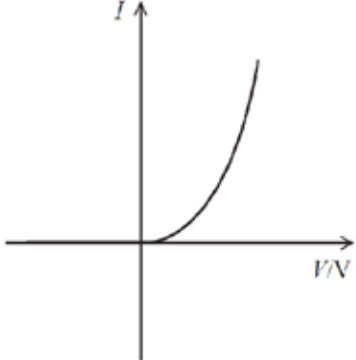
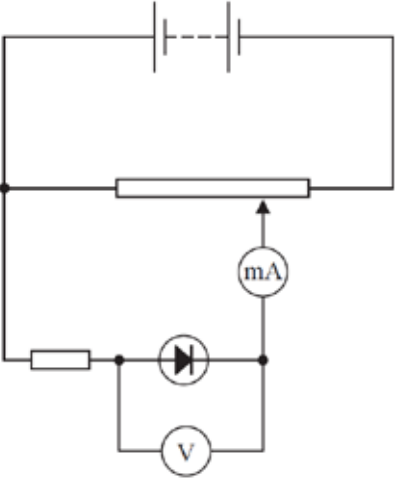


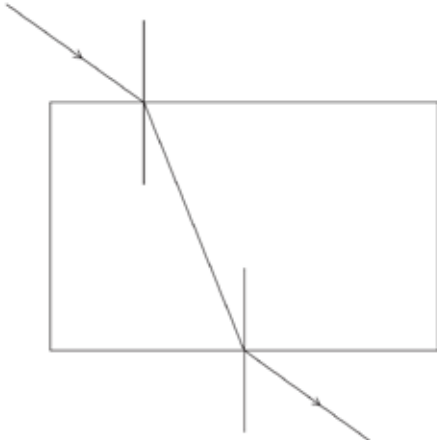
Unit 3: Practical Skills in Physics I - Mark scheme

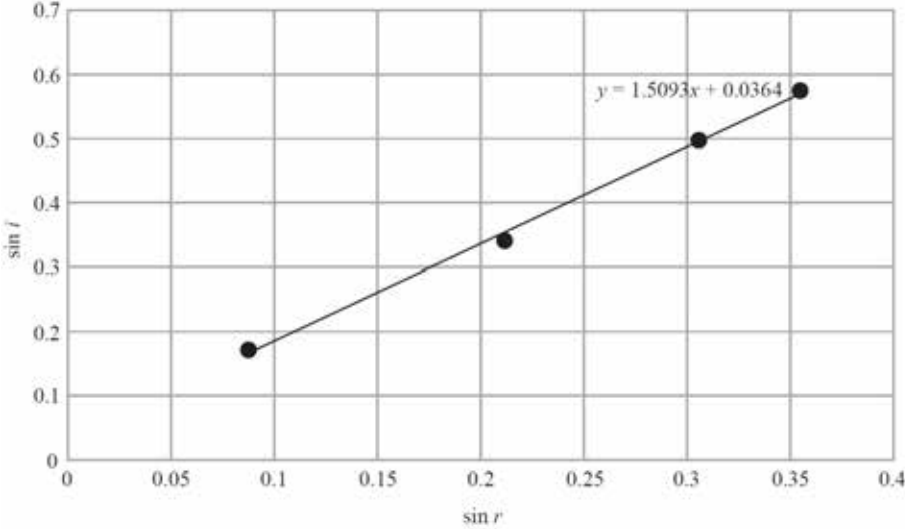
Question number	Answer	Mark
1(a)	<ul style="list-style-type: none"> Line of best fit minimises the effects of random errors Or line of best fit 'averages' results Anomalous readings can be identified Systematic errors can be detected 	(1) (1) (1)
1(b)	<ul style="list-style-type: none"> Take readings at different positions/orientations along the wire as the wire may not be uniform and calculate a mean 	(1) (1) (1)
Total for Question 1		6

Question number	Answer	Mark
2(a)	<ul style="list-style-type: none"> Use of half resolution (0.05 mm) Percentage uncertainty = 0.2% (Accept 0.21%) <p><u>Example of calculation</u> Uncertainty = $(0.05/24) \times 100 = 0.208 \%$</p>	(1) (1)
2(b)(i)	Metre rule	(1)
2(b)(ii)	<ul style="list-style-type: none"> Use of half range (2 mm) Percentage uncertainty = 1% (Accept 1.3%) <p><u>Example of calculation</u> Uncertainty = $(2/160) \times 100 = 1.25 \%$</p>	(1) (1)
2(c)	<ul style="list-style-type: none"> Use of volume = length $\times \pi d^2/4$ ($7.24 \times 10^{-5} \text{ m}^3$) Use of density = mass/volume Density = 8500 kg m^{-3} to 2 or 3 sig figs <p><u>Example of calculation</u> Volume = $0.160 \text{ m} \times 3.14 \times (0.024 \text{ m})^2/4$ Volume = $7.24 \times 10^{-5} \text{ m}^3$ Density = mass/volume = $0.616 \text{ kg} / 7.24 \times 10^{-5} \text{ m}^3$ Density = 8510 kg m^{-3}</p>	(1) (1) (1) (1)
Total for Question 2		9

