Additional Problems for Self Practice (APSP)

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

Max. Marks: 100 **Max. Time : 1 Hour**

Important Instructions:

A. General :

1. The test paper is of **1** hour duration.
2. The Test Paper consists of **25** questions and each questions carries **4** Marks. Test Paper consists of **Two** Sections.

B. Test Paper Format and its Marking Scheme:

1. Section-1 contains **20** multiple choice questions. Each question has four choices (1), (2), (3) and (4) out of which **ONE** is correct. For each question in Section-1, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. In all other cases, minus one **(–1)** mark will be awarded.
2. Section-2 contains **5** questions. The answer to each of the question is a **Numerical Value**. For each question in Section-2, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. No negative marks will be answered for incorrect answer in this section. In this section answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto two digit. If the numerical value has more than two decimal places **truncate/round-off** the value to **TWO** decimal placed.

SECTION-1

This section contains **20** multiple choice questions. Each questions has four choices (1), (2), (3) and (4) out of which Only **ONE** option is correct.

1. In the reaction : $Na_2S_2O_3 + 4Cl_2 + 5H_2O \longrightarrow Na_2SO_4 + H_2SO_4 + 8HCl$,
the equivalent weight of $Na_2S_2O_3$ will be : (M = molecular weight of $Na_2S_2O_3$)
(1) M/4 (2) M/8 (3) M/1 (4) M/2

2. In the reaction, $2CuSO_4 + 4KI \longrightarrow 2Cu_2I_2 + I_2 + 2K_2SO_4$
the equivalent weight of $CuSO_4$ will be :
(1) 79.75 (2) 159.5 (3) 329 (4) None of these

3. 100 milli moles of dichloroacetic acid ($CHCl_2COOH$) can neutralize how many moles of ammonia to form ammonium dichloroacetate :
(1) 0.0167 (2) 0.1 (3) 0.3 (4) 0.6

4. How many moles of $KMnO_4$ are needed to oxidise a mixture of 1 mole of each $FeSO_4$ & FeC_2O_4 in acidic medium :
(1) 4/5 (2) 5/4 (3) 3/4 (4) 5/3

5. 22.7 mL of (N/10) Na_2CO_3 solution neutralises 10.2 mL of a dilute H_2SO_4 solution. The volume of water that must be added to 400 mL of this H_2SO_4 solution in order to make it exactly N/10.
(1) 490.2 mL (2) 890.2 mL (3) 90.2 mL (4) 290.2 mL

6. The mass of oxalic acid crystals ($H_2C_2O_4.2H_2O$) required to prepare 50 mL of a 0.2 N solution is :
(1) 4.5 g (2) 6.3 g (3) 0.63 g (4) 0.45 g

7. When HNO_3 is converted into NH_3, the equivalent weight of HNO_3 will be :
(1) M/2 (2) M/1 (3) M/6 (4) M/8
(M = molecular weight of HNO_3)

8. A 5.0 cm^3 solution of H_2O_2 liberates 0.508 g of I_2 from an acidified KI solution. The strength of H_2O_2 solution in terms of volume strength at STP is :
(1) 2.24 V (2) 1.12 V (3) 4.48 V (4) 8.96 V

9. When hypo solution is added to $KMnO_4$ solution then
(1) $Na_2S_2O_3$ is converted to Na_2SO_4 (2) $Na_2S_2O_3$ is converted to $Na_2S_4O_6$
(3) $KMnO_4$ is converted to K_2MnO_4 (4) $KMnO_4$ is converted to $MnSO_4$

10. Which of the following equations is a balanced one :
(1) $5BiO_3^- + 22H^+ + Mn^{2+} \longrightarrow 5Bi^{3+} + 7H_2O + MnO_4^-$
(2) $5BiO_3^- + 14H^+ + 2Mn^{2+} \longrightarrow 5Bi^{3+} + 7H_2O + 2MnO_4^-$
(3) $2BiO_3^- + 4H^+ + Mn^{2+} \longrightarrow 2Bi^{3+} + 2H_2O + MnO_4^-$
(4) $6BiO_3^- + 12H^+ + 3Mn^{2+} \longrightarrow 6Bi^{3+} + 6H_2O + 3MnO_4^-$

11. 10 mL of sulphuric acid solution (specific gravity = 1.84) contains 98% by weight of pure acid. Calculate the volume of 2 N NaOH solution required to just neutralize the acid.
(1) 9.2 mL (2) 92 mL (3) 18.4 mL (4)184 mL

12. The equivalent mass of $MnSO_4$ is half its molecular mass when it is converted to :
(1) Mn_2O_3 (2) MnO_2 (3) MnO_4^- (4) MnO_4^{2-}

13. An aqueous solution of 6.3 g of oxalic acid dihydrate is made upto 250 mL. The volume of 0.1 N NaOH required to completely neutralise 10 mL of this solution is :
(1) 40 mL (2) 20 mL (3) 10 mL (4) 4 mL

14. In the reaction $H_2O_2^{18} + O_3 \rightarrow$ water + oxygen, radioactivity will be shown by which of the product :
(1) water (2) oxygen (3) both (1) & (2) (4) none of these

15. The normality of orthophosphoric acid having purity of 70% by weight and specific gravity 1.54 is :
(1) 11 N (2) 22 N (3) 33 N (4) 44 N

16. The normality of mixture obtained by mixing 100 mL of 0.2 M H_2SO_4 and 200 mL of 0.2 M HCl is :
(1) 0.0267 (2) 0.2670 (3) 1.0267 (4) 1.1670

17. 40 mL of 0.05 M solution of sodium sesquicarbonate ($Na_2CO_3.NaHCO_3.2H_2O$) is titrated against 0.05 M HCl. When phenoplhthalein is used as indicator, x mL HCl is used. In a separate titration of same using methyl orange as indicator, y ml of HCl is used. The value of (y – x) is :
(1) 80 mL (2) 30 mL (3) 120 mL (4) 180 mL

18. In the following reaction $2MnO_4^- + 5H_2O_2^{18} + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$
The radioactive oxygen will appear in :
(1) H_2O (2) O_2
(3) both (4) above reaction does not take place

19. One gram equimolecular mixture of Na_2CO_3 and $NaHCO_3$ is reacted with 0.1 NHCl. The milliliters of 0.1 N HCl required to react completely with the above mixture is :
(1) 15.78 mL (2) 157.8 mL (3) 198.4 mL (4) 295.5 mL

20. Equivalent weight of chlorine molecule in the equation is :
$$3\,Cl_2 + 6\,NaOH \longrightarrow 5\,NaCl + NaClO_3 + 3\,H_2O$$
(1) 42.6 (2) 35.5 (3) 59.1 (4) 71

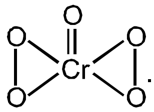
SECTION-2

This section contains **5** questions. Each question, when worked out will result in **Numerical Value**.

21. HNO_3 oxidises NH_4^+ ions to nitrogen and itself gets reduced to NO_2. The moles of HNO_3 required by 1 mole of $(NH_4)_2SO_4$ is :

22. Number of moles of CaO required to remove hardness from 1000 litre water having 324 ppm of calcium bicarbonate and 74.5 ppm of potassium chloride is :

23. 1 mole of how many of the following acids neutralize exactly one mol of NaOH, under required favourable conditions?
HCl, HNO_3, H_2SO_4, H_2SO_3, H_3PO_4, H_3PO_3, H_3PO_2, $H_4P_2O_5$, H_3BO_3

24. CrO_5 has structure as shown .
The oxidation number of chromium in the above compound is

25. One mole of acidified $K_2Cr_2O_7$ on reaction with excess KI will liberate ...... mole (s) of I_2.

Practice Test-1 (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25					
Ans.										

