Mark Scheme (Results)

June 2022

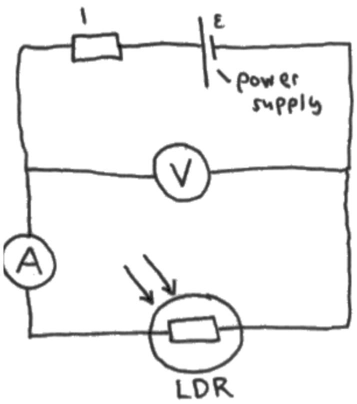
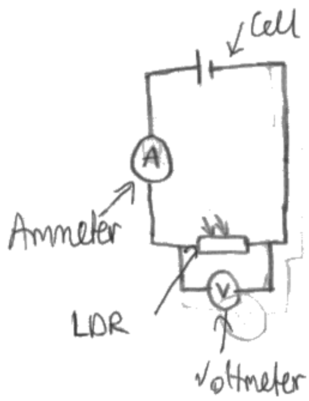
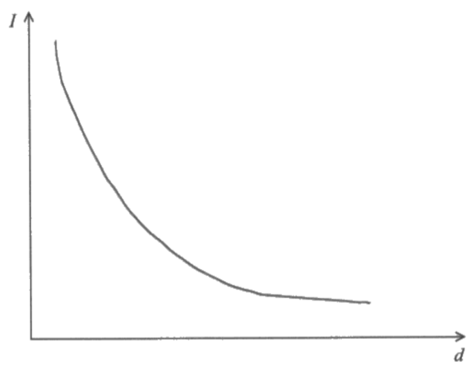
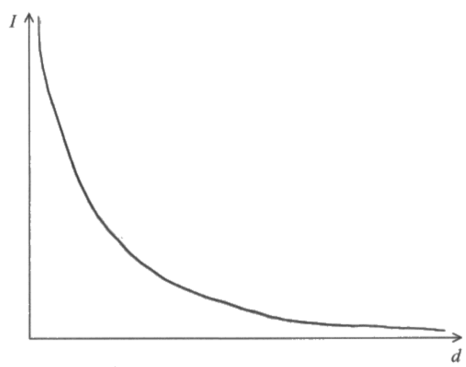
Pearson Edexcel
International Advanced Subsidiary Level in Physics (WPH13)
Paper 01: Unit 3 Practical Skills in Physics I

Question Number	Answer		Mark
1(a)	• Determines the average coin radius/diameter using at least five coins • Determines the average coin thickness using all 20 coins • Use of $V = \pi r^2 t$ **Or** use of $V = \pi \frac{d^2}{4} t$ • V between 1.14×10^{-6} and 1.22×10^{-6} m^3 <u>Example of calculation</u> Total length of 10 coins = 30.2 cm Average coin radius = 0.0151 m Total height of 20 coins = 3.3 cm Average coin thickness = 0.00165 m $V = \pi r^2 t$ $V = \pi \times (0.0151 \text{ m})^2 \times 0.00165 \text{ m}$ $V = 1.18 \times 10^{-6}$ m^3	(1) (1) (1) (1)	4
1(b)	• Use of $\rho = m/V$ • ρ between 8000 and 8600 kg m^{-3} Allow ecf for V from 1(a) for both marks. <u>Example of calculation</u> $\rho = m/V$ $\rho = 0.0098 \text{ kg}/1.18 \times 10^{-6} \text{ m}^3$ $\rho = 8300$ kg m^{-3}	(1) (1)	2
1(c)	**EITHER** • Calculates values for 2% range of the density of brass • Statement comparing this with 1(b) and relevant conclusion made **OR** • Calculates percentage difference between 8550 kg m^{-3} and the density from 1(b) • Statement comparing this with 2% and relevant conclusion made <u>Example of calculation</u> 8550 kg m^{-3} × 1.02 = 8721 kg m^{-3} 8550 kg m^{-3} × 0.98 = 8379 kg m^{-3}	(1) (1) (1) (1)	2

Question Number	Answer	Mark
1(d)	**EITHER** • Use of a displacement can filled with water (1) • Multiple coins added and volume of displaced water measured using a measuring cylinder (1) • Volume of displaced water divided by number of coins (1) • Coins added slowly to prevent splashing **Or** measuring cylinder read at eye level to avoid parallax **Or** ensure measuring cylinder is vertical **Or** displacement can is filled until overflowing and waits until drips stop (1) **OR** • Use of a measuring cylinder part filled with water (1) • Multiple coins added and the change in volume recorded (1) • Volume of displaced water divided by number of coins (1) • Coins added slowly to prevent splashing **Or** measuring cylinder read at eye level to avoid parallax **Or** ensure measuring cylinder is vertical (1) **OR** • Use of vernier/digital calipers **Or** use of a micrometer (screw gauge) (1) • Multiple coins measured **Or** multiple positions measured on the same coin (1) • Mean radius/diameter **and** thickness/height calculated (1) • Corrects/checks for zero error in the measuring device (1)	**4**
	Total for question 1	**12**

