§14.2 Describing Fields (continued)

Electric Field Intensity: $\vec{E} = \frac{\vec{F}_Q}{q}$ (N/C)

(radially inward or outward)
(based on a + test charge)

Gravitational Field Intensity: $\vec{g} = \frac{\vec{F}_g}{m}$ $(N/kg$ or $m/s^2)$

(radially inward)

Consider a <u>point source</u> charge (Q)

$$|\vec{E}| = \frac{|\vec{F}_Q|}{q} \qquad F_Q = \frac{kQq}{r^2}$$

$$|\vec{E}| = \frac{\frac{kQ\cancel{q}}{r^2}}{\cancel{q}}$$

$$\boxed{|\vec{E}| = \frac{kQ}{r^2}}$$

Q is the charge of the point source

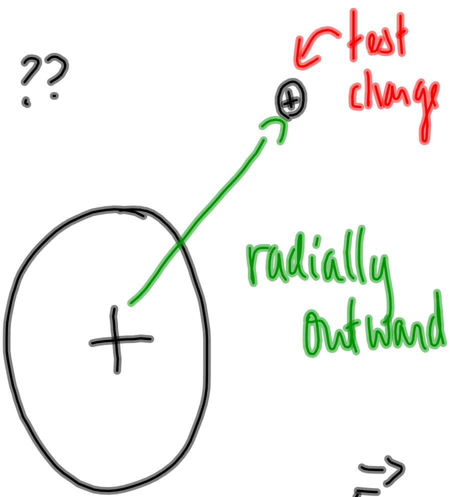
* This only gives you magnitude
* <u>Do not</u> use the sign on the charge
* Direction is based on the force acting on a positive test charge.

MP | 652

$r = 30.0\,cm$

$Q = +2.0\times10^{-6}\,C$

$\vec{E} = ??$



$$|\vec{E}| = \frac{kQ}{r^2}$$

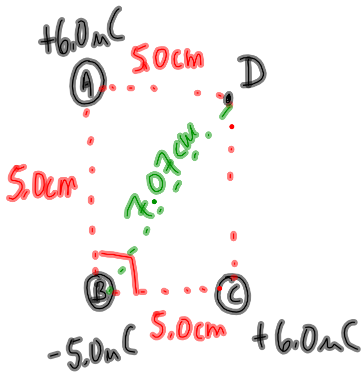
$$|\vec{E}| = \frac{\left(9.0\times10^{9}\,\frac{N\cdot \cancel{m^2}}{C^2}\right)\left(2.0\times10^{-6}\,C\right)}{(0.300\,\cancel{m})^2}$$

$$|\vec{E}| = 200\,000\,\frac{N}{C} \quad \left(2.0\times10^{5}\,\frac{N}{C}\right)$$

$$\vec{E} = 2.0\times10^{5}\,\frac{N}{C}\ [\text{radially outward}]$$

MP|653

Find the field intensity for each charge (magnitude)



$$|\vec{E}_A| = \frac{kQ_A}{r_A^2}$$

$$|\vec{E}_A| = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)\left(6.0\times10^{-6}C\right)}{(0.050\,m)^2}$$

$$|\vec{E}_A| = 2.16\times10^7 \frac{N}{C}$$

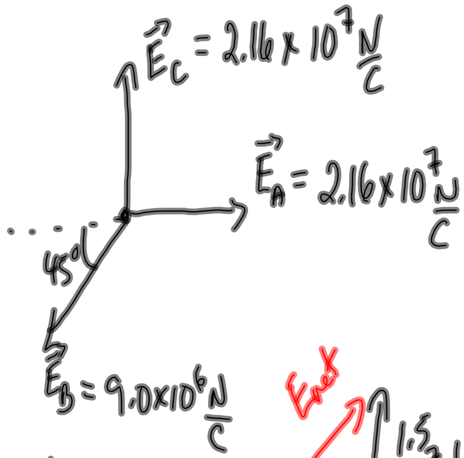
So: $|\vec{E}_C| = 2.16\times10^7 \frac{N}{C}$

$$|\vec{E}_B| = \frac{kQ_B}{r_B^2}$$

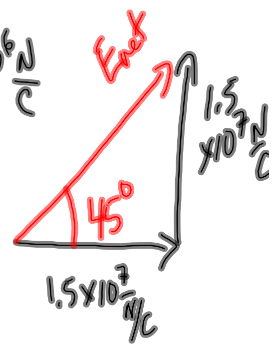
$$|\vec{E}_B| = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)\left(5.0\times10^{-6}C\right)}{(0.0707\,m)^2}$$

$$|\vec{E}_B| = 9.0\times10^6 \frac{N}{C}$$

Draw a FBD for a positive test charge at D



	x	y
E_A	$+2.16\times10^7 \frac{N}{C}$	0
E_B	$-\left(9.0\times10^6 \frac{N}{C}\right)(\cos 45°)$	$-9.0\times10^6 \frac{N}{C}(\sin 45°)$
E_C	0	$2.16\times10^7 N/C$
E_{net}	$1.5\times10^7 \frac{N}{C}$	$1.5\times10^7 \frac{N}{C}$



$E_{net} = 2.2\times10^7 \frac{N}{C}$ [45° ccw from +x-axis

Now consider the gravitational situation ... the field from a point source mass:

$$|\vec{g}| = \frac{|\vec{F_g}|}{m} \quad \text{and} \quad F_g = \frac{GMm}{r^2}$$

$$|\vec{g}| = \frac{\frac{GM\cancel{m}}{r^2}}{\cancel{m}}$$

$$|\vec{g}| = \frac{GM}{r^2}$$

gravitational field for a source mass

Think about:

g

Newton's Law of Gravitation: $F_g = \frac{GMm}{r^2}$

$|\vec{E}|$

Coulomb's Law: $F_Q = \frac{kQq}{r^2}$

yesterday

PP|646-647

PP|649

PP|655

PP|658