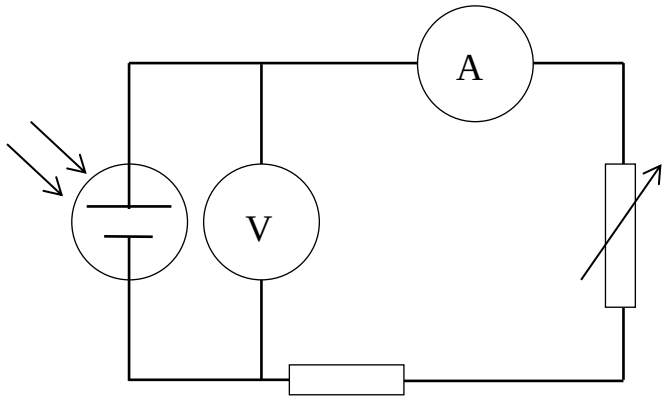
Pearson Edexcel

Mark Scheme (Final)

Summer 2023

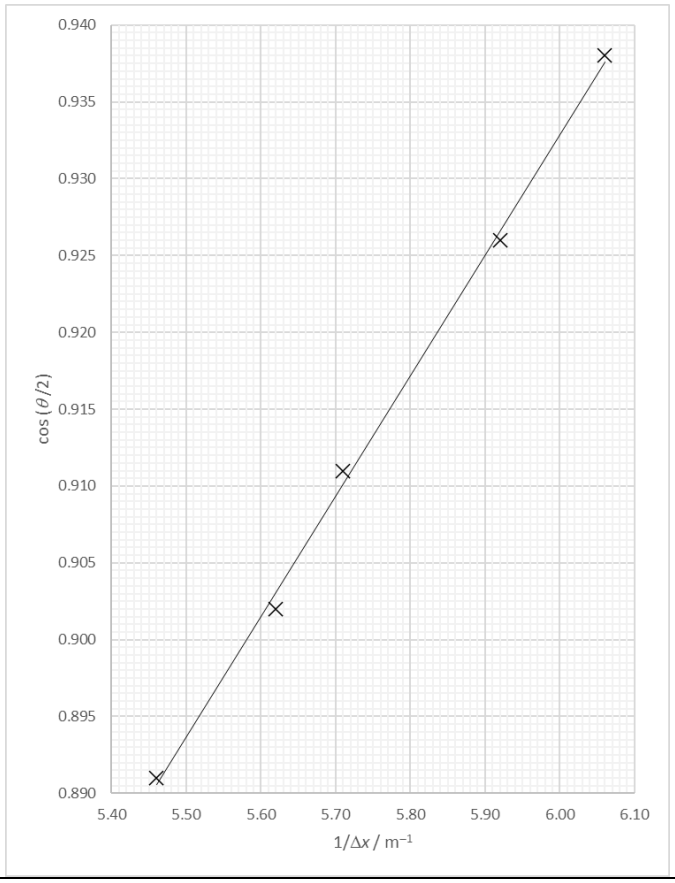
Pearson Edexcel International Advanced Subsidiary Level In Physics (WPH13)
Paper 01
Unit 3: Practical Skills in Physics I

Question Number	Answer	Mark
1(a)(i)	• 1.72 (mm) **(1)**	**1**
1(a)(ii)	• Use of percentage uncertainty = (half resolution / measurement) × 100% **(1)** • Percentage uncertainty = 0.29 (%) e.c.f. 1(a)(i) **(1)** Allow 1 mark only for a correct percentage calculated using the full resolution (0.01 mm) <u>Example of calculation</u> Percentage uncertainty = (0.005 / 1.72) × 100% = 0.29 %	**2**
1(a)(iii)	**EITHER** • Check for zero error (on the micrometer) **(1)** • to remove <u>systematic</u> error **(1)** **OR** • Prevent over-tightening/deformation **(1)** • By using the ratchet when closing **(1)**	**2**
1(b)	• Add the 20g mass (a distance from the pivot) **and** move the ruler to find the new balance point **Or** move the ruler to unbalance it **and** add/move the 20g mass to find the new balance point **(1)** • Measure the distance from the pivot to the centre of gravity of the ruler **and** measure the distance from the pivot to the (centre of the) 20g mass **(1)** • Calculate the mass of the ruler using the principle of moments • Repeat measurements of distance for different positions of the 20g mass **and** calculate the mean mass of the ruler **(1)** **(1)** Accept "centre of gravity" for balance point in MP1 Accept additions to the diagram for MP1 & MP2	**4**
	Total for question 1	**9**

