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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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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)	transformers ✓	1	1.1	ALLOW transformer IGNORE step up, step down
	(b)	increased decreased ✓	1	1.1	DO NOT ALLOW answers in incorrect order (must have both answers in this order)
	(c)	(i) 230 (V) ✓	1	1.1	ALLOW values in range 220-240 (V)
		(ii) (The high voltage/p.d.) may cause a high current ✓ Which may overheat wires /cause fires OR may cause electric shock/stop heart ✓ OR (The high voltage/p.d.) is a.c. ✓ can affect muscles / so you can't let go OR may cause electric shock/stop heart ✓	2	1.1x2	ALLOW electrocution ALLOW electrocution

Question			Answer	Marks	AO element	Guidance
6	(a)	(i)	Top line 237 ✓ Bottom line 93 ✓	2	1.2 x 2	
		(ii)	For e: top 0 and bottom -1 ✓ For Sm: top line 147 ✓ For Sm: bottom line 62 ✓	3	1.1 1.2x2	Both required for this mark
	(b)		Idea that Pm-147 emits β AND Am-241 emits α ✓ Idea that radiation from Am-241/alpha radiation will be completely absorbed/stopped ✓ Idea that radiation from Pm-147/beta radiation will be only partially absorbed/stopped (depending on thickness) ✓	3	2.1x3	DO NOT ALLOW Pm-147 without some attempt at valid explanation ALLOW no alpha will get through Only award this mark if Pm-147 is the chosen isotope ALLOW some beta will get through.
	(c)		To avoid irradiation of people AW ✓ Because it is ionising radiation OR damages cells/tissues/DNA OR can cause cell mutation ✓	2	2.1x2	IGNORE avoid harming/damaging/killing people IGNORE causes cancer / causes radiation poisoning

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 70 (m) award 4 marks</p> <p>Recall work done = force \times distance \checkmark</p> <p>Substitution $4.6 \times 10^7 = 2.3 \times 10^5 \times s \checkmark$</p> <p>Rearrangement and evaluation $s = 4.6 \times 10^7 \div 2.3 \times 10^5 = 200 \text{ (m)} \checkmark$</p> <p>$d = 200 - 130 = 70 \text{ (m)} \checkmark$</p>	4	1.2 2.1x3	<p>ALLOW any subject of the equation</p> <p>ALLOW an independent mark for recognition that the distance d is their value of s minus 130, as long as $s > 130$ and d correctly calculated</p>
		(ii)	<p>(Energy transferred) from kinetic (energy store of train) \checkmark</p> <p>to thermal energy (store) of brakes/train/surroundings \checkmark</p>	2	1.1 x 2	<p>ALLOW of air/tunnel walls IGNORE sound</p>
	(b)		<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 360 000 (N) award 5 marks</p> <p>Calculation $KE = (\frac{1}{2} \times 280\,000 \times 12^2) = 2.016 \times 10^7 \text{ (J)} \checkmark$</p> <p>$KE = \text{work done by force} \checkmark$</p> <p>Recall and rearrange work done = force \times distance \checkmark</p> <p>force = $2.016 \times 10^7 \div 56 \checkmark$</p> <p>force = 360 000 (N) \checkmark</p>	5	2.1 1.1 1.2 2.1 2.1	<p>ALLOW answers with more sf that round correctly to this value. ALLOW answers in standard form or using prefixes</p> <p>ALLOW if $KE = 2.016 \times 10^7 \text{ (J)}$ seen anywhere in response</p> <p>ALLOW $\frac{1}{2} \times 280\,000 \times 12^2$ for 2.016×10^7 ECF wrong value of KE</p>
	(c)		The KE of the trains is transferred by heating (and the	2	1.1	

Question	Answer	Marks	AO element	Guidance
	thermal store of the surroundings is increased). ✓ AND any one from: idea that: There are now more trains ✓ More people/passengers (transfer energy by heating surroundings) ✓ Not all of energy from motors/engines is transferred to KE of train as they are not 100% efficient. ✓		2.1	ALLOW (tunnels) used more frequently/often

Question		Answer	Marks	AO element	Guidance
8	(a)	<p>It changes speed as it enters and leaves the prism ✓ OR It slows down as it enters (the glass/prism) / It speeds up as it leaves (the glass/prism) ✓ it changes direction/bends. ✓</p>	2	1.1 x 2	ALLOW angle changes on entering/leaving
	(b)	<p>Red light has the lowest frequency ✓ Violet light is refracted most moving from air to glass ✓</p>	2	1.1 2.1	

