

# CHEMISTRY STUDY MATERIALS FOR CLASS 12 (NCERT BASED QUESTIONS WITH ANSWERS ) GANESH KUMAR                      DATE:- 22/07/2020

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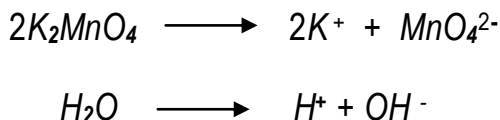
## The d & f - Block Elements

**Question 16:** Describe the preparation of potassium permanganate. How does the acidified Permanganate solution react with (i) iron (II) ions (ii) SO<sub>2</sub> and (iii) oxalic acid? Write the ionic equations for the reactions.

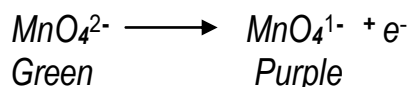
**Solution 16:** Potassium permanganate can be prepared from pyrolusite (MnO<sub>2</sub>). The ore is fused with KOH in the presence of either atmospheric oxygen or an oxidizing agent, such as KNO<sub>3</sub> or KClO<sub>4</sub>, to give K<sub>2</sub>MnO<sub>4</sub>.



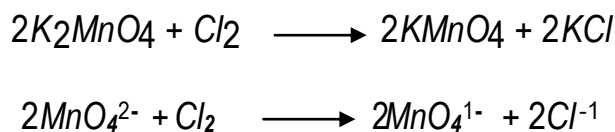
The green mass can be extracted with water and then oxidized either electrolytically or by passing chlorine/ozone into the solution. Electrolytic oxidation.



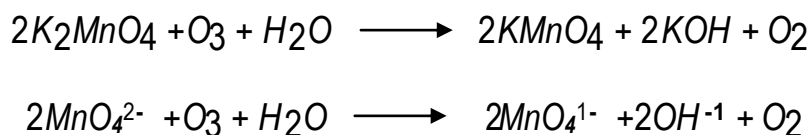
At anode, manganate ions are oxidized to permanganate ions.



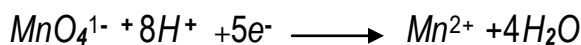
### **Oxidation by chlorine**

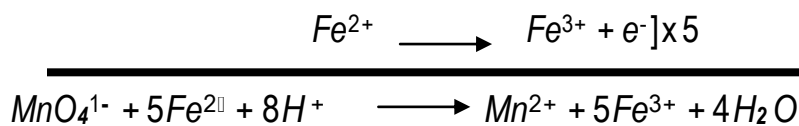


### **Oxidation by ozone**

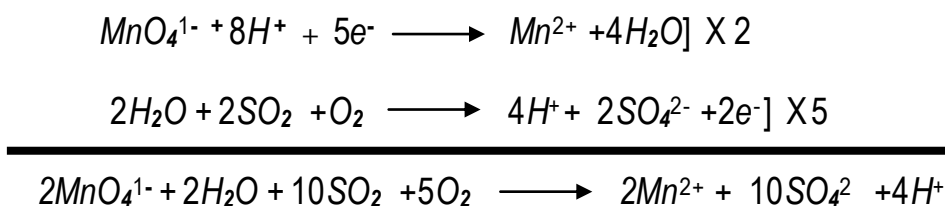


(i) Acidified KMnO<sub>4</sub> solution oxidizes Fe (II) ions to Fe (III) ions i.e.,

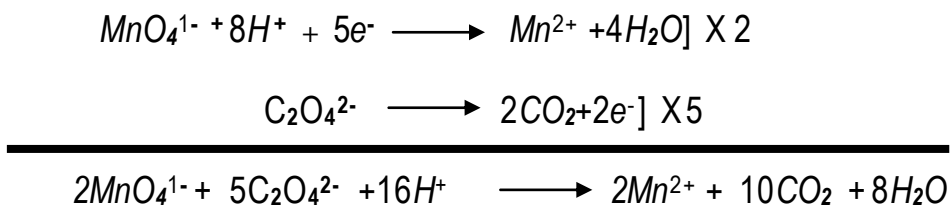




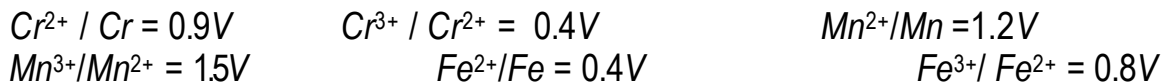
(ii) Acidified potassium permanganate oxidizes  $\text{SO}_2$  to sulphuric acid.



