GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

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CHAPTERWISE MULTIPLE CHOICE QUESTIONS FOR COMPETATIVE EXAM

SUBJECT: I PUC CHEMISTRY

NAME OF THE CHAPTER: UNIT: 07-REDOX REACTIONS

1. Redox reactions are those reactions in which oxidation and reduction takes place simultaneously

2. Classical view of redox reactions

Oxidation is addition of oxygen / electronegative element to a substance or removal of hydrogen / electropositive element from a substance

Reduction is removal of oxygen / electronegative element from a substance or addition of hydrogen / electropositive element to a substance

3. Redox reactions in terms of Electron transfer

Oxidation is defined as loss of electrons by any species

Reduction is defined as gain of electrons by any species

4. In oxidation reactions there is loss of electrons or increase in positive charge or decrease in negative charge

5. In reduction reactions there is gain of electrons or decrease in positive charge or increase in negative charge

6. Oxidizing agents are species which gain one or more electrons and get reduced themselves

7. Reducing agents are the species which lose one or more electrons and gets oxidized themselves

8. Oxidation number denotes the oxidation state of an element in a compound ascertained according to a set of rules. These rules are formulated on the basis that electron in a covalent bond belongs entirely to the more electronegative element.

9. Rules for assigning oxidation number to an atom

a) Oxidation number of Hydrogen is always +1 (except in hydrides, it is -1).

b) Oxidation number of oxygen in most of compounds is -2. In peroxides it is (-1). In superoxide, it is (-1/2). In OF_2 oxidation number of oxygen is +2. In O_2F_2 oxidation number of oxygen is +1

c) Oxidation number of Fluorine is -1 in all its compounds

d) For neutral molecules sum of oxidation number of all atoms is equal to zero

e) In the free or elementary state, the oxidation n umber of an atom is always zero. This is irrespective of its allotropic form

f) For ions composed of only one atom, the oxidation number is equal to the charge on the ion

g) The algebraic sum of the oxidation number of all the atoms in a compound must be zero

h) For ions the sum of oxidation number is equal to the charge on the ion

i) In a polyatomic ion, the algebraic sum of all the oxidation numbers of atoms of the ion must be equal to the charge on the ion

10. Oxidation state and oxidation number are often used interchangeably

11. According to Stock notation the oxidation number is expressed by putting a Roman numeral representing the oxidation number in parenthesis after the symbol of the metal in the molecular formula.

12. Types of Redox Reactions

a) Combination Reactions: Chemical reactions in which two or more substances (elements or compounds) combine to form a single substance.

b) Decomposition Reactions: Chemical reactions in which a compound breaks up into two or more simple substances

c) Displacement Reactions: Reaction in which one ion (or atom) in a compound is replaced by an ion (or atom) of another element

a. Metal Displacement Reactions: Reactions in which a metal in a compound is displaced by another metal in the uncombined state

b. Non-metal Displacement Reactions: Such reactions are mainly hydrogen displacement or oxygen displacement reactions

d) Disproportionation Reactions: Reactions in which an element in one oxidation state is simultaneously oxidized and reduced

13. Steps involved in balancing a Redox reaction by oxidation number method

a) Write the skeletal redox reaction for all reactants and products of the reaction

b) Indicate the oxidation number of all the atoms in each compound above the symbol of element

c) Identify the element/elements which undergo change in oxidation numbers

d) Calculate the increase or decrease in oxidation number per atom

e) Equate the increase in oxidation number with decrease in oxidation number on the reactant side by multiplying formula of oxidizing agent and reducing agents with suitable coefficients

f) Balance the equation with respect to all other atoms except hydrogen and oxygen

g) Finally balance hydrogen and oxygen. For balancing oxygen atoms add water molecules to the side deficient in it. Balancing of hydrogen atoms depend upon the medium

a. For reactions taking place in acidic solutions add H^+ ions to the side deficient in hydrogen atoms

b. For reactions taking place in basic solutions add H_2O molecules to the side deficient in hydrogen atoms and simultaneously add equal number of OH^- ions on the other side of the equation

e) Finally balance the equation by cancelling common species present on both sides of the equation

