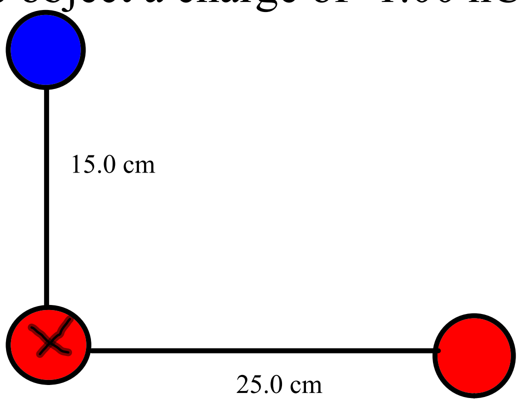
Advanced Placement Physics

Electrostatics

Coulomb's Law: explains the interaction between electric charges anywhere from the nuclear level all the way up to lightning bolts. Coulomb construced a torsion balance to measure the force of attraction and repulsion between charged pith balls.

$$F = k\frac{q_a q_b}{r^2}$$

Practice problem: calculate the net force on the red charged object as shown in the diagram. If the red object have charges of 1.00 nC and the blue object a charge of -1.00 nC.



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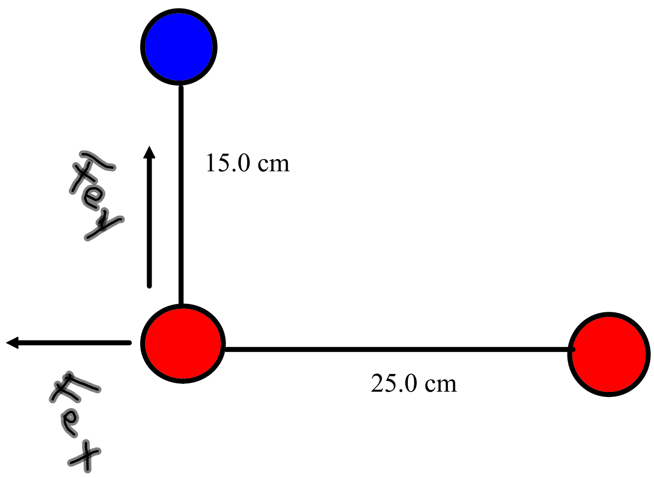
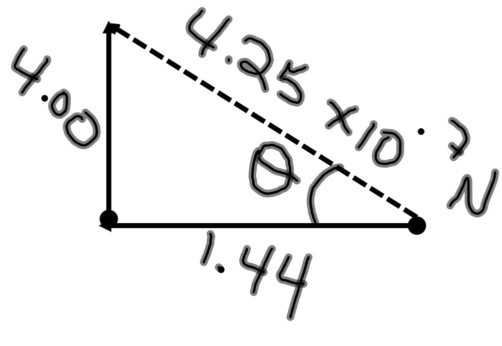


$F = kq_1q_2/r^2$

$F = k\,(1\text{ nC})(1\text{nC})/(.25\text{m})^2 = 1.44 \times 10^{-7}\text{ N}$

$F = k\,(1\text{ nC})(-1\text{nC})/(.15\text{m})^2 = -4.00 \times 10^{-7}\text{ N}$

$\theta = \tan^{-1}\left(\frac{4}{1.44}\right)$

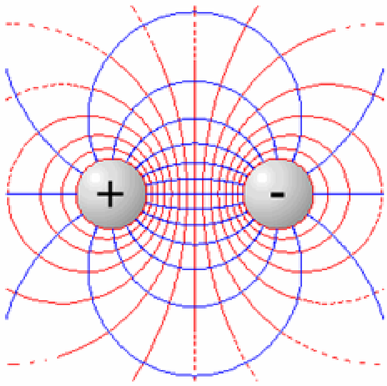


$\theta = 70.2°$

Electric Fields:

1.0 microcoulomb of charge is compossed of about 10^{15} elementary charge units.

Because these charges spread out over surfaces to try and use Coulombs law to explain the interaction of charged particles in detail is very difficult.



Instead of looking at individual charges we look at 'fields' of charge and see what happens when a test charge is placed into that field.

Michael Faraday did the first true work with electric fields. The son of a blacksmith, Faraday was apprenticed to a bookbinder and often read books brought in for rebinding. Luckily for science, one of those was the volume of the Encyclopaedia Britannica with the article about "electricity." His interest drove him to popular lectures given by **Humphry Davy**, Britain's leading chemist ("he lived in the odium/of having discovered sodium"), and when Davy needed an assistant, Faraday landed the job on the strength of notes he had kept of Davy's lectures. There followed a lifelong career in physics and chemistry, with many notable achievements.

