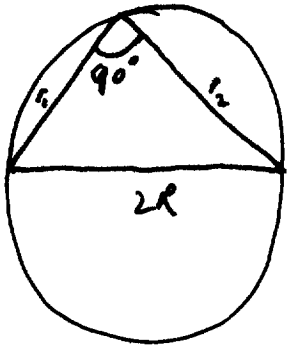
Homework #5 10/4

25-19



a) $r_2 = [(2R)^2 - r_1^2]^{1/2} = [(50)^2 - (30)^2]^{1/2} = 40\,cm$

$V = K[(q_1/r_1) + (q_2/r_2)]$

$= (9\times10^9\,C^2/Nm^2)\{[(24\times10^{-8}C)/(0.30m)] + [(-10\times10^{-8}C)/(0.4m)]\}$

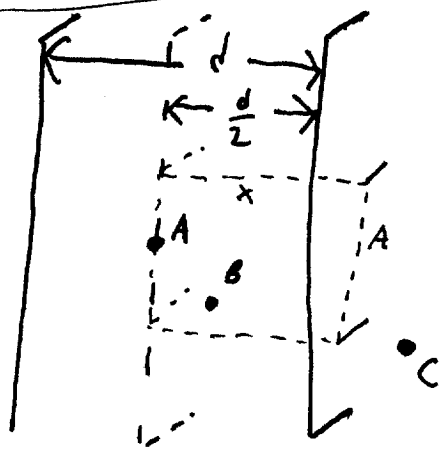
$= \boxed{5.0\times10^3\,V}$

b) $W = q\Delta V = (-2\times10^{-6}C)(5.0\times10^3\,V - 0)$

$= \boxed{-1\times10^{-3}\,J}$

Charge wants to move to the higher potential

25-25



a) $E_A = 0$ By symmetry

E_B

$$\oint E \cdot dA = EA = \frac{Q_e}{\epsilon_0}$$

$$E_{inside} = \rho x/\epsilon_0$$

$$E_{inside} = \rho x/\epsilon_0 = \frac{10^{-5}\,C/m^3}{8.85\times10^{-12}\,C^2/Nm^2}\,x$$

$$\boxed{E_{inside} = E_B = (1.13\times10^6\,N/Cm)\,x} \qquad x \le 1cm$$

$$E_{outside} = E_C = \rho\frac{d}{2}/\epsilon_0 = \frac{(10^{-5}C/m^3)(2\times10^{-2}m)}{2(8.85\times10^{-12}C^2/Nm^2}$$

$$\boxed{E_{outside} = E_C = 1.13\times10^4\,N/C} \qquad x > 1cm$$

b) $V_B = V_A - \int_0^x E_{inside}\cdot ds = 0 - (1.13\times10^6\,N/Cm)\int_0^x x'\,dx'$

$$\boxed{V_B = -(5.65\times10^5\,V/m^2)x^2} \qquad x \le 1cm$$

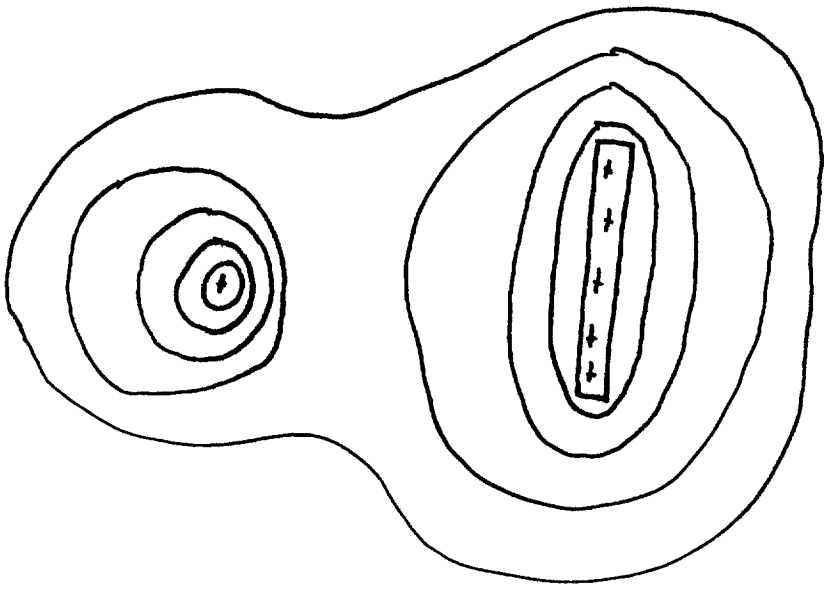
$$V_C = V_{edge} - \int_{.01}^x E_{outside}\cdot ds = -56.5V - 1.13\times10^4\,N/C\int_{.01}^x dx'$$

