

## Stoichiometry II

### [Acid – Base, Redox Reaction, n-factor & Equivalent Concept, Titration]

#### 1. Acid, Base & Acidity, Basicity

- Q 1. Mechanism of acid base reaction can be  
 (A) Can be written  
 (B) can't be written  
 (C) Sometimes can be written and sometimes can't  
 (D) can't said
- Problems # 2 - 6 are a list of various characteristic properties of either acids or bases. Identify them
- Q 2. They have a sour taste.
- Q 3. They turn litmus paper from blue to Red
- Q 4. They turn red litmus paper to blue.
- Q 5. They have a slippery feeling.
- Q 6. They react with active metals producing hydrogen gas.  
 (A) Acid (B) Base
- Q 7. A base is a proton acceptor.  
 (A) Arrhenius theory  
 (B) Bronsted-Lowry theory  
 (C) Lewis theory (D) None of these
- Q 8. Water is a/an  
 (A) Acid (B) Base  
 (C) Both Acid & Base (D) None
- Q 9. Which of the following substances is amphoteric?  
 (A)  $\text{Al(OH)}_3$  (B)  $\text{HCN}$   
 (C)  $\text{CsBr}$  (D)  $\text{Ca(OH)}_2$
- Q 10. According to the Lewis theory, a base  
 (A) is a proton acceptor.  
 (B) makes available a share in a pair of electrons.  
 (C) is any compound that contains electron pairs.  
 (D) accepts a share in a pair of electrons.
- Q 11. Based on the reactions we have studied, ammonia can be considered as  
 (A) an Arrhenius base (only)  
 (B) a Bronsted-Lowry base (only).  
 (C) both an Arrhenius base and a Lewis base.  
 (D) both a Bronsted-Lowry base & a Lewis base.
- Q 12. In a given situation, which one of the following can't act an acid as well as a base ?  
 (A)  $\text{HSO}_4^-$  (B)  $\text{NH}_3$   
 (C)  $\text{H}_2\text{O}$  (D)  $\text{CH}_3\text{COOH}$
- Q 13. Which one of the following species is capable of acting both as a bronsted acid & bronsted base?  
 (A)  $\text{F}^-$  (B)  $\text{CO}_3^{2-}$   
 (C)  $\text{HS}^-$  (D)  $\text{S}^{2-}$
- Q 14. Identify the Bronsted acid in the following equation:  
 $\text{PO}_4^{3-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HPO}_4^{2-}(\text{aq}) + \text{OH}^-(\text{aq})$   
 (A)  $\text{OH}^-$  (B)  $\text{H}_2\text{O}$   
 (C)  $\text{HPO}_4^{2-}$  (D)  $\text{PO}_4^{3-}$
- Q 15. The Basicity of Acid  $\text{H}_3\text{PO}_3$  is  
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 16. The Basicity of Acid  $\text{H}_3\text{PO}_2$  is  
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 17. The Basicity of a polybasic Acid depends on  
 (A) Acid itself (B) Reaction Dependent  
 (C) Depends on base with which it reacts  
 (D) None of these
- Q 18. The basicity of  $\text{B(OH)}_3$  is  
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 19. Find the concept from which the following Acid base reactions can be described  
 1).  $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$   
 2).  $\text{HC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{C}_2\text{H}_3\text{O}_2^-$   
 3).  $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$   
 4).  $\text{Ag}^+(\text{aq}) + 2\text{CN}^-(\text{aq}) \rightarrow \text{Ag}(\text{CN})_2^-(\text{aq})$   
 5).  $\text{HNO}_3(\text{aq}) + \text{NaOH} \rightarrow \text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$   
 6).  $\text{CCl}_3\text{COOH} + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CCl}_3\text{CO}_2^- + \text{H}_3\text{O}^+$   
 7).  $\text{AgCl}(\text{s}) + 2\text{NH}_3 \rightarrow (\text{NH}_3)_2\text{Ag}^+ + \text{Cl}^-$
- Q 20. Classify each of the following oxides as acidic, neutral, amphoteric, basic:  
 (A)  $\text{N}_2\text{O}_5$  (B)  $\text{SnO}$  (C)  $\text{CO}$   
 (D)  $\text{PbO}$  (E)  $\text{MnO}_2$  (F)  $\text{RaO}$   
 (G)  $\text{N}_2\text{O}$  (H)  $\text{FeO}$  (I)  $\text{Ag}_2\text{O}$   
 (J)  $\text{OsO}_4$  (K)  $\text{Al}_2\text{O}_3$  (L)  $\text{Fe}_2\text{O}_3$   
 (M)  $\text{CeO}_2$  (N)  $\text{CO}_2$  (O)  $\text{MgO}$   
 (P)  $\text{K}_2\text{O}$

## 2. Acidic Strength & Basic Strength

Classify the substances in Problems # 1-7

1.  $\text{Ca}(\text{OH})_2$     2.  $\text{NH}_3$     3.  $\text{HF}$   
 4.  $\text{H}_3\text{PO}_4$     5.  $\text{HCN}$     6.  $\text{KOH}$   
 7.  $\text{HClO}_4$

- (A) Strong base    (B) Weak base  
 (C) Strong acid    (D) Weak acid

Q 8. Rank the hydrohalic acids from strongest to weakest. **[JEE Main]**

- (A)  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$   
 (B)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$   
 (C)  $\text{HCl} > \text{HBr} > \text{HI} > \text{HF}$   
 (D)  $\text{HF} > \text{HI} > \text{HBr} > \text{HCl}$

Q 9. In which of the following is the acid strength ranking INCORRECT?

- (A)  $\text{H}_2\text{SO}_4 > \text{H}_2\text{SO}_3$     (B)  $\text{HNO}_3 > \text{HNO}_2$   
 (C)  $\text{HClO}_4 > \text{HClO}_3$     (D)  $\text{H}_2\text{SeO}_3 > \text{H}_2\text{SO}_3$

Q 10. Which of the following would be the most acidic substance in aqueous solution?

- (A)  $\text{SO}_4^{2-}$     (B)  $\text{H}_2\text{O}$   
 (C)  $\text{NH}_2^-$     (D)  $\text{NH}_4^+$

Q 11. In which of the following is the acid strength ranking CORRECT?

- (A)  $\text{H}_2\text{SO}_3 > \text{H}_2\text{SO}_4$     (B)  $\text{H}_2\text{S} > \text{HCl}$   
 (C)  $\text{H}_2\text{S} > \text{PH}_3$     (D) None of these

Q 12. The conjugate base of ammonia is

- (A)  $\text{NH}_3$     (B)  $\text{NH}_4^+$   
 (C)  $\text{NH}_2^-$     (D)  $\text{OH}^-$

Q 13. The conjugate acid of  $\text{H}_2\text{O}$  is

- (A)  $\text{H}_2\text{O}$     (B)  $\text{H}_3\text{O}^+$   
 (C)  $\text{OH}^-$     (D) None of these

Q 14. The conjugate base of  $\text{HPO}_4^{2-}$  is

- (A)  $\text{H}_3\text{PO}_4$     (B)  $\text{H}_2\text{PO}_4^-$   
 (C)  $\text{PO}_4^{3-}$     (D)  $\text{OH}^-$

Q 15. The conjugate acid of  $\text{Ac}^-$  is

- (A)  $\text{HAc}$     (B)  $\text{H}_3\text{O}^+$   
 (C)  $\text{H}_2\text{O}$     (D) None of these

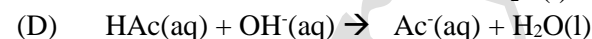
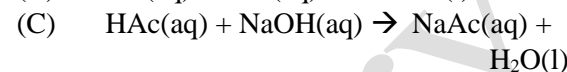
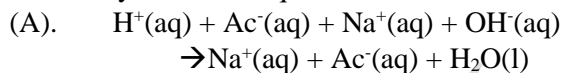
Q 16. Which of the following would be the most basic substance in aqueous solution?

- (A)  $\text{HSO}_4^-$     (B)  $\text{F}^-$   
 (C)  $\text{Cl}^-$     (D)  $\text{I}^-$

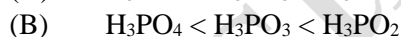
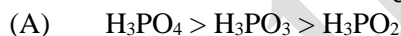
Q 17. Which one of the following is the weakest base as per the Bronsted concept? **[JEE Main 2016]**

- (A)  $[\text{ClO}_4]^-$     (B)  $[\text{ClO}_3]^-$   
 (C)  $[\text{ClO}_2]^-$     (D)  $[\text{ClO}]^-$

Q 18. Which of the following is the most correct net ionic equation for the reaction of acetic acid with sodium hydroxide in aqueous solution?



Q 19. The Correct order of acidic strength is



Q 20. The Strongest Acid Among  $\text{HI}$ ,  $\text{HBr}$ ,  $\text{HClO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_3\text{O}^+$  is



Q 21. The solution of  $\text{AlCl}_3$  in water acidic, basic or neutral?



