Paper 1 Foundation

Question number	Answer	Mark
1(a)(i)	(Carried by) electromagnetic wave	(1)

Question number	Answer	Mark
1(a)(ii)	As chemical energy in the battery	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	Calculation of area (1) 7 × 11 Substitution (1) 77 × 0.12 Answer (1) 9.2 (J)	77 ecf area award full marks for correct numerical answer without working	(3)

Question number	Answer	Additional guidance	Mark
1(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the heating effect for the oven and the phone depends on their power (1) • and since the power of an oven is much greater than the power of a phone, the oven produces a greater heating effect (1)	allow not the same wavelength/microwaves cover a range in wavelengths	(2)

Question number	Answer	Mark
2(a)	An answer that combines the following points of understanding to provide a logical description: • use a stopwatch (1) • start timing when flash is seen and stop when bang is heard (1)	**(2)**

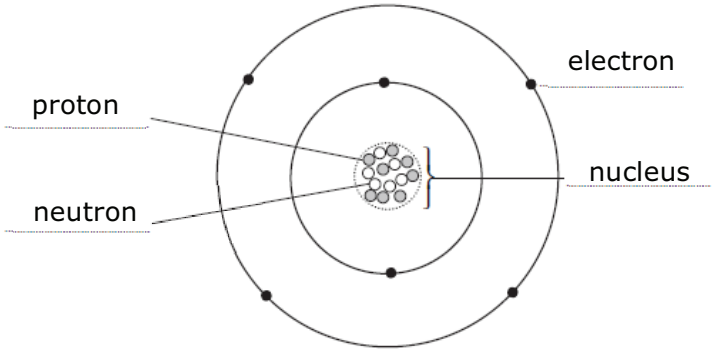
Question number	Answer	Mark
2(b)(i)	A	**(1)**

Question number	Answer	Mark
2(b)(ii)	C	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	electromagnetic wave	allow any named e.m. wave/seismic S wave	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	sound wave	allow ultrasound/infrasound/ seismic P wave	**(1)**

Question number	Answer	Additional guidance	Mark
2(d)	two minutes = 120 s (1) substitution (1) 26 400 ÷ 120 answer (1) 220 (m/s)	 ecf unit change award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
3(a)(i)	One mark for each correct label (4)  	(4)

Question number	Answer	Mark
3(a)(ii)	B	(1)

Question number	Answer	Mark
3(a)(iii)	zero/0/no charge	(1)

Question number	Answer	Mark
3(b)(i)	434	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	34	allow 29 to 39	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	Radioactive decay is a random process	allow because background count changes every time	(1)

Question number	Answer	Additional guidance	Mark
4(a)	An answer that combines the following points of understanding to provide a logical description: • shine the light along a radius (1) • by marking it on the paper before putting the block down (1)	allow shine the ray at the centre of the straight edge before putting the block down	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	all points correctly plotted to +/− half a square (2)	4 points plotted correctly (i.e. one error) (1)	**(2)**

Question number	Answer	Mark
4(b)(ii)	smooth curve through at least 3 of the points (1)	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(iii)	• continues line as far as 90° (1) • estimate between 43° and 47° (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
4(c)	An answer that provides a description by making reference to: • (all) light reflected (1) • back inside block (1)	**(2)**

Question number	Answer	Mark
5(a)(i)	D	**(1)**

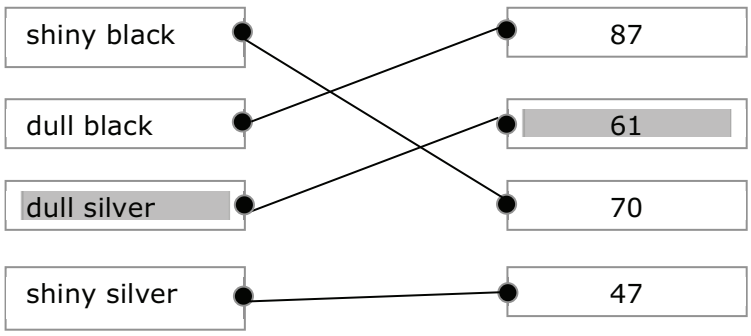
Question number	Answer	Additional guidance	Mark
5(a)(ii)	16.0 (m/s) read from graph (1) Substitution (1) (distance travelled =) 16 × 0.5 Answer (1) 8.0 (m) (1)	award full marks for correct numerical answer without working ecf for substitution and answer using wrong speed value	**(3)**

Question number	Answer	Mark
5(a)(iii)	A	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(iv)	Obtain readings from graph (1) Substitution (1) $\frac{16}{2.0}$ Answer (1) 8.0 (m/s^2)	award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)	Any three improvements from: • suitable instrument to measure distance (1) • using a greater distance (to reduce effect of reaction times) (1) • suitable instrument to measure time (1) • use of one student at the {first/second} lamp post to signal when to {start/stop} timing (1)	allow tape measure, trundle wheel allow stop watch/clock or timing app. on phone	**(3)**

