Master Card for quick revision of 2.Current Electricity (7marks)

Electric current – $i = \frac{q}{t}$, unit - Ampere. scalar

Drift velocity: $V = u + a\tau$

if $u = 0$ $\quad$ τ - relaxation time ($10^{-14}s$)

$V_d = a\tau$

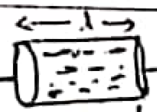
also $ma = eE = F$ $\therefore a = \frac{eE}{m}$

$V_d = \frac{eE\tau}{m}$ (10^{-5} m/s)

as $V = E \times l$

$\therefore$ $\boxed{V_d = \frac{eV\tau}{ml}}$

$i = \frac{q}{t} = \frac{nAle}{t}$



A - area
n - no. of free electrons in unit vol

Current $I = neAV_d$ $\quad$ $\frac{l}{t} = V_d$

$I = neA\frac{eV\tau}{ml}$

$\frac{I}{V} = \frac{ne^2\tau A}{ml}$

$V = IR$

$R = \frac{V}{I} = \frac{ml}{ne^2\tau A}$

Mobility $\mu = \frac{V_d}{E}$ ($m^2/s/V$)

Resistivity

$\rho = \frac{RA}{l}$

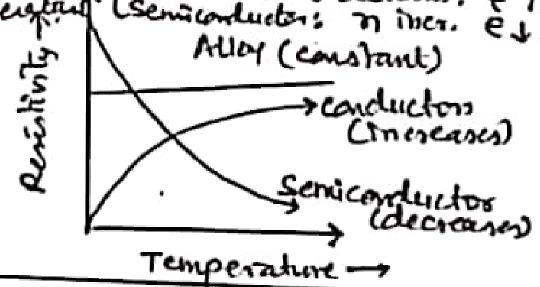
$\boxed{\rho = \frac{m}{ne^2\tau}}$

Also $\vec{J} = \sigma \vec{E}$

$J = \frac{I}{A}$ - current density (vector)

Temperature dependence of Resistivity

with increase in temperature:
conductors: τ decreases, ρ $\uparrow$ inc.
Semiconductors: n incr. ρ $\downarrow$ dec.



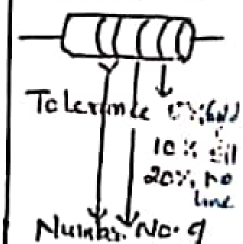
Electric Energy & Power

$E = V \cdot I \cdot t = I^2Rt = \frac{V^2}{R}t$

$P = V \cdot I = I^2R = \frac{V^2}{R}$

1 unit = 1 kWh = ..

Colour Code



0 Black, 1 Brown, 2 R, 3 O, 4 Y, 5 G, 6 B, 7 V, 8 Grey, 9 White

Series combination of Resistance $R = R_1 + R_2$. current same

parallel combination of Resistance $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ Voltage same

$E = V + ir$ charging

$E = V - ir$ discharging

cell in series – $i = \frac{nE}{nr + R}$ $\quad$ ext. Resistance high $R >> r$

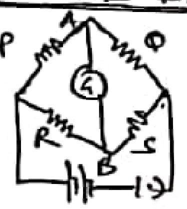
cell in parallel – $i = \frac{nE}{r + nR}$ $\quad$ internal Resistance high $r >> R$

KIRCHOFF'S LAWS

i) $\Sigma i = 0$ – junction

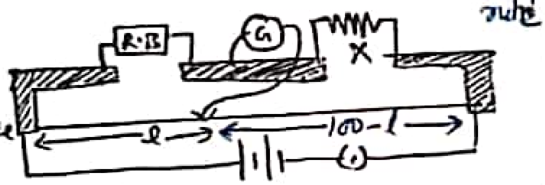
ii) $\Sigma iR = \Sigma E$ – Loop rule

WHEATSTONE BRIDGE:



- balance cond. $\frac{P}{Q} = \frac{R}{S}$
- Pot. at A & B same at null pt.
- Position of Galvanometer & battery can be interchanged at null pt.