Q 22. In reaction with  $\text{BeF}_2$  with  $2\text{F}^-$ , to form  $\text{BeF}_4^{2-}$ , which reactant is the Lewis Acid



## 3. Oxidation, Reduction & Oxidation Number

Q 1. Assign oxidation number of bold element in the following species: **[AIIMS/NCERT Including]**

|                              |                            |                                   |                             |
|------------------------------|----------------------------|-----------------------------------|-----------------------------|
| $\text{H}^+$                 | $\text{H}_2\text{O}$       | $\text{H}_2$                      | $\text{Cl}_2$               |
| $\text{ClO}^-$               | $\text{ClO}_2^-$           | $\text{ClO}_2$                    | $\text{ClO}_3^-$            |
| $\text{ClO}_4^-$             | $\text{NO}$                | $\text{NO}_2^-$                   | $\text{NO}_2$               |
| $\text{NO}_3^-$              | $\text{NH}_3$              | $\text{N}_2\text{H}_4$            | $\text{NH}_2\text{OH}$      |
| $\text{N}_2$                 | $\text{N}_2\text{O}$       | $\text{KNO}_3$                    | $\text{H}_2\text{CO}_3$     |
| $\text{NaH}_2\text{PO}_4$    | $\text{Al}(\text{NO}_3)_3$ | <b>B</b>                          | $\text{N}^{3-}$             |
| $\text{K}_2\text{O}$         | $\text{CO}_3^{2-}$         | $\text{KClO}_4$                   | $\text{MnO}_4^-$            |
| $\text{Al}_2(\text{SO}_4)_3$ | $\text{F}_2$               | $\text{NaHSO}_4$                  | $\text{CO}_3^{2-}$          |
| $\text{HCO}_3^-$             | $\text{PO}_4^{3-}$         | $\text{NH}_4^+$                   | $\text{K}_2\text{MnO}_4$    |
| $\text{NO}_3^-$              | $\text{Mg}_2\text{TiO}_4$  | $\text{K}_2\text{Cr}_2\text{O}_7$ | $\text{SO}_3^{2-}$          |
| $\text{SeO}_3^{2-}$          | $\text{Ba}_2\text{XeO}_6$  | $\text{NaAuCl}_4$                 | $\text{Ca}(\text{ClO}_2)_2$ |
| $\text{OF}_2$                | $\text{NaAlH}_4\text{Cl}$  | <b>Os</b> $\text{O}_4$            | $\text{C}_2\text{O}_4^{2-}$ |
| $\text{Ti}_2\text{O}$        | $\text{Fe}_2\text{O}_3$    | $\text{CuO}$                      | $\text{MnO}_2$              |

- Q 2. Assign oxidation number of bold element in the following species. [AIIMS/NCERT Including]
- |                    |               |                |              |
|--------------------|---------------|----------------|--------------|
| $H_4P_2O_7$        | $NH_4NO_3$    | $(NH_4)_2SO_4$ | $FeSO_4$     |
| $(CH_3)_2SO$       | $V(BrO_2)_2$  | $NOClO_4$      | $HNC$        |
| $[Co(NH_3)_6]Cl_3$ | $C_4H_{10}$   | $Co_2(SO_4)_3$ | $Fe_3O_4$    |
| $K_4[Fe(CN)_6]$    | $C_3H_8$      | $S_2O_3^{2-}$  | $H_2S_4O_6$  |
| $C_3O_2$           | $N_2O_3$      | $N_3^-$        | $SnS_3^{2-}$ |
| $Fe_{0.94}O$       | $S_2O_8^{2-}$ | $H_2SO_5$      | $CrO_5$      |
| $P_2O_8^{4-}$      | $N_2O_6$      | $H_2O_2$       | $Na_2O_2$    |
| $CrO_4$            | $HCO_3H$      | $H_3PO_5$      | $HAuCl_4$    |
| $H_2S_2O_7$        | $CaO_2$       | $CH_3COOH$     | $KI_3$       |
- Q 3. In which of the following species N exhibit two different oxidation state. [NCERT Exemplar]
- (A)  $NH_2OH$  (B)  $NH_4NO_2$   
(C)  $N_2H_4$  (D)  $N_3H$
- Q 4. Which arrangement represent increasing oxid. number central atom? [NCERT Examaplar]
- (A)  $CrO_2^-, ClO_3^-, CrO_4^{2-}, MnO_4^-$   
(B)  $ClO_3^-, CrO_4^{2-}, MnO_4^-, CrO_2^-$   
(C)  $CrO_2^-, ClO_3^-, MnO_4^-, CrO_4^{2-}$   
(D)  $CrO_4^{2-}, MnO_4^-, CrO_2^-, ClO_3^-$
- Q 5. The oxidation state of Sulphur in anion  $SO_3^{2-}$ ,  $S_2O_4^{2-}$  and  $S_2O_6^{2-}$  follow the order
- (A)  $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$   
(B)  $SO_3^{2-} > S_2O_4^{2-} > S_2O_6^{2-}$   
(C)  $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$   
(D)  $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
- Q 6. In which one of the following reactions, nitrogen is NOT Reduced?
- (A)  $NO_2 \rightarrow NO_2^-$  (B)  $NO_2^- \rightarrow NO$   
(C)  $NO_2^- \rightarrow NH_4^+$  (D)  $NH_4^+ \rightarrow N_2$
- Q 7. Which one of the following is the Redox reaction?
- (A)  $Pb(CH_3COO)_2 + Na_2CrO_4 \rightarrow PbCrO_4 + 2CH_3COONa$   
(B)  $Fe + 2HCl \rightarrow FeCl_2 + H_2$   
(C)  $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$   
(D)  $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$   
(E)  $H_2S + Cl_2 \rightarrow 2HCl + S$  [NCERT]  
(F)  $3Fe_3O_4 + 8Al \rightarrow 9Fe + 4Al_2O_3$  [NCERT]  
(G)  $2Na + H_2 \rightarrow 2NaH$  [NCERT]
- Q 8. Which of the following represent redox reaction?
- (A)  $K + O_2 \rightarrow KO_2$
- (B)  $H_2O_2 + KOH \rightarrow KHO_2 + H_2O$   
(C)  $H_2O_2 \rightarrow H_2O + (1/2)O_2$   
(D)  $Ca(HCO_3)_2 \rightarrow CaCO_3 + H_2O + CO_2$
- Q 9. Which of the following reactions is NOT an example of redox reaction? [NCERT Exemplar]
- (A)  $CuO + H_2 \rightarrow Cu + H_2O$   
(B)  $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$   
(C)  $2K + F_2 \rightarrow 2KF$   
(D)  $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$
- Q 10. Consider the following statements:  
In the reaction  
 $KIO_3 + 5KI + 6HCl = 3I_2 + 6KCl + 3H_2O$
1. KI is reduced to  $I_2$
  2.  $KIO_3$  is oxidised to  $I_2$
  3.  $KIO_3$  is reduced to I
  4. Oxidation number of I increases from (-1) in KI to zero in  $I_2$ , of these statements
- (A) 1, 3 and 4 are correct  
(B) 1, 2 and 4 are correct  
(C) 2 and 4 are correct  
(D) Only 1 is correct
- Q 11. Which of the following reactions intramolecular oxidation reduction reaction
- (A)  $3H_3PO_2 \rightarrow 2H_3PO_3 + PH_3$   
(B)  $NH_4NO_3 \rightarrow N_2O + 2H_2O$   
(C)  $2KClO_3 \rightarrow 2KCl + 3O_2$   
(D) None of these
- Q 12. Which of the following represent disproportionation reactions?
- (A)  $H_3PO_4 \rightarrow H_3PO_3 + PH_3$   
(B)  $NH_4NO_3 \rightarrow N_2O + 2H_2O$   
(C)  $2Cu^+ \rightarrow Cu + Cu^{2+}$   
(D)  $MnO_4^- + 3Mn^{2+} + 4OH^- \rightarrow 5MnO_2 + 2H_2O$
- Q 13. Identify the disproportionation reaction. [NCERT Exemplar]
- (A)  $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$   
(B)  $CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$   
(C)  $F_2 + 2OH^- \rightarrow 2F^- + OF_2 + H_2O$   
(D)  $2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$
- Q 14. Chlorine gas reacts with aqueous KOH solution as per chemical equation,  
 $3Cl_2 + 6KOH \rightarrow 5KCl + KClO_3 + 3H_2O$ . The reaction is an example of

- (A) Neutralization reaction  
 (B) substitution reaction  
 (C) Double decomposition reaction  
 (D) Disproportionation reaction
- Q 15. Which of the following species do not show disproportionation reaction? [NCERT]  
 (A)  $\text{ClO}^-$  (B)  $\text{ClO}_2^-$   
 (C)  $\text{ClO}_3^-$  (D)  $\text{ClO}_4^-$
- Q 16. Which of the molecules can act as oxidizing agent as well as reducing agent. [AIIMS 2005]  
 (A)  $\text{H}_2\text{S}$  (B)  $\text{SO}_3$   
 (C)  $\text{H}_2\text{O}_2$  (D)  $\text{F}_2$

