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6.02 Electric Field

There are many similarities between **gravitational** and ***electrostatic*** forces. One such similarity is that both forces can be exerted on objects that **are not in contact**.

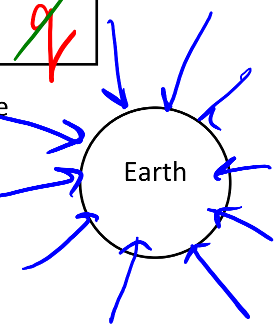
In the same way that a gravitational field surrounds any mass, we will imagine that an electric field surrounds any charge object.

Like gravitational fields, an electric field will depend on: ___size___ of and ___distance___ to the charge.

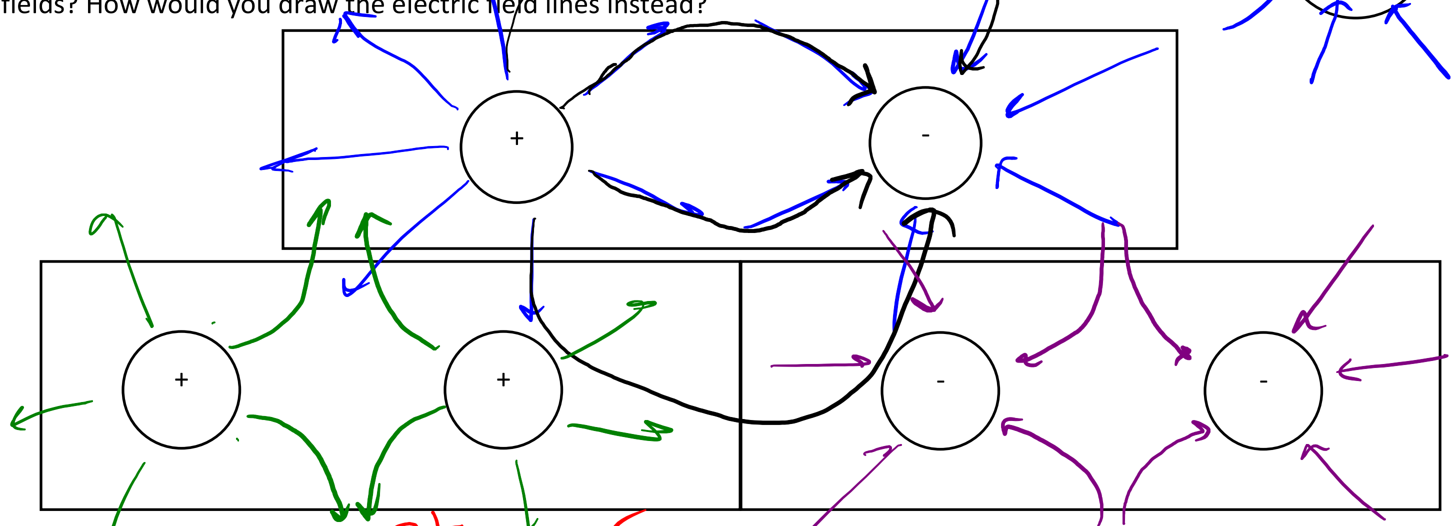
The electric field is the amount of force acted on a point charge with a charge of (C). $F_t = \frac{kQq}{r^2} / q$

$E_{field} = \frac{KQ}{r^2}$	(N)	k =
		q = test charge (C)
		Q = Point charge (C)

The electric field is another example of a ___force___ field, a vector that points in the direction that a ___positive___ charge would move in that field.



How does this represent the gravitational field s strengths? How would you draw these gravitational fields? How would you draw the electric field lines instead?



The denser the arrows, the ___stronger___ the field.

Ex. 1: Calculate the electric field 1.50 m from a 2.0 μC charge. (8.0 x 10[3] N/C away from charge)

$E_{field} = \frac{kq}{r^2} = \frac{9\times10^9(2\times10^{-6}C)}{1.50^2} = 8.0\times10^3 \frac{N}{C}$ away from charge

b) Calculate the force that an electron would experience at this point? The initial acceleration?

