

Exercise-1

☞ Marked questions are recommended for Revision.

PART - I : SUBJECTIVE QUESTIONS**Section (A) : Classical Concept of Equivalent weight / Mass, Equivalent weight, n-factor and Normality for Acid, Base and Precipitate**

A-1. Determine the equivalent weight of the following ions :

(a) Na^+	(b) Al^{3+}	(c) NO^+	(d) Cl^-
(e) CO_3^{2-}	(f) SO_4^{2-}	(g) PO_4^{3-}	

A-2. Determine the equivalent weights of the following salts :

(a) NaCl	(b) K_2SO_4	(c) $\text{Ca}_3(\text{PO}_4)_2$
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A-3. ☞ 1.12 litre dry chlorine gas at STP was passed over a heated metal when 5.56 g of chloride of the metal was formed. What is the equivalent weight of the metal?

Section (B) : Equivalent weight, n-factor and Normality for Oxidant and Reductant

B-1. ☞ A mixture of CuS (molecular weight = M_1) and Cu_2S (molecular weight = M_2) is oxidised by KMnO_4 (molecular weight = M_3) in acidic medium, where the product obtained are Cu^{2+} , Mn^{2+} and SO_2 . Find the equivalent weight of CuS , Cu_2S and KMnO_4 respectively.

B-2. Determine the equivalent weight of the following oxidising and reducing agents :

(a) KMnO_4 (reacting in acidic medium $\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$)
(b) KMnO_4 (reacting in neutral medium $\text{MnO}_4^- \rightarrow \text{MnO}_2$)

Section (C) : Equivalent Concept for Acid Base Titration and Precipitation Reactions

C-1. 0.98 g of the metal sulphate was dissolved in water and excess of barium chloride was added. The precipitated barium sulphate weighted 0.95 g. Calculate the equivalent weight of the metal.

C-2. A dilute solution of H_2SO_4 is made by adding 5 mL of 3N H_2SO_4 to 245 mL of water. Find the normality and molarity of the diluted solution.

C-3. ☞ What volume at NTP of gaseous ammonia will be required to be passed into 30 cm^3 of 1 N H_2SO_4 solution to bring down the acid strength of the latter to 0.2 N ?

Section (D) : Equivalent Concept for Redox reactions, KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ v/s Reducing Agents & their Redox Titration

D-1. ☞ 1.60 g of a metal A and 0.96 g of a metal B when treated with excess of dilute acid, separately, produced the same amount of hydrogen. Calculate the equivalent weight of A if the equivalent weight of B is 12.

D-2. It requires 40 mL of 1 M Ce^{4+} to titrate 20 mL of 1M Sn^{2+} to Sn^{4+} . What is the oxidation state of the Cerium in the product ?

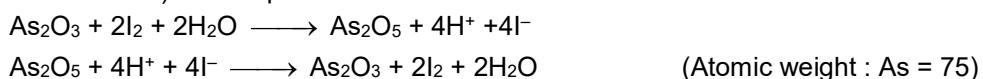
D-3. 25 mL of a solution of Fe^{2+} ions was titrated with a solution of the oxidizing agent $\text{Cr}_2\text{O}_7^{2-}$. 50 mL of 0.01 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution was required. What is the molarity of the Fe^{2+} solution ?

D-4. ☞ How many mL of 0.3M $\text{K}_2\text{Cr}_2\text{O}_7$ (acidic) is required for complete oxidation of 5 mL of 0.2 M SnC_2O_4 solution.

Section (E) : Iodometric/Iodimetric Titration, Calculation of Available Chlorine from a sample of Bleaching Powder

E-1. A 10 g sample of bleaching powder was dissolved into water to make the solution one litre. To this solution 35 mL of 1.0 M Mohr salt solution was added containing enough H_2SO_4 . After the reaction was complete, the excess Mohr salt required 30 mL of 0.1 M KMnO_4 for oxidation. The % of available Cl_2 approximately is (mol wt = 71)

E-2. A mixture containing As_2O_3 and As_2O_5 required 20 mL of 0.05 N iodine solution for titration. The resulting solution is then acidified and excess of KI was added. The liberated iodine required 1.116 g hypo ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$) for complete reaction. Calculate the mass of the mixture. The reactions are:



Section (F) : Volume strength of H_2O_2 , Hardness of water

F-1. 20 ml of H_2O_2 after acidification with dil H_2SO_4 required 30 ml of $\frac{N}{12}$ KMnO_4 for complete oxidation.