PART - II : JEE (MAIN) / AIEEE OFFLINE PROBLEMS (PREVIOUS YEARS)

1. The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is : **[AIEEE 2005, 3/225]**
(1) + 4 (2) + 6 (3) + 2 (4) + 3

2. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl, because HCl : **[AIEEE 2008, 3/105]**
(1) furnishes H^+ ions in addition to those from oxalic acid. (2) reduces permanganate to Mn^{2+}.
(3) oxidises oxalic acid to carbon dioxide and water. (4) gets oxidised by oxalic acid to chlorine.

3. 29.5 mg of an organic compound containing nitrogen was digested according to 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 : **[AIEEE 2010, 4/144]**
(1) 59.0 (2) 47.4 (3) 23.7 (4) 29.5

4. Consider the following reaction : $xMnO_4^- + yC_2O_4^{2-} + zH^+ \longrightarrow xMn^{2+} + 2yCO_2 + \frac{z}{2} H_2O$
The values of x, y and z in the reaction are, respectively : **[JEE(Main) 2013, 4/120]**
(1) 5, 2 and 16 (2) 2, 5 and 8 (3) 2, 5 and 16 (4) 5, 2 and 8

5. For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is : **[JEE(Main) 2014, 4/120]**
(1) 6% (2) 10% (3) 3% (4) 5%

PART-III : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. If the equivalent weight of an element is 32, then the percentage of oxygen in its oxide is :**[NSEC-2000]**
(A) 16 (B) 40 (C) 32 (D) 20

2. In alkaline medium, $KMnO_4$ reacts as follows (Atomic weights K = 39.09, Mn = 54.94, O = 16.00)

$$2KMnO_4 + 2KOH \rightarrow 2K_2MnO_4 + H_2O + [O]$$

Hence, its equivalent weight is : **[NSEC-2000]**

(A) 31.6 (B) 63.2 (C) 126.4 (D) 158

3. When 25 g of Na_2SO_4 is dissolved in 10^3 Kg of solution, its concentration will be **[NSEC-2000]**

(A) 2.5 ppm (B) 25 ppm (C) 250 ppm (D) 100 ppm

4. Which amongst the following has the highest normality ? **[NSEC-2002]**

(A) 16.0 g of NaOH in 200 mL of water (B) 1 N oxalic acid

(C) 2 M sulphuric acid (D) 1.5 hydrochloric acid

5. The volume of water which must be added to 0.4 dm^3 of 0.25 N oxalic acid in order to make it exactly decinormal is : **[NSEC-2002]**

(A) 0.2 dm^3 (B) 0.4 dm^3 (C) 0.6 dm^3 (D) 0.8 dm^3

6. The quantity of electricity required to reduce 0.05 mol of MnO_4^- to Mn^{2+} in acidic medium would be

(A) 0.01 F (B) 0.05 F (C) 0.15 F (D) 0.25 F **[NSEC-2003]**

7. You are given a solution of an alkali. In order to estimate its concentration in terms of normality, you need to know **[NSEC-2003]**

(A) the volume of the solution, the volume of the alkali present in it and its formula weight

(B) the mass of the solution, the mass of the alkali present in it and its equivalent weight.

(C) the volume of the solution, the mass of the alkali present in it and its equivalent weight

(D) the mass of the solution, the volume of the alkali present in it and its equivalent weight.

8. The normality of '20 volume' H_2O_2 solution is **[NSEC-2005]**

(A) 2.0 (B) 2.5 (C) 3.0 (D) 3.5

9. Hydrazine N_2H_4 acts as a reducing agent. To prepare 100 ml of 2 N hydrazine solution, the weight required will be **[NSEC-2006]**

(A) 6.4 g (B) 1.6 g (C) 3.2 g (D) 0.8 g

10. For the reaction shown below, which statement is true ? **[NSEC-2007]**

$2Fe + 3CdCl_2 \rightleftharpoons 2FeCl_3 + 3Cd$

(A) Fe is the oxidizing agent (B) Cd undergoes oxidation

(C) Cd is the reducing agent (D) Fe undergoes oxidation

11. Oxalic acid ($H_2C_2O_4$) reacts with permanganate ion according to the balanced equation given below :

$$5H_2C_2O_{4(aq)} + 2MnO_4\,(aq) + 6H^+_{(aq)} \rightarrow 2Mn^{2+}\,(aq) + 10CO_{2(g)} + 8H_2O_{(l)}$$

How many mL of 0.0154 M $KMnO_4$ solution are required to react with 25.0 mL of 0.0208 M $H_2C_2O_4$ solution ? **[NSEC-2008]**

(A) 13.5 mL (B) 18.5 mL (C) 33.8 mL (D) 84.4 mL

12. What volume of water should be added to 1600 ml of a 0.205 N solution so that the resulting solution will be 0.2 N ? **[NSEC-2008]**

(A) 40 mL (B) 50 mL (C) 100 mL (D) 20 mL

13. The compound which can act as an oxidizing agent as well as reducing agent is **[NSEC-2010]**

(A) HNO_2 (B) HI (C) HCN (D) HCOOH

14. Oxalic acid, $H_2C_2O_4$, reacts with paramanganate ion according to the balanced equation $5H_2C_2O_4(aq) + 2MnO_4^-(aq) + 6H^+(aq) \rightleftharpoons 2Mn^{2+}(aq) + 10\ CO_2(g) + 8\ H_2O(l)$. The volume in mL of 0.0162 M $KMnO_4$ solution required to react with 25.0 mL of 0.022 M $H_2C_2O_4$ solution is **[NSEC-2011]**

(A) 13.6 (B) 18.5 (C) 33.8 (D) 84.4

15. A 500 g toothpaste sample has 0.4 g fluoride concentration. The fluoride concentration in terms of ppm will be **[NSEC-2012]**

(A) 200 (B) 400 (C) 500 (D) 800

16. The number of moles of $KMnO_4$ that will be needed to react completely with one mole of ferrous oxalate $[Fe(C_2O_4)]$ in acidic solution is **[NSEC-2012]**
(A) 1 (B) 2/5 (C) 3/5 (D) 4/5

17. The rate of the reaction $MnO_4^-{}_{(aq.)} + 8H^+{}_{(aq.)} + 5Fe^{2+}{}_{(aq.)} \longrightarrow Mn^{2+}{}_{(aq.)} + 5Fe^{3+}{}_{(aq.)} + 4H_2O$ can be best measured by monitoring colorimetrically the concentration of : **[NSEC-2012]**
(A) $MnO^-{}_{4(aq.)}$ (B) $Mn^{2+}{}_{(aq.)}$ (C) $Fe^{2+}{}_{(aq.)}$ (D) $Fe^{3+}{}_{(aq.)}$

18. I. $5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$
II. $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$
The role of hydrogen peroxide in the above reaction is **[NSEC-2014]**
(A) oxidising in I and reducing in II (B) reducing in I and oxidising in II
(C) reducing in I as well as in II (D) oxidising in I as well as in II

19. A bottle of H_3PO_4 solution contains 70% acid. If the density of the solution is 1.54 g cm^{-3}, the volume of the H_3PO_4 solution required to prepare 1L of IN solution is. **[NSEC-2015]**
(A) 90mL (B) 45mL (C) 30mL (D) 23mL

20. The unbalanced equation for the reaction of P_4S_3 with nitrate in aqueous acidic medium is given below.
$$P_4S_3 + NO_3^- \rightarrow H_3PO_4 + SO_4^{2-} + NO$$
The number of mol of water required per mol of P_4S_3 is **[NSEC-2015]**
(A) 18 (B) 8/3 (C) 8 (D) 28

21. In the redox reaction $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$, 20 mL of 0.1 M $KMnO_4$ react quantitatively with **[NSEC-2015]**
(A) 20 mL of 0.1 M oxalate (B) 40 mL of 0.1 M oxalate
(C) 50 mL of 0.25 M oxalate (D) 50 mL of 0.1 M oxalate

