Pearson Edexcel

Mark Scheme (Results)

October 2022

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

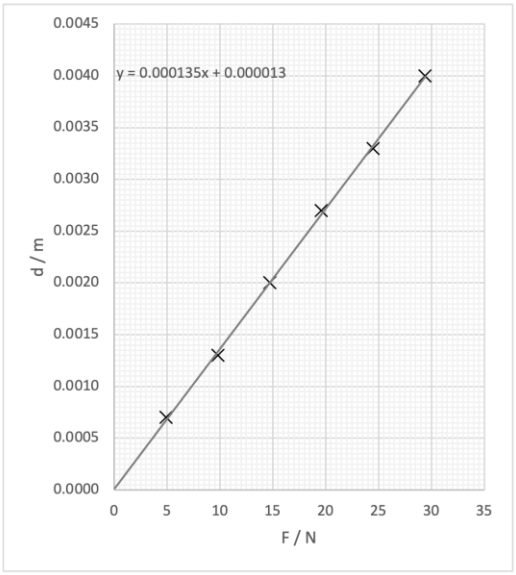
Question Number	Answer	Mark
1(a)(i)	**Mark 1(a)(i) and (ii) holistically to ensure approach used in 1(a)(i) matches the approach used in 1(a)(ii)** • Measures length of top and bottom edges, **and** calculates mean **(1)** (Accept inclusion of additional measurements taken horizontally) • Length of card = 0.065 m **(1)** Example of calculation Length of top edge = 6.6 cm Length of bottom edge = 6.4 cm Mean length = (6.6 cm + 6.4 cm)/2 = 6.5 cm	**2**
1(a)(ii)	**EITHER** • 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 **(1)** **(1)** • % uncertainty = 1.5% (accept 2%) **OR** **(1)** • Use of half ruler resolution if a single length value is measured/shown in 1(a)(i) **(1)** • % 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%	**2**
1(b)(i)	• Use of $v = s/t$ **(1)** • v = 0.512 (m s^{-1}) to 3 s.f. **(1)** • Use of $p = mv$ **(1)** • p = 0.140 (kg m s^{-1}) to 3 s.f. **(1)** (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 m / 0.205 s = 0.512 m s^{-1} $p = mv$ = 0.274 kg × 0.512 m s^{-1} = 0.140 kg m s^{-1}	**4**
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)** 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%	**2**

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)** MP3 is dependent on either of MP1 or MP2	**3**
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 glider to travel) **(1)** **Or** reducing the uncertainty (in time for the glider to travel)	**2**
	Total for question 1	**15**

Question Number	Answer	Mark
2(a)	• (*m* increases so) number of charge carriers increases **(1)** • Since $I = nAvq$, as *n* increases *I* increases **(1)** • The resistance decreases (and resistivity decreases) **(1)** MP3 is dependent on either MP1 or MP2	**3**
2(b)(i)	• States that points lie on a straight line **(1)** • States that the straight line passes through origin **(1)** • So 1/*ρ* is proportional to *m* **(1)** MP3 dependent on MP1 **and** MP2 If no other marks are awarded, allow only 1 mark for a straight line drawn through the origin and a statement that 1/*ρ* is proportional to *m*.	**3**
2(b)(ii)	• There are only four data points **(1)** • The range of masses is too small **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*) **(1)** • Measure the height from the paper to the filament/middle of the bulb (*u* + *v*) **(1)** • Subtract *v* to give *u* **(1)** **OR** **(1)** • Measure the height from the filament/middle of the bulb to the top of the liquid (*u*) **(1)** • Measure the height from the paper to the filament/middle of the bulb (*u* + *v*) **(1)** • Subtract *u* to give *v* **(1)** **OR** **(1)** • 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*)	**3**
3(a)(ii)	• Identifies relevant source of uncertainty **(1)** • Suggest suitable approach to reduce/eliminate the uncertainty **(1)** <u>Examples</u> • 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 base/paper • 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	**2**

Question Number	Answer	Mark
3(b)(i)	• Use of $P = \frac{1}{u} + \frac{1}{v}$ **(1)** • P = 4.30 (D) to 3 s.f. **(1)** <u>Example of calculation</u> $P = \frac{1}{u} + \frac{1}{v}$ $P = \frac{1}{0.615\ \text{m}} + \frac{1}{0.374\ \text{m}} = 4.2998\ \text{D}$ $P = 4.30\ \text{D}$	**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_{air} = 1 **(1)** • n_{lens} = 1.3 **(1)** Allow e.c.f from 3(b)(i) <u>Example of calculation</u> mean P = (4.28 D + 4.31 D + 4.30 D)/3 = 4.297 D $n_{\text{lens}} = Pr + 1$ $n_{\text{lens}} = (4.297\ \text{D} \times 0.070\ \text{m}) + 1$ $n_{\text{lens}} = 1.3$	**3**
	Total for question 3	**10**

Question Number	Answer	Mark
4(a)	• No repeat measurements **(1)** • 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 **(1)** • Sensible scales **(1)** • Plotting **(2)** • Line of best fit **(1)**  F/N | d/ m 4.9 | 0.0007 9.8 | 0.0013 14.7 | 0.002 19.6 | 0.0027 24.5 | 0.0033 29.4 | 0.004	**5**

Question Number	Answer	Mark
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 $\frac{d}{F}$ = gradient of the graph plotted **(1)**	**2**
4(c)(ii)	• Calculates gradient using large triangle **(1)** • Gradient in the range 1.30×10^{-4} to 1.40×10^{-4} (m N^{-1}) **(1)** <u>Example of calculation:</u> Gradient = (0.0035 – 0.0010) / (26 – 7.5) = 1.35×10^{-4}	**2**
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 2.41 GPa to 2.60 GPa Ecf for gradient value in (c)(ii) – but not power of 10 errors in substitution of l, w, or h <u>Example of calculation:</u> $E = \frac{l^3}{4wh^3m}$ $E = \frac{(0.30\ \text{m})^3}{4 \times\ 0.020\ \text{m} \times (0.010\ \text{m})^3 \times\ 1.35\times10^{-4}\ \text{m N}^{-1}} = 2.5 \times 10^9\ \text{Pa}$	**2**
4(d)	• A thinner beam would cause a larger d (for the same force) **(1)** • Reducing <u>percentage</u> uncertainty (in d) **(1)** MP2 dependent on MP1	**2**
4(e)	• Identifies physics relating to health & safety **(1)** • Suggests a relevant safety issue **(1)** <u>Examples</u> • Glass is brittle, so will snap/break • Sharp edges could cause injury by causing cuts • Glass is stiffer, so a larger force/mass would be needed • A large mass could cause injury if the mass falls on feet	**2**
	Total for question 4	**17**