Mark Scheme (Results)

Summer 2021

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

Question Number	Answer		Mark
1(a)	• Metre rule - 0.1 cm **and** Vernier calipers - 0.1 mm	(1)	**1**
1(b)	• Measure length and width of sheet in multiple positions **and** obtain mean • Measure thickness for at least 20 sheets • Measure total mass for at least 20 sheets • Calculate density = mass / (length × width × thickness) MP2/3 – reference to number of sheets need only be seen once but the same number of sheets must be used for measurements of thickness and mass.	(1) (1) (1) (1)	**4**
1(c)	• (Absolute) uncertainty would stay the same **Or** resolution of the measuring device is the same • So, <u>percentage</u> uncertainty in thickness/mass would reduce MP2 dependent on MP1	(1) (1)	**2**
	Total for question 1		**7**

Question Number	Answer		Mark
2(a)	• Difficult to identifying when sound was loudest **Or** Difficulty hearing tuning fork due to background noise • Tube moved when marking the water level **Or** Tube not vertical when water level was marked	 (1) (1)	 **2**
2(b)(i)	• Calculation of the mean using 5 values • Mean l = 18.8 cm to 3 s.f. <u>Example of calculation</u> Mean l = (18.4 + 18.0 + 19.2 + 19.4 + 19.2) / 5 Mean l = 18.8 cm	(1) (1)	 **2**
2(b)(ii)	• Use of half the range • Percentage uncertainty = 4 (%) **OR** • Use of value furthest from the mean (18.0) • Percentage uncertainty = 4 (%) Allow ecf from 2(b)(i) for use of 4 values (e.g. ignoring 18.0) for both mark points. <u>Example of calculation</u> Range = 19.4 – 18.0 = 1.4 cm Percentage uncertainty = (0.7 cm / 18.8 cm) × 100 % = 3.7 % Difference from mean = 18.8 – 18.0 = 0.8 cm Percentage uncertainty = (0.8 cm / 18.8 cm) × 100 % = 4.3 %	(1) (1)	 **2**
2(c)	• Use of $v = f\lambda$ • Speed of sound = 331 m s^{-1} Allow e.c.f from 2(b)(i) <u>Example of calculation</u> λ = 4 × 0.188 m = 0.752 m v = 440 Hz × 0.752 m = 331 m s^{-1}	(1) (1)	 **2**
2(d)	• Use of percentage uncertainty from (b)(ii) to calculate relevant maximum/minimum value for speed of sound from (c) • Statement comparing this with 343 m s^{-1} MP1 – only needs to calculate one boundary – e.g. maximum if their value in (c) is below 343 m s^{-1}, minimum if (c) is above 343 m s^{-1}. **OR** • Calculates the percentage difference between 343 m s^{-1} and their speed of sound from (c) • Statement comparing this with their percentage uncertainty from (b)(ii) <u>Example of calculation</u> Percentage uncertainty = 4 % v = 331 m s^{-1} Max v = 331 × 1.04 = 344 m s^{-1}	 (1) (1) (1) (1)	 **2**
	Total for question 2		**10**

