1. What is the correct order of spin only magnetic moment (in BM) of Mn^{2+}, Cr^{2+} and V^{2+} ?
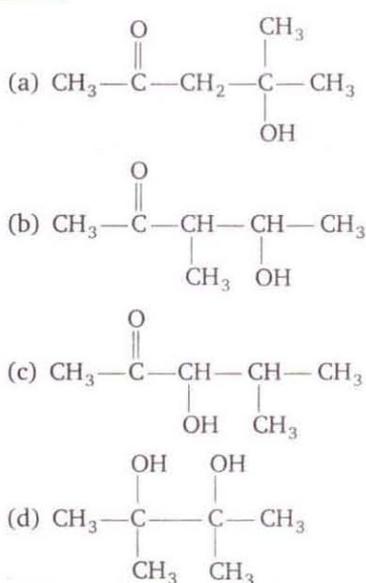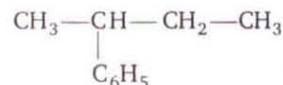   (a) $Mn^{2+} > V^{2+} > Cr^{2+}$
   (b) $V^{2+} > Cr^{2+} > Mn^{2+}$
   (c) $Mn^{2+} > Cr^{2+} > V^{2+}$
   (d) $Cr^{2+} > V^{2+} > Mn^{2+}$

2. Which of the following is used for making optical instruments ?
   (a) SiO_2
   (b) Si
   (c) SiH_4
   (d) SiC

3. Which of the following is not correct ?
   (a) $3O_2 \xrightleftharpoons[\text{discharge}]{\text{Silent electric}} 2O_3; \Delta H = -284.5 \text{ kJ}$
   (b) Ozone undergoes addition reaction with unsaturated carbon compounds
   (c) Sodium thiosulphate reacts with I_2 to form sodium tetrathionate and sodium iodide
   (d) Ozone oxidises lead sulphide to lead sulphate

4. Which of the following reactions can produce aniline as main product ?
   (a) $C_6H_5NO_2 + Zn/KOH$
   (b) $C_6H_5NO_2 + Zn/NH_4Cl$
   (c) $C_6H_5NO_2 + LiAlH_4$
   (d) $C_6H_5NO_2 + Zn/HCl$

5. Which of the following reagents when heated with ethyl chloride, forms ethylene ?
   (a) Aqueous KOH
   (b) Zn/HCl
   (c) Alcoholic KOH
   (d) HI

6. The energy of a photon is 3×10^{-12} erg. What is its wavelength in nm ?
   ($h = 6.62 \times 10^{-27}$ erg-s; $c = 3 \times 10^{10}$ cm/s)
   (a) 662
   (b) 1324
   (c) 66.2
   (d) 6.62

7. What is the time (in sec) required for depositing all the silver present in 125 mL of 1 M $AgNO_3$ solution by passing a current of 241.25 A ? (1F = 96500 C)
   (a) 10
   (b) 50
   (c) 1000
   (d) 100

8. The disperse phase, dispersion medium and nature of colloidal solution (lyophilic or lyophobic) of 'gold sol' respectively, are
   (a) solid, solid, lyophobic
   (b) liquid, liquid, lyophobic
   (c) solid, liquid, lyophobic
   (d) solid, liquid, lyophilic

9. The rate constant of a first order reaction at $27°C$ is 10^{-3} min^{-1}. The temperature coefficient of this reaction is 2. What is the rate constant (in min^{-1}) at $17°C$ for this reaction ?
   (a) 10^{-3}
   (b) 5×10^{-4}
   (c) 2×10^{-3}
   (d) 10^{-2}

10. A solution of an acid has $[H^+] = 2 \times 10^{-5}$. Find out the concentration of OH^- ions.
    (a) 5×10^{-10} N
    (b) 4×10^{-10} N
    (c) 2×10^{-5} N
    (d) 9×10^{-4} N

11. Which of the following is added to chloroform to slow down its aerial oxidation in presence of light ?
    (a) Carbonyl chloride
    (b) Ethyl alcohol
    (c) Sodium hydroxide
    (d) Nitric acid