14. Steps involved in balancing a Redox by Ion-Electron Method (Half reaction method)

a) Find the elements whose oxidation numbers are changed. Identify the substance that acts as an oxidizing agent and reducing agent

b) Separate the complete equation into oxidation half reaction and reduction half reaction

c) Balance the half equations by following steps

i. Balance all atoms other than H and O

ii. Calculate the oxidation number on both sides of equation. Add electrons to whichever side is necessary to make up the difference

iii. Balance the half equation so that both sides get the same charge

iv. Add water molecules to complete the balancing of the equation

d) Add the two balanced equations. Multiply one or both half equations by suitable numbers so that on adding two equations the electrons are balanced

15. Application of Redox reactions: Redox Titrations

Potassium permanganate in redox reactions: Potassium permanganate ($KMnO_4$) is very strong oxidizing agent and is used in determination of many reducing agents like Fe^{2+}, oxalate ions etc. It acts as self-indicator in redox reactions.

Equation showing $KMnO_4$ as an oxidising agent in acidic medium is:

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

Acidified Potassium dichromate ($K_2Cr_2O_7$) in redox reactions: $K_2Cr_2O_7$ is used as an oxidizing agent in redox reactions. Titrations involving $K_2Cr_2O_7$ uses diphenylamine and potassium ferricyanide (external indicator).

Equation showing $K_2Cr_2O_7$ as an oxidising agent in acidic medium is:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

Iodine (I_2) in redox reactions: I_2 acts as mild oxidising agent in solution according to equation

$$I_2 + 2e^- \rightarrow 2I^-$$

16. Direct redox reaction: Redox reactions in which reduction and oxidation occurs in same solution (i.e., same reaction vessel). In these reactions transference of electrons is limited to very small distance.

17. Indirect redox reactions: Redox reactions in which oxidation and reduction reactions take place in different reactions vessels and thus transfer of electrons from one species to another does not take place directly

18. Electrochemical cell is a device that converts chemical energy produced in a redox reaction into electrical energy. These cells are also called Galvanic cells or Voltaic cells

19. The electrode at which oxidation occurs is called anode and is negatively charged

20. The electrode at which reduction takes place is called cathode and is positively charged

21. In an electrochemical cell the transfer of electrons takes place from anode to cathode

22. In an electrochemical cell the flow of current is from cathode to anode

23. In the electrochemical cell, the electrical circuit is completed with a salt bridge. Salt bridge also maintains the electrical neutrality of the two half cells

24. A salt bridge is a U-shaped tube filled with solution of inert electrolyte like sodium chloride or sodium sulphate which will not interfere in the redox reaction. The ions are set in a gel or agar agar so that only ions flow when inverted

25. Electrical potential difference developed between the metal and its solution is called electrode potential. It can also be defined as tendency of an electrode in a half cell to gain or lose electrons

26. Oxidation potential is the tendency of an electrode to lose electrons or to get oxidized

27. Reduction potential is the tendency of an electrode to gain electrons or get reduced

28. In an electrochemical cell, by the present convention, the electrode potentials are represented as reduction potential

29. The electrode having a higher reduction potential will have a higher tendency to gain electrons

30. By convention, the standard electrode potential of hydrogen electrode is 0.00 volts

31. A redox couple is defined as having together oxidized and reduced forms of a substance taking part in an oxidation or reduction half reaction

32. The difference between the electrode potentials of eth two electrodes constituting the electrochemical cell is called EMF (Electromotive force) or the cell potential

33. EMF = E^o cathode - E^o anode

34. A negative E^o means that the redox couple is a stronger reducing agent

than the H^+/H_2 couple

35. A positive E^o means that the redox couple is a weaker reducing agent than

the H^+/H_2 couple

1. Which quantities are conserved in all oxidation reduction reaction?
   (a) Charge only (b) Mass only
   (c) Both charges and mass (d)Neither charge nor mass
2. In the reaction $H_2S + NO_2 \rightarrow H_2O + NO + S.H_2S$ ion is oxidised to
   (a) oxidised (b) reduced
   (c) precipitated (d)None of these
3. The conversion of sugar $C_{12}H_{22}O_{11} \rightarrow CO_2$ is following statements is false?
   (a) oxidation (b) reduction
   (c) Both oxidation and reduction (d) Neither oxidation nor reduction
4. The product of oxidation of I^- with MnO_4^- in alkaline medium is
   (a) IO^- (b) IO_3^-
   (c) IO_4^- (d) I_2
5. In the following reaction, which is the species being oxidized I^-?
   $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow I_2(aq) + 2Fe^{2+}(aq)$
   (a) Fe^{3+} (b) I^-
   (c) I_2 (d) Fe^{2+}
6. The compound that can work both as an oxidising as well as a reducing agent is
   (a) $KMnO_4$ (b) H_2SO_4
   (c) BaO_2 (d)H_2O_2
7. Which of the following substances acts as an oxidising as well as a reducing agent?
   (a) Na_2O (b) $SnCl_2$

