

Question number	Answer	Notes	Marks
3 (a)	(to the) left;  (because) repulsion (due to like magnetic poles);	allow towards A, away from B ignore backwards reject if mention of charge	2
(b)	(i) 0.045 (kg m/s);	allow 'the same'	1
	(ii) momentum of B after collision = $0.045 - (-0.021)$ ; evaluation;  e.g. $0.045 - -0.021$ (momentum $\Rightarrow$ ) 0.066 (kg m/s)	allow 0.024 for 1 mark  allow $0.045 + 0.021$	2
	(iii) substitution into $F = \text{change in momentum} / \text{time taken}$ ; evaluation;  e.g. $F = 0.066 / 0.19$ ( $F \Rightarrow$ ) 0.35 (N)	allow ECF from (ii)  use of 0.024 from (ii) gives 0.126... (N)  allow 0.347... (N)	2
	(iv) (to the) right;	allow towards B, away from A	1

**(Total for Question 3 = 8 marks)**

Question number	Answer	Notes	Marks
4 (a) (i)	speed = frequency $\times$ wavelength;	allow standard symbols and rearrangements e.g. $v = f \times \lambda$	1
(ii)	<p>determination of period; conversion from ms to s; evaluation of frequency; substitution into <math>v = f \times \lambda</math>;</p> <p>evaluation of speed;</p> <p>e.g. period = 4 squares period = <math>(4 \times 1 =) 4</math> ms frequency <math>(= 1/4 \times 10^{-3}) = 250</math> (Hz) speed = <math>1.4 \times 250</math> speed = 350 (m/s)</p>	<p>allow ECF from incorrect frequency -1 for POT error <math>175, 700</math> (m/s) = 3 marks</p> <p>allow 0.004 (s)</p>	5
(b)	<p>any five from:</p> <p>MP1. reference to reaction time;</p> <p>MP2. suggestion that light flash and sound may not be at the same time;</p> <p>MP3. idea that distance is too short (to give accurate value);</p> <p>MP4. idea that ruler is not appropriate to measure this distance;</p> <p>MP5. idea of mis-counting the number of ruler lengths;</p> <p>MP6. idea of zero error on ruler;</p> <p>MP7. idea of ruler not going in a straight line;</p> <p>MP8. idea of lack of repeats;</p> <p>MP9. idea that time of travel is too short to be measured by a human;</p>	<p>ignore descriptions of different experimental methods allow description of reaction time issues</p> <p>allow suggestion that trundle wheel/tape measure should be used</p> <p>allow ground not being level</p>	5