1.

2.

$A = \varepsilon cl$ ε = Molar extinction coefficient

A is unit less quantity

$\varepsilon = \frac{1}{cL}$ c = concentration (in M or moles/litre)
l = path length (in cm)

Unit of ε : $M^{-1}\ cm^{-1}$

or $mole^{-1}$ litre cm^{-1}

or $mole^{-1}\ dm^{3}\ cm^{-1}$

3.

$A = \varepsilon cl$ [here, $\varepsilon = 40\ M^{-1}\ cm^{-1}$
$C = 0.01\ M$, $l = 5\ cm$]

$\Rightarrow \log \frac{I_0}{I} = \varepsilon cl = 40 \times 0.01 \times 5$

$\Rightarrow \log \frac{I_0}{I} = 2$

$\Rightarrow \frac{I_0}{I} = 10^2 = 100$

or $\frac{I}{I_0} = 0.01$

So % of transmitted light = $0.01 \times 100\%$
= 1%

$\therefore$ Absorbance = 2

(4)

% of transmitted light $= (100 - 10)\%$
$= 90\%$

$\therefore \log \frac{I_0}{I} = \varepsilon \times c \times l$

$\Rightarrow \log \frac{100}{90} = \varepsilon \times 10^{-3} \times 1$ —— (i)

Let the concentration of the solnⁿ be c' which absorbs 90% of the light.

Then % of transmitted light at concⁿ c'
= 10%

$\therefore \log \frac{100}{10} = \varepsilon \times c' \times 1$ —— (ii)

(i) ÷ (ii) gives

$$\frac{\log \frac{100}{90}}{\log \frac{100}{10}} = \frac{\varepsilon \times 10^{-3} \times 1}{\varepsilon \times c' \times 1}$$

$$\Rightarrow c' = \frac{\left(\log \frac{100}{10}\right) \times 10^{-3}}{\log \left(\frac{100}{90}\right)}$$

$$= \frac{(\log 10) \times 10^{-3}}{\log 10^2 - \log 90} = \frac{10^{-3}}{2 - 1.954}$$

$= \cancel{0.00217\ (M)}$

$= 0.0217$ M

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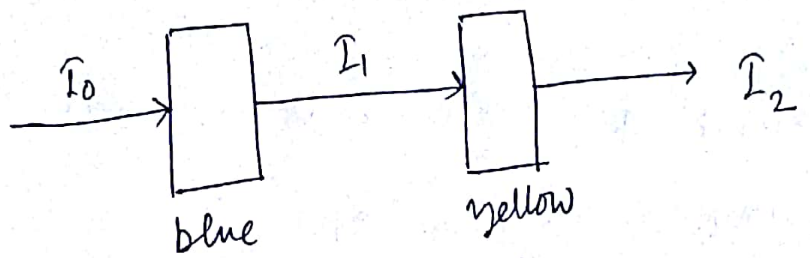
(5)



$$\frac{I_1}{I_0} = \frac{72.7}{100}$$

$$\frac{I_2}{I_1} = \frac{40.7}{100}$$

$\therefore$ Transmittance of two filters in combination

$$= \frac{I_2}{I_0} = \frac{I_2}{I_1} \times \frac{I_1}{I_0} = \frac{72.7 \times 40.7}{10^4}$$

$$= \underline{0.296}$$

(6)

$I = 75$ when $I_0 = 100$

$$\therefore \log \frac{100}{75} = \varepsilon \times 0.003 \times 1$$

$$\Rightarrow \varepsilon = 41.65\ M^{-1}\ cm^{-1}$$

for a 0.01 M solⁿ in the same cell

$$\log \frac{1}{T} = 41.65 \times 0.01 \times 1 = 0.4165$$

$$\Rightarrow T = 0.3833$$

% of Transmittance = 38.33%

% of Absorption = (100 − 38.33)%

= 61.67%

7.

for liquid A, 50% light is absorbed

$\therefore \log \frac{100}{50} = \varepsilon_A \times 10^{-3} \times 1$

$\Rightarrow 0.301 = \varepsilon_A \times 10^{-3}$

$\Rightarrow \varepsilon_A = 301 \ M^{-1} cm^{-1}$

for liquid B, 60% light is absorbed

$\therefore \log \frac{100}{40} = \varepsilon_B \times 10^{-3} \times 2 \times 1$

$\Rightarrow \cancel{0.398}$

$\Rightarrow 0.398 = \varepsilon_B \times 2 \times 10^{-3}$

$\Rightarrow \varepsilon_B = 198.97$

So when a soln containing A and B each with concentration 10^{-3} M is used then

Absorbance $= A = \varepsilon_A \times 10^{-3} \times 1 + \varepsilon_B \times 10^{-3} \times 1$

$= (\varepsilon_A + \varepsilon_B) \times 10^{-3}$

$= (301 + 198.97) \times 10^{-3}$

$= 0.4997$

$\therefore \log \frac{1}{T} = 0.4997$

$\Rightarrow T = 0.3164$

$\therefore$ % of transmittance $= 31.64\%$

$\therefore$ % of ~~Ab~~ absorption $= (100 - 31.64)\%$

$= \cancel{68.36} = 68.36\%$

8. optical density of A = $\log \frac{100}{50} = 0.30$

optical density of B = $\log \frac{100}{25} = 0.60$

Now optical density = $\varepsilon c l$,
for same cell and same wavelength
optical density $\propto$ c

In a mixture of equal ~~vol~~ volume
Concⁿ of each is halved so the
optical densities will also be halved.

Thus in mixture of equal volumes
of liquid A and B the
optical density $= \frac{0.30}{2} + \frac{0.60}{2}$

$= 0.45$

9

Absorbance A = $\varepsilon c l$

For dye X at 450 mμ,

$0.20 = \varepsilon_x \times 10^{-3} \times 1$

$\Rightarrow \boxed{\varepsilon_x = \frac{0.2}{10^{-3}} = 200}$

for dye X at 650 mμ

$0.05 = \varepsilon_x' \times 10^{-3} \times 1$

$\Rightarrow \boxed{\varepsilon_x' = 50}$

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for dye Y, at 450 mμ,

$$0.0 = \varepsilon_y \times 10^{-4} \times 1$$

$$\Rightarrow \varepsilon_y = 0$$

for dye Y, at 650 mμ

$$0.42 = \varepsilon_y' \times 10^{-4} \times 1$$

$$\Rightarrow \varepsilon_y' = 4200$$

~~if C_x and are the~~

if C_x and C_y are the concentrations of X and Y in the mixture then

at 450 mμ,

~~$0.38 = \varepsilon_x \times C_x \times 1 + \varepsilon_y \times C$~~

$$0.38 = \varepsilon_x \times C_x \times 1 + \varepsilon_y \times C_y \times 1$$

$$\Rightarrow 0.38 = 200 \times C_x + 0 \times C_y$$

$$\Rightarrow \boxed{C_x = \frac{0.38}{200} = 1.9 \times 10^{-3}\ M}$$

at 650 mμ,

$$0.71 = \varepsilon_x' \times C_x \times 1 + \varepsilon_y' \times C_y \times 1$$

$$\Rightarrow 0.71 = 50 \times 1.9 \times 10^{-3} + 4200 \times C_y$$

$$\Rightarrow \boxed{C_y = 1.46 \times 10^{-4}\ M}$$

10.