

Mark Scheme (Results)

October 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)(i)	Mark 1(a)(i) and (ii) holistically to ensure approach used in 1(a)(i) matches the approach used in 1(a)(ii)		
	Measures length of top and bottom edges, and calculates mean (Accept inclusion of additional measurements taken horizontally)	(1)	
	• Length of card = 0.065 m	(1)	2
	Example of calculation Length of top edge = 6.6 cm		
	Length of bottom edge = 6.4 cm		
1(a)(ii)	Mean length = (6.6 cm + 6.4 cm)/2 = 6.5 cm		
i(a)(ii)	 Use of half the range of values if multiple length values measured Or use of max distance from the mean if multiple length values measured % uncertainty = 1.5% (accept 2%) 	(1) (1)	
	 OR Use of half ruler resolution if a single length value is measured/shown 	(1) (1)	2
	in 1(a)(i) • % uncertainty = 0.77% (accept 0.8%)		
	Accept uncertainty = full the resolution for MP1, giving and answer of 1.5% for MP2 for this approach.		
	Allow e.c.f. from 1(a)(i) for both approaches.		
	Example of calculation		
	Half range = 0.1 cm % uncertainty = (0.1 cm / 6.5 cm) × 100% = 1.5%		
1(b)(i)	• Use of $v = s/t$	(1)	
	• $v = 0.512 \text{ (m s}^{-1}) \text{ to 3 s.f.}$	(1)	
	• Use of $p = mv$ • $p = 0.140$ (kg m s ⁻¹) to 3 s.f.	(1) (1)	4
	(accept p recorded to same s.f. as v , if v recorded to 1 or 2 s.f.)	(-,	-
	Example of calculation $v = s/t = 0.105 \text{ m} / 0.205 \text{ s} = 0.512 \text{ m s}^{-1}$		
44.44	$p = mv = 0.274 \text{ kg} \times 0.512 \text{ m s}^{-1} = 0.140 \text{ kg m s}^{-1}$		
1(b)(ii)	Calculates percentage difference between the total momentum before and after	(1)	
	 The (percentage) difference is small so momentum is conserved Or a conclusion consistent with a comparison of student's values 	(1)	2
	Example of calculation Percentage difference = ((0.143 kg m s ⁻¹ – 0.140 kg m s ⁻¹)/ 0.143 kg m s ⁻¹) × 100%		
	Percentage difference = 2.1%		

Question Number	Answer		Mark
1(c)	Different force could be applied each time		
	Or the force could be applied for a different time	(1)	
	 The time/velocity/momentum/acceleration for the moving glider is 		
	likely to be the different for each repeat	(1)	
	 Increasing uncertainty (in momentum) 	(1)	3
	MP3 is dependent on either of MP1 or MP2		
1(d)	Light gates and data logger eliminate (human) reaction time	(1)	
	Or using the stopwatch would include a (human) reaction time		
	• Which would reduce the effect of <u>random</u> error (in the time for the	(1)	2
	glider to travel)		
	Or reducing the uncertainty (in time for the glider to travel)		
	Total for question 1		15

Question Number	Answer		Mark
2(a)	 (<i>m</i> increases so) number of charge carriers increases Since <i>I</i> = <i>nAvq</i>, as <i>n</i> increases <i>I</i> increases 	(1) (1)	
	 The resistance decreases (and resistivity decreases) MP3 is dependent on either MP1 or MP2 	(1)	3
	•		
2(b)(i)	 States that points lie on a straight line States that the straight line passes through origin So 1/p is proportional to m MP3 dependent on MP1 and MP2 	(1) (1) (1)	3
	If no other marks are awarded, allow only 1 mark for a straight line drawn through the origin and a statement that $1/p$ is proportional to m .		
2(b)(ii)	 There are only four data points The range of masses is too small 	(1)	
	Or no data for masses less than 5 g		
	Or no data for masses greater than 8 g	(1)	2
	Total for question 2		8