	• two of three sets of students taking readings for the same car (1)		

Question number	Answer	Mark
6(a)(i)	All three correct (2) One or two correct (1)  	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)(ii)	Different surfaces emit (thermal) radiation at different rates	allow reference to surfaces in question	**(1)**

Question number	Answer	Mark
6(b)(i)	B	**(1)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	substitution and unit conversion (1) $470 \times 10^{-9} \times 6.30 \times 10^{14}$ answer (1) 2.96×10^{8} (m/s)	award full marks for correct numerical answer without working ecf unit conversion	**(2)**

Question number	Answer	Mark
6(c)(i)	B	**(1)**

Question number	Answer	Mark
6(c)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • as temperature increases, intensity increases (1) • as temperature increases, maximum intensity occurs at a shorter wavelength (1)	**(2)**

Question number	Answer	Additional guidance	Mark
7(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • at the time, there was only naked eye evidence (1) • which indicated Sun/Moon/planets appear to move across the sky (1) • in the same direction, same motion each day (1)	allow valid alternatives, e.g. references to comets	**(3)**

Question number	Answer	Additional guidance	Mark
7(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • both theories predict an expanding universe and the Big Bang theory also predicts that the universe had a beginning (1) • the red shift theory indicates that the universe is expanding so supports both theories (1) • whereas CMB also indicates that the universe had a beginning, so supports Big Bang theory (1)	provided evidence that the steady state theory was incorrect	**(3)**

Question number	Answer	Mark
7(c)(i)	B	**(1)**

Question number	Answer	Mark
7(c)(ii)	B	**(1)**

Question number	Answer	Mark
7(d)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (2 marks): • galaxy C is furthest away (1) • because it has the greatest red shift (1) • and therefore it has the greatest speed (1)	**(3)**

Question number	Answer	Mark
8(a)	Idea of a direct reading (without calculation)	**(1)**

Question number	Answer	
8(b)	If student B drops the ruler, they are not really measuring their own reaction time as they know when ruler has been dropped	**(1)**

Question number	Answer	Additional guidance	Mark
8(c)(i)	calculating the mean (1) 18.36 rounding to 2 s.f. (1) 18 (cm)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
8(c)(ii)	Rearrangement (1) $t = \sqrt{\frac{\text{distance}}{500}}$ Substitution and answer (1) time = 0.17 (s)	award full marks for correct numerical answer without working allow answers which round to 0.17, e.g. 0.1673	**(2)**

Question number	Answer	Additional guidance	Mark
8(d)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • 25.5 is an anomalous result (1) • (because) it is much further away from the mean than the other results (1)	ignore 19	**(2)**

Question number	Answer	Mark
8(e)	• Take more readings (1) • Idea that a third student should also measure the reaction time (1)	**(2)**

Question number	Answer	Additional guidance	Mark
8(f)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • using a larger group of students/large population of students (1) • and measure how their reaction time varies with age/height (1)	allow any suitable variable	**(2)**

Question number	Answer	Additional guidance	Mark
9(a)	rearrangement (1) $m = \frac{f}{a}$ substitution and conversion (1) $m = \frac{1870}{1.83}$ answer and rounding to 3 s.f. (1) 1020 (kg)	maximum 2 marks if kN not converted to N award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
9(b)	rearrangement of $\frac{(v-u)}{t} = a$ (1) $v = u + at$ substitution (1) $v = 0 + 1.83 \times 16$ answer (1) 29.3 (m/s)	award full marks for correct numerical answer without working	**(3)**

Question number	Indicative content	Mark
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2** • fuel forms a store of chemical (potential) energy • chemical energy is transferred to kinetic energy and thermal energy when the car moves • kinetic energy transferred to thermal energy as the car slows down **AO3** • during X, kinetic energy increases as the car's speed increases/car accelerates and the increase in kinetic energy is provided by the chemical energy store • during all three sections, work is done against frictional forces in the moving parts of the car and against the drag from the air • during Y, kinetic energy stays constant when the car moves at constant speed but energy is still transferred to thermal energy • during Z, kinetic energy decreases as the car slows down	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The description attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The description is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)

3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The description is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Question number	Answer	Additional guidance	Mark
10(a)	alpha cannot penetrate casing	alpha only travel a few cm in air	**(1)**

Question number	Answer	Mark
10(b)	• evidence of division of activity by 2 (1) • 120 (Bq) (1)	**(2)**

Question number	Answer	Mark
10(c)	• increase number of starting dice (1) • do more rolls (1)	**(2)**

Question number	Indicative content	Mark

***10(d)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • use a radioactive isotope of iodine as this is taken up by the gland • isotope given by injection or orally • gland is in the neck, so cannot use an alpha emitter as alpha will not exit through the skin • use beta or gamma emitter • isotope has to have a short enough half-life to minimise exposure to radiation but long enough for the reading to be taken • allow time for isotope to reach gland • use Geiger-Müller tube and counter to determine count rate of isotope in gland • compare with normal count rate to determine whether uptake of iodine is normal	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
1	1–2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)