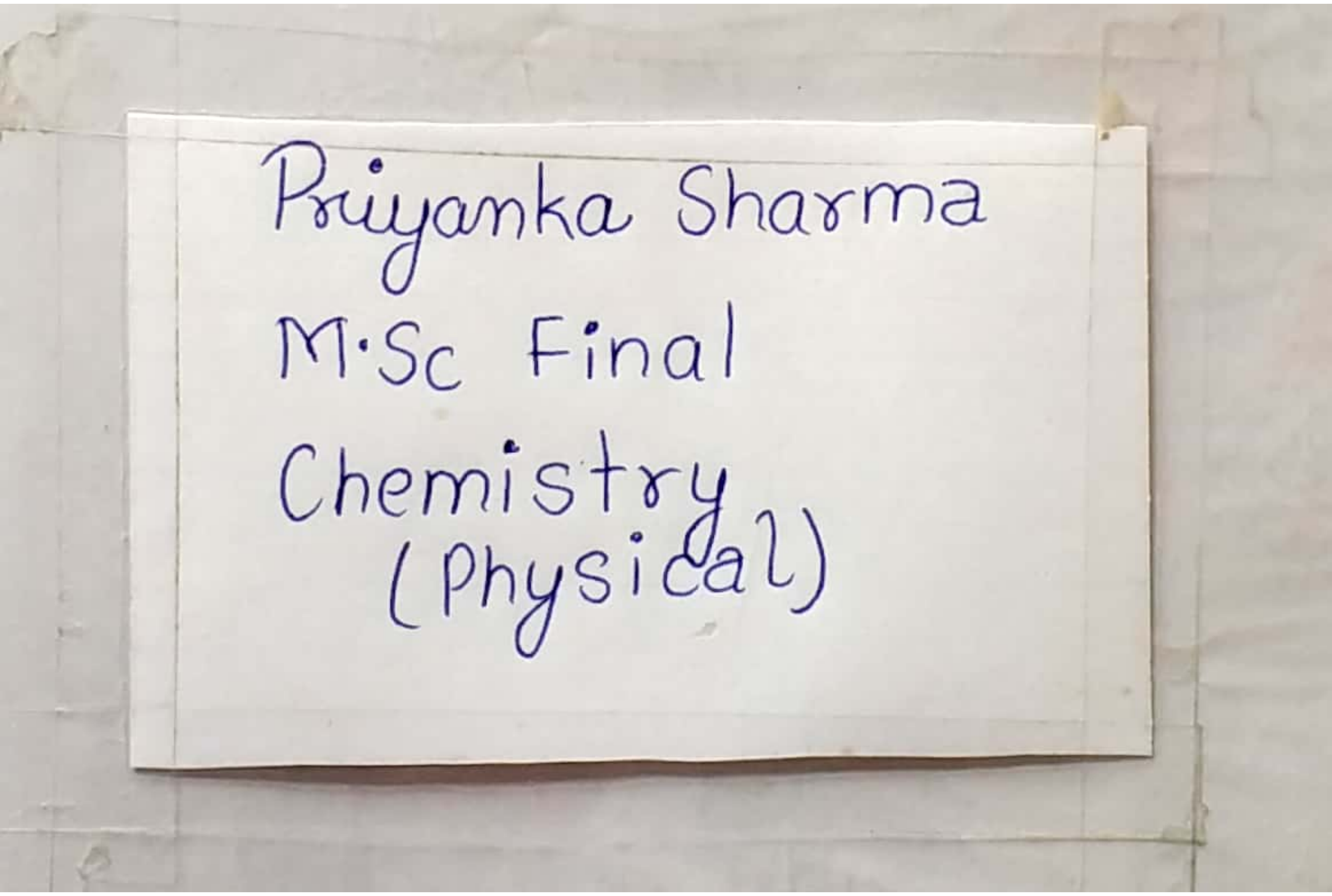


Priyanka Sharma
M·Sc Final
Chemistry
(Physical)

Index

Chemistry

Sr. No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	Remarks
1.	To determine indicator constant (PKa) of methyl red indicator.				
2.	To determine the formation constant for the $[Ce^{IV}-H_3PO_2]$ intermediate complex & also it's decomposition constant.				
3.	To determine the stability constant of $[Fe(SCN)]^{+2}$ complex ion keeping ionic strength constant.				
4.	To study & plot the forward and reversed bias characterstics of Ge & Si the semi-conductor diode.				
5	Deter. characterstics of PNP transistors.				

6. Dete. PH of Sol^n employing methyl red indicator spectrophotometrically

Experiment - 1

Object -

To determine the indicator constant (pka) of methyl red indicator.

Required Chemical -

(i) CH_3COONa Solⁿ = 0·04M & 0·01 M (100ml each)
(ii) CH_3COOH Solⁿ = 0·02M
(iii) HCl Solⁿ = 0·1M & 0·01 M
(iv) Indicator

Procedure -

(i) Prepared stock solution of indicator by dissolving 0·1gm of methyl red indicator in ethanol (130ml) and diluted it upto 50ml by adding water.

(ii) Took 5ml of this solution and added to it 25 ml alcohol and made it upto 50ml by adding water, it was the indicator solution.

(iii) Prepare two solution A & B as follows.

Solution A: Took 10ml indicator solution & added to it 10ml of 0·1m HCl Solⁿ and made it upto 100ml by adding water.
The pH of this solution is about two exclusively is in this forms.

Calculation :-

ε_{A_1} = Slope of O·D V/s Concⁿ for A at 520 nm.

$$\tan\theta = \frac{BC}{AB}$$

$$\text{Slope} = \frac{0{\cdot}275 - 0{\cdot}215}{(2{\cdot}8 - 2{\cdot}1)\times10^{-5}} = \frac{0{\cdot}67}{0{\cdot}7}\times10^{5}$$

$$= 8{\cdot}5\times10^{3}$$

ε_{A_2} = Slope of plot O·D V/s conc. for A at 440 nm

$$\text{Slope} = \frac{0{\cdot}104 - 0{\cdot}074}{(2{\cdot}8 - 2{\cdot}1)\times10^{-5}} = \frac{0{\cdot}03}{0{\cdot}7}\times10^{5}$$

$$= 4{\cdot}28\times10^{3}$$

ε_{B_1} = Slope of plot of O·D V/S conc. of B. at 520nm

$$\text{Slope} = \frac{0{\cdot}279 - 0{\cdot}235}{(3{\cdot}5 - 2{\cdot}8)\times10^{-5}} = \frac{0{\cdot}04}{0{\cdot}7}\times10^{5}$$

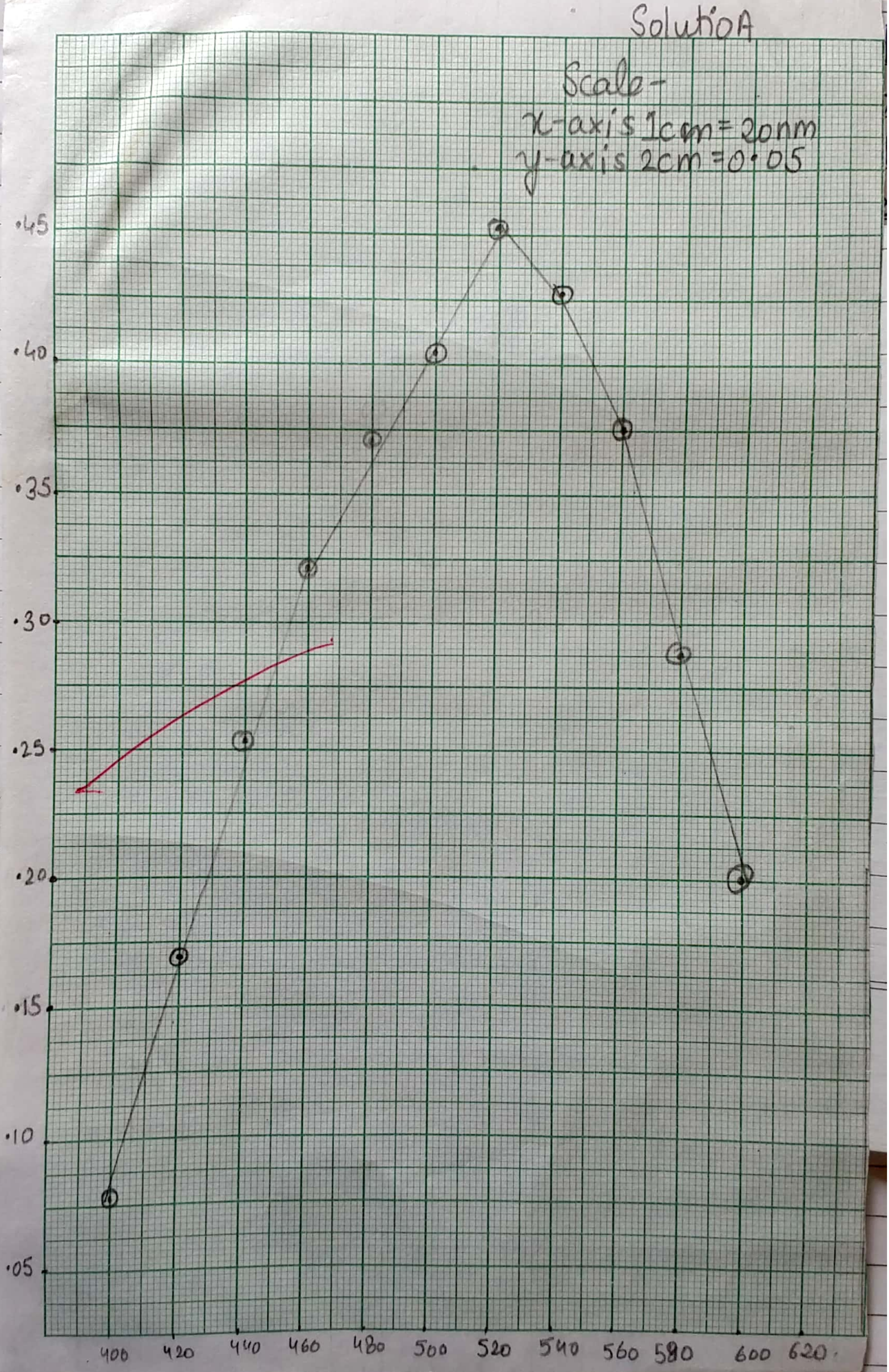
$$= 6{\cdot}28\times10^{3}$$

ε_{B_2} = Slope of plot of O·D V/S conc. for Solⁿ B at 440nm

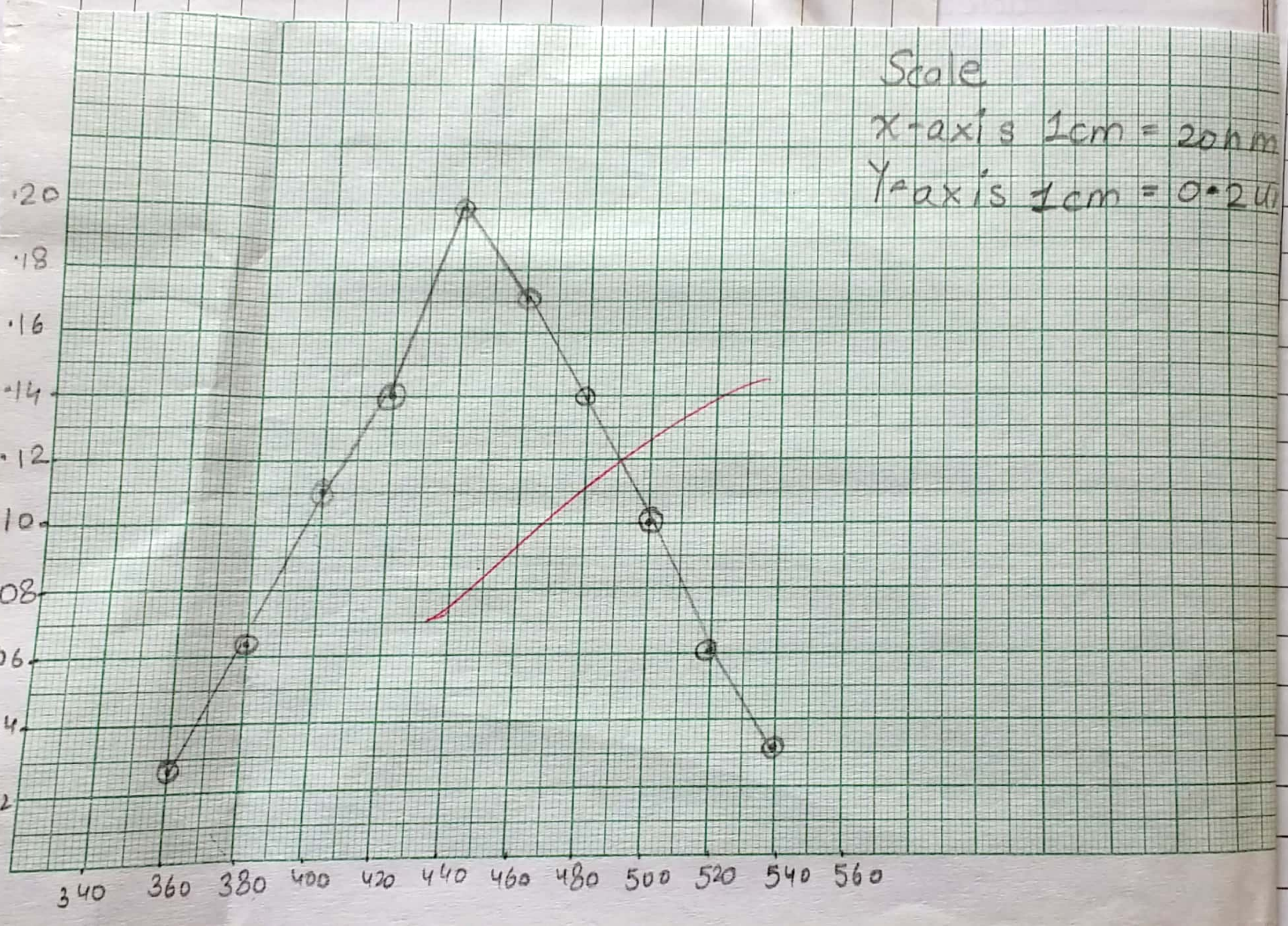
$$\text{Slope} = \frac{0{\cdot}114 - 0{\cdot}008}{(3{\cdot}5 - 2{\cdot}3)\times10^{-5}} = \frac{0{\cdot}106}{1{\cdot}2\times10^{-5}}$$

