



Mark Scheme (Final)

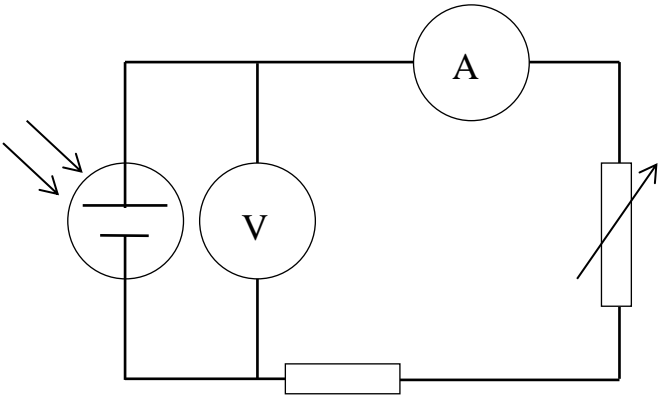
Summer 2023

Pearson Edexcel International Advanced
Subsidiary Level In Physics (WPH13)

Paper 01

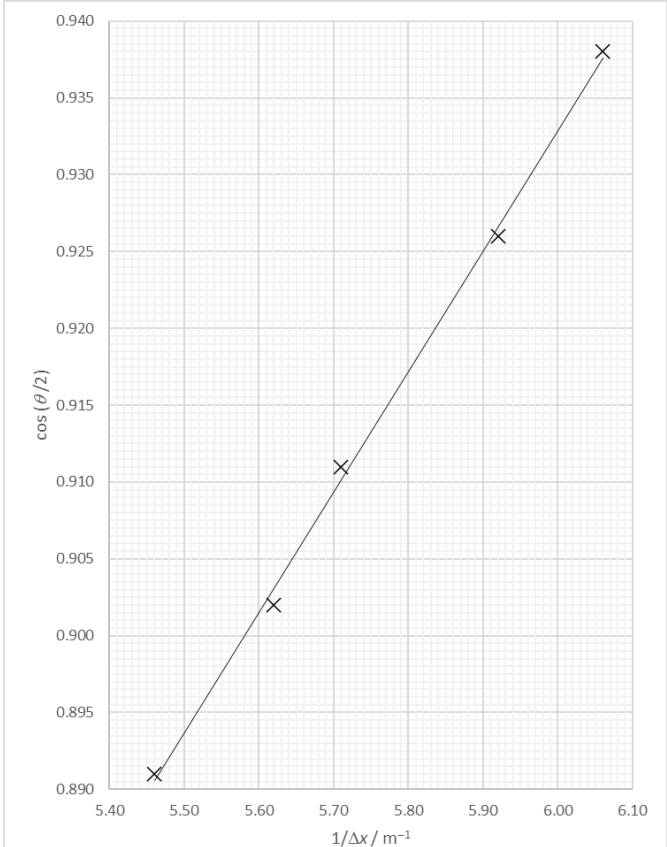
Unit 3: Practical Skills in Physics I

Question Number	Answer	Mark
1(a)(i)	<ul style="list-style-type: none"> 1.72 (mm) (1) 	1
1(a)(ii)	<ul style="list-style-type: none"> Use of percentage uncertainty = (half resolution / measurement) × 100% (1) Percentage uncertainty = 0.29 (%) e.c.f. 1(a)(i) (1) <p>Allow 1 mark only for a correct percentage calculated using the full resolution (0.01 mm)</p> <p><u>Example of calculation</u> Percentage uncertainty = $(0.005 / 1.72) \times 100\% = 0.29\%$</p>	2
1(a)(iii)	<p>EITHER</p> <ul style="list-style-type: none"> Check for zero error (on the micrometer) (1) to remove <u>systematic</u> error (1) <p>OR</p> <ul style="list-style-type: none"> Prevent over-tightening/deformation (1) By using the ratchet when closing (1) 	2
1(b)	<ul style="list-style-type: none"> Add the 20g mass (a distance from the pivot) and move the ruler to find the new balance point (1) 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 (1) Repeat measurements of distance for different positions of the 20g mass and calculate the mean mass of the ruler (1) <p>Accept “centre of gravity” for balance point in MP1 Accept additions to the diagram for MP1 & MP2</p>	4
Total for question 1		9

