Pearson Edexcel

Mark Scheme (Results)

January 2023

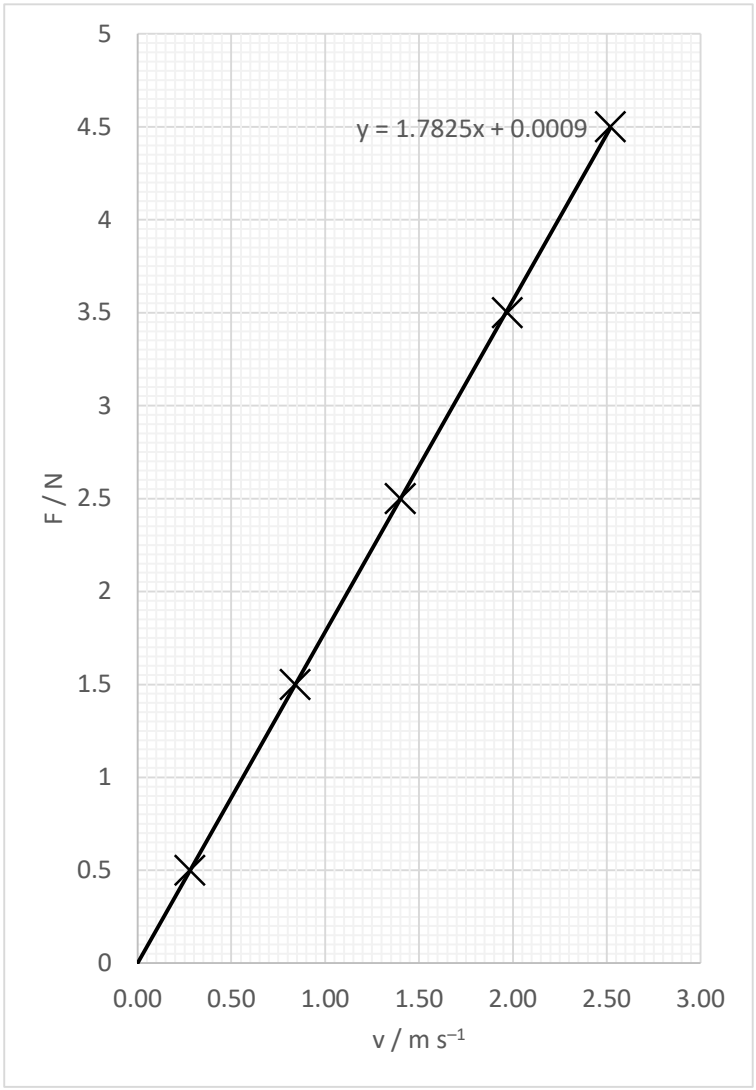
Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH13)
Paper 01 Unit 3: Practical Skills in Physics I

Question Number	Answer	Mark
1(a)(i)	• 0.001 MΩ **(1)**	1
1(a)(ii)	• Use of percentage uncertainty = half resolution / measurement × 100% **(1)** • Percentage uncertainty = 0.173 % **(1)** Accept use of percentage uncertainty = resolution / measurement × 100%, giving 0.346% for 1 mark only. Allow e.c.f. from 1(a)(i). <u>Example of calculation</u> Percentage uncertainty = 0.0005 MΩ / 0.289 MΩ × 100 % = 0.173 %	2
1(b)(i)	Mark 1(b)(i) and 1(b)(ii) holistically. • Use ruler to measure length between the electrodes **and** measure width of shading **Or** measure length between electrodes **and** width of shading using the squared paper **(1)** • Measure *R* at different values of length **(1)** • Plot graph of *R* vs length **(1)** • Calculate thickness using gradient = resistivity / (width × thickness) **(1)**	4
1(b)(ii)	Any ONE from • Contact resistance between electrode and pencil shading **(1)** • Zero error on ohmmeter (Accept zero error for a suitable measuring device named in (b)(i)) **(1)** • Electrodes not parallel **(1)**	1
	Total for question 1	**8**

Question Number	Answer	Mark
2(a)(i)	• To ensure the sound waves are coherent **Or** to ensure the two waves have a constant phase relationship **Or** to ensure the two sound waves have the same frequency **and** wavelength **Or** to ensure the sound waves are produced in phase **(1)**	**1**
2(a)(ii)	• Loud sound could damage hearing/ears (accept named part of the ear e.g., ear drum) **(1)** • Wear ear defenders/plugs **Or** limit the volume of sound **Or** limit the duration/time of the exposure **Or** do not stand too close to the loudspeakers **(1)**	**2**
2(b)(i)	• Subtraction of distance between two maxima **(1)** • Calculation of average distance between maxima using a minimum of 3 gaps **(1)** • $w = 0.62$ m **(1)** <u>Example of calculation</u> Total distance = 3.33 – 0.22 = 3.11 m Number gaps = 5 $w = 3.11 / 5 = 0.62$ m	**3**
2(b)(ii)	• Use of $w = \lambda D / s$ **(1)** • Correct value of λ to 2 s.f. with correct unit **(1)** Allow e.c.f. from 2(b)(i) <u>Example of calculation</u> $\lambda = sw / D = 1.10 \text{ m} \times 0.62 \text{ m} / 4.0 \text{ m} = 0.1705 = 0.17$ m	**2**
2(b)(iii)	• The connections to one of the speakers were reversed **Or** waves emitted from the two speakers are in antiphase **(1)** • So destructive interference takes place **(1)**	**2**
2(c)(i)	• As $v = f \lambda$, so the frequency would need to be determined **(1)** • States suitable apparatus to measure the <u>frequency</u> (e.g. frequency meter, oscilloscope, suitable app on a mobile phone, etc.) **(1)**	**2**
2(c)(ii)	• As $\lambda = v / f$, λ will increase (for a constant f) **Or** if v increases (for a constant f,) λ will increase **(1)** • (As $w = \lambda D / s$), w will increase as D and s remain constant **(1)** **OR** • $w = v D / f s$ **(1)** • Hence as v increases, w will increase as f, D and s remain constant **(1)**	**2**
	Total for question 2	**14**

