EXPERIMENT-4

Experiment: To determine hexavalent chromium content of a water sample by back-titration method.

Apparatus: Pipette, burette, beaker, conical flask, funnel, burette stand

Chemicals: $K_2Cr_2O_7$ of unknown strength, H_2SO_4, Mohr's salt; $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$, $KMnO_4$

Chemical equation:

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightleftharpoons 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

$$MnO_4^- + 8H^+ + 5Fe^{2+} \rightleftharpoons Mn^{2+} + 5Fe^{3+} + 4H_2O$$

Observation

a) Standardization of $KMnO_4$ solution

volume of 0.1N FAS (N_0) solution taken for Titration = 10 mL (V_0)

S.No.	Initial reading (ml)	Final reading (ml)	Vol. of $KMnO_4$ used
1.			
2.			
3.			

EXPERIMENT-4

Experiment: To determine hexavalent
content of a water sample b
titration method.

Apparatus: Pipette, burette, beakers
flask, funnel, burette stan

chemicals: Potassium dichromate sol
of unknown strength,
acid (H_2SO_4), Mohr's salt solut
ammonium sulphate; $FeSO_4$(NH
and potassium permanganate

Equations:

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightleftharpoons$$

$$MnO_4^- + 8H^+ + 5Fe^{2+} \rightleftharpoons M$$

Theory:

In an acidic solution
Fe^{2+} to Fe^{3+} while itself
the trivalent chromium
volume of the sample
Cr^{6+} ions is added
of the Mohr salt solu
tration) in presence
Cr^{6+} is reduced to Cr^{3}

EXPERIMENT-4

Experiment: To determine hexavalent chromium content of a water sample by back-titration method.

Apparatus: Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

Chemicals: Potassium dichromate solution ($K_2Cr_2O_7$) of unknown strength, sulphuric acid (H_2SO_4), Mohr's salt solution (Ferrous ammonium sulphate; $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$) and potassium permanganate ($KMnO_4$)

Equations:

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightleftharpoons 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

$$MnO_4^- + 8H^+ + 5Fe^{2+} \rightleftharpoons Mn^{2+} + 5Fe^{3+} + 4H_2O$$

Theory:

In an acidic solution of Fe^{2+}, Cr^{6+} oxidizes Fe^{2+} to Fe^{3+} while itself getting reduced to the trivalent chromium. If to a certain volume of the sample solution (containing Cr^{6+} ions is added a known amount of the Mohr salt solution (known concentration) in presence of sulphuric acid, Cr^{6+} is reduced to Cr^{3+}, while the Fe^{2+}

b) Determination of Cr^{6+} solution by back-titration method

Volume of $K_2Cr_2O_7$ sample solution taken for titration = 10 ml

Volume of Mohr's salt (0.1M) solution added = 10 ml

Sr No	Initial reading (ml)	Final reading (ml)	Vol. of $KMnO_4$ used
1			
2			
3.			

Calculations

a) Normality of $KMnO_4$ solution

Applying normality equation

N_0V_0 (Given FAS) = N_1V_1 ($KMnO_4$)

Calculate N_1 = normality of $KMnO_4$ being used

i) Determination Cr^{6+} contents

Total Fe^{2+} added to Cr^{6+} solution = 10 ml × 0.1 meq

= ______

Volume of N_1 $KMnO_4$ solution used in the titration = V_2 ml = ______

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is oxidised to Fe^{3+}. The un-reacted Fe^{2+} can then be determined by titrating against a standard $KMnO_4$ solution. From the volume of ferrous ion consumed, the amount of hexavalent chromium can be determined. The Mohr salt solution (Fe^{2+}) added to the dichromate is in excess so that complete reduction of Cr^{6+} ions to Cr^{3+} ions takes place. This method of volumetric analysis is known as back-titration method.

Procedure: a. Standardization of $KMnO_4$:

Transfer 10ml of the standard 0.1N FAS solution is a clean conical flask using a pipette following by addition of 5mL of 4N sulphuric acid. Titrate the solution against $KMnO_4$ solution taken in a burette. Note the volume of solution used when color of the solution in conical flask changes from colourless to pink. Repeat the titration minimum three times and take mean of the closely related readings. Treat this as volume V_1.

Fe^{2+} left in solution after conversion of Cr^{6+} to Cr^{3+} $= V_2N_1$ meq.

$=$ ________

Amount of Fe^{2+} reacted with Cr^{6+}

$$= [10 \times 0.1N\,(FAS) - V_2N_1] \text{ meq.}$$

This is equal to amount of Cr^{6+} present in 10ml of the solution

Equivalent weight of Chromium $= \frac{52}{3}$

$$= 17.33 \text{ gm/L}$$

Thus, amount of Cr^{6+} present in solution

$$= \left[\frac{\{10 \times 0.1N\,(FAS) - V_2N_1\} \times 17.33}{10}\right] \text{gm/L}$$

Result:

Amount of Cr^{6+} present in the given sample solution was found to be _____ g/L

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6: Determ

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6: Determination of Cr^{6+} content: Transfer 10ml of Cr^{6+} solution and 10 ml of the FAS solution with a pipette. Add 5ml of 5ml of 4N sulphuric acid with a graduated cylinder. Titrate the solution against the standardization $KMnO_4$ solution Note the volume of solution used when color of the solution in conical flask changes from green to pink. Repeat the titration minimum three times and take mean of the closely related readings. Treat this as volume V_2.

Calculations: a). Normality of $KMnO_4$ soln. = 0.1N

Applying normality equation

N_0V_0 (Given FAS) = N_1V_1 ($KMnO_4$)

Total Fe^{2+} added to Cr^{6+} solution = 10ml × 0.1N meq.

Volume of N_1 $KMnO_4$ solution used in the titration = V_2 mL

Fe^{2+} left in soln after conversion of Cr^{6+} to Cr^{3+} = V_2N_1 meq

Amount of Fe^{2+} reacted with Cr^{6+} = [10 × 0.1 N (FAS) − V_2N_1] meq

This is equal to amount of Cr^{6+} present in 10 ml of the solution

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Equivalent weight of chromium $= 52/3$
$= 17.33$ g/L

Thus, amount of Cr^{6+} present in solution
$= [\{10 \times 0.1N (FAS) - V_2N_1\} \times 17.33]/10$ g/L

Result: Amount of Cr^{6+} present in the given sample solution was found to be ---- g/L