$$= 8{\cdot}83\times10^{3}$$

Solution A



Scale-
x-axis 1cm = 20nm
y-axis 2cm = 0·05


Scale
X-axis 1cm = 20nm
Y-axis 1cm = 0·2U
·20
·18
·16
·14
·12
·10
·08
·06
·04
·02
340
360
380
400
420
440
460
480
500
520
540
560

Solution-B:- Took 10ml of indicator solution and 25ml of 0.04M CH_3COONa solution & made it upto 100ml by adding water the pH of this Sol^n is & where the indicator is in I form.

Then took spectra of both these solutions separatly in wavelength region 340-600 nm.

Took 15, 20, 25 & 30 mg R of solution in four (A 1, 2, 3, 4) different 100ml flasks & added 35, 30, 25, 20 ml of 0.01M HCl Sol^n to make up each solution of 50ml measured the absorbance of each solution at two wave-length at 520 & 440nm respectively.

Took 15, 20, 25 & 30 ml of Solution B ~~is~~ in four flask & made up to 50ml by adding measured absorbance at 520 & 440 nm respectively of each Solution (B - 1, 2, 3, 4 Sol^n).

- Then prepared the following sets :-
[Total Volume 50 ml].

Flask No.	1	2	3	4
Indicator sol^n.	5.0ml	5.0ml	5ml	5ml
0.04 M CH_3COONa(ml)	12.5ml	12.5ml	12.5ml	12.5ml
0.02 M CH_3COOH(ml)	25ml	12.5 ml	5ml	2.5ml
water (ml)	7.5ml	20.0ml	27.5 ml	30ml.
pH	4.84	5.15	5.53	5.81

According to eq^n ① & eq^n ②.

$A_1 = \varepsilon A_1 [HIn] + \varepsilon A_2 [In]$

$A_2 = \varepsilon B_1 [HIn] + \varepsilon B_2 [In]$

$A_1 = 0.432$; $A_2 = 0.190$

$0.432 = 8570 [HIn] + 4280 [In^-]$ — ③

$0.190 = 6280 [HIn] + 8830 [In^\ominus]$ — ④

multiply eq ⑤ by 8.252 & ④ by 4.

$3.565 = 70719.64 [HIn] + 355320 [In^-]$

$0.760 = 25120.60 [HIn] + 355320 [In^-]$

$-$ $-$ $-$

$2.805 = 45599.64 (HIn)$

$HIn = 6.15 \times 10^{-5}$ — ⑤.

eq^n ⑤ & ③.

$0.432 = 8570 \times 6.1 \times 10^{-5} + 4280 [In^-]$

$In^- = 1.89 \times 10^{-5}$

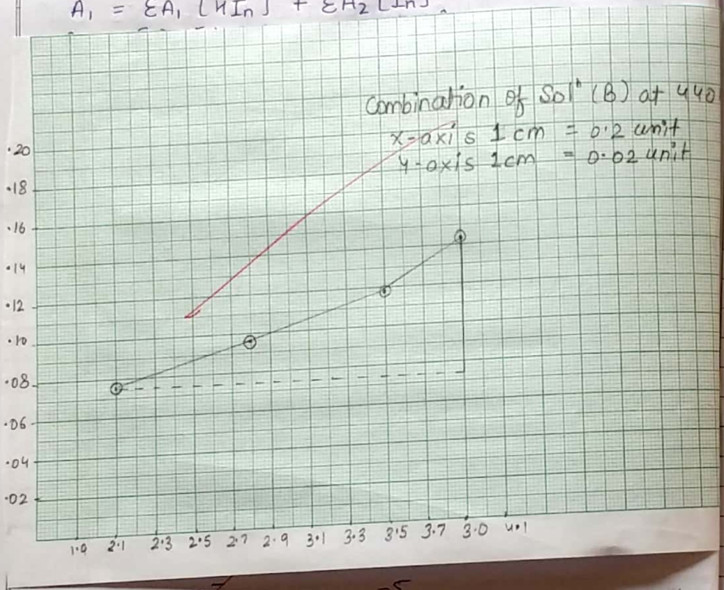
$\ln [In^-] = -4.72$

$\ln [HIn] = \ln [6.15 \times 10^{-5}]$

$= -4.21$

According to eq^n ① & eq^n ②

$A_1 = \varepsilon A_1 [HIn] + \varepsilon A_2 [In]$



$In^- = 1{\cdot}89 \times 10^{-5}$

$\ln [In^-] = -4{\cdot}72$

$\ln [HIn] = \ln [6{\cdot}15 \times 10^{-5}]$

$= -4{\cdot}21$

Date

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Page No.

Observation & Observation table :-

(i) Absorbance for solution A & B at different wavelength

Solution-A		Solution-B	
Wavelength	Absorbance	Wavelength	Absorbance
400	0·078	360	0·031
420	0·171	380	0·071
440	0·251	400	0·110
460	0·320	420	0·140
480	0·405	440	0·190
500	0·432	460	0·172
520	0·411	480	0·141
540	0·455	500	0·097
560	0·350	520	0·061
580	0·265	540	0·027
600	0·201		

λmax for Sol^n A – 520 nm.
λmax for Sol^n B – 440 nm
} from graph ① & ②

Absorbance at 520 nm = 0·432

Absorbance at 440 nm = 0·190

Teacher's Signature

$$\log \frac{[In]}{[HIn]} = \log [In^-] - \log [HIn]$$

$$= 4.72 + 4.21 = 0.51$$

$$pK_a = pH - \log \frac{[salt]}{[acid]}$$

for Sol^n (Buffer) No. 1.

$$pKa = pH - [-0.51]$$

$$= 4.84 + 0.51 = 5.35$$

for Sol^n (2) pKa (2) = 5.15 + 0.51 = 5.66

for Sol^n (3) pKa (3) = 5.53 + 0.51 = 6.04

for Sol^n (4) pKa (4) = 5.81 + 0.51 = 6.32

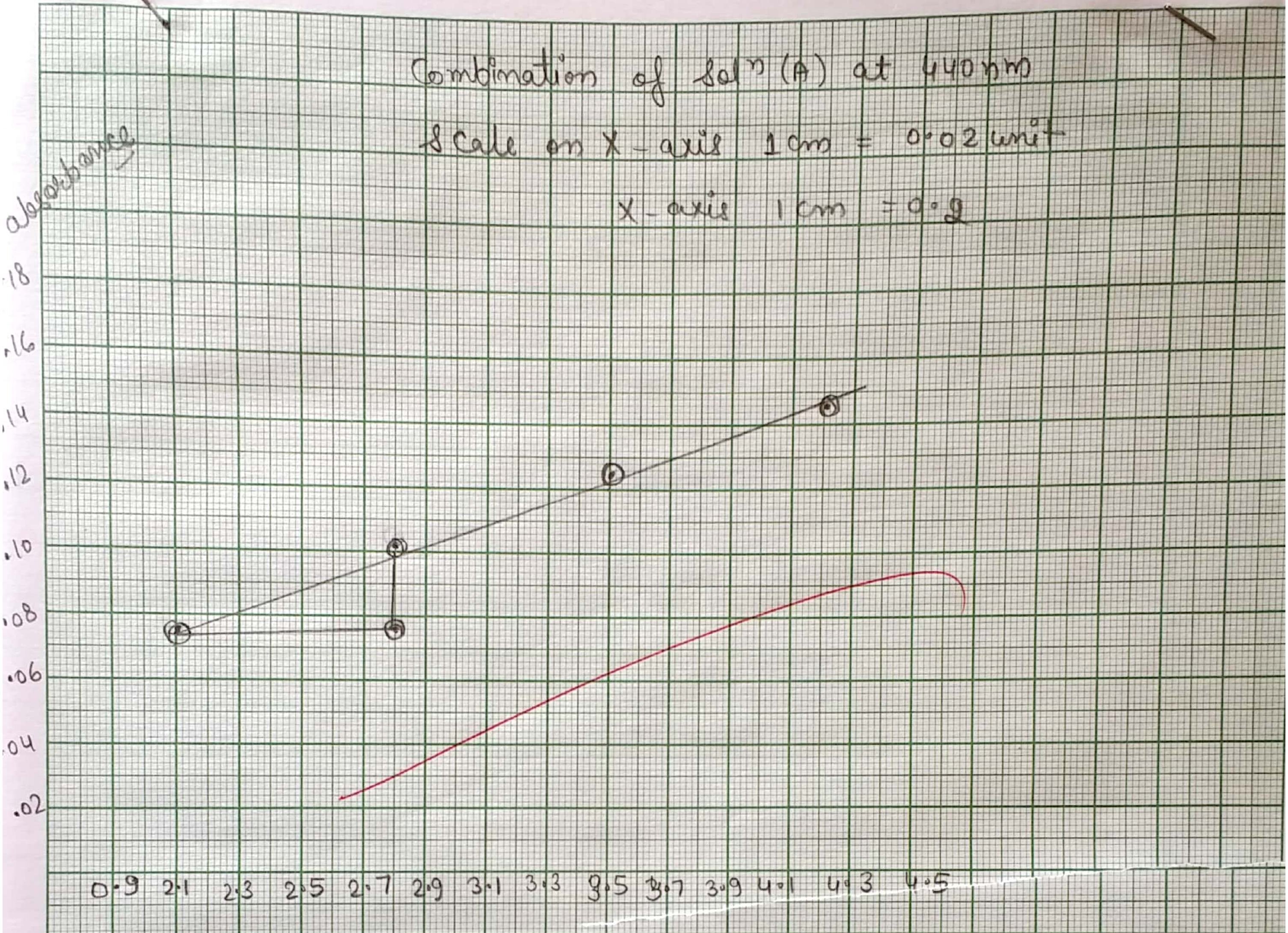
$$\text{Mean pKa} = \frac{5.35 + 5.66 + 6.04 + 6.32}{4}$$