#### 4. Oxidising & Reducing agent, Balancing of Redox Reaction, Precipitation Reaction

- Q 1. Identify the species as oxidizing agent/reducing agent in given Redox reaction: [NCERT Inc.]  
 (A).  $\text{Ce}^{4+} + \text{Sn}^{2+} \rightarrow \text{Ce}^{3+} + \text{Sn}^{4+}$   
 (B).  $\text{Zn} + \text{HCl} \rightarrow \text{Zn}^{2+} + \text{H}_2$   
 (C).  $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$   
 (D).  $\text{I}^- + \text{ClO}^- \rightarrow \text{I}_3^- + \text{Cl}^-$   
 (E).  $\text{As}_2\text{O}_3 + \text{NO}_3^- \rightarrow \text{H}_3\text{AsO}_4 + \text{NO}$   
 (F).  $\text{Al} + \text{MnO}_4^- \rightarrow \text{MnO}_2 + \text{Al}(\text{OH})_4^-$   
 (G).  $\text{Ag} + \text{CN}^- + \text{O}_2 \rightarrow \text{Ag}(\text{CN})_2^-$   
 (H).  $\text{Cl}_2 + \text{OH}^- \rightarrow \text{Cl}^- + \text{ClO}^-$   
 (I).  $\text{NO}_2^- + \text{Al} \rightarrow \text{NH}_3 + \text{AlO}_2^-$   
 (J).  $\text{HNO}_3 + \text{H}_3\text{AsO}_3 \rightarrow \text{NO} + \text{H}_3\text{AsO}_4 + \text{H}_2\text{O}$   
 (K).  $2\text{AgBr} + \text{C}_6\text{H}_6\text{O}_2 \rightarrow 2\text{Ag} + 2\text{HBr} + \text{C}_6\text{H}_4\text{O}_2$
- (l).  $\text{HCHO} + \text{Cu}^{2+} + \text{OH}^- \rightarrow \text{Cu}_2\text{O} + \text{HCOO}^- + \text{H}_2\text{O}$
- Q 2. Balance these oxidation-reduction reactions [NCERT based/Including]
- $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
  - $\text{NO}_2^- + \text{Al}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{AlO}_2^-$
  - $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{HNO}_2(\text{aq}) \rightarrow \text{Cr}^{3+}(\text{aq}) + \text{NO}_3^-(\text{aq})$  (acidic)
  - $\text{Cr}(\text{OH})_3(\text{s}) + \text{ClO}_3^-(\text{aq}) \rightarrow \text{CrO}_4^{2-}(\text{aq}) + \text{Cl}^-(\text{aq})$  (basic)
  - $\text{Cr}_2\text{O}_7^{2-} + \text{H}^+ + \text{H}_2\text{S} \rightarrow \text{Cr}^{3+} + \text{S} + \text{H}_2\text{O}$  (acidic)
  - $\text{V} + \text{H}_2\text{O} \rightarrow \text{HV}_6\text{O}_{17}^{3-} + \text{H}_2$  (in alkaline medium)
  - $\text{WO}_3 + \text{SnCl}_2 + \text{HCl} \rightarrow \text{W}_3\text{O}_8 + \text{H}_2\text{SnCl}_6 + \text{H}_2\text{O}$

- $\text{V}(\text{OH})_4\text{Cl} + \text{FeCl}_2 + \text{HCl} \rightarrow \text{VOCl}_2 + \text{FeCl}_3 + \text{H}_2\text{O}$
  - $\text{Sb}_2\text{O}_3 + \text{KIO}_3 + \text{HCl} + \text{H}_2\text{O} \rightarrow \text{HSb}(\text{OH})_6 + \text{KCl} + \text{ICl}$
  - $\text{Fe}(\text{CN})_6^{4-} + \text{H}^+ + \text{MnO}_4^- \rightarrow \text{Fe}^{3+} + \text{CO}_2 + \text{NO}_3^- + \text{Mn}^{2+}$
  - $\text{Cu}_3\text{P} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cu}^{2+} + \text{H}_3\text{PO}_4 + \text{Cr}^{3+}$
  - $\text{K}_4[\text{Fe}(\text{CN})_6] + \text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightarrow \text{K}_2\text{SO}_4 + \text{FeSO}_4 + (\text{NH}_4)_2\text{SO}_4 + \text{CO}$
  - $\text{Cu}_2\text{O} + \text{H}^+ + \text{NO}_3^- \rightarrow \text{Cu}^{2+} + \text{NO} + \text{H}_2\text{O}$
  - $\text{Cr}_2\text{O}_7^{2-} + \text{C}_2\text{H}_4\text{O} \rightarrow \text{C}_2\text{H}_4\text{O}_2 + \text{Cr}^{3+}$
  - $\text{FeS}_2 + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2$
  - $\text{HgS} + \text{HCl} + \text{HNO}_3 \rightarrow \text{HgCl}_2 + \text{NO} + \text{S} + \text{H}_2\text{O}$
  - $\text{Cl}_2 + \text{OH}^- \rightarrow \text{Cl}^- + \text{ClO}^-$
  - $\text{S} + \text{OH}^- \rightarrow \text{S}^{2-} + \text{S}_2\text{O}_3^{2-}$
  - $\text{Cu}(\text{s}) + \text{HNO}_3(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{NO}(\text{g}) + \text{H}_2\text{O}(\text{l})$  (acidic)
  - $\text{C}_2\text{H}_5\text{OH} + \text{I}_2 + \text{OH}^- \rightarrow \text{CHI}_3 + \text{HCO}_3^- + \text{I}^- + \text{H}_2\text{O}$
  - $\text{Cr}_2\text{O}_7^{2-} + \text{SO}_3^{2-} + \text{H}^+ \rightarrow \text{Cr}^{3+} + \text{SO}_4^{2-} + \text{H}_2\text{O}$
  - $\text{MnO}_4^- + \text{I}^- + \text{H}_2\text{O} \rightarrow \text{MnO}_2 + \text{I}_2 + \text{OH}^-$
- Q 3. Given  $x\text{HI} + y\text{HNO}_3 \rightarrow \text{NO} + \text{I}_2 + \text{H}_2\text{O}$  what are the values of x, y In that order?  
 (A) 3, 2 (B) 2, 3  
 (C) 6, 2 (D) 6, 1
- Q 4. Given:  $a\text{CN}^- + b\text{NO}_3^- + c\text{H}^+ \rightarrow (a+b)\text{NO} + a\text{CO}_2 + (c/2)\text{H}_2\text{O}$ . What are the values?  
 (A) 3, 7, 7 (B) 3, 10, 7  
 (C) 3, 10, 10 (D) 3, 7, 10
- Q 5. Find change in oxidation number per molecule for each species of the following compound:
- $\text{Cr}_2\text{O}_7^{2-} + \text{C}_2\text{H}_4\text{O} \rightarrow \text{C}_2\text{H}_4\text{O}_2 + \text{Cr}^{3+}$
  - $\text{Cl}_2 + \text{OH}^- \rightarrow \text{Cl}^- + \text{ClO}^-$
  - $\text{S} + \text{OH}^- \rightarrow \text{S}^{2-} + \text{S}_2\text{O}_3^{2-}$
  - $\text{Cu}_3\text{P} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cu}^{2+} + \text{H}_3\text{PO}_4 + \text{Cr}^{3+}$
  - $\text{Fe}(\text{CN})_6^{4-} + \text{MnO}_4^- \rightarrow \text{Fe}^{3+} + \text{CO}_2 + \text{NO}_3^- + \text{Mn}^{2+}$
  - $\text{WO}_3 + \text{SnCl}_2 + \text{HCl} \rightarrow \text{W}_3\text{O}_8 + \text{H}_2\text{SnCl}_6 + \text{H}_2\text{O}$

- Q 6.  $\text{Cu}_3\text{P}$  oxidises to form  $\text{CuSO}_4$  &  $\text{PO}_4^{3-}$ , the change in O.N. per molecule of the compound is  
 (A) 3 (B) 1  
 (C) 8 (D) 11
- Q 7. In a reaction, 4 mole of electrons are transferred to one mole of  $\text{HNO}_3$ . The possible product obtained due to reduction  
 (A) 0.5 mole of  $\text{N}_2$  (B) 0.5 mole of  $\text{N}_2\text{O}$   
 (C) 1 mole of  $\text{NO}_2$  (D) 1 mole of  $\text{NH}_3$
- Q 8. In a reaction, 8 electrons are transferred to 2 molecule of  $\text{V}_2\text{O}_5$ , final oxidation state of Vanadium  
 (A) 4 (B) 3  
 (C) 2 (D) None of these
- Q 9. In Non-stoichiometric Compound  $\text{Fe}_{0.98}\text{O}$ , the Percentage of Fe in +3 oxidation State is  
**[JEE Main 2013]**  
 (A) 4.08 % (B) 6.05 %  
 (C) 5.08 % (D) 7.01 %
- Q 10. Which of the pairs of reagent will reacts with each others to form precipitate. Write the formula of Precipitate?  
 (1).  $\text{KCl}$  &  $\text{AgNO}_3$  (2).  $\text{BaSO}_4$  &  $\text{KCl}$   
 (3).  $\text{K}_2\text{CrO}_4$  &  $\text{BaSO}_4$  (4).  $\text{AgCl}$  &  $\text{KMnO}_4$   
 (5).  $\text{K}_2\text{SO}_4$  and  $\text{BaCl}_2$  (6).  $\text{Ca}(\text{NO}_3)_2$  &  $\text{Na}_2\text{CO}_3$
- Q 11. Aqueous copper (II) nitrate reacts with potassium iodide to yield solid copper iodide, potassium nitrate, and iodine. Write the balanced net ionic equation for the reaction.
- Q 12. Write the net ionic reaction in the case of following reactions  
 (A).  $\text{HClO}_3 + \text{KOH} \rightarrow \text{KClO}_3 + \text{H}_2\text{O}$   
 (B).  $\text{Fe}_2(\text{SO}_4)_3 + \text{Fe} \rightarrow \text{FeSO}_4$   
 (C).  $\text{HC}_2\text{H}_3\text{O}_2 + \text{NaOH} \rightarrow \text{NaC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$   
 (D).  $\text{AlCl}_3 + 4\text{NaOH} \rightarrow \text{NaAl}(\text{OH})_4 + \text{NaCl}$   
 (E).  $\text{AgNO}_3 + \text{H}_2\text{S} \rightarrow \text{Ag}_2\text{S} + \text{HNO}_3$   
 (F).  $\text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{HCO}_3)_2$   
 (G).  $\text{Zn} + \text{HgCl}_2 \rightarrow \text{ZnCl}_2 + \text{Hg}$   
 (H).  $\text{CdS} + \text{I}_2 \rightarrow \text{CdI}_2 + \text{S}$   
 (I).  $\text{KOH} + \text{KMnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{O}_2 + \text{H}_2\text{O}$   
 (J).  $\text{Cu} + \text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{NO}_2$   
 (K).  $\text{Cu} + \text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{NO}$   
 (L).  $\text{I}_2 + \text{Na}_2\text{S}_2\text{O}_3 \rightarrow \text{Na}_2\text{S}_4\text{O}_6 + \text{NaI}$   
 (M).  $\text{NH}_4\text{Cl} + \text{NaOH} \rightarrow \text{NaCl} + \text{NH}_3 + \text{H}_2\text{O}$

