OCR
Oxford Cambridge and RSA

GCSE (9-1)

Combined Science B (Twenty First Century)

Unit **J260/07**: 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
	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 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)		**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
2*			*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.*	**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

Question			Answer	Marks	AO element	Guidance
			0 marks *No response or no response worthy of credit.*			

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = 0.86 Ω/ohm(s) award 5 marks

Recall and apply V = I R ✓

R = 12 ÷ 14 ✓

R = 0.857 ✓

= 0.86 (2 decimal places) ✓

Ω / ohm(s) ✓</td><td>5</td><td>1.2

2.1

2.1

1.2

1.1</td><td>mark awarded if substitution correct but not stated in words</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 potential difference across the battery increases if the resistance of the heating element increases.</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>4</td><td>1.1 x4</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>Resistance decreases ✓
AND
Because now two identical paths (for current to pass) ✓
OR
Because current shared equally (between two paths) ✓</td><td>2</td><td>2 x 1.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
						IGNORE current increases **note:** resistance halves includes the first marking point, hence two marks

Question			Answer	Marks	AO element	Guidance
4	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 32 (%) award 3 marks** (Total generated =) 83.3 x 100 ÷ 27 (TW h) ✓ (gas fired =) (99.8 ÷ 308.5) x 100 % ✓ = 32 (%) ✓	**3**	 **1.2** **1.2** **2.2**	 **ALLOW** 308.5 (TW h) **ALLOW** (99.8/83.3) x 27 for 2 marks **ALLOW** extra decimal places if rounds to 32
	(b)		Idea that renewable resources are replaced all the time (so they will not be used up) **OR** non-renewable resources (are being used faster than they are formed) eventually (they) will all be used up. ✓	**1**	**1.1**	**ALLOW** unlimited / not run out / can be used for ever / infinite **IGNORE** can be used again / recycled **ALLOW** limited / run out / finite **IGNORE** only use once / cannot be used again
	(c)		**Tidal power advantage** **Any one from:** Renewable ✓ Does not produce greenhouse gases/carbon dioxide / causes global warming ✓ **Tidal power disadvantage** **Any one from:** (Currently) does not produce much power / energy per year ✓ Few suitable sites✓ Requires large tidal lagoons to be built. ✓ Will affect marine life / birds ✓ Can only generate when there is a difference in water height ✓	**4**	**4 x 1.1**	 **ALLOW** there will always be water available **IGNORE** no pollution / no pollutant gases / no environmental impact **DO NOT ALLOW** just energy / electricity **ALLOW** changes habitat **IGNORE** harms nature/environment

Question			Answer	Marks	AO element	Guidance
			Gas-fired power station advantage **Any one from:** Lots of suitable sites / can build lots ✓ They can be used any time / on demand / quick start up✓ (Many gas power stations can be built and) can (currently) generate more power [or energy per year] ✓ **Gas-fired power station disadvantage** **Any one from:** Non-renewable / is a fossil fuel ✓ Burning gas produces greenhouse gases/carbon dioxide/ causes global warming. ✓			**ALLOW** can generate more energy than tidal lagoon **DO NOT ALLOW** just energy / electricity **IGNORE** pollution / pollutant gases / environmental impact / harms atmosphere **IGNORE** economic reasons in all parts

