5(a)	work done per unit charge
	work (done) moving positive charge from infinity (to the point)
5(b)(i)	potential (due to proton) = $(1.60 \times 10^{-19}) / (4\pi \times 8.85 \times 10^{-12} \times 10 \times 10^{-12})$ **or** potential (due to electron) = $(-1.60 \times 10^{-19}) / (4\pi \times 8.85 \times 10^{-12} \times 110 \times 10^{-12})$
	$V = [(1.60 \times 10^{-19}) / (4\pi \times 8.85 \times 10^{-12})] \times [(10^{-1} - 110^{-1}) \times 10^{12}] = 130$ V
5(b)(ii)	$V = [(1.60 \times 10^{-19}) / (4\pi \times 8.85 \times 10^{-12})] \times [(30^{-1} - 90^{-1}) \times 10^{12}]$
	= (+) 32 V
5(b)(iii)	cross drawn midway between the electron and the proton
5(b)(iv)	line from (10, +130) to (110, –130)
	curve getting shallower until x = 60 pm, crossing V = 0 at (60, 0) and then getting steeper after x = 60 pm
	curve passing through (30, ±32) and (90, ±32)

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

6(a)	plate X marked as negative and plate Y marked as positive
6(b)(i)	$E = V / x$
	$= (58 \times 10^3) / 0.041$ $= 1.4 \times 10^6$ N C^{-1}
6(b)(ii)	$ma = eE$
	$a = (1.60 \times 10^{-19} \times 1.41 \times 10^6) / (9.11 \times 10^{-31})$ $= 2.5 \times 10^{17}$ m s^{-2}
6(c)(i)	$eV = hc / \lambda$ **or** $eV = hf$ **and** $f = c / \lambda$
	$(1.60 \times 10^{-19} \times 58 \times 10^3) = (6.63 \times 10^{-34} \times 3.00 \times 10^8) / \lambda$
	clear conversion from m to pm leading to λ = 21 pm
6(c)(ii)	X-rays
6(c)(iii)	*Any two points from:* • waves are passed into structure and transmitted waves detected • different parts of the structure absorb different fractions of energy • difference in detected / transmitted intensities used (to form image)