① Determination of Hall Coefficient and carrier type for a Semiconducting material

Hall effect: When a current carrying conductor is placed in a transverse magnetic field, a potential difference is developed across the conductor in a direction perpendicular to the direction of both current and magnetic field.

Formula:

① Hall Coefficient $(R_H) = [(V_H \cdot t)/(I \cdot H)] \times 10^8 \ cm^3 C^{-1}$

where :- V_H = Hall voltage (volt)
I = Current (ampere)
H = Magnetic field (Gauss)
t = Thickness of sample (cm)

② Carrier density $(n) = 1/(R_H \cdot q) \quad cm^{-3}$

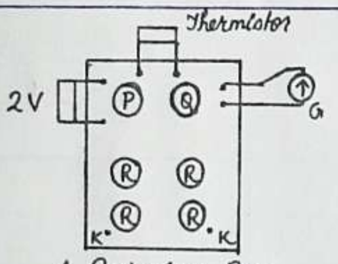
where :- R_H = Hall coefficient (cm^3C^{-1})
q = Charge of electron or hole (C)

③ Carrier mobility $(\mu) = R_H \cdot \sigma \quad cm^2V^{-1}s^{-1}$

where :- σ = conductivity $(CV^{-1}s^{-1}cm^{-1})$

② Band Gap determination using Post Office Box :

Principle: Wheatstone bridge principle for balancing a network: $P/Q = R/S$. Of four resistances, if three are known, the unknown resistance can be found out.



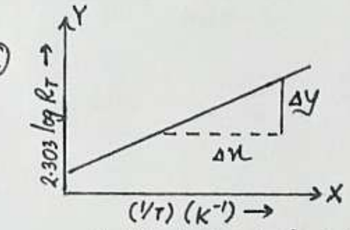
A Post office Box

Formula :

① The band gap $(E_g) = 2k\,[2.303 \log R_T/(1/T)]$

where : k = Boltzmann constant $= 1.38 \times 10^{-23}$ J/K $= 8.617 \times 10^{-5}$ eV/K
R_T = Resistance at T K

②



graph of $2.303\log R_T$ vs $1/T$

$$\text{slope} = \frac{dy}{dx} = \frac{y_2 - y_1}{x_2 - x_1}$$

From graph, band gap $(E_g) = 2k \times \text{slope} = 2k\,(dy/dx)$.

$(1 eV = 1.602 \times 10^{-19}$ J)

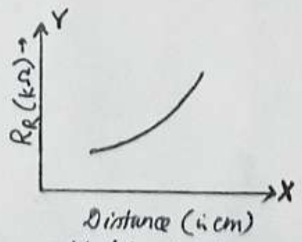
Result: The approx. band gap value of given thermistor $= 0.3594$ eV

③ To study V-I Characteristics of a Light Dependent Resistor (LDR) :

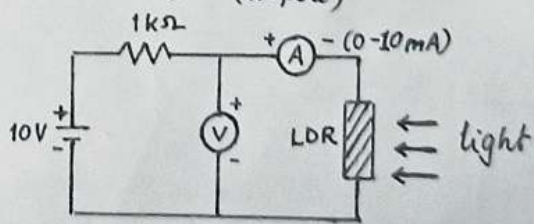
Principle: The photoconductive device is based on the decrease in the resistance of certain semiconductor materials when they are exposed to both infrared and visible radiations. The photoconductivity is the result of carrier excitation due to light absorption.

Formula: By ohm's law, $V = IR$ or $R = V/I$ ohm.

where : R = Resistance of the LDR when closed. (kΩ)
V = Voltage (volt)
I = current (ampere)



Model graph



circuit diagram

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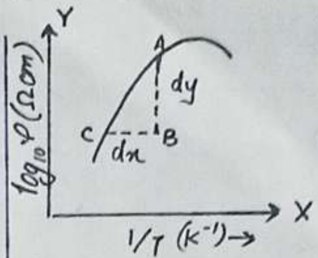
④ Resistivity determination for a semiconductor wafer using Four Probe Method

Formula:

① The energy band gap of a semiconductor is given by

$$E_g = 2k_B\left[2.3026 \log \rho / (1/T)\right] \ eV$$

where: k_B = Boltzmann constant = 8.617×10^{-5} eV/K
ρ = resistivity of semiconductor material



