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) $Al(OH)_3$ (B) HCN
(C) CsBr (D) $Ca(OH)_2$

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 Q 12. In a given situation, which one of the following can't act an acid as well as a base ?
(A) HSO_4^- (B) NH_3
(C) H_2O (D) CH_3COOH

Q 13. Which one of the following species is capable of acting both as a bronsted acid & bronsted base?
(A) F^- (B) CO_3^{2-}
(C) HS^- (D) S^{2-}

Q 14. Identify the Bronsted acid in the following equation:
$PO_4^{3-}(aq) + H_2O(l) \rightarrow HPO_4^{2-}(aq) + OH^-(aq)$
(A) OH^- (B) H_2O
(C) HPO_4^{2-} (D) PO_4^{3-}

Q 15. The Basicity of Acid H_3PO_3 is
(A) 1 (B) 2
(C) 3 (D) 4

Q 16. The Basicity of Acid H_3PO_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 $B(OH)_3$ 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). $HCl + NaOH \rightarrow NaCl + H_2O$
2). $HC_2H_3O_2 + H_2O \rightarrow H_3O^+ + C_2H_3O_2^-$
3). $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$
4). $Ag^+(aq) + 2CN^-(aq) \rightarrow Ag(CN)_2^-(aq)$
5). $HNO_3(aq) + NaOH \rightarrow NaNO_3(aq) + H_2O(l)$
6). $CCl_3COOH + H_2O(l) \rightarrow CCl_3CO_2^- + H_3O^+$
7). $AgCl(s) + 2NH_3 \rightarrow (NH_3)_2Ag^+ + Cl^-$

Q 20. Classify each of the following oxides as acidic, neutral, amphoteric, basic:
(A) N_2O_5 (B) SnO (C) CO
(D) PbO (E) MnO_2 (F) RaO
(G) N_2O (H) FeO (I) Ag_2O
(J) OsO_4 (K) Al_2O_3 (L) Fe_2O_3
(M) CeO_2 (N) CO_2 (O) MgO
(P) K_2O

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2. Acidic Strength & Basic Strength

Classify the substances in Problems # 1-7

1. $Ca(OH)_2$ 2. NH_3 3. HF
4. H_3PO_4 5. HCN 6. KOH
7. $HClO_4$

(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) HF > HCl > HBr > HI
(B) HI > HBr > HCl > HF
(C) HCl > HBr > HI > HF
(D) HF > HI > HBr > HCl

Q 9. In which of the following is the acid strength ranking INCORRECT?
(A) $H_2SO_4 > H_2SO_3$ (B) $HNO_3 > HNO_2$
(C) $HClO_4 > HClO_3$ (D) $H_2SeO_3 > H_2SO_3$

Q 10. Which of the following would be the most acidic substance in aqueous solution?
(A) SO_4^{2-} (B) H_2O
(C) NH_2^- (D) NH_4^+

Q 11. In which of the following is the acid strength ranking CORRECT?
(A) $H_2SO_3 > H_2SO_4$ (B) $H_2S > HCl$
(C) $H_2S > PH_3$ (D) None of these

Q 12. The conjugate base of ammonia is
(A) NH_3 (B) NH_4^+
(C) NH_2^- (D) OH^-

Q 13. The conjugate acid of H_2O is
(A) H_2O (B) H_3O^+
(C) OH^- (D) None of these

Q 14. The conjugate base of HPO_4^{2-} is
(A) H_3PO_4 (B) $H_2PO_4^-$
(C) PO_4^{3-} (D) OH^-

Q 15. The conjugate acid of Ac^- is
(A) HAc (B) H_3O^+
(C) H_2O (D) None of these

Q 16. Which of the following would be the most basic substance in aqueous solution?
(A) HSO_4^- (B) F^-
(C) Cl^- (D) I^-

Q 17. Which one of the following is the weakest base as per the Bronsted concept ? **[JEE Main 2016]**
(A) $[ClO_4]^-$ (B) $[ClO_3]^-$
(C) $[ClO_2]^-$ (D) $[ClO]^-$

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?
(A). $H^+(aq) + Ac^-(aq) + Na^+(aq) + OH^-(aq) \rightarrow Na^+(aq) + Ac^-(aq) + H_2O(l)$
(B) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
(C) $HAc(aq) + NaOH(aq) \rightarrow NaAc(aq) + H_2O(l)$
(D) $HAc(aq) + OH^-(aq) \rightarrow Ac^-(aq) + H_2O(l)$

