

Electrons

$q = -1.6 \times 10^{-19} \text{ coulombs (c)}$

$q = 9.11 \times 10^{-31} \text{ kg}$

$1 \text{ coulomb} = 6.25 \times 10^{18} \text{ e}$

Coulomb's Law

$$F_e = \frac{kQ_1 Q_2}{d^2} = qE$$

F_e = force between the 2 objects

$k = \text{constant} = 9 \times 10^9 \frac{\text{Nm}}{\text{C}^2}$

Q_1, Q_2 = charge of object 1 & 2 (C)

Surface Area of a sphere = $4\pi r^2$

Electric Field Strength
Force per coulomb exerted on a test charge at that point

$E = \frac{F}{q} = \frac{kq}{d^2} = \frac{V}{r}$ also $E = V/m = \frac{V}{d}$

$F_e = qE$

E = electric field strength (N/C) (NC^{-1}) (V/m)
In the same direction as F_e if Q is positive

Electric Potential near point charge Q

$$V_1 = \frac{kQ}{d_1} \quad V_2 = \frac{kQ}{d_2}$$

Potential 'v' of surface of a sphere $V = \frac{kQ}{r}$

ELECTRIC POTENTIAL DIFFERENCE
(work (joules) needed to move charge between 2 points)

$$\Delta V = \frac{W}{q} = \frac{\text{Joules}}{\text{Coulomb}} = \frac{\text{Nm}}{\text{C}} = V_2 - V_1 = Ed$$

HENCE $\frac{V}{m} = \frac{N}{C} = E$

ENERGY METHOD $W = qV = qEd = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2qV}{m}}$

Parallel oppositely charged plates UNIFORM

$E(V/m) = \frac{\text{Volts}}{\text{metre}} = \frac{V}{d} = \frac{F}{q} = \frac{kQ}{d^2}$

$V = Ed = \frac{W}{q} \quad W = qEd$

$F_e = \frac{kQ_1 Q_2}{d^2} = qE$

FORCE METHOD $a = \frac{F_e}{m} = \frac{qE}{m}$

$v^2 = u^2 + 2as \quad u = \frac{0}{s} \quad s = ad = \frac{1}{2}at^2$

$v = \sqrt{2as} = \sqrt{\frac{2qEds}{m}} = \sqrt{\frac{2F_e s}{m}}$

MILKING LAYER (in this position)

$F_e = Ee = F_n = mg$

$e = \frac{mg}{E}$

ELECTRON GUN

$eV = \frac{mv^2}{2} \rightarrow v = \sqrt{\frac{2 \times eV}{m}}$

Ohm's Law

$I = \frac{V}{R} = \frac{q}{t} = \frac{mqv}{t}$

$V = IR = \frac{qV}{t} = \frac{mqvR}{t} = Edv$

$R = \frac{V}{I} = \frac{Vt}{q} = \frac{V}{mqv}$

I = Electric current (**Amps**)
(rate of flow of charges with time)

R = Resistance of wire (ohms) (Ω) (volts/amp)
Depends on temperature 'T' & E

V = EMF voltage = the force moving e (V) (J/C)

v = e drift velocity (ms^{-1})

n = number of e per metre

$R \propto L \quad R \propto \frac{L}{A} \quad R = \rho \frac{L}{A}$

ρ = Resistivity of wire (Ω/m)

L = Length of wire

A = cross sectional area = πr^2



CURRENT CARRYING WIRE IN A MAGNETIC FIELD

$-I(R) = \rightarrow$ CONVENTIONAL CURRENT pos \rightarrow neg

Junction Law

$I_1 = I_2 + I_3$

RESISTORS IN SERIES

$R_T = R_1 + R_2 + R_3 + R_4$

RESISTORS IN PARALLEL

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$

Loop Law

$V - V_1 + V_2 + V_3 = 0$

$V = V_1 + V_2 + V_3$

Lower Resistance = Thicker Filament

POWER (Watts) Rate of energy transfer

$P = \frac{\text{Energy (W)}}{t} = \frac{qV}{t} = IV = \frac{V^2}{R} = I^2 R$

$R = \frac{P}{I^2} = \frac{qV}{qI^2} = \frac{V^2}{P} = \frac{V^2 t}{W} = \frac{W}{qI^2} = \frac{Vt}{q} = \frac{V}{I}$

$I = \frac{P}{V} = \frac{W}{qV} = \frac{q}{t} = \frac{C}{s} = \pm \sqrt{\frac{P}{R}} \text{ or } \sqrt{\frac{qV}{tR}} = \frac{V}{R}$

$V = \frac{P}{I} = \frac{Pt}{q} = \frac{W}{q} = \frac{W}{q} = \frac{I}{C} = \frac{\text{Nm}}{C} = \pm \sqrt{\frac{WP}{C}} = \frac{qV}{t} = IR$

$W = qV = \frac{V^2 t}{R} = I^2 R t = Pt = IVt = \frac{1}{2}mv^2$

Efficiency = $\frac{\text{Power to}}{\text{Power in}} \times 100$

$I_{\text{tot}} \leq 1 \text{ A}$

R_1 = Short resistor (**LOW R**)

$I_1 \times R_1 = I_{\text{tot}} \times R_{\text{tot}}$

$I_{\text{tot}} = I_1 + I_2$

$R_2 = \frac{I_{\text{tot}} \times R_{\text{tot}}}{I_{\text{tot}} - I_1}$

R_{tot} = series resistor (**HIGH R**)

$V = I_{\text{tot}} \times (R_1 + R_{\text{tot}})$

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