Pearson Edexcel

Mark Scheme (Results)

October 2021

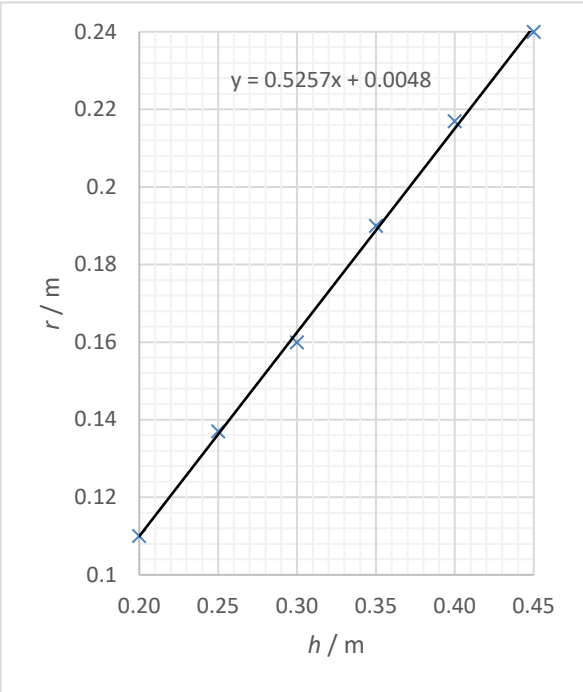
Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH13)
Paper 1
Practical Skills in Physics I

Question Number	Answer	Mark
1(a)	• Heating (to 100 ˚C) – suitable method described (e.g. water bath, kettle) (1) • Cooling (to 10 ˚C) – suitable method described (e.g. ice bath, freezer) (1)	**2**
1(b)	• Use of uncertainty = half resolution (0.005 V) (1) • Percentage uncertainty = 0.07 (%) (1) Accept use of resolution (0.01 V), giving percentage uncertainty of 0.15% for MP2 only <u>Example calculation</u> Percentage uncertainty = (0.005/6.85) × 100% Percentage uncertainty = 0.073%	**2**
1(c)(i)	• Line of best fit drawn up to *V* axis (1) • Value between 8.2 and 8.6 (V) (1) MP1 – accept a straight line of best fit covering at least the first 5 plots MP2 – if a line of best fit is drawn, the value given must match the y-axis intercept ± 1 mm and be within the range stated	**2**
1(c)(ii)	• Use of 12 V = ∑ p.d. (1) • Use of $V = IR$ (1) • Correct value calculated with unit (1) Note – ecf from 1(c)(i) applies MP1 & 2 can be awarded for correct use of the potential divider ratios rule (e.g., $V_{\text{fixed res}}$ / 12 V = 4700 Ω / (4700 Ω + R_{therm}) <u>Example calculation</u> V_{therm} = 8.4 V V_{fixed} = 3.6 V $V = IR$ 3.6 V = $I \times 4.7\times10^{3}$ Ω I = 3.6 V / 4.7×10^{3} Ω = 7.7×10^{-4} A $V = IR$ 8.4 V = 7.7×10^{-4} A × R R = 8.4 V / 7.7×10^{-4} A = 1.1×10^{4} Ω	**3**

1(d)	• Calculates $V \times \theta$ for at least two pairs of values from the graph/table **Or** calculates proportional change for at least two pairs of values (1) • Conclusion consistent with values calculated (1) Do not award MP2 if temperatures are not converted to Kelvin <u>Example calculation</u> Pair 1 $V \times \theta$ = 3.5 V × (60 + 273 K) = 1170 V K Pair 2 $V \times \theta$ = 5.7 V × (30 + 273 K) = 1730 V K	**2**
	Total for question 1	**11**

Question Number	Answer	Mark
2(a)	• Path difference between microwaves reflected from metal plate and reflected from glass plate **Or** phase difference between microwaves reflected from metal plate and reflected from glass plate (1) • (Reflected) waves superpose/interfere (at the receiver) (1) • As *d* is varied, path/phase difference changes causing constructive **and** destructive interference (1)	**3**
2(b)(i)	• Determines the mean distance between maxima (1) • λ = 2 × distance between maxima (1) • λ = 2.8 cm rounded to 2 s.f. (1) <u>Example calculation</u> Mean distance between maxima = (1.2 cm +1.6 cm +1.2 cm +1.5 cm)/4 Mean distance between maxima = 1.38 cm λ = 2 × 1.38 cm λ = 2.8 cm	**3**
2(b)(ii)	• Use of $c = f\lambda$ (1) • $f = 1.1\times10^{10}$ Hz (1) Note – allow ecf from 2(b)(i) <u>Example calculation</u> $c = f\lambda$ 3.0×10^{8} m $s^{-1} = f \times 0.028$ m $f = 3.0\times10^{8}$ m s^{-1} / 0.028 m $f = 1.1\times10^{10}$ Hz	**2**
	Total for question 2	**8**