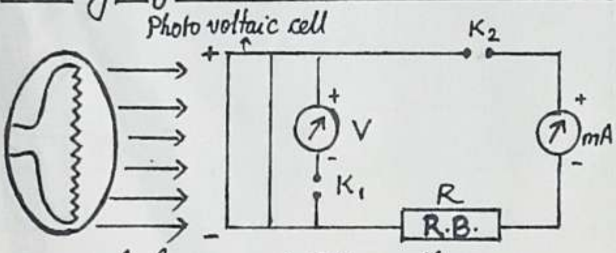
② $\rho = \rho_0 / [f(W/s)]$

where: $\rho_0 = (V \times 2\pi s)/I$; $\rho = (V \times 0.213)/I \ (\Omega cm)$
s = distance between the probes = 0.33 mm
W = thickness of semiconductor crystal = 0.5 mm
V = voltage across the crystal chip.
I = current across the crystal chip = 2 mA

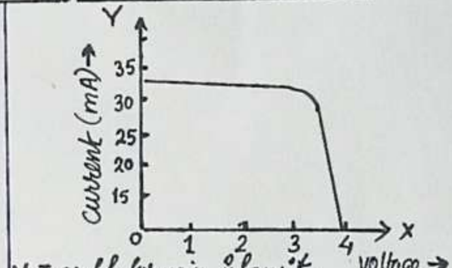
slope = $\frac{dy}{dx}$ = 1.2 Ω cm K^{-1}

$\therefore$ Band gap (E_g) = 0.396 × slope
= 0.396 × 1.2
= 0.4752 eV (Ge)

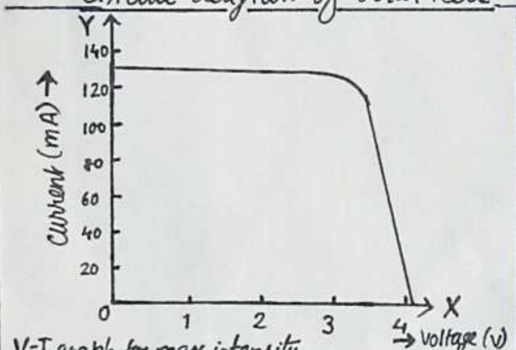
⑤ Study of V-I and V-R characteristics of a Solar cell :



