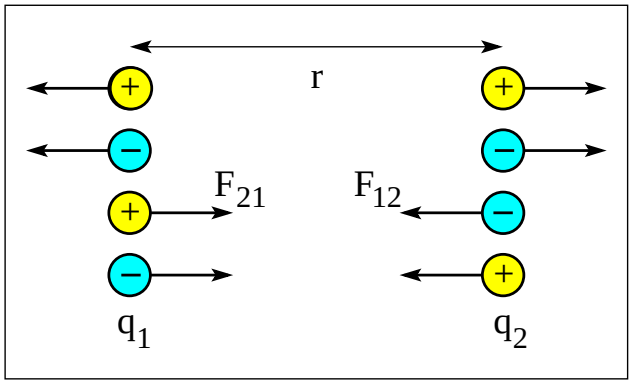
Coulomb's Law (1)

Electrostatic force between two charged particles:

$$F = \frac{1}{4\pi\epsilon_0}\frac{|q_1 q_2|}{r^2} = k\frac{|q_1 q_2|}{r^2}$$



Permittivity constant: $\epsilon_0 = 8.854 \times 10^{-12}\mathrm{C}^2\mathrm{N}^{-1}\mathrm{m}^{-2}$
Coulomb constant: $k = 8.99 \times 10^{9}\mathrm{Nm}^2\mathrm{C}^{-2}$

Action-reaction pair of forces: $\vec{F}_{21} = -\vec{F}_{12}$.

Newton's law of gravitation

Gravitational force between two massive particles:

$$F = G\frac{m_1 m_2}{r^2}$$

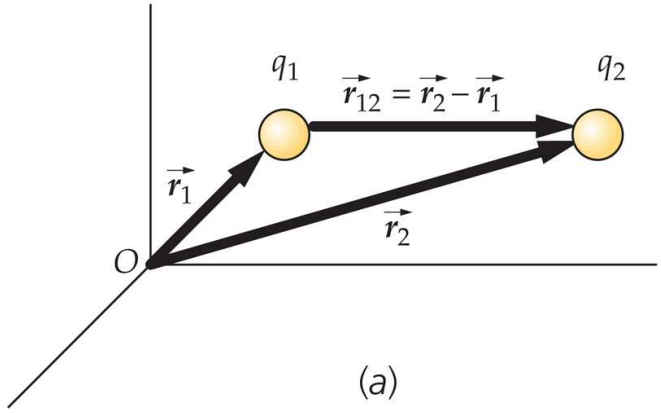
Gravitational constant: $G = 6.673 \times 10^{-11}\mathrm{Nm}^2\mathrm{kg}^{-2}$

Coulomb's Law (2)

Coulomb's law for electrostatic force in vector form:

$$\vec{F}_{12} = k\,\frac{q_1 q_2}{r_{12}^2}\,\hat{r}_{12},$$

$$\vec{r}_{12} \doteq \vec{r}_2 - \vec{r}_1, \quad \hat{r}_{12} \doteq \frac{\vec{r}_{12}}{r_{12}}.$$



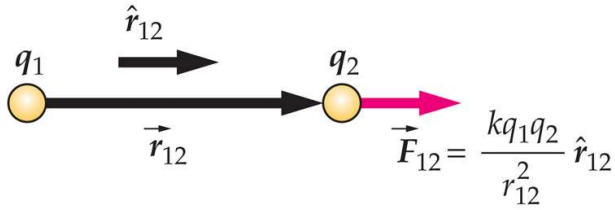
(a)

Electric force in hydrogen atom:

Average distance: $r = 5.3 \times 10^{-11}$m.

Elementary charge: $e = 1.60 \times 10^{-19}$C.

$$F = k\,\frac{|q_1 q_2|}{r^2}$$
$$= \frac{(8.99 \times 10^9 \mathrm{Nm^2/C^2})(1.60 \times 10^{-19}\mathrm{C})^2}{(5.3 \times 10^{-11}\mathrm{m})^2}$$
$$= 8.2 \times 10^{-8}\mathrm{N}.$$



(b)