Q 19. The Correct order of acidic strength is
(A) $H_3PO_4 > H_3PO_3 > H_3PO_2$
(B) $H_3PO_4 < H_3PO_3 < H_3PO_2$
(C) $H_3PO_3 > H_3PO_4 > H_3PO_2$
(D) $H_3PO_4 = H_3PO_3 > H_3PO_2$

Q 20. The Strongest Acid Among HI, HBr, $HClO_4$, H_2SO_4, HNO_3, HCl, H_3PO_4, H_3O^+ is
(A) $HClO_4$ (B) H_2SO_4
(C) HI (D) H_3O^+

Q 21. The solution of $AlCl_3$ in water acidic, basic or neutral?
(A) Acidic (B) Basic
(C) Neutral (D) Amphoteric

Q 22. In reaction with BeF_2 with $2F^-$, to form BeF_4^{2-}, which reactant is the Lewis Acid
(A) BeF_2 (B) $2F^-$
(C) BeF_4^{2-} (D) None of these

3. Oxidation, Reduction & Oxidation Number

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

$\mathbf{H}^+$	$\mathbf{H}_2O$	$\mathbf{H}_2$	$\mathbf{Cl}_2$
$\mathbf{Cl}O^-$	$\mathbf{Cl}O_2^-$	$\mathbf{Cl}O_2$	$\mathbf{Cl}O_3^-$
$\mathbf{Cl}O_4^-$	$\mathbf{N}O$	$\mathbf{N}O_2^-$	$\mathbf{N}O_2$
$\mathbf{N}O_3^-$	$\mathbf{N}H_3$	$\mathbf{N}_2H_4$	$\mathbf{N}H_2OH$
$\mathbf{N}_2$	$\mathbf{N}_2O$	$K\mathbf{N}O_3$	$H_2\mathbf{C}O_3$
$NaH_2\mathbf{P}O_4$	$Al(\mathbf{N}O_3)_3$	**B**	$\mathbf{N}^{-3}$
$K_2\mathbf{O}$	$\mathbf{C}O_3^{-2}$	$K\mathbf{Cl}O_4$	$\mathbf{Mn}O_4^-$
$Al_2(\mathbf{S}O_4)_3$	$\mathbf{F}_2$	$NaH\mathbf{S}O_4$	$\mathbf{C}O_3^{2-}$
$H\mathbf{C}O_3^-$	$\mathbf{P}O_4^{3-}$	$\mathbf{N}H_4^+$	$K_2\mathbf{Mn}O_4$
$\mathbf{N}O_3^-$	$Mg_2\mathbf{T}iO_4$	$K_2\mathbf{Cr}_2O_7$	$\mathbf{S}O_3^{2-}$
$\mathbf{Se}O_3^{2-}$	$Ba_2\mathbf{Xe}O_6$	$Na\mathbf{Au}Cl_4$	$Ca(\mathbf{Cl}O_2)_2$
$\mathbf{O}F_2$	$Na\mathbf{Al}H_4Cl$	$\mathbf{Os}O_4$	$\mathbf{C}_2O_4^{2-}$
$\mathbf{Ti}_2O$	$\mathbf{Fe}_2O_3$	$\mathbf{Cu}O$	$\mathbf{Mn}O_2$

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Q 2. Assign oxidation number of bold element in the following species. **[AIIMS/NCERT** Including]

$H_4\mathbf{P}_2O_7$	$\mathbf{N}H_4\mathbf{N}O_3$	$(NH_4)_2\mathbf{S}O_4$	$Fe\mathbf{S}O_4$
$(CH_3)_2\mathbf{S}O$	$\mathbf{V}(BrO_2)_2$	$\mathbf{NOCl}O_4$	$H\mathbf{N}C$
$[\mathbf{Co}(NH_3)_6]Cl_3$	$\mathbf{C}_4H_{10}$	$Co_2(SO_4)_3$	$\mathbf{Fe}_3O_4$
$K_4[\mathbf{Fe}(CN)_6]$	C_3H_8	$\mathbf{S}_2O_3^{2-}$	$H_2\mathbf{S}_4O_6$
$\mathbf{C}_3O_2$	N_2O_3	$\mathbf{N}_3^-$	$Sn\mathbf{S}_3^{2-}$
$\mathbf{Fe}_{0.94}O$	$\mathbf{S}_2O_8^{2-}$	$H_2\mathbf{S}O_5$	$\mathbf{Cr}O_5$
$\mathbf{P}_2O_8^{4-}$	$\mathbf{N}_2O_6$	$\mathbf{H}_2O_2$	$\mathbf{Na}_2O_2$
$\mathbf{Cr}O_4$	$H\mathbf{C}O_3H$	$H_3\mathbf{P}O_5$	$H\mathbf{Au}Cl_4$
$H_2\mathbf{S}_2O_7$	$Ca\mathbf{O}_2$	$\mathbf{C}H_3\mathbf{C}OOH$	$K\mathbf{I}_3$

