



Mark Scheme (Results)

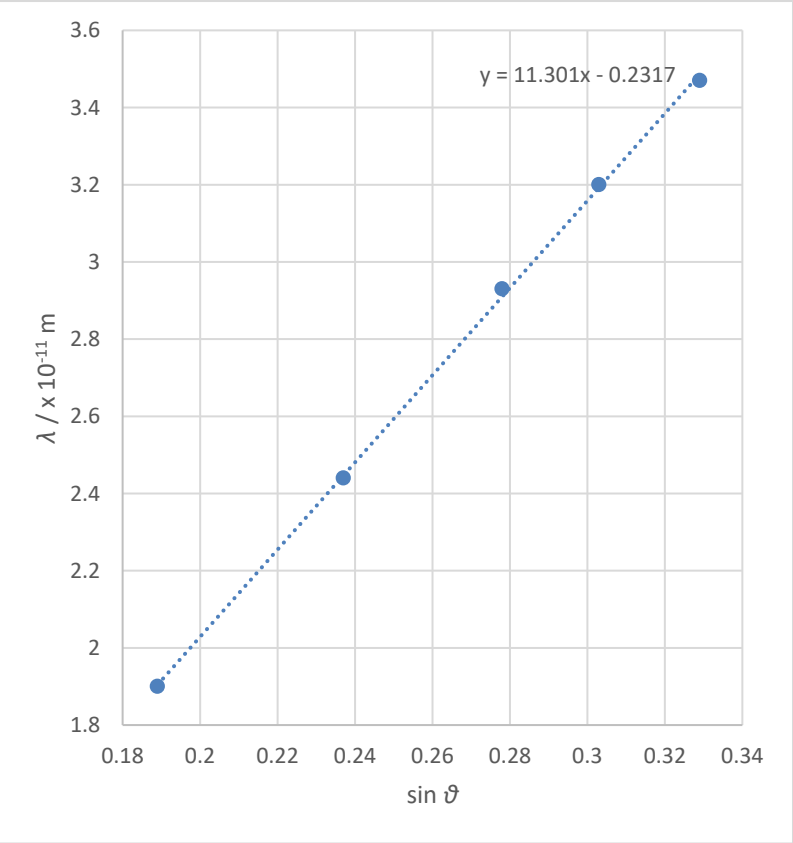
June 2019

Pearson Edexcel International Advanced
Subsidiary Level
In Physics (WPH13)
Paper 01 Practical Skills in Physics I

