18.1 $e = -1.60 \times 10^{-19}\,C$ note: $e \equiv$ charge of an electron.
$e^- \equiv$ an electron

So how many e in $-2.4\,\mu C$?

Well $-2.4\,\mu C = -2.4 \times 10^{-6}\,C \rightarrow \dfrac{-2.4 \times 10^{-6}\,C}{-1.6 \times 10^{-19}\,C} = 1.5 \times 10^{13}\,e^-$

18.2 Same as above reasoning wise.

we want a charge of $5\,\mu C$. How many e^- in $5\,\mu C$? just divide by e

$\rightarrow 3.1 \times 10^{13}\,e^-$

18.3

Now we multiply instead of divide. Note $q \equiv$ amount of charge

$q = (6.0 \times 10^{13})(-1.6 \times 10^{-19}\,C) = -9.6 \times 10^{-6}\,C = -9.6\,\mu C$

18.4 O.k. we're shuffling electrons around here, so if I got more negative I'm GETTING e^- and if I got more positive I'm loosing electrons

electrons have mass. The one that got more negative got e^- added and its mass went up

So $N_e = q/e = \dfrac{3 \times 10^{-6}\,C}{1.6 \times 10^{-19}\,C} = 1.9 \times 10^{13}\,e^-$

Mass e^-
$9.11 \times 10^{-31}\,kg$ So $\rightarrow (1.9 \times 10^{13})(9.11 \times 10^{-31}) = 1.7 \times 10^{-17}\,kg$

is how much mass rod A gained.

18.5

	A	B	C	Total q
0.	5	-1	0	4
1.	2	2	0	4
2.	1	2	1	4
3.	1	1.5	1.5	4

add then split the net charge between the two

charge is always conserved!

1 liter = 10^3 g H_2O by defn of gram

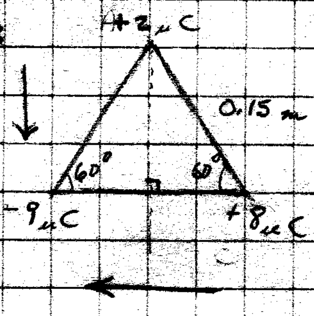
$$10^3 g \cdot \frac{1\,mol}{18\,g} \cdot \frac{6.022 \times 10^{23}}{mol} \times 10\ e^- \text{ for each } H_2O \rightarrow 3.35 \times 10^{26}\ e^-$$

See prob 1 for getting the charge

18.8 $F = k\, q_1 q_2 / r^2$, remember equal and opposite forces

$= 26$ N

18.13



1. So break into x and y directions

$$\vec{F}_x = \vec{F}_{92x} + \vec{F}_{82x}$$

$$= k\left[\frac{q_9 q_2}{r_{92}^2}(\cos 60°)\hat{x} + \frac{q_8 q_2}{r_{82}^2}(\cos 60°)\hat{x}\right]$$

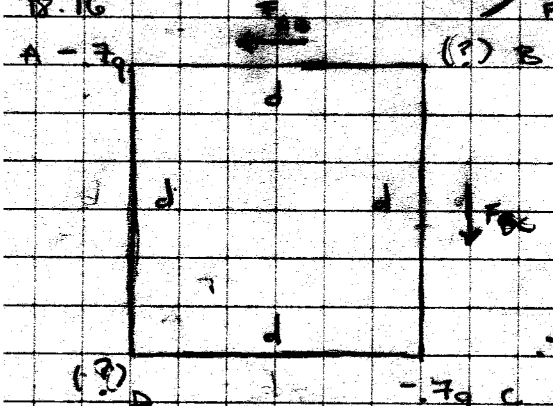
$$\vec{F}_y = k\left[\frac{q_9 q_2}{r_{92}^2}(\sin 60°)\hat{y} + \frac{q_8 q_2}{r_{82}^2}(\sin 60°)\hat{y}\right]$$

2. mag $\vec{F}_{tot} = \|\vec{F}_x + \vec{F}_y\| = \left[(F_x)^2 + (F_y)^2\right]^{1/2}$

Remember your directions when dealing with vectors.