22. 1.250 g of metal carbonate (MCO_3) was treated with 500 mL of 0.1 M HCl solution. The unreacted HCl required 50.0 mL of 0.500 M NaOH solution for neutralization. Identify the metal M **[NSEC-2016]**
(A) Mg (B) Ca (C) Sr (D) Ba

23. Battery acid (H_2SO_4) has density 1.285 g cm^{-3}. 10.0 cm^3 of this acid is diluted to 1L. 25.0 cm^3 of this diluted solution requires 25.0 cm^3 of 0.1 N sodium hydroxide solution for neutralization. The percentage of sulphuric acid by mass in the battery acid is : **[NSEC-2016]**
(A) 98 (B) 38 (C) 19 (D) 49

24. A sample of water from a river was analyzed for the presence of metal ions and the observations were recorded as given below

Reagent added	Observation
dil. HCl	No change
aq. Na_2CO_3	White precipitate
Aq. Na_2SO_4	No change

The water sample is likely to contain **[NSEC-2018]**
(A) Ba^{2+} (B) Cu^{2+} (C) Li^+ (D) Mg^{2+}

25. An ion exchange resin, RH_2 can replace Ca^{2+} in hard water as $RH_2 + Ca^{2+} \longrightarrow RCa^{2+} + 2H^+$. When a 1.0 L hard water sample was passed through the resin, all H^+ ions were replaced by Ca^{2+} ions and the pH of eluted water was found to be 2.0. The hardness of water (as ppm of Ca^{2+}) in the sample of water treated is **[NSEC-2018]**
(A) 50 (B) 100 (C) 125 (D) 200

PART - IV : HIGH LEVEL PROBLEMS (HLP)

SUBJECTIVE QUESTIONS

1. A solution contains a mixture of Na_2CO_3 and NaOH. Using phenolphthalein as indicator, 25 mL of mixture required 19.5 mL of 0.995 N HCl for the end point. With methyl orange (MeOH), 25 mL of the solution required 25 mL of the same HCl for the end point. Calculate gram per litre of each substance in the mixture.

2. Hydrogen peroxide solution (20 mL) reacts quantitatively with a solution of $KMnO_4$ (20mL) acidified with dilute H_2SO_4. The same volume of the $KMnO_4$ solution is just decolourised by 10 mL of $MnSO_4$ in neutral medium simultaneously forming a dark brown precipitate of hydrated MnO_2. The brown precipitate is dissolved in 10 mL of 0.2 M sodium oxalate under boiling condition in the presence of dilute H_2SO_4. Write the balanced equations involved in the reactions and calculate the molarity of H_2O_2.
[JEE 2001, 5/100]

ONLY ONE OPTION CORRECT TYPE

3. 0.7 g of $(NH_4)_2SO_4$ sample was boiled with 100 mL of 0.2 N NaOH solution till all the NH_3 gas is evolved. The resulting solution was diluted to 250 mL. 25 mL of this solution was neutralized using 10 mL of a 0.1 N H_2SO_4 solution. The percentage purity of the $(NH_4)_2SO_4$ sample is :
(A) 94.3 (B) 50.8 (C) 47.4 (D) 79.8

4. A mixture of 0.02 mole of $KBrO_3$ and 0.01 mole of KBr was treated with excess of KI and acidified. The volume of 0.1 M $Na_2S_2O_3$ solution required to consume the liberated iodine will be :
(A) 1000 mL (B) 1200 mL (C) 1500 mL (D) 800 mL

5. 10 mL of a H_2SO_4 solution is diluted to 100 mL. 25 mL of this diluted solution is mixed with 50 mL of 0.5 N NaOH solution. The resulting solution requires 0.265 g Na_2CO_3 for complete neutralization. The normality of original H_2SO_4 solution is :
(A) 12 N (B) 11 N (C) 3 N (D) 0.275 N

6. Dichloroacetic acid ($CHCl_2$ COOH) is oxidised to CO_2, H_2O and Cl_2 by 600 meq of an oxidising agent. Same amount of acid can neutralize how many moles of ammonia to form ammonium dichloroacetate :
(A) 0.0167 (B) 0.1 (C) 0.3 (D) 0.6

7. 1.2 g of carbon is burnt completely in oxygen (limited supply) to produce CO and CO_2. This mixture of gases is treated with solid I_2O_5 (to know the amount of CO produced). The liberated iodine required 120 mL of 0.1 M hypo solution for complete titration. The % of carbon converted into CO is :
(A) 60% (B) 100% (C) 50% (D) 30%

8. A mixed solution of potassium hydroxide and sodium carbonate required 15 mL of an N/20 HCl solution when titrated with phenolphthalein as an indicator. But the same amount of the solution, when titrated with methyl orange as an indicator, required 25 mL of the same acid. The amount of KOH present in the solution is :
(A) 0.014 g (B) 0.14 g (C) 0.028 g (D) 1.4 g

9. Phenolphthalein is not a good indicator for titrating :
(A) NaOH against oxalic acid (B) NaOH against HCl
(C) Ferrous sulphate against $KMnO_4$ (D) NaOH against H_2SO_4

10. A 1 g sample of H_2O_2 solution containing x % H_2O_2 by mass requires x cm^3 of a $KMnO_4$ solution for complete oxidation under acidic conditions. Calculate the normality of $KMnO_4$ solution.
(A) 0.588 N (B) 0.294 N (C) 0.882 N (D) 0.735 N

11. A solution of H_2O_2 labelled as '20 V' was left open. Due to this some, H_2O_2 decomposed and volume strength of the solution decreased. To determine the new volume strength of the H_2O_2 solution, 10 mL of the solution was taken and it was diluted to 100 mL. 10 mL of this diluted solution was titrated against 25 mL of 0.0245 M $KMnO_4$ solution under acidic condition. Calculate the volume strength of the H_2O_2 solution.
(A) 15.00 V (B) 17.15 V (C) 20.00 V (D) 12.30 V

NUMERICAL VALUE TYPE

12. If a mixture of Na_2CO_3 and NaOH in equimolar quantities when reacts with 0.1 M HCl in presence of phenolphthalein indicator consumes 30 ml of the acid. What will be the volume (in mL) of 0.15 M H_2SO_4 used in the separate titration of same mixture in presence of methyl orange indicator.

PART - IV : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr. **Max. Marks : 66**

Important Instructions

A. General :

1. The test is of 1 hour duration.
2. The Test Booklet consists of 22 questions. The maximum marks are 66.

B. Question Paper Format :

3. Each part consists of five sections.
4. Section-1 contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
5. Section-2 contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
6. Section 3 contains 6 questions. The answer to each of the questions is numerical value, ranging from 0 to 9 (both inclusive).
7. Section 4 contains 1 paragraphs each describing theory, experiment and data etc. 3 questions relate to paragraph. Each question pertaining to a partcular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
8. Section 5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme :

9. For each question in Section 1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
10. For each question in Section 2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
11. For each question in Section 3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.

SECTION-1 : (Only One option correct Type)

This section contains 7 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.

