Pearson Edexcel

Mark Scheme (Results)

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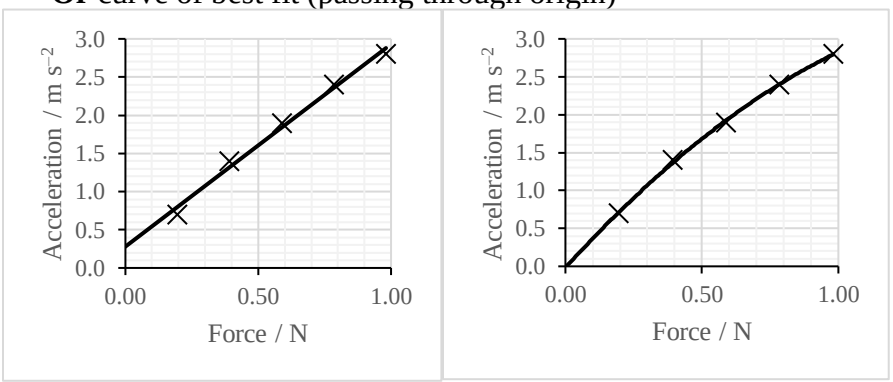
Pearson Edexcel International Advanced Subsidiary In Physics (WPH13)
Paper 1 Practical Skills in Physics I

Question Number	Answer	Mark
1(a)	• A measurement of distance travelled (1) • A measurement of time taken (1) • Appropriate measuring equipment for both, e.g. metre rule, stop clock, light gates (1) • See $s = ut + ½at^2$ (1) • Repeat and calculate mean (1) **OR** • A measurement of distance travelled (1) • A measurement of (initial and) final velocity (1) • Appropriate measuring equipment for both, e.g. metre rule, stop clock, light gates (1) • See $v^2 = u^2 + 2as$ (1) • Repeat and calculate mean (1) **OR** • A measurement of (initial and) final velocity (1) • A measurement of time taken (1) • Appropriate measuring equipment for both, e.g. stop clock, light gates (1) • See $a = (v – u)/t$ (1) • Repeat and calculate mean (1) For MP4 - accept correctly re-arranged versions - accept gradient of a correctly described graph - accept versions of equations where $u = 0$ has already been included. e.g. $s = ½at^2$ MP1-2 could be described for the falling mass, as acceleration is the same	**5**
1 (b)(i)	• (0.98, 2.8) and (0.78, 2.4) plotted correctly (1) • Straight line of best fit with a positive *y*-axis intercept **Or** curve of best fit (passing through origin) (1) 	**2**
1 (b)(ii)	• (Straight) line of best fit does not pass through the origin, so the conclusion is correct **Or** line of best fit is a curve, so the conclusion is correct **Or** accept answer consistent with incorrectly drawn line in (b)(i) (1)	**1**
1(c)	• Masses removed from the hanger are placed on the glider **Or** masses removed from the glider are placed on the hanger (1)	**1**
	Total for question 1	**9**

Question Number	Answer		Mark
2(a)(i)	• Normal drawn and critical angle indicated	(1)	**1**
2(a)(ii)	• Use of $\sin C = \frac{1}{n}$ with their measured value of C • Refractive index = 1.58 to 1.70	(1) (1)	**2**

C / ˚	n
36	1.70
37	1.66
38	1.62
39	1.59

MP1 accept correct use of $n_1 \sin\theta_1 = n_2 \sin\theta_2$, with $n_2 = 1$ and $\theta_2 = 90^\circ$

Example calculation
$C = 38^\circ$
$\sin 38^\circ = \frac{1}{n}$
$n = 1.62$

2(b)	• Use of $\sin C = \frac{1}{n}$ with either 40.5˚ or 41.5˚ • Range of refractive index calculated	(1) (1)	**2**

Example calculation
$\sin 40.5^\circ = \frac{1}{n}$
$n = 1.54$
$\sin 41.5^\circ = \frac{1}{n}$
$n = 1.51$
$1.51 \leq n \leq 1.54$

2(c)	• Use of $n_1 \sin\theta_1 = n_2 \sin\theta_2$ • Refractive index = 1.53 • Comparative statement consistent with the range from (b)	(1) (1) (1)	**3**

Example calculation
$\sin 64 = n \sin 36$
$n = 1.53$

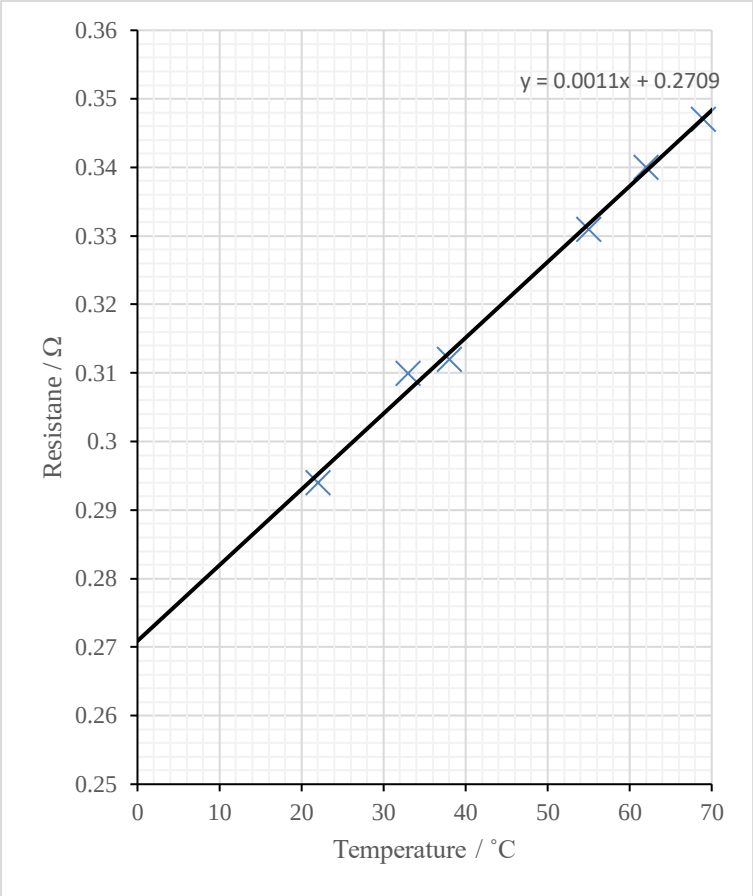
2(d)	• The monochromatic light has a single wavelength/frequency **Or** White light is a mixture/range of wavelengths/frequencies • The different wavelengths/colours would refract by different angles **Or** different wavelengths/colours would have different refractive indexes • Monochromatic light would give less uncertainty in the angle (incident/refraction/critical) **Or** monochromatic light allows for a more accurate measurement of angle	(1) (1) (1)	**3**
2(e)	• Angle resolution of 0.1˚ compared to protractor resolution of 1˚ • Beam from the collimator is narrower (than the ray from a ray box) • So, uncertainty in angle (of refraction) is smaller	(1) (1) (1)	**3**