Q 3. In which of the following species N exhibit two different oxidation state. **[NCERT Examplar]**

(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 Examplar]**

(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 1 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 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 Examplar]**

(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

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(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) ClO^- (B) ClO_2^-
(C) ClO_3^- (D) ClO_4^-

Q 16. Which of the molecules can act as oxidizing agent as well as reducing agent. **[AIIMS 2005]**

(A) H_2S (B) SO_3
(C) H_2O_2 (D) 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: **[NCRET** Inc.]

(A). $Ce^{4+} + Sn^{2+} \rightarrow Ce^{3+} + Sn^{4+}$
(B). $Zn + HCl \rightarrow Zn^{2+} + H_2$
(C). $CH_4 + O_2 \rightarrow CO_2 + H_2O$
(D). $I^- + ClO^- \rightarrow I_3^- + Cl^-$
(E). $As_2O_3 + NO_3^- \rightarrow H_3AsO_4 + NO$
(F). $Al + MnO_4^- \rightarrow MnO_2 + Al(OH)_4^-$
(G). $Ag + CN^- + O_2 \rightarrow Ag(CN)_2^-$
(H). $Cl_2 + OH^- \rightarrow Cl^- + ClO^-$
(I). $NO_2^- + Al \rightarrow NH_3 + AlO_2^-$
(J). $HNO_3 + H_3AsO_3 \rightarrow NO + H_3AsO_4 + H_2O$
(K). $2AgBr + C_6H_6O_2 \rightarrow 2Ag + 2HBr + C_6H_4O_2$
(l). $HCHO + Cu^{2+} + OH^- \rightarrow Cu_2O + HCOO^- + H_2O$

Q 2. Balance these oxidation-reduction reactions [**NCERT** based/Including]

1. $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$
2. $NO_2^- + Al(s) \rightarrow NH_3(g) + AlO_2^-$
3. $Cr_2O_7^{2-}(aq) + HNO_2(aq) \rightarrow Cr^{3+}(aq) + NO_3^-(aq)$ (acidic)
4. $Cr(OH)_3(s) + ClO_3^-(aq) \rightarrow CrO_4^{2-}(aq) + Cl^-(aq)$ (basic)
5. $Cr_2O_7^{2-} + H^+ + H_2S \rightarrow Cr^{3+} + S + H_2O$ (acidic)
6. $V + H_2O \rightarrow HV_6O_{17}^{3-} + H_2$ (in alkaline medium)
7. $WO_3 + SnCl_2 + HCl \rightarrow W_3O_8 + H_2SnCl_6 + H_2O$
8. $V(OH)_4Cl + FeCl_2 + HCl \rightarrow VOCl_2 + FeCl_3 + H_2O$
9. $Sb_2O_3 + KIO_3 + HCl + H_2O \rightarrow HSb(OH)_6 + KCl + ICl$
10. $Fe(CN)_6^{4-} + H^+ + MnO_4^- \rightarrow Fe^{3+} + CO_2 + NO_3^- + Mn^{2+}$
11. $Cu_3P + Cr_2O_7^{2-} \rightarrow Cu^{2+} + H_3PO_4 + Cr^{3+}$
12. $K_4[Fe(CN)_6] + H_2SO_4 + H_2O \rightarrow K_2SO_4 + FeSO_4 + (NH_4)_2SO_4 + CO$
13. $Cu_2O + H^+ + NO_3^- \rightarrow Cu^{2+} + NO + H_2O$
14. $Cr_2O_7^{2-} + C_2H_4O \rightarrow C_2H_4O_2 + Cr^{3+}$
15. $FeS_2 + O_2 \rightarrow Fe_2O_3 + SO_2$
16. $HgS + HCl + HNO_3 \rightarrow HgCl_2 + NO + S + H_2O$
17. $Cl_2 + OH^- \rightarrow Cl^- + ClO^-$
18. $S + OH^- \rightarrow S^{2-} + S_2O_3^{2-}$
19. $Cu(s) + HNO_3(aq) \rightarrow Cu(NO_3)_2 + NO(g) + H_2O(l)$ (acidic)
20. $C_2H_5OH + I_2 + OH^- \rightarrow CHI_3 + HCO_3^- + I^- + H_2O$
21. $Cr_2O_7^{2-} + SO_3^{2-} + H^+ \rightarrow Cr^{3+} + SO_4^{2-} + H_2O$
22. $MnO_4^- + I^- + H_2O \rightarrow MnO_2 + I_2 + OH^-$