Determine the strength of H_2O_2 solution.

F-2. A 100 mL sample of water was treated to convert any iron present to Fe^{2+} . Addition of 25 mL of 0.002 M $\text{K}_2\text{Cr}_2\text{O}_7$ resulted in the reaction :



The excess $\text{K}_2\text{Cr}_2\text{O}_7$ was back-titrated with 7.5 mL of 0.01 M Fe^{2+} solution. Calculate the parts per million (ppm) of iron in the water sample.

F-3. By which reason temporary and permanent hardness occur ?

F-4. Define two method by which we can soften the water sample.

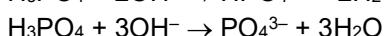
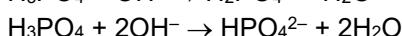
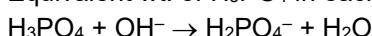
PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Classical Concept of Equivalent weight / Mass, Equivalent weight, n-factor and Normality for Acid, Base and Precipitate

A-1. x g of the metal gave y g of its oxide. Hence equivalent weight of the metal

(A) $\frac{y-x}{x} \times 8$ (B) $\frac{x}{(y-x)} \times 8$ (C) $\frac{x}{y} \times 8$ (D) $\frac{x+y}{x} \times 8$

A-2. Equivalent wt. of H_3PO_4 in each of the reaction will be respectively -



(A) 98, 49, 32.67 (B) 49, 98, 32, 67 (C) 98, 32.67, 49 (D) 32.67, 49, 98

A-3. 3 g of an oxide of a metal is converted to chloride completely and it yielded 5 g of chloride. Equivalent weight of the metal is :

(A) 33.25 (B) 3.325 (C) 12 (D) 20

Section (B) : Equivalent weight, n-factor and Normality for Oxidant and Reductant

B-1. An ion is reduced to the element when it absorbs 6×10^{20} electrons. The number of equivalents of the ion is:

(A) 0.1 (B) 0.01 (C) 0.001 (D) 0.0001

Section (C) : Equivalent Concept for Acid Base Titration and Precipitation Reactions

C-1. If one mole of H_2SO_4 reacts with one mole of NaOH , equivalent weight of H_2SO_4 will be :
(A) 98 (B) 49 (C) 96 (D) 48

C-2. How many millilitres of 0.1N H_2SO_4 solution will be required for complete reaction with a solution containing 0.125 g of pure Na_2CO_3 :
(A) 23.6 mL (B) 25.6 mL (C) 26.3 mL (D) 32.6 mL

C-3. One litre of a solution contains 18.9 g of HNO_3 and one litre of another solution contains 3.2 g of NaOH . In what volume ratio must these solution be mixed to obtain a neutral solution?
(A) 3 : 8 (B) 8 : 3 (C) 15 : 4 (D) 4 : 15

Section (D) : Equivalent Concept for Redox reactions, KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ v/s Reducing Agents & their Redox Titration

Section (E) : Iodometric/Iodimetric Titration, Calculation of Available Chlorine from a sample of Bleaching Powder

Section (F) : Volume strength of H₂O₂, Hardness of water

F-1. A substance which participates readily in both acid-base and oxidation-reduction reactions is :
 (A) Na₂CO₃ (B) KOH (C) KMnO₄ (D) H₂C₂O₄

F-2. A fresh H₂O₂ solution is labeled as 11.2 V. Calculate its concentration in wt/vol percent.
 (A) 3.4 (B) 6.8 (C) 1.7 (D) 13.6

F-3. The amount of lime, Ca(OH)₂ required to remove the hardness in 60 L of pond water containing 1.62 mg of calcium bicarbonate per 100 ml of water, will be :
 (A) 4.44 g (B) 0.222 g (C) 2.22 g (D) 0.444 g

F-4. What will the concentration of [Ca²⁺] in a sample of 1 litre hard water if after treatment with washing soda 10 g insoluble CaCO₃ is precipitated.
 (A) 0.2 M (B) 0.1 M (C) 0.3 M (D) 0.4 M

PART - III : MATCH THE COLUMN

1. Column I	Column II
(A) 4.1 g H ₂ SO ₃	(p) 200 mL of 0.5 N base is used for complete neutralization
(B) 4.9 g H ₃ PO ₄	(q) 200 millimoles of oxygen atoms
(C) 4.5 g oxalic acid (H ₂ C ₂ O ₄)	(r) Central atom is in its highest oxidation number
(D) 5.3 g Na ₂ CO ₃	(s) May react with an oxidising agent

Exercise-2

Marked questions are recommended for Revision.