Question Number	Answer	Mark
1(a)(i)	<ul style="list-style-type: none"> Resolution = 0.1 mm (accept 0.01 cm, 0.0001m, 1×10^{-4} m, etc.) 	(1) 1
1(a)(ii)	<ul style="list-style-type: none"> Percentage uncertainty is small Because resolution much less than diameter of ball bearing MP2 requires comparison between resolution and measurements size. Accept attempted calculation of percentage uncertainty using screen value of 13.2mm for MP2	(1) (1) 2
1(b)	<ul style="list-style-type: none"> Percentage uncertainty = 0.24 % (accept 0.2% and 0.244%) <u>Example of Calculation</u> Percentage uncertainty = $(0.05 \text{ mm} / 20.5 \text{ mm}) \times 100 \% = 0.24 \%$	(1) 1
1(c)	Max 2 from <ul style="list-style-type: none"> Take readings in different orientations/positions Check for zero error Ensure measurement is at widest point 	(1) (1) (1) 2
1(d)(i)	<ul style="list-style-type: none"> Calculation of mean diameter (using 4 or 5 diameters) Anomaly (18.3 mm) not included giving mean diameter = 19.0 mm <u>Example of Calculation</u> Mean diameter = $(19.0 \text{ mm} + 19.1 \text{ mm} + 18.9 \text{ mm} + 19.1 \text{ mm}) / 4 = 19.0 \text{ mm}$	(1) (1) 2
1(d)(ii)	<ul style="list-style-type: none"> Use of half range (0.1 mm) Or value furthest from mean Percentage uncertainty = 0.5 % Allow full ecf for use of range of values in 1(d)(i) – e.g. use of half range of 5 values If the half range of all 5 is used, but was not use in 1(d)(i) – MP2 only If whole range (e.g. 0.2 or 0.8) is used – award only MP2 <u>Example of Calculation</u> Range = $19.1 \text{ mm} - 18.9 \text{ mm} = 0.2 \text{ mm}$ Percentage uncertainty = $(0.1 \text{ mm} / 19.0 \text{ mm}) \times 100 \% = 0.53 \%$	(1) (1) 2
1(e)	<ul style="list-style-type: none"> Use of $V = \frac{4}{3}\pi r^3$ Use of $\rho = \frac{m}{V}$ Density = $7.89 \times 10^3 \text{ kg m}^{-3}$ (7.89 g cm^{-3}) Value given to 3 s.f. <u>Example of Calculation</u> $V = \frac{4}{3}\pi(10.25 \times 10^{-3} \text{ m})^3 = 4.51 \times 10^{-6} \text{ m}^3$ $\rho = \frac{35.6 \times 10^{-3} \text{ kg}}{4.51 \times 10^{-6} \text{ m}^3} = 7.89 \times 10^3 \text{ kg m}^{-3}$	(1) (1) (1) (1) 4
1(f)	<ul style="list-style-type: none"> Uses percentage uncertainty to calculate the range of density values Comparative statement consistent with their value for density from (e) <u>Example of Calculation</u> $7.75 \times 10^3 \text{ kg m}^{-3} \times 1.02 = 7.91 \times 10^3 \text{ kg m}^{-3}$ $7.75 \times 10^3 \text{ kg m}^{-3} \times 0.98 = 7.60 \times 10^3 \text{ kg m}^{-3}$	(1) (1) 2
	Total for question 1	16

Question Number	Answer	Mark
2(a)	<ul style="list-style-type: none"> Reference to Force = mg Or reference to use of a Newtonmeter to measure weight (1) Measure initial length of spring and length with load, and subtract to give extension Or align zero on ruler to bottom end of spring and read opposite bottom when loaded to measure extension Or read scale opposite bottom of spring initially and again with load, and subtract to get extension (1) Use of a set square to ensure the ruler is vertical Or use of a set square to reduce parallax error when measuring length/extension Or use of a pointer attached to the lower end of spring to reduce parallax error when measuring length/extension Or ensure ruler and spring are at eye-level to reduce parallax (1) Uses a range of masses/forces to obtain multiple pairs of values (1) 	4
2(b)	<ul style="list-style-type: none"> $k = \text{gradient}$ Or $k = \Delta F / \Delta x$ (1) Gradient should be calculated using values from linear section of the graph (1) 	2
Total for question 2		6

Question Number	Answer	Mark
3(a)	<ul style="list-style-type: none"> • Use of Vernier calipers Or use of dividers/calipers to transfer the measurement to a ruler Or use of paper (tape) and marking points to be measured with a ruler Or use a flexible measuring tape (1) • Measure diameter of (first) ring and divide by 2 (1) • Measure in multiple orientations and calculate the mean (1) • Measure to the middle/brightest part of the ring Or refers to surface of the screen being curved (so diameter cannot be measured directly) (1) 	4
3(b)	<ul style="list-style-type: none"> • (Diffracted) electrons experience (constructive) interference/superposition Or the pattern is evidence electrons have interfered/superposed (1) • Diffraction/interference is a wave property (1) <p>For MP1 – it must be clear they are referring to electrons, not waves.</p>	2
3(c)(i)	<p>Max 2 from</p> <ul style="list-style-type: none"> • Inconsistent number of significant figures (for wavelength) (1) • Only 5 sets of results (1) • Range of values of angle/wavelength is too small (1) • No evidence of repeat (1) 	2

