Experiment 1: Estimation of Fe^{2+} by Potentiometric Titration

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Slot: L11-L12

Date: 21/09/21

OBSERVATIONS:

Rough Titration:

Strength of standard potassium dichromate = 0.05N

Volume of FAS solution = 20mL

S. No	Volume of $K_2Cr_2O_7$ (mL)	EMF (Volt)
1	0.0000	0.4110
2	1.0000	0.4130
3	2.0000	0.4160
4	3.0000	0.4370
5	4.0000	0.5710
6	5.0000	0.5920
7	6.0000	0.6030
8	7.0000	0.6160
9	8.0000	0.6190
10	9.0000	0.6220
11	10.0000	0.6240

Fair Titration:

Strength of standard potassium dichromate = 0.05N

Volume of FAS solution = 20mL

S. No	Volume of $K_2Cr_2O_7$ (mL)	EMF(Volt)	ΔE (Volt)	ΔV (mL)	ΔE/ΔV (Volt/mL)	Average Volume (mL)
1	0.0000	0.4110				
2	1.0000	0.4130	0.0020	1.0000	0.0020	0.5000
3	2.0000	0.4160	0.0030	1.0000	0.0030	1.5000
4	2.2000	0.4180	0.0020	0.2000	0.0100	2.1000
5	2.4000	0.4230	0.0050	0.2000	0.0250	2.3000
6	2.6000	0.4280	0.0050	0.2000	0.0250	2.5000
7	2.8000	0.4330	0.0050	0.2000	0.0250	2.7000
8	3.0000	0.4370	0.0040	0.2000	0.0200	2.9000
9	3.2000	0.4480	0.0110	0.2000	0.0550	3.1000
10	3.4000	0.4680	0.0200	0.2000	0.1000	3.3000
11	3.6000	0.4960	0.0280	0.2000	0.1400	3.5000
12	3.8000	0.5370	0.0410	0.2000	0.2050	3.7000
13	4.0000	0.5710	0.0340	0.2000	0.1700	3.9000
14	5.0000	0.5920	0.0210	1.0000	0.0210	4.5000
15	6.0000	0.6030	0.0110	1.0000	0.0110	5.5000

1. $\Delta E = 0.002\,V$

$\Delta V = 1\,mL$

$\frac{\Delta E}{\Delta V} = 0.002\,\frac{V}{mL}$

2. $\Delta E = 0.003\,V$

$\Delta V = 1\,mL$

$\frac{\Delta E}{\Delta V} = 0.003\,\frac{V}{mL}$

3. $\Delta E = 0.002\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.01\,V/mL$

4. $\Delta E = 0.005\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.025\,\frac{V}{mL}$

5. $\Delta E = 0.005\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.0250\,\frac{V}{mL}$

6. $\Delta E = 0.005\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.025\,\frac{V}{mL}$

7. $\Delta E = 0.004\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.02\,V/mL$

8. $\Delta E = 0.011\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.055\,V/mL$

9. $\Delta E = 0.02\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.1\,V/mL$

10. $\Delta E = 0.0280\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.1400\,\frac{V}{mL}$

11. $\Delta E = 0.0410\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.2050\,\frac{V}{mL}$

12. $\Delta E = 0.0340\,V$

$\Delta V = 0.2\,mL$

$\frac{\Delta E}{\Delta V} = 0.17\,\frac{mL}{V}$

13. $\Delta E = 0.0210\,V$

$\Delta V = 1.00\,mL$

$\frac{\Delta E}{\Delta V} = 0.0210\,\frac{V}{mL}$

14. $\Delta E = 0.0110$

$\Delta V = 1\,mL$

$\frac{\Delta E}{\Delta V} = 0.011\,\frac{V}{mL}$

CALCULATIONS:

Volume of $K_2Cr_2O_7$ (from derivative graph) (V_1) = 3.7 mL

Normality of $K_2Cr_2O_7$ (N_1) = 0.05 N

Volume of Fe^{2+} solution (V_2) = 20 mL

Normality of Fe^{2+} solution (N_2) = ?