Q 3. Given xHI + yHNO$_3$ → NO + I$_2$ + H$_2$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 CN^- + bNO_3^- + cH^+ → (a+b) NO + aCO_2 + (c/2) H_2O.
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:

(A). $Cr_2O_7^{2-} + C_2H_4O \rightarrow C_2H_4O_2 + Cr^{3+}$
(B). $Cl_2 + OH^- \rightarrow Cl^- + ClO^-$
(C). $S + OH^- \rightarrow S^{2-} + S_2O_3^{2-}$
(D). $Cu_3P + Cr_2O_7^{2-} \rightarrow Cu^{2+} + H_3PO_4 + Cr^{3+}$
(E). $Fe(CN)_6^{4-} + MnO_4^- \rightarrow Fe^{3+} + CO_2 + NO_3^- + Mn^{2+}$
(F). $WO_3 + SnCl_2 + HCl \rightarrow W_3O_8 + H_2SnCl_6 + H_2O$

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Q 6. Cu_3P oxidises to form $CuSO_4$ & 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 HNO_3. The possible product obtained due to reduction
(A) 0.5 mole of N_2 (B) 0.5 mole of N_2O
(C) 1 mole of NO_2 (D) 1 mole of NH_3

Q 8. In a reaction, 8 electrons are transferred to 2 molecule of V_2O_5, final oxidation state of Vanadium
(A) 4 (B) 3
(C) 2 (D) None of these

Q 9. In Non-stoichiometric Compound $Fe_{0.98}O$, 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). KCl & $AgNO_3$ (2). $BaSO_4$ & KCl
(3). K_2CrO_4 & $BaSO_4$ (4). $AgCl$ & $KMnO_4$
(5). K_2SO_4 and $BaCl_2$ (6). $Ca(NO_3)_2$ & Na_2CO_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). $HClO_3 + KOH \rightarrow KClO_3 + H_2O$
(B). $Fe_2(SO_4)_3 + Fe \rightarrow FeSO_4$
(C). $HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$
(D). $AlCl_3 + 4NaOH \rightarrow NaAl(OH)_4 + NaCl$
(E). $AgNO_3 + H_2S \rightarrow Ag_2S + HNO_3$
(F). $CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$
(G). $Zn + HgCl_2 \rightarrow ZnCl_2 + Hg$
(H). $CdS + I_2 \rightarrow CdI_2 + S$
(I). $KOH + KMnO_4 \rightarrow K_2MnO_4 + O_2 + H_2O$
(J). $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + H_2O + NO_2$
(K) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + H_2O + NO$
(L). $I_2 + Na_2S_2O_3 \rightarrow Na_2S_4O_6 + NaI$
(M). $NH_4Cl + NaOH \rightarrow NaCl + NH_3 + H_2O$

5. n – factor Concept

Q 1. Calculate valancy factor/n–factor for following Species.
(A) Na (B) Ba (C) Al
(D) O (E) Cl (F) SO_4^{2-}
(G) ClO_4^- (H) NaClO (I) Na_3PO_4
(J) CH_3COO^- (K) $K_2C_2O_4$ (L) $Al_2(SO_{4)3}$
(M) Zn_3P_2 (N) NH_4^+ (O) Mg^{2+}

Q 2. Calculate n–factor tor of following acid & Base.
(A) NaOH (B) $Ba(OH)_2$ (C) $Al(OH)_3$
(D) KOH (E) HCl (F) H_2SO_4
(G) $HClO_4$ (H) HClO (I) H_3PO_4
(J) CH_3COOH (K) $H_2C_2O_4$ (L) NH_3
(M) H_3O^+ (N) $B(OH)_3$ (O) H_3PO_3

