OCR
Oxford Cambridge and RSA

GCSE (9-1)

Combined Science A (Gateway)

Unit **J250/12**: Physics

General Certificate of Secondary Education

Mark Scheme for June 2018

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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 A:

	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.

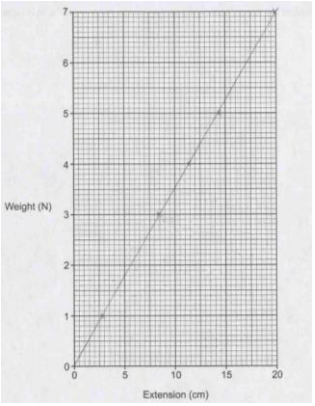
For answers to section A if an answer box is blank ALLOW correct indication of answer e.g. circled or underlined.

Question	Answer	Marks	AO element	Guidance
1	C ✓	**1**	**2.1**	
2	D ✓	**1**	**1.1**	
3	A ✓	**1**	**1.1**	
4	B ✓	**1**	**1.1**	
5	B ✓	**1**	**1.2**	
6	A ✓	**1**	**1.2**	
7	C ✓	**1**	**1.1**	
8	A ✓	**1**	**1.1**	
9	C ✓	**1**	**1.1**	
10	B ✓	**1**	**2.2**	

BLANK PAGES MUST BE ANNOTATED TO SHOW THEY HAVE BEEN SEEN

Question			Answer	Marks	AO element	Guidance
11	(a)		Distance between 2 points on a wave which are in phase or identical / distance between the peaks / distance between the troughs (is 6 m) ✓	1	2.1	**ALLOW** descriptions of peaks and troughs e.g. the distance between the highest parts of the wave / from maximum amplitude to maximum amplitude **ALLOW** one (complete) cycle of a wave (is 6 m) / the first wave starts at 0 m and ends at 6 m **ALLOW** descriptions together with annotations on the graph e.g. distance between points X and Y with the X and Y correctly positioned on the graph **DO NOT ALLOW** descriptions about the height or amplitude of the wave e.g. from 3 to -3 it is 6 m
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 3 (m/s) award 3 marks** (v =) f × λ **OR** speed = frequency × wavelength ✓ (v =) 0.5 × 6 ✓ (v =) 3 (m / s) ✓	3	 1.2 2.1 2.1	

Question	Answer	Marks	AO element	Guidance
(c)	**Either any two from:** **Count** number of waves passing a point ✓ Measure time (for these waves) with a **stopwatch** ✓ (Use frequency =) number of waves ÷ time or divide number of waves by time ✓ Repeat and take average values ✓ **Or any two from:** Measure length of ***n*** waves with ruler ✓ Divide by ***n*** to get wavelength ✓ Measure time (for these waves) with a **stopwatch** ✓ Use speed = distance ÷ time ✓ Use frequency = speed ÷ wavelength ✓ Repeat and take average values ✓	2	2 × 2.2	**ALLOW count** or **measure** the number of waves **in** a certain time ✓✓ **DO NOT ALLOW** frequency is measured using a stopwatch **ALLOW** measure the length of **one** wave with a ruler **IGNORE** measure how long the waves are **ALLOW** measure the length of waves in a certain amount of time with a stopwatch **ALLOW** v = d/t **ALLOW** use speed from part (b) **ALLOW** f = v/λ

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>12</td><td>(a)</td><td></td><td>All 5 points correctly plotted to within ± ½ a square ✓</td><td>1</td><td>2.2</td><td>Ignore line but if line covering plotting assumes plots are under the line
 

