- **LAMBERT'S LAW:**

'When a beam of monochromatic radiation passes through a homogenous absorbing medium, the rate of decrease of intensity of radiation with thickness of absorbing medium is proportional to the intensity of incident radiation.'

$$-\frac{dI}{dx} = kI$$

I = intensity of radiation after passing through thickness x, of medium.

$-\frac{dI}{dx}$ = rate of decrease of intensity of radiation with thickness of the absorbing medium.

k = absorption coefficient.

Let $I_0$ be intensity of radiation before entering the absorbing medium ($x=0$), and I be intensity of radiation after passing through thickness, x of medium

$$-\frac{dI}{dx} = kI \Rightarrow \frac{dI}{I} = -k\,dx$$

$$\int_{I_0}^{I}\frac{dI}{I} = -\int_{x=0}^{x=x} k\,dx \Rightarrow \ln\frac{I}{I_0} = -kx \Rightarrow \frac{I}{I_0} = e^{-kx}$$

$$I = I_0 e^{-kx} \quad -① \quad \Rightarrow I = I_0 10^{-ax} \quad \left[a = \frac{k}{2.303}\right]$$

Intensity of radiation absorbed,

$$I_{abs} = I_0 - I = I_0 - I_0 e^{-kx} \quad (\text{By eq}^n\text{-①})$$

$$= I_0(1-e^{-kx})$$

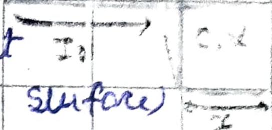
• BEER'S LAW:

"when a beam of monochromatic radiation is passed through a solⁿ of an absorbing substance, the rate of decrease of intensity of radiation with thickness of the absorbing solⁿ is proportional to the intensity of incident radiation as well as the concentration of the sol."

$$-\frac{dI}{dx} = k' I c$$

where c = conc. of solⁿ (moles/l)

k' = molar absorption coeffecient
(depends upon nature of absorbing surface)



$$\int_{I_0}^{I} \frac{dI}{I} = -\int_{x=0}^{x=x} k' c \, dx$$

$$I = I_0 e^{-k'cx}$$

By changing the logarithm to base 10, $I = I_0 \cdot 10^{-a'cx}$

$\frac{k'}{2.303} = a'$, $a'$ = molar extinction coefficient of absorbing solⁿ

Beer's law can also be stated as:

when a monochromatic light is passed through a solⁿ of an absorbing substance, it's absorption remain constant when the conc (c) and the thickness of the absorption layer (x) are changed in the inverse ratio.

on combining the two laws, Beer-Lambert Law:

$$\log \frac{I_0}{I} = \varepsilon . c . l = A$$

where,

$I_0$ = intensity of incident light

I = Intensity of transmitted light

C = conc. of soln (moles/L)

l = path length of the sample (usually 1 cm)

ε = molar absorptivity / molar extinction coefficient (L/mol-cm)

A = Absorbance

Limitations of Beer Lambert Law- This law is not obeyed.

i) In keto-enol tautomers ii) in fluoroscent compounds

iii) when solute and solvent form complexes.