## 5. n – factor Concept

- Q 1. Calculate valency factor/n-factor for following Species.  
 (A) Na (B) Ba (C) Al  
 (D) O (E) Cl (F)  $\text{SO}_4^{2-}$   
 (G)  $\text{ClO}_4^-$  (H)  $\text{NaClO}$  (I)  $\text{Na}_3\text{PO}_4$   
 (J)  $\text{CH}_3\text{COO}^-$  (K)  $\text{K}_2\text{C}_2\text{O}_4$  (L)  $\text{Al}_2(\text{SO}_4)_3$   
 (M)  $\text{Zn}_3\text{P}_2$  (N)  $\text{NH}_4^+$  (O)  $\text{Mg}^{2+}$
- Q 2. Calculate n-factor of following acid & Base.  
 (A)  $\text{NaOH}$  (B)  $\text{Ba}(\text{OH})_2$  (C)  $\text{Al}(\text{OH})_3$   
 (D)  $\text{KOH}$  (E)  $\text{HCl}$  (F)  $\text{H}_2\text{SO}_4$   
 (G)  $\text{HClO}_4$  (H)  $\text{HClO}$  (I)  $\text{H}_3\text{PO}_4$   
 (J)  $\text{CH}_3\text{COOH}$  (K)  $\text{H}_2\text{C}_2\text{O}_4$  (L)  $\text{NH}_3$   
 (M)  $\text{H}_3\text{O}^+$  (N)  $\text{B}(\text{OH})_3$  (O)  $\text{H}_3\text{PO}_3$
- Q 3. In the Reaction given below, n-factor of  $\text{H}_3\text{PO}_4$  is:  
 $\text{H}_3\text{PO}_4 + \text{NaOH} \rightarrow \text{Na}_2\text{HPO}_4 + \text{H}_2\text{O}$   
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 4. In the Reaction given below, n-factor of  $\text{H}_3\text{PO}_4$  is  
 $\text{H}_3\text{PO}_4 + \text{NaOH} \rightarrow \text{Na}_3\text{PO}_4 + \text{H}_2\text{O}$   
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 5. In Reaction given below, Eq. weight of  $\text{H}_3\text{PO}_4$  is  
 $\text{H}_3\text{PO}_4 + \text{NaOH} \rightarrow \text{Na}_2\text{HPO}_4 + \text{H}_2\text{O}$   
 (A) 98 (B) 32.66  
 (C) 49 (D) None of these
- Q 6. In Reaction given below, n-factor of  $\text{HC}_2\text{H}_3\text{O}_2$  is  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{C}_2\text{H}_3\text{O}_2^-$   
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 7. Find the valency factor of Bold Species in the following reactions  
 1.  $\text{Zn} + \text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{H}_2$   
 2.  $\text{Cr}_2\text{O}_7^{2-} + \text{HNO}_2 \rightarrow \text{Cr}^{3+} + \text{NO}_3^-$   
 3.  $\text{Cr}(\text{OH})_3 + \text{ClO}_3^- \rightarrow \text{CrO}_4^{2-} + \text{Cl}^-$   
 4.  $\text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{S} \rightarrow \text{Cr}^{3+} + \text{S} + \text{H}_2\text{O}$   
 5.  $\text{WO}_3 + \text{SnCl}_2 + \text{HCl} \rightarrow \text{W}_3\text{O}_8 + \text{H}_2\text{SnCl}_6 + \text{H}_2\text{O}$   
 6.  $\text{V}(\text{OH})_4\text{Cl} + \text{FeCl}_2 + \text{HCl} \rightarrow \text{VOCl}_2 + \text{FeCl}_3 + \text{H}_2\text{O}$   
 7.  $\text{Sb}_2\text{O}_3 + \text{KIO}_3 + \text{HCl} \rightarrow \text{HSb}(\text{OH})_6 + \text{KCl} + \text{ICl}$   
 8.  $\text{Cu}_3\text{P} + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cu}^{2+} + \text{H}_3\text{PO}_4 + \text{Cr}^{3+}$   
 9.  $\text{Fe}(\text{CN})_6^{4-} + \text{H}^+ + \text{MnO}_4^- \rightarrow \text{Fe}^{3+} +$



10.  $\text{Cu(s)} + \text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{NO} + \text{H}_2\text{O}$
11.  $\text{FeS}_2 + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2$
12.  $\text{Cl}_2 + \text{OH}^- \rightarrow \text{Cl}^- + \text{ClO}_3^-$
13.  $\text{S} + \text{OH}^- \rightarrow \text{S}^{2-} + \text{S}_2\text{O}_3^{2-}$
- Q 8. In the Reaction given below, n-factor of  $\text{Cu}_2\text{S}$  is  
 $\text{Cu}_2\text{S} \rightarrow \text{Cu}^{2+} + \text{SO}_2$   
 (A) 2 (B) 6  
 (C) 8 (D) 4
- Q 9. In the Reaction given below, n-factor of HCl is  
 $\text{K}_2\text{Cr}_2\text{O}_7 + \text{HCl} \rightarrow \text{KCl} + \text{CrCl}_3 + \text{Cl}_2 + \text{H}_2\text{O}$   
 (A) 6 (B) 14/6  
 (C) 6/14 (D) 1
- Q 10. In the Reaction given below, Equivalent weight of V is  
 $\text{V} \rightarrow \text{HV}_6\text{O}_{17}^{3-} + \text{H}_2$   
 (A) 51 (B) 51/30  
 (C) 51/5 (D) 51/6
- Q 11. In the Reaction given below, Equivalent Volume of HCl at NTP is  
 $\text{Sb}_2\text{O}_3 + \text{KIO}_3 + \text{HCl} \rightarrow \text{HSb(OH)}_6 + \text{KCl} + \text{ICl}$   
 (A) 22.4 lit (B) 11.2 lit  
 (C) 44.8 lit (D) 5.6 lit
- Q 12. In the Reaction given below, Equivalent weight of  $\text{H}_2\text{SO}_4$  is  
 $\text{Pb} + \text{PbO}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + \text{H}_2\text{O}$   
 (A) 49 (B) 98  
 (C) 196 (D) None of these
- Q 13. In Reaction given below, n-factor of  $\text{MnO}_4^-$  is  
 $3\text{MnO}_4^- \rightarrow 2\text{Mn}^{2+} + \text{MnO}_2$  (Mn is balanced)  
 (A) 15 (B) 10  
 (C) 3 (D) 13/3
- Q 14. In Reaction given below, n-factor of  $\text{Cr}_2\text{O}_7^{2-}$  is  
 $2\text{Cr}_2\text{O}_7^{2-} \rightarrow 3\text{Cr}^{3+} + \text{Cr}^{4+}$  (Cr is balanced)  
 (A) 6 (B) 9  
 (C) 11/2 (D) 11/4
- Q 15. In the Reaction given below, n-factor of  $\text{NH}_3$  is  
 $6\text{NH}_3 \rightarrow 2\text{N}_2 + \text{N}_2\text{O}_5$  (Only N is balanced)  
 (A) 3 (B) 2  
 (C) 14/3 (D) 16/3
- 6. Equivalent Concept, Normality**
- Q 1. If Equivalent weight of  $\text{H}_2\text{S}$  is E as Acid then Eq. Wt. of  $\text{H}_2\text{S}$  in the conversion  $\text{H}_2\text{S} \rightarrow \text{SO}_2$   
 (A) E (B) E/6  
 (C) E/3 (D) E/2
- Q 2. If  $\text{KHC}_2\text{O}_4 \cdot \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$  has eq. wt. some value E as an acid then what will be the eq. wt. when it act as reducing agent.  
 (A) E/4 (B) 3E/4  
 (C) 4E/3 (D) 2E
- Q 3. If HClO has Eq. Wt. equal to E then what is Eq. Wt. in terms of E when it act as strongest oxidizing agent.  
 (A) 8E (B) E/8  
 (C) E/4 (D) 4E
- Q 4. The two acids  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  are neutralized separately by the same amount of an alkal when sulphate and dihydrogen orthophosphate are formed respectively. Find the ratio of the masses of  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$ .  
 (A) 0.5 (B) 2  
 (C) 3/2 (D) 2/3
- Q 5. Equivalent weight of sulphur in  $\text{SCl}_2$  is 16, what is the equivalent weight of S in  $\text{S}_2\text{Cl}_2$ ?  
 (A) 16 (B) 32  
 (C) 64 (D) 8
- Q 6. If Equivalent Weight of a metal is 12 then equivalent weight of its oxide is  
 (A) 20 (B) 16  
 (C) 24 (D) 28
- Q 7. The Equivalent Wt. of sodium salt of a monobasic acid is 82. Find out the Eq. Wt. of acid.  
 (A) 59 (B) 60  
 (C) 81 (D) None of these
- Q 8. Equivalent wt of potassium salt of tribasic acid is 180, what will be the Equivalent Wt of Acid  
 (A) 141 (B) 144  
 (C) 142 (D) None of these
- Q 9. Find no of Equivalent in 0.5 mole of  $\text{H}_2\text{S}$  in the reaction  $\text{H}_2\text{S} \rightarrow \text{SO}_2$ , is  
 (A) 6 (B) 3  
 (C) 2 (D) None of these
- Q 10. Find no of Equivalent in 0.25 mole of  $\text{Cl}_2$  in the reaction  $\text{Cl}_2 \rightarrow \text{Cl}^- + \text{ClO}_3^-$ , is  
 (A) 5/12 (B) 5/6