$$N_1 V_1 = N_2 V_2$$

$$N_2 = (N_1 V_1)/(V_2)$$

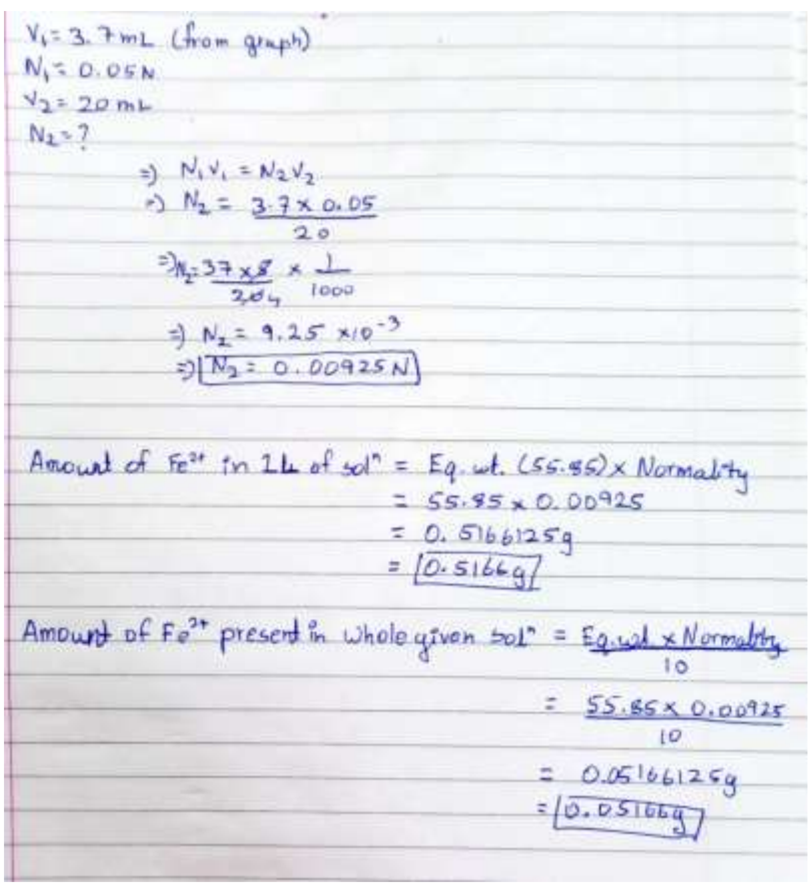
$$= 0.00925 \text{ N}$$

Amount of Fe^{2+} present in 1 liter of the given solution = Eq. wt. (55.85) x Normality

$$= 0.5166125 \text{ g}$$

Amount of Fe^{2+} present in whole given solution = [Eq. wt. (55.85) x Normality] / 10

$$= 0.05166125 \text{ g}$$



$V_1 = 3.7$ mL (from graph)
$N_1 = 0.05$ N
$V_2 = 20$ mL
$N_2 = ?$

$\Rightarrow N_1 V_1 = N_2 V_2$

$\Rightarrow N_2 = \frac{3.7 \times 0.05}{20}$

$\Rightarrow N_2 = \frac{37 \times \cancel{5}}{\cancel{20}\ 4} \times \frac{1}{1000}$