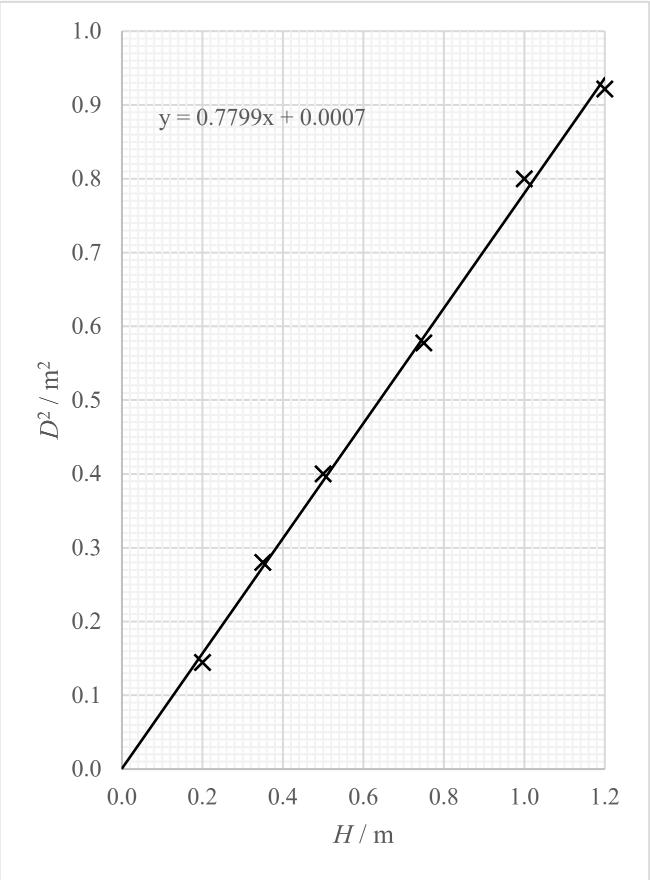
Question Number	Answer		Mark
2(a)	• Uncertainty is half resolution (0.5˚) • Use of percentage uncertainty = (uncertainty / angle value) × 100% for either angle • % uncertainty in θ_1 = 1.4% (accept 1%) **and** % uncertainty in θ_2 = 0.8% If the full resolution of protractor is used (1˚) – award MP2 for use of equation and MP3 for correctly values 2.9% (3%) and 1.6% (2%) <u>Example Calculation</u> % uncertainty in θ_1 = (0.5˚ / 35˚) × 100% = 1.4% % uncertainty in θ_2 = (0.5˚ / 62˚) × 100% = 0.81%	(1) (1) (1)	**3**
2(b)(i)	• See $n_1 \sin\theta_1 = n_2 \sin\theta_2$ with refractive index of air $n_2 = 1$ • Rearranges **and** compares with $y = mx$ (+ c) **Or** rearranges **and** compares $n_1 = \frac{\sin\theta_2}{\sin\theta_1}$ with gradient $= \frac{\Delta\sin\theta_2}{\Delta\sin\theta_1}$ • Identifies n_1 = gradient For MP1 accept $n \sin\theta_1 = \sin\theta_2$ For MP2 accept comparing $\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1}$ with gradient $= \frac{\Delta\sin\theta_2}{\Delta\sin\theta_1}$	(1) (1) (1)	**3**
2(b)(ii)	• Uses two points on the line to determine the gradient • n_1 between 1.46 and 1.54 MP2 dependent on MP1 MP2 allow correct use of gradient = 1/n from 2(b)(i) <u>Example Calculation</u> $n_1 = (0.77 – 0.17) / (0.50 – 0.10)$ $n_1 = 1.5$	(1) (1)	**2**

