

Electrons

INDUCTION

$E = -1.6 \times 10^{-19}$ coulombs (C)

$B = 2.0 \times 10^{-12}$ T

$I = 10 \text{ milliA} = 0.001 \text{ A}$

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

F_e : Force between the 2 objects

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

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

$\text{Surface Area of sphere} = 4\pi r^2$

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

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

$F_e = qE$

E = electric field strength (N/C) (NC⁻¹ V/m⁻¹)
In the same direction as F_e , if Q_1 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)

$AV = \frac{w}{q} = \frac{\text{Joules}}{\text{Coulomb}} = \frac{Nm}{C} = V_2 - V_1 = \text{Volts}$

INHENCE $\frac{V}{m} = \frac{N}{C}$

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

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

Parallel oppositely charged plates UNIFORM

$E(V \text{ new } \rightarrow) = \frac{\text{Volts}}{\text{metre}} = \frac{V}{d} = \frac{F_e}{q} = \frac{qE}{q}$

$V = Ed = \frac{w}{q}$ $w = qpd$

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

FORCE METHOD: $w = \frac{F_e}{q} = \frac{qE}{q}$

$w^2 = w^2 + 2pd \quad w = \sqrt{w^2 + 2pd} \quad w = \sqrt{w^2 + 2pd^2}$

$w = \sqrt{2pd} = \sqrt{\frac{2qpd}{q}} = \sqrt{\frac{2Vd}{q}}$

INSULATING LAYER (in μ m per volt)

$V_1 = Ed = E_1 d = \frac{qE}{q}$

$E = \frac{q}{d}$

ELECTRON GUN

$q_0 \times V = \frac{mv^2}{2} \Rightarrow V = \sqrt{\frac{2 \times q_0 \times V}{m}}$

$I = \frac{V}{R} = \frac{q}{t} = \frac{q}{t} = \text{amps}$

$V = IR = \frac{qV}{t} = \text{amps} \cdot R = \text{amps} \cdot V$

$I = \frac{V}{R} = \frac{q}{t} = \frac{q}{t} = \frac{C}{t} = \pm \sqrt{\frac{P}{R}} \Leftrightarrow \sqrt{\frac{qV}{tR}} = \frac{V}{R}$

$V = \frac{P}{I} = \frac{W}{q} = \frac{W}{q} = \frac{I}{q} = \frac{P}{q} = \pm \sqrt{P \cdot R} = \frac{\sqrt{P}}{\sqrt{R}} = \sqrt{PR}$

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

Ohm's Law

$V = IR = \frac{qV}{t} = \text{amps} \cdot R = \text{amps} \cdot V$

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

RESISTANCE

$R = \text{Electric current (Amps)}/(\text{rate of flow of charges with time})$

$R = \text{Resistance of wire (Oms)} (\Omega) = (\text{Volts}/\text{amps})$
Dependent on Temperature (T) & I

$V = \text{EMF voltage} = \text{Force moving I (V)}$

$V = \text{EMF voltage} = \text{Force moving I (V)}$

$v = \text{drift velocity} (\text{m/s})$

$n = \text{number of free electrons}$

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

$\rho = \text{Resistivity of wire} (\Omega \cdot \text{metre})$

$L = \text{Length of wire}$

$A = \text{cross sectional area} = \text{m}^2$

Surface $\frac{V}{m} = \frac{N}{C}$ **Interior** $\frac{V}{m} = R$

CONVENTIONAL CURRENT goes to the right

Junction Law

$I_1 = I_2 + I_3$

RESISTORS IN SERIES

$R_T = R_1 + R_2 + R_3 + R_4 \dots$

RESISTORS IN PARALLEL

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

Loop Law

$V = V_1 + V_2 + V_3 = 0$

$V = V_1 + V_2 + V_3$

Copper Resistance = Thicker filament

POWER (Watts) Rate of energy transfer

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

$R = \frac{V^2}{I^2} = \frac{qV}{tI^2} = \frac{V^2 \cdot t}{qV} = \frac{wt}{qV} = \frac{Vt}{q} = \frac{V}{I}$

$I = \frac{V}{R} = \frac{q}{t} = \frac{q}{t} = \frac{C}{t} = \pm \sqrt{\frac{P}{R}} \Leftrightarrow \sqrt{\frac{qV}{tR}} = \frac{V}{R}$

$V = \frac{P}{I} = \frac{W}{q} = \frac{W}{q} = \frac{I}{q} = \frac{P}{q} = \pm \sqrt{P \cdot R} = \frac{\sqrt{P}}{\sqrt{R}} = \sqrt{PR}$

RESISTIVITY = $\frac{\text{Conductivity}}{\text{Conductivity}} \approx 1.6 \times 10^{-8}$

Series Resistor

$R_{\text{series}} \leq R_{\text{shunt}}$

$I_{\text{series}} = I_{\text{shunt}} + I_{\text{shunt}}$

$R_{\text{shunt}} = \frac{I_{\text{shunt}} \cdot R_{\text{series}}}{I_{\text{shunt}} - I_{\text{series}}}$

Parallel Resistor

$R_{\text{parallel}} = \frac{I_{\text{shunt}} \cdot R_{\text{series}}}{I_{\text{shunt}} + I_{\text{series}}}$

$I^* = I_{\text{shunt}} \times (R_{\text{shunt}} + R_{\text{series}})$

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