2(a)	(electric) force is (directly) proportional to product of charges
	force (between point charges) is inversely proportional to the square of their separation
2(b)(i)	charge = (+)2e
2(b)(ii)	$F = 2 \times (1.60 \times 10^{-19})^2 / [4\pi \times 8.85 \times 10^{-12} \times (170 \times 10^{-12})^2] = 1.6 \times 10^{-8}$ N
2(c)(i)	$F = mv^2 / r$
	$v = [\ (1.6 \times 10^{-8} \times 170 \times 10^{-12}) / (9.11 \times 10^{-31})\ ]^{½}$ $= 1.7 \times 10^6$ m s^{-1}
2(c)(ii)	$F = mr\omega^2$ **and** $\omega = 2\pi / T$ $F = 4\pi^2 mr / T^2$
	$T = [\ (4\pi^2 \times 9.11 \times 10^{-31} \times 170 \times 10^{-12}) / (1.6 \times 10^{-8})\ ]^{½}$ $= 6.2 \times 10^{-16}$ s
	or
	$v = 2\pi r / T$
	$T = (2\pi \times 170 \times 10^{-12}) / (1.73 \times 10^6)$ $= 6.2 \times 10^{-16}$ s
2(d)(i)	$E \propto Q / r^2$
	ratio = $[1.60 \times 10^{-19} \times (170 \times 10^{-12})^2] / [3.2 \times 10^{-19} \times (340 \times 10^{-12})^2]$ $= 0.13$
2(d)(ii)	resultant force slightly less (than 1.6×10^{-8} N) so speed lower **or** resultant force slightly less (than 1.6×10^{-8} N) so period greater

2(a)	(electric) force is (directly) proportional to product of charges
	force (between point charges) is inversely proportional to the square of their separation
2(b)(i)	charge = (+)2*e*
2(b)(ii)	$F = 2 \times (1.60 \times 10^{-19})^2 / [4\pi \times 8.85 \times 10^{-12} \times (170 \times 10^{-12})^2] = 1.6 \times 10^{-8}$ N
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2(d)(ii)	resultant force slightly less (than 1.6×10^{-8} N) so speed lower **or** resultant force slightly less (than 1.6×10^{-8} N) so period greater

4(a)	(electric) force is (directly) proportional to product of charges
	force (between point charges) is inversely proportional to the square of their separation
4(b)(i)	arrows showing tension upwards in direction of string, electric force horizontally to the right and weight vertically downwards and all three labelled
4(b)(ii)	$F_E = \frac{96 \times 10^{-9} \times 64 \times 10^{-9}}{4 \times \pi \times 8.85 \times 10^{-12} \times 0.080^2}$ $(= 8.63 \times 10^{-3}\ \text{N})$
	either angle to vertical $= \sin^{-1} 0.080 / 1.2$ $(= 3.82°)$
	weight $= F_E / \tan 3.82 = 8.63 \times 10^{-3} / \tan 3.82$ $(= 0.129\ \text{N})$
	mass $= 0.129 / 9.81$ $= 0.013\ \text{kg}$
	or $T \sin\theta = mg$ **and** $T \cos\theta = F_E$ **or** $\tan\theta = mg / F_E$
	$\tan\theta = 1.2 / 0.080$
	$m = (1.2 \times 8.63 \times 10^{-3}) / (0.080 \times 9.81)$ $= 0.013\ \text{kg}$
4(b)(iii)	$E_p = \frac{Q_1 Q_2}{4\pi\varepsilon_o r} = \frac{96 \times 10^{-9} \times 64 \times 10^{-9}}{4 \times \pi \times 8.85 \times 10^{-12} \times 0.080}$ $= 6.9 \times 10^{-4}\ \text{J}$
4(c)(i)	towards the top of the page / towards plate P
4(c)(ii)	$F = QE$ **and** $E = V / d$
	$F = 1.6 \times 10^{-19} \times 250 / 0.018$ $= 2.2 \times 10^{-15}\ \text{N}$
4(c)(iii)	**either** the force is not (always) perpendicular to the velocity **or** the force is always in the same direction