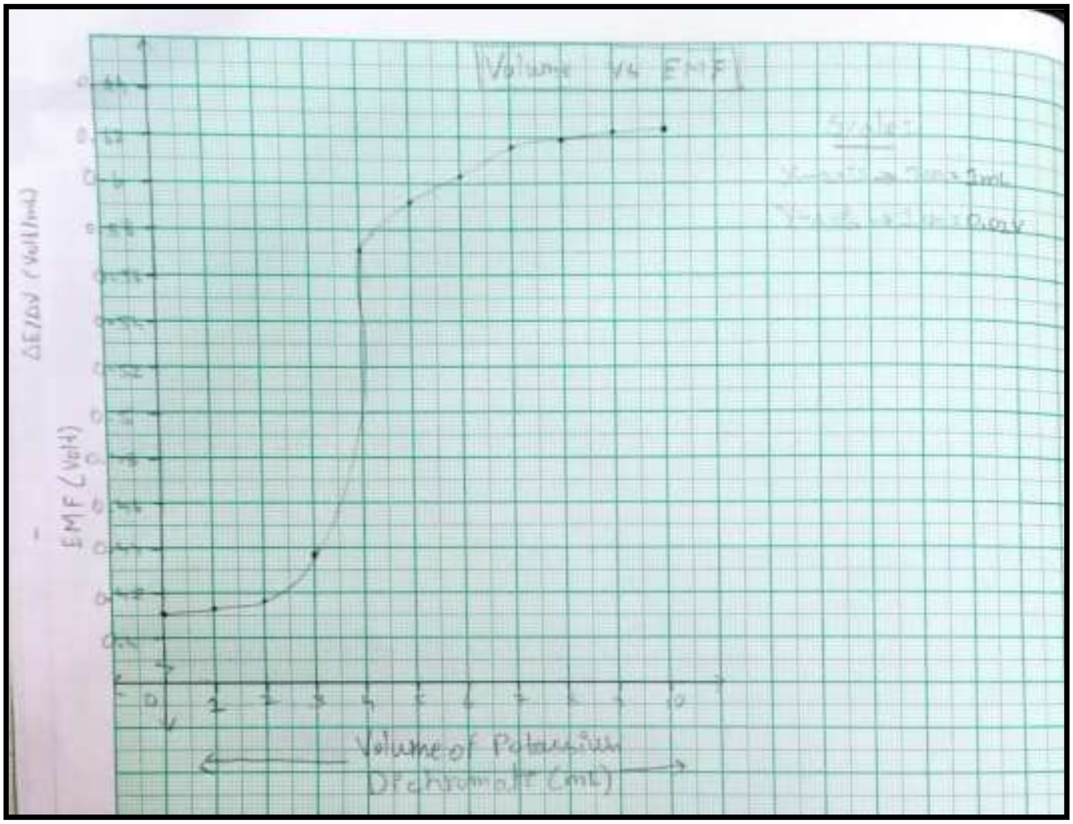
$\Rightarrow N_2 = 9.25 \times 10^{-3}$

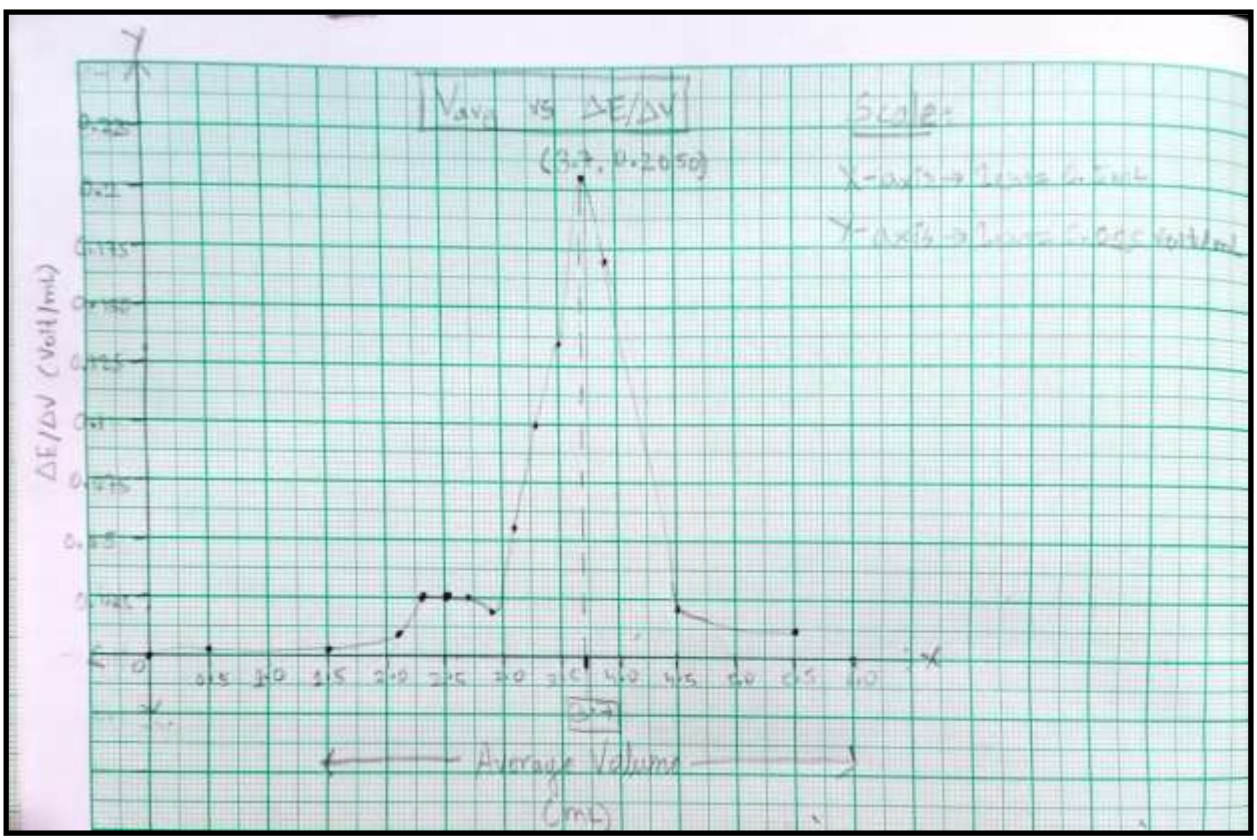
$\Rightarrow \boxed{N_2 = 0.00925 \text{ N}}$

Amount of Fe^{2+} in 1L of sol^n = Eq. wt. (55.85) x Normality
= 55.85 x 0.00925
= 0.5166125g
= $\boxed{0.5166g}$

Amount of Fe^{2+} present in whole given sol^n = $\frac{\text{Eq. wt} \times \text{Normality}}{10}$
= $\frac{55.85 \times 0.00925}{10}$
= 0.05166125g
= $\boxed{0.05166g}$

GRAPH:


Volume vs EMF
Scale:
EMF (Volt)
Volume of Potassium Dichromate (mL)


Vavg vs ΔE/ΔV
Scale:
(3.7, 0.2050)
ΔE/ΔV (Volt/mL)
Average Volume (mL)

Result:

1. Equivalence point determined from the graph = 3.7 ml
2. The amount of Fe^{2+} ion present in one litre of the given solution = 0.5166g