$$= 5.84$$

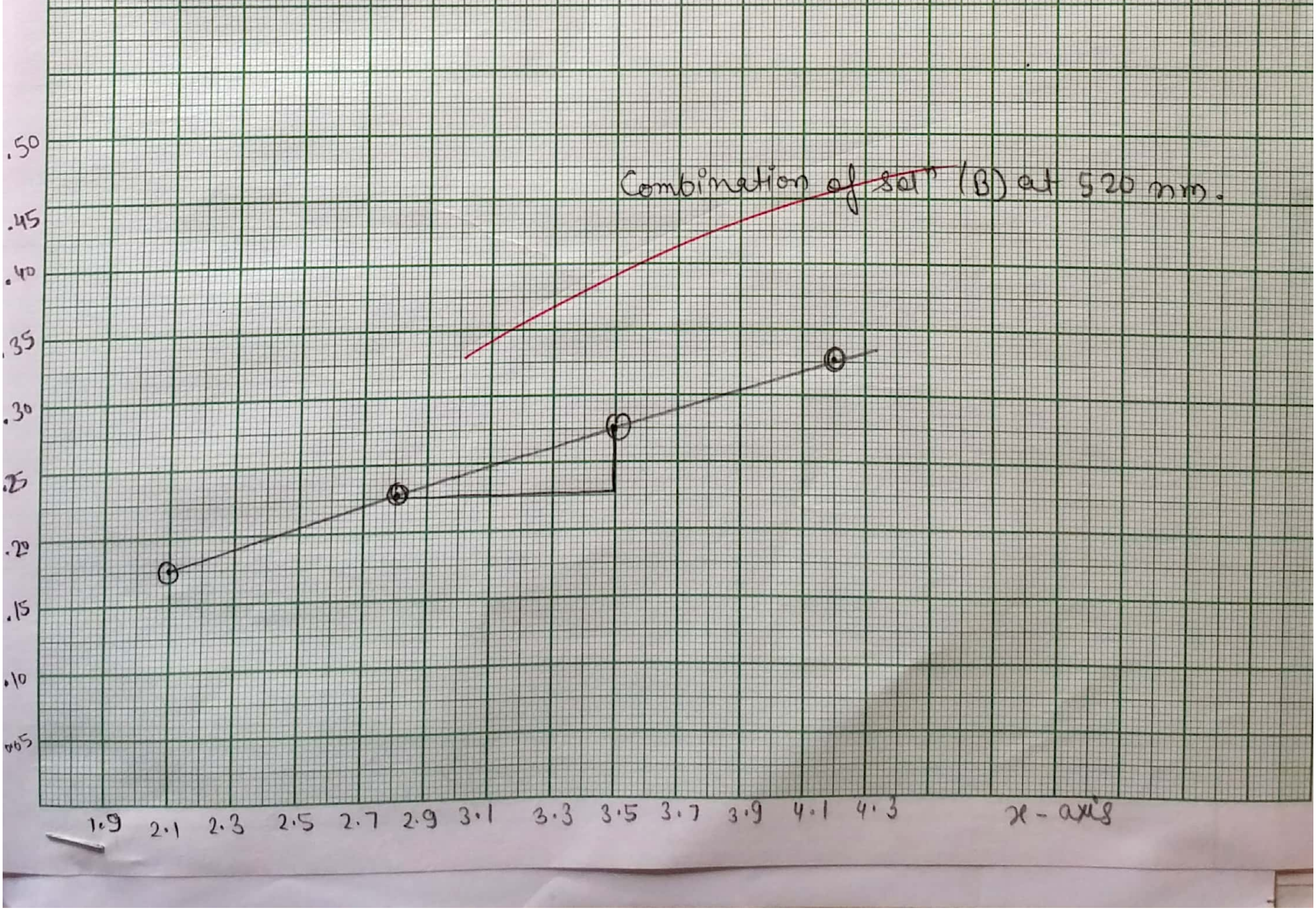
Combination of soln (A) at 440 nm

Scale on X-axis 1 cm = 0.02 unit

X-axis 1 cm = 0.2



Combination of soln (B) at 520 nm.



Date

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(ii) Absorbance for the solution which are made by Sol^n^ A & B.

S.No	Concentration (m)	Absorbance	
		At. 520nm	At 440nm
A_1	2.1×10^{-5}	0.215	0.074
A_2	2.8×10^{-5}	0.275	0.104
A_3	3.5×10^{-5}	0.324	0.132
A_4	4.2×10^{-5}	0.381	0.161
B_1	2.1×10^{-5}	0.181	0.074
B_2	2.8×10^{-5}	0.235	0.096
B_3	3.5×10^{-5}	0.279	0.114
B_4	4.2×10^{-5}	0.329	0.132

(iii) Absorbance for Solution which are prepared in (vi) step :-

Flask No.	PH of the Sol^n^	Absorbance	
		at 520nm	at 440nm
1.	4.84	0.282	0.121
2.	5.15	0.231	0.125
3.	5.53	0.180	0.114
4.	5.81	0.122	0.127

Calculation :

Plotted a graph b/w absorbance and concentration of indicator A/c to absorbance table (ii)

Teacher's Signature

A straight line is obtained (passing through the Origin) the slope of each line will give molar extenction cofficient (ε_2).

εA_1 (at 520nm) = $8 \cdot 57 \times 10^3$
εA_2 (at 440nm) = $4 \cdot 28 \times 10^3$
εB_1 (at 520nm) = $6 \cdot 28 \times 10^3$
εB_2 (at 440nm) = $8 \cdot 83 \times 10^3$

Thus following eq^n is formed for these "A" &

$$A_1 = \varepsilon A_1 [HIn] + \varepsilon A_2 [In^{\ominus}] \quad — ①$$
$$A_2 = \varepsilon B_1 [HIn] + \varepsilon B_2 [In^{\ominus}] \quad — ②$$

- By solving these eq^n we calculate the (HIn) & (In)
- Thus calculate the pka value & for all four sets –

pH	pka
4·84	5·35
5·15	5·66
5·53	6·04
5·81	5·84

Result –

The pka of methyl red indicator as determined spectrophatometrically is 5·84.

Surendra
28/4/18

Experiment - 2.

Object :

To determine the formation constant for the [$Ce^{(IV)}$ - H_3PO_2] intermediate complex & also it's decomposition rate constant at 45°C.

Chemical Reaction -

$$2Ce^{4+} + H_3PO_2 + H_2O \longrightarrow 2Ce^{3+} + H_3PO_3 + 2H^{\oplus}.$$

(mechanism)

$$Ce^{4+} + H_3PO_2 \xrightleftharpoons{K} [Ce^{4+}, H_3PO_2] \xrightarrow{K} \text{Product}$$

Preparation of Solution :-

(i) 0·01 M Cerric ammonium nitrate solution in 1M H_2SO_4 Sol^n (250 ml).
(Took cerric ammonium nitrate) sufficiently larger than required for added it into 100ml 1M than H_2SO_4 solution and boiled till the salt is dissolved & the solution turns to arrange colour.
Determined the molority of this Ce(IV) sol^n by titrating it with 0·05 m ferrous ammonium sulphate solution using ferrous indicator.

(ii) 0·1 M hypophosphite in water (250ml)

(iii) 4M H_2SO_4 Solution (500ml)

(iv) 0·002 M ferrous ammonium sulphate solution (250ml)

Calculation -

(0·02ml)

For Bottle "A" —

$m_1 = $ conc^n of Cerric Sulphate

$V_1 = $ Volume of Cerric Sulphate used from Burate (V_1)

$$m_1 V_1 = m_2 V_2$$

$M_2 = $ conc^n of Ce^{+4} in Rxn mecha

$V_2 = $ Volume of Ce^{+4} in " "

$$m_2 = \frac{0.02 \times V_1}{20} \, m$$

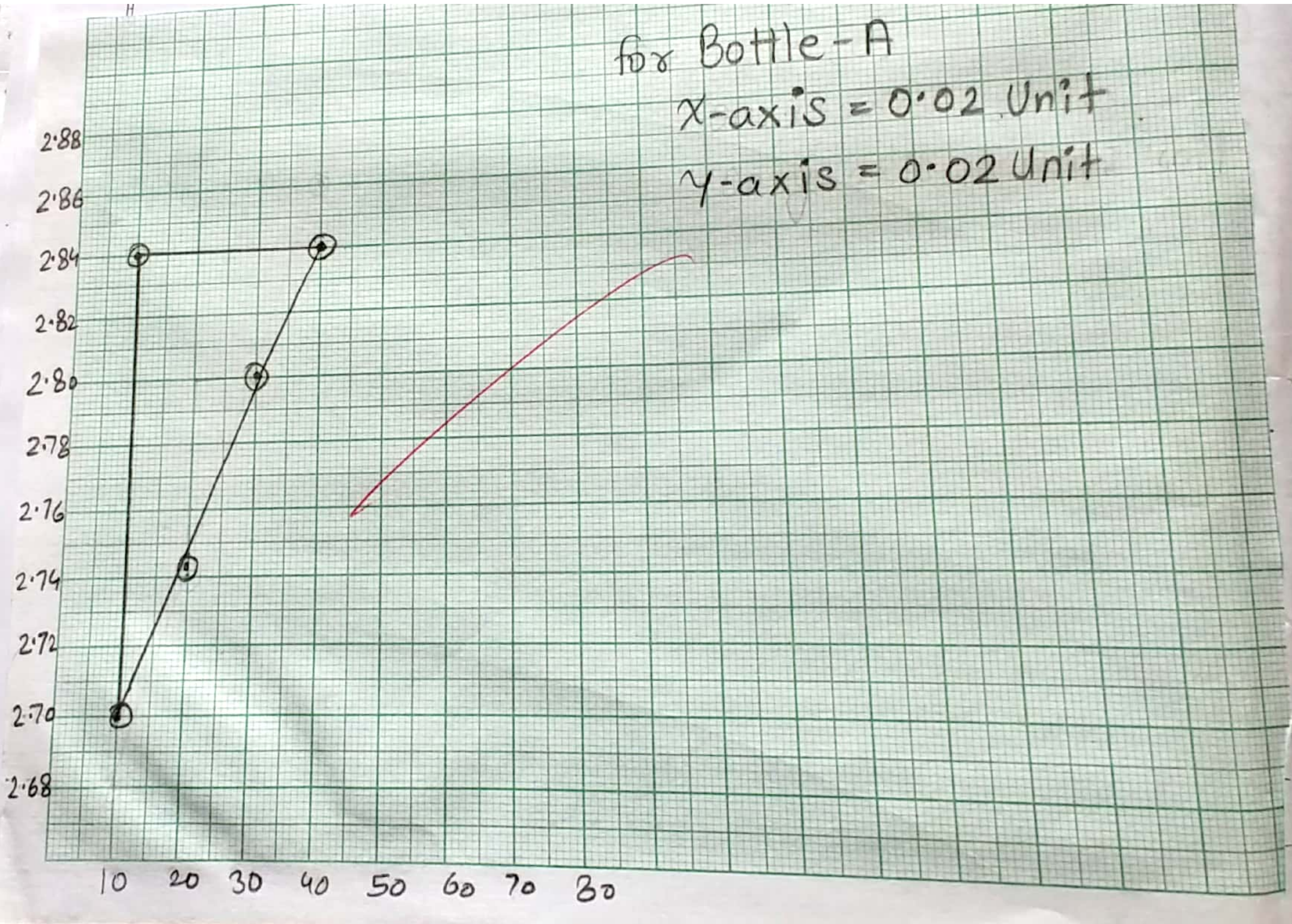
(i) At $t = 40$ min ; $m_1 = 0.002 \times \frac{19.9}{20} = 0.00199\,m$

(ii) At $t = 30$ min ; $m_2 = 0.002 \times \frac{17.4}{20} = 0.00174\,m$

(iii) At $t = 20$ min ; $m_3 = 0.002 \times \frac{15.5}{20} = 0.00155\,m$

(iv) At $t = 10$ min ; $m_4 = 0.002 \times \frac{14.4}{20} = 0.00144\,m$

Similarly applied these calculation for Bottle B, C, D is absorption table (2), (3), (4) Respectively.


for Bottle - A
X-axis = 0·02 Unit
Y-axis = 0·02 Unit
2·88
2·86
2·84
2·82
2·80
2·78
2·76
2·74
2·72
2·70
2·68
10
20
30
40
50
60
70
80

Procedure -

Mixed the reagents as follows as mentioned in following table.

S.No.	Bottle No.	Volume of (H_3PO_2) (0.1M)	Volume of (H_2SO_4) (4ml)	Volume of H_2O (ml)	Volume of Ce(IV) Sol^n
1.	A	60	20	20	20
2.	B	40	20	20	20
3.	C	20	20	40	20
4.	D	10	20	50	20.

Added Ce(IV) Sol^n in the end to start the reaction recorded the time of intiation.

Took out 10ml Rxn mixture of an interval of 10min & added to 10ml of Fe (II) Sol^n in conical flask.

Titrated the solution constants against 0.002M. cerric ammonium sulphate from the burate using n-phenyl anthranilic acid as an indicator.

