OCR
Oxford Cambridge and RSA

GCSE (9-1)

Combined Science B (Twenty First Century)

Unit **J260/03**: 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
A	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 Combined Science 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)		radio waves ✓	1	1.1	
	(b)	(i)	ultraviolet ✓	1	2.1	
	(b)	(ii)	(blackened) thermometer (bulb) **OR** thermistor **OR** temperature sensor ✓ detects rise in temperature ✓	2	2.1 x 2	**ALLOW** use hand/skin **ALLOW** infrared camera **ALLOW** it would feel hot/warmer.
	(c)		Example, e.g. Heating / cooking / communication (signals) / TV remote control / astronomy / thermal cameras / rangefinders ✓	1	1.1	**ALLOW** any correct example **ALLOW** to detect (breast) cancer **IGNORE** Night vision goggles etc.

Question			✓Answer	Marks	AO element	Guidance
2	(a)		force ✓ attraction ✓ mass ✓	3	1.1 2.1 2.1	**ALLOW** force and attraction in either order
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 26 (N) award 2 marks** = 2.6 x 10 ✓ = 26 (N) ✓	2	2.1 x2	
	(c)		Take a reading of the pan only ✓ Take reading of egg and subtract reading of pan✓	2	1.2 x2	**ALLOW** zero newton meter with pan on and then take reading with egg for 2 marks

Question			Answer	Marks	AO element	Guidance
3	(a)		Weight OR gravitational attraction ✓ Downwards ✓ (normal) reaction ✓ Upwards ✓	4	1.1 x4	**Allow** reverse order Note: no direction mark if force is **WRONG or missing.** **ALLOW** gravity **ALLOW** down onto the slide **IGNORE** down the slide **IGNORE** Reactant / upthrust / upforce
	(b)	(i)	Friction ✓	1	2.1	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 200 (N) award 2 marks** = 40 x 5 ✓ = 200 (N) ✓	2	2.1 x2	
	(c)		Tick in the second box (two arrows both the same length) ✓	1	2.1	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 13.75/13.8 award 2 marks

165 ÷ 12 ✓
= 13.75 / 13.8 ✓

A / amp(s) / ampere(s) ✓</td><td>3</td><td>2.1 x2

1.2</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th></th><th>True</th><th>False</th></tr><tr><td>If the current changes the resistance of the heating element remains constant.</td><td></td><td>✓</td></tr><tr><td>The size of the current depends on the potential difference across the heating element.</td><td>✓</td><td></td></tr><tr><td>The size of the current depends on the resistance of the heating element.</td><td>✓</td><td></td></tr></table></td><td>3</td><td>1.1 x3</td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>Chemical ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>doing work ✓
heating ✓</td><td>2</td><td>2.1 x2</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Thermal ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>Recall Power = energy (transferred) / time OR $P = E / t$
OR energy (transferred) = power x time OR $E = P\,t$ ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 9900 (J) award 2 marks

= 165 × 60 ✓
= 9900 (J) ✓</td><td>2</td><td>2.1 x2</td><td>ECF from (d)(i)</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	Transverse: disturbance/oscillation is perpendicular **OR** at right angles to direction of motion ✓ Longitudinal: disturbance/oscillation is parallel to direction of motion ✓	**2**	**1.1 x 2**	**ALLOW** diagrams with direction of travel labelled and direction of disturbance/oscillation shown to be perpendicular for transverse, parallel for longitudinal.
		(ii)	Reflected ✓	**1**	**2.1**	
	(b)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5000 (m/s) award 2 marks** 18000 x 1000 / 60 x 60 ✓ = 5000 (m/s) ✓	**2**	 **1.2** **2.2**	 **ALLOW** divide by 3600
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2700 (m) award 3 marks** Choose speed from table 1500 (m/s) ✓ = 1500 x 1.8 ✓ = 2700 (m) ✓	**3**	 **2.2** **2.1 x2**	
		(iii)	depth = (2700 ÷ 2 **OR** 1500 x 0.9) = 1350 (m) ✓	**1**	**2.2**	**ALLOW ECF** from (b)(ii)
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.21 (m) award 4 marks** Unit conversion: 20 kHz = 20 000 Hz ✓ = 4100 ÷ 20 000 ✓ = 0.205 ✓ = 0.21 (m) (2 decimal places) ✓	**4**	 **1.2** **2.1** **2.1** **1.2**	 **ALLOW** 2 marks for 205 (no unit conversion done)

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	Measuring cylinder ✓	1	3.3a	**DO NOT ALLOW** beaker **IGNORE** water
		(ii)	**Any two from:** The stone is covered with water. ✓ The can is full to the level of the spout. ✓ The measuring cylinder starts empty. ✓ All the displaced water is collected. ✓ Fingers are not immersed in water when the stone is added. ✓	2	3.3a x 2	**IGNORE** Repeat(s) **ALLOW** Water does not splash out of the can. **ALLOW** The measuring cylinder is read at eye level **OR** to bottom of meniscus.
	(b)		Mass per unit volume **OR** volume of 1 kg of something **OR** mass of a known volume	1	1.1	**ALLOW** mass divided by volume
	(c)	(i)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 44(.0) (cm^3) award 2 marks** 43.0 + 44.5 + 43 + 45 + 44.5 ✓ = 44(.0) (cm^3)✓	2	2.2 x2	
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5 (g/cm^3) award 3 marks** Recall density = mass ÷ volume ✓ = 220 ÷ 44 ✓ = 5 (g/cm^3) ✓	3	 1.2 2.1 x2	 **ECF** volume from (c)(i)
	(d)	(i)	Haematite ✓	1	3.2b	**ECF** density from (c)(ii)

