PP|649

18 $g_{saturn} = 10.4\ N/kg$ at R (on the surface of Saturn)

g'_{saturn} at $2R$ = ?

(where R = radius of Saturn)

inverse square relationship.

$$g \propto \frac{1}{r^2}$$

$$g = \frac{k}{r^2}$$

$$g' = \frac{k}{(2r)^2}$$

$$g' = \frac{1}{4}\left(\frac{k}{r^2}\right) g$$

$$g' = \frac{1}{4} g$$

$$g' = \frac{1}{4}(10.4\ N/kg)$$

Fields due to Point Sources

Consider a test charge (q_t) at a certain distance (r) from the centre of a source charge (q):

$$\vec{E} = \frac{\vec{F_Q}}{q_t}$$

$$|\vec{E}| = \frac{|\vec{F_Q}|}{q_t}$$ ← magnitude

recall: $F_Q = \frac{k q_1 q_2}{r^2}$

$$|\vec{E}| = \frac{\frac{k q q_t}{r^2}}{q_t}$$

$$|\vec{E}| = \frac{kq}{r^2}$$ ← the charge of the source charge (no signs!)

This only gives the magnitude, to get the direction you need to consider the force acting on a positive test charge.

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$q = +2.0 \times 10^{-6}\,C$

$r = 30.0\,cm$

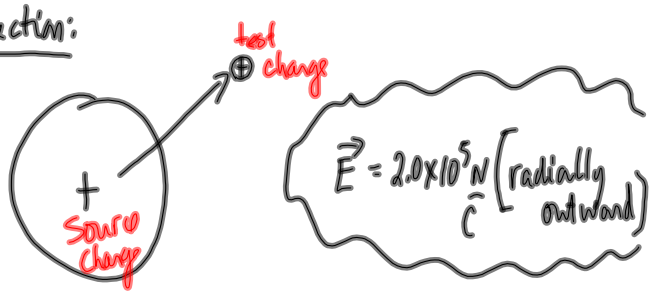
$\vec{E} = ??$

$$|\vec{E}| = \frac{kq}{r^2}$$ (no signs!)

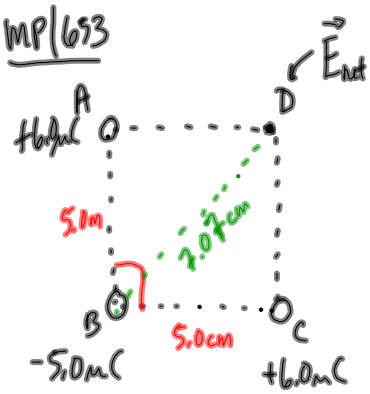
$$|\vec{E}| = \frac{\left(9.0 \times 10^9 \frac{N \cdot m^2}{C^2}\right)\left(2.0 \times 10^{-6}\,C\right)}{(0.300\,m)^2}$$

magnitude → $|\vec{E}| = 2.0 \times 10^5 \frac{N}{C}$

Direction:

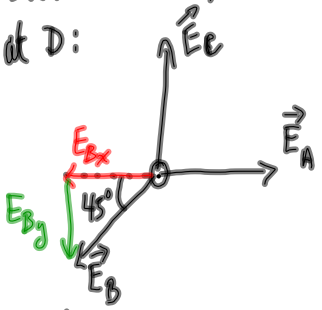


MP|633



What field does a positive test charge experience at D?

DRAW A FBD for a test charge at D:

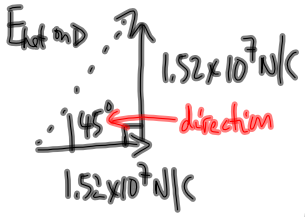


$$|\vec{E}_A| = \frac{kq_A}{r_A^2} = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)\left(6.0\times10^{-6}C\right)}{(0.050m)^2} = 2.16\times10^7 \frac{N}{C}$$

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

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

	x	y
E_A	2.16×10^7 N/C	0
E_B	$-\left(9.0\times10^6 \frac{N}{C}\right)\cos45°$ -6.36×10^6 N/C	$-\left(9.0\times10^6 \frac{N}{C}\right)\sin45°$ -6.36×10^6 N/C
E_C	0	2.16×10^7 N/C
$E_{net\ on\ D}$	$1.52\times10^7 \frac{N}{C}$	$1.52\times10^7 \frac{N}{C}$



$$c^2 = a^2 + b^2$$

$$c^2 = (1.52\times10^7)^2 + (1.52\times10^7)^2$$

$$c = 2.15\times10^7 \frac{N}{C}$$

magnitude

The net field experienced by a charge at D will be: $2.15\times10^7 \frac{N}{C}$ [45° ccw from + x-axis]

Gravitational Field Strength due to a Point Source:

$$\vec{g} = \frac{\vec{F_g}}{m}$$

$$|\vec{g}| = \frac{|\vec{F_g}|}{m}$$

Recall: $F_g = \frac{GMm}{r^2}$ (g)

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

$$|\vec{g}| = \frac{GM}{r^2}$$ where M is the source mass

TO DO:

① PP|655 → $\vec{E}$

② Look over MP|657 } $\vec{g}$

③ PP|658