(c) Na_2O_2 (d)$NaNO_2$

8. In the reaction $2FeCl_3 + H_2S \rightarrow 2FeCl_2 + 2HCl + S$

(a) $FeCl_3$acts as an oxidising agent. (b) Both H_2S and $FeCl_3$are oxidised.

(c) $FeCl_3$is oxidised while H_2S is reduced. (d) H_2S acts as an oxidising agent.

9. When iron is rusted, it is

(a) oxidised (b) reduced

(c) evaporated (d)decomposed

10. Which of the following is not an intermolecular redox reaction?

(a) $MgCO_3 \rightarrow MgO + CO_2$ (b) $O_2 + 2H_2 \rightarrow 2H_2O$

(c) $K + H_2O \rightarrow KOH + (1/2)H_2$ (d) $MnBr_3 \rightarrow MnBr_2 + (1/2)Br_2$

11. In the reaction $3Mg + N_2 \rightarrow Mg_3N_2$

(a) magnesium is reduced (b)magnesium is oxidized

(c) nitrogen is oxidized (d)None of these

12. One gas bleach the colour of flowers by reduction, while the other by oxidation

(a) CO and Cl_2 (b) $SO_2$and Cl_2

(c) H_2S and Br_2 (d)$NH_3$and SO_2

13. In reaction of $KMnO_4$and Mohr's salt, $FeSO_4$is oxidised to

(a) Fe^{2+} (b) Fe^{3+}

(c) Fe (d)All of these

14. Match the following Column-I with Column-II

Column-I	**Column-II**
(1) $2Mg + O_2 \rightarrow 2MgO$	(p) Removal of hydrogen
(2) $Mg + Cl_2 \rightarrow MgCl_2$	(q)Removal of electropositive element
(3) $2H_2S + O_2 \rightarrow 2S + 2H_2O$	(r) Addition of oxygen
(4) $2KI + H_2O + O_3 \rightarrow 2KOH + I_2 + O_2$	(s) Addition of electronegative element, chlorine

(a) A – (s), B – (q), C – (p), D – (r) (b) A – (r), B – (s), C – (p), D – (q)
(c) A – (s), B – (r), C – (q), D – (p) (d) A – (r), B – (p), C – (s), D – (q)

TOPIC 2: Oxidation Number

15. The oxidation number of chromium in potassium dichromate is

(a) + 6 (b) – 5

(c) – 2 (d)+ 2

16. Phosphorus has the oxidation state of + 3 in

(a) phosphorous acid (b) orthophosphoric acid

(c) hypophosphorous acid (d)metaphosphoric acid.

17. In which of the following reactions, nitrogen undergoes change in oxidation state?

(a) $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ (b) $2NO_2 \rightarrow N_2O_4$

(c) $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$ (d) $N_2O_5 + H_2O \rightarrow 2HNO_3$

18. The brown ring complex compound is formulated as $[Fe(H_2O)_5(NO)]SO_4$. The oxidation state of iron is

(a) 1 (b) 2

(c) 3 (d) 0

19. The pair of compounds in which both the metals are in the highest possible oxidation state is

(a) $\left[Fe(CN)_4\right]^{4-}, \left[Co(CN)_6\right]^{3-}$ (b) CrO_2Cl_2, MnO_4^-

