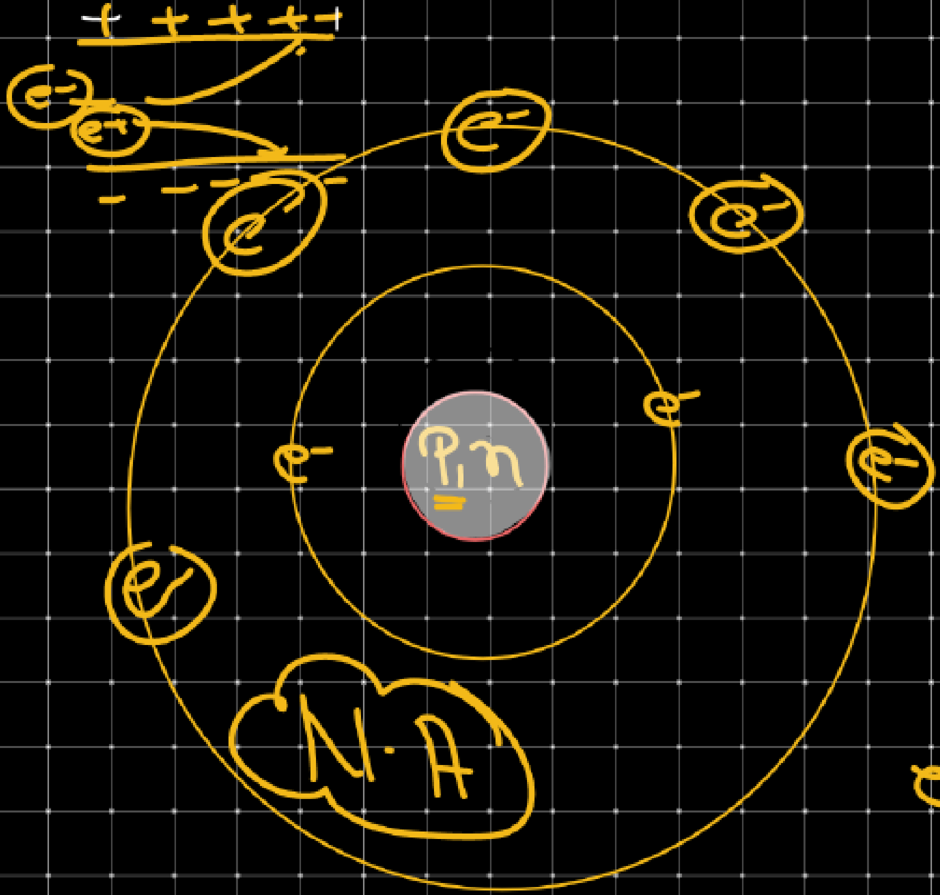
Electrostatics

↳ Study of charge when charge is at rest.

→ **Charge :-**



⇒ number of proton are fixed.

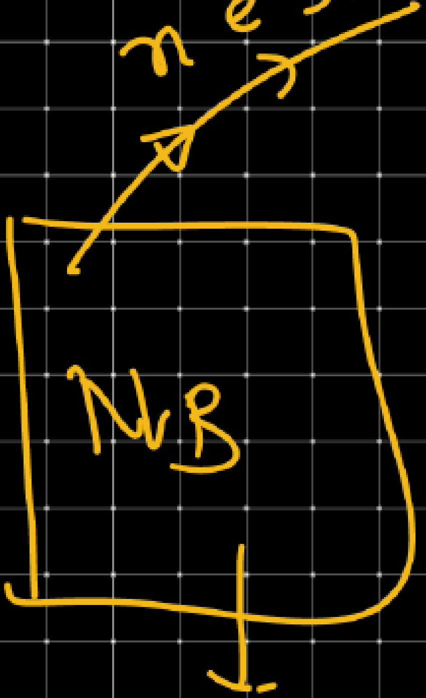
⇒ In a neutral atom.