- (C)  $5/3$  (D) None of these
- Q 11. Which of the following relations is correct?  
 (A)  $3 \text{ N Al}_2(\text{SO}_4)_3 = 0.5 \text{ M Al}_2(\text{SO}_4)_3$   
 (B)  $3 \text{ M H}_2\text{SO}_4 = 6 \text{ N H}_2\text{SO}_4$   
 (C)  $1 \text{ M H}_3\text{PO}_4 = 1/3 \text{ N H}_3\text{PO}_4$   
 (D)  $1 \text{ M Al}_2(\text{SO}_4)_3 = 6 \text{ N Al}_2(\text{SO}_4)_3$
- Q 12. The mass of Oxalic acid crystal ( $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ ) required to prepare 50 ml of 0.2 N solution is  
 (A) 4.5 g (B) 6.3 g  
 (C) 0.63 g (D) 0.45 g
- Q 13. The Normality of 0.3 M Phosphorus acid  $\text{H}_3\text{PO}_3$  is  
 (A) 0.1 (B) 0.9 (C) 0.6 (D) 0.3
- Q 14. What is the Normality of a solution obtained by mixing 0.45 N and 0.60 N NaOH solution in 2:1 volume ratio.  
 (A) 0.50 N (B) 0.55 N  
 (C) 0.42 N (D) None of these
- Q 15. 10 ml of Normal, 20 ml of 0.5 N  $\text{H}_2\text{SO}_4$  and 30 ml of  $1/3 \text{ N HNO}_3$  are mixed together and volume made to one litre. The Normality of  $\text{H}^+$  in the resulting solution is  
 (A) 0.06 N (B) 0.12 N (C) 0.03 N (D) 0.09 N
- Q 16. 100 ml of 0.3 N HCl solution were mixed with 200 ml of 0.6 N  $\text{H}_2\text{SO}_4$  solution. The final  
 (A) 0.9 N (B) 0.6 N (C) 0.5 N (D) 0.4 N
- Q 5. 0.2 g of oxygen and 3.17 g of a halogen combine separately with same amount of a metal. What is the equivalent wt of the halogen?  
 (A) 35.5 (B) 80 (C) 127 (D) 180
- Q 6. The oxide of a metal contain 60% of the metal. What will be the % of the bromine in the bromide of the metal, if the valency of the metal is the same in both the oxide and the bromide.  
 (A) 87 (B) 70 (C) 77 (D) 93
- Q 7. 1.80 g of metal oxide required 833 ml of Hydrogen gas at NTP to be reduced to its metal. Find the equivalent weight of the metal?  
 (A) 24.2 (B) 16.2  
 (C) 8.2 (D) None of these
- Q 8. A certain amount of metal whose equivalent weight is 28, displaces 0.7 litre of  $\text{H}_2$  gas at NTP from an acid. Calculate the weight of the metal.  
 (A) 1 g (B) 1.75 g (C) 1.25 g (D) 3.50 g
- Q 9. 2 g of a metal dissolved in Nitric acid and convert into Nitrate. The Nitrate was then precipitated to 2.66 g of the metal chloride. Find the Eq Wt of the metal.  
 (A) 120 (B) 107.57 (C) 53.8 (D) 215.14
- Q 10. 2 g of anhydrous  $\text{BaCl}_2$  present in a solution was quantitatively converted into 2.25 g of  $\text{BaSO}_4$ . Find the equivalent weight of the metal?  
 (A) 129 (B) 64.5  
 (C) 32.25 (D) None of these

## 7. Principle of g Equivalence,

### Principle of Chemical Equivalence

- Q 1. Percentage of metal in a metal oxide is 45.6 % find its equivalent weight  
 (A) 12.40 (B) 6.70  
 (C) 20.11 (D) None of these
- Q 2. In metal Peroxide, the % by weight of Oxygen is 4.1 %, Find the equivalent weight of Metal  
 (A) 23 (B) 25.8  
 (C) 11.5 (D) None of these
- Q 3. The equivalent weight of a metal is double to that of oxygen. How many times is the weight  
 (A)  $3/2$  (B)  $1/3$   
 (C)  $2/3$  (D) None of these
- Q 4. 9.44 g of Metal oxide is formed by combination of 5 g of the metal. Calculate the Eq wt of metal.  
 (A) 9 (B) 10 (C) 18 (D) 4.5
- Q 11. Metal Chloride contains 47.23 % Metal. 1 g of this metal displaced from another a compound 0.88 g of another metal N. Find the equivalent weight of the metal Metal.  
 (A) 31.77 (B) 27.96  
 (C) 21.77 (D) 41.77
- Q 12. How many gm of  $\text{H}_2\text{S}$  will react with 6.32 g of  $\text{KMnO}_4$  to produce  $\text{K}_2\text{SO}_4$  and  $\text{MnO}_2$ ?  
 (A) 0.511 (B) 0.255  
 (C) 1.022 (D) 51.1
- Q 13. What is the weight of 1 gm equivalent of the oxidizing agent in the following reaction?  

$$\text{Zn} + \text{V}_2\text{O}_5 \rightarrow \text{ZnO} + \text{V}$$
  
 (A) 32.69 (B) 22.96  
 (C) 42.69 (D) None of these
- Q 14. 1 g of the acid  $\text{C}_6\text{H}_{10}\text{O}_4$  requires 0.768 g of KOH for complete neutralization. How many neutralisable H – atoms are present in the acid?  
 (A) 1 (B) 2 (C) 3 (D) 4

## 8. Acid Base Titration

- Q 1. The volume of 1.5 M  $H_3PO_4$  Solution required to neutralize exactly 90 ml of 0.5 M  $Ba(OH)_2$  Solution is  
 $2H_3PO_4 + 3Ba(OH)_2 \longrightarrow Ba_3(PO_4)_2 + 6H_2O$   
 (A) 10 ml (B) 30 ml  
 (C) 20 ml (D) 60 ml
- Q 2. 1.25 g of a solid dibasic acid is completely neutralized by 25 ml of 0.25 molar  $Ba(OH)_2$  Solution, then molecular weight of the acid is  
 (A) 150 (B) 200  
 (C) 250 (D) 300
- Q 3. 0.45 g of an acid of molecular weight 90 was neutralized by 20 ml of 0.54 N caustic Potash (KOH), then Basicity of acid is  
 (A) 1 (B) 2  
 (C) 3 (D) 4
- Q 4. In the reaction,  
 $Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$ , The equivalent weight of  $Na_2CO_3$  is  
 (A) 53 (B) 106  
 (C) 10.6 (D) 5.3
- Q 5. 0.126 g of an acid requires 20 ml of 0.1 N NaOH for complete neutralization. Equivalent weight of the acid is  
 (A) 45 (B) 53  
 (C) 40 (D) 63
- Q 6.  $H_3PO_4$  is a tribasic acid and one of its salt is  $NaH_2PO_4$ . What volume of 1 M NaOH solution should be added to 12 g of  $NaH_2PO_4$  to convert it into  $Na_3PO_4$ .  
 (A) 100 ml (B) 200 ml  
 (C) 80 ml (D) 300 ml
- Q 7. 0.7 g of  $Na_2CO_3 \cdot XH_2O$  is dissolved in 100 ml of water, 20 ml of which required 19.8 ml of 0.1 N HCl. The Value of X is  
 (A) 4 (B) 3 (C) 2 (D) 1
- Q 8. 100 ml of 0.1 N HCl was added to 20 mL of 0.1 N KOH. The excess of KOH was neutralized by 0.05 N  $H_2SO_4$ . The amount of  $H_2SO_4$  consumed was  
 (A) 10 ml (B) 15 ml  
 (C) 20 ml (D) 30 ml
- Q 9. An aqueous solution of 6.3 g of oxalic acid

dehydrate is made upto 250 ml. The volume of 0.1 N NaOH required to completely neutralized 10 ml of this solution is

- (A) 40 ml (B) 20 ml  
 (C) 10 ml (D) 4 ml
- Q 10. 0.5 g of fuming  $H_2SO_4$  (Oleum) is diluted with water. This solution is completely neutralized by 26.7 ml of 0.4 N NaOH solution. The percentage of free  $SO_3$  in the sample is  
 (A) 30.6% (B) 40.6%  
 (C) 20.6% (D) 50%
- Q 11. 1 mole of a mixture of CO &  $CO_2$  requires exactly 20 g of NaOH in Solution for complete conversion of all  $CO_2$  into  $Na_2CO_3$ . How much NaOH would require extra for conversion into  $Na_2CO_3$  if the mixture is completely oxidized to  $CO_2$ .  
 (A) 60 g (B) 80 g  
 (C) 40 g (D) 20 g
- Q 12. A certain weight of pure  $CaCO_3$  is made to react completely with 200 mL of an HCl solution to give 224 ml of  $CO_2$  at NTP. The normality of HCl solution is  
 (A) 0.05 N (B) 0.1 N  
 (C) 1.0 N (D) 0.2 N

## 9. Back Titration, Indicator Titration

- Q 1. 50 g of a sample of  $Ca(OH)_2$  is dissolved in 50 ml of 0.5N HCl solution. The excess of HCl was treated with 0.3 N NaOH. The volume of NaOH used was 20 cc. Calculate % purity of  $Ca(OH)_2$   
 (A) 0.35% (B) 0.7%  
 (C) 1.40% (D) 2.8%
- Q 2. 29.5 g of an organic compound containing Nitrogen was digested in Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 ml of 0.1 M NaOH solution for complete neutralization. The percentage of nitrogen in the compound is  
 (A) 59.0 (B) 47.4  
 (C) 23.7 (D) 29.5
- Q 3. One gram of a mixture of  $Na_2CO_3$  and  $NaHCO_3$  consumes y gm equivalents of HCl for complete



neutralization. One gm of the mixture is strongly heated then cooled and residue is treated with HCl. How many gm equivalents of HCl would be required for complete neutralization?

