PHYSICS III – Winter 2000
Dr. Joenathan

Homework IV
Chapter 22; 2, 13, 15, 21, 35, 59

22-2.

$$m_{cu} = \frac{63.546\, gm/mole}{6.02\times10^{23}\, atoms/mole} = 1.06\times10^{-22}\, gm/atom$$

$$N = \frac{M}{m_{cu}} = \frac{2.65 gm}{1.06\times10^{-22}\, gm/atom} = 2.51\times10^{22}\, atoms$$

$$No.\ of\ \ electrons = NZ_{cu}$$
$$= (2.51\times10^{22})(29)$$
$$= 7.28\times10^{23}$$

22-13.

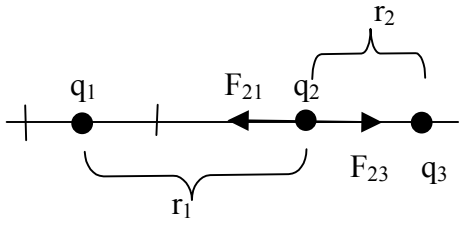
$$F = 1.00\, dyne = 1.00\times10^{-5}\, N = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$$

$$r = \sqrt{\frac{e^2}{4\pi\varepsilon_0 F}} = \left[(8.99\times10^9\, N - m^2/C^2)\frac{(1.60x10^{-19}\, C)^2}{(1.00x10^{-5}\, N)}\right]^{1/2}$$

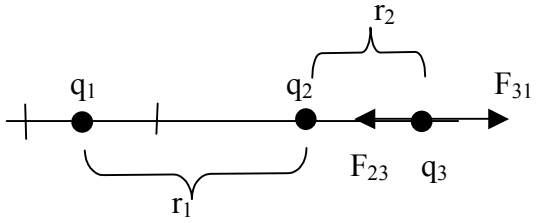
$$= 4.80\times10^{-12}\, m$$

22-15.

(a)



(b)



22-15. (a)

$$F_2 = F_{21}\hat{r}_{12} + F_{23}\hat{r}_{32}$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\left(\frac{q_1|q_2|}{r_1^2}\right)(-\hat{i}) + \left(\frac{|q_2|q_3}{r_2^2}\right)\hat{i}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}|q_2|\,\hat{i}\left(-\frac{q_1}{r_1^2}+\frac{q_2}{r_2^2}\right)$$

$$= \left(8.99\times10^9\ \frac{N-m^2}{C^2}\right)(1.80\times10^{-6}C)\left(-\frac{3.60\times10^{-6}C}{(1.50m)^2}+\frac{2.40\times10^{-6}C}{(1.00m)^2}\right)\hat{i}$$

$$= (1.29\times10^{-2}N)\hat{i}$$

(b)

$$F_3 = F_{31}\hat{r}_{31} + F_{32}\hat{r}_{23}$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\left(\frac{q_3q_1}{(r_1+r_2)^2}\right)\hat{i} + \left(\frac{|q_2|q_3}{r_2^2}\right)(-\hat{i})\right]$$

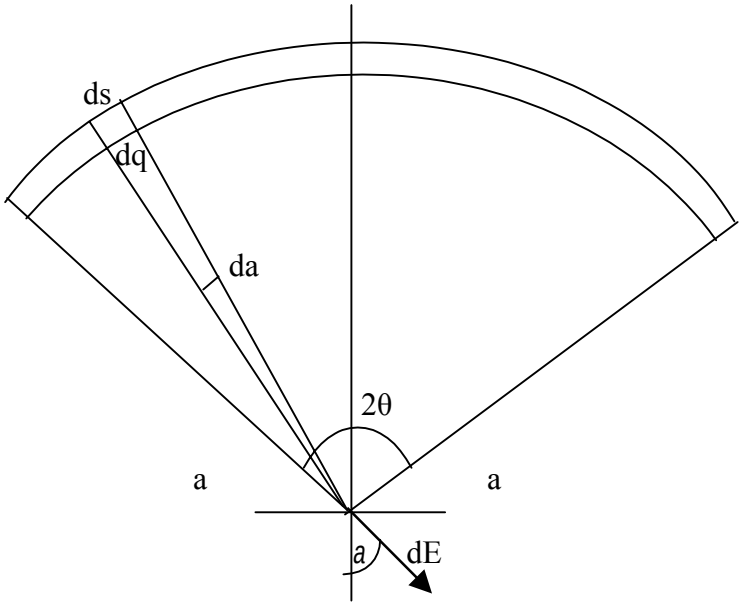
$$= \frac{1}{4\pi\varepsilon_0}q_3\,\hat{i}\left(\frac{q_1}{(r_1+r_2)^2}-\frac{|q_2|}{r_2^2}\right)$$