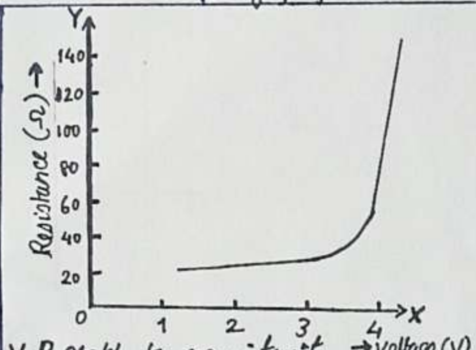
Circuit diagram of Solar cell



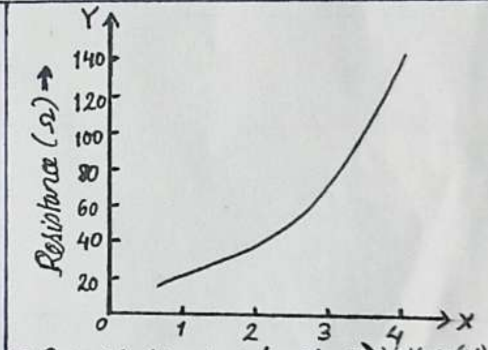
V-I graph for min intensity



V-I graph for max intensity

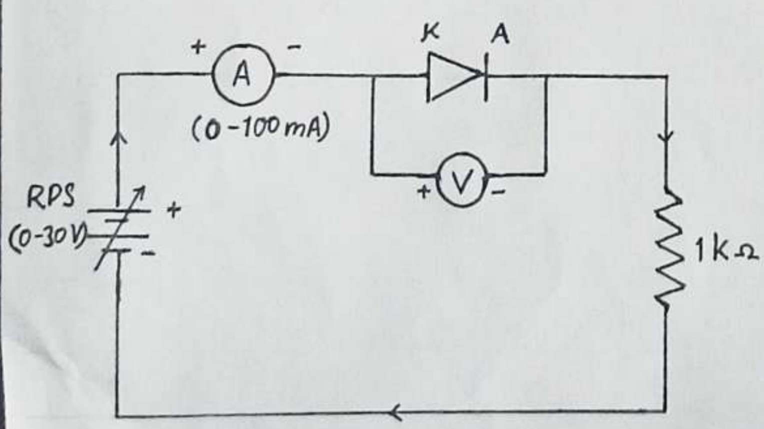


V-R graph for max intensity

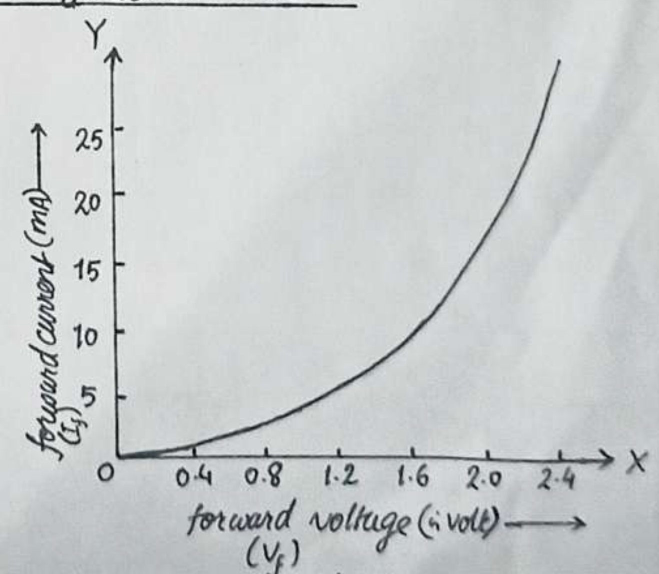


V-R graph for min intensity

⑥ Characteristics of PN junction diode under forward bias :



Forward biased pn junction diode



I-V characteristics of pn junction diode

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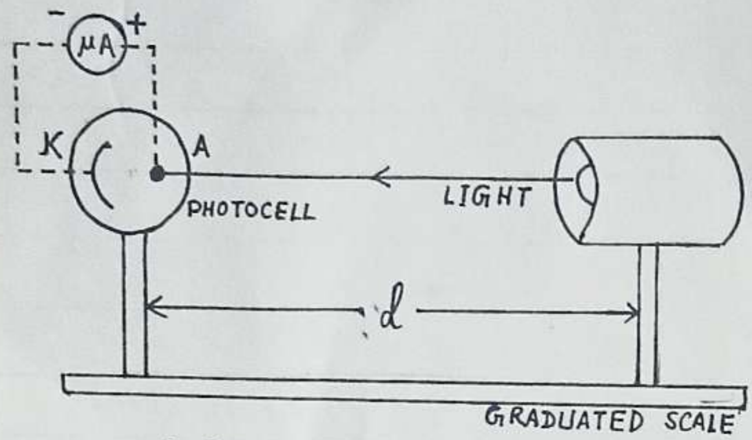
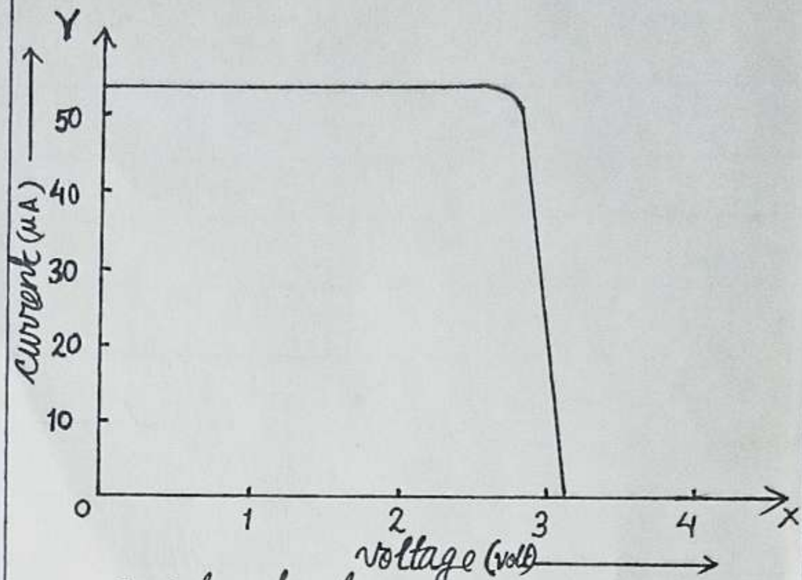
⑦ To study the I-V characteristics of a photo cell :



