

## Paper 5 P1H Mark scheme

Question number	Answer	Mark
1(a)	<p>An answer that provides a description by making reference to:</p> <ul style="list-style-type: none"> <li>transverse waves have oscillations perpendicular to direction of travel of the wave (1)</li> <li>whereas longitudinal waves have oscillations in the same direction as the direction of travel of the wave (1)</li> </ul>	(2)

Question number	Answer	Mark
1(b)(i)	<p>An answer that combines the following points of understanding to provide a logical description:</p> <ul style="list-style-type: none"> <li>take time <math>T</math> for waves to pass a fixed point (1)</li> <li>and frequency = <math>\frac{\text{number of waves}}{\text{time taken}}</math> (1)</li> </ul>	(2)

Question number	Answer	Mark
1(b)(ii)	A	(1)

Question number	Answer	Mark
1(b)(iii)	D	(1)

Question number	Answer	Additional guidance	Mark
2(a)(i)	<p>Calculating the mean (1) 18.36</p> <p>Rounding to 2 s.f. (1) 18 (cm)</p>	award full marks for correct numerical answer without working	(2)

Question number	Answer	Additional guidance	Mark
2(a)(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
2(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): <ul style="list-style-type: none"> <li>• 25.5 is an anomalous result (1)</li> <li>• (because) it is much further away from the mean than the other results (1)</li> </ul>	ignore 19	(2)

Question number	Answer	Mark
2(c)	<ul style="list-style-type: none"> <li>• Take more readings (1)</li> <li>• Idea that a third student should also measure the reaction time (1)</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
2(d)	An answer that combines the following points to provide a logical description of the plan/method/experiment: <ul style="list-style-type: none"> <li>• using a larger group of students / large population of students (1)</li> <li>• and measure how their reaction time varies with age/height (1)</li> </ul>	allow any suitable variable	(2)

Question number	Answer	Additional guidance	Mark
3(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
3(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	Answer	Mark
3(c)	Correctly identifies data points from the graph to calculate areas (1)  Calculates area under AB (1) 240 m  Calculates area under CD (1) 135 m  distance travelled at constant speed = 240 m is greater than distance travelled when slowing down = 135 m (1)	(4)

Question number	Answer	Mark
4(a)	B	(1)

Question number	Answer	Additional guidance	Mark
4(b)(i)	The time taken for the activity of a radioactive nuclide to halve (1)	accept for nuclide: isotope sample	(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	<p>Determines number of half-lives and rounds (1)  <math>263/87.7 = 3</math></p> <p>Determines that 3 half-lives is <math>1/2 \times 1/2 \times 1/2 = 1/8</math> (1)</p> <p>Determines mass of Pu-238 after 3 half-lives (1)  <math>925/8 = 115.625</math> (g)</p> <p>Determines average energy released per second (1)  <math>115.625 \times 0.54 = 62.4</math> (J)</p>	<p>allow repeated division by 2  allow ecf from step 2 for 1 mark  (mass of Pu-238 after 1 half-life <math>925/2 = 462.5</math> (g))</p> <p>allow ecf from 1 half-life or from step 3</p>	(4)

Question number	Answer	Mark
4(c)(i)	<p>An answer that combines the following points of application of knowledge and understanding to provide a logical description:</p> <ul style="list-style-type: none"> <li>proton number/atomic number decreases by 1 (1)</li> <li>nucleon number/mass number remains unchanged (as p and n have same mass and mass of electron is (assumed) negligible) (1)</li> </ul>	(2)

Question number	Answer	Mark
4(c)(ii)	C	(1)

Question number	Answer	Additional guidance	Mark
5(a)	<p>An answer that combines the following points of understanding to provide a logical description:</p> <ul style="list-style-type: none"> <li>• measurement of time between(or at) two positions using suitable timing equipment (1)</li> <li>• measurement of suitable distance along the runway with metre rule (1)</li> <li>• measurement of vertical height to starting position (1)</li> <li>• repeats AND averages AND use of a correct equation (1)</li> </ul>	<p>allow</p> <p>stopwatch, light gates</p> <p>minimum is 0.5 m metal tape measure</p> <p>average speed = distance/time OR average speed = (speed at A – speed at B)/2</p>	(4)

Question number	Answer	Additional guidance	Mark
5(b)(i)	<p>Substitution of correct data from graph and mass conversion (1)</p> $0.5 \times 0.65 \times (0.61)^2$ <p>Answer (1)</p> <p>0.12 (J)</p>	<p>maximum of 1 mark if mass in g used</p> <p>allow tolerance of <math>\pm 0.2</math> for speed</p>	(2)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	<ul style="list-style-type: none"> <li>• Tangent to the graph at <math>h = 0.1</math> (1)</li> <li>• Answer in the region 3.5 to 3.6</li> </ul>	<p>either seen on graph or suitable pairs of values of <math>\Delta v</math> and <math>\Delta h</math></p>	(2)

Question number	Answer	Mark
5(b)(iii)	<p>An answer that combines points of interpretation/evaluation to provide a logical description:</p> <ul style="list-style-type: none"> <li>for each change in height, as the height increases the speed of the trolley increases</li> <li>the greatest change in speed is between the change in height from 0.04 m to 0.9 m</li> </ul>	(2)

Question number	Answer	Additional guidance	Mark
5(c)	<p>An answer that combines the following points to provide a logical description of the plan/method/experiment:</p> <ul style="list-style-type: none"> <li>identifies control variables (1)</li> <li>uses at least 3 different surfaces (1)</li> <li>calculates average speed for each surface and repeats (1)</li> </ul>	constant height, constant slope, constant starting points and same length of surface	(3)

Question number	Answer	Additional guidance	Mark
6(a)	<p>An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark):</p> <ul style="list-style-type: none"> <li>the wavelength decreases because wavelength is the ratio of wave velocity to frequency (1)</li> <li>and the wave velocity reduces at the boundary but the frequency remains the same (1)</li> </ul>	allow the same number of waves per second arrive at the boundary as leave it for no change in frequency at the boundary	(2)

Question number	Indicative content	Mark
6(b)	<p>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.</p> <p>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.</p> <p style="text-align: center;"><b>AO1 (6 marks)</b></p> <ul style="list-style-type: none"> <li>• point A reaches the glass block before point B</li> <li>• A moves into the glass block and slows down</li> <li>• as light travels more slowly in glass than in air</li> <li>• B is still in air so is travelling faster than A</li> <li>• this causes part of the wavefront to change direction/refract</li> <li>• by the time B reaches the block it will have travelled further than A</li> <li>• therefore, the whole wavefront changes direction/refracts towards the normal</li> <li>• at the other face, A exits first so the process is reversed</li> <li>• the wavefront changes direction again so it is parallel to its original direction/refracts away from the normal</li> </ul>	<b>(6)</b>

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> <li>• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1)</li> <li>• Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1)</li> <li>• Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1)</li> <li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

Question number	Answer	Additional guidance	Mark
6(c)	Substitution into $v = \frac{s}{t}$ to find $v$ (1)  $v = \frac{1.5 \times 10^{11}}{500}$  Substitution into $v = f \times \lambda$ and unit conversion (1)  $v = \frac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ Transposition (1) Rearrangement (1)  $f = \frac{(1.5 \times 10^{11})}{500 \times (670 \times 10^{-9})}$  Answer (1) $4.5 \times 10^{14}$ (Hz)	$s$ is distance  award full marks for correct numerical answer without working  maximum 3 marks if $\lambda$ in nm  $4.4776 \times 10^{14}$ (Hz)	<b>(4)</b>