Question Number	Answer		Mark
3(a)	• Diameter value = 17.90 mm • Use of half resolution (0.005 mm) • Percentage uncertainty = 0.03 (%) <u>Example of calculation</u> Percentage uncertainty = (0.005 mm / 17.90 mm) × 100 % = 0.028 %	(1) (1) (1)	**3**
3(b)	• Check for zero error Allow do not overtighten	(1)	**1**
3(c)(i)	• When stationary, the reading on the force meter = weight (− upthrust) • When moving (at a constant speed), the reading on the force meter = weight + drag (− upthrust) • Subtracting the two readings gives the value of drag For MP1 and MP2 – accept descriptions given as an equation e.g. When stationary $F_1 = W - U$ When moving $F_2 = W + D - U$	(1) (1) (1)	**3**
3(c)(ii)	• Subtracts the two forces (F = 0.09 N) • Use of $F = 6\pi\eta rv$ • η = 1.7 (Pa s) <u>Example of calculation</u> F = 0.29 N – 0.20 N F = 0.09 N $F = 6\pi\eta rv$ $\eta = F/6\pi rv$ $\eta = 0.09\ \text{N} / (6 \times \pi \times 0.00895\ \text{m} \times 0.32\ \text{m s}^{-1})$ η = 1.67 Pa s	(1) (1) (1)	**3**
3(d)	• A comment assessing uncertainty in force • A comment assessing uncertainty in distance • A comment assessing uncertainty in time • Conclusion justified by their assessments MP4 requires some numerical comparison <u>Examples of assessments for MP1-3</u> *Force* • Resolution of the force meter is 0.01 N, so percentage uncertainty is 11% (accept 5.5% or 6%) • Force difficult to keep constant, variation likely to be larger than 0.01 N *Distance* • Meter rule resolution of 1mm, so percentage uncertainty is small • Percentage uncertainty in distance measurement is 0.2% (accept 0.4%) *Time* • Resolution of the stopwatch is 0.01 s, so percentage uncertainty is 0.6 % (accept 1.2%) • Time is short, so reaction time (0.2 s) will be a significant percentage (25%) or fraction (1/4) of the time measured • Not enough time to move eyeline, so there may be parallax error when judging when the sphere has passed the rubber band.	(1) (1) (1) (1)	**4**

	Total for question 3	14

Question Number	Answer	Mark
4(a)	• Re-arranges equation $V_a = \frac{hc}{e}\frac{1}{\lambda} + \frac{W}{e}$ and compares to $y = mx + c$ (1) • Identifies $gradient = \frac{hc}{e}$ (1) • States that h, c and e are all constants (1)	**3**
4(b)(i)	• Correct values calculated (1) • Values correctly rounded to 3 sig. fig. (1) Example λ / × 10^{-7} m — $1/\lambda$ / × 10^{6} m^{-1} 6.60 — 1.52 6.12 — 1.63 5.92 — 1.69 5.85 — 1.71 5.30 — 1.89 4.70 — 2.13	**2**
4(b)(ii)	• Labels axes with quantities and units (1) • Sensible scales (1) • Plotting – 2 points furthest from their line (1) • Plotting – 2 points at the ends (1) • Line of best fit (1) Refer to Mark Scheme Notes – Section 5 for guidance on axis labels, suitable scales & checking accuracy of plots. An example of the graph can be seen on page 11. V_a / V — $1/\lambda$ / × 10^{6} m^{-1} 1.82 — 1.52 1.97 — 1.63 2.02 — 1.69 2.07 — 1.71 2.31 — 1.89 2.58 — 2.13	**5**
4(b)(iii)	• Calculates gradient using large triangle - at least half their line of best fit (1) • Use of gradient = hc/e (1) • $h = 6.65\times10^{-34}$ to 6.85×10^{-34} J s (1) Example calculation Gradient = (2.55 – 1.80) V / (2.10 – 1.60)×10^{6} m^{-1} = 1.25×10^{-6} V m h = 1.25×10^{-6} V m × 1.60×10^{-19} C / 3.00×10^{8} m s^{-1} = 6.67×10^{-34} J s	**3**
4(b)(iv)	• Mathematical comparison between their value from (b)(iii) and 6.63×10^{-34} J s (1) • Comparative statement consistent with MP1 (1) MP2 is for a statement that is justified by their value for h. E.g. Difference between the values is 0.04 (×10^{-34}) is very small compared to 6.63 (×10^{-34}), so method is accurate. **Or** Percentage difference is 0.6%, which is small, so method is accurate.	**2**

4(c)	• Manufacturer's wavelength would be shorter (than the wavelength of photons with least energy) **Or** Manufacturer's wavelength would be shorter (than the wavelength of photons emitted at V_a) • A lower λ would give a higher 1/λ **Or** the line would shift to the right, **EITHER** • Difference in wavelength would be small, so negligible shift in points (Accept shift would be the same for all points, so same gradient) • No change in the value of *h* obtained. **OR** • Points for longer λ would shift 1/λ values less, decreasing the gradient • Decreasing the value of *h* obtained.	(1) (1) (1) (1) (1) (1)	**4**
	Total for question 5		**19**

Example of a graph for 4(b)(ii)

(ii) Plot a graph of V_a on the y-axis against $1/\lambda$ on the x-axis.

(5)