(c) TiO_3, MnO_2 (d) $\left[Co(CN)_6\right]^{3-}, MnO_3$

20. The oxidation number of Sin $S_2O_8^{2-}$ is

(a) +2 (b) +4

(c) +6 (d) +7

21. The oxidation number of oxygen in O_2PtF_6 is

(a) –0.5 (b) Zero

(c) +0.5 (d) +1

22. In which of the following compounds, iron has lowest oxidation state?

(a) $K_3[Fe(CN)_6]$ (b) $K_4[Fe(CN)_6]$

(c) $FeSO_4.(NH4)_2SO_4.6H_2O$ (d)$Fe(CO)_5$

23. In which of the following compounds does manganese exhibit the highest oxidation state?

(a) MnO_2 (b) Mn_3O_4

(c) K_2MnO_4 (d)$MnSO_4$

24. On reduction of $KMnO_4$by oxalic acid in acidic medium, the oxidation number of Mn changes,

(a) From 7 to 2 (b)From 6 to 2

(c) From 5 to 2 (d)From 7 to 4

25. When $SO_2$is passed into an acidified potassium dichromate solution, the oxidation numbers of sulphur and chromium in the final products respectively are

(a) +6, +6 (b) +6, +3

(c) 0, +3 (d)+2, +3

26. In which of the following coordination compounds does the transition metal have an oxidation number of +6?

(a) $[Cr(H_2O)_5Cl]SO_4$ (b) $Cr\left[\eta^6 - C_6H_6\right]_2$

(c) $K_2\left[Cr(CN)_2O_2(O_2)NH_3\right]$ (d)$\left[Cr(NH_3)_4(SCN)_2\right]\left[CR(NH_3)_2(SCN)_4\right]$

27. In which of the following transition metal complexes does the metal exhibit zero oxidation state?

(a) $\left[Co(NH_3)_6\right]Cl_3$ (b) $\left[Fe(H_2O)_6\right]SO_4$

(c) $Ni(CO)_4$ (d)$[Fe(H_2O)_6]X_3$

28. Oxidation numbers of chlorine atoms in $CaOCl_2$are

(a) 0, 0 (b) –1, –1

(c) –1, +1 (d)None of these

29. The oxide, which cannot act as a reducing agent, is

(a) NO_2 (b) SO_2

(c) CO_2 (d)ClO_2

30. Point out the correct statement of the following about$Na_2S_4O_6$.

(a) Average oxidation number of S atom is +2

(b) Oxidation number of two S atoms is zero each and that of other two is +5 each

(c) Oxidation number of two S atoms is +1 each and that of other two is +4 each

(d)None of these

31. The oxidation state of the most electronegative element in the products of the reaction between $BaO_2$and $H_2SO_4$are

(a) 0 and –1 (b) –1 and – 2

(c) – 2 and 0 (d)– 2 and +1

32. When ethane is burnt in presence of excess of oxygen, the oxidation number of carbon changes by

(a) +8 (b) +7

(c) +3 (d) +4

TOPIC 3: Disproportionation and Balancing of Redox Reactions

33. Which of the following is not a redox reaction?

(a) $4KClO_3 \rightarrow 3KClO_4 + KCl$ (b) $Na_2O + 2HCl \rightarrow 2NaCl + H_2O$

(c) $SO_2 + 2H_2S \rightarrow 2H_2O + 3S$ (d) $2Na + O_2 \rightarrow Na_2O_2$

34. For the reaction: $NH_3 + OCl^- \rightarrow N_2H_4 + Cl^-$ in basic medium, the coefficients of NH_3, OCl^- and N_2H_4 for the balanced equation are respectively.

(a) 2, 2, 2 (b) 2, 2, 1

(c) 2, 1, 1 (d)4, 4, 2

35. In the reaction, $Cl_2 + 2OH^- \rightarrow OCl^- + Cl^- + H_2O$

(a) OH^- is oxidising and Cl_2 is reducing agent (b) Cl_2 is oxidising and OH^- is reducing agent

(c) OH^- is both oxidising and reducing agent (d) Cl_2 is both oxidising and reducing agent

36. When phosphorous reacts with caustic soda, the products are $PH_3$and NaH_2PO_2. This reaction is an example of

(a) oxidation (b) reduction

(c) disproportionation (d)none of these

37. $KMnO_4$oxidises oxalic acid in acidic medium. The number of CO_2molecules produced as per the balanced equation is