(iii) Acidified potassium permanganate oxidizes oxalic acid to carbon dioxide.



**Question 17:** For  $M^{2+} / M$  and  $M^{3+} / M^{2+}$  systems, the  $E^\ominus$  values for some metals are as follows



Use this data to comment upon:

- (i) The stability of  $\text{Fe}^{3+}$  in acid solution as compared to that of  $\text{Cr}^{3+}$  or  $\text{Mn}^{3+}$  and
- (ii) The ease with which iron can be oxidized as compared to a similar process for either chromium or manganese metal.

**Solution 17:** (i) The  $E^\ominus$  value for  $\text{Fe}^{3+} / \text{Fe}^{2+}$  is higher than that for  $\text{Cr}^{3+} / \text{Cr}^{2+}$  and lower than that for  $\text{Mn}^{3+} / \text{Mn}^{2+}$ . So, the reduction of  $\text{Fe}^{3+}$  to  $\text{Fe}^{2+}$  is easier than the reduction of  $\text{Mn}^{3+}$  to  $\text{Mn}^{2+}$ , but not as easy as the reduction of  $\text{Cr}^{3+}$  to  $\text{Cr}^{2+}$ . Hence,  $\text{Fe}^{3+}$  is more stable than  $\text{Mn}^{3+}$ , but less stable than  $\text{Cr}^{3+}$ . These metal ions can be arranged in the increasing order of their stability as:  $\text{Mn}^{3+} < \text{Fe}^{3+} < \text{Cr}^{3+}$

(ii) The reduction potentials for the given pairs increase in the following order.

$\text{Mn}^{2+} / \text{Mn} < \text{Cr}^{2+} / \text{Cr} < \text{Fe}^{2+} / \text{Fe}$ . So, the oxidation of  $\text{Fe}$  to  $\text{Fe}^{2+}$  is not as easy as the oxidation of  $\text{Cr}$  to  $\text{Cr}^{2+}$  and the oxidation of  $\text{Mn}$  to  $\text{Mn}^{2+}$ . Thus, these metals can be arranged in the increasing order of their ability to get oxidized as:  $\text{Fe} < \text{Cr} < \text{Mn}$

**Question 18: Predict which of the following will be coloured in aqueous solution?**

$Ti^{3+}$ ,  $V^{3+}$ ,  $Cu^{+}$ ,  $Sc^{3+}$ ,  $Mn^{2+}$ ,  $Fe^{3+}$  and  $Co^{2+}$ . Give reasons for each.

**Solution 18: Only the ions that have electrons in *d*-orbital will be coloured. The ions in which *d*-orbital is empty will be colourless.**

Element	Atomic Number	Ionic State	Electronic configuration in ionic State
Ti	22	$Ti^{3+}$	$[Ar]3d^1$
V	23	$V^{3+}$	$[Ar]3d^2$
Cu	29	$Cu^{+}$	$[Ar]3d^{10}$
Sc	21	$Sc^{3+}$	$[Ar]$
Mn	25	$Mn^{2+}$	$[Ar]3d^5$
Fe	26	$Fe^{3+}$	$[Ar]3d^5$
Co	27	$Co^{2+}$	$[Ar]3d^7$

From the above table, it can be easily observed that only  $Sc^{3+}$  has an empty *d*-orbital. All other ions, except  $Sc^{3+}$ , will be coloured in aqueous solution because of *d-d* transitions.

**Question 19: Compare the stability of +2 oxidation state for the elements of the first transition series.**

Sc			+3				
Ti	+1	+2	+3	+4			
V	+1	+2	+3	+4	+5		
Cr	+1	+2	+3	+4	+5	+6	
Mn	+1	+2	+3	+4	+5	+6	+7
Fe	+1	+2	+3	+4	+5	+6	
Co	+1	+2	+3	+4	+5		
Ni	+1	+2	+3	+4			
Cu	+1	+2	+3				
Zn		+2					

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