Question Number	Answer	Mark
2(a)(i)	• Using the lens produces a parallel beam of light **Or** using the lens concentrates the light on the solar cell **(1)** • The light from the filament bulb spreads out **Or** to increase the intensity of light **Or** to ensure the intensity of light is even **(1)** Accept use of diagrams to support statement for MP1 / MP2	**2**
2(a)(ii)	**Max TWO from** • Control background light [Accept any method to control background light] **(1)** • Keep the solar cell at the same distance from the filament bulb **(1)** • Keep the solar cell at the same angle to the filament bulb **(1)**	**2**
2(b)(i)	• Ammeter in series with the solar cell, resistor and variable resistor **(1)** • Voltmeter in parallel with the solar cell **(1)** 	**2**
2(b)(ii)	• To limit the (maximum) current in the solar cell **Or** to avoid short-circuiting the solar cell **(1)**	**1**
2(c)	**Max TWO from** • Solar cells do not emit greenhouse gases [accept a named greenhouse gas] **Or** using solar cells does not contribute to global warming **Or** using solar cells would not cause acid rain **Or** using solar cells would reduce the need for fossil fuels **(1)** • Solar cells use a renewable energy source **(1)** • Sunlight/energy used is free **(1)** • No need for mains wiring **Or** can be used where there is no mains electricity **(1)**	**2**
	Total for question 2	**9**

Question Number	Answer	Mark
3(a)(i)	**Max TWO from** • The vernier calipers have a smaller resolution **Or** the vernier calipers have a lower uncertainty **(1)** • The vernier calipers can measure without parallax error **(1)** • Tips of vernier calipers are easier to align with the rings (as surface is curved) **(1)**	**2**
3(a)(ii)	• Repeat the measurement **and** calculate a mean value **(1)** • Measure the diameter in different orientations **(1)** If no other marks awarded, allow 1 mark for "check for zero error before measuring"	**2**
3(b)(i)	• Calculation of mean value using all three values **(1)** • Mean $a = 1.22 \times 10^{-18}$ (m^2 V) rounded to 3 s.f. **(1)** Example of calculation Mean value of $a = (1.23 + 1.11 + 1.32) \times 10^{-18} / 3 = 1.22 \times 10^{-18}$ m^2 V	**2**
3(b)(ii)	• Use of half their range for uncertainty [Accept use of furthest value from the mean] **(1)** • Percentage uncertainty = 9 (%) e.c.f. 3(b)(i) **(1)** Example of calculation Uncertainty = half range = $(1.32 - 1.11) \times 10^{-18} / 2 = 0.105 \times 10^{-18}$ m^2 V Percentage uncertainty = $(0.105 \times 10^{-18} / 1.22 \times 10^{-18}) \times 100 = 8.6$ %	**2**
3(b)(iii)	**Max TWO from** • More pairs of values were used • Adding a line of best fit acts as an averaging method **(1)** • Adding a line of best fit can identify anomalous values **(1)** • The gradient value will ignore any systematic error **(1)** **Or** the line/intercept will identify any systematic error [accept named examples of systematic error, e.g., zero error] **(1)**	**2**
3(c)(i)	• Use of $a = \frac{h^2}{2em_e}$ **(1)** • $h = 6.52 \times 10^{-34}$ (J s) **(1)** Example of calculation $h = \sqrt{(2 \times 1.6 \times 10^{-19} \times 9.11 \times 10^{-31} \times 1.46 \times 10^{-18})} = 6.52 \times 10^{-34}$ (J s)	**2**
3(c)(ii)	**EITHER** **(1)** • Calculation of upper limit of h **(1)** • Conclusion based on comparison to 6.63×10^{-34} J s e.c.f. 3(c)(ii) For 1 mark only – accept the calculation of 6% limit of 6.63×10^{-34} J s **OR** • Calculation of percentage difference from 6.63×10^{-34} J s e.c.f. 3(c)(i) **(1)** • Conclusion based on comparison to 6 % **(1)** Examples of calculation Upper limit of $h = 6.52 \times 10^{-34} \times 1.06 = 6.92 \times 10^{-34}$ J s As this is above value of 6.63×10^{-34} J s then the calculated value is accurate Percentage difference = $((6.63 - 6.52) \times 10^{-34} / 6.63 \times 10^{-34}) \times 100 = 1.7$ % As this is less than 6 % then calculated value is accurate	**2**
	Total for question 3	**14**

