

Fri: HW Spm

Ex 2, 4, 6, 8, 10, 11, 15, 16 10pts

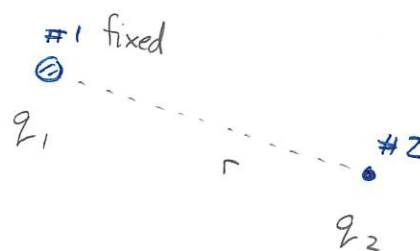
Mon: Warm Up 2 D2LCoulomb's Law

The basic law for forces where one charge is at rest is:

The force exerted by particle 1 on particle 2 has magnitude

$$F_{1on2} = k \frac{|q_1| |q_2|}{r^2} = \frac{1}{4\pi\epsilon_0} \frac{|q_1| |q_2|}{r^2}$$

and direction along the line connecting the particles according to attract/repel.

Here $k = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$$

are constants that apply in all situations.

Note that charge is an inherent property of an object and only partly determines the force that the charge exerts.

Quiz! 90%

The force also depends on the locations



Schematically

Collection of objects
with (inherent) charges

Actual arrangement in
space

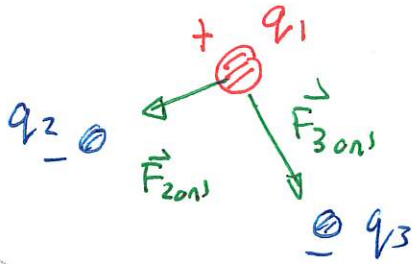
Both
determine

Force exerted by one
charge on another

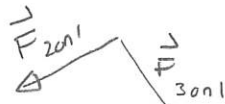
Warm Up 1

These forces can now be inserted into the framework of Newtonian mechanics

Collection of charged
objects. Choose one
of interest (1)



Construct FBD



Net force

$$\vec{F}_{net} = \sum \vec{F}_i$$

Acceleration

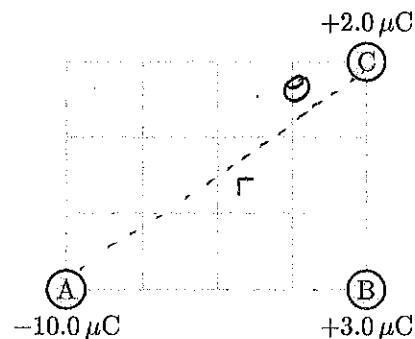
$$\vec{F}_{net} = m\vec{a}$$

Coulomb's Law
gives individual forces

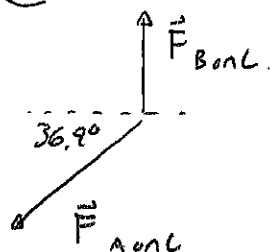
Quiz 2 70% - 95%

14 Two dimensional charge arrangements: force, 1

Three charged particles are held fixed as illustrated; the grid units are each 0.010 m. Determine the magnitude and direction of the net force on charge C. (132Sp2022)



Answer: Step ① FBD



Step ② Geometry for A vs C.

$$r_{AC} = \sqrt{(0.030\text{m})^2 + (0.040\text{m})^2}$$

$$r_{AC} = 0.050\text{m}$$

$$\tan \theta = \frac{0.03}{0.04} = 0.75 \Rightarrow \theta = \tan^{-1}(0.75) = 36.9^\circ$$

Step ③ Magnitudes

$$F_{AonC} = k \frac{|q_A||q_C|}{r_{AC}^2} = 8.99 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2} \frac{2 \times 10^{-6}\text{C} \times 10 \times 10^{-6}\text{C}}{(0.050\text{m})^2}$$

$$= 72\text{N}$$

$$F_{BonC} = k \frac{|q_B||q_C|}{r_{BC}^2} = 8.99 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2} \frac{2 \times 10^{-6}\text{C} \times 3 \times 10^{-6}\text{C}}{(0.030\text{m})^2}$$

$$= 60\text{N}$$

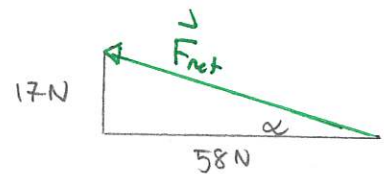
Step ④ Vector components.

$$F_{AonC_x} = -72N \cos 36.9^\circ \\ = -58N$$

$$F_{AonC_y} = -72N \sin 36.9^\circ \\ = -43N$$

	x	y
F_{AonC}	-58 N	-43 N
F_{BonC}	0	60 N

Step ⑤ $F_{net x} = -58N + 0N = -58N$
 $F_{net y} = -43N + 60N = 17N$



$$\text{Magnitude} = \sqrt{(17N)^2 + (58N)^2} = 60N$$

$$\text{Angle } \alpha = \tan^{-1} \frac{17}{58} = 16^\circ$$

Quiz 3

Warm Up 2