Chapter 8

# Redox Reactions and Volumetric Analysis

1. The mass of potassium dichromate crystals required to oxidise 750 $cm^3$ of 0.6 M Mohr's salt solution is: (Given molar mass : potassium dichromate = 294, Mohr's salt = 392)

**[AIEEE-2011]**

(1) 2.2 g (2) 0.49 g

(3) 0.45 g (4) 22.05 g

2. 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]**

(1) 5, 2 and 16 (2) 2, 5 and 8

(3) 2, 5 and 16 (4) 5, 2 and 8

3. The chemical nature of hydrogen peroxide is

**[JEE (Main)-2019]**

(1) Oxidising and reducing agent in both acidic and basic medium

(2) Oxidising and reducing agent in acidic medium, but not in basic medium

(3) Reducing agent in basic medium, but not in acidic medium

(4) Oxidising agent in acidic medium, but not in basic medium

4. Consider the following reduction processes:

$Zn^{2+} + 2e^- \rightarrow Zn(s)$; $E^o = -0.76$ V

$Ca^{2+} + 2e^- \rightarrow Ca(s)$; $E^o = -2.87$ V

$Mg^{2+} + 2e^- \rightarrow Mg(s)$; $E^o = -2.36$ V

$Ni^{2+} + 2e^- \rightarrow Ni(s)$; $E^o = -0.25$ V

The reducing power of the metals increases in the order : **[JEE (Main)-2019]**

(1) Ca < Mg < Zn < Ni

(2) Ni < Zn < Mg < Ca

(3) Ca < Zn < Mg < Ni

(4) Zn < Mg < Ni < Ca

5. 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]**

(1) 1 (2) 10

(3) 2 (4) 5

6. A 10 mg effervescent tablet containing sodium bicarbonate and oxalic acid releases 0.25 ml of $CO_2$ at T = 298.15 K and p = 1 bar. If molar volume of $CO_2$ is 25.0 L under such condition, what is the percentage of sodium bicarbonate in each tablet?

[Molar mass of $NaHCO_3$ = 84 g $mol^{-1}$]

**[JEE (Main)-2019]**

(1) 33.6 (2) 8.4

(3) 0.84 (4) 16.8

7. 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]**

(1) 25 mL (2) 12.5 mL

(3) 50 mL (4) 75 mL

8. 50 mL of 0.5 M oxalic acid is needed to neutralize 25 mL of sodium hydroxide solution. The amount of NaOH in 50 mL of the given sodium hydroxide solution is **[JEE (Main)-2019]**

(1) 10 g (2) 4 g

(3) 20 g (4) 80 g

9. In order to oxidise a mixture of one mole of each of $FeC_2O_4$, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is **[JEE (Main)-2019]**

(1) 1.5 (2) 2

(3) 3 (4) 1

10. An example of a disproportionation reaction is:
**[JEE (Main)-2019]**

(1) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

(2) $2CuBr \rightarrow CuBr_2 + Cu$

(3) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

(4) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

11. Oxidation number of potassium in $K_2O$, $K_2O_2$ and $KO_2$, respectively, is **[JEE (Main)-2020]**

(1) +1, +2 and +4

(2) +2, +1 and $+\frac{1}{2}$

(3) +1, +4 and +2

(4) +1, +1 and +1

12. The redox reaction among the following is
**[JEE (Main)-2020]**

(1) Reaction of $[Co(H_2O)_6]Cl_3$ with $AgNO_3$

(2) Formation of ozone from atmospheric oxygen in the presence of sunlight.

(3) Combination of dinitrogen with dioxygen at 2000 K

(4) Reaction of $H_2SO_4$ with NaOH

13. While titrating dilute HCl solution with aqueous NaOH, which of the following will not be required?
**[JEE (Main)-2020]**

(1) Pipette and distilled water

(2) Clamp and phenolphthalein

(3) Burette and porcelain tile

(4) Bunsen burner and measuring cylinder

14. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and $K_2FeO_4$, respectively, are x, y and z. The sum of x, y and z is _____.
**[JEE (Main)-2020]**

15. A 20.0 mL solution containing 0.2 g impure $H_2O_2$ reacts completely with 0.316 g of $KMnO_4$ in acid solution. The purity of $H_2O_2$ (in %) is _____
(mol. wt. of $H_2O_2$ = 34; mol. wt. of $KMnO_4$ = 158)
**[JEE (Main)-2020]**

16. Consider the following equations :

$2Fe^{2+} + H_2O_2 \rightarrow xA + yB$

(in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'C + y'D + z'E$

(in acidic medium)

The sum of the stoichiometric coefficients

x, y,, x′, y′ and z′ for products A, B, C, D and E, respectively, is _____. **[JEE (Main)-2020]**

17. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is _____. **[JEE (Main)-2020]**

18. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3 \cdot xH_2O$. The normality of the solution is 0.1 N. The value of x is _____. **[JEE (Main)-2020]**

(The atomic mass of Na is 23 g/mol)

19. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is _____.

