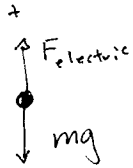
## 22-39




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

$ma_y = \sum F_y$'s

$ma_y = F_{electric} - mg$

$ma_y = qE - mg$

if stationary

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

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

$m$ = density × vol

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

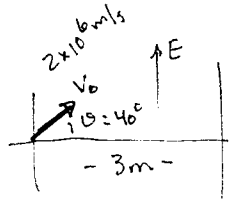
$= \left(0.851\times10^3 \frac{kg}{m^3}\right)\frac{4}{3}\pi(1.64\times10^{-6})^3$

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

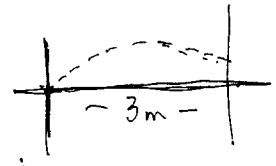
First get values for the acceleration vector

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

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

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

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




$10^6$

Position:

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

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

$V_{0x} = (2\times10^6)\cos 40°$
$= 1.532\times10^6$ m/s

$V_{0y} = (2\times10^6)\sin 40°$
$= 1.286\times10^6$ m/s

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

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

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:

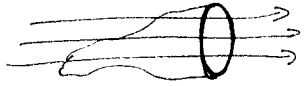
$V_x(t) = V_{0x} + \cancel{a_x t}$ $\qquad V_y(t) = V_{0y} + a_y t$

$V_x(t) = (1.532\times10^6)$ $\qquad V_y(t) = (1.286\times10^6) + (-8.80\times10^{11})\cdot(1.958\times10^{-6})$

$V_x = 1.532\times10^6$ m/s $\qquad V_y = -4.37\times10^5$ m/s

$\vec{V} = V_x\,\hat{i} + V_y\,\hat{j}$

23-4



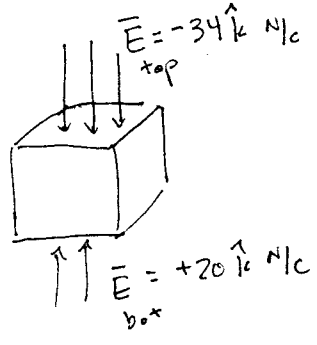
The $\phi_{net}$ out of the region of the net is zero. Note that what goes in through the net, goes out through the rim.

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

Therefore the flux

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

23-6




cube
3m on a side

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

No flux through sides

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

top $\bar{E}\uparrow\downarrow\hat{n}$ $\quad -20(3^2)$ $\quad -34(3^2) =$ $\quad \downarrow\bar{E}\uparrow\hat{n}$ bottom

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

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

23-23

cylindrical symmetry
∴ choose gaussian surface as cylinder

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

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

$$2.3\times10^5 = \frac{1}{2\pi(8.85-12)}\frac{Q/0.42}{0.12}$$
$$Q = 6.44\times10^{-7}\ \text{coul}$$

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

$$E = \frac{1}{2\pi\epsilon_0}\frac{Q/L}{r}$$
$$2.3\times10^5 = \frac{1}{2\pi(8.85-12)}\frac{Q/0.28}{0.08}$$
$$Q = 2.86\times10^{-7}\ \text{Coul}$$