Q 3. In the Reaction given below, n–factor of H_3PO_4 is: $H_3PO_4 + NaOH \rightarrow Na_2HPO_4 + H_2O$
(A) 1 (B) 2
(C) 3 (D) 4

Q 4. In the Reaction given below, n–factor of H_3PO_4 is
$H_3PO_4 + NaOH \rightarrow Na_3PO_4 + H_2O$
(A) 1 (B) 2
(C) 3 (D) 4

Q 5. In Reaction given below, Eq. weight of H_3PO_4 is
$H_3PO_4 + NaOH \rightarrow Na_2HPO_4 + H_2O$
(A) 98 (B) 32.66
(C) 49 (D) None of these

Q 6. In Reaction given below, n–factor of $HC_2H_3O_2$ is
$HC_2H_3O_2 + H_2O \rightarrow H_3O^+ + C_2H_3O_2^-$
(A) 1 (B) 2
(C) 3 (D) 4

Q 7. Find the valancy factor of Bold Species in the following reactions
1. $\mathbf{Zn} + \mathbf{HNO_3} \rightarrow Zn(NO_3)_2 + H_2$
2. $\mathbf{Cr_2O_7^{2-}} + \mathbf{HNO_2} \rightarrow \mathbf{Cr^{3+}} + \mathbf{NO_3^-}$
3. $\mathbf{Cr(OH)_3} + \mathbf{ClO_3^-} \rightarrow \mathbf{CrO_4^{2-}} + \mathbf{Cl^-}$
4. $\mathbf{Cr_2O_7^{2-}} + \mathbf{H_2S} \rightarrow \mathbf{Cr^{3+}} + \mathbf{S} + H_2O$
5. $\mathbf{WO_3} + \mathbf{SnCl_2} + HCl \rightarrow \mathbf{W_3O_8} + \mathbf{H_2SnCl_6} + H_2O$
6. $\mathbf{V(OH)_4Cl} + \mathbf{FeCl_2} + HCl \rightarrow VOCl_2 + \mathbf{FeCl_3} + H_2O$
7. $\mathbf{Sb_2O_3} + \mathbf{KIO_3} + HCl \rightarrow \mathbf{HSb(OH)_6} + KCl + \mathbf{ICl}$
8. $\mathbf{Cu_3P} + \mathbf{Cr_2O_7^{2-}} \rightarrow \mathbf{Cu^{2+}} + \mathbf{H_3PO_4} + \mathbf{Cr^{3+}}$
9. $\mathbf{Fe(CN)_6^{4-}} + H^+ + \mathbf{MnO_4^-} \rightarrow \mathbf{Fe^{3+}} +$

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$CO_2 + NO_3^- + Mn^{2+}$

10. $Cu(s) + HNO_3 \rightarrow Cu(NO_3)_2 + NO + H_2O$

11. $FeS_2 + O_2 \rightarrow Fe_2O_3 + SO_2$

12. $Cl_2 + OH^- \rightarrow Cl^- + ClO_3^-$

13. $S + OH^- \rightarrow S^{2-} + S_2O_3^{2-}$

Q 8. In the Reaction given below, n–factor of Cu_2S is
$Cu_2S \rightarrow Cu^{2+} + SO_2$
(A) 2 (B) 6
(C) 8 (D) 4

Q 9. In the Reaction given below, n – factor of HCl is
$K_2Cr_2O_7 + HCl \rightarrow KCl + CrCl_3 + Cl_2 + H_2O$
(A) 6 (B) 14/6
(C) 6/14 (D) 1

Q 10. In the Reaction given below, Equivalent weight of V is
$V \rightarrow HV_6O_{17}^{3-} + H_2$
(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
$Sb_2O_3 + KIO_3 + HCl \rightarrow HSb(OH)_6 + KCl + ICl$
(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 H_2SO_4 is
$Pb + PbO_2 + H_2SO_4 \rightarrow PbSO_4 + H_2O$
(A) 49 (B) 98
(C) 196 (D) None of these

Q 13. In Reaction given below, n - factor of MnO_4^- is
$3MnO_4^- \rightarrow 2Mn^{2+} + MnO_2$ (Mn is balanced)
(A) 15 (B) 10
(C) 3 (D) 13/3

Q 14. In Reaction given below, n - factor of $Cr_2O_7^{2-}$ is
$2Cr_2O_7^{2-} \rightarrow 3Cr^{3+} + Cr^{4+}$ (Cr is balanced)
(A) 6 (B) 9
(C) 11/2 (D) 11/4