Question			Answer	Marks	AO element	Guidance
5	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.09 (J) award 3 marks** Converts 5 cm to 0.05 m ✓ Calculation showing area under graph between extension = 0 and 5cm e.g. ½ (3.5 x 0.05) ✓ =0.09 (J) ✓	**3** **1.2** **2.2** **2.2**		**ECF** if fails to convert i.e. uses 5 cm **ALLOW** extra decimal places if rounds to 0.09
	(b)	**(i)**	4 points correctly plotted ✓	**1**	**2.2**	all 4 points need to be plotted to within ½ small square **DO NOT ALLOW** more than 4 plotted points **IGNORE** any lines
		(ii)	(Relationship was) proportional ✓ after 4N it is not proportional ✓	**2**	**2 x 3.1a**	**ALLOW** linear **IGNORE** as one increases so does the other / correlation **ALLOW** after 4N Hooke's law does not apply / after 4N becomes non-linear **Note:** after 4N it is no longer proportional, or equivalent wording, gains 2 marks
		(iii)	permanently deformed **OR** does not go back to original length ✓ Plastic behaviour **OR** no longer elastic **OR** gone past its elastic limit ✓	**2**	**3.2b x2**	**IGNORE** plastic deformation / overstretched / does not go back to original shape **ALLOW** plastic deformation
	(c)		**Any five from:** Method of measuring force: e.g. hang masses/weights on spring. ✓	**5**	**3.3a x5**	Marking points can be shown on a **labelled** diagram **DO NOT ALLOW** measure the force with no indication of how this is to be measured **OR** 'with a forcemeter' with no indication of how to use it.

Question			Answer	Marks	AO element	Guidance
			Method of measuring extension: e.g. measure length with no force/unextended length ✓ measure extended length and subtract unextended length from extended length ✓ **OR** Clamp a ruler so that the zero mark is level with the bottom of the unextended spring ✓ Read off the value indicated by the pointer when the spring is extended ✓ **OR** Read off value indicated by a pointer when spring is not extended ✓ Read off the value indicated by the pointer when the spring is extended and subtract unextended reading from extended reading ✓ Wear goggles / method of catching weights safely if spring breaks / stand clamped to table ✓ Do not overload the spring ✓ Use a ruler vertical/parallel close to spring **OR** read at eye level ✓ Repeat measurements as spring is unloaded **OR** repeat measurements and take mean value ✓			**ALLOW** Any suitable method that results in extension and not length. **DO NOT ALLOW** measuring extended length **OR** reading of a pointer without indication of how extension and not length is measured

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.116 (m) award 3 marks**	3		
			Two correct readings from same point on the ant ✓		**2.2**	e.g head 0.8 and 12.4 (cm) Look at diagram
			Distance = 11.6 (cm) ✓		**2.2**	
			Converts 11.6 (cm) to 0.116 (m) ✓		**1.2**	**ECF** from distance value **DO NOT ALLOW** 0.12 (m) (unless distance =12)
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 7.3 (m/s) award 5 marks**	5		
			4 ms = 0.004 s ✓		**1.2**	
			4 frames/intervals = 4 x 0.004 = 0.016 (s) ✓		**2.2**	**ECF** if 5 frames used giving t = 0.02 (s)
			Recall and apply $s = d/t$ ✓		**1.2**	mark awarded if substitution correct but not stated in words
			s = 0.116 ÷ 0.016 ✓		**2.1**	**ECF** distance from (i) and t = 0.02 if 5 frames used
			s = 7.3 m/s ✓		**2.1**	**ALLOW** 7.2(5) m/s
		(iii)	Underestimate ✓	2	**3.2b**	No mark for stating underestimate or overestimate without reasonable attempt at explanation about distance/direction. e.g. did not run parallel to ruler **IGNORE** speed of ant
			Idea that ant covered a greater distance because it is further from the ruler at the end / may not have travelled in a straight line ✓		**3.2a**	
	(b)		**Any three from:** reflecting light reduces temperature ✓	3	**1.1 x 3**	**ALLOW** cools for temperature reduces **ALLOW** light not absorbed for reflecting
			radiating infra-red reduces temperature✓ sunshine/radiation increases temperature ✓ actual temperature is a balance of all 3 effects. ✓			**ALLOW** cools for temperature reduces **ALLOW** gets hot for increases temperature **note:** all answers are about temperature change not heat/thermal energy