Question Number	Answer	Mark
2(a)(i)	<ul style="list-style-type: none"> 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 (1) Or to ensure the intensity of light is even (1) <p>Accept use of diagrams to support statement for MP1 / MP2</p>	2
2(a)(ii)	<p>Max TWO from</p> <ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> Ammeter in series with the solar cell, resistor and variable resistor (1) Voltmeter in parallel with the solar cell (1) 	2
2(b)(ii)	<ul style="list-style-type: none"> To limit the (maximum) current in the solar cell Or to avoid short-circuiting the solar cell (1) 	1
2(c)	<p>Max TWO from</p> <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> The vernier calipers have a smaller resolution (1) 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)	<ul style="list-style-type: none"> Repeat the measurement and calculate a mean value (1) Measure the diameter in different orientations (1) <p>If no other marks awarded, allow 1 mark for “check for zero error before measuring”</p>	2
3(b)(i)	<ul style="list-style-type: none"> Calculation of mean value using all three values (1) Mean $a = 1.22 \times 10^{-18} \text{ (m}^2 \text{ V)}$ rounded to 3 s.f. (1) <p><u>Example of calculation</u> Mean value of $a = (1.23 + 1.11 + 1.32) \times 10^{-18} / 3 = 1.22 \times 10^{-18} \text{ m}^2 \text{ V}$</p>	2
3(b)(ii)	<ul style="list-style-type: none"> 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) <p><u>Example of calculation</u> Uncertainty = half range = $(1.32 - 1.11) \times 10^{-18} / 2 = 0.105 \times 10^{-18} \text{ m}^2 \text{ V}$ Percentage uncertainty = $(0.105 \times 10^{-18} / 1.22 \times 10^{-18}) \times 100 = 8.6 \%$</p>	2
3(b)(iii)	Max TWO from <ul style="list-style-type: none"> More pairs of values were used (1) 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 (1) [accept named examples of systematic error, e.g., zero error] 	2
3(c)(i)	<ul style="list-style-type: none"> Use of $a = \frac{h^2}{2em_e}$ (1) $h = 6.52 \times 10^{-34} \text{ (J s)}$ (1) <p><u>Example of calculation</u> $h = \sqrt{(2 \times 1.6 \times 10^{-19} \times 9.11 \times 10^{-31} \times 1.46 \times 10^{-18})} = 6.52 \times 10^{-34} \text{ (J s)}$</p>	2
3(c)(ii)	EITHER (1) <ul style="list-style-type: none"> Calculation of upper limit of h (1) Conclusion based on comparison to $6.63 \times 10^{-34} \text{ J s}$ e.c.f. 3(c)(ii) <p>For 1 mark only – accept the calculation of 6% limit of $6.63 \times 10^{-34} \text{ J s}$</p> <p>OR</p> <ul style="list-style-type: none"> Calculation of percentage difference from $6.63 \times 10^{-34} \text{ J s}$ e.c.f. 3(c)(i) (1) Conclusion based on comparison to 6 % (1) <p><u>Examples of calculation</u> Upper limit of $h = 6.52 \times 10^{-34} \times 1.06 = 6.92 \times 10^{-34} \text{ J s}$ As this is above value of $6.63 \times 10^{-34} \text{ J s}$ 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</p>	2
Total for question 3		14

Question Number	Answer	Mark
4(a)	<p>EITHER</p> <ul style="list-style-type: none"> The elastic cord may snap (1) So, wear safety goggles (1) Or use a safety screen <p>OR</p> <ul style="list-style-type: none"> The stands may topple over (1) Clamp stands to the bench (1) Or put a heavy mass on the stand base <p>OR</p> <ul style="list-style-type: none"> The mass may fall (1) Wear safety gloves/boots (1) Or keep hands/feet away from under the mass Or place cushion/box under the mass <p>MP2 is dependent on MP1</p>	2
4(b)(i)	<p>Mark 4(b)(i) and (b)(ii) holistically</p> <p>Max TWO from</p> <ul style="list-style-type: none"> Parallax error when using the metre rule [accept x] (1) 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 (1) Or protractor/rule may move while measuring Applying an additional force to the cord while measuring (1) Or cord/mass may move while measuring 	2
4(b)(ii)	<p>Max ONE from</p> <ul style="list-style-type: none"> Ensure viewing measurement perpendicular to protractor/rule (1) 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 <p>[suggested modification must be linked to a source of uncertainty mentioned in (b)(i)]</p>	1
4(c)(i)	<ul style="list-style-type: none"> $\cos\left(\frac{\theta}{2}\right) = \left(\frac{mg}{k}\right) \frac{1}{x}$ is in the form $y = mx (+ c)$ (1) Or gradient = $\frac{\cos(\frac{\theta}{2})}{\frac{1}{x}}$ So, the gradient is $\left(\frac{mg}{k}\right)$ (1) Or $g = \frac{\text{gradient} \times k}{m}$ 	2

Question Number	Answer	Mark																		
4(c)(ii)	<ul style="list-style-type: none"> Correct values of $\frac{1}{\Delta x}$ rounded to 3 s.f. Labels axes with quantities and units Sensible scales Plotting Line of best fit <table border="1"> <thead> <tr> <th>$\cos\left(\frac{\theta}{2}\right)$</th><th>$\Delta x / \text{m}$</th><th>$\frac{1}{\Delta x} / \text{m}^{-1}$</th></tr> </thead> <tbody> <tr> <td>0.938</td><td>0.165</td><td>6.06</td></tr> <tr> <td>0.926</td><td>0.169</td><td>5.92</td></tr> <tr> <td>0.911</td><td>0.175</td><td>5.71</td></tr> <tr> <td>0.902</td><td>0.178</td><td>5.62</td></tr> <tr> <td>0.891</td><td>0.183</td><td>5.46</td></tr> </tbody> </table> 	$\cos\left(\frac{\theta}{2}\right)$	$\Delta x / \text{m}$	$\frac{1}{\Delta x} / \text{m}^{-1}$	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	(1) (1) (1) (2) (1) 6
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4(c)(iii)	<ul style="list-style-type: none"> Calculates gradient using large triangle Gradient value between 0.076 and 0.079 (m) Gradient rounded to 2 or 3 s.f. <p><u>Example of calculation</u> gradient = $(0.9405 - 0.8935) / (6.1 - 5.5) = 0.047 / 0.6 = 0.078$</p>	(1) (1) (1) 3																		
4(c)(iv)	<ul style="list-style-type: none"> Use of gradient = mg / k Correct value of g from gradient given with a correct unit [ecf from 4(c)(iii)] <p><u>Example of calculation</u> $g = \frac{\text{gradient} \times k}{m} = \frac{0.078 \times 145}{1.2} = 9.43 \text{ m s}^{-2}$</p>	(1) (1) 2																		
Total for question 4		18																		