	1	2.1	
		(iii)	**D** ✓	1	2.1	
		(iv)	**C** ✓	1	2.1	
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 200 (kPa) award 2 marks** 100 (kPa) × 300 (cm^3) = 30000 (kPa cm^3) ✓ New P × 150 (cm^3) = 30000 (kPa cm^3) New P = 30000 (kPa cm^3)/ 150 cm^3 = 200 (kPa) ✓ **OR** 100 (kPa) × 300 (cm^3) = New P × 150 (cm^3) ✓ New P = 100 (kPa) × 300 (cm^3) ÷ 150 (cm^3) New P = 200 (kPa) ✓	2	1.2 2.1 1.2 2.1	**ALLOW** e.g 'half V means double P'
	(c)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 150 000 (Pa) award 3 marks** Pressure = force/area ✓ = 300 (N)/0.002 (m^2) ✓ = 150000 (Pa) ✓	3	1.2 2.1 2.1	

Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	As the illuminance increases, the change in resistance becomes less and less. (3rd option) ✓	1	1.2	
	(a)	(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer is between 14.0 & 16.0 (kΩ) award 2 marks** *R* (at 10 lux) = 20 (kΩ) **OR** *R* (at 70 lux) = {5 ± 1} (kΩ) ✓ Second *R* and ΔR = 20 (kΩ) – {5 ± 1}(kΩ) = 14.0 – 16.0 (kΩ) ✓	2	2.2 × 2	**ALLOW** + or – for ΔR as this is a decrease
	(b)	(i)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer= 0.000 20(5)/2.0(5) x10 $^{-4}$ (A) award 3 marks** current = *V*/*R* ✓ = 4.5 (V) / 22 000 (Ω) ✓ = 0.000 20(5) / 2.0(5) x 10^{-4} (A) ✓	3	1.2 2.1 2.1	**IGNORE** significant figure errors or rounding errors **ALLOW** any form of equation for mp1 and mp 2 Incorrect *R* loses mp2 **ECF** own values but penalise for power of ten errors
	(b)	(ii)	**FIRST CHECK THE ANSWER ON THE ANSWER LINE.** **If answer = 2.0(5) (V) award 3 marks** Unit conversion 10 k(Ω) = 10000 (Ω) ✓ p.d. = 0.000 20(5) (A) × 10 000 (Ω) ✓ = 2.0(5) (V) ✓ **OR** p.d. = 4.5 (V) × {R/R_{total}} ✓ = 4.5 (V) × 10 000 (Ω) ÷ 22 000 (Ω) ✓ = 2.0(5) (V) ✓	3	1.2 1.2 2.1	**ECF** from (b)(i)

Question			Answer	Marks	AO element	Guidance
		(iii)	(As illuminance increases) resistance decreases /current increases ✓ p.d. (across 10 k Ω resistor) increases. ✓ Resistance changes get smaller / less as illuminance increases, so change in p.d. becomes smaller ✓	3	2.2 3.1a × 2	**ALLOW** potential divider argument for mp2 & mp3

Question			Answer	Marks	AO element	Guidance
9	(a)*		*Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Correct calculation to check whether the value of SLH is greater than 2300 J/g **AND** specific evaluation / development. *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)** Correct calculation to check whether the value of SLH is greater than 2300 J/g **OR** Identifies at least one shortcoming of Sarah's experiment **OR** suggests at least one valid improvement. *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)** May attempt to use data to check statement **OR** Makes generic suggestion(s) to improve the procedure, e.g. repeat readings, use a more accurate balance. *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**	**2.2 × 2** **3.1b × 2** **3.3a × 2**	**Indicative scientific points may include:** **AO2.2 Calculation of SLH** • P = 3.0 A × 12 V = 36 W • $\Delta E = Pt$ = 36 W × 150 s = 5400 J • Δm = {185.3 g – 184.3 g} = 1.0 g • $L = \Delta E/\Delta m$ = 5400 J/1.0 g = 5400 J/g **AO3.1b Evaluation of experiment** • Heat losses constitute the (most) significant shortcomings • Not all of heater in the water • Thermal energy will dissipate through sides and bottom of beaker • Thermal energy will dissipate from the water surface • Relatively low mass of water evaporated **AO3.3a Development of experimental procedure** • Ensure water level is above top of heater. • Surround beaker sides and bottom with insulating material • Cover top of beaker to limit convection losses (but still allow water vapour to escape) • Use higher powered heater to evaporate more water in the same time • Make sure water is boiling before starting measurements. • Longer time/higher current/voltage to evaporate more water.

Question			Answer	Marks	AO element	Guidance
9	(b)		**Any three from:** Force between particles in water are stronger than those in alcohol / AW ✓ Bonds must be broken to change state ✓ (from table) *L* for alcohol < *L* for water ✓ Alcohol is more volatile than water ✓ Water is denser than alcohol ✓ Water molecules are smaller/closer together than alcohol molecules ✓ More molecules in 1g of water than in 1g of alcohol ✓ More intermolecular bonds to be broken ✓	**3**	**1.1** **1.1** **3.2a**	**ALLOW** atoms/molecules for particles

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