For MP1 – accept descriptions of protractor with resolution 0.5˚
For MP3 – must be clear the uncertainty is for the angle measurement

	Total for question 2	**14**

Question Number	Answer	Mark
3(a)	• Diagram showing rubber band suspended/clamped at one end (e.g. hanging from a clamp stand) (1) • Force applied to band (e.g. slotted masses hanging on free end) (1) • Measure initial length using a ruler **Or** mark position of bottom of band on ruler (1) • Measure new length/position and calculate extension (1) • Additional detail to improve accuracy e.g. method for reducing parallax **Or** additional detail to improve safety e.g. ensure feet are not under the masses in case they fall (1) MP2-5 could be awarded for information shown on the diagram (e.g. metre rule and set squares seen on the diagram). Allow MP3 and 4 for set-up where 0 on metre rule is aligned with end of band before masses are added, to measure extension directly.	**5**
3(b)	• Estimates the area inside the loop by counting squares **Or** estimates the area inside the loop by using simple shapes (1) • Calculates the energy of each square **Or** calculates the energy for one shape (1) • Energy transferred = 0.85 to 1.00 J (1) MP1 and 2 Accept calculation of area under both curves which are then subtracted <u>Example calculation</u> 77 squares counted Energy of 1 square = 0.5 N × 0.025 m = 0.0125 J Energy transferred = 77 × 0.0125 J = 0.96 J	**3**
	Total for question 3	**8**

Question Number	Answer	Mark
4(a)	• Percentage uncertainty = 2.4% (accept 2%, 2.38%, 2.381%) (1) Example Calculation $\text{Percentage uncertainty} = \frac{0.25}{10.5} \times 100\%$ Percentage uncertainty = 2.4%	**1**
4(b)	**Max 3 from** • (Percentage) uncertainty will be reduced (1) • The multimeter screen/display will not cause a parallax error (1) • The multimeter can measure to a higher resolution **Or** the multimeter resolution can be increased by changing the setting **Or** the multimeter measures to 2 d.p. (1) • The digital multimeter will not require interpolation of values (1)	**3**
	Total for question 4	**4**

Question Number	Answer	Mark
5(a)	• Inconsistent number of decimal places for resistance **Or** resistance should be to 3 d.p. (to match ohmmeter resolution) (1) • Inconsistent intervals in temperature **Or** large jump in temperature from 38 to 55 ˚C (1)	**2**
5(b)	• Labels axes with quantities and units (1) • Sensible scales (1) • Plotting (2) • Line of best fit (1)  T /˚C | R / Ω 69 | 0.347 62 | 0.34 55 | 0.331 38 | 0.312 33 | 0.31 22 | 0.294	**5**
5(c)	• Extends line to y-axis intercept (1) • Correct R_0 for the line drawn (1) • Calculates gradient using large triangle (1) • Use of gradient = αR_0 (1) • $\alpha = 4.0\times10^{-3}$ to 4.2×10^{-3} (˚C^{-1}) (1) • Value of α to 2 or 3 sig fig and with correct units ˚C^{-1} (1) For MP5 – accept a correct calculation using the given value for R_0 and gradient. For MP1 – 5 accept calculation of y-axis intercept using gradient or use of simultaneous equations for 2 pairs of points on the line. <u>Example calculation</u> Gradient = (0.348-0.282) / (70-10) = 0.0011 Ω ˚C^{-1} α = gradient / R_0 = 0.0011 / 0.271 = 4.1×10^{-3} ˚C^{-1}	**6**

5(d)	• Realistic modification suggested (1) • Explains how this improves the accuracy of the values (1) <u>Examples</u> • Take a resistance measurement at 0 ˚C • to measure R_0 accurately • Take resistance measurements for lower temperatures • to improve the accuracy of the gradient **Or** to improve the accuracy of the *y*-axis intercept • Take resistance measurements for smaller increments of temperature • to improve the accuracy of the gradient **Or** to improve the accuracy of the *y*-axis intercept • Take resistance measurements for a wider range of temperatures • to improve the accuracy of the gradient **Or** to improve the accuracy of the *y*-axis intercept • Stir the water regularly **Or** place the thermometer inside the copper coil • so the temperature of water plotted is the same as the temperature of the copper • Use a datalogger to measure temperature and resistance • so that the values are recorded simultaneously • Use a digital thermometer • to avoid parallax error Ignore higher resolution for a digital thermometer.	**2**
	Total for question 5	**15**