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1. Volume V_1 mL of 0.1M $K_2Cr_2O_7$ is needed for complete oxidation of 0.678 g N_2H_4 in acidic medium. The volume of 0.3 M $KMnO_4$ needed for same oxidation in acidic medium will be:

(A) $\frac{2}{5}V_1$ (B) $\frac{5}{2}V_1$ (C) 113 V_1 (D) can not be determined

2. $Hg_5(IO_6)_2$ oxidizes KI to I_2 in acid medium and the other product containing iodine is K_2HgI_4. If the I_2 liberated in the reaction requires 0.004 mole of $Na_2S_2O_3$, the number of moles of $Hg_5(IO_6)_2$ that have reacted is :

(A) 10^{-3} (B) 10^{-4} (C) 2.5×10^{-4} (D) 2.5×10^{-2}

3. 10 mL of 1 N HCl is mixed with 20 mL of 1 M H_2SO_4 and 30 mL of 1 M NaOH. The resultant solution has :

(A) 20 meq of H^+ ions (B) 20 meq of OH^-
(C) 0 meq of H^+ or OH^- (D) 30 milli moles of H^+

4. 20 mL of H_2O_2 after acidification with dilute H_2SO_4 required 30 mL of N/12 $KMnO_4$ for complete oxidation. The strength of H_2O_2 solution is: [Molar mass of H_2O_2 = 34]

(A) 2 g/L (B) 4 g/L (C) 8 g/L (D) 6 g/L

5. x gram of pure As_2S_3 is completely oxidised to respective highest oxidation states by 50 mL of 0.1 M hot acidified $KMnO_4$, then mass of As_2S_3 taken is : (Molar mass of As_2S_3 = 246)

(A) 22.4 g (B) 43.92 g (C) 64.23 g (D) None of these

6. During the titration of a mixture of Na_2CO_3 and $NaHCO_3$ against HCl :
(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 first end point
(D) Phenolphthalein is used to detect the first and second end point

7. In the reaction $CrO_5 + H_2SO_4 \longrightarrow Cr_2(SO_4)_3 + H_2O + O_2$, one mole of CrO_5 will liberate how many moles of O_2 :
(A) 5/2 (B) 5/4 (C) 9/2 (D) 7/4

Section-2 : (One or More than one options correct Type)
This section contains 5 multipole choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

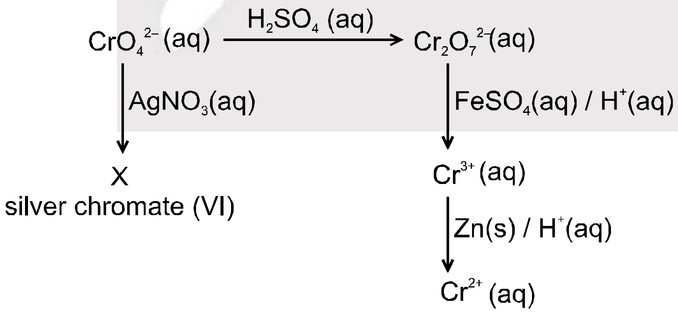
8. Consider the redox reaction $2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2\,I^-$:
(A) $S_2O_3^{2-}$ gets reduced to $S_4O_6^{2-}$
(B) $S_2O_3^{2-}$ gets oxidised to $S_4O_6^{2-}$
(C) I_2 gets reduced to I^-
(D) I_2 gets oxidised to I^-

9. Which of the following relations is/are correct for solutions ?
(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 $Al_2(SO_4)_3$

10. Which of the following statements is/are correct :
(A) 0.2 moles of $KMnO_4$ will oxidise one mole of ferrous ions to ferric ions in acidic medium.
(B) 1.5 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate to one mole of ferric ion and carbon dioxide in acidic medium in acidic medium.
(C) 0.6 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate to one mole of ferric ion and carbon dioxide in acidic medium.
(D) 1 mole of $K_2Cr_2O_7$ will oxidise 2 moles of ferrous oxalate to ferric ions and carbon dioxide in acidic medium.

11. $H_2C_2O_4$ and $NaHC_2O_4$ behave as acids as well as reducing agents. Which are the correct statements?
(A) equivalent weight of $H_2C_2O_4$ and $NaHC_2O_4$ are equal to their molecular weights when behaving as reducing agents.
(B) 100 ml of 1 (N) solution of each is neutralised by equal volume of 1 (M) $Ca(OH)_2$
(C) 100 ml of (N) solution $H_2C_2O_4$ is neutralised by equal volume of 1(N) $Ca(OH)_2$
(D) 100 ml of (M) solution of each is oxidised by same volume of 1 (M) $KMnO_4$

12. Consider the reactions shown below :



Which of the following statements is True : [Atomic Mass of Zinc = 65.4]
(A) Silver chromate (VI) has the formula Ag_2CrO_4.
(B) The minimum mass of zinc required to reduce 0.1 mole of Cr^{3+} to Cr^{2+} is 6.54 g.
(C) The conversion of CrO_4^{2-} into $Cr_2O_7^{2-}$ is not a redox reaction.
(D) The equation $Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$ correctly describes the reduction of $Cr_2O_7^{2-}$ by acidified $FeSO_4$.

Section-3 : (Numerical Value Type.)

This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

13. A 3 mole mixture of $FeSO_4$ and $Fe_2(SO_4)_3$ required 100 mL of 2M $KMnO_4$ solution in acidic medium. Find the mole of $FeSO_4$ in the mixture.

14. A 7.1 g sample of bleaching powder suspended in H_2O was treated with enough acetic acid and KI solution. Iodine thus liberated required 80 mL of 0.2 N hypo solution for titration. Calculate the % of available chlorine:

15. If the number of N-atoms in 1 molecule of Hyponitrous acid is x and the basicity of Boric acid is y, find the sum (x + y).

16. Find the valency factor (n) for NH_2OH in given reaction :

$$Fe^{3+} + NH_2OH \longrightarrow Fe^{2+} + N_2O + H^+ + H_2O$$

17. A solution of $Na_2S_2O_3$ is standardised iodometrically against 3.34 g of pure $KBrO_3$ (converted to Br^-), requiring 40 mL $Na_2S_2O_3$ solution. What is the molarity of $Na_2S_2O_3$ solution ? (Molar mass of $KBrO_3$ = 167 g mol^{-1})

18. 2 moles of a mixture of O_2 and O_3 is reacted with excess of acidified solution of KI. The iodine liberated require 1L of 2M hypo solution for complete reaction. The weight % of O_3 in the initial sample is x. Find $\frac{x}{10}$.

SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 3 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

Paragraph for Questions 19 to 21

The overall equation for the reaction between sodium carbonate solution and dilute hydrochloric acid is

$$Na_2CO_3\ (aq.) + 2HCl\ (aq.) \longrightarrow NaCl\ (aq) + CO_2(g) + H_2O\ (\ell)$$

If you had the two solutions of the same concentration, you would have to use double volume of HCl to reach the equivalence point.

Indicators change their colours at the end point of the reaction and hence we are able to know the end points (equivalence points of reactions).

19. How many ml of 1N HCl are required for X milimoles of Na_2CO_3 with methyl orange indicator

(A) X ml (B) 2 X ml (C) 3 X ml (D) 4X ml

20. How many ml of 1N HCl are required for X milimoles of NaOH + Y milimoles of Na_2CO_3 + Z milimoles of $NaHCO_3$ with methyl orange indicator

(A) (2X + Y + Z) ml (B) (X + 2 Y + 2 Z) ml (C) (X + 2 Y + 3 Z) ml (D) (X + 2 Y + Z) ml

21. 25 ml of Na_2CO_3 solution requires 100ml of 0.1M HCl to reach end point with phenolphthalein indicator. Molarity of HCO_3^- ions in the resulting solution is

(A) 0.008 M (B) 0.04M (C) 0.16M (D) 0.08M

SECTION-5 : Matching List Type (Only One options correct)

This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct.

22. Match each List-I with an appropriate pair of characteristics from List-II and select the correct answer using the code given below the lists.

	List-I		List-II
(A)	Sn^{+2} + MnO_4^- (acidic) 3.5 mole 1.2 mole	(p)	Amount of oxidant available decides the number of electrons transfer
(B)	$H_2C_2O_4$ + MnO_4^- (acidic) 8.4 mole 3.6 mole	(q)	Amount of reductant available decides the number of electrons transfer
(C)	$S_2O_3^{-2}$ + I_2 7.2 mole 3.6 mole	(r)	Number of electrons involved per mole of oxidant > Number of electrons involved per mole of reductant
(D)	Fe^{+2} + $Cr_2O_7^{-2}$ (acidic) 9.2 mole 1.6 mole	(s)	Number of electrons involved per mole of oxidant < Number of electrons involved per mole of reductant.