Rate eq^n -

Plot log (Ce^{4+}) versus time in each of the four cases. A straight line will be obtained in each case. Pseudo Ist Order rate constant (K) -

$$K' = \text{Slope} \times 2.303.$$

Calculation of rate Constant –

(1) for Bottle (A)

$K_1 = \text{Slope} \times 2{\cdot}303$

$= 5 \times 10^{-3} \times 2{\cdot}303$

$= 11{\cdot}515 \times 10^{-3}$

(2) for Bottle (B)

$K_1' = \text{Slope} \times 2{\cdot}303.$

$K' = 7 \times 10^{-3} \times 2{\cdot}303$

$= 16{\cdot}121 \times 10^{-3}$

(3) for Bottle (C)

$K' = \text{Slope} \times 2{\cdot}303$

$= 6 \times 10^{-3} \times 2{\cdot}803$

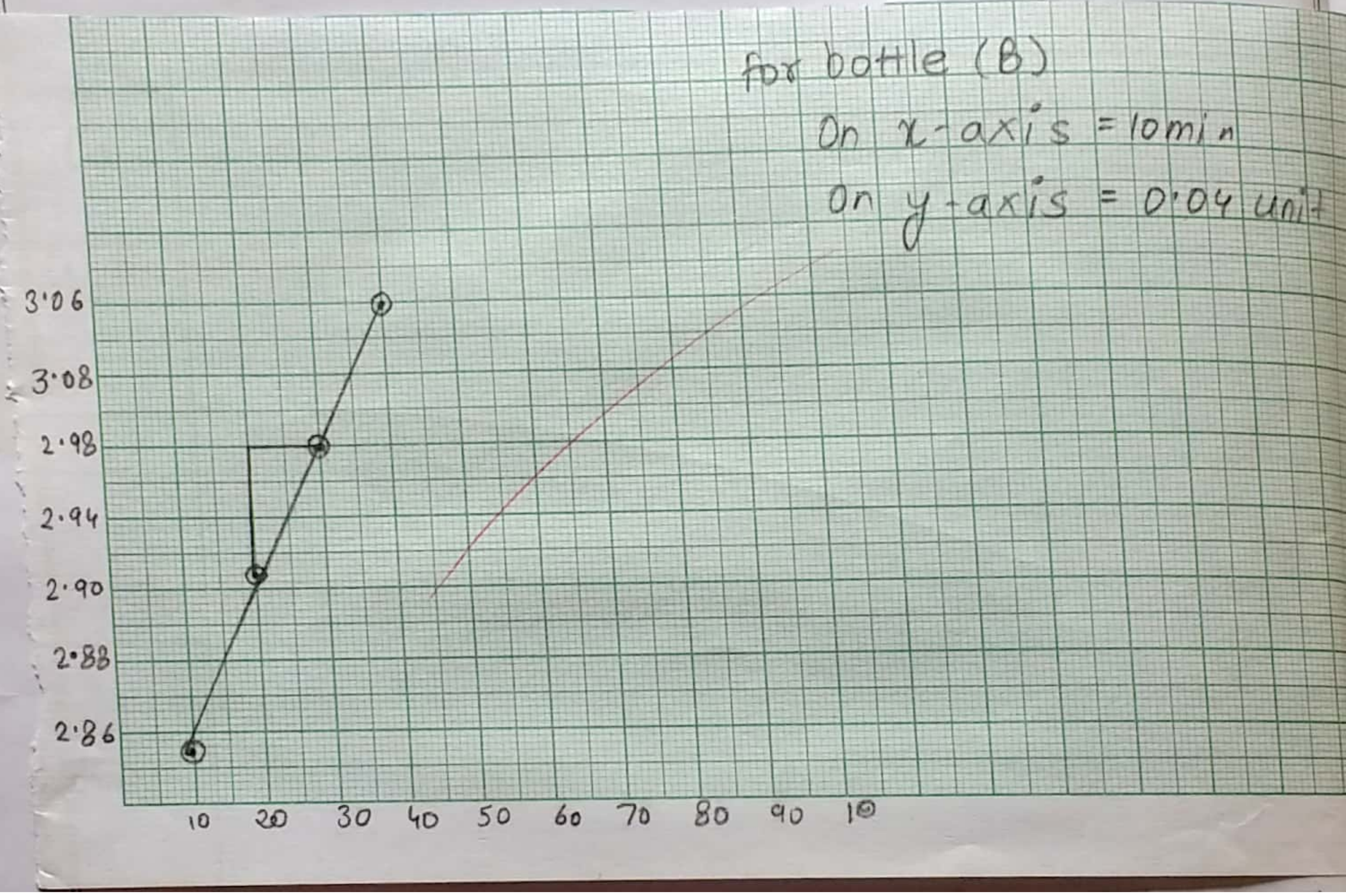
$= 13{\cdot}818 \times 10^{-3}$

(4) for Bottle (D)

$K' = \text{Slope} \times 2{\cdot}303$

$= 8 \times 10^{-3} \times 2{\cdot}303$

$= 18{\cdot}424 \times 10^{-3}$



for bottle (B)

On x-axis = 10min

On y-axis = 0·04 unit

Plot 1/k' versus $1/CH_3PO_2$ on another group paper. A straight line with on intracept on the 1/k' axis would be obtained.

Determine the intercept (I) & slope (s) of the time.

$$\text{Rate eq}^n = \frac{-d[Ce^{4+}]}{dt} = \frac{2kK[H_3PO_2][Ce^{3+}]}{1+K[H_3PO_2]}$$

$$\text{or} \quad k' = \frac{2K[H_3PO_2]}{1+[H_3PO_2]}$$

Taking resiprocal -

$$\frac{1}{k'} = \frac{1}{K[H_3PO_2]} + \frac{1}{K}$$

Plot a graph of 1/k' Versus $1/H_3PO_2$

$$\text{Intercept} = \frac{1}{k} \; ; \quad \text{Slope} = \frac{1}{kK}$$

$$K = \text{Slope}/\text{intercept}.$$

Observation Table -

S.N.	Time	Vol. of cerric sulphate use from burate (ml)	$[Ce^{4+}]$	$\log[Ce^{4+}]$
1	10	19.9	0.00199	-2.7011
2	20	17.4	0.00174	-2.7595
3	30	15.5	0.00155	-2.8097
4	40	14.4	0.00144	-2.8416

Calculation of Slope for mix. A, B, C, D

(i) For Bottle "A" - Slope = $\frac{\Delta Y}{\Delta X} = \frac{-2.70 - (-2.80)}{20}$

$= 5 \times 10^{-3}$

(ii) For Bottle "B" - Slope = $\frac{\Delta Y}{\Delta X} = \frac{-2.91 - (-2.98)}{30-20}$

$= 7 \times 10^{-3}$

(iii) For Bottle - ~~B~~"C" = Slope = $\frac{\Delta Y}{\Delta X} = \frac{-2.78 - (-2.841)}{30-20}$

$= 6 \times 10^{-3}$

(iv) For Bottle "D" = Slope = $\frac{\Delta Y}{\Delta X} = \frac{-2.94 - (-3.02)}{40-30}$

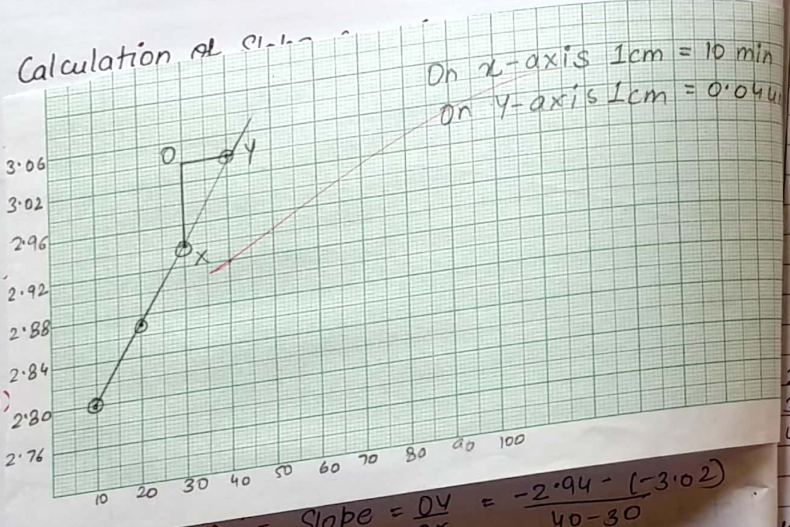
$= 8 \times 10^{-3}$

Calculation of Sl

(i

(ii

(iii)



(iv) For Bottle D = $\text{Slope} = \frac{OY}{OX} = \frac{-2.94-(-3.02)}{40-30}$

$= 8\times10^{-3}$

2. for bottle "B" –

1.	10	14·6	0·00186	−2·7305
2.	20	12·4	0·00166.	−2·7799
3.	30	10·5	0·00145	−2·8386
4.	40	8·6	0·00124	−2·9066

3. For bottle "C" –

1	10	18·6	0·00186	−2·7305
2	20	16·6	0·00166	−2·7799
3	30	14·5	0·00145	−2·8386
4	40	12·4	0·00124.	−2·9066

4. For bottle "D" –

1	10	15·6	0·00156	−2·8069
2	20	13·6	0·00136	−2·8665
3	30	11·4	0·00114	−2·9931
4	40	9·5	0·00095	−2·0223

Bottle No.	H_3PO_2(m)	[$1/H_3PO_2$]	k'	1/k'
A	0·06	16·67	12.660×10^{-3}	52·37
B	0·04	25	25.338×10^{-3}	68·41
C	0·02	50	16.121×10^{-3}	62·05
D	0·01	100	11.515×10^{-3}	86·84

Teacher's Signature ____________

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Result -

The formation constant of the Rxn (K) is 2.418×10^{2} mol^{-1} the rate constant of the Rxn (k) 1.0623×10^{-2} mol^{-1} Sec^{-1} L at 35°c.

Experiment- 3

Object –

To determine the stability constant of $[Fe(SCN)]^{2+}$ complex ion keeping ionic strength constant.

Principle –

$[Fe(SCN)_n]^{(3-n)+}$ complex are formed when solution of Fe^{3+} ion & thiocynate ion are mixed (where $n=16$).

The complex of red colour that means it is not due to a single complex species as the singlet shift in λ_{max} is observed on increasing the conc^n of thiocynate ion in the mixture.

However the conc^n of Fe^{3+} ion is taken in excess our that of thiocynate ion the following equilibrium exist predomindntly.

$$Fe^{3+} + SCN^- \longrightarrow [Fe(SCN)]^{2+}.$$

$$K = \frac{[Fe(SCN)]^{2+}}{Fe^{3+}\ [SCN^-]} \quad \text{———} ①$$

The ionic strength of the mixture is maintained by HNO_3 the former is also required to check the hydrolysis of Fe(II)

Under such condition of excess of $[Fe^{3+}] >> [SCN]$ λ_{max} is 460nm for complex ion $[Fe\cdot(SCN)]^{2+}$

Let the initial conc^n of Fe^{3+} & SCN^- be "a" & "b" respectively & "A" be the absorbance of the mixture at wavelength (λ) 460nm.

$[A] = [Fe(SCN)]^{2+}$ (from Berius law)

or $[Fe(SCN)]^{2+} = \frac{A}{\varepsilon t}$ — ②

Where εt is the molar extinction cofficient of the complex at 460nm at equibirium "a" & $\left[b - \frac{A}{\varepsilon t}\right]$ are the concentration of Fe^{3+} & $SCN^{\ominus}$ respectively substituting there concentration of Fe^{3+} & ~~SN~~ $SCN^{\ominus}$ in eq ①.

$$K = \frac{A/\varepsilon l}{a(b-A)/\varepsilon \cdot l}$$

$$K = \frac{A}{a(b \cdot \varepsilon l - A)} \quad \text{— ③}$$

$$\text{or} \quad \frac{1}{A} = \frac{1}{K \cdot b \cdot \varepsilon \cdot l} \times \frac{1}{a} + \frac{1}{b \cdot \varepsilon \cdot l} \quad \text{— ④}$$

Thus a plot of 1/A Vs 1/a at constant thiocyanate conc. gives a straight line whose slope and intercept are $1/b \cdot \varepsilon \cdot l \cdot K$ & $1/b \cdot \varepsilon \cdot l$ respectively.

Calculation -

Calculation of ionic Strength for each set of Solⁿ

$$\mu = \frac{1}{2} \sum c_i z_i^2$$

C_i = Concⁿ of ith Compound / component
Z_i = Charge of ith Component.

$$[K(CNS)] = \frac{0.005 \times 1}{25} = 0.0002\,m.$$

So, it ~~is~~ can be changed neglected in calculation of ionic strength.