Define: positive $\hat{y}$ as up or North
positive $\hat{x}$ as right or East.

18.16



OK Our charge (?) is pushed away from the (?) at the bottom and we have a square. But the negative charges at A and C put it in equilibrium.

∴ (?) B and (?) D must be positive.

$\boxed{\text{Since } \vec{F}_{AB} + \vec{F}_{BC} = \vec{F}_{BD} = 0}$

18.16 cont'd

So, $\sqrt{(F_{AB})^2 + (F_{BC})^2} = F_{BD}$ NOTE: These are magnitudes here

The rest is algebra:

$$\frac{k^2}{d^4}\left[((.7)q)^2 + ((.7)q)^2 \right] = \frac{k^2}{(\sqrt{2}d)^4} q^4$$

$\uparrow$ use Pythagoras for $r_{BD} = \sqrt{2}\, d$

$$(.7)^2 q^2 + (.7)^2 q^2 = \frac{q^4}{4}$$

$$2q^2 (.7)^2 = q^4/4$$

$$(.7)^2 = q^2/8$$

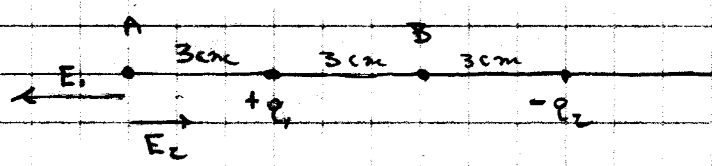
$$\rightarrow \quad q = 2\sqrt{2}\,(.7\,\mu C)$$

18.25

$F = qE$ by definition

$= (7 \times 10^{-6}\, C)(260{,}000\, N/C) = 1.8\, N$

18.28

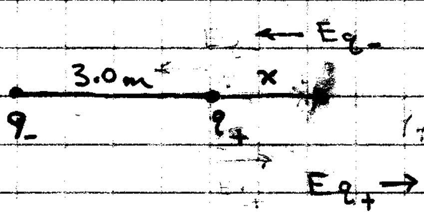


At A, $|E| = |-E_1| + |E_2|$ or $\vec{E} = k\left[\frac{-q_1}{r_{A1}^2}\hat{x} + \frac{q_2}{r_{A2}^2}\hat{x} \right]$

At B, $|E| = |E_1| + |E_2|$ or

$$\vec{E} = k\left[\frac{q_1}{r_{B1}^2} + \frac{q_2}{r_{B2}^2} \right]\hat{x}$$

18.29



$\rightarrow k q_- / (3+x)^2 = k q_+ / x^2$

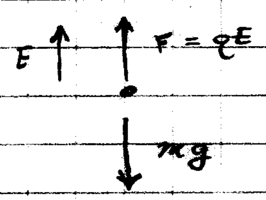
Use quadratic form. to solve for x.

18.34

$$E = -E_3 + E_4 = \frac{-kq_3}{r_3^2} + \frac{kq_4}{r_4^2}$$

mind directions

18.35



A. To go up the droplet must be +

B. $mg = qE \rightarrow q = E/mg$

18. 44

$E = \sigma/\epsilon_0$ for a plate in a capacitor. This comes from Gauss's law.

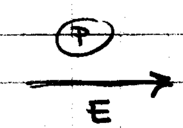
a) So $\sigma = \epsilon_0 E$

b) $A = \pi r^2$

$q = \sigma A = \sigma \pi r^2$

18.66

The proton covers a distance d



$$\text{Work} = F \cdot d = qEd = \Delta KE$$

$$qEd + \frac{1}{2}mv_0^2 = \frac{1}{2}mv_f^2$$

$$v_f = \left[\frac{2}{m}\left(qEd + \frac{1}{2}mv_0^2\right)\right]^{1/2}$$