Phys 112 HW 1

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No. 1

Date

Concept Questions: 4, 5, 6, 9

4) a) The new charge is inbetween the two charges because they are both negative

b) The new charge should be positive

c) The equilibrium is unstable because if an charge moves a little bit, it all comes undone

5) Every direction has net zero force except from +y and -y

There is a net $+2q$ at distance r

$$F = k\frac{2q_2}{r^2} = k\frac{2q^2}{r^2} \text{ at } 90°$$

6) a) The conductor is neutral because the charge evens out from the ground connection after the ball is removed

b) The conductor is negatively charged

9) a) The magnitudes are the same but inverse.

b) It is less than 2F

c) The x components cancel

d) The y components add together

e) The net force is in the direction of the adding components

f) The direction is 90° ccw from +x

g) The direction of the net force for 2 is 270° from +x

h) ~~There zero net force on the particle~~ The net force is 0° ccw from +x

i) The net force is 180 ccw from +x

Problems: 3, 4, 5, 11, 13, 19

3) $q_1 = 26pC$ $q_2 = -47pC$ $F_e = 5.7N$ $F_e = k\frac{q_1 q_2}{r^2}$ $5.7 = k\frac{26pC \cdot 47pC}{r^2}$

$$r = \sqrt{k\frac{26pC \cdot 47pC}{5.7}}$$

$$r = 1.39m$$

$\boxed{r = 1.39m}$

4) $q = it$ $i = 2.5e4$ $t = 20ps$ ~~$q = 2.5e4$~~

$q = 2.5e4 \cdot 20ps = 0.5C$

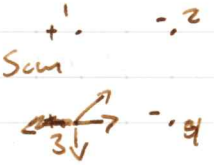
$\boxed{q = 0.50C}$

5) $q_1 = 3e\text{-}6C$ $q_2 = -1.5e\text{-}6C$ $r = 12cm$ $F_e = k\frac{|q_1||q_2|}{r^2}$

$$F_e = \frac{3e\text{-}6C \cdot 1.5e\text{-}6C}{0.12m^2} = 2.81N$$

$\boxed{F_e = 2.81N}$

11) $q_1 = -q_2 = 100nC$ $q_3 = -q_4 = 200nC$ $a = 5cm$



a) x axis

$F_x = F_{13} + F_{23}\cos 45$

$F_x = k\left(\frac{|200nC||200nC|}{0.05^2} + \frac{200nC \cdot 100nC}{a^2}\cos 45\right)$

$\boxed{F_x = 9.17N}$

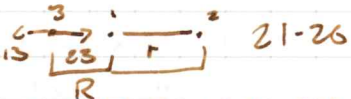
b) y axis

$F_y = -F_{13} + F_{23}\sin 45$

$F_y = k\left(-\frac{100 \cdot 200}{0.05^2} + \frac{100 \cdot 300}{0.005}\cos 45\right)$

$\boxed{F_y = -0.046N}$

13) $q_1 = 1\mu C$ $q_2 = -3\mu C$ $r = 10.0cm$



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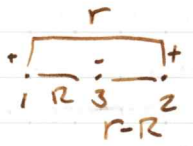
$F_{23} - F_{13} = 0$ $F_{23} = F_{13}$ $k\frac{q_3 \cdot q_2}{(R+r)^2} = k\frac{q_3 \cdot q_1}{R^2}$ $\frac{|q_2|}{(R+r)^2} = \frac{|q_1|}{R^2}$

$\frac{R_2}{(R+r)^2} = \frac{q_1}{q_2}$ $\frac{R}{R+r} = \sqrt{\frac{q_1}{q_2}}$ $\frac{R}{R} + \frac{r}{R} = \sqrt{\frac{q_2}{q_1}}$ $R = r\left(\sqrt{\frac{q_2}{q_1}} - 1\right)$

$R = 0.05(\sqrt{3} - 1)$ $R = \frac{0.05}{\sqrt{3}-1} = 0.14m$

a) -14cm on the x-axis
b) 0cm on y-axis

19) $q_1 = 1q$ $q_2 = 4q$ $r = 9cm$



but $r_{23} = r - R$

$F_{net} = F_{23} - F_{13} = 0$ $F_{23} = F_{13}$ $\frac{4q}{(r-R)^2} = \frac{1q}{R^2}$ $4 = \frac{(r-R)^2}{R^2}$ $2 = \frac{r}{R} - \frac{R}{R}$

$3 = \frac{r}{R}$ $R = \frac{r}{3}$ $R = \frac{0.09}{3}$ $R = 3cm$

a) + 3cm from x-axis

b) 0cm from y-axis

c) $0 = k\left(\frac{q_3 q}{R^2} + \frac{4q^2}{r^2}\right)$ $\frac{q_3^2}{R^2} = \frac{4q^2}{r^2}$

$\frac{q_3}{q} = \frac{-4 \cdot 0.03^2}{0.09^2} = -0.444$

c) -0.444