CIRCUIT DIAGRAM



I-V characteristics of a photo cell

⑧ Particle Size Determination using Laser :-

Formula :

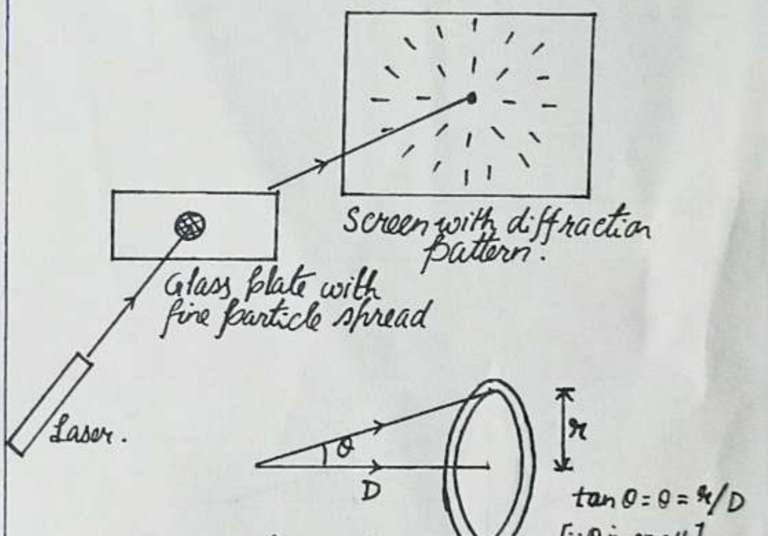
According to the theory, the diameter 'a' of a circular obstacle is given by :-

$$2a = (1.22\, n \lambda D)/r_n$$

where : r_n = radius of n^{th} order of dark ring (m)

D = distance between obstacle and screen.

λ = wavelength of laser light = 6328 Å.



Particle size determination using laser.

avg size of particle = 8.8778 μm

⑨ Study of Attenuation and Propagation characteristics of Optical Fibre Cable :-

Principle :

If a beam of power P_i is launched into one end of optical fibre and P_f is the power remaining after the length 'L' km has been traversed, then attenuation is given by ;

① attenuation = $10[\log(P_i/P_f)]/L$ dB/km

Formula :

② Numerical Aperture (NA) = $W/\sqrt{4L^2 + W^2} = \sin\theta_{max}$

③ Acceptance angle = $2\theta_{max}$ (deg)

where : L = distance of the screen from the fibre end in meter.

W = diameter of the spot in meter.