PART - I : ONLY ONE OPTION CORRECT TYPE

1. The equivalent weight of a metal is double that of oxygen. How many times is the weight of its oxide greater than weight of the metal?
 (A) 1.5 (B) 2 (C) 0.5 (D) 3

2. Oxalic acid, H₂C₂O₄, reacts with paramagnet ion according to the balanced equation 5H₂C₂O₄ (aq) + 2MnO₄⁻ (aq) \rightleftharpoons 2 Mn²⁺ (aq) + 10 CO₂ (g) + 8 H₂O (l). The volume in mL of 0.0162 M KMnO₄ solution required to react with 25.0 mL of 0.022 M H₂C₂O₄ solution is :
 (A) 13.6 (B) 18.5 (C) 33.8 (D) 84.4

3. x mmol of KMnO₄ react completely with y mmol of MnSO₄ in presence of fluoride ions to give MnF₄ quantitatively. Then :
 (A) x = y (B) 4x = y (C) x > y (D) x < y

4. 1 mol each of H₃PO₂, H₃PO₃ and H₃PO₄ will neutralise respectively x mol of NaOH, y mol of Ca(OH)₂ and z mol of Al(OH)₃ (assuming all as strong electrolytes). x, y, z are in the ratio of :
 (A) 3 : 1.5 : 1 (B) 1 : 2 : 3 (C) 3 : 2 : 1 (D) 1 : 1 : 1

5. The amount of wet NaOH containing 15% water required to prepare 70 litres of 0.5 N solution is :
 (A) 1.65 kg (B) 1.4 kg (C) 16.5 kg (D) 140 kg

6. 28 NO₃⁻ + 3As₂S₃ + 4H₂O \longrightarrow 6AsO₄³⁻ + 28NO + 9SO₄²⁻ + 8H⁺.
 What will be the equivalent mass of As₂S₃ in above reaction : (Molecular mass of As₂S₃ = M)
 (A) $\frac{M}{2}$ (B) $\frac{M}{4}$ (C) $\frac{M}{24}$ (D) $\frac{M}{28}$

PART - II : NUMERICAL VALUE TYPE

1. How many equivalents of Mg would have to react in order to liberate $4 N_A$ electrons? ($Mg - 2e^- \rightarrow Mg^{2+}$)

2. A certain weight of pure $CaCO_3$ is made to react completely with 20 mL of a HCl solution to give 224 mL of CO_2 gas at STP. The normality of the HCl solution is:

3. The volume of 3 M $Ba(OH)_2$ solution required to neutralize completely 120 mL of 1.5M H_3PO_4 solution is:

4. In an experiment, 50 mL of 0.1 M solution of a salt reacted with 25 mL of 0.1 M solution of sodium sulphite. The half equation for the oxidation of sulphite ion is :
 $SO_3^{2-} (aq) + H_2O \longrightarrow SO_4^{2-} (aq) + 2H^+ + 2e^-$
If the oxidation number of metal in the salt was 3, what would be the new oxidation number of metal :

5. When tetracarbonylnickel(0) is heated, it dissociates into its components. If 5 moles of this compound is heated and the resulting gaseous component is absorbed by sufficient amount of I_2O_5 , liberating I_2 . What volume of 4M Hypo solution will be required to react with this I_2 : $Ni(CO)_4 \xrightarrow{\Delta} Ni + 4CO$

6. 1 mole of OH^- ions is obtained from 85 g of hydroxide of a metal. What is the equivalent weight of the metal?

7. An oxide of a metal contains 40% oxygen, by weight. What is the equivalent weight of the metal?

8. In the following reaction, $3\text{Fe} + 4\text{H}_2\text{O} \longrightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$, if the atomic weight of iron is 56, then its equivalent weight will be :

9. What volume of 0.05 M $\text{Ca}(\text{OH})_2$ solution is needed for complete conversion of 10 mL of 0.1 M H_3PO_4 into $\text{Ca}(\text{H}_2\text{PO}_4)_2$?

10. Potassium acid oxalate $\text{K}_2\text{C}_2\text{O}_4 \cdot 3\text{H}_2\text{C}_2\text{O}_4 \cdot 4\text{H}_2\text{O}$ can be oxidized by MnO_4^- in acid medium. Calculate the volume of (in mL) 1 M KMnO_4 reacting in acid solution with 5.08 gram of the acid oxalate.