plots are:
<table><tr><th>Weight of cube (N)</th><th>Extension of spring (cm)</th></tr><tr><td>1.0</td><td>2.9</td></tr><tr><td>3.0</td><td>8.4</td></tr><tr><td>4.0</td><td>11.4</td></tr><tr><td>5.0</td><td>14.4</td></tr><tr><td>7.0</td><td>20.0</td></tr></table>
IGNORE extra marks and dots on the grid as they may be from answering the next question</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>3</td><td></td><td>Question asks candidates to show that the spring constant is 35 N / m so DO NOT credit an answer of 35 with no workings</td></tr>
<tr><td></td><td></td><td></td><td>F = k × e OR k = F ÷ e OR k is the slope or gradient ✓</td><td></td><td>1.2</td><td>ALLOW evidence of gradient on graph</td></tr>
<tr><td></td><td></td><td></td><td>Correct numbers from table or graph to calculate k ✓</td><td></td><td>2.1</td><td>Examples of correct numbers:
3.5 ÷ 10 ✓✓
7 ÷ 20 ✓✓
any pair of numbers from the table
<table><tr><th>Weight of cube (N)</th><th>Extension of spring (cm)</th></tr><tr><td>1.0</td><td>2.9</td></tr><tr><td>3.0</td><td>8.4</td></tr><tr><td>4.0</td><td>11.4</td></tr><tr><td>5.0</td><td>14.4</td></tr><tr><td>7.0</td><td>20.0</td></tr></table></td></tr>
<tr><td></td><td></td><td></td><td>Correct conversion from cm to m (to give k) ✓</td><td></td><td>2.1</td><td>Examples of correct conversion:
3.5 ÷ 0.1 ✓✓✓
7 ÷ 0.2 ✓✓✓

ALLOW correct calculation using proportion

Correct numbers from table and calculates extension per N
e.g. 20 ÷ 7 = 2.857 (cm/N) ✓
Understanding of k = force to give one metre extension ✓
Calculate force needed for extension of 100cm
100 ÷ 2.857 = 35 ✓✓ ✓or 2.857 x 35 = 100 ✓✓✓</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
	(c)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.7 (J) award 2 marks** $E = 0.5 \times 35 \times 0.2^2$ ✓ $E = 0.7$ (J) ✓	**2**	**2 × 2.1**	**ALLOW** 7000 (J) ✓

Question			Answer	Marks	AO element	Guidance
13	*		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)** **Describes and explains what the graph shows about the differences in braking or thinking distances and deceleration using calculations** *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)** **Describes and explains what the graph shows about the differences in braking or thinking distances or deceleration using calculations** *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 basic differences between graphs** *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 × 2.1** **2 × 3.1a** **2 × 3.2b**	**AO2.1 – Applies knowledge and understanding of thinking and braking time to describe some basic differences between graphs** • thinking time for A < thinking time for B / AW • braking time for A > braking time for B / AW • stopping time = thinking time + braking time **AO3.2b – Analyses information and ideas to draw conclusions about deceleration by applying the acceleration formula** • deceleration of B > deceleration of A / AW • because slope of graph B > slope of graph A / slope of graph B steeper / AW • deceleration for A: $a = (0 - 25)/8 = -3.13\,m/s^2$ • deceleration for B: $a = (0 - 25)/4 = -6.25\,m/s^2$ **AO3.1a – Analyses information and idea to interpret the graph to describe differences in the thinking and braking distances** • stopping distance = bd + td • as area under graph = distance travelled • thinking distance for A < thinking distance for B • braking distance for A > braking distance for B • td for A = 1 × 25 = 25 m • td for B = 2 × 25 = 50 m • bd for A = ½ × 25 × 8 = 100 m • bd for B = ½ × 25 × 4 = 50 m