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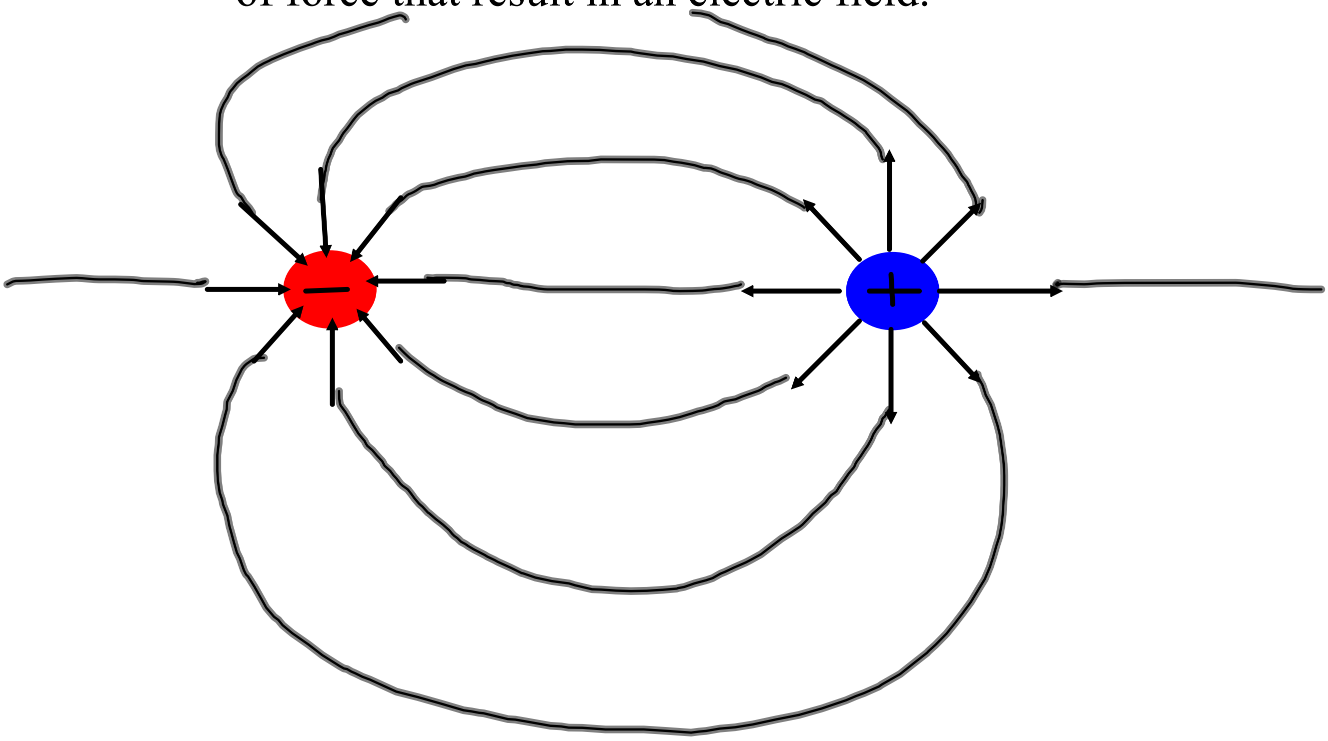
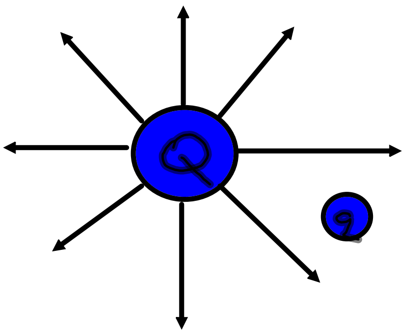
Michael Faraday was the first person to realize that a charged particle must emit lines of force that result in an electric field.



$E = \frac{F}{q}$



$E = k\frac{Q}{r^2}$

The force to move the smaller charge in towards the larger charge can be calculated using Coulombs law. This also allows us to define The electric field.

E=F/q (also E=V/d)
Electric field strength = force needed to move test charge times the charge (N/C)

If we realize that F is the electrostatic force between these charged bodies we can create a new equation.

$E=F/q$ and $F=kq_1q_2/r^2$

$F=Eq$ so;

$Eq = kq_1q_2/r^2$ and $q = q_2$ so;

$E=kq_1/r^2$ which allows us to calculate the electric field strength of a charged body.

Calculate the electric field strength from a 1.0 C charge 1.0 meters away.

$9x10^9$ N/C

$C = amp \cdot s$

$amp = \frac{C}{s}$

Φ_{ε}

6.24×10^{18} e^-

Attachments

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