(Molar mass of Fe = 56 g $mol^{-1}$)

**[JEE (Main)-2020]**

20. The ammonia ($NH_3$) released on quantitative reaction of 0.6 g urea ($NH_2CONH_2$) with sodium hydroxide (NaOH) can be neutralized by

**[JEE (Main)-2020]**

(1) 200 ml of 0.4 N HCl

(2) 100 ml of 0.1 N HCl

(3) 200 ml of 0.2 N HCl

(4) 100 ml of 0.2 N HCl

21. The reaction of sulphur in alkaline medium is given below:

$$S_{8(s)} + a\,OH^-_{(aq)} \longrightarrow b\,S^{2-}_{(aq)} + c\,S_2O_3^{2-}{}_{(aq)} + d\,H_2O_{(l)}$$

The value of 'a' is _____. (Integer answer)

**[JEE (Main)-2021]**

22. 0.4 g mixture of NaOH, $Na_2CO_3$ and some inert impurities was first titrated with $\frac{N}{10}$ HCl using phenolphthalein as an indicator, 17.5 mL of HCl was required at the end point. After this methyl orange was added and titrated. 1.5 mL of same HCl was required for the next end point. The weight percentage of $Na_2CO_3$ in the mixture is _____. (Rounded-off to the nearest integer)

**[JEE (Main)-2021]**

23. In basic medium $CrO_4^{2-}$ oxidises $S_2O_3^{2-}$ to form $SO_4^{2-}$ and itself changes into $Cr(OH)_4^-$. The volume of 0.154 M $CrO_4^{2-}$ required to react with 40 mL of 0.25 M $S_2O_3^{2-}$ is _____ mL. (Rounded-off to the nearest integer)

**[JEE (Main)-2021]**

24. Consider titration of NaOH solution versus 1.25 M oxalic acid solution. At the end point following burette readings were obtained. **[JEE (Main)-2021]**

(i) 4.5 mL (ii) 4.5 mL

(iii) 4.4 mL (iv) 4.4 mL

(v) 4.4 mL

If the volume of oxalic acid taken was 10.0 mL then the molarity of the NaOH solution is ____ M. (Rounded-off to the nearest integer)

25. $2MnO_4^- + bC_2O_4^{2-} + cH^+ \rightarrow x\,Mn^{2+} + yCO_2 + z\,H_2O$

If the above equation is balanced with integer coefficients, the value of c is ____.

**[JEE (Main)-2021]**

26. The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M $H_3PO_3$ solution and 100 mL of 2 M $H_3PO_2$ solution, respectively, are:

**[JEE (Main)-2021]**

(1) 100 mL and 100 mL

(2) 50 mL and 50 mL

(3) 100 mL and 200 mL

(4) 100 mL and 50 mL

27. 15 mL of aqueous solution of $Fe^{2+}$ in acidic medium completely reacted with 20 mL of 0.03 M aqueous $Cr_2O_7^{2-}$. The molarity of the $Fe^{2+}$ solution is _____ $\times 10^{-2}$ M.

(Round off to the Nearest Integer).

**[JEE (Main)-2021]**

28. The oxidation states of nitrogen in NO, $NO_2$, $N_2O$ and $NO_3^-$ are in the order of : **[JEE (Main)-2021]**

(1) $NO_2 > NO_3^- > NO > N_2O$

(2) $NO_3^- > NO_2 > NO > N_2O$

(3) $N_2O > NO_2 > NO > NO_3^-$

(4) $NO > NO_2 > N_2O > NO_3^-$

29. 10.0 mL of $Na_2CO_3$ solution is titrated against 0.2 M HCl solution. The following titre values were obtained in 5 readings: **[JEE (Main)-2021]**

4.8 mL, 4.9 mL, 5.0 mL, 5.0 mL and 5.0 mL

Based on these readings and convention of titrimetric estimation the concentration of $Na_2CO_3$ solution is _____ mM

(Round off the Nearest integer).

30. The species given below that does NOT show disproportionation reaction is **[JEE (Main)-2021]**

(1) $BrO_3^-$ (2) $BrO^-$

(3) $BrO_2^-$ (4) $BrO_4^-$

31. 4 g equimolar mixture of NaOH and $Na_2CO_3$ contains x g of NaOH and y g of $Na_2CO_3$. The value of x is _____g. **[JEE (Main)-2021]**

(Nearest integer)

32. When 10 mL of an aqueous solution of $Fe^{2+}$ ions was titrated in the presence of dil $H_2SO_4$ using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing $Fe^{2+}$ ions is $x \times 10^{-2}$ M. The value of x is _____. (Nearest integer) **[JEE (Main)-2021]**

33. Identify the process in which change in the oxidation state is five : **[JEE (Main)-2021]**

(1) $C_2O_4^{2-} \rightarrow 2CO_2$

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

(3) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

(4) $CrO_4^{2-} \rightarrow Cr^{3+}$

34. The oxidation states of 'P' in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$, respectively are **[JEE (Main)-2021]**

(1) 5, 4 and 3 (2) 7, 5 and 6

(3) 6, 4 and 5 (4) 5, 3 and 4

35. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is _____ $\times 10^{-2}$ g/L.