$$V_{edge} = -(5.65\times10^5\,V/m^2)(.01m)^2 = -56.5V$$

$$\boxed{V_C = +56.5V - 1.13\times10^4\,V/m} \qquad x > 1cm$$

HW 2

25-30



25-43

E-field is Radial

$E_r = -\partial V / dr$

$r < R$

$$V_{r<R} = \left(Q/4\pi\epsilon_0 R\right)\left[-2 + 3(r/R)^2\right]$$

$$E_{r<R} = -K\left(\frac{Q}{R}\right)\left(\frac{6r}{R^2}\right) = -KQ\left(\frac{6r}{R^3}\right)$$

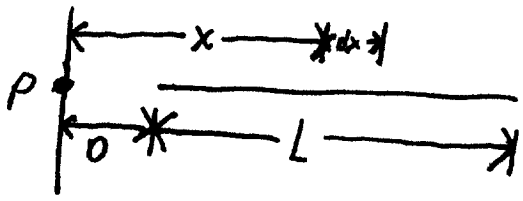
$$\boxed{E_{r<R} = -KQ\left(\frac{6r}{R^3}\right)\hat{r}}$$

$r < R$

$$V_{r>R} = K\left(\frac{Q}{r}\right)$$

$$E_{r>R} = -K\left(\frac{-Q}{r^2}\right) = \boxed{E_{r>R} = \left(\frac{KQ}{r^2}\right)\hat{r}}$$

25-51



$$dV = k\frac{dq}{x} \qquad dq = \lambda dr \qquad \lambda = q/L$$

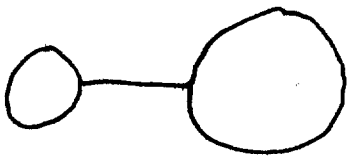
$$V = k\lambda \int_0^{0+L} \frac{dx}{x} = k\lambda \ln\left(\frac{0+L}{0}\right)$$

$$= \frac{kq}{L} \ln\left(\frac{0+L}{0}\right)$$

$$= \left(9.0 \times 10^9 \, N m^2/C^2\right) \frac{2 \times 10^{-6} C}{.2m} \left(\ln\left[\frac{.1m + .2m}{.1m}\right]\right.$$

$$\boxed{V = 9.9 \times 10^4 V}$$

25-61



a) $V_1 = V_2$

$$k\frac{q_1}{R_1} = k\frac{q_2}{R_2} \qquad q_1 = \left(\frac{R_1}{R_2}\right)q_2 \qquad q_2 = 5q_1$$

$$F = k\frac{q_1 q_2}{r^2} \qquad F = \frac{k(5q_1^2)}{r^2}$$

$$3.5\,N = (9\times10^9\,C^2/Nm^2)(5q_1^2)/(.25m)^2$$

$$q_1 = 2.2\times10^{-6}\,C = 2.2\,\mu C$$
$$q_2 = 5q_1 = 11\,\mu C$$

b) $$E_1 = k\frac{q_1}{R_1^2} = 9.0\times10^9\,C^2/Nm^2\ \ 2.2\times10^{-6}C/(.02\,m)^2$$

$$E_1 = 4.95\times10^7\,V/m \text{ radial}$$

$$E_2 = k\frac{q_2}{R_2^2} = 9\times10^9\,C^2/Nm^2\ \ 11\times10^{-6}C/(.1m)^2$$

$$E_2 = 9.9\times10^6\,V/m \text{ radial}$$

26-11

$Q = \text{constant}$

$Q = C_{min} V_{max} = C_{max} V_{min}$

$V_{max} = \left(\frac{C_{max}}{C_{min}}\right) V_{min}$

$\left(\frac{.2\,\mu F}{.01\,\mu F}\right)(300V) = 6 \times 10^3 V$

$V_{max} = 6\,kV$