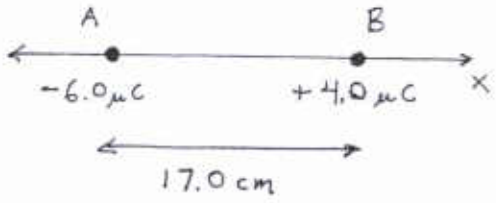
Name_____ Units? Units?

Phys 2020, Section 1
Quiz #1 — Spring 2002

1. Particles A and B both lie on the x axis; A has charge $-6.0\,\mu$C and B has charge $+4.0\,\mu$C. They are separated by 17.0 cm.



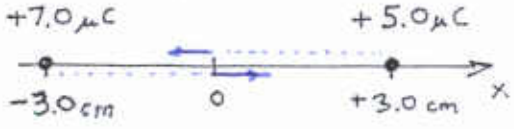
Find the magnitude and direction of the force on charge B.

From Coulomb's Law, force on charge B is

$$F = k\frac{|q_1 q_2|}{r^2} = \left(8.99\times10^9 \tfrac{N\cdot m^2}{C^2}\right)\frac{(6.0\times10^{-6}\,C)(4.0\times10^{-6}\,C)}{(17.0\times10^{-2}\,m)^2} = \boxed{7.47\ N}$$

This force is attractive (opp. signs) so the force on B points in the $\boxed{-x}$ direction (to the $\boxed{\text{left}}$).

2. A point charge of $+7.0\,\mu$C is located at $x = -3.0$ cm. A point charge of $+5.0\,\mu$C is located at $x = +3.0$ cm.



Find the magnitude and direction of the **E** field at the origin.

Contributions from the two charges are:

$+7.0\,\mu$C: $E = k\frac{|q|}{r^2} = \left(8.99\times10^9 \frac{N\cdot m^2}{C^2}\right)\frac{(7.0\times10^{-6}\,C)}{(3.0\times10^{-2}\,m)^2} = 6.99\times10^7 \frac{N}{C}$

Points in $+x$ dir.

$+5.0\,\mu$C: $E = k\frac{|q|}{r^2} = \left(8.99\times10^9 \frac{N\cdot m^2}{C^2}\right)\frac{(5.0\times10^{-6}\,C)}{(3.0\times10^{-2}\,m)^2} = 4.99\times10^7 \frac{N}{C}$

Points in $-x$ dir.

(Net) $\vec{E}$ field has only an x component and:

$$E_x = +6.99\times10^7 \frac{N}{C} - 4.99\times10^7 \frac{N}{C} = \boxed{+2.00\times10^7 \frac{N}{C}}$$

i.e. mag. is $2.00\times10^7 \frac{N}{C}$ points in $+x$ direction.

3. An electron is placed in a uniform electric field of magnitude $3.50 \times 10^4 \frac{\text{N}}{\text{C}}$

What is the magnitude of the force on the electron?

$|\vec{F}| = |q\vec{E}| = (1.602 \times 10^{-19} \text{C})(3.50 \times 10^4 \frac{\text{N}}{\text{C}}) = \boxed{5.6 \times 10^{-15} \text{ N}}$

4. How much work is required to move a $+3.0\,\mu$C charge through a change in potential of +180 V?

Work required = ΔEPE, and:

$\Delta EPE = q\Delta V = (3.0 \times 10^{-6} \text{C})(+180 \text{V})$

$= \boxed{5.4 \times 10^{-4} \text{ J}}$

You must show all your work and include the right units with your answers!

$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}$ $\quad \epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}$ $\quad F = k\frac{|q_1 q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1 q_2|}{r^2}$

$\mathbf{F} = m\mathbf{a}$ $\quad g = 9.80 \frac{\text{m}}{\text{s}^2}$ $\quad m_{\text{elec}} = 9.1094 \times 10^{-31}$ kg $\quad e = 1.602 \times 10^{-19}$ C

$\mathbf{F} = q\mathbf{E}$ $\quad E_{\text{pt ch}} = k\frac{|q|}{r^2}$ $\quad E_{\text{plates}} = \frac{\sigma}{\epsilon_0}$ $\quad \Delta\text{EPE} = q\Delta V$ $\quad V_{\text{pt ch}} = k\frac{q}{r}$