Question Number	Answer	Mark
2(c)	• Realistic cause of a systematic error in measured data suggested (1) • Suitable method to reduce effect of the cause suggested (1) MP2 dependent on MP1 <u>Examples</u> • Normal line not correctly drawn at 90˚ to the flat surface • Use a protractor/set square to check the normal line • Zero error because protractor not aligned correctly • Ensure the protractor is aligned to the normal • Ray of light not directed to centre of the flat surface **Or** incident ray not perpendicular to curved surface • Mark the position of the centre of the flat surface on paper • Block moved • Mark the position of the block on paper **Or** tape the block in position • Did not repeat measurements with angles of incidence either side of the normal • Repeat measurements (for angles of incidence on both sides of the normal) and calculate mean value	2
	Total for question 2	**10**

Question Number	Answer		Mark
3(a)	• Power supply (e.g., battery), ammeter and LDR connected in series • Voltmeter connected in parallel with LDR MP1 – accept incorrect symbol labelled as LDR **or** an LDR symbol without circle MP2 – we can accept a voltmeter in parallel with a single resistive component in the series circuit unless an LDR is given <u>Examples</u> 	(1) (1)	2
3(b)	• Distance between bulb and LDR (d) measured with a metre rule (accept tape measure) • Record current and potential difference and use $V = IR$ to calculate resistance **Or** use an ohmmeter or multimeter set to measure resistance • Repeat for the same values of d and calculate the mean value of R **Or** use a set square/marker to reduce parallax when measuring d **Or** look down at ruler at eye-level to reduce parallax when measuring d	(1) (1) (1)	**3**
3(c)	• Downwards curved line with decreasing gradient • Line not touching/crossing either axis MP2 dependent on MP1 <u>Examples</u> 	(1) (1)	**2**
3(d)	• Use of $A = 4\pi r^2$ • Use of $I = \frac{P}{A}$ • I = 18 W m^{-2} <u>Example Calculation</u> $I = 9.0\ \text{W} / (4 \times \pi \times (0.20\ \text{m})^2) = 17.9\ \text{W m}^{-2}$	(1) (1) (1)	**3**

Question Number	Answer	Mark
3(e)(i)	**Mark 3(e)(i) and (ii) holistically** • Suitable control variable (1) e.g., background light level, current in bulb, brightness/power of bulb, angle of light to LDR, temperature of the LDR	**1**
3(e)(ii)	• Suitable method of control for the control variable identified (1)	**1**
	Total for question 3	**12**

Question Number	Answer		Mark
4(a)	• (Energy is conserved, so) $mg\Delta h = \frac{1}{2}mv^2$ • $v = \sqrt{2g\Delta h}$ **Or** $v^2 \propto \Delta h$ **Or** states that m and g are constants • Δh is constant so v is always the same **Or** Δh is constant so v^2 is always the same If no other marks awarded, accept GPE (decrease) and KE (increase) are the same for 1 mark If suvat equations are used to show $v = \sqrt{2as}$ or $v^2 \propto s$, do not award MP1 or MP2, but MP3 is still available	(1) (1) (1)	3
4(b)	• Inconsistent d.p. in H • H/D should be measured to nearest mm **Or** H/D should be recorded to 3 d.p. Allow "No repeats shown" for either marking point	(1) (1)	2
4(c)(i)	• Correct D^2 values rounded to 2 s.f. • Labels axes with quantities and units • Sensible scales • Plotting • Line of best fit	(1) (1) (1) (2) (1)	6



H / m	D^2 / m^2
0.20	0.14
0.35	0.28
0.50	0.40
0.75	0.58
1.00	0.79
1.20	0.92

Question Number	Answer	Mark
4(c)(ii)	• Calculates gradient using large triangle (1) • Use of $gradient = \frac{2v^2}{g}$ (1) • v between 1.92 and 1.98 (m s^{-1}) (1) <u>Example Calculation</u> $gradient = \frac{0.78-0.16}{1.0-0.2} = 0.775$ m $v = \sqrt{\frac{g \times gradient}{2}} = \sqrt{\frac{9.81 \text{ m s}^{-2} \times 0.775 \text{ m}}{2}} = 1.95 \text{ m s}^{-1}$	3
4(c)(iii)	• States actual/percentage difference between the two values **Or** identifies that their value is slower/faster (1) • Comment identifying a potential cause for the difference **Or** comment on the accuracy of the values (1) <u>Examples</u> • The speed given by the graph is slower • Air resistance reduced the size of *D* • The speed given by the graph is only 0.03 m s^{-1} slower than the value she calculated • The difference is only 2%, so the experiment is accurate **Or** the difference is small, so the experiment is accurate • Calculates the percentage difference between 1.98 m s^{-1} and the value from 4(c)(ii) • The percentage difference is small, so the experiment is accurate **Or** the percentage difference is large, so the experiment is not accurate	2
	Total for question 4	**16**