(1.3 x 10[-15] N towards charge, 1.4 x 10[15] m/s[2] towards charge)

$E_{field} = \frac{F}{e}$

$F_e = E_{field}\, e = 8.0\times10^3 \frac{N}{C}(1.6\times10^{-19}C) = 1.3\times10^{-15}N$

$\frac{1.3\times10^{-15}N}{9.11\times10^{-31}kg} = 1.4\times10^{15} m/s^2$ towards the ⊕ charge

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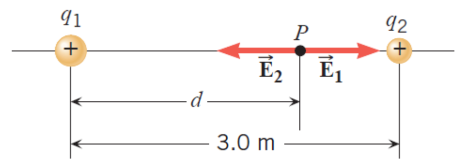
Ex. 2: Two positive point charges, q_1 = + 16 μC and q_2 = +4.0 μC, are separated in a vacuum by a distance of 3.0 m. Find the spot on the line between the charges where the net electric field is zero. (d = 2.0 m or 2.0 m right of q_1)



Since electric fields are **vectors**, we must add them **tip to tail**.

Ex. 3: Find the magnitude and direction of the electric field at the point P due to the charges as shown.

(4650 N/C 50.°East of South)

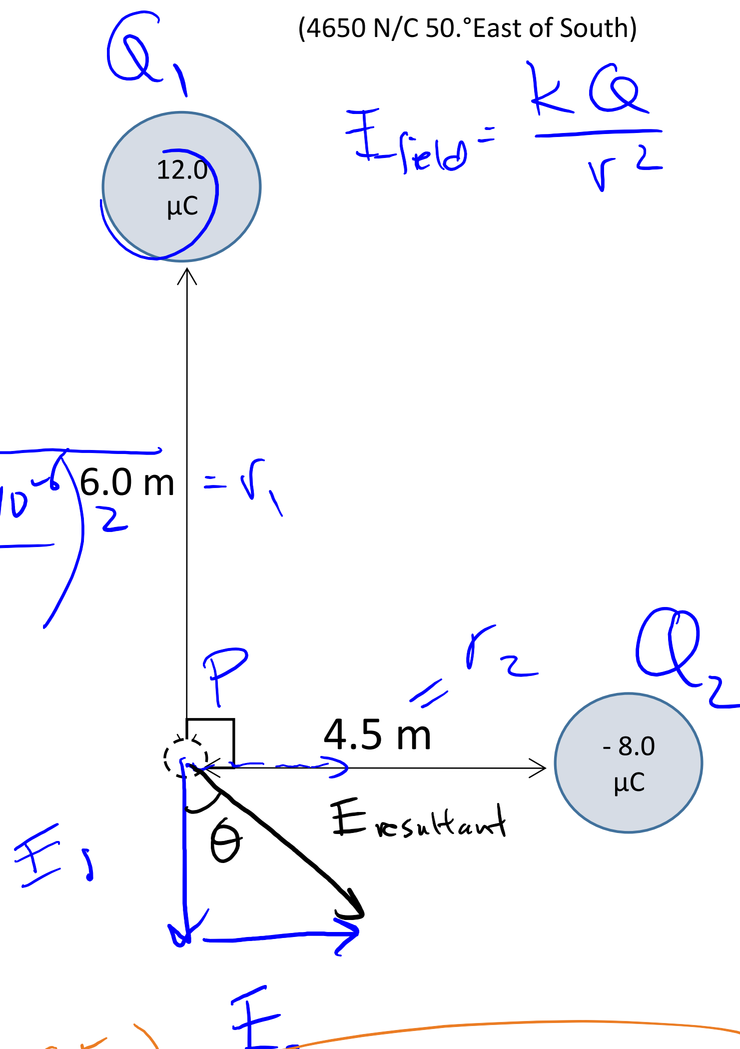
$$E_{field} = \frac{kQ}{r^2}$$

$$E_{resultant} = \sqrt{E_1^2 + E_2^2}$$

$$= \sqrt{\left(\frac{kQ_1}{r_1^2}\right)^2 + \left(\frac{kQ_2}{r_2^2}\right)^2}$$

$$= \sqrt{\left(\frac{9\times10^9 \times 12\times10^{-6}}{6.0^2}\right)^2 + \left(\frac{9\times10^9 \times 8\times10^{-6}}{4.5^2}\right)^2}$$

$$= 4650\ N/C$$



$$\theta = \tan^{-1}\left(\frac{E_2}{E_1}\right) = 50.^\circ \text{ East of South}$$

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