- (A)  $2Y$  equivalent      (B)  $\frac{3y}{4}$  equivalent  
(C)  $\frac{3y}{2}$  equivalent      (D)  $Y$  equivalent

Q 4. A commercial sample of 2.013 g NaOH contains  $\text{Na}_2\text{CO}_3$  as impurity was dissolved to give 250 ml of solution. A 10 mL portion of the solution required 20 mL of 0.1 N  $\text{H}_2\text{SO}_4$  solution for complete neutralization. Calculate the % by weight of  $\text{Na}_2\text{CO}_3$  in the sample.

- (A) 22.9 %      (B) 2.29 %  
(C) 1.145 %      (D) 45.8 %

Q 5. 5 ml of 8 N  $\text{HNO}_3$ , 4.8 ml of 5N HCl and a certain volume of 17M  $\text{H}_2\text{SO}_4$  are mixed together & made up to 2 litre. 30 ml of this acid mixture completely neutralise 42.9 ml of  $\text{Na}_2\text{CO}_3$  solution containing one gram of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  in 100 ml of water. Calculate the amount in gram of the sulphate ions in the solution.

- (A) 6.635 g      (B) 12.73 g  
(C) 3.1825 g      (D) None of these

Q 6. A sample of peanut oil weighing 1.5763 gm is added to 25 ml of 0.4210 M KOH after saponification is complete 8.46 ml of 0.2732 M  $\text{H}_2\text{SO}_4$  is needed to neutralize excess KOH. The soapification number (mg of Base required to neutralize acid from 1 g of fat) of peanut oil is

- (A) 208.9      (B) 108.9  
(C) 98.8      (D) 218.9

Q 7. 10.78 g of  $\text{H}_3\text{PO}_4$  in 550 ml solution is 0.40 N. Thus the acid is

- (A) has been neutralized to  $\text{HPO}_4^{2-}$   
(B) has been neutralized to  $\text{PO}_4^{3-}$   
(C) has been neutralized to  $\text{HPO}_3^{2-}$   
(D) has been neutralized to  $\text{H}_2\text{PO}_4^-$

Q 8. During the titration of  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  against HCl is

- (A) phenolphthalein is used to detect the first end point  
(B) phenolphthalein is used to detect the second end point

(C) Methyl orange is used to detect the second end point

(D) Methyl orange is used to detect the first end point

Q 9. A solution containing  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$ , 10 ml of the solution required 2.5 mL of 0.1 M  $\text{H}_2\text{SO}_4$  for neutralization using phenolphthalein as indicator. Methyl orange is then added when a further of 2.5 ml of 0.2 M  $\text{H}_2\text{SO}_4$  was required. The amount of  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  in 1 lit solution is

- (A) 5.3 g & 4.2 g respectively  
(B) 3.3 g & 6.2 g respectively  
(C) 4.2 g & 5.3 g respectively  
(D) 6.2 g & 3.3 g respectively

#### Passage Type question:

The salt  $\text{Na}_2\text{CO}_3 \cdot X\text{NaHCO}_3 \cdot Y\text{H}_2\text{O}$  gave the following results: 2.5 g of the salt is dissolved in water and made up to 250 ml of the solution. 50 ml of the solution needed 22 ml of 0.1 N HCl to the phenolphthalein end point, while 25 ml of the solution required 33.1 ml to the methyl orange end point.

Q 10. What is the value of x.

- (A) 1      (B) 2  
(C) 4      (D) None of these

Q 11. What is the value of y.

- (A) 1      (B) 2  
(C) 3      (D) 4

Q 12. Weight of  $\text{CaCO}_3$  precipitated when 10 g of salt is strongly heated with  $\text{CaCl}_2$

- (A) 8.48 g      (B) 6.24 g  
(C) 6.64 g      (D) 8.84 g

Q 13. When mixture of 0.1 mole each of the reactants mentioned under column 1 are reacted with 1 M HCl solution in presence of indicator methyl orange, the volume required in ml of HCl solution for complete neutralisation will be

- | Column 1  | Column II  |
|---|------------|
| a). $\text{Na}_2\text{CO}_3 + \text{NaHCO}_3$               | p). 300 ml |
| b). $\text{NaOH} + \text{NaHCO}_3$                          | q). 400 ml |
| c). $\text{Na}_2\text{CO}_3 + \text{Na}_2\text{CO}_3$       | r). 200 ml |
| d). $\text{Na}_2\text{CO}_3 + \text{NaHCO}_3 + \text{NaOH}$ |            |

## 10. Redox Titration

- Q 1. It requires 40 ml of 1 M  $Ce^{4+}$  to titrate 20 ml of 1 M  $Sn^{2+}$  to  $Sn^{4+}$ . What is the oxidation state of Ce in the product.  
 (A) +2 (B) +3  
 (C) +4 (D) +5
- Q 2. 25 ml of a solution of  $Fe^{2+}$  ions was titrated with a solution of the oxidizing agent  $Cr_2O_7^{2-}$ , 50 ml of 0.01 M  $K_2Cr_2O_7$  solution was required. What is the molarity of  $Fe^{2+}$  solution?  
 (A) 0.06 (B) 0.08  
 (C) 0.12 (D) 0.16
- Q 3. How many ml of 0.3 M  $K_2Cr_2O_7$  (acidic) is required for complete oxidation of 5 ml of 0.2 M  $SnC_2O_4$  solution?  
 (A) 2.22 ml (B) 3.33 ml  
 (C) 4.44 ml (D) 5.55 ml
- Q 4. Potassium acid oxalate  $K_2C_2O_4 \cdot 3H_2C_2O_4 \cdot 4H_2O$  can be oxidized by  $MnO_4^-$  in acidic medium. Calculate the volume of 0.1 M  $KMnO_4$  reacting in acid solution with 1 g of acid oxalate is  
 (A) 15.84 (B) 31.68  
 (C) 47.52 (D) 63.36
- Q 5. How many lit. of  $Cl_2$  at NTP will be liberated by oxidation of NaCl with 10 g of acidic  $KMnO_4$ .  
 (A) 3.54 lit (B) 7.08 lit.  
 (C) 1.77 lit. (D) None of these
- Q 6. Volume  $V_1$  ml of 0.1  $K_2Cr_2O_7$  is needed for complete oxidation of 0.678 g of  $N_2H_4$  in acidic medium. The volume of 0.3  $KMnO_4$  needed for same oxidation in acidic medium is  
 (A)  $0.4 V_1$  (B)  $2.5 V_1$   
 (C)  $113 V_1$  (D) None of these
- Q 7. The number of moles of  $KMnO_4$  needed to oxidize 1 mole of  $FeC_2O_4$  in acidic medium is  
 (A) 0.6 (B) 1.67  
 (C) 0.2 (D) 0.4
- Q 8. 8 g of Sulphur is burnt to form  $SO_2$  which is oxidized by  $Cl_2$  water. The solution is treated with  $BaCl_2$  Solution. The amount of  $BaSO_4$  precipitated is  
 (A) 1 Mole (B) 0.5 Mole  
 (C) 0.24 Mole (D) 0.25 Mole
- Q 9. A sample of Pure Cu (3.18 g) is heated in a stream of oxygen for some times & gains in weight with the formation of black oxide of

copper ( $CuO$ ). The final weight is 3.92 g. what is the percentage of Cu remained unoxidised?

- (A) 6.5 (B) 6.9  
 (C) 7.2 (D) 7.9

- Q 10. The equivalent weight of  $MnSO_4$  is half its molecular weight when it converts into

[IIT-JEE 1988(S)]

- (A)  $Mn_2O_3$  (B)  $MnO_2$   
 (C)  $MnO_4^-$  (D)  $MnO_4^{2-}$

- Q 11. The number of moles of  $KMnO_4$  that will be needed to react with 1 mole of sulphite ion in acidic medium is

- (A) 0.4 (B) 0.6  
 (C) 0.8 (D) 1

- Q 12. In the reaction  $VO + Fe_2O_3 \rightarrow V_2O_5 + FeO$ . The equivalent weight of  $V_2O_5$  is

- (A) Mol. Wt. (B) Mol. Wt./8  
 (C) Mol. Wt./3 (D) None of these

- Q 13. In the reaction of  $Na_2S_2O_3$  with  $K_2Cr_2O_7$ , the equivalent weight of  $K_2Cr_2O_7$  is

- (A) Mol. Wt./2 (B) Mol. Wt./6  
 (C) Mol. Wt./3 (D) Mol. Wt.