Question Number	Answer	Mark
4(a)	**EITHER** • The elastic cord may snap **(1)** • So, wear safety goggles **Or** use a safety screen **(1)** **OR** • The stands may topple over **(1)** • Clamp stands to the bench **Or** put a heavy mass on the stand base **(1)** **OR** • The mass may fall **(1)** • Wear safety gloves/boots **Or** keep hands/feet away from under the mass **Or** place cushion/box under the mass **(1)** MP2 is dependent on MP1	**2**
4(b)(i)	**Mark 4(b)(i) and (b)(ii) holistically** **Max TWO from** • Parallax error when using the metre rule [accept x] **Or** parallax error when using the protractor [accept θ] **(1)** • Error measuring θ due to thickness of cord **(1)** • (Zero of) protractor/rule not aligned correctly **Or** protractor/rule may move while measuring **(1)** • Applying an additional force to the cord while measuring **Or** cord/mass may move while measuring **(1)**	**2**
4(b)(ii)	**Max ONE from** • Ensure viewing measurement perpendicular to protractor/rule **Or** hold the protractor/rule close to the cord **(1)** • Mark the position of the centre of the cord **(1)** • Clamp metre rule and/or protractor **(1)** • Ensure the protractor/rule does not touch the cord/mass **(1)** [suggested modification must be linked to a source of uncertainty mentioned in (b)(i)]	**1**
4(c)(i)	• $\cos\left(\frac{\theta}{2}\right) = \left(\frac{mg}{k}\right)\frac{1}{x}$ is in the form $y = mx$ (+ c) **Or** gradient $= \frac{\cos\left(\frac{\theta}{2}\right)}{\frac{1}{x}}$ **(1)** • So, the gradient is $\left(\frac{mg}{k}\right)$ **Or** $g = \frac{\text{gradient} \times k}{m}$ **(1)**	**2**

Question Number	Answer	Mark
4(c)(ii)	• Correct values of $\frac{1}{\Delta x}$ rounded to 3 s.f. **(1)** • Labels axes with quantities and units **(1)** • Sensible scales **(1)** • Plotting **(2)** • Line of best fit **(1)** $\cos\left(\frac{\theta}{2}\right)$ / Δx / m / $\frac{1}{\Delta x}$ / m^{-1} 0.938 / 0.165 / 6.06 0.926 / 0.169 / 5.92 0.911 / 0.175 / 5.71 0.902 / 0.178 / 5.62 0.891 / 0.183 / 5.46 	**6**
4(c)(iii)	• Calculates gradient using large triangle **(1)** • Gradient value between 0.076 and 0.079 (m) **(1)** • Gradient rounded to 2 or 3 s.f. **(1)** <u>Example of calculation</u> gradient = (0.9405–0.8935)/(6.1–5.5) = 0.047/0.6 = 0.078	**3**
4(c)(iv)	• Use of gradient = mg / k **(1)** • Correct value of g from gradient given with a correct unit [ecf from 4(c)(iii)] **(1)** <u>Example of calculation</u> g = = $\frac{\text{gradient} \times k}{m}$ = $\frac{0.078 \times 145}{1.2}$ = 9.43 m s^{-2}	**2**
	Total for question 4	**18**