Electrostatics

charges ↓ rest

fundamental property

produce or experience electric & magnetic effects

neutral → charges balanced

\+ −

Positively charged

e^- are less than protons

11g 11g −ively charged

+2C −2C

$\bar{e}$ are more than protons

−ively charge 11g > +ively charge

(1) Charge is scalar

(2) charge can't exist without mass

(3) charge is quantised.

unit comes in packets

Smallest charge = $e = 1.6 \times 10^{-19}$ C

$\frac{1.6\ C}{10^{19}}$

$Q = ne$

n should be integer

Q is charge of 1.6×10^{-20} C possible

Sol $Q = ne$

$1.6 \times 10^{-20} = n\ 1.6 \times 10^{-19}$

$n = \frac{10^{-20}}{10^{-19}} = 10^{-20+19}$

$= 10^{-1}$

$= \frac{1}{10} = 0.1$

0.1 is not integer

∴ this charge isn't possible

Q How many e^-'s will make charge of 1 C?

Sol $Q = ne$

$1 = n\ 1.6 \times 10^{-19}$

$n = \frac{1}{1.6 \times 10^{-19}}$

$= \frac{1}{1.6} \times 10^{+19}$

$= 0.625 \times 10^{19}$

6.25×10^{18}

Q When a piece of polythene is rubbed with wool a charge of -2×10^{-7} C is developed on polythene what is amount of mass transferred to polythene

Sol $Q = ne$

$2 \times 10^{-7} = n\ 1.6 \times 10^{-19}$

$$n = \frac{2}{1.6} \times 10^{+19+7}$$

$$n = 1.25 \times 10^{12}$$

$\therefore$ mass transferred $= 1.25 \times 10^{12} \times$ mass of $\bar{e}$

$= 1.25 \times 10^{12} \times 9.1 \times 10^{-31}$ kg

11.375×10^{-19} kg

④ charge is conserved

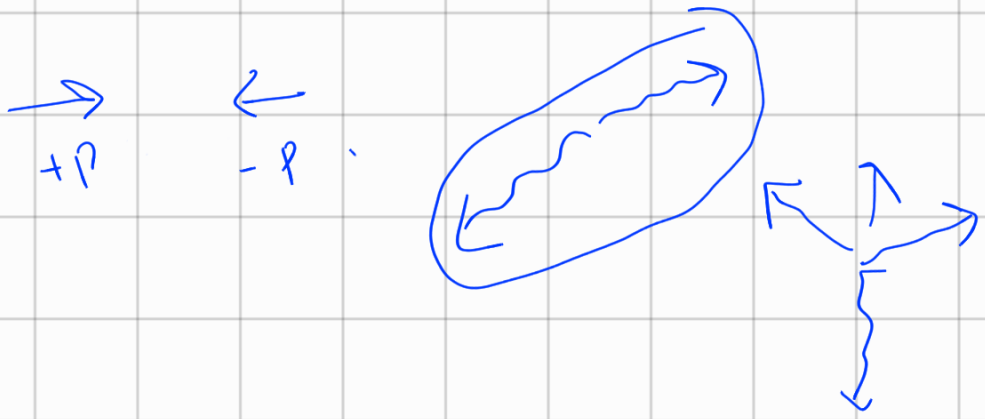
we can't, destroy can't create

we can only transfer charge

$\gamma \rightarrow e^- + e^+$

$E = mc^2$ photon

$e^- + e^+ \rightarrow n\gamma$



Coulomb's law

interaction law.

$q_1 = 0$

$F \propto q_1 q_2$

$F \propto \frac{1}{r^2}$

$F \propto q_1 + q_2$

$F \propto q_1 - q_2$

$F \propto q_1 / q_2$ ✗

$F \propto q_1 \cdot q_2$ ✓

$F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$ → medium dependent.

vol. $\frac{4}{3}\pi r^3$

$4\pi r^2$

$F \propto \frac{1}{r^3}$

$F \propto \frac{1}{r^2}$ ✓

$F \propto \frac{1}{r}$

$F \propto \frac{1}{r^4}$

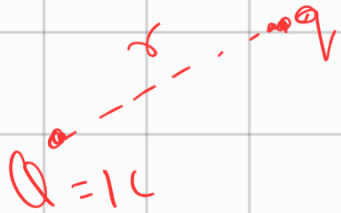
$F \propto \frac{1}{r^n}$

2D

3D

Force is decreasing as surface area of sphere increases

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$



$$E = \frac{F}{q_{test}}$$

mass of water

density of water = mass / volume

= 1000 kg/m³

independent of volume

$$F = \frac{q_{sum} q_{test}}{4\pi\varepsilon_0 r^2}$$

$$\frac{1}{4\pi\varepsilon_0} = K = 9 \times 10^9 \ Nm^2/C^2$$

huge value.

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

6.6×10^{-11}

very low value.