Q 15. In the Reaction given below, n - factor of NH_3 is
$6NH_3 \rightarrow 2N_2 + N_2O_5$ (Only N is balanced)
(A) 3 (B) 2
(C) 14/3 (D) 16/3

6. Equivalent Concept, Normality

Q 1. If Equivalent weight of H_2S is E as Acid then Eq. Wt. of H_2S in the conversion $H_2S \rightarrow SO_2$
(A) E (B) E/6
(C) E/3 (D) E/2

Q 2. If $KHC_2O_4.H_2C_2O_4.2H_2O$ 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 H_2SO_4 and H_3PO_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 H_2SO_4 and H_3PO_4.
(A) 0.5 (B) 2
(C) 3/2 (D) 2/3

Q 5. Equivalent weight of sulphur in SCl_2 is 16, what is the equivalent weight of S in S_2Cl_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 H_2S in the reaction $H_2S \rightarrow SO_2$, is
(A) 6 (B) 3
(C) 2 (D) None of these

Q 10. Find no of Equivalent in 0.25 mole of Cl_2 in the reaction $Cl_2 \rightarrow Cl^- + ClO_3^-$, is
(A) 5/12 (B) 5/6

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(C) 5/3 (D) None of these

Q 11. Which of the following relations is correct?
(A) 3 N $Al_2(SO_4)_3$ = 0.5 M $Al_2(SO_4)_3$
(B) 3 M H_2SO_4 = 6 N H_2SO_4
(C) 1 M H_3PO_4 = 1/3 N H_3PO_4
(D) 1 M $Al_2(SO_4)_3$ = 6 N $Al_2(SO_4)_3$

Q 12. The mass of Oxalic acid crystal ($H_2C_2O_4.2H_2O$) 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 H_3PO_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 2:1volume 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 H_2SO_4 and 30 ml of 1/3 N HNO_3 are mixed together and volume made to one litre. The Normality of 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 H_2SO_4 solution. The final
(A) 0.9 N (B) 0.6 N (C) 0.5 N (D) 0.4 N

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 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 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 $BaCl_2$ present in a solution was quantitatively converted into 2.25 g of $BaSO_4$. Find the equivalent weight of the metal?
(A) 129 (B) 64.5
(C) 32.25 (D) None of these

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 H_2S will react with 6.32 g of $KMnO_4$ to produce K_2SO_4 and 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?
$Zn + V_2O_5 \rightarrow ZnO + V$
(A) 32.69 (B) 22.96
(C) 42.69 (D) None of these

Q 14. 1 g of the acid $C_6H_{10}O_4$ 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

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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 $Na_2CO_3.XH_2O$ 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 concersion 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 ans 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 Na_2CO_3 as impurity was dissoleved to give 250 ml of solution. A 10 mL portion of the solution required 20 mL of 0.1 N H_2SO_4 solution for complete neutralization. Calculate the % by weight of Na_2CO_3 in the sample.

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

Q 5. 5 ml of of 8 N HNO_3, 4.8ml of 5N HCl and a certain volume of 17M H_2SO_4 are mixed together & made up to 2 litre. 30 ml of this acid mixture completely neutralise 42.9ml of Na_2CO_3 solution containing one gram of $Na_2CO_3.10H_2O$ 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 weighting 1.5763 gm is added to 25 ml of 0.4210 M KOH after saponification is complete 8.46 ml of 0.2732 M H_2SO_4 is needed to neutralize excess KOH. The soapnification 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 H_3PO_4 in 550 ml solution is 0.40 N. Thus the acid is

(A) has been neutralized to HPO_4^{2-}

(B) has been neutralized to PO_4^{3-}

(C) has been neutralized to HPO_3^{2-}

(D) has been neutralized to $H_2PO_4^-$

Q 8. During the titration of Na_2CO_3 and $NaHCO_3$ 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 Na_2CO_3 and $NaHCO_3$, 10 ml of the solution required 2.5 mL of 0.1 M H_2SO_4 for neutralization using phenolphthalein as indicator. Methyl orange is then added when a further of 2.5 ml of 0.2 M H2SO4 was required. The amount of Na_2CO_3 and $NaHCO_3$ 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 $Na_2CO_3.XNaHCO_3.YH_2O$ gave the following results: 2.5 g of the salt is dissolved in water and made upto 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 $CaCO_3$ precipitated when 10 g of salt is strongly heated with $CaCl_2$