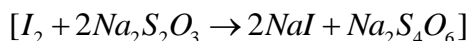
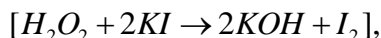
## 11. Back Titration, Iodometry, Hardness of Water

- Q 1. X millimole of  $KIO_3$  react completely with y mmol of KI to give  $I_2$  quantitatively. Then  
 (A)  $X = Y$  (B)  $5X = Y$   
 (C)  $X = 5Y$  (D)  $X > Y$
- Q 2. In basic medium,  $CrO_4^{2-}$  oxidizes  $S_2O_3^{2-}$  to form  $SO_4^{2-}$  and itself changes into  $Cr(OH)_4^-$ . How many ml of 0.154 M  $CrO_4^{2-}$  are required to react with 400 ml of 0.246 M  $S_2O_3^{2-}$ .  
 (A) 200 ml (B) 156.4 ml  
 (C) 170.4 ml (D) 190.4 ml
- Q 3. 5.5 g of a mixture of  $FeSO_4 \cdot 7H_2O$  and  $Fe_2(SO_4)_3 \cdot 9H_2O$  required 5.4 ml of 0.1 N  $KMnO_4$  Solution for complete oxidation. Calculate the mole of hydrated ferric sulphate in the mixture.  
 (A)  $9.5 \times 10^{-3}$  (B)  $4.75 \times 10^{-3}$   
 (C)  $1.9 \times 10^{-2}$  (D) None of these

- Q 4. 25 ml of  $H_2O_2$  solution were added to excess of acidified solution of KI and Iodine so liberated required 20 ml of 0.1 N  $Na_2S_2O_3$  for titration. The normality of  $H_2O_2$  solution is
- (A) 0.02 (B) 0.04  
(C) 0.03 (D) 0.08

**Paragraph:**

Some amount of 20V  $H_2O_2$  is mixed with excess of acidified solution of KI. The iodine so liberated required 200 ml of 0.1 N  $Na_2S_2O_3$  for titration.



- Q 5. The Volume of  $H_2O_2$  solution used
- (A) 11.2 ml (B) 37.2 ml  
(C) 5.6 ml (D) 22.4 ml
- Q 6. The mass of  $K_2Cr_2O_7$  needed to oxidize the above volume of  $H_2O_2$  solution, will be
- (A) 3.6 g (B) 0.8 g  
(C) 4.2 g (D) 0.98 g
- Q 7. The volume of  $O_2$  at NTP that would be liberated by above  $H_2O_2$  solution, will be
- (A) 56 ml (B) 112 ml  
(C) 168 ml (D) 224 ml
- Q 8. 5 g of pyrolusite (impure  $MnO_2$ ) were heated with conc. HCl &  $Cl_2$  evolved was passed through excess of KI solution. The iodine liberated required 40 ml of 0.10 N hypo solution. Find the % by wt of  $MnO_2$  in pyrolusite.
- (A) 1.16 % (B) 2.32 %  
(C) 3.48 % (D) 4.64 %
- Q 9. A piece of brass weighing 220 mg was dissolved and prepared for iodometric titration. Excess of KI was added & liberated  $I_2$  required 30 ml of 0.08 M hypo solution. Find %  $MnO_2$  in Pyrolustie.
- (A) 39.3 % (B) 49.3 %  
(C) 59.3 % (D) 69.3 %
- Q 10. 1.1 g sample of Copper ore is dissolved &  $Cu^{2+}$  (aq) is treated with KI. The iodine liberated required 12.12 ml of 0.1 M  $Na_2S_2O_3$  solution for complete reaction. Find the percentage of Copper in the ore.
- (A) 17 % (B) 70 %  
(C) 7 % (D) 27 %

- Q 11. An aqueous solution containing 0.10g  $KIO_3$  was treated with an excess of KI solution. The solution was acidified with HCl. The liberated  $I_2$  consumed 45.0 ml of thiosulphate solution to decolourise the blue starch-iodine complex. Calculate the molarity of sodium thiosulphate solution. [IIT JEE -1998]
- (A) 0.03115 M (B) 0.1246 M  
(C) 0.0623 M (D) None of these
- Q 12. 100 ml of 0.5 M  $NH_3$  is reacted with 200 ml of HCl & the excess of  $NH_3$  undergoes oxidation to  $N_2$  by 50 ml of 0.2 N  $KMnO_4$ . Find the molarity of HCl Solution.
- (A) 0.115 M (B) 0.233 M  
(C) 0.20 M (D) 0.25 M
- Q 13. 100 ml of  $HClO_3$  is treated with 200 ml of 0.5 M KOH & the remained acid is treated with 50 ml of 0.5 M  $K_2Cr_2O_7$  solution. Find the molarity of  $HClO_3$  taekn.
- (A) 0.50 M (B) 1.75 M  
(C) 1.25 M (D) 1.50 M
- Q 14. 1 lit sample of water contains 4.44 mg of  $CaCl_2$  and 1.9 mg of  $MgCl_2$  What is the total hardness in terms of ppm of  $CaCO_3$ ?
- (A) 2 ppm (B) 3 ppm  
(C) 4 ppm (D) 6 ppm
- Q 15. If hardness of water sample is 200 ppm then select the incorrect statement
- (A) Mass ratio of  $CaCO_3$  to  $H_2O$  is  $\frac{0.02}{100}$   
(B) Mole ratio of  $CaCO_3$  to  $H_2O$  is  $3.6 \times 10^{-5}$   
(C) In hard water Mass of  $CaCO_3$  is 0.2 g/lit.  
(D) 1 mili equivalent of  $CaCO_3$  present in 1 Kg of hard water
- Q 16. 1 lit of pond water contains 20 mg of  $Ca^{2+}$  and 12 mg of  $Mg^{2+}$  ions. What is the volume of 2 N  $Na_2CO_3$  solution required to soften 5000 kg of pond water
- (A) 500 lit (B) 50 lit  
(C) 5 lit (D) None of these

## Answer Key

## 1. Acid, Base &amp; Acidity, Basicity

- (1). C (2). A (3). A  
 (4). B (5). B (6). A  
 (7). B (8). C (9). A  
 (10). B (11). D (12). D  
 (13). C (14). B (15). B  
 (16). A (17). B (18). A

19.

- (i). Arrhenius (ii). Bronsted  
 (iii). Bronsted (iv). Lewis  
 (v). Arrhenius (vi). Bronsted  
 (vii). Lewis

20.

- (A) Acidic (B) Amphoteric  
 (C) Neutral (D) Amphoteric  
 (E) Amphoteric (F) Basic  
 (G) Neutral (H) Basic  
 (I) Basic (J) Neutral  
 (K) Amphoteric (L) Basic  
 (M) Basic (N) Acidic  
 (O) Basic (P) Basic

## 2. Acidic Strength &amp; Basic Strength

- (1). A (2). B (3). D  
 (4). D (5). D (6). A  
 (7). C (8). B (9). D  
 (10). D (11). C (12). C  
 (13). B (14). C (15). A  
 (16). B (17). A (18). D  
 (19). B (20). C (21). A  
 (22). B

## 3. Oxidation, Reduction &amp; Oxidation Number

1.

|    |    |    |    |
|----|----|----|----|
| +1 | +1 | 0  | 0  |
| +1 | +3 | 4  | +5 |
| +7 | -3 | -2 | -1 |
| 0  | +1 | +2 | +3 |
| +4 | +5 | +5 | +4 |
| +5 | +5 | 0  | -3 |
| -2 | +4 | +7 | +7 |
| +6 | 0  | +6 | +4 |
| +4 | +5 | -3 | +6 |
| +5 | +4 | +6 | +6 |
| +4 | +5 | +3 | +1 |

|    |    |    |    |
|----|----|----|----|
| +1 | +3 | +8 | +3 |
| +4 | +3 | +2 | +4 |

2.

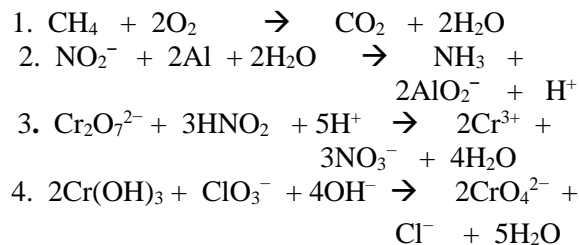
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|-----------|-----------------|---------|--------|
| +5        | -3, +5          | +6      | +6     |
| 0         | +2              | +3, +7  | +2     |
| +3        | -2, -3          | +6      | +2, +3 |
| +2        | -2, -3          | 0, +4   | 0, +5  |
| 0, +2     | +2, +4          | +1, -1  | 0, -2  |
| +2, +3    | +6              | +6      | +6     |
| +5        | +5              | +1      | +1     |
| +6        | +2              | +5      | +3     |
| (3). B, D | (4). A          | (5). D  |        |
| (6). D    | (7). B, E, F, G |         |        |
| (8). A, C | (9). D          | (10). A |        |
| (11). A   | (12). C         | (13). D |        |
| (14). D   | (15). D         | (16). B |        |