Ionic strength of HNO_3 & $NaNO_3$ for each set of solution (Taken Volume is same for each set).

$$HNO_3 \text{ Sol}^n \rightarrow \mu = \frac{1}{2}[C_1 Z_1^2 + C_2 Z_2^2]$$

$$C = [HNO_3] = \frac{1.5 \times 6.6}{25} = 0.396\,m$$

$$\mu = 0.396\,m$$

$$NaNO_3 \text{ Sol}^n = \mu = \frac{1}{2}(C_1 Z_1^2 + C_2 Z_2^2)$$

$$C = [NaNO_3] = \frac{1.5 \times 10}{25} = 0.6\,m.$$

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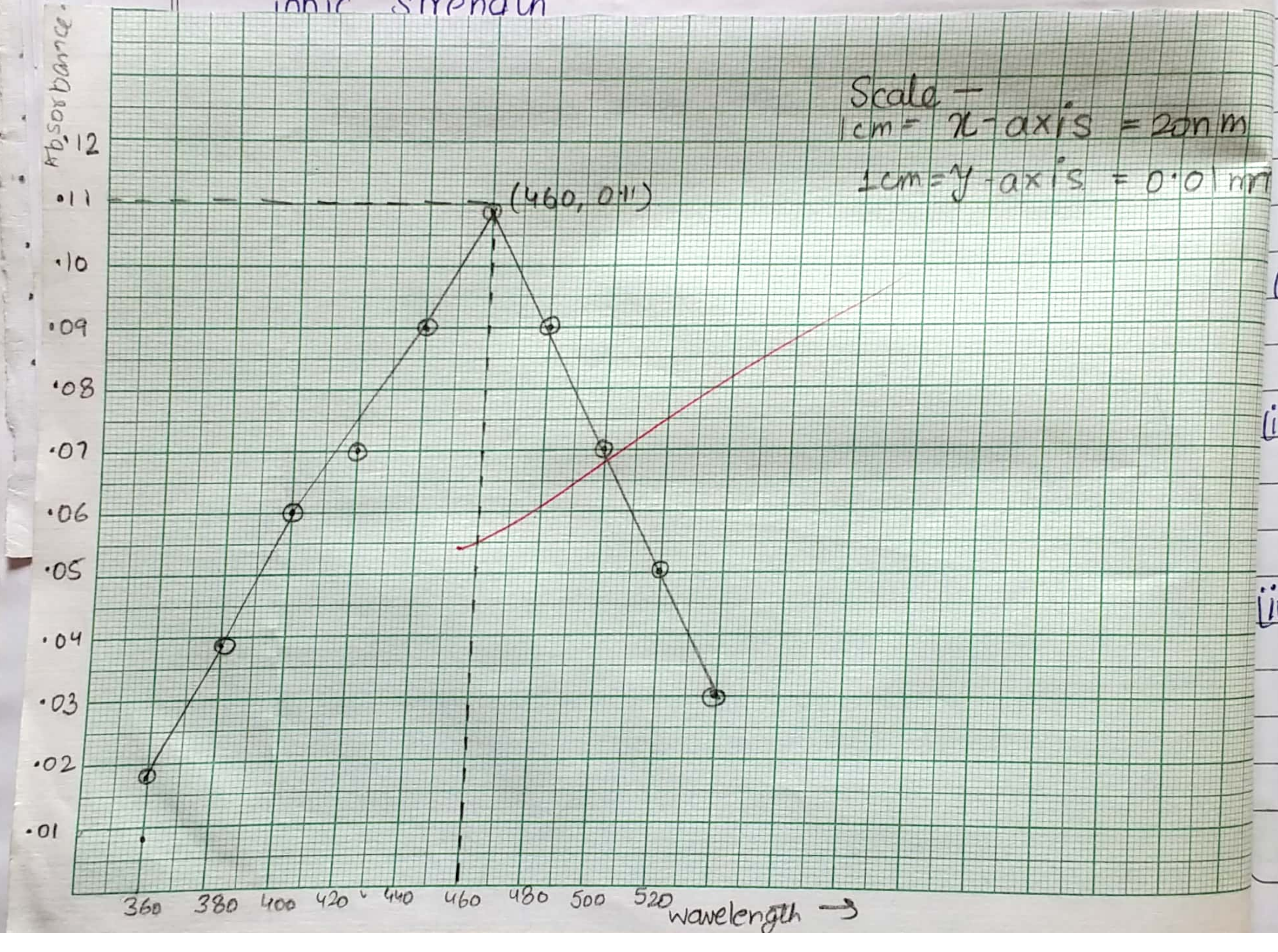
ionic strength



(i)

(ii)

(iii)

Therefore

$$K = \frac{\text{Intercept}}{\text{Slope}} = \frac{[1] / b \cdot \varepsilon \cdot l]}{[1 / (K \cdot b \cdot \varepsilon \cdot l]}$$

Required Chemical-

(i) 0·3M ferric nitrate in 0·01 M HNO_3 (100ml)
(ii) 0·005M KCNS solution (100ml)
(iii) 1·5M HNO_3 Solution (100ml)
(iv) 1·5M $NaNO_3$ solution (100ml)

Procedure -

Proposed the following sets of mixture which are given in following table the observed optical density for each set of solution also given is this table.

(i) Took solution 5 and measured it's absorbance in the wavelength region 400-600 nm.

(ii) Plotted a graph in b/w absorbedance & wave length A spectrum of the complex is obtained & λmax is calculated from it.

(iii) Fixed the spectraphatometer at λmax & took absorbance for each solution of the pridisc--urred table -

For Ist set of the Sol^{n}.

Calculation $\Rightarrow [Fe(NO_3)_3] = 0.3 \times 2 = c' \times 25$.

$$c' = \frac{0.3 \times 2}{25} = 0.024\ m.$$

$$\mu_1 = \frac{1}{2}[C_1 Z_1^2 + C_2 Z_2^2 + C_3 Z_3^2 + C_4 Z_4^2 + C_5 Z_5^2 + C_6 Z_6^2]$$

$C_1\ C_2$ & $Z_1 ; Z_2$ → Belong to $[Fe(NO_3)_3]$ Sol

C_3, C_4 & $Z_3 ; Z_4$ → Belong to HNO_3 Sol^{n}

C_5, C_6 & Z_5, Z_6 → Belong to $NaNO_3$ Sol^{n}

$$\mu = \frac{1}{2}[(0.024(3)^2 + 3(0.024)(-1)^2] + [0.396] + [0.6]$$

$$\mu_1 = 0.144 + 0.396 + 0.6.$$

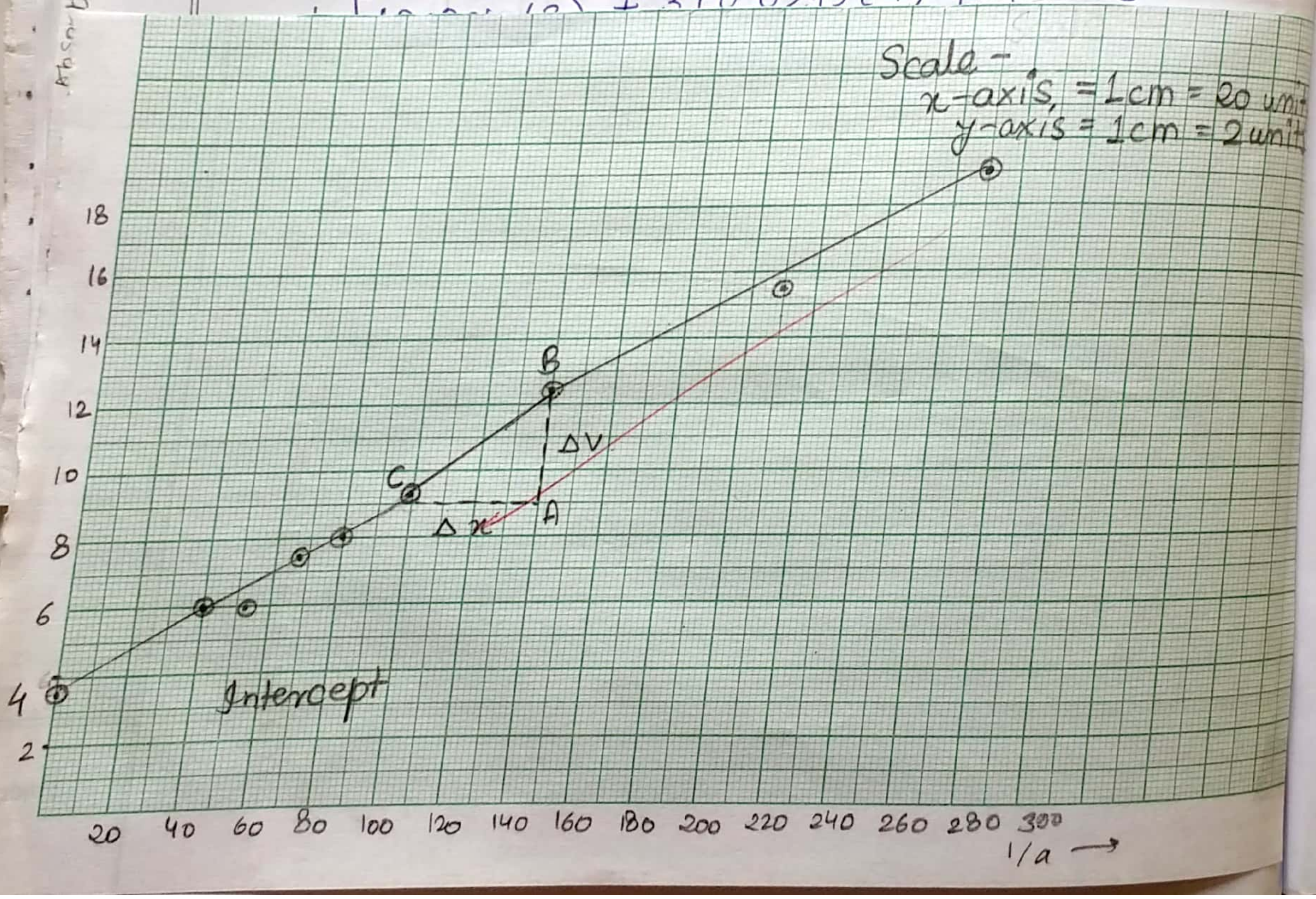
$$\mu = 1.14\ M$$

Similarly -
For IInd set -

$$\mu_2 = \frac{1}{2}[(0.018) \times 3^2 + 3(0.018)(-1)^2] + 0.396 + 0$$

$$\mu_2 = 1.104\ M.$$

$\left[\ldots(2)^{2} + 3(0.024)(-1)^{2}\right] + [0.396] + [0.6]$



Recorded their absorbance in another table.

Flask No.	Value of Fe $(NO_3)_3$ Sol^n (ml)	[KCNS] Sol^n (ml)	HNO_3 sol^n (ml)	$NaNO_3$ sol^n (ml)	water (ml)
1.	2·0	1·0	6·6	10·0	5·4
2.	1·5	1·0	6·6	10·0	5·9
3	1·3	1·0	6·6	10·0	6·1
4	1·0	1·0	6·6	10·0	6·4
5	·8	1·0	6·6	10·0	6·6
6	·6	1·0	6·6	10·0	6·8
7.	·5	1·0	6·6	10·6	6·9
8	0·4	1·0	6·6	10·0	7·0
9	0·3	1·0	6·6	10·0	7·1
10	0·2	1·0	6·6	10·0	7·2

Observation table for Solution No. ⑤ -

S.No.	Wavelength (nm)	Absorbance
1.	360	0·017
2	380	0·039
3.	400	0·056
4.	420	0·069
5.	440	0·089
6.	460	0·019
7.	480	0·099
8.	500	0·079
9.	520	0·059
10.	540	0·037
11.	560	0·027

(iii) For IIIrd set.

$$\mu_3 = \frac{1}{2}\left[(0.0156)(3)^2\right] + \left[3(0.0156)(-1)^2\right] + \left[0.396\right] + \left[0.6\right]$$

$$\mu_3 = 1.0896\,M.$$

(iv) For IVth set

$$\mu_4 = \frac{1}{2}\left[(0.012)(5)^2 + 3(0.012)(-1)^2\right] + \left[0.396\right] + 0.6.$$

$$\mu_4 = 1.068\,M$$

(v) For V set $\mu_5 = \frac{1}{2}\left[(0.096)(3)^2 + 3(0.0096)(-1)^2 + [0.396) + (0.1)\right.$.

$$\mu_5 = 1.0536\,M.$$

(vi) for VI set

$$\mu_6 = \frac{1}{2}\left[(0.0072)(3)^2 + 3(0.0072)(-1)^2\right] + \left[0.396\right] + \left[0.6\right]$$

$$\mu_6 = 1.0392\,M.$$

(vii) for VII set

$$\mu_7 = \frac{1}{2}\left[(0.006)(3)^2 + 3(0.006)(-1)^2\right] + (0.396) + \left[0.6\right]$$

$$\mu_7 = 1.022\,M.$$

(ii) Observation table for absorbance for different flask

Flask No.	Ionic Strength (μ)	Intial conc^n of Fe^{3+} (ml)	1/a	Absorbance	1/A
1.	1·140	0·024	41·66	0·180	5·36
2.	1·104	0·018	64·10	0·166	6·02
3.	1·0896	0·0156	55·53	0·147	6·8
4.	1·0680	0·0012	83·33	0·104	6·9
5.	1·0536	0·0096	104·16	0·119	8·4
6	1·0392	0·0072	138·88	0·094	10·63
7	1·032	0·0060	166·67	0·083	12·04
8	1·0176	0·0048	208·33	0·071	14·08
9	1·242	0·0036	277·78	0·056	17·79
10	1·0104	0·0024.	416·67	0·045	22·22

Plotted a graph in b/w 1/A & 1/a, a straight is obtained. The Slope & intercept can be calculated form graph.

Then stability const,

$$K = \frac{\text{Intercept}}{\text{Slope}}$$

$$K = \frac{3{\cdot}4}{1{\cdot}84\times10^{-2}}$$

$$K = 1{\cdot}85\times10^{2}\ \text{l/mol}$$

VIII for VIII set.