(a) 10 (b) 8

(c) 6 (d) 3

38. Which of the following does not represent redox reaction?

(a) $2Ca(OH)_2 + Cl_2 \rightarrow Ca(ClO)_2 + CaCl_2 + 2H_2O$

(b) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

(c) $NaIO_3 + NaHSO_3 \rightarrow NaHSO_4 + Na_2SO_4 + I_2 + H_2O$

(d) $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

39. Amongst the following, the strongest oxidising agent is

(a) $KMnO_4$ (b) $K_2Cr_2O_7$

(c) H_2O_2 (d)O_3

40. Number of moles of $K_2Cr_2O_7$reduced by one mole of Sn^{2+}ions is

(a) 1/3 (b) 3

(c) 1/6 (d)6

41. The reaction $3ClO^-(aq) \rightarrow ClO_3^-(aq) + 2Cl^-(aq)$ is an example of -

(a) Oxidation reaction (b) Reduction reaction

(c) Disproportionation reaction (d)Decomposition reaction

42. The species that undergoes disproportionation in an alkaline medium are

(a) Cl_2 (b) MnO_4^{2-}

(c) NO_2 (d)All of these

43. What products are expected from the disproportionation reaction of hypochlorous acid?

(a) HCl and Cl_2O (b) HCl and $HClO_3$

(c) $HClO_3$and Cl_2O (d)$HClO_2$and $HClO_4$

44. Amongst the following which can act as an oxidising as well as reducing agent?

(a) F_2 (b) SO_3

(c) H_2O_2 (d)H_2O

45. The number of electrons lost in the following change is $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

(a) 2 (b) 4

(c) 6 (d) 8

46. In which of the following reactions, SO_2behaves as an oxidising agent?

(a) $2MnO_4^- + 5SO_2 + 2H_2O \rightarrow 5SO_4^{2-} + 2Mn^{2+} + 4H^+$ (b) $Cl_2 + SO_2 \rightarrow SO_2Cl_2$

(c) $2H_2S + SO_2 \rightarrow 3S + 2H_2O$ (d) $SO_2 + H_2O \rightarrow H_2SO_3$

47. The oxidation numbers of C-1, C-2 and C-3 in propyne $\left(\overset{3}{\mathrm{C}}\mathrm{H}_3\overset{2}{\mathrm{C}}\equiv\overset{1}{\mathrm{C}}\mathrm{H}\right)$ respectively are

(a) –1, 0, –3
(b) –1, 1, –4
(c) –2, 0, –3
(d) +1, -2, -3

TOPIC 4: Electrode Potential

48. Standard reduction potentials of the half reactions are given below:

$F_2(g) + 2e^- \rightarrow 2F^-(aq);\ E° = +2.85\ V$
$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq);\ E° = +1.36\ V$
$Br_2(l) + 2e^- \rightarrow 2Br^-(aq);\ E° = +1.06\ V$
$I_2(s) + 2e^- \rightarrow 2I^-(aq);\ E° = +0.53\ V$

The strongest oxidising and reducing agents respectively are:

(a) F_2 and I^-
(b) Br_2 and Cl^-
(c) Cl_2 and Br^-
(d) Cl_2 and I_2

49. Standard electrode potentials of redox couples

A^{2+}/A, B^{2+}/B, C^{2+}/C and D^{2+}/D are 0.3 V, – 0.5 V, – 0.75 V and 0.9 V respectively. Which of these is good oxidising agent and reducing agent respectively:

(a) D^{2+}/D and B^{2+}/B
(b) B^{2+}/B and D^{2+}/D
(c) D^{2+}/D and C^{2+}/C
(d) C^{2+}/C and D^{2+}/D

50. The standard electrode potentials of four elements A, B, C and D are –3.05, –1.66, –0.40 and +0.80.

The highest chemical reactivity will be exhibited by:

(a) A
(b) B
(c) C
(d) D

KEY ANSWERS

1	c	11	b	21	c	31	b	41	c
2	a	12	b	22	d	32	b	42	d
3	a	13	b	23	c	33	b	43	b
4	b	14	b	24	a	34	c	44	c
5	b	15	a	25	b	35	d	45	d
6	d	16	a	26	c	36	c	46	c
7	d	17	c	27	c	37	a	47	a
8	a	18	a	28	c	38	b	48	a
9	a	19	b	29	c	39	d	49	c
10	a	20	c	30	b	40	a	50	a

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