Question			Answer	Marks	AO element	Guidance
7	(a)		Arrow down labelled *W*/weight/*mg/ force of gravity* ✓ Arrow up, same length, labelled lift/thrust ✓	2	2.1 x2	vertical by eye **ALLOW** label 18 N **IGNORE** just gravity equal by eye **IGNORE** upthrust/upward force **IGNORE** horizontal arrows
	(b)	(i)	diagonal to left and upwards labelled lift/thrust ✓ arrow vertically down labelled W/weight/mg/force of gravity/18N ✓ horizontal arrow opposite to direction of travel and labelled (air) resistance/drag ✓	3	2.1 1.1 2.1	same as angle in diagram above by eye **ECF** lift label from diagram above **ECF** weight label from diagram above
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.2 (m/s^2) award 5 marks** Resultant forward force = 6 – 2 = 4 (N) ✓ Recall *F* = *ma* ✓ *a* = 4 ÷ 1.8 ✓ = 2.22 (m/s^2) ✓ = 2.2 (m/s^2) ✓ (2 sf)	5	 2.2 1.2 2.1 2.1 1.2	 award mark if substitution correct but not stated in words **ALLOW** extra decimal places if rounds to 2.2
		(iii)	0 N✓	1	1.1	
		(iv)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8 (m/s) award 3 marks** Rearrange: speed^2 = 2 x K.E ÷ mass ✓ speed^2 = 2 x 58 ÷ 1.8 **OR** 64.4 ✓ speed = 8(.0) (m/s) ✓	3	 1.2 2.1 2.1	 Award mark if substitution correct but not stated in words **ALLOW** extra decimal places if rounds to 8

Question			Answer	Marks	AO element	Guidance
8	(a)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 50 (g) award 4 marks**	4		
			Apply volume of a cylinder = $\pi \times (\text{radius})^2 \times \text{height}$ $= \pi \times (7.5)^2 \times 40 = 7068$ ✓		2.2	
			recall density = mass / volume ✓		1.2	Award mark if substitution correct but not stated in words
			mass = $7.1 \times 10^{-3} \times 7068$ ✓		2.1	**ECF** volume
			= 50 (g) ✓		2.1	**ALLOW** extra decimal places if rounds to 50
	(b)		The molecules move faster/ gain kinetic energy ✓	3	1.1 x 3	
			Frequency of collisions with (walls of the) can increases **OR** They make more collisions with (the walls of) the can (per second) ✓			**IGNORE** more collisions between molecules/just more collisions
			the total change in momentum when they collide with the walls is greater ✓			

Question			Answer	Marks	AO element	Guidance
9	(a)		Chooses a count rate **AND** ½ initial value **OR** ¼ ✓ 5.5 ± 0.5 (years) ✓	2	2 x 2.2	Initial count rate chosen must be 96000 or less Values to within 1 small square look on graph and in answer space **ALLOW** extra decimal places if rounds to 5.5 ± 0.5
	(b)		**FIRST CHECK THE ANSWERS ON ANSWER LINES** **If first answer = 4** **AND second answer = 22 (years) award 4 marks** Halves 1.2×10^{13} repeatedly (to 7.5×10^{11}) ✓ **OR** doubles 7.5×10^{11} repeatedly (to 1.2×10^{13}) ✓ **OR** $1.2 \times 10^{13} \div 7.5 \times 10^{11} = 16$ ✓ **OR** $7.5 \times 10^{11} \div 1.2 \times 10^{13} = 0.0625$ **OR** 1/16 ✓ Number of half-lives = 4 ✓ 4 x 5.5 ✓ time before replacement = 22 (years) ✓	4	 2.2 2.2 2.1 2.1	 **ALLOW** any correct method **ECF** half-life from (a) **ALLOW** extra decimal places if rounds to 22
	(c)		**Any four from:** A very high activity source would give too high a dose. ✓ The activity of the source decreases as time passes so dose decreases. ✓ The higher the speed (the less exposure time) so lower the dose. **ORA** ✓ To increase the overall activity: sources can be added **OR** the lowest activity sources can be replaced with high activity sources ✓ Speed can be reduced as the activity drops/time passes to increase dose. ✓	4	2.1 x4	

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