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SECOND MIDTERM

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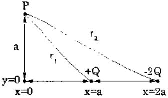
Discussion Section #

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

In the geometry shown the charge +Q is at x = +a and the charge -2Q is at x = +2a. The point P is at x = 0, y = +a.

(a) Find the electric potential at point P (with the standard convention for V = 0).
(b) If Q = 750 pC and a = 1.35 cm, calculate a numerical value for the potential at P, including the sign.
(c) How much work (numerical answer) is required to bring an electron from infinity to point P?



With standard convention ($V=0$ @ $r=\infty$), $V = \frac{kq}{r}$

+15 (-3 for wrong r's)(-2 for wrong Q's)

a) so $V_P = \frac{kQ}{r_1} + \frac{-2kQ}{r_2}$, $r_1 = \sqrt{a^2+a^2} = \sqrt{2}a$

$r_2 = \sqrt{4a^2+a^2} = \sqrt{5}a$

$$V_P = \frac{kQ}{\sqrt{2}a} - \frac{2kQ}{\sqrt{5}a} = \frac{kQ}{a}\left(\frac{1}{\sqrt{2}} - \frac{2}{\sqrt{5}}\right) = \frac{kQ}{a}\left(\frac{\sqrt{2}}{2} - \frac{2\sqrt{5}}{5}\right) = \frac{kQ}{a}\left(\frac{5\sqrt{2}-4\sqrt{5}}{10}\right)$$

$$= -.187\frac{kQ}{a}$$

+5 (-2 for sign)(-1 for unit)(-2 for wrong conversion)

b) $Q = 750\times10^{-12}$ C, $a = .0135$ m, $k = 9.00\times10^9 \frac{N\cdot m^2}{C^2}$

$$V_P = -93.7 \text{ V}$$

+5 (-2 for sign)(-1 for unit)

c) $W = \Delta U = q\Delta V$

$\Delta V = V_P - V_\infty = V_P$

$q = -1.60\times10^{-19}$ C

$$W = 1.50\times10^{-17} \text{ J}$$ (We had to do work)

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