

5(a)	potential is (defined as) zero at infinity
	proton has a positive charge and so repels another positive charge
	work is done on two (positive) charges to move them towards each other or work is done by two (positive) charges as they move apart from each other
5(b)(i)	arrow drawn through Q in a WSW direction directly away from the centre of the sphere
5(b)(ii)	curve in at least one quadrant passing through $(\pm R, \pm E_0)$ and $(\pm 2R, \pm \frac{1}{4}E_0)$
	curve between $-3R$ and $-R$ of increasing magnitude of gradient and curve between R and $3R$ of decreasing magnitude of gradient
	two lines drawn, one in the top right quadrant, the other in the bottom left quadrant
5(c)	$E_P = - (1.60 \times 10^{-19})^2 / [4\pi \times 8.85 \times 10^{-12} \times (5.3 \times 10^{-11})]$
	$= -4.3 \times 10^{-18} \text{ J}$

5(a)	work done per unit charge
	work done (on charge) in moving positive charge from infinity (to the point)
5(b)(i)	electric field strength inversely proportional to distance ²
	$E = 3^2 \times 2.0 \times 10^5$ $= 1.8 \times 10^6 \text{ N C}^{-1}$
5(b)(ii)	$V = Q / 4\pi\epsilon_0 r$ and $E = Q / 4\pi\epsilon_0 r^2$ (so $E = V / r$)
	$r = (9.0 \times 10^4) / (1.8 \times 10^6) = 0.050 \text{ m} = 5.0 \text{ cm}$
5(b)(iii)	$Q = 4\pi\epsilon_0 V r$
	$= 4\pi \times 8.85 \times 10^{-12} \times 9.0 \times 10^4 \times 0.050$
	$= 5.0 \times 10^{-7} \text{ C}$
5(b)(iv)	$C = Q / V$
	$= (5.0 \times 10^{-7}) / (9.0 \times 10^4)$
	$= 5.6 \times 10^{-12} \text{ F}$