11. In the following reaction, SO_2 acts as a reducing agent :

$$\text{SO}_2 + \text{Cl}_2 + 2\text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_4 + 2\text{HCl}$$

 Find the equivalent weight of SO_2 .

PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

1. In the titration of $\text{K}_2\text{Cr}_2\text{O}_7$ and ferrous sulphate, following data is obtained :
 V_1 mL of $\text{K}_2\text{Cr}_2\text{O}_7$ solution of molarity M_1 requires V_2 mL of FeSO_4 solution of molarity M_2 .
 Which of the following relations is/are true for the above titration :
 (A) $6 M_1 V_1 = M_2 V_2$ (B) $M_1 V_1 = 6 M_2 V_2$ (C) $N_1 V_1 = N_2 V_2$ (D) $M_1 V_1 = M_2 V_2$

2. Choose the correct statement(s) :
 (A) 1 mole of MnO_4^- ion can oxidise 5 moles of Fe^{2+} ion in acidic medium.
 (B) 1 mole of $\text{Cr}_2\text{O}_7^{2-}$ ion can oxidise 6 moles of Fe^{2+} ion in acidic medium.
 (C) 1 mole of Cu_2S can be oxidised by 1.6 moles of MnO_4^- ion in acidic medium.
 (D) 1 mole of Cu_2S can be oxidised by 1.33 moles of $\text{Cr}_2\text{O}_7^{2-}$ ion in acidic medium.

3. Which of the following samples of reducing agents is /are chemically equivalent to 25 mL of 0.2 N KMnO_4 to be reduced to Mn^{2+} and water :
 (A) 25 mL of 0.2 M FeSO_4 to be oxidized to Fe^{3+}
 (B) 50 mL of 0.1 M H_3AsO_3 to be oxidized to H_3AsO_4
 (C) 25 mL of 0.1 M H_2O_2 to be oxidized to H^+ and O_2
 (D) 25 mL of 0.1 M SnCl_2 to be oxidized to Sn^{4+}

4. To a 25 ml H_2O_2 solution excess acidified solution of KI was added. The iodine liberated 20 ml of 0.3 N sodium thiosulphate solution. Use these data to choose the correct statements from the following :
 (A) The weight of H_2O_2 present in 25 ml solution is 0.102 g
 (B) The molarity of H_2O_2 solution is 0.12 M
 (C) The weight of H_2O_2 present in 1 L of the solution is 0.816 g
 (D) The volume strength of H_2O_2 is 1.344 L

5. There are two sample of HCl having molarity 1N and 0.25 N. Find volume of these sample taken in order to prepare 0.75 N HCl solution. (Assume no water is used) :
 (A) 20 mL, 10 mL (B) 100 mL, 50 mL (C) 40 mL, 20 mL (D) 50 mL, 25 mL

6. If mass of KHC_2O_4 (potassium acid oxalate) required to reduce 100 mL of 0.02 M KMnO_4 in acidic medium is x g and to neutralise 100 mL of 0.05 M $\text{Ca}(\text{OH})_2$ is y g, then which of the following options may be correct :
 (A) $2x = y$ (B) $x = 2y$
 (C) $x = y$ (D) absolute values of x & y cannot be determined.

PART - IV : COMPREHENSION

Read the following passage carefully and answer the questions.

Comprehension # 1

Equivalent Mass :

The equivalent mass of a substance is defined as the number of parts by mass of it which combine with or displace 1.0078 parts by mass of hydrogen, 8 parts by mass of oxygen and 35.5 parts by mass of chlorine.

The equivalent mass of a substance expressed in grams is called **gram equivalent mass**.

The equivalent mass of a substance is not constant. It depends upon the reaction in which the substance is participating. A compound may have different equivalent mass in different chemical reactions and under different experimental conditions.