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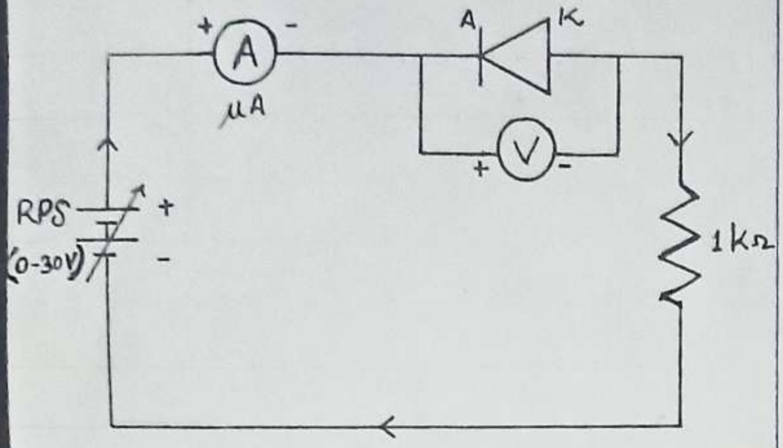
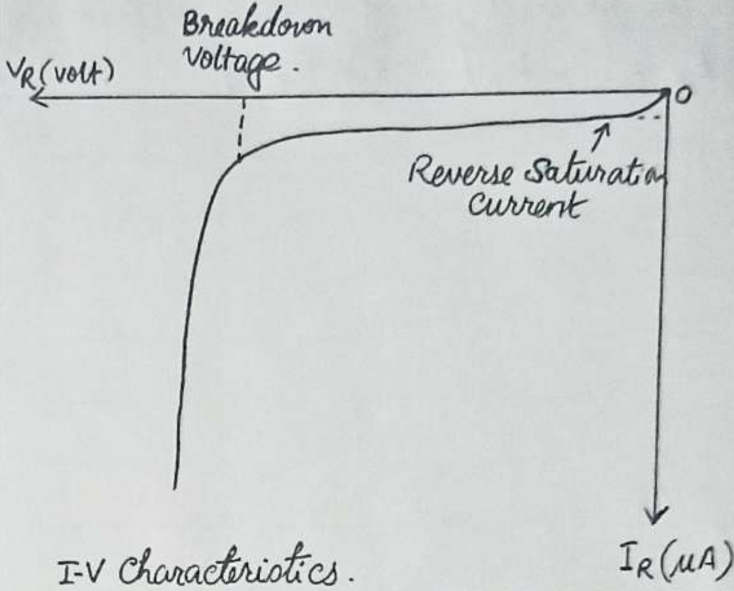
⑩ Characteristics of PN junction diode under reverse bias :



Reversed biased p-n junction diode.



I-V Characteristics.

⑪ Determination of Efficiency of a solar cell :

Formula :

Efficiency of solar cell :

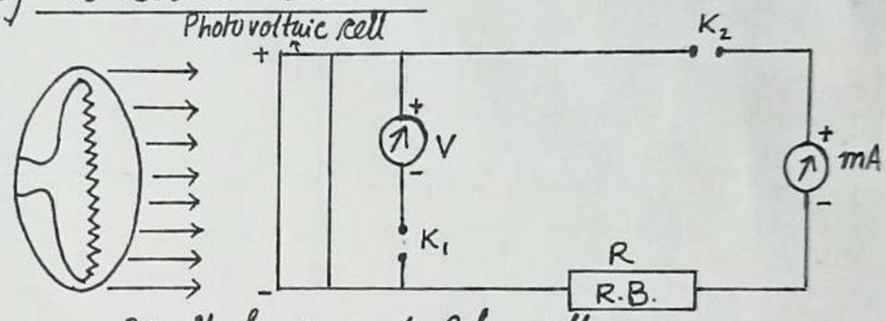
$$\eta = [P_{max} / A I_0] \times 100$$

where:- P_{max} = max. power = $I_{MP} \times V_{MP}$ watt

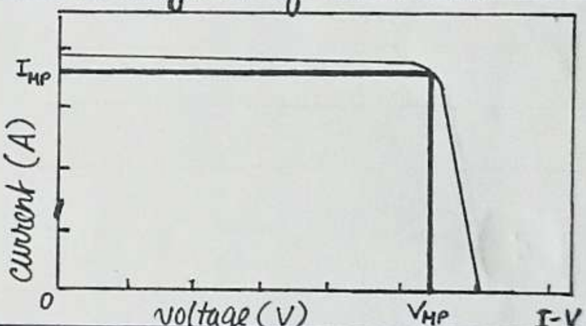
A = area of solar panel $[7.2 \times 4.5]\, cm^2$

I_0 = intensity of light = Power of bulb $/ 4\pi d^2$

d = dist. between solar panel and bulb



Circuit diagram of Solar cell



I-V Graph.

⑫ Calculation of Lattice Cell Parameters - X-ray Diffraction :

Formula :

The lattice parameter and interplanar distance for a cubic crystal are :

① $a = (\lambda / 2\sin\theta)(\sqrt{h^2 + k^2 + l^2})$ Å

$d = (a / \sqrt{h^2 + k^2 + l^2})$ Å

where: a = lattice parameters
d = Interplanar distance
λ = Wavelength of CuK α radiations (1.5405 Å)
h, k, l = Miller integers.

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