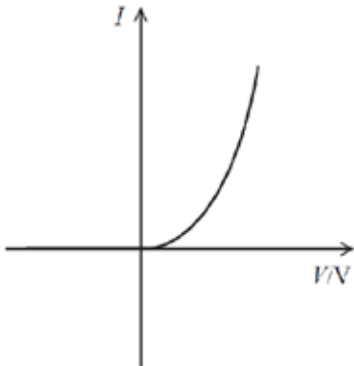
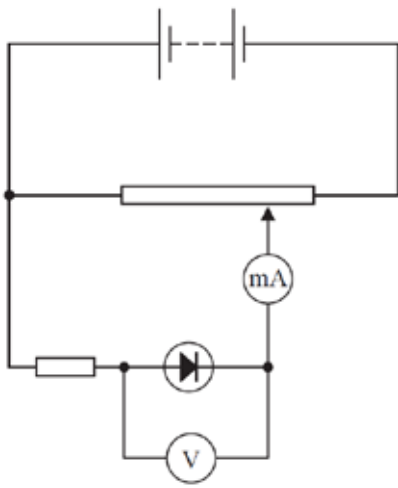


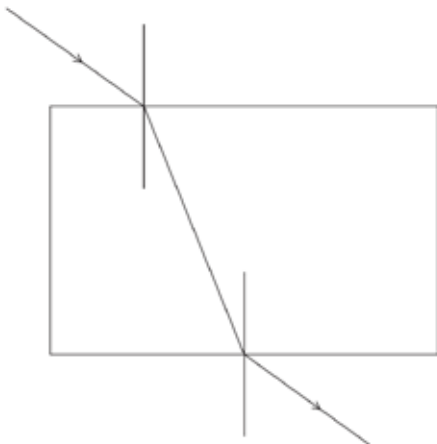
## Unit 3: Practical Skills in Physics I - Mark scheme

Question number	Answer	Mark
1(a)	<ul style="list-style-type: none"> <li>Line of best fit minimises the effects of random errors (1)</li> <li>Or line of best fit 'averages' results (1)</li> <li>Anomalous readings can be identified (1)</li> <li>Systematic errors can be detected (1)</li> </ul>	3
1(b)	<ul style="list-style-type: none"> <li>Take readings at different positions/orientations along the wire (1)</li> <li>as the wire may not be uniform (1)</li> <li>and calculate a mean (1)</li> </ul>	3
<b>Total for Question 1</b>		<b>6</b>

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

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

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

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

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

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