Question			Answer	Marks	AO element	Guidance
14	(a)	(i)	(Average) time taken ✓ for number of (un-decayed or unstable) **<u>nuclei</u>** to halve / for activity to halve / for count rate to halve ✓	2	2 × 1.1	**ALLOW** how long it takes **IGNORE** half the time taken **IGNORE** for half of it to disappear **IGNORE** for the radioisotopes to halve **ALLOW** for the radioactivity to halve **IGNORE** for the reactivity to halve
		(ii)	**Q** **AND** activity is high(er) for a longer / it takes longer to become less active / lower or smaller gradient (throughout) ✓	1	3.2a	**BOTH** needed **ALLOW** does not drop as fast **ALLOW** activity decrease less rapidly **ALLOW** less steep
	(b)		$^{131}_{53}X \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}e$ Correct symbol of Xe ✓ (Xe) correct mass and atomic number (131 and 54) ✓ e correct mass and atomic number (0 and –1) ✓	3	3 × 1.1	**ALLOW** Xe and beta in any order **ALLOW** β or β^- or e^- for e
	(c)	(i)	4 ✓	1	2.2	**ALLOW** 4:1 **DO NOT ALLOW** 1:4 **DO NOT ALLOW** units e.g. 4 Bq
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 8 (days) award 2 marks** (Ratio of 4:1 implies) 2 half lives (have elapsed) / AW ✓ 2 half lives = 16 days so half life = 8 (days) ✓	2	2 × 2.2	**DO NOT ALLOW** 8 as the answer if 131 has been used in the calculation **ALLOW ECF** from (c)(i) e.g. ratio of 2:1 implies 1 half life

Question			Answer	Marks	AO element	Guidance
15	(a)	(i)	As resistance or Ω or R decreases the power or W or P increases / ORA ✓	1	3.1a	**ALLOW** inversely proportional / as one goes up the other goes down
		(ii)	As resistance or Ω decreases the current or I increases / ORA ✓ **AND one from:** (As current is increased the power increases because) P = VI (and V is constant) / ORA ✓ (As current is increased the power increases because) $P = I^2R$ (and I increases by the same factor as R increases) / ORA ✓ (As current is increased the power increases because) $P = V^2/R$ and V constant for these mains appliances so R goes down when P goes up / ORA ✓	2	2 × 1.1	**ALLOW correct answers seen in (a)(i)** **ALLOW** as R goes up I goes down / power of current increases so resistance goes down / large current causes low resistance
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.6 (kWh) award 4 marks** 0.75 (hours) seen ✓ 0.5 (kW) seen ✓ (E =) 0.5 × 0.75 × 7 **or** 2.625 seen ✓ (E =) 2.6 (kWh) to 2sf ✓	4	 1.2 1.2 2.1 2.1	 **ALLOW** 3/4 (hour) **ALLOW** incorrect conversions or no conversions for time and power (i.e. time x 7 x power) e.g. ((45 x 7) / 3600) x 500 ✓ e.g. 45 x 7 x 500 ✓ e.g. 45 x 7 x 0.5 or 2625 or 262500 or 2600 ✓✓ so 0.5 × 0.75 × 7 **or** 2.625 seen ✓✓✓ **No ECF** for sig fig mark for calculated answer

Question			Answer	Marks	AO element	Guidance
	(c)		**Direct voltage:** Voltage does not change **direction** / stays at + or stays at – ✓ **Alternating voltage:** Voltage changes **direction** / becomes + and – ✓	**2**	**2 × 1.1**	**ALLOW** current or p.d. in description for voltage **ALLOW** stays in one direction/ goes one way **ALLOW** does not oscillate **IGNORE** just stays the same or is constant / goes straight to the house or appliance / from a battery **ALLOW** current or p.d. in description for voltage **ALLOW** goes in both directions or both ways or two ways but **DO NOT ALLOW** goes in many or multiple directions **ALLOW** oscillates **IGNORE** just changes or switches / from the mains **ALLOW** answers on a labelled diagram with 0 or clear + and –
	(d)		It is insulated / it has a plastic case / it is double insulated / case cannot become live ✓	**1**	**1.1**	**ALLOW** no touchable metal parts / does not have a metal case / cannot get an (electric) shock
	(e)		Chemical **store** (involved in this process) / Thermal **store** (involved this process) ✓ **and then any two from:** (Chemical store) being **emptied** ✓ (Thermal store) being **filled** ✓ Amount of energy gained (by thermal store) = amount of energy lost (by chemical store) ✓	**3**	**1 × 2.1** **2 × 3.2b**	**ALLOW** heat energy **store** **ALLOW** Chemical store being emptied ✓✓ Thermal store being filled ✓✓ Amount of energy gained by thermal store = amount of energy lost by chemical store ✓✓✓ If no marks awarded **ALLOW** chemical energy converted to thermal energy ✓ but **DO NOT ALLOW** energy is created