(Round off to the Nearest Integer).

**[JEE (Main)-2021]**

36. When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _____ $\times 10^{-2}$. (Nearest integer)

[Atomic mass of K = 39, Mn = 55, O = 16]

**[JEE (Main)-2021]**

37. In which one of the following sets all species show disproportionation reaction?

**[JEE (Main)-2021]**

(1) $ClO_4^-, MnO_4^-, ClO_2^-$ and $F_2$

(2) $ClO_2^-, F_2, MnO_4^-$ and $Cr_2O_7^{2-}$

(3) $MnO_4^-, ClO_2^-, Cl_2$ and $Mn^{3+}$

(4) $Cr_2O_7^{2-}, MnO_4^-, ClO_2^-$ and $Cl_2$

38. 1 L aqueous solution of $H_2SO_4$ contains 0.02 m mol $H_2SO_4$. 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A), 0.01 m mol of $H_2SO_4$ are added. Total m mols of $H_2SO_4$ in the final solution is _____ × $10^3$ m mols.

**[JEE (Main)-2022]**

39. The neutralization occurs when 10 mL of 0.1M acid 'A' is allowed to react with 30 mL of 0.05 M base $M(OH)_2$. The basicity of the acid 'A' is_____.

[M is a metal] **[JEE (Main)-2022]**

40. Which one of the following is an example of disproportionation reaction? **[JEE (Main)-2022]**

(1) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(2) $MnO_4^- + 4H^+ + 4e^- \rightarrow MnO_2 + 2H_2O$

(3) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$

(4) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

41. A 2.0 g sample containing $MnO_2$ is treated with HCl liberating $Cl_2$. The $Cl_2$ gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of $MnO_2$ in the sample is _____. (Nearest integer)

[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16, I = 127, Na = 23, K = 39, S = 32]

**[JEE (Main)-2022]**

42. 0.01 M $KMnO_4$ solution was added to 20.0 mL of 0.05 M Mohr's salt solution through a burette. The initial reading of 50 mL burette is zero. The volume of $KMnO_4$ solution left in burette after the end point is _____ml. [nearest integer] **[JEE (Main)-2022]**

43. $SO_2Cl_2$ on reaction with excess of water results into acidic mixture

$$SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$$

16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture. The number of moles of $SO_2Cl_2$ used is

**[JEE (Main)-2022]**

(1) 16 (2) 8

(3) 4 (4) 2

44. Which of the given reactions is not an example of disproportionation reaction? **[JEE (Main)-2022]**

(1) $2H_2O_2 \rightarrow 2H_2O + O_2$

(2) $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

(3) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

(4) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

45. The dark purple colour of $KMnO_4$ disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is : **[JEE (Main)-2022]**

(1) 5 (2) 1

(3) 7 (4) 2

46. 20 mL of 0.02 M hypo solution is used for the titration of 10 mL of copper sulphate solution, in the presence of excess of KI using starch as an indicator. The molarity of $Cu^{2+}$ is found to be _____ × $10^{-2}$ M. [nearest integer]

Given : $2\,Cu^{2+} + 4\,I^- \rightarrow Cu_2I_2 + I_2$

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ **[JEE (Main)-2022]**

47. 20 mL of 0.02 M $K_2Cr_2O_7$ solution is used for the titration of 10 mL of $Fe^{2+}$ solution in the acidic medium. The molarity of $Fe^{2+}$ solution is _____×$10^{-2}$ M. (Nearest integer)

**[JEE (Main)-2022]**

48. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**.

**Assertion A:** Permanganate titrations are not performed in presence of hydrochloric acid.

**Reason R:** Chlorine is formed as a consequence of oxidation of hydrochloric acid.

In the light of the above statements, choose the ***correct*** answer from the options given below.

**[JEE (Main)-2022]**

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

49. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be **[JEE (Main)-2022]**

(1) 5 (2) 1

(3) 0 (4) 3

50. The normality of $H_2SO_4$ in the solution obtained on mixing 100 mL of 0.1 M $H_2SO_4$ with 50 mL of 0.1 M NaOH is _____ $\times 10^{-1}$ N. (Nearest Integer)

**[JEE (Main)-2022]**

51. In the titration of $KMnO_4$ and oxalic acid in acidic medium, the change in oxidation number of carbon at the end point is _____ **[JEE (Main)-2022]**

❑ ❑ ❑