Electrostatic Energy (W):

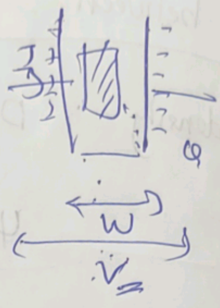
→ It is defined as the work done to build up the charge in capacitor.

→ Capacitor stores electrostatic energy.

$$W = \frac{1}{2} C V^2 \text{ Joules.}$$

(or)

$$W = \frac{1}{2} Q V$$ when $C = QV$



Problems:

① Two small identical conducting spheres have charge -1 nano coloumbs and 2 nano coulombs respectively. If they are brought in contact and then seperated by 4 cm. What is the force between them? find the magnitude of the force btw the

Given: $Q_1 = -1 \times 10^{-9}$ C, $Q_2 = 2\times10^{-9}$ C, $r = 4\times10^{-2}$ m

-1×10^{-9} C 2×10^{-9} C

$Q_1 \longleftrightarrow Q_2$

Case 1: Before the charges are brought into contact.

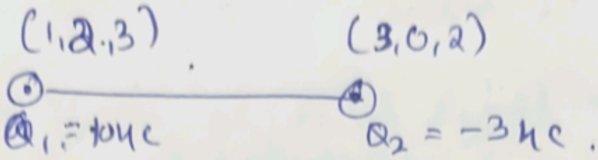
$$|\vec{F}| = \left|\frac{Q_1 Q_2}{4\pi\varepsilon_0 r_{12}^2}\right| \quad r_{12} = 4\text{ cm} = 4\times10^{-2}\text{ m}$$

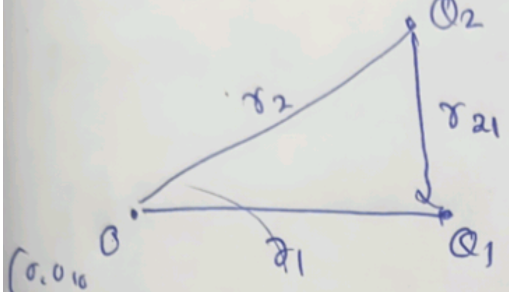
$$|\vec{F}| = \left|\frac{2\times10^{-9}\times(-1\times10^{-9})}{4\pi\varepsilon_0\times(4\times10^{-2})^2}\right| = 11.234 \text{ nN}$$

② A point charge of 10 μC is located at (1,2,3) and another point charge of -3 μC is located at (3,0,2) in vaccum. Find the force between them.

Given: $Q_1 = 10\ \mu C = 10\times10^{-6}$ C $r_1 = a_x + 2a_y + 3a_z$

$Q_2 = -3\ \mu C = -3\times10^{-6}$ C $r_2 = 3a_x + 2a_z$





$r = r_2 - r_1$.

$= (3-1)\bar{a}_x + (0-2)\vec{a_y} + (2-3)\bar{a}_z$

$$\boxed{r = 2\bar{a}_x - 2\vec{a_y} - \vec{a_z}}$$

$$|r| = \sqrt{4+4+1} = 3$$

Unit vector $\bar{a} = \frac{r}{|r|} = \frac{2\vec{a_x} - 2\vec{a_y} - \vec{a_z}}{3}$

$$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}\,\bar{a}$$

$10^{-12} \times 10^{9}$

-3×10^{-11}

$$= \frac{10\times10^{-6} \times (-3)\times10^{-6}}{4\pi \times \frac{1}{36\pi\times10^{9}} \times (3)^2}\left(\frac{2\vec{a_x} - 2\vec{a_y} - \vec{a_z}}{3}\right)$$

1.0011×10^{-9}

$\frac{30 \times 36\pi \times 10^{9}}{4\pi \times 9}$

$$= \frac{120}{9}\times10^{-3}\left(\frac{2\bar{a}_x - 2\bar{a}_y - \bar{a}_z}{3}\right)$$

$$= 4.44\times10^{-3}\left(-2\vec{a_x} + 2\vec{a_y} + \vec{a_z}\right) \text{ Newtons.}$$