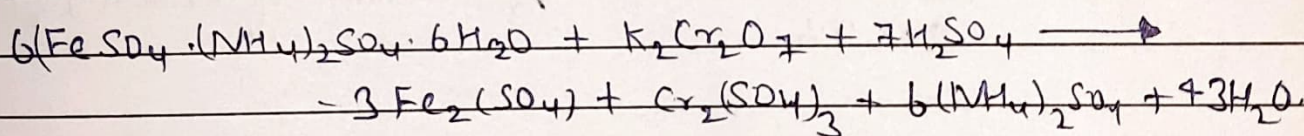Object :- Determine the strength of unknown Ferrous ammonium sulphate (FAS) solution by titrating it with potassium dichromate solution using N-phenyl anthranilic acid as an internal indicator.

Apparatus / Reagents required :- Burette, pipette, conical flask (100 ml), known & unknown FAS solution, unknown $K_2Cr_2O_7$ solution, N-phenyl anthranilic acid, sulphuric Acid (10%) etc.

Theory :- In acidic medium (HCl or H_2SO_4) $K_2Cr_2O_7$ solution acts as an oxidizing agent & gives three atoms oxygen for oxidation of reducing agent.

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_2 + 4H_2O + 3[O]$$
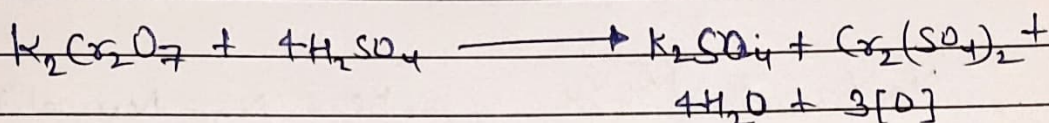
The oxygen so liberated oxidize Fe^{+2} to Fe^{+3} in FAS solution by adding 5-6 drops N-phenyl anthranitic acid as an internal indicator, the green colour of solution changes purple reddish tinge at the end point.

$$6(FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O) + K_2Cr_2O_7 + 7H_2SO_4 \longrightarrow$$
$$- 3Fe_2(SO_4) + Cr_2(SO_4)_3 + 6(NH_4)_2SO_4 + 43H_2O.$$

Procedure :- (1) Prepare standard solution FAS in distilled water.

(2) Fill the burette with known $K_2Cr_2O_7$ solution.

(3) Take 10 ml of standard (FAS) solution & 10 ml Sulphuric

Calculation

For standard FAS solution with $K_2Cr_2O_7$

$$N_1V_1 = N_2V_2$$

$$N_1 \times 9.6 = \frac{N}{30} \times 10$$

$$N_1 = \frac{N}{3 \times 9.6}$$

here N_2 = Normality of known
solution = $N/30$
V_2 = 10 ml
V_1 = volume of $K_2Cr_2O_7$
N_1 = Normality of $K_2Cr_2O_7$

Now for standard unknown FAS Solution with
same $K_2Cr_2O_7$

$$N_3V_3 = N_4V_4$$

$$\frac{N}{3 \times 9.6} \times 5.4 = N_4 \times 10$$

$$N_4 = \frac{N \times 5.4}{30 \times 9.6}$$

$$N_4 = 0.01875\ N$$

here N_3 = Normality of $K_2Cr_2O_7$
= N_1
N_4 = Normality of Unknown
FAS
V_4 = Volume of unkown FAS
V_3 = Volume of known $K_2Cr_2O_7$

---

acid in a conical flask.

4. Add 5-6 drops of N phenyl anthranilic acid into the conical flask.
5. Add $K_2Cr_2O_7$ solution from burette into (FAS) solution with constant shaking. to observe the colour change
6. Add solution drop wise until the solution in conical flask green due to the formation of $Cr_2(SO_4)_3$
7. Addition of $K_2Cr_2O_7$ solution suddenly changes the green colour to purple reddish tinge. This indicates the end point.
8. Repeat the titration till concordant reading is obtained
9. Follow the titration procedure for the Unknown solution to obtain the burette reading.

Observation :-

(A) Titration between standard FAS solution to indermediate $K_2Cr_2O_7$.

