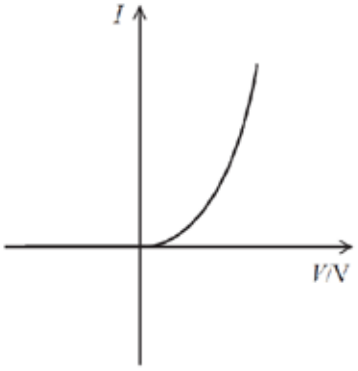
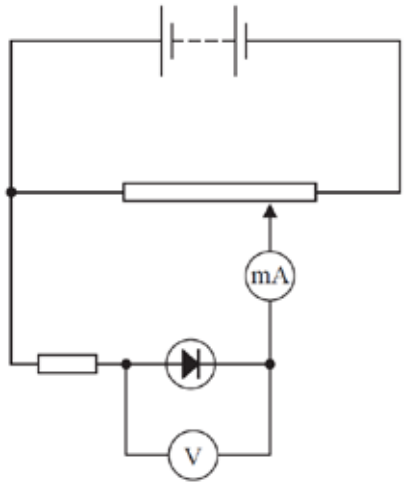
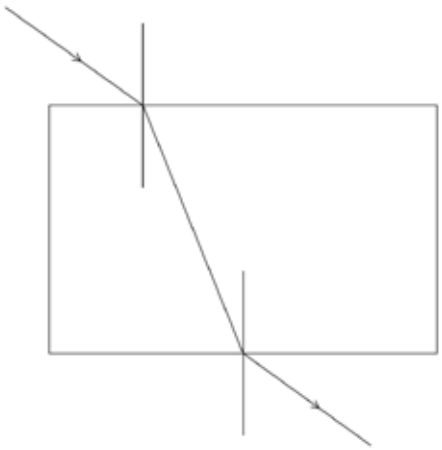
Unit 3: Practical Skills in Physics I - Mark scheme

Question number	Answer	Mark
1(a)	• Line of best fit minimises the effects of random errors **Or** line of best fit 'averages' results (1) • Anomalous readings can be identified (1) • Systematic errors can be detected (1)	3
1(b)	• Take readings at different positions/orientations along the wire (1) • as the wire may not be uniform (1) • and calculate a mean (1)	3
	Total for Question 1	6

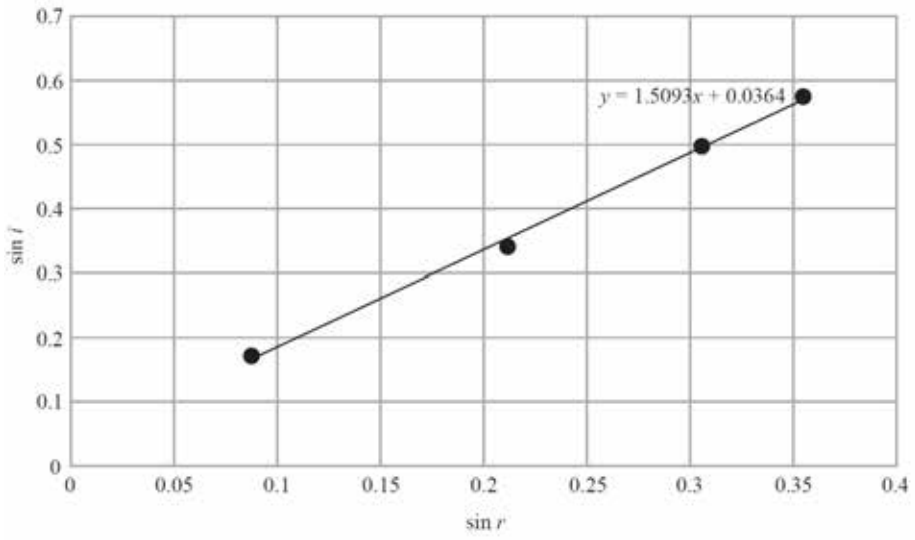
Question number	Answer	Mark
2(a)	• Use of half resolution (0.05 mm) (1) • Percentage uncertainty = 0.2% (Accept 0.21%) (1) Example of calculation Uncertainty = (0.05/24) × 100 = 0.208 %	2
2(b)(i)	Metre rule (1)	1
2(b)(ii)	• Use of half range (2 mm) (1) • Percentage uncertainty = 1% (Accept 1.3%) (1) Example of calculation Uncertainty = (2/160) × 100 = 1.25 %	2
2(c)	• Use of volume = length × $\pi d^2/4$ (7.24×10^{-5} m^3 (1) • Use of density = mass/volume (1) • Density = 8500 kg m^{-3} (1) • to 2 or 3 sig figs (1) Example of calculation Volume = 0.160 m × 3.14 × (0.024 m)^2 /4 Volume = 7.24×10^{-5} m^3 Density = mass/volume = 0.616 kg /7.24×10^{-5} m^3 Density = 8510 kg m^{-3}	4
	Total for Question 2	9

Question number	Answer	Mark
3(a)	• Reverse bias: zero current (1) • Forward bias: zero current for small values of p.d. then current increasing rapidly (1) <u>Example of graph</u>  	**2**
3(b)	• Correct potential divider circuit with diode and fixed resistor (1) • Voltmeter in parallel with diode (1) • Ammeter in series with diode (1) **Experimental procedure** • 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) <u>Example of circuit</u>  	**6**
3(c)	• The temperature of the diode may increase distorting the readings of current (1) • The readings on the meters may fluctuate (1)	**2**
3(d)	• Comment on level of risk and associated justification (1) <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	**1**

Question number	Answer	Mark
3(e)	• 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)	• 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) 	2
4(b)	• 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)	**Any 2 from** • 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

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>4(c)(ii)</td><td>
• Correct sin r values to two s.f. (1)
• Labels on axes with sin i along the y-axis (1)
• Sensible scales (1)
• Plotting (2)
• Line of best fit (1)

<table>
<tr><td>i / °</td><td>r / °</td><td>sin i</td><td>sin r</td></tr>
<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>
</table>


</td><td>6</td></tr>
<tr><td>4(c)(iii)</td><td>
• Use of large triangle to determine gradient (1)
• Refractive index = 1.5 (1)
• Value given to 2 or 3 sig fig (1)

Accept refractive index in the range 1.3 to 1.7
</td><td>3</td></tr>
<tr><td></td><td>Total for Question 4</td><td>15</td></tr>
</table>

Question number	Answer	Mark
5(a)	• Use of $v = \frac{2r^2(\rho_s - \rho_l)g}{9\eta}$ (1) • Viscosity = 1.0 Pa s (1) • Answer to 2 or 3 sig fig (1) • Unit: Pa s (Accept N s m^{-2}) (1) Example of calculation Viscosity = $(2 \times (1.55 \times 10^{-3})^2 \times (8500 - 1260) \times 9.81)/(9 \times 0.038)$ 0.9979 Pa s	4
5(b)	**Any 3 from** • 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