$\mu_8 = \frac{1}{2}[(0.0048) \times 3^2 + 3(0.0048)(-1)^2 + [0.396] + [0.6]$

$\mu_8 = 1.0248\,M.$

IX for IX set :

$\mu_9 = \frac{1}{2}[(0.0036)(3)^2 + 3(0.0036)(-1)^2] + (0.396) + 0.6$

$\mu_9 = 1.0176\,M.$

X for X set –

$\mu_{10} = \frac{1}{2}[(0.0024)(3)^2 + 3(0.0024)(-1)^2 + [0.396]\,[0.6]$

$\mu_{10} = 1.010\,M$

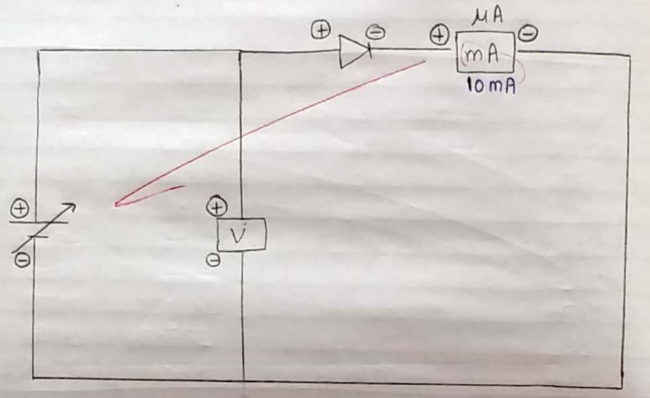
Stability Const. (K) = $\frac{\text{Intercept}}{\text{Slope}}$

$\text{Slope} = \frac{10.63 - 9.61}{138.88 - 8.333} = \frac{1.02}{55.55} = 184 \times 10^{-2}\ \text{mol/L}$

$K = \frac{3.4}{184 \times 10^{-2}} = 1.85 \times 10^{-2}\ \text{L/mol}$

Result –

The stability constant for complex ion is $1.85 \times 10^{2}\ \text{mol}^{-1}$



- Diode with forward bias.

Experiment - 4

Object -

To study and plot the forward & reverse bias characterstics of (Ge & Si) semiconductor diodes.

Apparatus -

(i) 0-10V D.C at 50mA continously variable with course & fine plots, regulated power supply.

(ii) D.C Voltmeter 65mm regctangular dial with switch selectable range of 1V to 10V

(iii) D.C Micrometer, 65 mm rectangular dial with switch selectable range of 50µA & 10mA.

(iv) Ge & Si semiconductor diodes

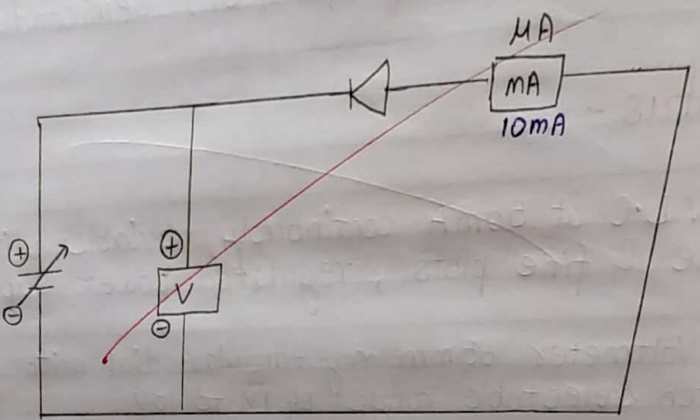
(v) Adequate no. of other electric components.

(vi) Main on/off switch & fuse.

Theory -

Characterstic Curve -

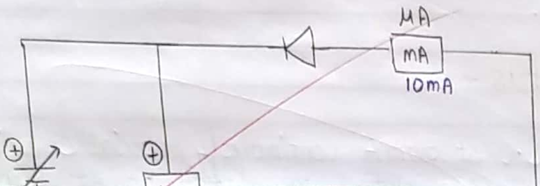
The current flowing through the p-n junction diode depends upon the bias voltage applied.

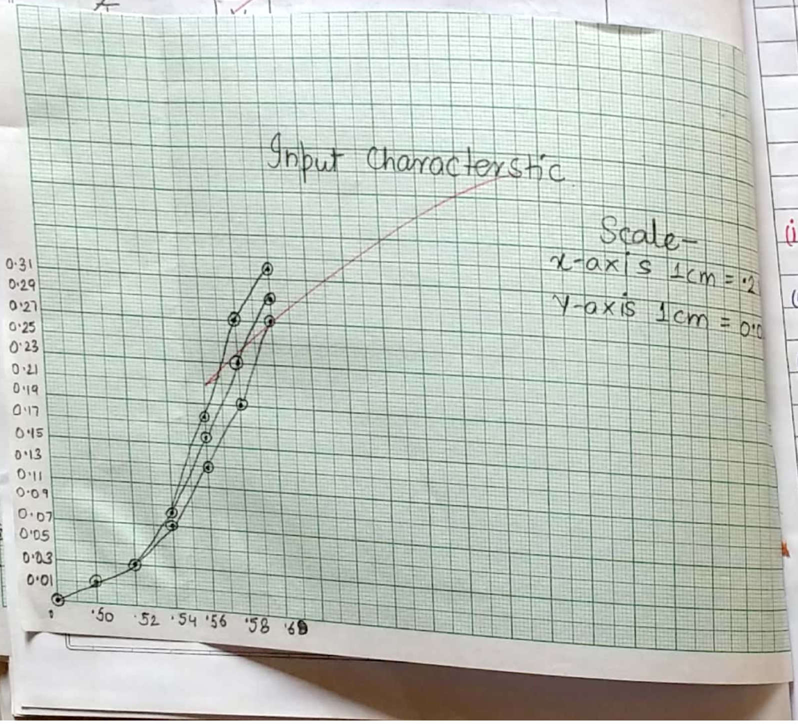


Diode with reverse bias.

the graph plotted
the current followi
the reverse bias char
The dependence of Cur
(V) is as follows.

$I = I_0 (e^{NV/RT}$





The graph plotted b/w the forward voltage & forward current is the forward charactersitics of the Junction diode.

In the reverse bias arrangement the graph plotted b/w the reverse bias voltage the current following through the diode is the reverse bias characteritic of diode.

The dependence of Current (I) upon Voltage (v) is as follows.

$$I = J_0 (e^{NV/RT})^{-1}$$

where

e is the electric Charge
T is the absolute temp.
K Boltzmann constant.

(ii) Resistance of P-N Junction diode -

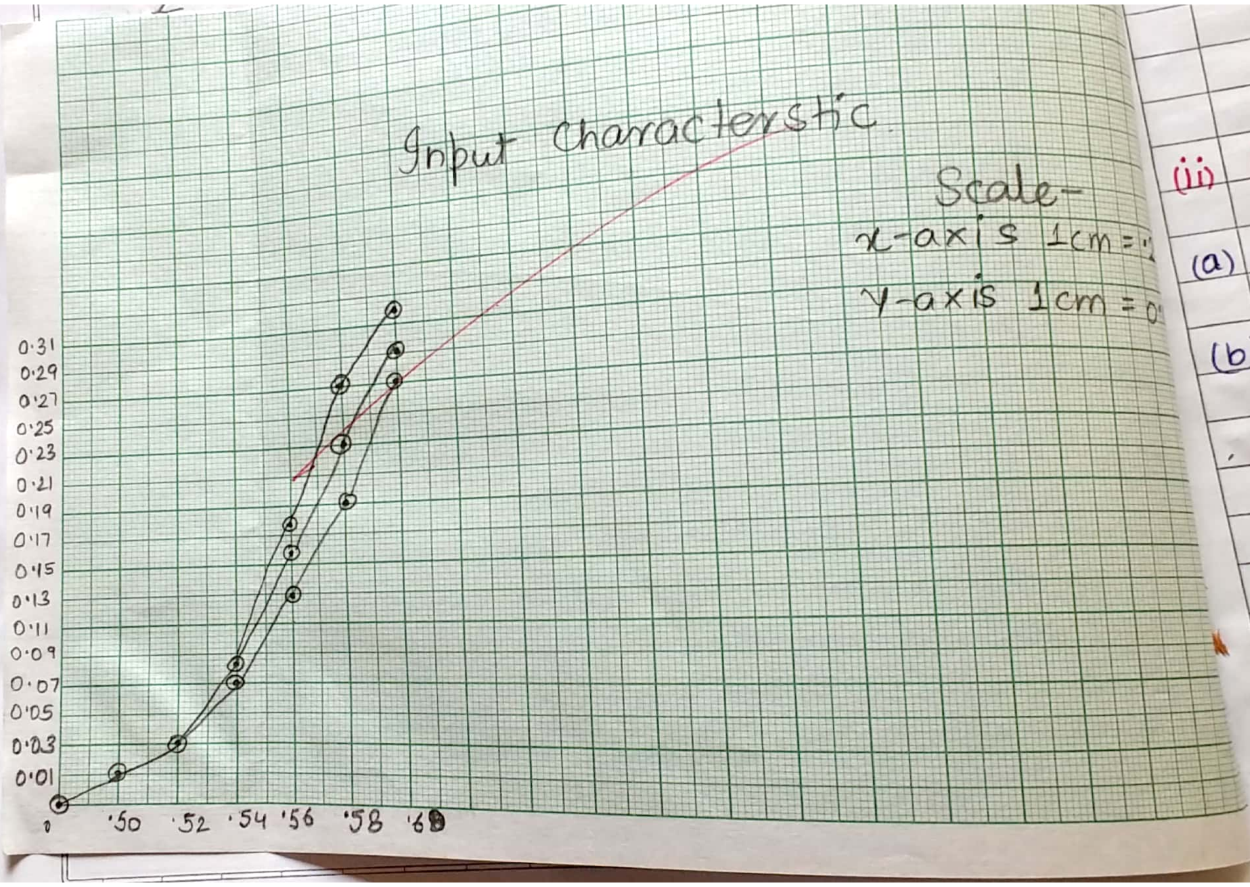
(a) Forward bias Resistance = $\frac{\Delta V_E}{\Delta I_E}$ Ohm (Ω)

(b) Reverse bias Resistance = $\frac{\Delta V_E}{\Delta I_E}$ Ohm (Ω)