no of e⁻ = no of e⁺ or p

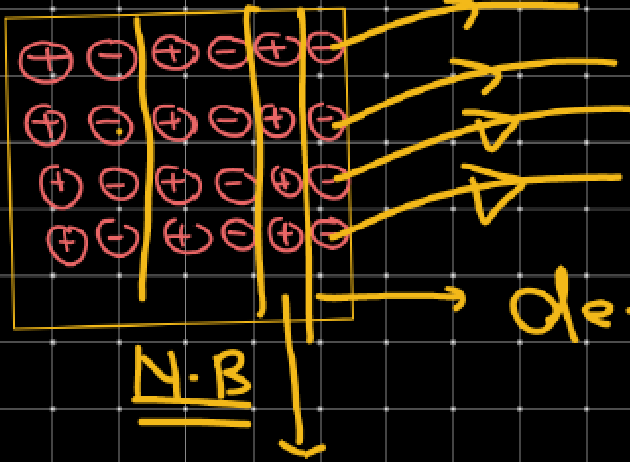
$|e^-| = |e^+|$ $q_T = 0$

Charge on electron $= -1.6 \times 10^{-19}$ C

Charge on e^+ proton $= +1.6 \times 10^{-19}$ C.



$q = ne^{+}$



$q = ne$

$q = 4e^{+}$

$q = 4 \times 1.6 \times 10^{-19}\ C$

$q = 6.4 \times 10^{-19}\ C$

$$q = \pm ne$$

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

10e⁻ add

Excess of electron

N.B.

$$q = 10e^-$$

$$= 10 \times [-1.6 \times 10^{-19}\, C]$$

$$= -1.6 \times 10^{-18}\, C$$

Q1) 10^{12} electron added on a neutral body. find Net charge on body after adding electron

Sol)

$q = ne^-$

$q = -ne$

$= -10^{12} \times 1.6 \times 10^{-19}$

$$q = -1.6 \times 10^{-7}\ C$$

Q2) 10^{10} electron remove from N.B. find Net Charge on body after removing electron.

Sol)

$$q = ne$$

$$q = 10^{10} \times 1.6 \times 10^{-19} C$$

$$q = 1.6 \times 10^{-9} C$$

$m_e = 9.1\times10^{-31}\ kg$

N.B

$\underline{m_0}$

add $4e^-$

$4e^-$ remove

$q = -ne$

$q = ne^-$

$q = 4\times(-1.6\times10^{-19})$

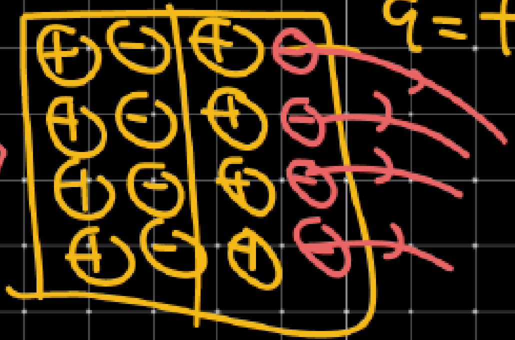
$q = -6.4\times10^{-19}\ C$

$m^{\ominus} = m_0 + 4m_e$

$m^- > m_0 > m^+$

$m^{\oplus} = m_0 - 4m_e$

$q = +6.4\times10^{-19}\ C$



Properties of charge:-

(i) It is a scalar quantity

(ii) Charge on a body does not depends speed of body

$m > m_0$

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

v → speed of particle

c → speed of light.

[Specific charge = $\frac{q}{m}$]

q,

10kg

rest

$\frac{q}{10} = \; > \; \frac{q}{10.0503}$

q, m'

$\longrightarrow 3\times10^7$ m/s

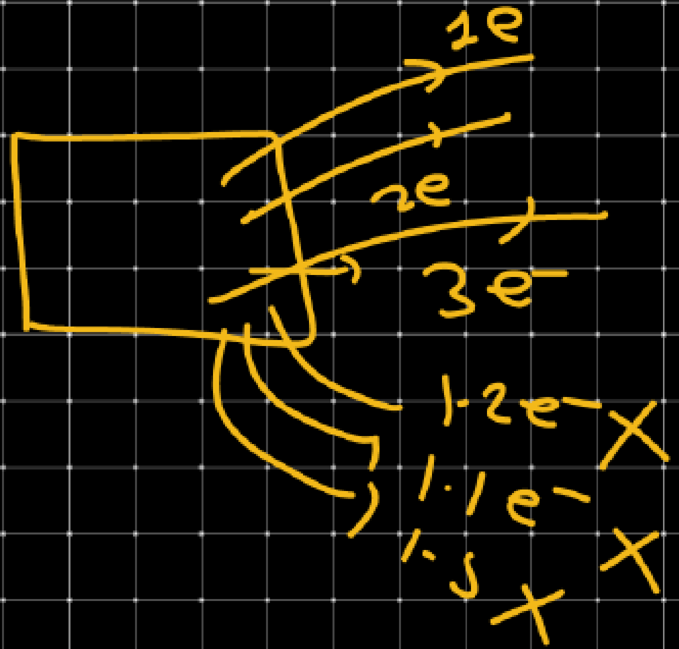
$$m' = \frac{10}{\sqrt{1-\frac{(3\times10^7)^2}{(3\times10^8)^2}}}$$