METRE BRIDGE:



unknown Resistance

$\frac{R}{X} = \frac{l}{100 - l}$

$\therefore$ $\boxed{X = \frac{R(100 - l)}{l}}$

Resistivity $\rho = \frac{RA}{L}$

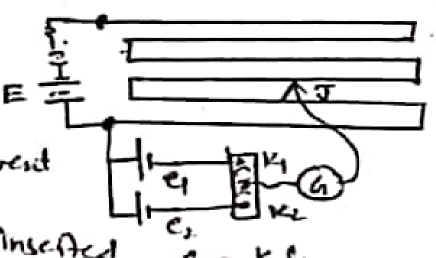
$= \frac{R\pi r^2}{L}$ $\Omega \cdot m$.

mt. bridge is most sensitive when null pt. is in middle.

POTENTIOMETER: principle – If constant current flows through wire of uniform cross section then potential drop is directly proportional to length of that portion

$\boxed{e_1/e_2}$

$K = \frac{E}{L}$ pot. gradient

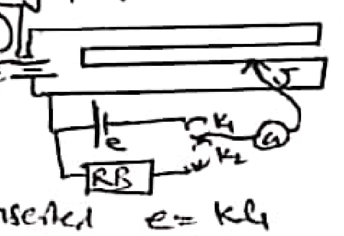


when K_1 inserted $\quad e_1 = Kl_1$

when K_2 inserted ..

$\boxed{r = R\left(\frac{l_1}{l_2} - 1\right)}$

INTERNAL RESISTANCE



only K_1 inserted $\quad e = Kl_1$

both K_1, K_2 inserted and resistance R taken from R.B.

$V = Kl_2$

- preferred over voltmeter as give exact reading and draw no current
- sensitivity increased by increasing length, decr. main circuit ci
- single sided deflection when i) $E < e$ ii) wrong connection

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GAUSS THEOREM: Total electric flux (total no. of lines of forces) emerges from closed surface is $1/\epsilon_0$ times the charge enclosed. $\oint E.ds = \phi = q/\epsilon_0$

1. $\vec{E}$ Due to Long Charged Wire:

Linear charge density $\lambda = q/l$

$\oint E.ds = q/\epsilon_0$

$\int E ds_1 + \int E ds_2 + \int E ds_3 = q/\epsilon_0$

For ds_2 & ds_3 $\theta = 90°$ $\therefore \cos 90° = 0$

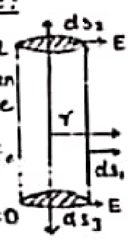
For curved surface ds_1, $\theta = 0$

$\therefore E \int ds = q/\epsilon_0$

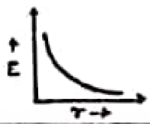
$E(2\pi r l) = q/\epsilon_0$

$E = \frac{q}{2\pi r l \epsilon_0} = \frac{2q/l}{\pi 4 \epsilon_0 r}$

$$\boxed{\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{2\lambda}{r}}$$



$\int E ds = \int E ds \cos\theta$



2. $\vec{E}$ Due to Charged Plane Sheet:

Surface charge density $\sigma = q/A$

For non conducting plate charge is on both side

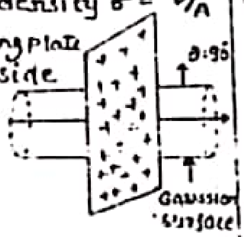
$2\int E ds = q/\epsilon_0$

$E \int ds = q/\epsilon_0$

$2EA = q/\epsilon_0$

$E = \frac{q}{2\epsilon_0 A}$ or $\boxed{E = \frac{\sigma}{2\epsilon_0}}$

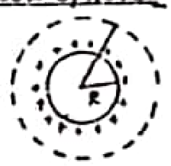
For conducting sheet $\boxed{E = \frac{\sigma}{\epsilon_0}}$



* $\vec{E}$ is independent of distance from the sheet.

3. $\vec{E}$ Due Charged Hallow Sphere:

Volume charge density $\rho = q/V$

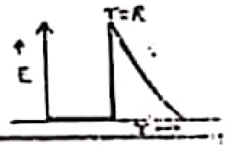


$\int E ds = q/\epsilon_0$

$E \int ds = q/\epsilon_0$

$E\, 4\pi R^2 = q/\epsilon_0$

$E = \frac{1}{4\pi\epsilon_0}\frac{q}{R^2}$	on surface
$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$	outside
$\vec{E} = 0$ as $q = 0$ inside.	



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