Observation table -

Forward Biasing

S.No.	Voltage in Volts	Current in mA
1	0·1	0·0
2	0·2	0·0



K Bolt

(ii) Resistance of

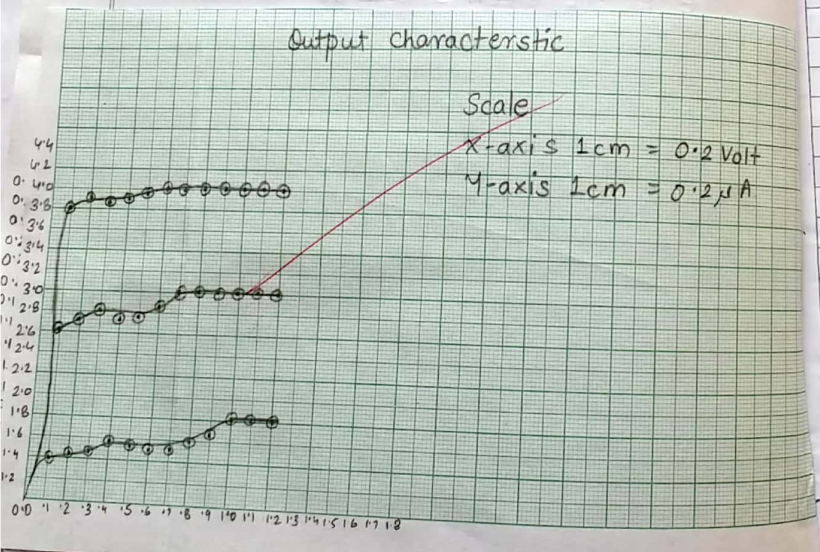
(a) Forward bias

(b) Reverse bia

Observat

Forward

S.No.
1
2

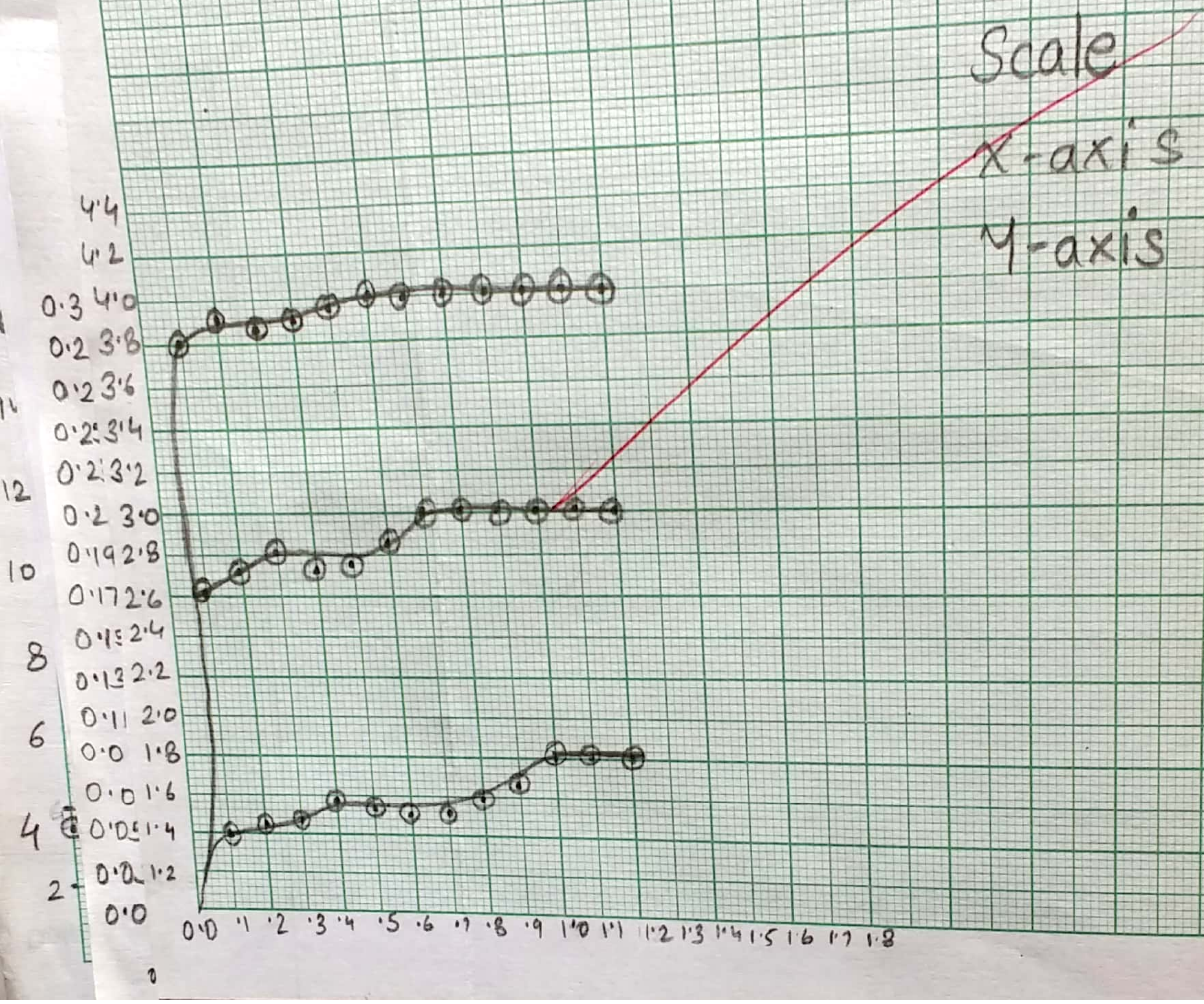


3	0·4	0·0
4	0·6	0·0
5	0·8	0·1
6	1·0	0·2
7	1·2	0·4
8	1·4	0·6
9	1·6	1·0
10	1·8	1·6
11	2·0	2·2
12	2·2	3·2
13	2·4	3·8
14	2·6	4·2
Total	= 18·3	= 17·3

Reverse biasing –

S·No.	Voltage in Volts	Currents (mA)
1	0·0	0·0
2	0·5	1·77
3	1·0	2·30
4	1·5	2·72
5	2·0	3·03
6	2·5	3·50
7	3·0	3·88
8	3·5	4·27
9	4·0	4·68
	T = 18	T = 26·15

Output characterstic



Scale

X-axis 1cm = 0·2 Volt

Y-axis 1cm = 0·2 μA

Calculation –

(i) From the forward bias characterstic current p-N-junction diode the forward Resistance is given by

$$R_E = \frac{\Delta V_E}{\Delta I_E} = \frac{1{\cdot}3071}{1{\cdot}2357} = 1{\cdot}0577.$$

(ii) From the resistance for reverse bias characterstic curve of P-N Junction diode the reverse is given by –

$$R_r = \frac{\Delta V_r}{\Delta I_r} = \frac{2{\cdot}25}{3{\cdot}2687} = 0{\cdot}68834.$$

Result -

It is clear that a diode offers a less forward bias resistance than reverse resistance and very high reverse resistance.

This fact is also clear from the Calculation

(A) Forward Resistance = 1·0577
(B) Reversed Resistance = 0·68834.

Precaution -

(i) In the state of forward bias the Voltage must be changed through small values with the help of Rheostate & the value of current help of due to Ting voltage, should not exceed the maximum allowed current for the Junction diode.

(ii) V.T.V.M is more suitable for the measurement of the bias voltage.

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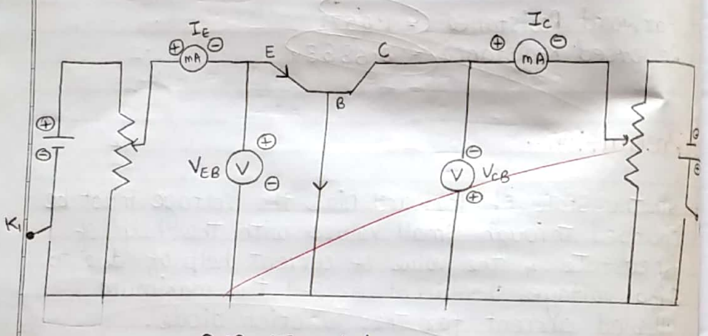


PNP- Transistor

Experiment -5.

Object -

Determine the characterstics of PNP transisters in common base configuration.

Apparatus -

(i) One PNP Junction Transistors
(ii) Voltmeter
(iii) Milli ~~Voltage~~ Voltmeter
(iv) Two milli ammeter
(v) Two battery etc.

Theory -

(A) Input Characterstics -

(i) $= \left[\frac{\Delta V_{EB}}{\Delta I_E}\right]_{V_{CB}}$

(ii) $= \left[\frac{\Delta V_{EB}}{\Delta V_{CB}}\right]_{IE}$

(B) Output characterstics -

$$= \left(\frac{\Delta I_C}{\Delta V_{CB}}\right)_{I_E}.$$

$$= \left(\frac{\Delta I_C}{\Delta I_E}\right)_{V_{CB}}.$$

Calculation –

$V_{CB} = 1 \quad h_{ib} = \left(\frac{\Delta V_{EB}}{\Delta I_E}\right)_{V_{CB}} = \frac{0.55}{0.1166} = 4.7169$

$V_{CB} = 2 \quad = \frac{0.55}{0.1316} = 4.1793$

$h_{rb} = \left(\frac{\Delta V_{EB}}{\Delta V_{CB}}\right)_{VC} = \frac{0.55}{1} = 0.55$

$= \frac{0.55}{2} = 0.275$

$= \frac{0.55}{3} = 0.1833$

where –

V_{EB} = Emitter Base Voltage
V_{CB} = Collector Base Voltage
I_B = Base Current
I_C = Collective Current

Observation Table –

(A) Input Characterstics

S.No.	V_{CB} = Volt		V_{CB} = 2 Volt		V_{CB} = 3 Volt	
	V_{EB}(mv)	I_E(mA)	V_{EB}(mv)	= I_E (mA)	V_{CB}(mv)	I_E(mA)
1.	0·50	0·01	0·50	0·01	0·50	0·01
2.	0·52	0·03	0·52	0·03	0·52	0·03
3.	0·54	0·07	0·54	0·07	0·54	0·08
4.	0·56	0·13	0·56	0·11	0·56	0·18
5.	0·58	0·19	0·58	0·22	0·58	0·22
6.	0·60	0·23	0·60	0·29	0·60	0·27
Total=	3·30	= 0·27	= 3·30	= 0·73	= 3·30	= 0·79
$\frac{\Delta V_{EB}}{6}$	= 0·55	= 0·1160	= 0·55	= 0·1216	= 0·55	= 0·1316

Output —

(i) $h_{ab} = \left(\frac{\Delta I_c}{\Delta V_{CB}}\right)_{I_E} = \frac{3\cdot9833}{0\cdot65} = 6\cdot1281$

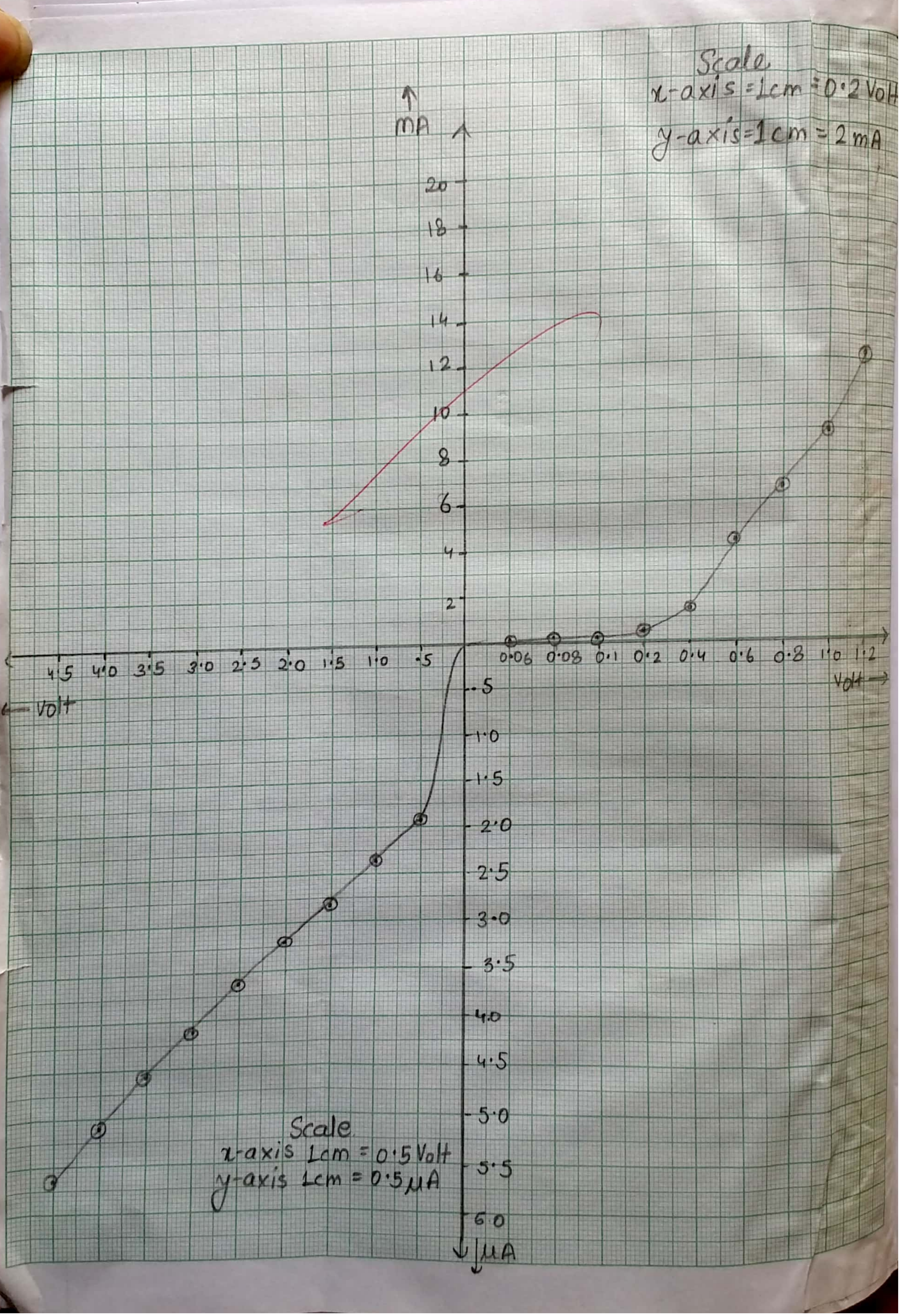
$= \frac{2\cdot8916}{0\cdot65} = 4\cdot4486$

$= \frac{1\cdot6583}{0\cdot65} = 2\cdot5512$

(ii) $h_{rb} = \left(\frac{\Delta I_E}{\Delta I_E}\right)_{V_{CB}} = \frac{3\cdot9833}{0}$

$= \frac{2\cdot8916}{1} = 2\cdot8916$

$= \frac{1\cdot6583}{2} = 0\cdot8291$


Scale
x-axis = 1cm = 0·2 Volt
y-axis = 1cm = 2 mA
mA
20
18
16
14
12
10
8
6
4
2
4·5
4·0
3·5
3·0
2·5
2·0
1·5
1·0
·5
0·06
0·08
0·1
0·2
0·4
0·6
0·8
1·0
1·2
Volt
Volt
·5
1·0
1·5
2·0
2·5
3·0
3·5
4·0
4·5
5·0
5·5
6·0
μA
Scale
x-axis 1cm = 0·5 Volt
y-axis 1cm = 0·5 μA

Output Characterstics :-

S.No.	$I_E = 0mA$		$I_E = 1mA$		$I_E = 2mA$	
	V_{CB} (volt)	I_C (mA)	V_{CB} (volt)	I_C (mA)	V_{CB} (volt)	I_C (mA
1.	0.1	3.8	0.1	2.6	0.1	1.4
2.	0.2	3.9	0.2	2.7	0.2	1.5
3	0.3	3.9	0.3	2.8	0.3	1.5
4	0.4	4.0	0.4	2.9	0.4	1.6
5	0.5	4.0	0.5	2.9	0.5	1.6
6	0.6	4.0	0.6	2.8	0.6	1.6
7	0.7	4.0	0.7	3.0	0.7	1.6
8	0.8	4.0	0.8	3.0	0.8	1.8
9	0.9	4.0	0.9	3.0	0.9	1.8
10	1.0	4.0	1.0	3.0	1.0	1.7
11	1.1	4.0	1.1	3.0	1.1	1.8
12	1.2	4.3	1.2	3.0	1.2	1.8
Total	7.8	47.8	7.8	34.7		19.9.

