

Question number	Answer	Notes	Marks
6 (a)	17 (degrees);	Allow in range 15-19 degrees	1
(b)	refractive index = $\sin(i) / \sin(r)$;	accept n or η for refractive index accept any valid rearrangement	1
(c)	substitution; evaluation of either sine correctly; evaluation; e.g. refractive index = $\sin(29)/\sin(17)$ refractive index = 0.484.../0.292... refractive index = 1.7	allow ecf from (a) 0.48480962/0.292371705 1.6581961	3

(Total for Question 6 = 5 marks)

Question number	Answer	Notes	Marks
9	<p>Any FIVE from:</p> <p>MP1 reference to Doppler effect;</p> <p>MP2 wavefronts are emitted at constant frequency by buzzer;</p> <p>MP3 wavefronts arrive at student (A) further apart than when they were emitted;</p> <p>MP4 distance between wavefronts is the wavelength;</p> <p>MP5 $\text{speed} = \text{frequency} \times \text{wavelength}$;</p> <p>MP6 speed of waves is constant;</p> <p>MP7 as speed is constant and wavelength has increased, frequency must decrease;</p> <p>MP8 decrease in frequency is experienced as a decrease in pitch;</p>	<p>Allow 'wavelength increases' if MP3 or MP4 not awarded</p>	5

(Total for Question 9 = 5 marks)