Question			Answer	Marks	AO element	Guidance
16	(a)		**Any two from**: Stir the water ✓ Make sure immersion heater is completely in the water / the immersion heater is in the same position ✓ Insulate the beaker / fit lid to beaker / cover the beaker ✓ Do not lift thermometer out of water when taking temperature reading ✓ Read the thermometer at eye level ✓ Use a digital thermometer ✓ Make sure the thermometer only touches the water (not the sides of the container) ✓ Measure the mass or volume of the water before adding the thermometer or immersion heater ✓	**2**	**3.3a** **3.3b**	**IGNORE** take an average / repeat the readings / use a power source **ALLOW** named insulation around beaker **ALLOW** 'don't let the heat escape' **IGNORE** 'don't let room temperature affect it' **ALLOW** do not remove the thermometer (to read it)

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	No AND points lie close to the line of best fit / little scatter of points about line / AW ✓	1	3.1b	BOTH needed **ALLOW** no **AND** points are only slightly off the line / the line passes though or close to all the points / points are all close together / points following the pattern / points are following the line of best fit / no outliers **IGNORE** it shows a positive correlation / no value out of range
		(ii)	No **AND** point not far enough from line of best fit / point fits in with trend shown by data / AW ✓	**1**	**3.2a**	**BOTH** needed **ALLOW** no **AND** it is only slightly off the line **/** the line passes though or close to it / it is following the pattern / it is close to the line of best fit / it is still connected to the line / it is not an outlier **IGNORE** it is not out of range
	(c)	(i)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.028 - 0.036 (°C / s) award 2 marks** Gradient calculation from line of best fit ✓ Gradient = 0.0317 (°C / s) ✓	**2** **1.2** **2.1**		Each small square is 0.4 °C on the scale **ALLOW** a tolerance of + or – 0.2 °C e.g. 1.6 ÷ 50 / 8 ÷ 250 / 7.6 ÷ 240 **ALLOW** answers in the inclusive range 0.028 - 0.036

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td>(c)</td><td>(ii)</td><td>FIRST CHECK THE ANSWER ON ANSWER LINE
If answer = (inclusive range of) 3555 – 4571 (J / kg °C) award 4 marks

P × t = m × c × ΔT ✓

(P x t) 12.8 × time from graph used in (c)(i) or correct time from graph or table ✓

0.1 x c x ΔT from graph in (c)(i) or matching temperature from graph or table ✓

c value calculated (J / kg °C) ✓</td><td>4</td><td>1.2

3 x 2.1</td><td>ALLOW ECF from (c)(i)
ALLOW e.g. 4042 (J / kg °C) as answer ✓✓✓✓
ALLOW other numbers in the range as correct answers but DO NOT ALLOW 4200 without workings

e.g. 12.8 x 300 or 12.8 x 60

ALLOW e.g.12.8 × 240 = 0.1 × c × 7.6 ✓✓✓

e.g. using values from graph:
E = P × t = 12.8 × 240 = 3072 (J) ✓
E = m × c × ΔT = 0.1 × c × 7.6 (J) ✓
3072 = 0.76 × c ✓
c = 4042 (J / kg °C) ✓

Possible values from the graph
(+ or - 0.2 for temperature)

<table>
<tr><th>time</th><th>matching temp</th></tr>
<tr><td>50</td><td>1.6</td></tr>
<tr><td>60</td><td>2.0</td></tr>
<tr><td>100</td><td>3.2</td></tr>
<tr><td>150</td><td>4.8</td></tr>
<tr><td>200</td><td>6.4</td></tr>
<tr><td>240</td><td>7.6</td></tr>
<tr><td>250</td><td>8.0</td></tr>
<tr><td>300</td><td>9.5</td></tr>
</table>
</td></tr>
</table>

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