$$= \left(8.99\times10^9\ \frac{N-m^2}{C^2}\right)(2.40\times10^{-6}C)\left(\frac{3.60\times10^{-6}C}{(2.50m)^2}-\frac{1.80\times10^{-6}C}{(1.00m)^2}\right)\hat{i}$$

$$= -(2.64\times10^{-2}N)\hat{i}$$

22-21.

$$E = \frac{F}{q_0} = \frac{6.40\times10^{-14}\ N}{1.60\times10^{-19}\ C} = 4.00\times10^5\ N/C$$



22-35

$$dE = \frac{1}{4\pi\varepsilon_0}\left(\frac{dq}{a^2}\right) = \frac{1}{4\pi\varepsilon_0}\left(\frac{\lambda ds}{a^2}\right) = \frac{1}{4\pi\varepsilon_0}\left(\frac{\lambda a d\alpha}{a^2}\right)$$

$$\frac{\lambda d\alpha}{4\pi\varepsilon_0 a}$$

$$E_x = \int dE_x = \int dE \sin\ \alpha = 0 \quad (By\ symmetry)$$

$$E_y = \int dE_y = \int dE \cos\ \alpha = \frac{\lambda}{4\pi\varepsilon_0 a}\int_{-\theta}^{+\theta} \cos\alpha d\alpha$$

$$= \frac{\lambda}{4\pi\varepsilon_0 a}\sin\alpha\Big|_{-0}^{+0} = \frac{\lambda}{4\pi\varepsilon_0 a}(2\sin\theta)$$

$$= \frac{\lambda}{2\pi\varepsilon_0 a}\sin\theta$$

$$E = -\frac{\lambda}{2\pi\varepsilon_0 a}\sin\theta\ \hat{j}$$

Homework IV

22-59 a)

$$a_y = \frac{eE}{m} = \frac{\left(-1.60\times10^{-19}\,C\right)\left(-2.00\,N/C\right)}{9.11\times10^{-31}\,kg}$$

$$= 3.52\times10^{11}\,m/s^2$$

$$y - y_0 = v_{cy}t + \frac{1}{2}at^2 = \left(-v_0\sin\theta\right)t + \frac{1}{2}a_y t^2$$

$$+0.100m = \left[\left(-5.00\times10^4\,m/s\right)\sin\left(36.87^0\right)\right]t + \frac{1}{2}\left(3.52\times10^{11}\,m/s^2\right)t^2$$

$$(1.76\times10^{11})\,t^2 - (3.00\times10^4)\,t - 0.100 = 0$$

$$t = 8.44\times10^{-7}\,s$$

b)

$$x - x_0 = v_{0x}t = \left(v_0\cos\theta\right)t$$

$$= \left[\left(5.00\times10^4\,m/s\right)\cos\left(36.87^0\right)\right]\left(8.44\times10^{-7}\,s\right)$$

$$= 3.38\times10^{-2}\,m$$

c)

$$v_y = v_{0y} + at = -v_0\sin\theta + at$$

$$= -(5.00\times10^4\,m/s)\sin(36.87^0) + (3.52\times10^{11}\,m/s^2)(8.44\times10^{-7}\,s)$$

$$= 2.67\times10^5\,m/s$$

$$v_x = v_0\cos\theta = (5.00\times10^4\,m/s)\cos(36.87^0)$$

$$= 4.00\times10^4\,m/s$$

$$v = \sqrt{v_x^2 + v_y^2} = 2.70\times10^5\,m/s$$

$$\theta = \arctan\left(\frac{v_y}{v_x}\right) = 81.6^0 \quad \textit{above the + x axis}$$