Practice Test-2 ((IIT-JEE (ADVANCED Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

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

APSP Answers

PART - I

1.	(2)	**2.**	(2)	**3.**	(2)	**4.**	(1)	**5.**	(1)
6.	(3)	**7.**	(4)	**8.**	(3)	**9.**	(1)	**10.**	(2)
11.	(4)	**12.**	(2)	**13.**	(1)	**14.**	(2)	**15.**	(3)
16.	(2)	**17.**	(1)	**18.**	(2)	**19.**	(2)	**20.**	(1)
21.	6	**22.**	2	**23.**	4	**24.**	6	**25.**	3

PART - II

1.	(4)	**2.**	(2)	**3.**	(3)	**4.**	(3)	**5.**	(2)

PART - III

1.	(D)	**2.**	(D)	**3.**	(B)	**4.**	(C)	**5.**	(C)
6.	(D)	**7.**	(C)	**8.**	(D)	**9.**	(B)	**10.**	(D)
11.	(A)	**12.**	(A)	**13.**	(A)	**14.**	(A)	**15.**	(D)
16.	(C)	**17.**	(A)	**18.**	(C)	**19.**	(C)	**20.**	(B)
21.	(D)	**22.**	(B)	**23.**	(B)	**24.**	(D)	**25.**	(D)

PART - IV

1. Na_2CO_3 = 23.2 g/L, NaOH = 22.28 g/L. **2.** 0.1 M

3.	(A)	**4.**	(B)	**5.**	(A)	**6.**	(B)	**7.**	(D)
8.	(A)	**9.**	(C)	**10.**	(A)	**11.**	(B)	**12.**	**15**

PART - V

1.	(A)	**2.**	(C)	**3.**	(A)	**4.**	(A)	**5.**	(D)
6.	(A)	**7.**	(D)	**8.**	(BC)	**9.**	(ABD)	**10.**	(ACD)
11.	(BCD)	**12.**	(ACD)	**13.**	1	**14.**	8	**15.**	3
16.	2	**17.**	3	**18.**	6	**19.**	(B)	**20.**	(D)
21.	(D)	**22.**	(A) – p, r ; (B) – q, r ; (C) – p, q, r ; (D) – q, r.						

APSP Solutions

PART - I

1. $Na_2\overset{+2}{S_2}O_3 \longrightarrow Na_2\overset{+6}{S}O_4$

the total change in oxidation number = 4 × 2 = 8

$\therefore \quad E_{Na_2S_2O_3} = \dfrac{\text{mol. wt.}}{\text{V.f}} = \dfrac{M}{8}$

2. $2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + I_2 + 2K_2SO_4$.

$Cu^{2+} + 1e^- \longrightarrow Cu^+$.

E_{Cu} = ?. V.F. = 1.

$E_{CuSO_4} = \dfrac{159.5}{1} = 159.5$

3. $eq_{acid} = eq_{base}$ (VF = 1 for both)

$CHCl_2COOH + NH_3 \longrightarrow CHCl_2COONH_4$

From reaction, m.moles of NH_3 = m.moles of dichloroacetic acid = 100

$\therefore \quad$ Moles of $NH_3 = \dfrac{100}{1000} = 0.1$

4. Equivalent of $KMnO_4$ = equivalent of $FeSO_4$ + equivalent of FeC_2O_4

$x \times 5 = 1 \times 1 + 1 \times 3$

$x = \dfrac{4}{5}$ mole

5. meq of Na_2CO_3 = meq of H_2SO_4

$\dfrac{1}{10} \times 22.7 = N \times 10.2$

Normality = 0.2225 N

$0.2225 \times 400 = \dfrac{1}{10} \times V_f \quad$ or $\quad V_f = 890.2$ mL

$\therefore \quad$ Volume of H_2O mixed = 890.2 – 400 = 490.2 mL

6. $H_2C_2O_4.\,2H_2O = 2 + 24 + 64 + 36 = 126$ and Equivalent wt. = $\left[\dfrac{126}{2}\right]$

$0.2 = \dfrac{W \times 1000}{\left(\dfrac{126}{2}\right) \times 50} \qquad \therefore W = 0.63$ g

7. $H\overset{+5}{N}O_3 \longrightarrow \overset{-3}{N}H_3 \quad \therefore$ V.f. of $HNO_3 = 8$

Eq. wt. = M/8.

8. meq H_2O_2 = meq I_2

$N \times 5 = \dfrac{0.508 \times 2}{254} \times 1000$ or Normality = 0.8 N

Volume strength = $5.6 \times N = 5.6 \times .8 = 4.48$ V.

9. $8KMnO_4 + 3Na_2S_2O_3 + H_2O \rightarrow 2KOH + 8MnO_2 + 3Na_2SO_4 + 3K_2SO_4$

10. Reduction ($BiO_3^- \rightarrow Bi^{3+}$)

$BiO_3^- + Mn^{2+} \longrightarrow Bi^{3+} + MnO_4^-$

Oxidation ($Mn^{2+} \rightarrow MnO_4^-$)

(i) $2e + 6H^+ + BiO_3^- \longrightarrow Bi^{3+} + 3H_2O$
(ii) $4H_2O + Mn^{2+} \longrightarrow MnO_4^- + 8H^+ + 5e$

(i) × 5 + (ii) × 2, we get $14H^+ + 5BiO_3^- + 5Mn^{2+} \longrightarrow 5Bi^{3+} + 2MnO_4^- + 7H_2O$
Hence, (2) is the correct balanced reaction.

11. m.eq. of H_2SO_4 = m.eq. of NaOH

$$\frac{98 \times 1.84 \times 10}{98} \times 2 \times 10 = 2 \times V_1$$

$V_1 = 184$ mL

12. $$\text{Eq. mass} = \frac{\text{Molecular weight}}{\text{Change in oxidation no. of Mn}} = \frac{\text{Mol. wt.}}{4-2} = \frac{\text{Mol. wt.}}{2}$$

(O.N. of Mn in $MnSO_4$ = +2; O.N. of Mn in MnO_2 = +4).

13. (1) Equilivalents of $H_2C_2O_4.2H_2O$ in 10 mL = Equivalents of NaOH

$$\left(\frac{6.3}{126/2} \times \frac{1000}{250}\right) \times \frac{10}{1000} = 0.1 \times V \text{ (in litre)}$$

$\therefore$ V = 0.04 L = 40 mL.

14. O_3 will oxidise H_2O_2 into oxygen, hence radioacitve oxygen of H_2O_2 will go only in oxygen, not in water.
Half reactions : $O_3 + 2H^+ + 2e^- \longrightarrow O_2 + H_2O$; $H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-$

15. 70% by weight means
70 g of orthophosphoric acid is present in 100 g acid

$$N = \frac{w}{\text{Eq. wt.}} \times \frac{1000}{V_{(cc)}}$$

w = 70 g

$$\text{Eq. wt.} = \frac{\text{mol. mass}}{\text{no. replacable H-atoms}} = \frac{98}{3}$$

$$V = \frac{\text{mass}}{\text{density}} = \frac{100}{1.54}$$

$$N = \frac{70 \times 3 \times 1000 \times 1.54}{98 \times 100} = 33 \text{ N}$$

16. Normality of a mixture (N) = $\frac{N_1V_1 + N_2V_2}{V_1 + V_2}$

Normality(N_1) of H_2SO_4 = molarity × basicity = 0.2 × 2 = 0.4 N
$N_2 = 0.2 \times 1 = 0.2$ N
$V_1 = 100$ mL, $V_2 = 200$ mL

$$N = \frac{N_1V_1 + N_2V_2}{V_1 + V_2} = \frac{40 + 40}{300} = \frac{80}{300} = 0.2670 \text{ N}$$

Normality of mixture of acid and base(N')

$$(N') = \frac{N_1V_1 \sim N_2V_2}{V_1 + V_2}$$

17. In presence of phenoplhthalein,

$\frac{1}{2}$ meq. of Na_2CO_3 = meq. of HCl

$$2 \times 40 \times 0.05 \times \frac{1}{2} = x \times 0.05$$

$\therefore$ x = 40 mL
with M.O.