$\Delta V_{CB} = 0.65$ $\Delta I_C = 3.9833$ $\Delta V_{CB} = 0.65$ $\Delta I_E = 2.8916$ $\Delta I_C = 1.658$

Result –

$h_{ib} = 4.5230\ \Omega$

$h_{rb} = 0.275\ \Omega$

$h_{ab} = 4.4486\ \Omega$

$\alpha = 2.8916\ \Omega$

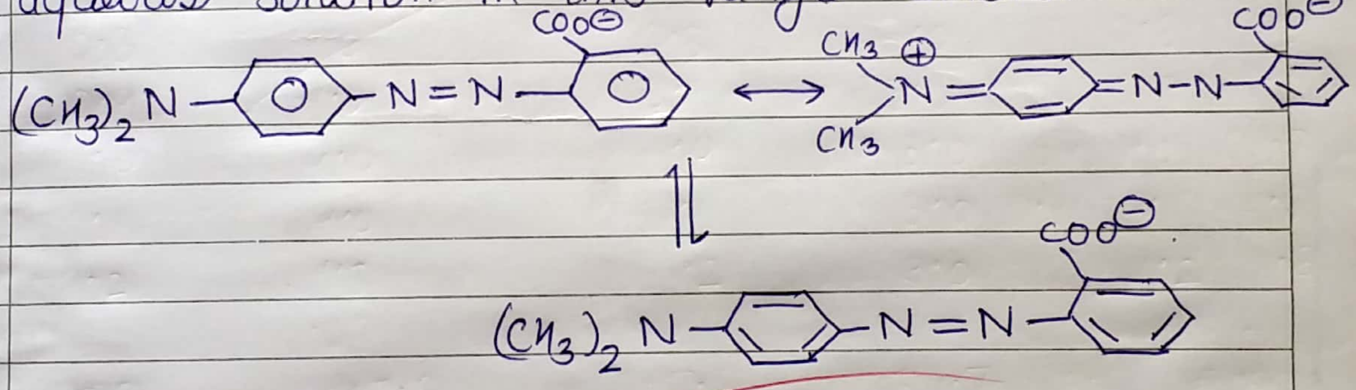
Experiment - 6.

Object -

Determine the pH of the solution employing methyl red indicator spectrophatometrically.

Theory -

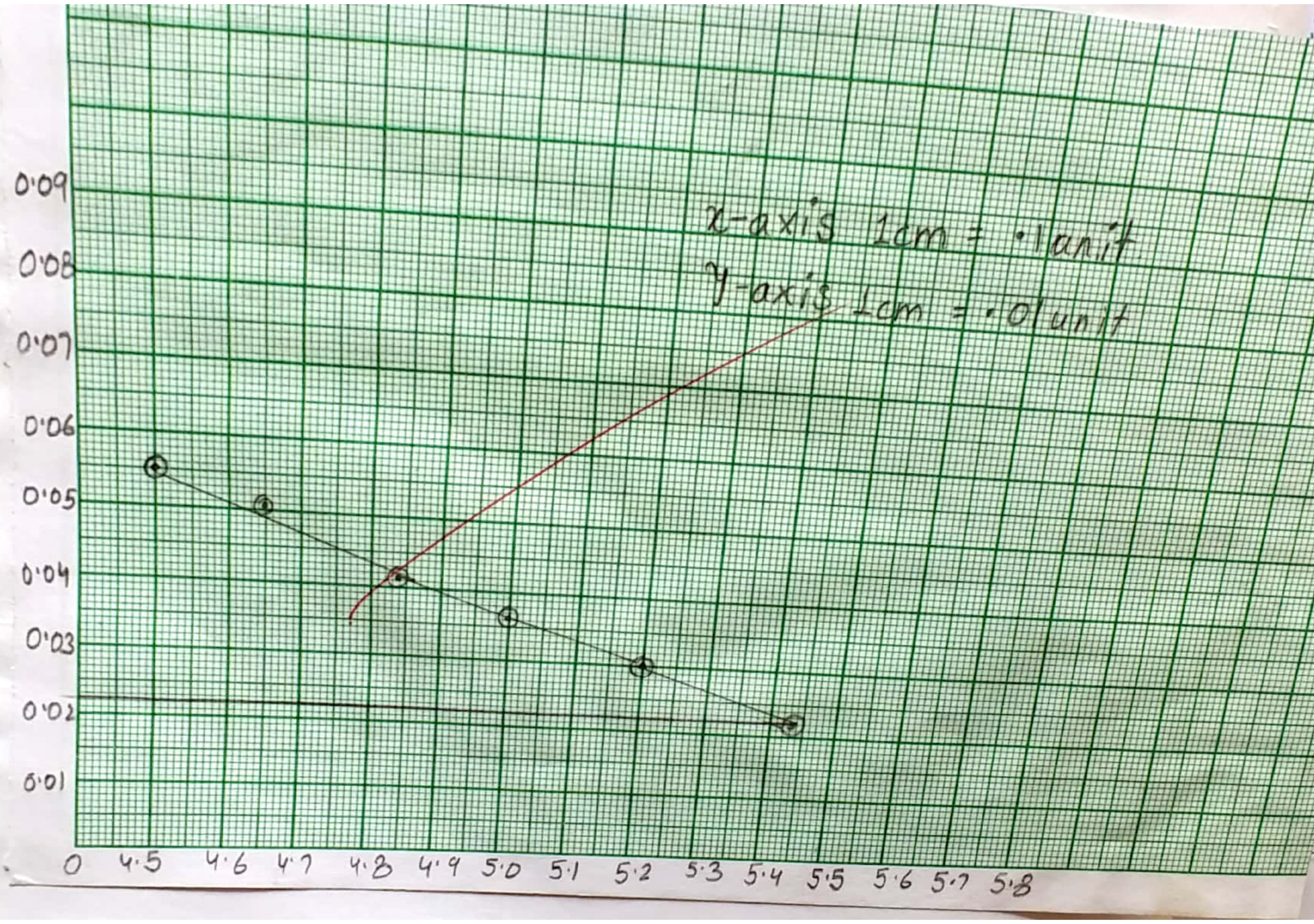
The indicator range of methyl red is in the pH region (4·2 - 6·3). Thus the following acid-base equilibrium of the indicator in the aqueous solution in this range exists.



The pH of the following solution is given by the following equation

$$pH = p^{k}In + \log\frac{[Salt]}{[Acid]}$$

$$= p^{k}In + \log\frac{\text{Colour due to basic form}}{\text{Colour due to acidic form}}$$



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Procedure -

Prepared acetate buffer sol^n of the pH as mentioned in the following table :-

S.No.	Volume of 0·2M CH_3COOH	Volume of 0·2M CH_3COONa	Total Volume (ml)
1.	15·0	10·00	25
2.	12·5	12·50	25
3.	10·0	15·00	25
4.	7·5	17·50	25
5.	5·0	20·00	25
6.	2·5	22·50	25

(ii) Prepared the stock solution of indicator by dissolving 0·1 gm of methyl red in ethanol (30ml) and diluted it upto 50ml by adding water.

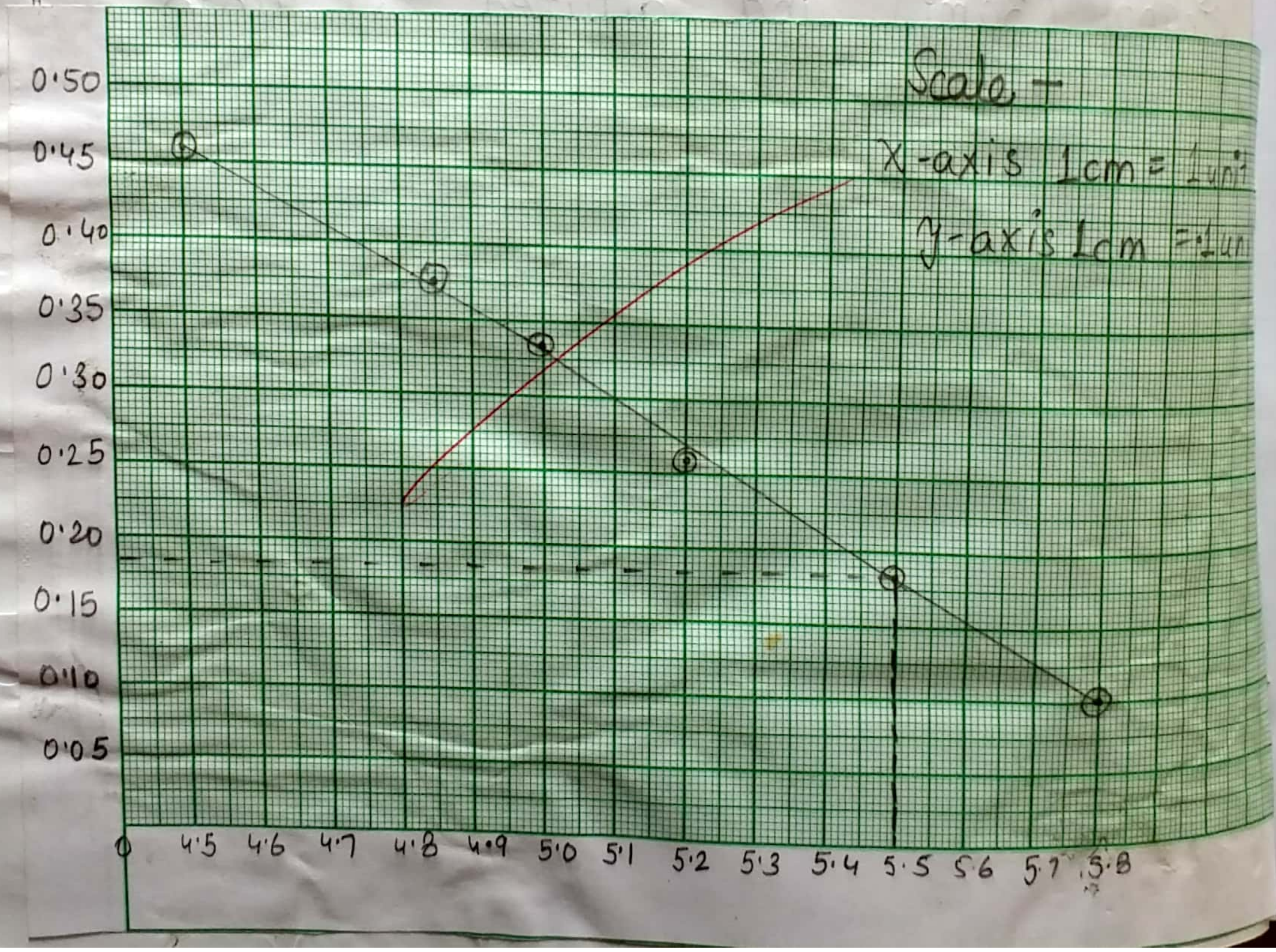
Took 5ml of this sol^n added to it 25ml alcohol & made it upto 50ml by adding water. It was the indicator Sol^n.

Added 1·5ml of this indicator Sol^n to each of the buffer Sol^n [25ml] as mentioned above in the table.

Measured absorbance of these sol^n at three wavelength such as at 400, 500, 550 nm respectively.

Calculation -

$$\text{Mean value of pH} = \frac{5{\cdot}45 + 5{\cdot}5 + 5{\cdot}49}{3} = 5{\cdot}48.$$



Expt. No.

Obser

S.No.	PH c
1.	4·5
2.	4·6
3.	4·8
4.	5·
5.	5·
6.	5·
7.	Unk

Calcul

absorb

(i) PH of
(ii) PH of
(iii) PH of
(iv) Mean

Result

Expt. No. ______ Date ______ Page No. ______

Observation Table -

S.No.	pH of Sol^n	Absorbance at 400nm	Absorbance at 500nm	Absorbance at 550nm
1.	4·57	0·055	0·461	0·401
2.	4·65	0·049	0·424	0·360
3.	4·85	0·041	0·376	0·312
4.	5·0	0·038	0·335	0·279
5.	5·8	0·030	0·291	0·226
6.	5·8	0·010	0·151	0·075
7.	Unknown Sol^n	0·022	0·221	0·150

Calculation -

Plotted the graphs in between the absorbance & pH at each wavelength

(i) pH of unknown Sol^n at 400nm = 5·45
(ii) pH of unknown Sol^n at 500nm = 5·57
(iii) pH of unknown Sol^n at 550 nm = 5·49
(iv) Mean Value of pH = 5·48

Result -

pH of unknown indicator Sol^n is 5·48

Surendra
28/4/18

Teacher's Signature ______