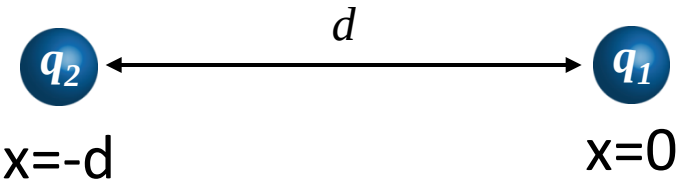
Example: Two Point Charges

Calculate the change in potential energy for two point charges originally very far apart moved to a separation of "d"



$$\Delta U \equiv -\int_i^f \vec{F} \cdot d\vec{r}$$

$$= \int_{-\infty}^{-d} F \cdot dx$$

$$= \int_{-\infty}^{-d} k \frac{q_1 q_2}{x_{12}^2} dx$$

$$= -kq_1 q_2 \left[-\frac{1}{d} - \left(-\frac{1}{\infty} \right) \right] = k \frac{q_1 q_2}{d} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{d}$$

Charged particles with the same sign have an increase in potential energy when brought closer together.

For point charges often choose r = infinity as "zero" potential energy.