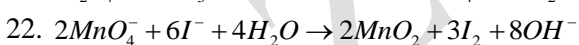
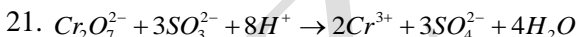
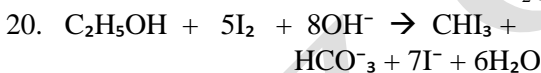
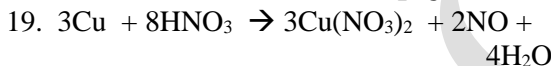
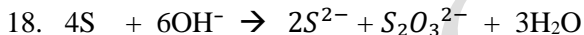
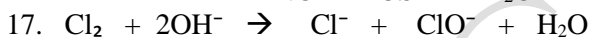
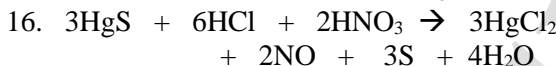
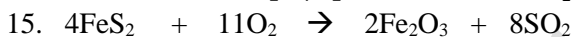
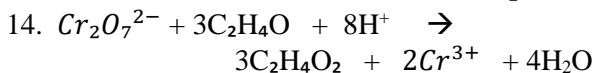
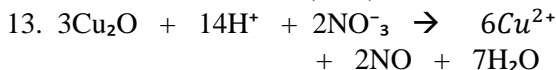
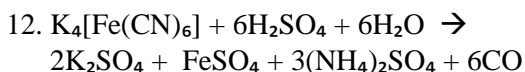
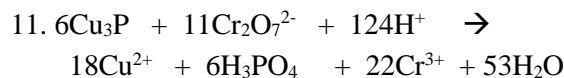
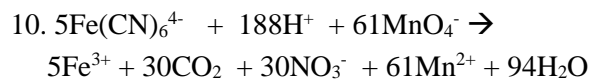
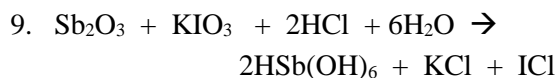
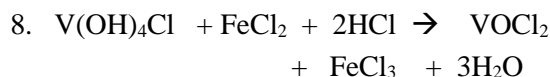
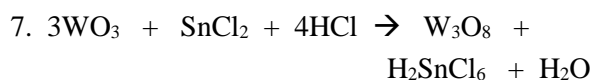
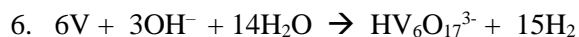
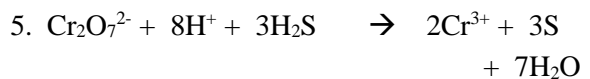
## 4. Oxidising &amp; Reducing agent, Balancing of Redox Reaction, Precipitation Reaction

1.

| Number | Oxidising Agent               | Reducing Agent                               |
|--------|-------------------------------|--|
| A      | Ce <sup>4+</sup>              | Sn <sup>2+</sup>                             |
| B      | HCl                           | Zn   |
| C      | O <sub>2</sub>                | CH <sub>4</sub>                              |
| D      | ClO <sup>-</sup>              | I <sup>-</sup>                               |
| E      | NO <sub>3</sub> <sup>-</sup>  | As <sub>2</sub> O <sub>3</sub>               |
| F      | MnO <sub>4</sub> <sup>-</sup> | Al   |
| G      | O <sub>2</sub>                | Ag   |
| H      | Cl <sub>2</sub>               | Cl <sub>2</sub>                              |
| I      | NO <sub>2</sub> <sup>-</sup>  | Al   |
| J      | HNO <sub>3</sub>              | H <sub>3</sub> AsO <sub>3</sub>              |
| k      | AgBr                          | C <sub>6</sub> H <sub>6</sub> O <sub>2</sub> |
| l      | Cu <sup>2+</sup>              | HCHO   |

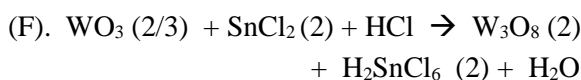
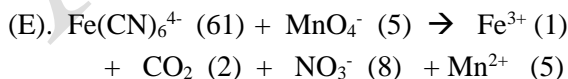
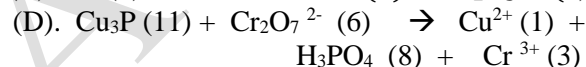
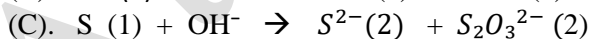
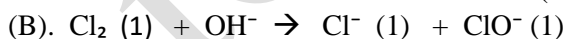
2.





(3). C (4). D

(5).



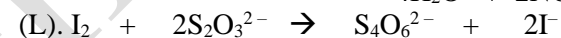
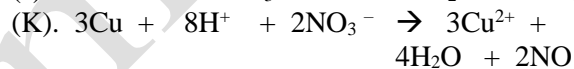
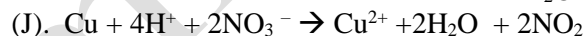
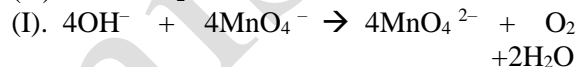
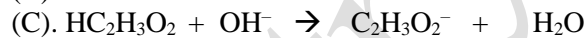
(6). D (7). B (8). B

(9). A

(10). (1). AgCl (5). BaSO<sub>4</sub> (6). CaCO<sub>3</sub>

(11). Complete Molecular Reaction:  
 $2\text{Cu}(\text{NO}_3)_2 + 4\text{KI} \rightarrow \text{Cu}_2\text{I}_2 + 4\text{KNO}_3 + \text{I}_2$   
 Net Ionic Reaction:  $2\text{Cu}^{2+} + 4\text{I}^- \rightarrow \text{Cu}_2\text{I}_2 + \text{I}_2$

(12).



### 5. n – factor Concept

(1).

|       |       |       |
|-------|-------|-------|
| (A) 1 | (B) 2 | (C) 3 |
| (D) 2 | (E) 1 | (F) 2 |
| (G) 1 | (H) 1 | (I) 3 |
| (J) 1 | (K) 2 | (L) 6 |
| (M) 6 | (N) 1 | (O) 2 |

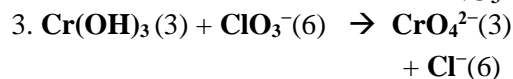
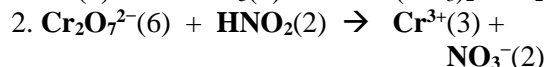
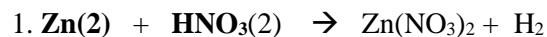
(2).

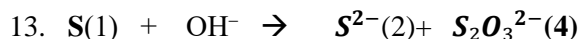
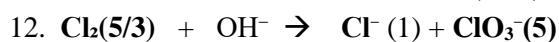
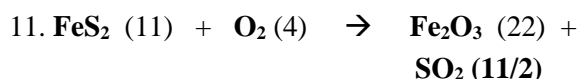
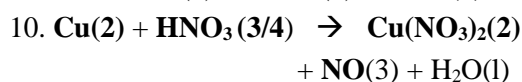
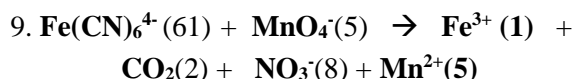
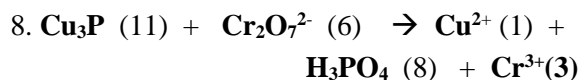
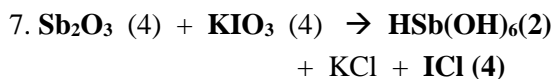
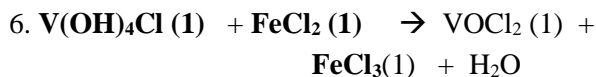
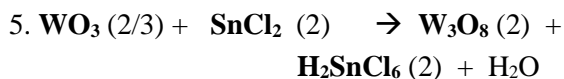
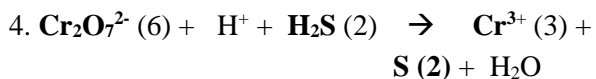
|       |       |       |
|-------|-------|-------|
| (A) 1 | (B) 2 | (C) 3 |
| (D) 1 | (E) 1 | (F) 2 |
| (G) 1 | (H) 1 | (I) 3 |
| (J) 1 | (K) 2 | (L) 1 |
| (M) 1 | (N) 1 | (O) 2 |

(3). B (4). C (5). C

(6). A

(7).





(8). C      (9). C      (10). C

(11). B      (12). B      (13). D

(14). C      (15). C

### 6. Equivalent Concept, Normality

(1). C      (2). B      (3). B

(4). A      (5). B      (6). A

(7). B      (8). C      (9). B

(10). A      (11). C      (12). C

(13). D      (14). A      (15). B

(16). C

### 7. Principle of g Equivalence,

#### Principle of Chemical Equivalence

(1). B      (2). A      (3). A

(4). A      (5). C      (6). A

(7). B      (8). B      (9). B

(10). B      (11). A      (12). A

(13). A      (14). B

### 8. Acid Base Titration

(1). C      (2). A      (3). B

(4). B      (5). D      (6). B

(7). C      (8). C      (9). A

(10). B      (11). C      (12). A

### 9. Back Titration, Indicator Titration

(1). C      (2). C      (3). D

(4). B      (5). A      (6). A

(7). A      (8). A, C      (9). A

(10). A      (11). B      (12). C

(13). A - p, B - r, C - q, D - q

### 10. Redox Titration

(1). B      (2). C      (3). A

(4). B      (5). A      (6). A

(7). A      (8). D      (9). C

(10). B      (11). A      (12). C

(13). B

### 11. Back Titration, Iodometry, Hardness of Water

(1). B      (2). C      (3). A

(4). C      (5). C      (6). D

(7). B      (8). C      (9). D

(10). C      (11). C      (12). B

(13). C      (14). D      (15). D

(16). C