12. Which of the products is formed when acetone is reacted with barium hydroxide solution ?

(a)
$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$$

(b)
$$CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{|}{\underset{CH_3}{|}}}{CH}-\overset{\overset{|}{\underset{OH}{|}}}{CH}-CH_3$$

(c)
$$CH_3-\overset{\overset{O}{\|}}{C}-\overset{\overset{|}{\underset{OH}{|}}}{CH}-\overset{\overset{|}{\underset{CH_3}{|}}}{CH}-CH_3$$

(d)
$$CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$$

13. When acetaldehyde is heated with Fehling solution, a red precipitate is formed. Which of the following is that ?
(a) Cu_2O (b) Cu
(c) CuO   (d) $CuSO_4$

14. What is the correct order of occurrence (% by weight) in air of Ne, Ar and Kr ?
(a) Ne > Ar > Kr   (b) Ar > Ne > Kr
(c) Ar > Kr > Ne   (d) Ne > Kr > Ar

15. Which of the following compounds when heated with CO at 150°C and 500 atm pressure in presence of BF_3 forms ethyl propionate ?
(a) C_2H_5OH (b) CH_3OCH_3
(c) $C_2H_5OC_2H_5$ (d) $CH_3OC_2H_5$

16. Identify the reaction for which $\Delta H \neq \Delta E$.
(a) S (rhombic) $+ O_2(g) \longrightarrow SO_2(g)$
(b) $N_2(g) + O_2(g) \longrightarrow 2NO(g)$
(c) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$
(d) $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$

17. Hydrolysis of NCl_3 gives NH_3 and X. Which of the following is X ?
(a) $HClO_4$ (b) $HClO_3$
(c) HOCl   (d) $HClO_2$

18. What are the metal ions present in carnallite ?
(a) Mg, K   (b) Al, Na
(c) Na, Mg   (d) Zn, Mg

19. Ethyl chloride reacts with sodium ethoxide to form a compound A. Which of the following reactions also yields A ?
(a) C_2H_5Cl, KOH (alc.), Δ
(b) $2C_2H_5OH$, conc. H_2SO_4, 140°C
(c) C_2H_5Cl, Mg (dry ether)
(d) C_2H_2 dil. H_2SO_4, $HgSO_4$

20. The number of sigma and pi (π) bonds present in benzene respectively are
(a) 12, 6   (b) 6, 6
(c) 6, 12   (d) 12, 3

21. Edge length of a cube is 400 pm, its body diagonal would be
(a) 566 pm   (b) 600 pm
(c) 500 pm   (d) 693 pm

22. The number of α-particles emitted by $_{84}Ra^{218} \longrightarrow _{82}Pb^{206}$ is
(a) 3   (b) 4
(c) 6   (d) 2

23. The IUPAC name of the following compound is
$$CH_3-\overset{\overset{|}{\underset{C_6H_5}{|}}}{CH}-CH_2-CH_3$$
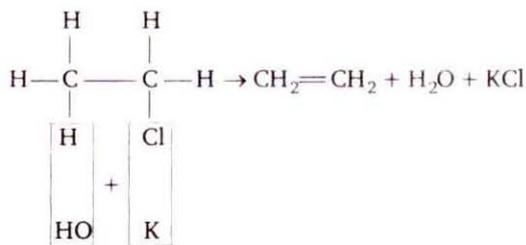(a) 2-cyclohexylbutane
(b) sec-butylbenzene
(c) 3-cyclohexylbutane
(d) 2-phenylbutane

24. The reaction of primary amine with chloroform and ethanolic solution of KOH is called
(a) Hofmann's reaction
(b) Reimer-Tiemann's reaction
(c) Carbylamine reaction
(d) Kolbe's reaction

25. 0.01 mole of a non-electrolyte is dissolved in 10 g of water. The molality of the solution is
(a) 0.1 m   (b) 0.5 m
(c) 1.0 m   (d) 0.18 m

26. Atoms with same atomic number and different mass numbers are called
(a) isobars   (b) isomers
(c) isotones   (d) isotopes

27. The shape of the orbital with the value of $l = 2$ and $m = 0$ is
(a) spherical   (b) dumb-bell
(c) trigonal planar (d) square-planar