(A) Equivalent mass of an acid : It is the mass of an acid in grams which contains 1.0078 g of replaceable H^+ ions or it is the mass of acid which contains one mole of replaceable H^+ ions. It may be calculated as :

$$\text{Equivalent mass of acid} = \frac{\text{Molecular mass of acid}}{\text{Basicity of acid}}$$

Basicity of acid = number of replaceable hydrogen atoms present in one molecule of acid

(B) Equivalent mass of a base : It is the mass of the base which contains one mole of replaceable OH^- ions in molecule.

$$\text{Equivalent mass of base} = \frac{\text{Molecular mass of base}}{\text{Acidity of base}}$$

Acidity of base = Number of replaceable OH^- ions present in one molecule of the base

Equivalent mass of an oxidising agent :

(a) **Electron concept** : Equivalent mass of oxidising agent =
$$\frac{\text{Molecular mass of oxidising agent}}{\text{Number of electrons gained by one molecule}}$$

(b) Oxidation number concept : Equivalent mass of oxidising agent =
$$\frac{\text{Molecular mass of oxidising agent}}{\text{Total change in oxidation number per molecule of oxidising agent}}$$

1. Equivalent mass of $\text{Ba}(\text{MnO}_4)_2$ in acidic medium is : (where M stands for molar mass)
(A) M/5 (B) M/6 (C) M/10 (D) M/2

2. Equivalent mass of $\text{Fe}_{0.9}\text{O}$ in reaction with acidic $\text{K}_2\text{Cr}_2\text{O}_7$ is : (M = Molar mass)
(A) 7 M/10 (B) 10 M/7 (C) 7 M/9 (D) 9 M/7

3. Equivalent weight of oxalic acid salt in following reaction is : (Atomic masses : O = 16, C = 12, K = 39)
$$\text{H}_2\text{C}_2\text{O}_4 + \text{Ca}(\text{OH})_2 \longrightarrow \text{CaC}_2\text{O}_4 + \text{H}_2\text{O}$$

(A) 90 (B) 45 (C) 64 (D) 128

Comprehension # 2

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 $\text{Na}_2\text{S}_2\text{O}_3$ for titration.

4. The volume of H_2O_2 solution is :
(A) 11.2 mL (B) 37.2 mL (C) 5.6 mL (D) 22.4 mL

5. The mass of $\text{K}_2\text{Cr}_2\text{O}_7$ needed to oxidise the above volume of H_2O_2 solution is :
(A) 3.6 g (B) 0.8 g (C) 4.2 g (D) 0.98 g

6. The volume of O_2 at STP that would be liberated by above H_2O_2 solution on disproportionation is :
(A) 56 mL (B) 112 mL (C) 168 mL (D) 224 mL

Comprehension # 3

Answer Q.7, Q.8 and Q.9 by appropriately matching the information given in the three columns of the following table.

Equivalent weight = $\frac{\text{Molecular weight}}{\text{Atomic weight}}$ n-factor is very important in redox as well as non-n-factor redox reactions.

In general n-factor of acid/base is number of moles of H^+ / OH^- furnished per mole of acid/base. n-factor of reactions is number of moles of electrons lost or gained per mole of reactant columns 1, 2, 3 contain reactions, n-factor & equivalent weight respectively.

Column-1		Column-2		Column-3	
(I)	$\text{MnO}_4^- + 2\text{H}_2\text{O} \longrightarrow \text{MnO}_2 + 4\text{OH}^-$	(i)	1	(P)	158
(II)	$\text{MnO}_4^- \longrightarrow \text{MnO}_4^{2-}$	(ii)	$\frac{10}{6}$	(Q)	96
(III)	$\text{Br}_2 + \text{OH}^- \longrightarrow \text{BrO}_3^- + \text{Br}^-$	(iii)	3	(R)	34
(IV)	$\text{H}_2\text{O}_2 \longrightarrow \text{O}_2 + \text{H}_2\text{O}$	(iv)	2	(S)	52.6

7. For KMnO_4 in strong basic medium correct combination is -
(A) (I) (ii) (R) (B) (II) (i) (P) (C) (II) (iii) (S) (D) (I) (iv) (Q)
8. For KMnO_4 in neutral medium correct combination is -
(A) (I) (iii) (Q) (B) (II) (i) (R) (C) (I) (iii) (S) (D) (II) (iii) (R)
9. For a disproportionation reaction the only correct combination is -
(A) (I) (ii) (R) (B) (II) (ii) (Q) (C) (IV) (i) (S) (D) (III) (ii) (Q)

Exercise-3

* Marked Questions may have more than one correct option.

PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

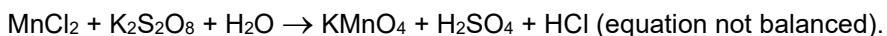
1. In basic medium, I^- is oxidised by MnO_4^- . In this process, I^- changes to : [JEE 2004, 3/144]
(A) IO_3^- (B) I_2 (C) IO_4^- (D) IO^-
2. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is : [JEE 2007, 3/162]
(A) 3 (B) 4 (C) 5 (D) 6
3. The reagent (s) used for softening the temporary hardness of water is (are) : [JEE 2010, 3/163]
(A) $\text{Ca}_3(\text{PO}_4)_2$ (B) $\text{Ca}(\text{OH})_2$ (C) Na_2CO_3 (D) NaOCl

Paragraph for Questions Nos. 4 to 5

Bleaching powder and bleach solution are produced on a large scale and used in several house hold products. The effectiveness of bleach solution is often measured by iodometry.

4. 25 mL of household bleach solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N $\text{Na}_2\text{S}_2\text{O}_3$ was used to reach the end point. The molarity of the household bleach solution is [IIT-JEE 2012, 3/136]
(A) 0.48 M (B) 0.96 M (C) 0.24 M (D) 0.024 M
5. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is [IIT-JEE 2012, 3/136]
(A) Cl_2O (B) Cl_2O_7 (C) ClO_2 (D) Cl_2O_6
- 6.* For the reaction : $\text{I}^- + \text{ClO}_3^- + \text{H}_2\text{SO}_4 \longrightarrow \text{Cl}^- + \text{HSO}_4^- + \text{I}_2$
The correct statement(s) in the balanced equation is/are : [JEE (Advanced) 2014, 3/120]
(A) Stoichiometric coefficient of HSO_4^- is 6. (B) Iodide is oxidized.
(C) Sulphur is reduced. (D) H_2O is one of the products.

7. To measure the quantity of $MnCl_2$ dissolved in an aqueous solution, it was completely converted to $KMnO_4$ using the reaction.



Few drops of concentrated HCl were added to this solution and gently warmed. Further, oxalic acid (225 mg) was added in portions till the colour of the permanganate ion disappeared. The quantity of $MnCl_2$ (in mg) present in the initial solution is _____.
(Atomic weights in g mol⁻¹ : Mn = 55, Cl = 35.5)

[JEE (Advanced) 2018, 3/120]

PART - II : JEE (MAIN) ONLINE PROBLEMS (PREVIOUS YEARS)

1. Hydrogen peroxide acts both as an oxidising and as a reducing agent depending upon the nature of the reacting species. In which of the following cases H_2O_2 acts as a reducing agent in acid medium ?
[JEE(Main) 2014 Online (12-04-14), 4/120]

(1) MnO_4^- (2) $Cr_2O_7^{2-}$ (3) SO_3^{2-} (4) KI

2. Permanent hardness in water cannot be cured by : [JEE(Main) 2015 Online (10-04-15), 4/120]

(1) Treatment with washing soda (2) Boiling
(3) Ion exchange method (4) Calgon's method

3. 1.4 g of an organic compound was digested according to Kjeldahl's method and the ammonia evolved was absorbed in 60 mL of M/10 H_2SO_4 solution. The excess sulphuric acid required 20 mL of M/10 NaOH solution for neutralization. The percentage of nitrogen in the compound is :
[JEE(Main) 2015 Online (10-04-15), 4/120]

(1) 24 (2) 5 (3) 10 (4) 3

4. The volume of 0.1 N dibasic acid sufficient to neutralize 1 g of a base that furnishes 0.04 mole of OH^- in aqueous solution is : [JEE(Main) 2016 Online (10-04-16), 4/120]

(1) 400 mL (2) 600 mL (3) 200 mL (4) 80 mL

5. For standardizing NaOH solution, which of the following is used as a primary standard ?
[JEE(Main) 2018 Online (16-04-18), 4/120]

(1) Sodium tetraborate (2) Ferrous Ammonium Sulfate
(3) Oxalic acid (4) dil. HCl

6. The temporary hardness of water is due to : [JEE(Main) 2019 Online (09-01-19), 4/120]

(1) $CaCl_2$ (2) $Ca(HCO_3)_2$ (3) NaCl (4) Na_2SO_4

7. In the reaction of oxalate with permanganate in acidic medium, the number of electrons involved in producing one molecule of CO_2 is : [JEE(Main) 2019 Online (10-01-19), 4/120]

(1) 5 (2) 1 (3) 2 (4) 10

8. 25 mL of the given HCl solution requires 30 mL of 0.1 M sodium carbonate solution. What is the volume of this HCl solution required to titrate 30 mL of 0.2 M aqueous NaOH solution?
[JEE(Main) 2019 Online (11-01-19), 4/120]