Question Number	Answer		Mark
3(a)(i)	Mark 3(a)(i) and (ii) holistically		
	 EITHER Measure the height from the paper to the top of the liquid (v) Measure the height from the paper to the filament/middle of the bulb (u + v) Subtract v to give u 	(1) (1) (1)	
	 OR Measure the height from the filament/middle of the bulb to the top of the liquid (u) Measure the height from the paper to the filament/middle of the bulb (u + v) Subtract u to give v OR Measure the height from the paper to the top of the liquid (v) Move the ruler so that zero aligns with the lens Measure the distance from the lens to the filament/middle of the bulb (u) 	(1) (1) (1) (1) (1) (1)	3
3(a)(ii)	 Identifies relevant source of uncertainty Suggest suitable approach to reduce/eliminate the uncertainty Examples Parallax error when measuring the height of the bulb/lens with the ruler Use a set square from rule to bulb/lens Metre rule not vertical Use a set square to ensure metre rule is perpendicular to the 	(1) (1)	2
	 Zero error when measuring the height from the lens to the bulb Check zero on the rule is aligned with top of the liquid Filament sealed within glass, so cannot measure distance directly Measure to the middle of the bulb 		

Question Number	Answer	Mark
3(b)(i)	• Use of $P = \frac{1}{u} + \frac{1}{v}$ (1)	
	• $P = 4.30 \text{ (D) to } 3 \text{ s.f.}$ (1)	2
	Example of calculation	
	$P = \frac{1}{-} + \frac{1}{-}$	
	$P = \frac{1}{u} + \frac{1}{v}$ $P = \frac{1}{0.615 \text{ m}} + \frac{1}{0.374 \text{ m}} = 4.2998 \text{ D}$	
	P = 4.30 D	
	1 1100 2	
3(b)(ii)	• Use of $P = \frac{n_{\text{lens}} - n_{\text{air}}}{n_{\text{air}}} \left(\frac{1}{r}\right)$ (1)	
	• with $n_{cir} = 1$	
	• $n_{\text{lens}} = 1.3$ (1)	3
	Allow e.c.f from 3(b)(i)	
	Evample of calculation	
	Example of calculation mean $P = (4.28 D + 4.31 D + 4.30 D)/3 = 4.297 D$	
	$n_{\text{lens}} = Pr + 1$	
	$n_{\text{lens}} = (4.297 \text{ D} \times 0.070 \text{ m}) + 1$	
	$n_{\rm lens} = 1.3$	
	Total for question 3	10

Question Number	Answer		Mark
4(a)	 No repeat measurements Inconsistent d.p. for d Or all values of d should be recorded to the same d.p. Or measurements of d are not all recorded to the same resolution (of the device) 	(1)	2
4(b)	Labels axes with quantities and units Sensible scales Plotting Line of best fit	(1) (1) (2) (1)	5
	0.0000 V 0 5 10 15 20 25 30 35 F/N		