Question			Answer	Marks	AO element	Guidance
		(ii)	**Any three from:** (Sundip is correct) You can't tell between two types of rocks with same density. ✓ Relevant example from table. ✓ You can rule out rocks of different density. ✓ You can't tell if there are other rocks not in the table with same density ✓	**3**	**3.2a x 3**	**ALLOW** 'You can only rule out rocks (in the table), you can't say it is one (in the table)' ✓✓ **ALLOW** it might be a rock not in the table.

Question			Answer	Marks	AO element	Guidance
7	(a)		The (average) time it takes ✓ For the number of nuclei (of an isotope in a sample) to halve ✓	2	2x 1.1	**ALLOW** average time for activity/count rate to halve ✓✓
	(b)		Chooses a count rate **AND** ½ initial value **OR** ¼ ✓ 10 (minutes) ✓	2	2x 2.2	**ALLOW** between 10 and 11 inclusive

Question			Answer	Marks	AO element	Guidance
8	(a)		Jack **AND** Two forces **OR** more than one force is needed✓	1	1.1	**DO NOT ALLOW** a tick for Jack without a reason
	(b)	(i)	Wear eye protection / goggles ✓ Protect feet from weights falling e.g. bucket to catch weights ✓	2	3.3a x2	Either order **ALLOW** protect floor/bench from weights falling
		(ii)	with mass/weight on spring: Record position of end of spring OR measure length of spring ✓ with no mass/weight on spring: Record position of end of spring OR measure length of spring ✓ Find the difference/subtract to get the extension. ✓	3	3 x 2.2	**ALLOW** description of setting zero on ruler to unstretched length of spring for 2nd and 3rd mark.
		(iii)	90 (cm) ✓	1	3.1a	
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (N) award 4 marks** Recall $F = kx$ ✓ Conversion: 35(cm) = 0.35(m) ✓ F = 8.0 x 0.35 ✓ = 2.8 (N) ✓	4	 1.2 1.2 2.1 x2	 **ALLOW** 3 marks for 280 (unit not converted)
	(d)		Rubber band: The graph is not a straight line/is not linear / The extension is not proportional to the force. ✓ Spring: The graph is a straight line /is linear/ The extension is proportional to the force. ✓	2	1.1 x 2	Answer can be shown by sketch graph

Question			Answer	Marks	AO element	Guidance
9	(a)		**Any five from:** Shown on diagram or written: central nucleus ✓ containing protons ✓ containing neutrons ✓ shells of / orbiting electrons ✓ nucleus positive ✓ electrons negative ✓ electron shell structure e.g. 2,8,8 ✓	5	5 x 1.1	**ALLOW** protons positive/neutrons no charge
	(b)	(i)	10^{-10} m ✓	1	1.1	
		(ii)	much smaller / about a 1000 times smaller✓	1	1.1	**DO NOT ALLOW** smaller unqualified **ALLOW** Tiny **ALLOW** converse e.g much bigger
	(c)	(i)	electrons ✓	1	1.1	**ALLOW** negative particles
		(ii)	idea of matter /stuff / continuous medium ✓ containing electrons ✓ matter positive OR electrons negative ✓	3	3 x 1.1	**ALLOW** 'like pudding with (electrons as) plums/currants' **DO NOT ALLOW** reference to (electron) shells
	(d)		number of neutrons / mass /mass number ✓ **OR** carbon 14 has two more neutrons(than carbon 12) / carbon 12 has two fewer neutrons than carbon 14 ✓✓	2	2 x 2.1	**ALLOW** Atomic mass/RAM correct reference to size of difference in number of neutrons gains both marks

Question			Answer	Marks	AO element	Guidance
10*			*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)** Correctly chooses transformer B based on correct calculations. **AND** Justified based on an evaluation of the data. *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)** Correctly chooses transformer B, based on attempt to complete the calculations. **AND** An attempt to justify choice based on an evaluation of the data. **OR** Chooses transformer A or C (incorrect choice), based on attempt to complete the calculations. **AND** An attempt to justify choice based on an evaluation of the data. *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)** States a transformer **and** provides a reason for the choice. *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**	**1x 3.2a** **3 x 2.1** **2 x 3.1b**	**AO3.2a Analyse information and ideas to make judgements** Transformer B chosen **AO2.1 Apply knowledge and understanding of how to calculate currents and p.d.s** For example • substitutes values into equation *IV* in primary = *IV* in secondary • in secondary: 12 V x 3 A = 36 W • In primary: 36 W ÷ 230 V = 0.16 A • **A** 30 W ÷ 12 V = 2.5 A • **B** 60 W ÷ 12 V = 5 A **AO3.1b Analyse data and evaluate which transformer is suitable** For example • Transformer B is suitable because power 60 W > 36 W **OR** Transformer A is too low power because power 30 W <36 W **OR** same analysis with calculated 2.5 A or 5 A compared with 3A required • Transformer C is unsuitable • because p.d. is not 12V

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