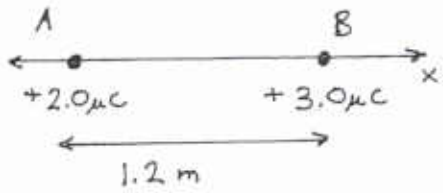
Name_____ Units? Units?

Phys 2020, Section 2
Quiz #1 — Spring 2002

1. Particles A and B both lie on the x axis; A has charge $+2.0\,\mu$C and B has charge $+3.0\,\mu$C. They are separated by 1.2 m.

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

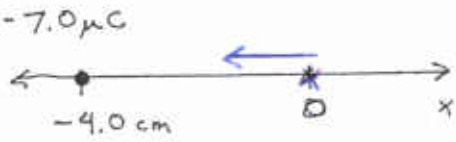


From Coulomb's law, magnitude of force on B is

$$F = k\frac{|q_1 q_2|}{r^2} = \left(8.99\times10^9 \frac{N m^2}{C^2}\right)\frac{(2.0\times10^{-6}C)(3.0\times10^{-6}C)}{(1.2\,m)^2} = \boxed{3.75\times10^{-2}\,N}$$

Force is repulsive (same sign chs) so force on B is in the $\boxed{+x}$ direction (to the $\boxed{\text{right}}$).

2. A point charge of $-7.0\,\mu$C is located at $x = -4.0$ cm. Find the magnitude and direction of the **E** field at the origin.

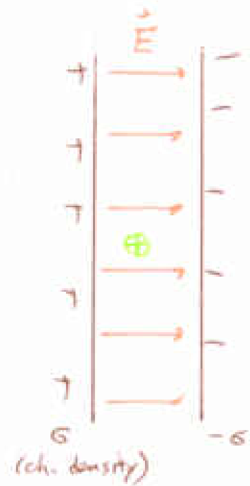


only one charge here; gives $\vec{E}$ field of magnitude

$$E = k\frac{|q|}{r^2} = \left(8.99\times10^9 \frac{N m^2}{C^2}\right)\frac{(7.0\times10^{-6}C)}{(4.0\times10^{-2}m)^2} = \boxed{3.93\times10^7 \frac{N}{C}}$$

$\vec{E}$ field due to this one charge points toward charge hence at the origin it is in the $\boxed{-x}$ direction (to the $\boxed{\text{left}}$).

3. Two large parallel plates carry opposite charges; the charge densities on the plates are $\pm 3.5 \times 10^{-11}\,\frac{\mathrm{C}}{\mathrm{m}^2}$. Protons pass between the plates.



a) What is the magnitude of the electric field between the plates?

Use the "plates" formula for the $\vec{E}$ field,

$$E = \frac{\sigma}{\epsilon_0} = \frac{3.5\times10^{-11}\ \mathrm{C/m^2}}{8.85\times10^{-12}\ \frac{\mathrm{C^2}}{\mathrm{N\cdot m^2}}} = \boxed{3.95\ \mathrm{N/C}}$$

b) What is the magnitude of the force on the protons?

$$|\vec{F}| = |q\vec{E}| = (1.602\times10^{-19}\,\mathrm{C})(3.95\,\tfrac{\mathrm{N}}{\mathrm{C}}) = \boxed{6.34\times10^{-19}\ \mathrm{N}}$$

c) What is the magnitude of the acceleration of the protons?

$$|\vec{a}| = |\vec{F}|/m = (6.34\times10^{-19}\,\mathrm{N})/(1.67\times10^{-27}\,\mathrm{kg}) = \boxed{3.79\times10^{8}\ \mathrm{m/s^2}}$$

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

$$k = \frac{1}{4\pi\epsilon_0} = 8.99\times10^{9}\,\frac{\mathrm{N\cdot m^2}}{\mathrm{C^2}} \qquad \epsilon_0 = 8.85\times10^{-12}\,\frac{\mathrm{C^2}}{\mathrm{N\cdot m^2}} \qquad F = k\frac{|q_1 q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1 q_2|}{r^2}$$

$$\mathbf{F} = m\mathbf{a} \qquad g = 9.80\,\tfrac{\mathrm{m}}{\mathrm{s}^2} \qquad \mathbf{F} = q\mathbf{E}$$

$$E_{\text{pt ch}} = k\frac{|q|}{r^2} \qquad E_{\text{plates}} = \frac{\sigma}{\epsilon_0} \qquad \Delta\mathrm{EPE} = q\Delta V \qquad V_{\text{pt ch}} = k\frac{q}{r}$$

$$e = 1.602\times10^{-19}\ \mathrm{C} \qquad m_{\text{elec}} = 9.1094\times10^{-31}\ \mathrm{kg} \qquad m_{\text{proton}} = 1.6726\times10^{-27}\ \mathrm{kg}$$