$$m' = \frac{10}{\sqrt{1-\frac{9\times10^{14}}{9\times10^{16}}}} = \frac{10}{\sqrt{1-\frac{1}{100}}}$$

$$m' = \frac{10}{\sqrt{\frac{100-1}{100}}} = \frac{10}{\frac{\sqrt{99}}{10}} = \frac{100}{\sqrt{99}} = \underline{10.0503\text{ Kg}}$$

(iii) quantization of charge:

$q = ne$



$1e^- \longrightarrow +1.6\times10^{-19}\,C$

$2e^- \longrightarrow +2\times1.6\times10^{-19}$

$2e^- \longrightarrow 3.2\times10^{-19}\,C$

$3e^- \longrightarrow 4.8\times10^{-19}\,C$

1g

1.01g

1.001g

$q = \pm ne$

$n \in I^+$

$n = 1, 2, 3, 4 \ldots$

(iii) quantization of charge:-

$$q = \pm ne \quad [e = 1.6 \times 10^{-19} C]$$

$$q = +ne \quad [e^- \rightarrow remove]$$

$$q = -ne \quad [e^- \ add]$$

$$q = \pm ne \quad n \in I^+$$

Q2) Which charge is possible on a body.

(i) 1.6×10^{-19} C ✓ (ii) 1.6×10^{-20} C (iii) 6.4×10^{-18} C

Sol)

$q = ne$

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

$10^{5} = n$

$n = 500000$

$q = ne$

$1.6 \times 10^{-20} = 1.6 \times 10^{-15} \times n$

$\frac{10^{-20}}{10^{-15}} = n$

$n = 0.1$ ✗

$q = ne$

$6.4 \times 10^{-18} = n \times 1.6 \times 10^{-15}$

$4 \times \frac{10^{-18}}{10^{-15}} = n$

$n = 40$

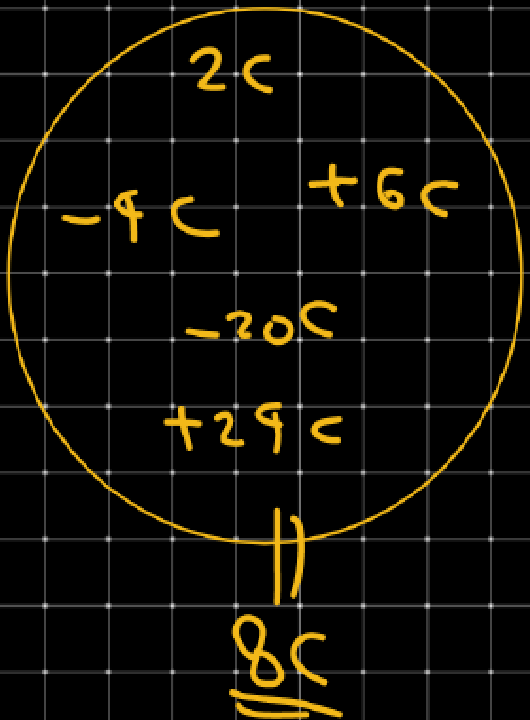
Find minimum possible charge in (+ve) & (−ve) nature

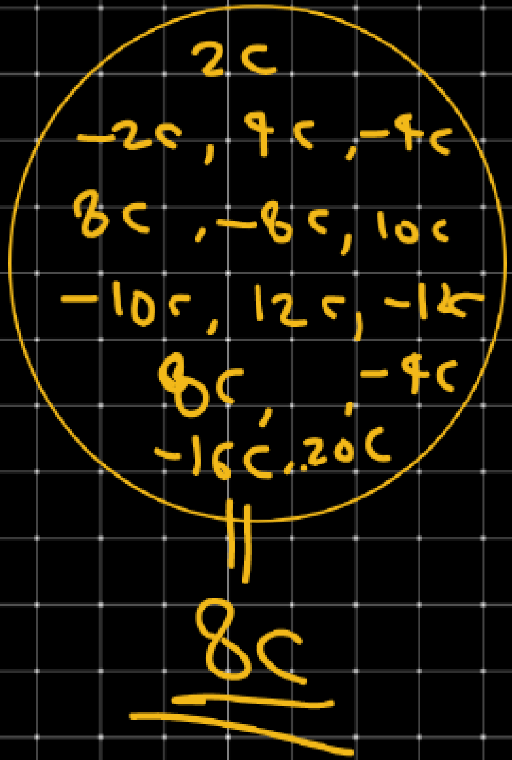
Is.