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

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

Column 1	Column II
a). $Na_2CO_3 + NaHCO_3$	p). 300 ml
b). $NaOH + NaHCO_3$	q). 400 ml
c). $Na_2CO_3 + Na_2CO_3$	r). 200 ml
d). $Na_2CO_3 + NaHCO_3 + NaOH$	

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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 $K_2C_2O_4.3H_2C_2O_4.4H_2O$ 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 KMnO4 needed for same oxidation in acidic medium is
(A) 0.4 V_1 (B) 2.5V_1
(C) 113V_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 from 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 unxoidised?
(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 milimole of KIO_3 react completely with y m mol 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 $FeSO_4.7H_2O$ and $Fe_2(SO_4)_3.9H_2O$ 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) 9.5×10^{-3} (B) 4.75×10^{-3}
(C) 1.9×10^{-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.

$[H_2O_2 + 2KI \rightarrow 2KOH + I_2]$,

$[I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6]$

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 iodometirc titration. Excess of KI was added & linerted 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 undergores 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 3.6×10^{-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

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Answer Key

1. Acid, Base & 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). Arhenius	(ii). Bronsted
(iii). Bronsted	(iv). Lewis
(v). Arhenius	(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 & 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 & 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.

+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 & Reducing agent, Balancing of Redox Reaction, Precipitation Reaction

1.

Number	Oxidisng Agent	Reducing Agent
A	Ce^{4+}	Sn^{2+}
B	HCl	Zn
C	O_2	CH_4
D	ClO^-	I^-
E	NO_3^-	As_2O_3
F	MnO_4^-	Al
G	O_2	Ag
H	Cl_2	Cl_2
I	NO_2^-	Al
J	HNO_3	H_3AsO_3
k	AgBr	$C_6H_6O_2$
l	Cu^{2+}	HCHO

2. 1. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

2. $NO_2^- + 2Al + 2H_2O \rightarrow NH_3 + 2AlO_2^- + H^+$

3. $Cr_2O_7^{2-} + 3HNO_2 + 5H^+ \rightarrow 2Cr^{3+} + 3NO_3^- + 4H_2O$

4. $2Cr(OH)_3 + ClO_3^- + 4OH^- \rightarrow 2CrO_4^{2-} + Cl^- + 5H_2O$

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5. $Cr_2O_7^{2-} + 8H^+ + 3H_2S \rightarrow 2Cr^{3+} + 3S + 7H_2O$
6. $6V + 3OH^- + 14H_2O \rightarrow HV_6O_{17}^{3-} + 15H_2$
7. $3WO_3 + SnCl_2 + 4HCl \rightarrow W_3O_8 + H_2SnCl_6 + H_2O$
8. $V(OH)_4Cl + FeCl_2 + 2HCl \rightarrow VOCl_2 + FeCl_3 + 3H_2O$
9. $Sb_2O_3 + KIO_3 + 2HCl + 6H_2O \rightarrow 2HSb(OH)_6 + KCl + ICl$
10. $5Fe(CN)_6^{4-} + 188H^+ + 61MnO_4^- \rightarrow 5Fe^{3+} + 30CO_2 + 30NO_3^- + 61Mn^{2+} + 94H_2O$
11. $6Cu_3P + 11Cr_2O_7^{2-} + 124H^+ \rightarrow 18Cu^{2+} + 6H_3PO_4 + 22Cr^{3+} + 53H_2O$
12. $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O \rightarrow 2K_2SO_4 + FeSO_4 + 3(NH_4)_2SO_4 + 6CO$
13. $3Cu_2O + 14H^+ + 2NO^-_3 \rightarrow 6Cu^{2+} + 2NO + 7H_2O$
14. $Cr_2O_7^{2-} + 3C_2H_4O + 8H^+ \rightarrow 3C_2H_4O_2 + 2Cr^{3+} + 4H_2O$
15. $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$
16. $3HgS + 6HCl + 2HNO_3 \rightarrow 3HgCl_2 + 2NO + 3S + 4H_2O$
17. $Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$
18. $4S + 6OH^- \rightarrow 2S^{2-} + S_2O_3^{2-} + 3H_2O$
19. $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
20. $C_2H_5OH + 5I_2 + 8OH^- \rightarrow CHI_3 + HCO^-_3 + 7I^- + 6H_2O$
21. $Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$
22. $2MnO_4^- + 6I^- + 4H_2O \rightarrow 2MnO_2 + 3I_2 + 8OH^-$

(3). C (4). D

(5).