(1) 12.5 mL (2) 75 mL (3) 50 mL (4) 25 mL

9. The hardness of water sample (in terms of equivalents of $CaCO_3$) containing 10^{-3} M $CaSO_4$ is : (molar mass of $CaSO_4$ = 136 g mol⁻¹)
[JEE(Main) 2019 Online (12-01-19), 4/120]

(1) 10 ppm (2) 50 ppm (3) 90 ppm (4) 100 ppm

10. The volume strength of 1M H_2O_2 is: (Molar mass of H_2O_2 = 34 g mol⁻¹)
[JEE(Main) 2019 Online (12-01-19), 4/120]

(1) 11.35 (2) 22.4 (3) 16. 8 (4) 5.6

Answers**EXERCISE - 1****PART - I**

A-1. (a) 23 ; (b) $E = 9$; (c) $E = 30$; (d) $E = \frac{35.5}{1}$; (e) $E = 30$; (f) $E = 48$; (g) $E = 31.67$

A-2. (a) $E = 58.5$ or $E = 58.5$; (b) $E = 87$ or $E = 87$; (c) $E = 51.67$ or $E = 51.67$

A-3. 20.1 **B-1.** $\frac{M_1}{6}$, $\frac{M_2}{8}$, $\frac{M_3}{5}$ **B-2.** (a) 31.6 ; (b) 52.67 **C-1.** 72.61

C-2. 0.06 N, 0.03 M **C-3.** 537.6 mL

D-3. 0.12 M. **D-4.** 2.22 mL. **E-1.** 7.1% **E-2.** 0.25075 g

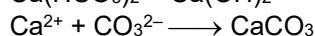
F-1. 2.12 g/L **F-2.** 126 ppm

F-3. Temporary hardness - due to bicarbonates of Ca & Mg

Permanent hardness - due to chlorides & sulphates of Ca & Mg.

F-4. There are some method by which we can soften the water sample.

(a) By boiling : $2\text{HCO}_3^- \longrightarrow \text{H}_2\text{O} + \text{CO}_2 + \text{CO}_3^{2-}$
or By Slaked lime : $\text{Ca}(\text{HCO}_3)_2 + \text{Ca}(\text{OH})_2 \longrightarrow \text{CaCO}_3 + 2\text{H}_2\text{O}$



(b) By Washing Soda : $\text{CaCl}_2 + \text{Na}_2\text{CO}_3 \longrightarrow \text{CaCO}_3 + 2\text{NaCl}$

(c) By ion exchange resins : $\text{Na}_2\text{R} + \text{Ca}^{2+} \longrightarrow \text{CaR} + 2\text{Na}^+$

(d) By adding chelating agents like $(\text{PO}_3^{3-})_3$ etc.

PART - II

A-1. (B) **A-2.** (A) **A-3.** (A) **B-1.** (C) **B-2.** (D)

B-3. (A) **C-1.** (A) **C-2.** (A) **C-3.** (D) **D-1.** (B)

D-2. (D) **D-3.** (B) **D-4.** (A) **E-1.** (B) **E-2.** (B)

F-1. (D) **F-2.** (A) **F-3.** (D) **F-4.** (B)

PART - III

1. $(A - p, s) ; (B - q, r) ; (C - p, q, s) ; (D - r)$

EXERCISE - 2**PART - I**

1. (A) 2. (A) 3. (D) 4. (D) 5. (A)

6. (D) 7. (D) 8. (A) 9. (D) 10. (A)

11. (A) 12. (A) 13. (A) 14. (A)

PART - II

1. 4 2. 1 3. 90 4. 2 5. 2

6. 68 7. 12 8. 21 9. 10 mL 10. 16

11. 32

PART - III

1. (AC)	2. (ABCD)	3. (ACD)	4. (ABD)	5. (ABCD)
6. (BCD)				

PART - IV

1. (C)	2. (B)	3. (C)	4. (C)	5. (D)
6. (B)	7. (B)	8. (C)	9. (D)	

EXERCISE - 3**PART - I**

1. (A)	2. (D)	3. (B)	4. (C)	5. (A)
6.* (ABD)	7. 126 mg			

PART - II

1. (1)	2. (2)	3. (3)	4. (1)	5. (3)
6. (2)	7. (2)	8. (4)	9. (4)	10. (1)