S.N.	Volume of known FAS Solution (ml)	Volume of $K_2Cr_2O_7$ Initial	Volume of $K_2Cr_2O_7$ Final	Difference (ml)	Concordant Reading.
1.	10	0	9.6	9.6	9.6
2.	10	9.6	19.2	9.6	

Now the strength of unknown FAS

$$Strength = \frac{N}{3} \times eq.\,weight$$

$$= 0.01875 \times 392.16$$

$$= 7.353 \; gm/Lit.$$

(B) Titration between unknown FAS solution & $K_2Cr_2O_7$

S.No	Volume of unknown FAS solution (ml)	Volume of $K_2Cr_2O_7$		Difference (ml)	Concordant Reading
		Initial (ml)	Final (ml)		
1.	10	0	5.5	5.5	5.4
2.	10	5.5	10.9	5.4	

Result :- The strength of unknown FAS solution is 7.353 gm/lit.

Precautions :- (i) All the apparatus should be washed properly.
(ii) $K_2Cr_2O_7$ solution should be added drop wise
(iii) End point should be observed carefully

Industrial Application :-
(i) It is used to determine the strength of unknown solution
(ii) Titration is used to analyse acid rain.
(iii) Titration are used to determine the concentration of contaminents in surface water.
(iv) It is also used in food & beverage industry to analyse the standard concentration of specific additives.
(v) FAS is used in the fickers dose meter to measurement high dies of gamma rays.

* **Viva Questions:-**

Q1 Why dil.H_2SO_4 is added in the preparetion by FAS solution?
Ans Dilute Sulphuric Acid (H_2SO_4) is added to prevent
the hydrolysis of ferrous sulphate. It prevent
of the. Fe^{+2} ion .to Fe^{+3} ions(Yellow)

Q2 What do you mean by volumetric analysis?
Ans Volumatric analysis any method of quantitive.
chemical analysis in which the amount of a
substance is determined by mortusing to volume that
is occupies.

Q3 What do you understand by concordant reading?
Ans • Readings have been taken several times & the
readings are indentical or close to each other. This
is known as concordant reading.
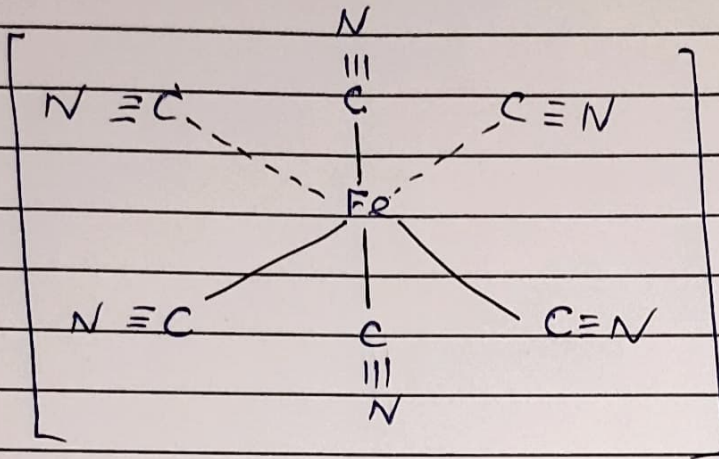
Q4 Explain the types of indicator.
Ans Indicator are the substance that change colour when
they are added to acidic or alkaline solutions.
Litmus, phemelphthalein and methyl orange, N-phenyl
enthranilic acid and pottessium ferricyanide, are
used in the laboratory change in property is
observed when they come in contact with an
acidic or basic solution.

Q5 Which indicator is used in this s. titration. write its structure.

Ans Potassium ferricyanide is used in this titration as external indicator.

$$N \equiv C \cdots Fe \cdots C \equiv N$$

(Structure showing Fe coordinated with six $C \equiv N$ / $N \equiv C$ groups, with two axial $\overset{|||}{C}-N$ groups top and bottom)

Structure

Q6 Explain the principle involved in this titration.

Ans Ferrous ammonium sulphate in a stable double salt with $FeSO_4$ being its active constituent. It is a compound of iron and sulphate in which the ratio of ammonium iron $(+2)$ to sulphate ions $(+3)$ is 2:1:2

Q7 Why distilled water is used to prepare standard solution?
Because it does not contain impurities like dissolved iron ions