# CHEMISTRY STUDY MATERIALS FOR CLASS 12 (NCERT BASED NOTES OF CHAPTER -8) GANESH KUMAR DATE:- 08/08/2021

## The d & f - Block Elements

### Potassium dichromate, K2Cr2O7:

**Preparation:** It is prepared from chromite ore or ferro chromes (FeCr2O4 or FeOCr2O3) by following steps.

(a) Fusion of the ore with molten alkali in presence of air

 $4FeCr2O4 + 16 NaOH + 7O2 \rightarrow 8Na2CrO4 + 2Fe2O3 + 8H2O.$ 

The fused mass is extracted with water and filtered.

(b) Conversion of sodium chromate into sodium dichromate by treating the filtrate with dil H2SO4

 $2Na2CrO4 + H2SO4 \rightarrow Na2Cr2O7 + Na2SO4 + H2O$ 

Na2SO4 being less soluble is separated as Na2SO410H2O by fractional crystallization.

(c) Conversion of sodium dichromate into potassium dichromate by heating with KCI. Na2Cr2O7 + 2KCI  $\rightarrow$  K2Cr2O7 + 2NaCl

Potassium dichromate being less soluble is obtained by fractional crystallization.

#### **Properties:**

- (i) Physical state : Potassium dichromate forms orange red crystals which melts at 669K. It is moderately soluble in cold water but freely soluble in hot water.
- (ii) **Action of heat** : When heated strongly to white heat, it decomposes with the evolution of oxygen.

 $\begin{array}{rcl} 4\text{K}2\text{Cr}2\text{O7} & \stackrel{\Delta}{\rightarrow} & 4\text{K}2\text{Cr}\text{O4}+2\text{Cr}2\text{O3}+3\text{O2} \\ \text{Pot. Dichromate} & \text{Pot. Chromate chromic oxide} \end{array}$ 

 (iii) Action of alkalis: When an alkali is added to an orange red solution containing dichromate ions, a yellow solution is obtained due to the formation of chromate ions. For example,

K2Cr2O7+ 2KOH	$\rightarrow$	2K2CrO4 + H2O
Pot. Dichromate		Pot. Chromate

On acidifying the above yellow solution containing chromate ions, it again change to orange red due to the formation of dichromate ions.

 $2K_2CrO4 + H_2SO4 \rightarrow K_2Cr_2O7 + K_2SO4 + H_2O$ Pot. Chromate Pot. Dichromate

In fact, in any given solution, dichromate ions and chromate ions exist in equilibrium and are interconvertible by altering the pH of the solution.



(iv) Action of concentrated sulphuric acid : In cold, red crystals of chromic anhydride (CrO3) are formed

 $K2Cr2O7 + 2H2SO4(conc) \rightarrow 2CrO3 + 2KHSO4 + H2O$ 

(v) Oxidising properties : Potassium dichromate is a powerful oxidizing agent. In acidic solution, its oxidizing action can be represented as follows.

Ionic equation :  $CrO7^{2-} \rightarrow 2Cr^{3+} + 7 H_2O + 14H^+ + 6e^- [E^0 = +1.31V]$ Molecular equ<sup>n</sup> : K\_2Cr\_2O7 + 4H\_2SO4  $\rightarrow$  K\_2SO4 Cr\_2(SO4)3 + 4H\_2O + 3[O]

(a) It oxidises iodides to iodine

 $Cr_{2}O7^{2-} + 14H^{+} + 6I^{-} \rightarrow 2Cr^{3+} + 7H_{2}O + 3I_{2}$  (Ionic Equation)

This reaction is used in the estimation of iodide ions in the volumetric analysis.

(b) It oxidises ferrous salts of ferric salts:

 $Cr_{2}O7^{2-} + 14H^{+} + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_{2}O + 6Fe^{3+}$ 

This reaction is used in the estimation of ferrous ions in the volumetric analysis.

(c) In oxidises H2S to S :

 $Cr_{2}O7^{2-} + 8H^{+} + 3H_{2}S \rightarrow 2Cr^{3+} + 7H_{2}O + 3S$ 

(d) It oxidises sulphur dioxide to sulphuric acid :

 $Cr_{2}O7^{2-} + 2H^{+} + 3SO_{2} \rightarrow 2Cr^{3+} + H_{2}O + 3SO_{4}^{2-}$ 

(e) If oxidises ethyl alcohol to acetaldehyde and acetic acid :

 $K_2Cr_2O7 + 4H_2SO4 \rightarrow K_2SO4 + Cr_2(SO4)_3 + 4H_2O + 3[O]$ 

 $C2H5OH + [O] \rightarrow CH3CHO + H2O$ 

 $\mathsf{CH3CHO}+[\mathsf{O}] \quad \rightarrow \quad \mathsf{CH3COOH}$ 

(vi) **With hydrogen peroxide** : Acidified potassium dichromate forms a deep blue colour with hydrogen peroxide due to the formation of CrO5.

 $K2Cr2O7 + H2SO4 + 4H2O2 \rightarrow 2CrO5 + K2SO4 + 5H2O$ 

The blue colour fades away gradually due to decomposition of CrO5 into  $Cr^{3+}$  ions and oxygen.



#### (vii) Structure of chromate and dichromate ions :

#### Uses.

- (i) In volumetric estimation of reducing agents e.g., ferrous salts, iodides and sulphites. This is due to the fact that K2Cr2O7 is obtained in a much higher degree of purity than Na2Cr2O7
- (ii) In the preparation of chromium compounds e.g., chrome alum.
- (iii) In photography for hardening of gelatin.
- (iv) In dyeing for producing Cr(OH)3 as mordant.
- (v) Chromic acid mixture (K2Cr2O7 + conc. H2SO4) is used for cleaning glass wares in the laboratory.
- (vi) As an oxidizing agent.