Question Number	Answer	Mark
3(a)	• Sample of nylon secured at one end (1) • Slotted masses hung from the opposite end (1) • Force/mass increased until sample breaks (1) • $F = mg$ to calculate the force **Or** use a force meter to measure the weight of the mass (1) MP1 & 2 can be awarded from a diagram.	**4**
3(b)	• Comment identifying an appropriate safety issue (1) • Associated control measure (1) <u>Examples</u> • Masses falling on feet • Ensure feet are not underneath • Snapped nylon hitting eyes • Wear safety glasses	**2**
3(c)(i)	• Mean diameter = 0.55 (mm) (1) • Use of half range **Or** value furthest from mean (1) • Percentage uncertainty = 3.6 (%) (1) <u>Example of Calculation</u> Mean = (0.55 mm + 0.57 mm + 0.54 mm + 0.55 mm + 0.53 mm)/5 Mean = 0.55 mm Range = 0.57 mm – 0.53 mm = 0.04 mm Percentage uncertainty = (0.02 mm / 0.55 mm) × 100 % = 3.6 %	**3**
3(c)(ii)	• Use of $A = \pi r^2$ **Or** use of $A = \pi d^2/4$ (1) • Use of $\sigma = F / A$ for sample before absorbing water (1) • Use of $\sigma = F / A$ for sample after absorbing water (1) • Calculation of a percentage change (1) • Comparative statement consistent with calculated values (1) <u>Example of Calculation</u> Before: $A = \pi r^2$; $A = \pi \times (2.25\times10^{-4}\ m)^2$; $A = 1.59\times10^{-7}\ m^2$; $\sigma = F / A$; $\sigma = 65.8\ N / 1.59\times10^{-7}\ m^2$; $\sigma = 4.1\times10^{8}\ Pa$ After: $A = \pi r^2$; $A = \pi \times (2.3\times10^{-4}\ m)^2$; $A = 1.66\times10^{-7}\ m^2$; $\sigma = F / A$; $\sigma = 57.8\ N / 1.66\times10^{-7}\ m^2$; $\sigma = 3.5\times10^{8}\ Pa$ Percentage change % difference = $((4.1\times10^{8} – 3.5\times10^{8}) / 4.1\times10^{8}) \times 100\% = 15\%$	**5**
	Total for question 3	**14**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>4(a)(i)</td><td>Max 2 from
• Inconsistent d.p. in r (1)
• No repeat readings (for r) (1)
• All values (of h and r) should be to the nearest mm
Or all values (of h and r) should be to 3 d.p. (1)</td><td>2</td></tr>
<tr><td>4(a)(ii)</td><td>• Labels axes with quantities and units (1)
• Sensible scales (1)
• Plotting (2)
• Line of best fit (1)
 

<table>
<tr><th>h / m</th><th>r / m</th></tr>
<tr><td>0.20</td><td>0.11</td></tr>
<tr><td>0.25</td><td>0.137</td></tr>
<tr><td>0.30</td><td>0.16</td></tr>
<tr><td>0.35</td><td>0.19</td></tr>
<tr><td>0.40</td><td>0.217</td></tr>
<tr><td>0.45</td><td>0.24</td></tr>
</table></td><td>5</td></tr>
<tr><td>4(b)(i)</td><td>• $mgh = ½mv^2$ (1)
• Algebra steps shown leading to $u = \sqrt{2gh}$ (1)
Do not accept use of $v^2 = u^2 + 2as$</td><td>2</td></tr>
<tr><td>4(b)(ii)</td><td>• See $v = \sqrt{2gr}$ (1)
• Shows that $e = \frac{\sqrt{r}}{\sqrt{h}}$ (1)
• Gradient = $\frac{\Delta r}{\Delta h}$ therefore gradient = e^2 (1)

Accept substitution of $u = \sqrt{2gh}$ and v= $\sqrt{2gr}$ into $e = v/u$ and re-arrangement into $y = mx$ format for MP2 and 3</td><td>3</td></tr>
<tr><td>4(c)</td><td>• Calculates gradient using large triangle
(allow use of $e^2 = \frac{r}{h}$) (1)
• Gradient / e^2 value between 0.51 and 0.56
Or e value between 0.71 and 0.75 (1)
• Correct choice of metal for value of e calculated (1)

<u>Example of Calculation</u>
$e^2 = (0.22 – 0.12)/(0.41 – 0.22)$</td><td>3</td></tr>
</table>

	$e^2 = 0.53$ $e = 0.73$ so stainless steel	
4(d)	• Acceleration along the ramp would be smaller, so r would be lower (for a given h) **Or** friction would reduce velocity, so r would be lower (for a given h) **Or** friction would dissipate energy, so r would be lower (for a given h) (1) • (The gradient and) the value obtained for e would be smaller [dependent on MP1] (1)	**2**
	Total for question 4	**17**