Mark Scheme (Results)

June 2019

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

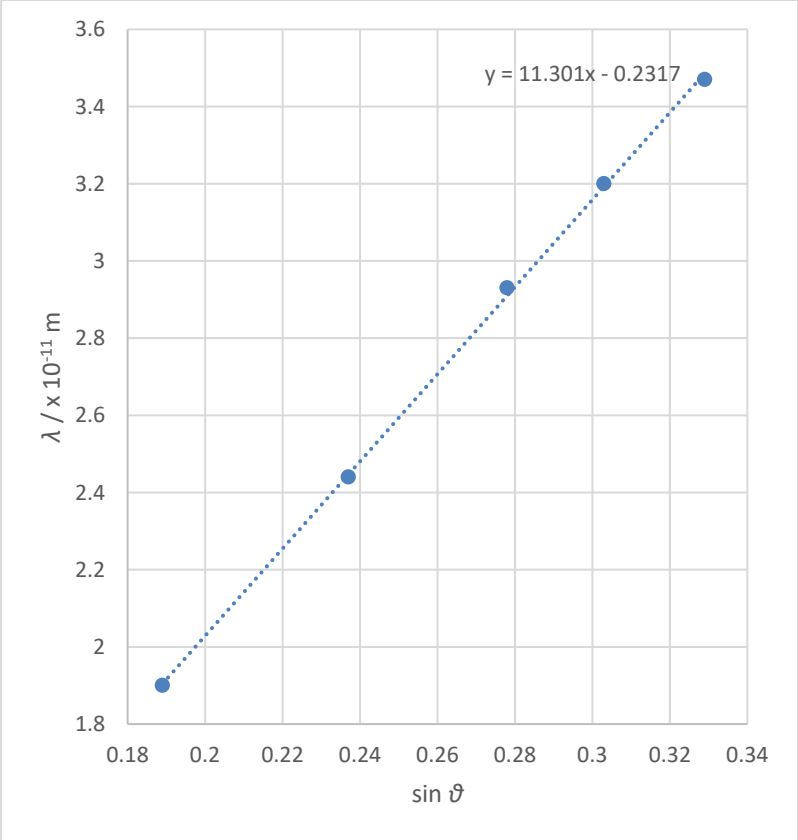
Question Number	Answer	Mark
1(a)(i)	• Resolution = 0.1 mm (accept 0.01 cm, 0.0001m, 1×10^{-4} m, etc.) (1)	**1**
1(a)(ii)	• Percentage uncertainty is small (1) • Because resolution much less than diameter of ball bearing (1) MP2 requires comparison between resolution and measurements size. Accept attempted calculation of percentage uncertainty using screen value of 13.2mm for MP2	**2**
1(b)	• Percentage uncertainty = 0.24 % (accept 0.2% and 0.244%) (1) Example of Calculation Percentage uncertainty = (0.05 mm / 20.5 mm) × 100 % = 0.24 %	**1**
1(c)	**Max 2 from** • Take readings in different orientations/positions (1) • Check for zero error (1) • Ensure measurement is at widest point (1)	**2**
1(d)(i)	• Calculation of mean diameter (using 4 or 5 diameters) (1) • Anomaly (18.3 mm) not included giving mean diameter = 19.0 mm (1) Example of Calculation Mean diameter = (19.0 mm + 19.1 mm + 18.9 mm + 19.1 mm) / 4 = 19.0 mm	**2**
1(d)(ii)	• Use of half range (0.1 mm) (1) **Or** value furthest from mean • Percentage uncertainty = 0.5 % (1) 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 Example of Calculation Range = 19.1 mm – 18.9 mm = 0.2 mm Percentage uncertainty = (0.1 mm / 19.0 mm) × 100 % = 0.53 %	**2**
1(e)	• Use of $V = \frac{4}{3}\pi r^3$ (1) • Use of $\rho = \frac{m}{V}$ (1) • Density = 7.89×10^3 kg m^{-3} (7.89 g cm^{-3}) (1) • Value given to 3 s.f. (1) Example of Calculation $V = \frac{4}{3}\pi(10.25 \times 10^{-3}\text{ m})^3 = 4.51 \times 10^{-6}$ m^3 $\rho = \frac{35.6 \times 10^{-3}\text{ kg}}{4.51 \times 10^{-6}\text{ m}^3} = 7.89 \times 10^3$ kg m^{-3}	**4**
1(f)	• Uses percentage uncertainty to calculate the range of density values (1) • Comparative statement consistent with their value for density from (e) (1) Example of Calculation 7.75×10^3 kg m^{-3} × 1.02 = 7.91×10^3 kg m^{-3} 7.75×10^3 kg m^{-3} × 0.98 = 7.60×10^3 kg m^{-3}	**2**
	Total for question 1	**16**

Question Number	Answer	Mark
2(a)	• 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)	• k = 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)	• 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)	• (Diffracted) electrons experience (constructive) interference/superposition Or the pattern is evidence electrons have interfered/superposed (1) • Diffraction/interference is a wave property (1) For MP1 – it must be clear they are referring to electrons, not waves.	**2**
3(c)(i)	**Max 2 from** • 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)	• Correct sin θ values to 3 s.f. • Labels axes with quantities **and** unit for λ and with no unit for sin θ (Accept sin(θ/°) but not sin θ/°) • Sensible scales • Plotting values • Line of best fit	(1) (1) (1) (2) (1)	**6**
3(c)(iii)	• Use of large triangle to determine gradient • gradient = 1.10×10^{-10} to 1.20×10^{-10} • Value given to 2 or 3 s.f. **and** correct unit (m)	(1) (1) (1)	**3**
3(c)(iv)	• Comparison between $(n)\lambda = d \sin\theta$ and $y = mx$ (+ c) • d is a constant given by the gradient **and** n=1 MP2 is dependent on MP1 being awarded.	(1) (1)	**2**
	Total for question 3		**19**

λ / × 10^{-11} m	θ / °	sin θ
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



Question Number	Answer	Mark
4(a)	• Use of $\sqrt{\frac{mg}{\mu}} = f\lambda$ (1) • Use of $l = 1.5 \times \lambda$ (1) • $\mu = 3.2 \times 10^{-4}$ kg m^{-1} (1) Example of calculation $1.5 \times \lambda = 1.25$ m $\lambda = 0.833$ m $\mu = (0.25 \text{ kg} \times 9.81 \text{ m s}^{-2}) / (105^2 \text{ Hz}^2 \times 0.833^2 \text{ m}^2)$ $\mu = 3.21 \times 10^{-4}$ kg m^{-1}	**3**
4(b)(i)	Mark 4(b)(i) and (b)(ii) holistically **Max 2 from** *Frequency* • Uncertainty in identifying when nodes form (1) • Uncertainty in identifying maximum amplitude (1) *Length* • Parallax error when measuring length (1) • Uncertainty in measuring length to top of pulley **Or** uncertainty in measuring length as string is not straight (1) *Mass* • Zero error on mass balance (1)	**2**
4(b)(ii)	**Max 4 (from only 2 pairs)** **For each source from (b)(i)** Description of experimental technique (1) Additional detail (1) *Examples* *Frequency* • 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) *Length* • Use a set square to reduce parallax error in length **Or** hold ruler in contact with the wire to reduce parallax error in length **Or** ensure ruler and string are at eye-level (1) • Switch off vibrator **Or** ensure string is straight (1) *Mass* • Zero balance before each measurement (1) • To remove systematic error **Or** idea that this error is not reduced by repeating (1)	**4**
	Total for question 4	**9**