Question		Answer	Marks	AO element	Guidance												
9	(a)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 31 (m/s) award 3 marks</p> <p>$110 \times 1000 \div (60 \times 60) \checkmark$</p> <p>$= 30.5(5) \text{ (m/s)} \checkmark$</p> <p>$= 31 \text{ (m/s)} \checkmark$</p>	3	1.2 2.1 1.2	<p>ALLOW 31 m/s and all answers that round correctly to 31 m/s</p> <p>ALLOW $110000 \div 3600$</p>												
	(b)	(i)	A scalar has magnitude only. A vector has magnitude and direction. \checkmark	1	1.1	<p>Must have both to be awarded the mark</p> <p>ALLOW size for magnitude</p> <p>IGNORE examples</p>											
		(ii)	<table border="1"> <tr> <td>\checkmark acceleration</td> <td></td> <td rowspan="5" style="text-align: center; vertical-align: middle;">\checkmark</td> </tr> <tr> <td>\checkmark displacement</td> <td></td> </tr> <tr> <td></td> <td>\checkmark distance</td> </tr> <tr> <td></td> <td>\checkmark speed</td> </tr> <tr> <td>\checkmark velocity</td> <td></td> </tr> </table>	\checkmark acceleration		\checkmark	\checkmark displacement			\checkmark distance		\checkmark speed	\checkmark velocity		1	1.1	All must be correct to award the mark
\checkmark acceleration		\checkmark															
\checkmark displacement																	
	\checkmark distance																
	\checkmark speed																
\checkmark velocity																	
	(c)	(i)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.5 (m/s²) award 3 marks</p> <p>Attempt to calculate gradient of negative slope \checkmark</p> <p>Uses a correct pair of values e.g. $(-)(18-0)/(47-35) \checkmark$</p> <p>Deceleration = 1.5 (m/s²) \checkmark</p>	3	2.2x3	<p>IGNORE sign</p> <p>ALLOW $18/(47-35)$ and other correct pairs where zero omitted.</p> <p>ALLOW any correct fraction eg 18/12</p> <p>IGNORE negative sign of gradient</p> <p>ALLOW correctly calculated answers that round to 1.5 (m/s²)</p>											

Question		Answer	Marks	AO element	Guidance
	(ii)	<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 108 (m) or 110 (m) award 3 marks</p> <p>Identifies stopping distance = area under negative slope line ✓</p> <p>Recall area of triangle = $\frac{1}{2}$ base x height ✓</p> <p>Stopping distance = 108 (m) ✓</p>	3	1.2 2.2x2	<p>ALLOW counting squares method ALLOW for counting squares, answers that round to 110 (m) IGNORE distance = speed x time</p> <p>ALLOW $\frac{1}{2} \times 12 \times 18$ ECF height and/or base from 9ci</p> <p>ALLOW 110 (m) to 2sf</p>
(d)	(i)	<p>Straight lines drawn on graph:</p> <p>(0, 0) to (1-24, 26) ✓</p> <p>(1-24, 26) to (21-44, 20) ✓</p> <p>(21-44, 20) to (45, 0) ✓</p>	3	2.2 x 3	<p>With a ruler and $\pm \frac{1}{2}$ small square</p> <p>Must start from (0, 0)</p> <p>ECF first point (x, y), 2nd point (x + 20, y - 6)</p> <p>ECF 2nd point to (45, 0)</p>
	(ii)	<p>(second gazelle because) The area (under the curve) is larger ✓</p>	1	3.2a	

Question		Answer	Marks	AO element	Guidance
10		<p>FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.4 (A) award 2 marks</p> <p>Substitution into force = magnetic flux density \times current \times length of conductor $0.63 = 1.8 \times I \times 0.25$ ✓</p> <p>Current = 1.4 (A) ✓</p>	2	2.1x2	ALLOW calculation of 1.4 A and a final answer slightly more (to allow for lifting the rod)

Question		Answer	Marks	AO element	Guidance
11	(a)	<p>particles gain kinetic energy/move faster (when heated/ as temperature rises) ✓</p> <p>particles move further apart (when heated/change state) ✓</p> <p>particles escape from liquid (as they enter gaseous state) ✓</p>	3	1.1 x 3	<p>ALLOW atoms, molecules for 'particles' throughout</p> <p>DO NOT ALLOW vibrate faster/more for 'move faster'</p>
	(b)	<p>Idea that (for a fixed mass) latent heat is greater than specific heat. ✓</p> <p>energy from water is transferred to the solid PCM by heating OR energy from liquid PCM is transferred to water/night air by heating ✓</p> <p>energy from water melts the solid PCM by heating OR the liquid PCM freezes by heating the night air/water ✓</p>	3	<p>2.1</p> <p>3.1ax2</p>	
	(c)	(i)	2	3.2ax2	DO NOT ALLOW just A without justification
		(ii)	5		

Question	Answer	Marks	AO element	Guidance
	<p>If answer = 150 000 (J/kg) award 5 marks</p> <p>Deduce time required from graph = [160-35] OR 125 (s) ✓</p> <p>Recall and rearrange to energy = power x time ✓</p> <p>$E = 120 \times 125$ OR 15000 (J) ✓</p> <p>Select and apply energy = mass x specific latent heat $E = 100 \times 10^{-3} \times \text{SLH}$ ✓</p> <p>$\text{SLH} = 15000 \div [100 \times 10^{-3}] = 150\,000$ (J/kg) ✓</p>		<p>2.2</p> <p>1.2</p> <p>2.1x3</p>	<p>ALLOW ECF from their calculated value of E using energy = power x time</p> <p>150 (J/kg) scores 4 marks</p>

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