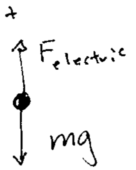
22-39



$m\vec{a} = \sum \vec{F}$'s

$ma_y = \sum F_y$'s

$ma_y = F_{electric} - mg$

$m\cancel{a_y} = qE - mg$

0 if stationary

$0 = q(1.92\times10^{5}) - (1.572\times10^{-14})9.8$

$q = 8.03\times10^{-19}$ Coul

$m =$ density × vol

$= \rho \frac{4}{3}\pi r^3$

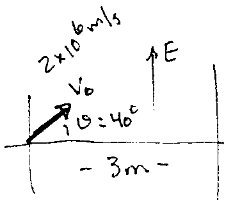
$= \left(0.851\times10^{3}\,\frac{kg}{m^3}\right)\frac{4}{3}\pi(1.64\times10^{-6})^3$

$= 1.572\times10^{-14}$ kg

This is equivalent to

$\frac{8.03\times10^{-19}}{1.602\times10^{-19}} = 5$ fundamental charges

22-54



This is similar to the projectile problems from SP211.

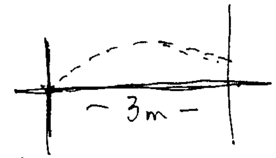
First get values for the acceleration vector

$m\vec{a} = \vec{F} = q\vec{E}$

$(9.1\times10^{-31}\,kg)\,\vec{a} = (-1.602\times10^{-19})(5\,\hat{j})$

$\vec{a} = -8.80\times10^{11}\,m/s^2\ \hat{j}$

$a_x = 0$ $\quad a_y = -8.80\times10^{11}\,m/s^2$



10^6

Position:

$x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$ $\qquad y(t) = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

$x_0 = 0$ $\qquad y_0 = 0$

$v_{0x} = (2\times10^6)\cos 40^\circ = 1.532\times10^6$ m/s $\qquad v_{0y} = (2\times10^6)\sin 40^\circ = 1.286\times10^6$ m/s

$a_x = 0$ $\qquad a_y = -8.80\times10^{11}$ m/s²

$x(t) = (1.532\times10^6)t$ $\qquad y(t) = (1.286\times10^6)t + \frac{1}{2}(-8.80\times10^{11})t^2$

the electron reaches the screen when

$x = 3 = (1.532\times10^6)t$

$\rightarrow t = 1.958\times10^{-6}$ sec

– we could calculate the height at the screen if we wanted to with the y(t) eqn.

Velocity:

$v_x(t) = v_{0x} + \cancel{a_x}t$ (0)

$v_x(t) = (1.532\times10^6)$

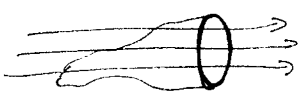
$v_y(t) = v_{0y} + a_y t$

$v_y(t) = (1.286\times10^6) + (-8.80\times10^{11})\cdot(1.958\times10^{-6})$

$v_x = 1.532\times10^6$ m/s $\qquad v_y = -4.37\times10^5$ m/s

$\vec{v} = v_x\,\hat{i} + v_y\,\hat{j}$

23-4



The $\phi_{\cancel{net}}$ out of the region of the net is zero. Note that what goes in through the net, goes out through the rim.

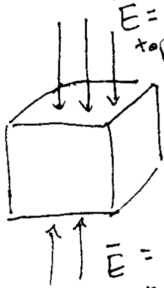
$$\phi_{rim} = \int E \cdot dA = E\,\pi a^2$$
$$= (3\times10^{-3})\,\pi(0.11)^2$$
$$= 1.14\times10^{-\cancel{4}}\ \frac{N}{C}m^2$$

therefore the flux

$$\phi_{netting} = -1.14\times10^{-4}\ \frac{N}{c}m^2$$

23-6

$\bar{E} = -34\hat{k}$ N/c
top



cube
3 m on a side

$\bar{E} = +20\hat{k}$ N/c
bot

$$\phi_{total} = \oint \bar{E}\bullet d\bar{A} = \frac{Q_{enclosed}}{\epsilon_0}$$

No flux through sides

$$\phi_{bot} + \phi_{top} = \frac{Q_{enclosed}}{\epsilon_0}$$

top $\bar{E}\uparrow\downarrow\hat{n}$ $\qquad$ $\bar{E}\downarrow\uparrow\hat{n}$ bottom

$$\bullet\,20(3^2) \quad -34(3^2) =$$

$$-486 = \frac{Q_{encl}}{\epsilon_0}$$

$$Q_{encl} = 4.30\times10^{-9}\ \text{Coul.}$$

23-23

cylindrical symmetry
∴ choose gaussian surface as cylinder

a)
$$\oint \bar{E}\bullet d\bar{A} = \frac{Q_{encl}}{\epsilon_0}$$
$$E\cdot 2\pi r L = \frac{Q}{\epsilon_0}$$
$$E = \frac{1}{2\pi\epsilon_0}\frac{Q/L}{r}$$

$E = 2.3\times10^{5}$ N/c
$r = 0.12$ m
$L = 0.42$ m

$$2.3\times10^{5} = \frac{1}{2\pi(8.85\text{-}12)}\ \frac{Q/0.42}{0.12}$$

$$Q = 6.44\times10^{-7}\ \text{coul}$$

b) Redo with $E = 2.3\times10^{5}$ N/c
$r = 0.08$ m
$L = 0.28$ m

$$E = \frac{1}{2\pi\epsilon_0}\frac{Q/L}{r}$$

$$2.3\times10^{5} = \frac{1}{2\pi(8.85\text{-}12)}\ \frac{Q/0.28}{0.08}$$

$$Q = 2.86\times10^{-7}\ \text{Coul}$$