Question Number	Answer	Mark
3(a)(i)	• The uncertainty would be 0.05 cm **Or** resolution would be 0.1 cm **(1)** • The percentage uncertainty would be about 1% (which is small) **(1)** Allow MP1 for correct uncertainty as seen in a calculation. Accept uncertainty as full resolution (0.1 cm) giving percentage uncertainty of 2% for MP2	**2**
3(a)(ii)	**Max TWO from** • Attach a marker to the spring **Or** use a set square between ruler and spring **Or** ensure ruler is close to spring **(1)** • View the scale at right angles **(1)** • Ensure the ruler is at zero at the support **(1)** • Ensure the ruler is vertical using a set square **(1)**	**2**
3(b)(i)	• Number of decimal places varies (for both W and l) **(1)**	**1**
3(b)(ii)	• The student should check the value at $W = 0.39$ N, $l = 12$ cm **(1)** • As it is furthest from the line of best fit **(1)**	**2**
3(b)(iii)	• W in the range of 0.22 to 0.24 (N) **(1)**	**1**
3(c)(i)	• Use of density of modelling clay = density water × W_1 / (W_1 – W_2) **(1)** • Density of modelling clay = 1700 kg m^{-3} **(1)** <u>Example of calculation</u> Density of modelling clay = 1000 kg m^{-3} × 0.65 N / (0.65 N – 0.27 N) Density of modelling clay = 1710 kg m^{-3}	**2**
3(c)(ii)	• Calculation of relevant limit of density of modelling clay from (c)(i) **(1)** • Conclusion consistent with calculated limit/range **(1)** <u>Example of calculation</u> Limit of density = 1710 × 1.04 = 1778 kg m^{-3} As this is above value 1760 kg m^3 then it could be polymer clay **OR** • Calculation of percentage difference (from 1760 kg m^{-3}) **(1)** • Conclusion based on comparison of the percentage difference and 4 % **(1)** <u>Example of calculation</u> Percentage difference = (1760 kg m^{-3} – 1710 kg m^{-3}) / 1760 kg m^{-3} × 100% = 2.8 % As this is less than 4 % then it could be polymer clay Allow e.c.f. from 3(c)(i)	**2**
	Total for question 3	**12**

Question Number	Answer		Mark
4(a)(i)	• Calculation of mean • Mean t = 3.56 (s) to 3 s.f. Example of calculation Mean value of time = (3.57 s + 3.61 s + 3.54 s + 3.51 s) / 4 = 3.5575 = 3.56 s	**(1)** **(1)**	**2**
4(a)(ii)	• Use of half range for uncertainty **Or** uncertainty = max distance from the mean • Percentage uncertainty = 1.4% Allow e.c.f. from 4(a)(i) Example of calculation Uncertainty = half range = (3.61 s – 3.51 s) / 2 = 0.05 s Percentage uncertainty = 0.05 s / 3.56 s × 100% = 1.4 %	**(1)** **(1)**	**2**
4(b)	• Place a light gate (at each marker) • To (start and) stop an electronic/digital timer **Or** use a datalogger/computer to determine the time **OR** • Use video camera • Valid method to find time (e.g., count the number of frames)	**(1)** **(1)** **(1)** **(1)**	**2**
4(c)(i)	• Rearranges equation to $F = (M / t)\ v$ and compares with $y = mx\ (+ c)$ • So, the gradient = M / t **OR** • Rearranges equation to $F / v = M / t$ • States that gradient of graph = F / v **OR** • Rearranges equation to $t = M\ v / F$ • States that gradient of graph = F / v **Or** states that 1/gradient of graph = v / F	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**2**

4(c)(ii)	• Labels axes with quantities and units **(1)** • Sensible scales **(1)** • Plotting **(2)** • Line of best fit **(1)**  | F/N | v/m s^{-1} | |---|---| | 0.5 | 0.28 | | 1.5 | 0.84 | | 2.5 | 1.40 | | 3.5 | 1.97 | | 4.5 | 2.52 |	**5**
4(c)(iii)	• Calculates gradient using large triangle **(1)** • Use of gradient = M / t **(1)** • t in the range of 0.068 to 0.072 s **(1)** <u>Example of calculation</u> Gradient $= \frac{4.0-1.0}{2.25-0.55} = 1.76$ $t = \frac{0.125 \text{ kg}}{1.76 \text{ N m}^{-1}\text{s}} = 0.07$ s	**3**
	Total for question 4	**16**