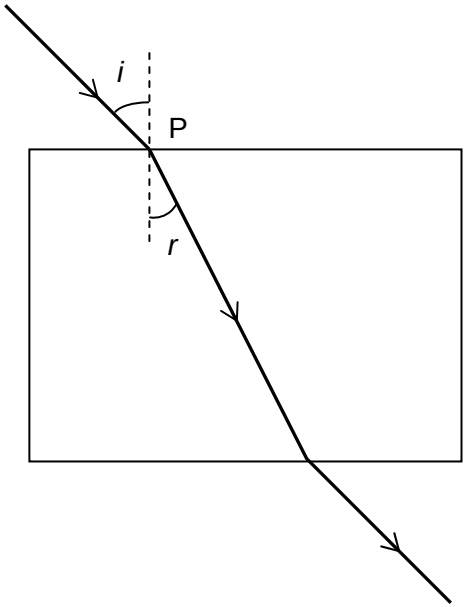
Question number	Answer	Accept	Reject	Marks
5 (a)	Refraction into glass towards the normal (r > 0); Angle of incidence <u>and</u> angle of refraction both labelled correctly at the same surface; Refraction at the lower surface into air away from the normal; Emergent ray parallel to incident ray after correct refraction (by eye);  	Accept dotted lines Ignore any reflections Ignore a second incorrectly labelled pair		4

<table>
<tr><th>Question number</th><th>Answer</th><th>Accept</th><th>Reject</th><th>Marks</th></tr>
<tr><td>5 (b) (i)</td><td>One mark for either sin i or sin r correct;

<table><tr><td>i</td><td>60°</td></tr><tr><td>r</td><td>34°</td></tr><tr><td>sin i</td><td>0.87</td></tr><tr><td>sin r</td><td>0.56</td></tr></table></td><td>sin i = 0.866;
sin i = 0.8660;
sin r = 0.559;
sin r = 0.5592;

Ignore degree sign

Ignore any other values</td><td></td><td>1</td></tr>
<tr><td>(ii)</td><td>n = sin i ÷ sin r;</td><td>Accept
refractive index = sin i ÷sin r</td><td></td><td>1</td></tr>
<tr><td>(iii)</td><td>Two marks for correct answer
Refractive index = 1.55;;
Or
Refractive index = 1.6;;
Or
Refractive index = 1.5;;</td><td>Accept for one mark only any other value in the range
1.5 < n < 1.6;
Any power of 10 error, e.g. 155.36;</td><td></td><td>2</td></tr>
</table>

Question number	Answer	Accept	Reject	Marks
5 (c)	Any three of: MP1 any mention of repetition / take an average of readings; MP2 vary *i* to obtain more values ; MP3 plot a graph of <u>sin i against sin r</u> ; OR Calculate/work out/ find n; MP4 find gradient of graph ; OR Calculate average of n; MP5 sensible experimental precaution / improvement to method (e.g. mark lines on paper, thinner beam, fix block firmly in position, remove anomalies, sharper pencil, use a more precise protractor e.g. ½°);	Ignore reference to critical angle Ignore second glass block Ignore different colours		3

Total 11 marks

Question number	Answer	Accept	Reject	Marks
9 (a) (i)	momentum = mass x velocity;			1
(ii)	Substitution into correct equation; Calculation; e.g. momentum = 0.15 x 6 = 0.9;; Unit: kg m/s;	kg ms^{-1} Ns		3
(iii)	0.9 = (0.15 + 0.05) x v; v = 0.9 ÷ 0.2 = 4.5 (m/s);	Ecf from 8(a) (ii) (i.e. answer for 8aii ÷ 0.2 or answer for 8aii x 5)		2
(b)	The student is wrong; Because variables are not controlled; e.g. mass of cloth different, mass of (other) tins different, cloth velocity not measured	Student is right if the mass of the second cloth is 0.3 kg;; Student is right if the momentum of the second cloth is 1.8 kg m/s;; (assuming all tins are 0.05 kg/ throws new cloth with exactly the same velocity)		2

Total 8 marks

PAPER TOTAL: 60 MARK