Meq. of Na_2CO_3 + Meq. of $NaHCO_3$ = Meq. of HCl
$2 \times 40 \times 0.05 + 40 \times 0.05 = y \times 0.05$
y = 120 mL
$\therefore$ (y – x) = 80 mL

18. During oxidation of H_2O_2, O–O bond is not broken.

19. Suppose the molecules of Na_2CO_3 and $NaHCO_3$ in a mixture are 'a'.
milli-equivalent of HCl
$N_1V_1 + N_2V_2 = NV$
$a \times 2 \times 1000 + a \times 1 \times 1000 = 0.1\ V$
$3a = 10^{-4}\ V$ ......(i)
[$\because$ N = basicity/acidity × M]
wt. of Na_2CO_3 + wt. of $NaHCO_3$ = 1 g
($\therefore$ wt. of mixture = 1 g)
$\Rightarrow$ $a \times 106 + a \times 84 = 1$
$a = 5.26 \times 10^{-3}$ ....(ii)
From Eqs. (i) and (ii) we have $3 \times 5.26 \times 10^{-3} = 10^{-4}V$
V = 157.8 mL

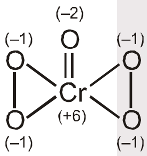
20. $Cl_2 + OH^- \longrightarrow Cl^- + ClO_3^- + H_2O$; v.f. of $Cl_2 = \frac{2 \times 10}{2 + 10} = \left(\frac{5}{3}\right)$

$\therefore$ Eq. wt. of $Cl_2 = \frac{71}{5/3} = 42.6$

21. $HNO_3 + NH_4^+ \longrightarrow N_2 + NO_2$
V.F. of HNO_3 = (5 – 4) = 1
V.F. of NH_4^+ = [0 – (–3)] = 3
so molar ratio of HNO_3 and NH_4^+ is 3 : 1.
1 mole $(NH_4)_2SO_4$ is found to contain 2 mole of NH_4^+
So, required moles of HNO_3 is 3 × 2 = 6 mole.

22. $Ca(HCO_3)_2 + CaO \longrightarrow 2CaCO_3\downarrow + H_2O$
$\frac{324}{162} = n_{CaO} = 2$

23. (HCl, HNO_3, H_3PO_2, H_3BO_3) H_2SO_4, H_2SO_3, H_3PO_3, $H_4P_2O_5$ are diprotic. HCl, HNO_3, H_3PO_2, H_3BO_3 are monoprotic.

24. 

25. $Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 3I_2 + 2Cr^{3+} + 7H_2O$
(v.f.=6) (v.f.=2)
Equivalents of $K_2Cr_2O_7$ = equivalents of I_2
1 × 6 = moles of I_2 × 2
Moles of I_2 = 3

PART - II

1. $\overset{+6}{Cr_2}O_7^{2-} + 14H^+ + 6I^- \longrightarrow \overset{+3}{Cr^{3+}} + 7H_2O + 3I_2$

2. HCl reduces MnO_4^- to Mn^{2+} and itself oxidises to Cl_2.

3. Weight of organic compound = 29.5 mg

$NH_3 + HCl \longrightarrow NH_4Cl$

HCl (remaining) + NaOH $\longrightarrow$ NaCl + H_2O
(1.5 m mole)

Total milimole of HCl = 2

mili mole of HCl used by NH_3 = 2 – 1.5 = 0.5

mili mole of NH_3 = 0.5

weight of NH_3 = 0.5 × 17 mg = 8.5 mg

weight of nitrogen = $\frac{14}{17} \times 8.5$ mg = 7 mg

∴ % of Nitrogen in compound = $\frac{7}{29.5} \times 100 = 23.7$ %.

4. $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^2 + CO_2 + \frac{z}{2} H_2O$

vf = 1(7 –2) = 5   vf = 2(3–2) = 2

Balanced Equation :

$2MnO_4^- + 5C_2O_4^{2-} + 16 H^+ \longrightarrow 2Mn^{2+} + 10 CO_2 + 8H_2O$

So, x = 2, y = 5 & z = 16.

5. Mass of organic compound = 1.4 g

let it contain x mmole of N atom.

organic compound $\longrightarrow NH_3$
x m mole

$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2 SO_4$. (1st)
6 mmole
initially taken.

$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$ (2nd)
2 mmole
reacted

Hence m moles of H_2SO_4 reacted in 2nd equation = 1

⇒ m moles of H_2SO_4 reacted from 1st equation = 6 – 1 = 5 m moles

⇒ m moles of NH_3 in 1st equation = 2 × 5 = 10 m moles

⇒ m moles of N atom in the organic compound = 10 m moles

⇒ mass of N = $10 \times 10^{-3} \times 14 = 0.14$ g

⇒ % of N = $\frac{0.14}{1.4} \times 100 = 10$ %

PART - IV

1. At phenolphthalein end point

eq. of Na_2CO_3 + eq. of NaOH = eq. of HCl used

Let x mole of Na_2CO_3 and y mole of NaOH present in 25 mL solution

$x \times 1 + y \times 1 = 19.5 \times 0.995 \times 10^{-3}$

$x + y = 19.4 \times 10^{-3}$ .... (i) (The v.f. of Na_2CO_3 is 1 when phenolphthalein is used)

At Methyl orange (MeOH) end point,

eq. of Na_2CO_3 + eq. of NaOH = eq. of HCl used

$x \times 2 + y \times 1 = 25 \times 0.995 \times 10^{-3}$

$2x + y = 24.875 \times 10^{-3}$ .... (ii) (The v.f. of Na_2CO_3 is 2 when methyl orange (MeOH) is used)

On solving eq. (1) and (2),

$x = 5.475 \times 10^{-3}$ and $y = 13.925 \times 10^{-3}$

or wt. of Na_2CO_3 in 25 mL = $5.475 \times 10^{-3} \times 106$

wt. of Na_2CO_3 in 1 litre = $\frac{5.475 \times 10^{-3} \times 106}{25} \times 1000$ = **23.2 g Ans.**

wt. of NaOH in 25 mL solution = $13.925 \times 10^{-3} \times 40$

wt. of NaOH in 1 litre = $\dfrac{13.925 \times 10^{-3} \times 40}{25} \times 1000$ = **22.28 g Ans.**

2. $2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

$2KMnO_4 + 3MnSO_4 + 2H_2O \longrightarrow 5MnO_2 + 2H_2SO_4 + K_2SO_4$

$MnO_2 + Na_2C_2O_4 + 2H_2SO_4 \longrightarrow MnSO_4 + 2CO_2 + Na_2SO_4 + 2H_2O$.