3(c)(ii)	<ul style="list-style-type: none"> Correct $\sin \theta$ values to 3 s.f. (1) Labels axes with quantities and unit for λ and with no unit for $\sin \theta$ (Accept $\sin(\theta/^\circ)$ but not $\sin \theta/^\circ$) (1) Sensible scales (1) Plotting values (2) Line of best fit (1) <table border="1" data-bbox="400 477 748 835"> <thead> <tr> <th>$\lambda / \times 10^{-11} \text{ m}$</th><th>$\theta / ^\circ$</th><th>$\sin \theta$</th></tr> </thead> <tbody> <tr><td>3.47</td><td>19.2</td><td>0.329</td></tr> <tr><td>3.2</td><td>17.7</td><td>0.304</td></tr> <tr><td>2.93</td><td>16.1</td><td>0.277</td></tr> <tr><td>2.44</td><td>13.7</td><td>0.237</td></tr> <tr><td>1.9</td><td>10.9</td><td>0.189</td></tr> </tbody> </table> 	$\lambda / \times 10^{-11} \text{ m}$	$\theta / ^\circ$	$\sin \theta$	3.47	19.2	0.329	3.2	17.7	0.304	2.93	16.1	0.277	2.44	13.7	0.237	1.9	10.9	0.189	6
$\lambda / \times 10^{-11} \text{ m}$	$\theta / ^\circ$	$\sin \theta$																		
3.47	19.2	0.329																		
3.2	17.7	0.304																		
2.93	16.1	0.277																		
2.44	13.7	0.237																		
1.9	10.9	0.189																		
3(c)(iii)	<ul style="list-style-type: none"> Use of large triangle to determine gradient (1) gradient = 1.10×10^{-10} to 1.20×10^{-10} (1) Value given to 2 or 3 s.f. and correct unit (m) (1) 	3																		
3(c)(iv)	<ul style="list-style-type: none"> Comparison between $(n)\lambda = d \sin \theta$ and $y = mx (+ c)$ (1) d is a constant given by the gradient and $n=1$ (1) <p>MP2 is dependent on MP1 being awarded.</p>	2																		
Total for question 3		19																		

Question Number	Answer	Mark
4(a)	<ul style="list-style-type: none"> Use of $\sqrt{\frac{mg}{\mu}} = f\lambda$ (1) Use of $l = 1.5 \times \lambda$ (1) $\mu = 3.2 \times 10^{-4} \text{ kg m}^{-1}$ (1) <p><u>Example of calculation</u> $1.5 \times \lambda = 1.25 \text{ m}$ $\lambda = 0.833 \text{ m}$ $\mu = (0.25 \text{ kg} \times 9.81 \text{ m s}^{-2}) / (105^2 \text{ Hz}^2 \times 0.833^2 \text{ m}^2)$ $\mu = 3.21 \times 10^{-4} \text{ kg m}^{-1}$</p>	3
4(b)(i)	<p>Mark 4(b)(i) and (b)(ii) holistically</p> <p>Max 2 from</p> <p><i>Frequency</i></p> <ul style="list-style-type: none"> Uncertainty in identifying when nodes form (1) Uncertainty in identifying maximum amplitude (1) <p><i>Length</i></p> <ul style="list-style-type: none"> Parallax error when measuring length (1) Uncertainty in measuring length to top of pulley (1) Or uncertainty in measuring length as string is not straight (1) <p><i>Mass</i></p> <ul style="list-style-type: none"> Zero error on mass balance (1) 	2
4(b)(ii)	<p>Max 4 (from only 2 pairs)</p> <p>For each source from (b)(i)</p> <p>Description of experimental technique (1)</p> <p>Additional detail (1)</p> <p><u>Examples</u></p> <p><i>Frequency</i></p> <ul style="list-style-type: none"> Repeat and calculate the mean frequency (1) Vary frequency from above and below resonance to find two values for the frequency when the standing wave forms (1) <p><i>Length</i></p> <ul style="list-style-type: none"> Use a set square to reduce parallax error in length (1) Or hold ruler in contact with the wire to reduce parallax error in length (1) Or ensure ruler and string are at eye-level (1) Switch off vibrator (1) Or ensure string is straight (1) <p><i>Mass</i></p> <ul style="list-style-type: none"> Zero balance before each measurement (1) To remove systematic error (1) Or idea that this error is not reduced by repeating 	4
	Total for question 4	9