Question number	Answer	Mark
3(a)	<ul style="list-style-type: none"> • Reverse bias: zero current (1) • Forward bias: zero current for small values of p.d. then current increasing rapidly (1) <p><u>Example of graph</u></p> 	2
3(b)	<ul style="list-style-type: none"> • Correct potential divider circuit with diode and fixed resistor (1) • Voltmeter in parallel with diode (1) • Ammeter in series with diode (1) <p>Experimental procedure</p> <ul style="list-style-type: none"> • Record current for varying p.d.s. (1) • Reverse terminals for reverse bias (1) • Take extra readings at small intervals when the diode begins conducting for the sharp part of the curve (1) <p><u>Example of circuit</u></p> 	6
3(c)	<ul style="list-style-type: none"> • The temperature of the diode may increase distorting the readings of current (1) • The readings on the meters may fluctuate (1) 	2
3(d)	<ul style="list-style-type: none"> • Comment on level of risk and associated justification (1) <p><u>Examples of answer</u> This is a low-risk experiment as it uses a 12 V power supply Or diode may explode so goggles should be worn</p>	1

Question number	Answer	Mark
3(e)	<ul style="list-style-type: none"> Use the graph to read the value of current at the given p.d. (1) Use $R = V/I$ to calculate resistance (1) 	2
Total for Question 3		13

Question number	Answer	Mark
4(a)	<ul style="list-style-type: none"> Refraction towards the normal at the first boundary and refraction away from the normal at the second boundary (1) Emerging ray parallel to the incident ray (1) <div style="text-align: center;">  </div>	2
4(b)	<ul style="list-style-type: none"> Place block on white paper, trace round it and draw points on incident and emergent rays (1) Remove block, join up points and draw ray within block using a ruler (1) 	2
4(c)(i)	<p>Any 2 from</p> <ul style="list-style-type: none"> Too few sets of results Or only 4 sets of results (1) Range of values of i are too small (1) No evidence of use of readings as ray leaves the block (1) 	2

Question number	Answer	Mark																					
4(c)(ii)	<ul style="list-style-type: none"> • Correct $\sin r$ values to two s.f. • Labels on axes with $\sin i$ along the y-axis • Sensible scales • Plotting • Line of best fit <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>$i / ^\circ$</th> <th>$r / ^\circ$</th> <th>$\sin i$</th> <th>$\sin r$</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>5</td> <td>0.17</td> <td>0.087</td> </tr> <tr> <td>20</td> <td>12</td> <td>0.34</td> <td>0.21</td> </tr> <tr> <td>30</td> <td>18</td> <td>0.50</td> <td>0.31</td> </tr> <tr> <td>35</td> <td>21</td> <td>0.57</td> <td>0.36</td> </tr> </tbody> </table> 	$i / ^\circ$	$r / ^\circ$	$\sin i$	$\sin r$	10	5	0.17	0.087	20	12	0.34	0.21	30	18	0.50	0.31	35	21	0.57	0.36	<p>(1) (1) (1) (2) (1)</p>	6
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4(c)(iii)	<ul style="list-style-type: none"> • Use of large triangle to determine gradient • Refractive index = 1.5 • Value given to 2 or 3 sig fig <p>Accept refractive index in the range 1.3 to 1.7</p>	<p>(1) (1) (1)</p>	3																				
Total for Question 4		15																					

Question number	Answer	Mark
5(a)	<ul style="list-style-type: none"> • Use of $v = \frac{2r^2(\rho_s - \rho_l)g}{9\eta}$ <ul style="list-style-type: none"> • Viscosity = 1.0 Pa s (1) • Answer to 2 or 3 sig fig (1) • Unit: Pa s (Accept N s m⁻²) (1) <p><u>Example of calculation</u> Viscosity = $(2 \times (1.55 \times 10^{-3})^2 \times (8500 - 1260) \times 9.81) / (9 \times 0.038)$ 0.9979 Pa s</p>	4
5(b)	<p>Any 3 from</p> <ul style="list-style-type: none"> • Ensure the temperature is kept constant (1) • Use a long column of liquid (1) • Drop ball in centre of liquid column (1) • Repeat timings (1) • Use light gates (rather than stopwatch) (1) • Use sphere of small diameter compared to diameter of liquid column (1) 	3
	Total for Question 5	7