4(c)(i) EITHER • Re-arranges equation and compares to $y = mx (+ c)$ (1) • Shows that $m = \frac{l^3}{4wh^3E}$ (1) OR • Re-arranges equation to $\frac{d}{F} = \frac{l^3}{4wh^3E}$ (1) • States that $\frac{d}{F} = \text{gradient of the graph plotted}$ (1) • Calculates gradient using large triangle • Gradient in the range 1.30×10^{-4} to 1.40×10^{-4} (m N-1) (1) Example of calculation: Gradient = $(0.0035 - 0.0010) / (26 - 7.5) = 1.35 \times 10^{-4}$ 4(c)(iii) • Use of gradient = $\frac{l^3}{4wh^3E}$ (1) Or use of substituted values of F and d into $E = \frac{l^3F}{4wh^3d}$ (1) • E value in the range E 2.41 GPa to E 2.60 GPa Ecf for gradient value in (c)(ii) – but not power of 10 errors in substitution of E 1, E 2, E 3, E 3, E 4 E 3, E 4 E 4 E 4 E 4 E 4 E 5, E 4 E 4 E 6 E 4 E 6 E 4 E 6 E 4 E 6 E 7 E 8 E 6 E 7 E 8 E 6 E 7 E 8 E 7 E 8 E 7 E 8 E 8 E 7 E 8 E 8 E 8 E 9 E 9 E 9 E 8 E 8 E 9 E	Question Number	Answer		Mark
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$I, w, \text{ or } h$ $Example of calculation:$ $E = \frac{l^3}{4wh^3m}$ $E = \frac{(0.30 \text{ m})^3}{4 \times 0.020 \text{ m} \times (0.010 \text{ m})^3 \times 1.35 \times 10^{-4} \text{ m N}^{-1}} = 2.5 \times 10^9 \text{ Pa}$ $4(d) \qquad \bullet \text{A thinner beam would cause a larger } d \text{ (for the same force)}$ $\bullet \text{Reducing percentage uncertainty (in } d) \qquad \qquad (1)$ $MP2 \text{ dependent on MP1}$ $4(e) \qquad \bullet \text{Identifies physics relating to health & safety} \qquad (1)$				
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$E = \frac{l^3}{4wh^3m}$ $E = \frac{(0.30 \text{ m})^3}{4 \times 0.020 \text{ m} \times (0.010 \text{ m})^3 \times 1.35 \times 10^{-4} \text{ m N}^{-1}} = 2.5 \times 10^9 \text{ Pa}$ $\bullet \text{A thinner beam would cause a larger } d \text{ (for the same force)}$ $\bullet \text{Reducing } \underbrace{\text{percentage}}_{\text{uncertainty (in } d)} \text{ (1)}$ $\bullet \text{MP2 dependent on MP1}$ $\bullet \text{Identifies physics relating to health \& safety}$		I, w, or h		
$E = \frac{(0.30 \text{ m})^3}{4 \times 0.020 \text{ m} \times (0.010 \text{ m})^3 \times 1.35 \times 10^{-4} \text{ m N}^{-1}} = 2.5 \times 10^9 \text{ Pa}$ $\bullet \text{A thinner beam would cause a larger } d \text{ (for the same force)}$ $\bullet \text{Reducing percentage uncertainty (in } d) $ $\bullet \text{MP2 dependent on MP1}$ $\bullet \text{Identifies physics relating to health \& safety}$ $\bullet \text{Identifies physics relating to health } d \in \mathbb{R}$		Example of calculation:		
$E = \frac{(0.30 \text{ m})^3}{4 \times 0.020 \text{ m} \times (0.010 \text{ m})^3 \times 1.35 \times 10^{-4} \text{ m N}^{-1}} = 2.5 \times 10^9 \text{ Pa}$ $\bullet \text{A thinner beam would cause a larger } d \text{ (for the same force)}$ $\bullet \text{Reducing percentage uncertainty (in } d) $ $\bullet \text{MP2 dependent on MP1}$ $\bullet \text{Identifies physics relating to health \& safety}$ $\bullet \text{Identifies physics relating to health } d \in \mathbb{R}$		$F = \frac{l^3}{l^3}$		
 4(d) • A thinner beam would cause a larger d (for the same force) • Reducing percentage uncertainty (in d) (1) 2 MP2 dependent on MP1 4(e) • Identifies physics relating to health & safety (1) 		$4wh^3m$ (0.30 m) ³		
 4(d) • A thinner beam would cause a larger d (for the same force) • Reducing percentage uncertainty (in d) (1) 2 MP2 dependent on MP1 4(e) • Identifies physics relating to health & safety (1) 		$E = \frac{(0.50 \text{ m})}{4 \times 0.020 \text{ m} \times (0.010 \text{ m})^3 \times 1.25 \times 10^{-4} \text{ m N}^{-1}} = 2.5 \times 10^9 \text{ Pa}$		
 Reducing percentage uncertainty (in d) MP2 dependent on MP1 Identifies physics relating to health & safety (1) 		4 × 0.020 III × (0.010 III) × 1.33×10 III N		
 Reducing percentage uncertainty (in d) MP2 dependent on MP1 Identifies physics relating to health & safety (1) 	4(d)	• A thinner beam would cause a larger <i>d</i> (for the same force)	(1)	
4(e) • Identifies physics relating to health & safety (1)			(1)	2
4(e) • Identifies physics relating to health & safety (1)		MD2 I MD4		
	4(0)		(4)	
I IA SURGOCTE A POLOVANT CATOTV ICCUO	4(e)			2
• Suggests a relevant safety issue (1) 2		Juggests a relevant sarety issue	(1)	2
<u>Examples</u>		<u>Examples</u>		
Glass is brittle, so will snap/break		Glass is brittle, so will snap/break		
Sharp edges could cause injury by causing cuts		Sharp edges could cause injury by causing cuts		
Glass is stiffer, so a larger force/mass would be peeded		• Class is stiffer so a larger force/mass would be needed		
 Glass is stiffer, so a larger force/mass would be needed A large mass could cause injury if the mass falls on feet 		_		
A large mass could cause injury if the mass rails off feet		7. Targe mass could cause injury if the mass rails on feet		
Total for question 4		Total for question 4		17