$\therefore$ meq. of MnO_2 = meq of $Na_2C_2O_4$ = 10 × 0.2 × 2 = 4

$\therefore$ millimoles of $MnO_2 = \dfrac{4}{2} = 2$ $\left[\begin{array}{l} Mn^{4+} + 2e \rightarrow Mn^{2+} \\ \therefore \text{Valency factor of } MnO_2 = 2 \end{array}\right]$

Now, $2KMnO_4 + 3MnSO_4 + 2H_2O \longrightarrow 5MnO_2 \downarrow + K_2SO_4 + 2H_2O$

Since MnO_2 is derived from $KMnO_4$ and $MnSO_4$ both, thus it is better to proceed by mole concept

millimoles of $KMnO_4$ = millimoles of MnO_2 × (2/5) = 4/5

Also, $5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \longrightarrow 2MnSO_4 + K_2SO_4 + 8H_2O + 5O_2$

$\therefore$ millimoles of H_2O_2 = millimoles of $KMnO_4$ × $\dfrac{5}{2} = \dfrac{4}{5} \times \dfrac{5}{2} = 2$

$\therefore$ $M_{H_2O_2} \times 20 = 2$ or $M_{H_2O_2}$ = **0.1 M**

3. m.eq of $(NH_4)_2SO_4$ + m.eq of H_2SO_4 = m.eq of NaOH

(m.moles × 2) + (0.1 × 10 × $\dfrac{250}{25}$) = 0.2 × 100

$\therefore$ m.mole of $(NH_4)_2SO_4$ = 5

wt. of $(NH_4)_2SO_4$ = $\dfrac{5}{1000}$ × 132 = 0.66 g

$\therefore$ % of $(NH_4)_2SO_4$ = $\dfrac{0.66}{0.7}$ × 100 = 94.28 % ≈ 94.3 %

4. $BrO_3^- + 6I^- \longrightarrow 3I_2 + Br^-$

moles of I_2 = 3 × moles of $KBrO_3$

$\therefore$ moles of I_2 = 0.02 × 3 = 0.06

Eq of I_2 = Eq of Hypo

0.06 × 2 = 0.1 ×V

V = 1.2 L = 1200 mL.

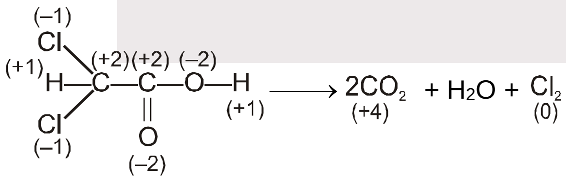
5. meq of H_2SO_4 = meq of NaOH + meq of Na_2CO_3

N × 25 = 0.5 × 50 + $\dfrac{0.265}{106/2} \times 10^3$ or N = 1.2

In original H_2SO_4 solution

$N_1V_1 = N_2V_2$ or $N_1 \times 10 = 1.2 \times 100$ or N_1 = 12 N

6.



$\therefore$ v.f. of dichloroacetic acid = 2 (4 – 2) + 2 (0 – (– 1)) = 6

m.eq. of dichloroacetic acid = m.eq. of oxidising agent = 600

$\therefore$ m.moles of dichloroacetic acid = $\dfrac{600}{6}$ = 100

$CHCl_2COOH + NH_3 \longrightarrow CHCl_2COONH_4$

From reaction, m.moles of NH_3 = m.moles of dichloroacetic acid = 100

$\therefore$ Moles of $NH_3 = \dfrac{100}{1000} = 0.1$

7. $C + O_2 \longrightarrow CO + CO_2$ ......(i)

t = 0 0.1 – –

t = t 0 x (0.1 – x)

$5CO + I_2O_5 \longrightarrow 5CO_2 + I_2$ ......(ii)

t = 0 x

t = t 0 x/5

$I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI$

$\therefore$ moles of I_2 liberated = $\frac{1}{2}$ × moles of hypo consumed = $\frac{1}{2} \times 120 \times 10^{-3} \times 0.1 = 60 \times 10^{-4}$

So, $x = 5 \times 60 \times 10^{-4} = 0.03$ moles (from reaction (ii) : 5 × mole of I_2 = mole of CO)

So, % of C forming CO = $\frac{0.03 \times 12}{1.2} \times 100 = 30\%$

8. KOH + Na_2CO_3

a m.moles b m.moles

m.eq. of KOH + m.eq. of Na_2CO_3 (v.f. = 1) = m.eq. of HCl (in presence of phenolphthalein)

$a \times 1 + b \times 1 = 15 \times \frac{1}{20}$

$\therefore$ $a + b = 0.75$ ...(i) (in presence of phenolphthalein)

m.eq. of KOH + m.eq. of Na_2CO_3 (v.f. = 2) = m.eq. of HCl (in presence of methyl orange)

$1 \times a + 2 \times b = 25 \times \frac{1}{20}$

$\therefore$ $a + 2 \times b = 1.25$ ...(ii) (in presence of methyl orange)

by solving (i) & (ii), a = 0.25 m.moles.

$\therefore$ mass of KOH = $\frac{0.25}{1000} \times 56 = 0.014$ g

10. Redox changes are :

$Mn^{+7} + 5e^- \longrightarrow Mn^{2+}$

$O_2^{2-} \longrightarrow O_2 + 2e^-$

$\therefore$ Eq. wt. of $H_2O_2 = \frac{34}{2}$

Now m.eq. of $KMnO_4$ = m.eq. of H_2O_2

$N.(X) = \frac{X}{100 \times 34/2} \times 1000 \Rightarrow$ N = **0.588 N**

11. Assuming new normality of original H_2O_2 solution = X

After dilution to 100 mL of 10 mL of this solution, new normality will be (say X_1)

$\therefore$ $X \times 10 = X_1 \times 100$

$X_1 = \frac{X}{10}$ .... (i)

10 mL of this dilute solution is titrated with 25 mL, 0.0245 M $KMnO_4$ solution.

So, $N_1V_1 = N_2V_2$

$\frac{X}{10} \times 10 = 0.0245 \times 5 \times 25$

X = 3.0625 N

So, volume strength of original H_2O_2 solution = X × 5.6 = 3.0625 × 5.6 = 17.15 V

12. In presence of Hph indicator

m. eq. of HCl = m. eq. of Na_2CO_3 + m.eq. of NaOH

$30 \times 0.1 = (a \times 1) + (a \times 1)$ $\therefore$ a = 1.5

In presence of MeOH indicator

m. eq. of H_2SO_4 = m. eq. of Na_2CO_3 + m. eq. of NaOH

$0.15 \times 2 \times V = (a \times 2) + (a \times 1)$

V = 15 ml

PART - V

1. Equivalent of $K_2Cr_2O_7$ = equivalent of N_2H_4
also equivalent of $KMnO_4$ = equivalent of N_2H_4
So, equivalent of $K_2Cr_2O_7$ = equivalent of $KMnO_4$
$0.1 \times 6 \times V_1 = 0.3 \times 5 \times V_2$ ∴ so V_2 **= 2/5 V_1**

2. Eq. of $Hg_5(IO_6)_2$ = Eq. of I_2 = Eq. of $Na_2S_2O_3$
∴ (moles of $Hg_5(IO_6)_2$) × 16 = 0.004 × 1
∴ moles of $Hg_5(IO_6)_2 = 2.5 \times 10^{-4}$.

3. (A) Explanation : No. of meq of H^+ = 10 × 1 + 20 × 2 = 50 [∵ H_2SO_4 , N = 2 M]
No. of meq of OH^- = 30 × 1 = 30
No. of meq of H^+ left unreacted = 50 – 30 = 20 meq
Hence , (A) is correct, (B), (C) and (D) are ruled out.

4. meq. of $KMnO_4$ = meq of H_2O_2

$$30 \times \frac{1}{12} = 20 \times N' \quad \Rightarrow \quad N' = \frac{30}{12 \times 20} = \frac{1}{8} N$$

∴ strength = N′ × equivalent mass = $\frac{1}{8} \times 17 = 2.12$ g/L.