(A). $Cr_2O_7^{2-}$ (6) + C_2H_4O (2) → $C_2H_4O_2$(2) Cr^{3+} (3)

(B). Cl_2 (1) + OH^- → Cl^- (1) + ClO^- (1)

(C). S (1) + OH^- → S^{2-}(2) + $S_2O_3^{2-}$ (2)

(D). Cu_3P (11) + $Cr_2O_7^{2-}$ (6) → Cu^{2+} (1) + H_3PO_4 (8) + Cr^{3+} (3)

(E). $Fe(CN)_6^{4-}$ (61) + MnO_4^- (5) → Fe^{3+} (1) + CO_2 (2) + NO_3^- (8) + Mn^{2+} (5)

(F). WO_3 (2/3) + $SnCl_2$ (2) + HCl → W_3O_8 (2) + H_2SnCl_6 (2) + H_2O

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

(9). A

(10). (1). AgCl (5). $BaSO_4$ (6). $CaCO_3$

(11). Complete Molecular Reaction:
$2Cu(NO_3)_2 + 4KI \rightarrow Cu_2I_2 + 4KNO_3 + I_2$
Net Ionic Reaction: $2Cu^{2+} + 4I^- \rightarrow Cu_2I_2 + I_2$

(12).

(A). $H^+ + OH^- \rightarrow H_2O$
(B). $2Fe^{3+} + Fe \rightarrow 3Fe^{2+}$
(C). $HC_2H_3O_2 + OH^- \rightarrow C_2H_3O_2^- + H_2O$
(D). $AlCl_3 + 4OH^- \rightarrow Al(OH)_4^- + 3Cl^-$
(E). $2Ag^+ + H_2S \rightarrow Ag_2S + 2H^+$
(F). $CaCO_3 + CO_2 + H_2O \rightarrow Ca^{2+} + 2HCO_3^-$
(G). $Zn + HgCl_2 \rightarrow Zn^{2+} + 2Cl^- + Hg$
(H). $S^{2-} + I_2 \rightarrow 2I^- + S$
(I). $4OH^- + 4MnO_4^- \rightarrow 4MnO_4^{2-} + O_2 + 2H_2O$
(J). $Cu + 4H^+ + 2NO_3^- \rightarrow Cu^{2+} + 2H_2O + 2NO_2$
(K). $3Cu + 8H^+ + 2NO_3^- \rightarrow 3Cu^{2+} + 4H_2O + 2NO$
(L). $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$
(M). $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$

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).

1. **Zn(2)** + **HNO_3**(2) → $Zn(NO_3)_2$ + H_2
2. **$Cr_2O_7^{2-}$**(6) + **HNO_2**(2) → **Cr^{3+}**(3) + **NO_3^-**(2)
3. **$Cr(OH)_3$** (3) + **ClO_3^-**(6) → **CrO_4^{2-}**(3) + **Cl^-**(6)

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4. $Cr_2O_7^{2-}$ (6) + H^+ + H_2S (2) → Cr^{3+} (3) + S (2) + H_2O

5. WO_3 (2/3) + $SnCl_2$ (2) → W_3O_8 (2) + H_2SnCl_6 (2) + H_2O

6. $V(OH)_4Cl$ (1) + $FeCl_2$ (1) → $VOCl_2$ (1) + $FeCl_3$(1) + H_2O

7. Sb_2O_3 (4) + KIO_3 (4) → $HSb(OH)_6$(2) + KCl + ICl (4)

8. Cu_3P (11) + $Cr_2O_7^{2-}$ (6) → Cu^{2+} (1) + H_3PO_4 (8) + Cr^{3+}(3)

9. $Fe(CN)_6^{4-}$ (61) + MnO_4^-(5) → Fe^{3+} (1) + CO_2(2) + NO_3^-(8) + Mn^{2+}(5)

10. Cu(2) + HNO_3 (3/4) → $Cu(NO_3)_2$(2) + NO(3) + H_2O(l)

11. FeS_2 (11) + O_2 (4) → Fe_2O_3 (22) + SO_2 (11/2)

12. Cl_2(5/3) + OH^- → Cl^- (1) + ClO_3^-(5)

13. S(1) + OH^- → S^{2-}(2)+ $S_2O_3^{2-}$(4)

(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

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