(+) min = 1.6×10^{-19} C

(−) min = -1.6×10^{-19} C

#4] Charge on an Isolated body is conserved





(#) NCERT) Find +ive & -ive charge on 1 Cup of water.

[1 Cup - 250 g water] $H_2O = 18g$

1 molecule of H_2O → Net charge = 0 $\underbrace{H_2}_{2e^+ + 2e^-}$ + $\underbrace{O}_{8e^-, 8e^+}$

1 molecule of H_2O = $10e^+ + 10e^-$

1 molecule of H_2O = $10 \times 1.6 \times 10^{-19} C$, $-1.6 \times 10^{-18} C$

$= 1.6 \times 10^{-18} C$

+ive charge in 1 molecule of H_2O = $+1.6 \times 10^{-18} C$

number of mole of H_2O in 250 g of water.

$n = \frac{250 g}{18}$ number of mol.

number of molecule in 250 g of water

$$= \text{mole} \times N_A$$

$$= \left(\frac{250}{18} \times 6.023 \times 10^{23}\right) \text{molecules}$$

Total +ive charge $= 1.6 \times 10^{-18}\,C \times \frac{250}{18} \times 6.023 \times 10^{23}$

(7) Minimum Possible charge = $\pm 1.6 \times 10^{-19}$ c

Q) which charge is greater 4C or -4C

both are equal

AIIMS)

Q) Positive charge on a body due to.

(a) due to adding of proton. ✗

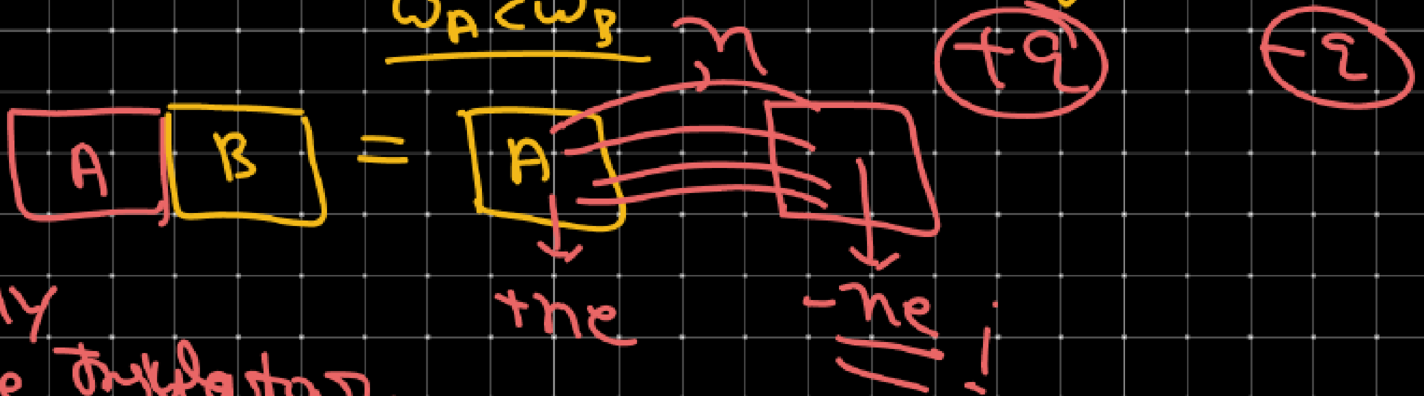
(b) due to adding of electron. ✗

(c) due to removing of electron. ✓

(d) due to removing of proton. ✗

↳ **Charging by friction)** When two body rub each other due to frictional work, temperature of both body ↑ses, due to increases in temperature · electron remove from one body to other body,

$W_A < W_B$



↳ one body must be insulator.