5. $5As_2S_3 + 28KMnO_4 + H^+ \longrightarrow 10H_3AsO_4 + 28Mn^{2+} + SO_4^{2-}$
m.moles of $KMnO_4$ = 50 × 0.1 = 5
28 m.moles of $KMnO_4 \longrightarrow$ 5 m.moles of As_2S_3
∴ 1 m.mole of $KMnO_4 \longrightarrow$ 5/28 m.moles of As_2S_3
∴ 5 m.mole of $KMnO_4 \longrightarrow \frac{5 \times 5}{28}$ m.moles of As_2S_3

Mass of As_2S_3 = x = $246 \times \frac{5 \times 5}{28} \times 10^{-3} = 0.22$ g

7. $4CrO_5 + 6H_2SO_4 \longrightarrow 2Cr_2(SO_4)_3 + 6H_2O + 7O_2$ (Balanced reaction)
∴ 1 mole CrO_5 produces 7/4 moles of O_2.

8. S undergoes increase in oxidation number from +2 to +2.5, while I undergoes decrease in oxidation number from 0 to –1.

9. Normality = Molarity × v.f. ∴ 1M H_3PO_4 = 3N H_3PO_4

10. $MnO_4^- + 5e^- + 8H^+ \longrightarrow Mn^{2+} + 4H_2O$
⇒ 1 mole of MnO_4^- accepts 5 mole of e^-
1/5 mole of MnO_4^- accepts 1 mole of e^-
⇒ 0.2 mole of MnO_4^- accepts 1 mole of e^-
⇒ 0.6 mole of MnO_4^- accepts 3 mole of e^-
$Fe^{2+} \longrightarrow Fe^{3+} + e^-$
⇒ 1 mole of Fe^{2+} will liberate 1 mole of e^-
$Cr_2O_7^{2-} + 6e^- + 14H^+ \longrightarrow 2Cr^{+3} + 7H_2O$
⇒ 1 mole of $Cr_2O_7^{2-}$ will accept 6 moles of e^-
1 mole of $FeC_2O_4 \longrightarrow Fe^{3+} + CO_2 + 3e^-$
⇒ 1 moles of ferrous oxalate gives 3 moles of e^-
⇒ 0.2 moles of $KMnO_4$ = 1/5 moles of $KMnO_4$ oxidises 1 mole of Fe^{2+} ion. (Tallies with statement A)
0.6 moles of $KMnO_4$ = 3/5 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate.
(Tallies with statement C)
1 mole of $K_2Cr_2O_7$ will oxidise 2 moles of ferrous oxalate. (Tallies with statement D)
Hence ,(A) , (C) , (D) are correct while (B) is incorrect.

12. **(A)** Formula of silver chromate (VI) will be Ag_2CrO_4

(B) Minimum mass of zinc required for reduction of 0.1 mole of Cr^{3+} to Cr^{2+} = $\frac{0.1}{2}$ moles of Zn

(v.f. of Zn = 2 & v.f. of Cr^{3+} = 1) $= \frac{6.54}{2}$ g = 3.27 g

(C) $CrO_4^{2-} \rightleftharpoons Cr_2O_7^{2-}$

in both ions, chromium is in +6 oxidation state.

(D) Given reaction is correct.

13. Lets mole of $FeSO_4$ = x

Now, $KMnO_4$ oxidises only $FeSO_4$

equivalent of $FeSO_4$ = equivalent of $KMnO_4$

$x \times 1 = \frac{100}{1000} \times 2 \times 5 \quad \Rightarrow \quad x = 1$

14. moles of iodine = moles of chlorine = $\frac{80 \times 0.2}{2} \times 10^{-3} = 8 \times 10^{-3}$

so required % = $\frac{8 \times 71 \times 10^{-3}}{7.1} \times 100\% = 8\ \%$

15. Hyponitrous acid = $H_2N_2O_2$ $\therefore$ x = 2

Basicity of Boric acid = y = 1

$\therefore$ x + y = 2 + 1 = 3.

16. $NH_2OH \longrightarrow N_2O$

(–1) (+1) oxidation number of nitrogen.

$\therefore$ Vf = change in oxidation number of nitrogen = 2.

17. Necessary equations :

$KBrO_3 + KI \longrightarrow I_2 + Br^-$

$I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + NaI$

equivalent of I_2 = equivalent of $KBrO_3$ = 12×10^{-2}

equivalent of $Na_2S_2O_3$ = equivalent of I_2

$M \times 1 \times \frac{40}{1000} = 12 \times 10^{-2}$

so molarity = 3 M.

18. $KI + O_3 \longrightarrow I_2 + H_2O + O_2$.

O_3: v.f = 2, moles = x. I_2: v.f = 2

$I_2 + Na_2S_2O_3 \longrightarrow I^- + Na_2S_4O_6$

I_2: v.f = 2; $Na_2S_2O_3$: M = 2, V = 1L, v.f = 1

eq of O_3 = eq of I_2 = eq of hypo

$\Rightarrow$ $2 \times x = 2$

x = 1 mole

$\Rightarrow$ weight % of O_3 = $\frac{1 \times 48}{1 \times 48 + 1 \times 32} \times 100$

$= \frac{3}{5} \times 100 = 60\%$ Ans. = $\frac{60}{10} = 6$.

19. In presence of MeOH indicator, velence factor of Na_2CO_3 = 2
Equivalent of HCl = Equivalent of Na_2CO_3
NV = mole × V.F
$1\ V = x \times 10^{-3} \times 2$
$V = 2x \times 10^{-3}$ L = 2x ml

20. Equivalent of HCl = Equivalent of (NaOH + Na_2CO_3 + $NOHCO_3$]
$1 \times V = [x \times 10^{-3} \times 1] + [Y \times 10^{-3} \times 2] + [Z \times 10^{-3} \times 1]$
$V = [x + 2Y + Z] \times 10^{-3}$ L
V = [X + 2Y + Z] ml

21. In presence of phenophthalein indicator valence factor of Hph = 1
Equivalents of HCl = Equivalent of Na_2CO_3
$N_1V_1 = N_2V_2$
For HCl $N_1 = M_1$ and Na_2CO_3 $N_2 = N_2$ $M_1 V_1 = M_2V_2$
$0.1 \times 100 = N_2 \times 25$
$M_2 = 0.4$
Reaction is $Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$
in moles of Na_2CO_3 = MV
$= 0.4\ 018 \times 25 \times 10^{-3}$
= moles of $NaHCO_3$
molarity of HCO_3^- $= \dfrac{\text{Moles of } NaHCO_3}{\text{Volume}} = \dfrac{0.4 \times 25 \times 10^{-3} \times 1000}{125} = 0.08$

22. (A) Eq of Sn^{2+} = Moles × v.f. = 3.5 × 2 = 7.
Eq of MnO_4^- = Moles × v.f. = 1.2 × 5 = 6.
Since MnO_4^- (O.A) is the LR, so the amount of oxidant available decides the number of electron transfer.
Also, electron involved per mole of OA (5) > electron involved per mole of RA (2).
(B) Eq of $H_2C_2O_4$ = Moles × v.f. = 8.4 × 2 = 16.8.
Eq of MnO_4^- = Moles × v.f. = 3.6 × 5 = 18.
Since $H_2C_2O_4$ (RA) is the LR, so the amount of reductant available decides the number of electron transfer.
Also, electron involved per mole of OA (5) > electron per mole of RA (2).
(C) Eq of $S_2O_3^{2-}$ = Moles × v.f. = 7.2 × 1 = 7.2.
Eq of I_2 = Moles × v.f. = 3.6 × 2 = 7.2.
Since $S_2O_3^{2-}$ (RA) and I_2 (OA) both completely get consumed, so both the amount of reductant and oxidant decides the number of electron transfer.
Also, electron involved per mole of OA (2) > electron involved per mole of RA (1).
(D) Eq of Fe^{2+} = Moles × v.f. = 9.2 × 1 = 9.2.
Eq of $Cr_2O_7^{2-}$ = Moles × v.f. = 1.6 × 6 = 9.6.
Since Fe^{2+} (RA) is the LR, so the amount of reductant available decides the number of electron transfer.
Also, electron involved per mole of OA (6) > electron involved per mole RA (1).