28. In the following, the element with the highest ionisation energy is
    (a) $[Ne]\, 3s^2\, 3p^1$ (b) $[Ne]\, 3s^2 3p^3$
    (c) $[Ne]\, 3s^2 3p^2$ (d) $[Ne]\, 3s^2 3p^4$

29. In the conversion of Br_2 to BrO_3^-, the oxidation number of Br changes from
    (a) zero to +5   (b) +1 to +5
    (c) zero to –3   (d) +2 to +5

30. Among the alkali metals cesium is the most reactive because
    (a) its incomplete shell is nearest to the nucleus
    (b) it has a single electron in the valence shell
    (c) it is the heaviest alkali metal
    (d) the outermost electron is more loosely bound than the outermost electron of the other alkali metals

31. Which of the following represents the Lewis structure of N_2 molecule ?
    (a) ${}_x^x N \equiv N_x^x$ (b) ${}_x^x N \equiv N_x^x$
    (c) ${}_x^x N_x^x{-}N_x^x$ (d) ${}_x^x N \equiv N_x^x$

32. Hydrogen bond is strongest in
    (a) S—H$\cdots$O   (b) O—H$\cdots$S
    (c) F—H$\cdots$F   (d) O—H$\cdots$N

33. The density of a gas is 1.964 g dm^{-3} at 273 K and 76 cm Hg. The gas is
    (a) CH_4 (b) C_2H_6
    (c) CO_2 (d) Xe

34. The shape of PCl_3 molecule is
    (a) trigonal bipyramidal
    (b) tetrahedral
    (c) pyramidal
    (d) square planar

35. The concentration of a reactant X decreases from 0.1 M to 0.005 M in 40 min. If the reaction follows first order kinetics, the rate of the reaction when the concentration of X is 0.01 M will be
    (a) 1.73×10^{-4} M min^{-1}
    (b) 3.47×10^{-4} M min^{-1}
    (c) 3.47×10^{-5} M min^{-1}
    (d) 7.5×10^{-4} M min^{-1}

36. Which of the following does not conduct electricity ?
    (a) Fused NaCl   (b) Solid NaCl
    (c) Brine solution   (d) Copper

37. Solubility product of a salt AB is 1×10^{-8} M^2 in a solution in which the concentration of A^+ ions is 10^{-3} M. The salt will precipitate when the concentration of B^- ions is kept
    (a) between 10^{-8} M to 10^{-7} M
    (b) between 10^{-7} M to 10^{-8} M
    (c) $> 10^{-5}$ M
    (d) $< 10^{-8}$ M

38. The pH of 10^{-8} M HCl solution is
    (a) 8
    (b) more than 8
    (c) between 6 and 7
    (d) slightly more than 7

39. For a reaction to be spontaneous at all temperatures
    (a) ΔG and ΔH should be negative
    (b) ΔG and ΔH should be positive
    (c) $\Delta G = \Delta S = 0$
    (d) $\Delta H < \Delta G$

40. Which of the following electrolytes will have maximum flocculation value for $Fe(OH)_3$ sol ?
    (a) NaCl   (b) Na_2S
    (c) $(NH_4)_3PO_4$ (d) K_2SO_4

41. What is the order of a reaction which has a rate expression
    $$rate = k\,[A]^{3/2}[B]^{-1} ?$$
    (a) $\dfrac{3}{2}$ (b) $\dfrac{1}{2}$
    (c) 0   (d) $\dfrac{4}{2}$

42. Inductive effect involves
    (a) displacement of σ-electrons
    (b) delocalisation of π-electrons
    (c) delocalisation of σ-electrons
    (d) displacement of π-electrons

43. Which of the following compound is expected to be optically active ?
    (a) $(CH_3)_2CHCHO$
    (b) $CH_3CH_2CH_2CHO$
    (c) $CH_3CH_2CHBrCHO$
    (d) $CH_3CH_2CBr_2CHO$

$$\underset{\begin{array}{c}|\\ HO\end{array}}{\overset{\begin{array}{c}H\\|\\H-C\\|\\H\end{array}}{}} \underset{\begin{array}{c}|\\ K\end{array}}{\overset{\begin{array}{c}H\\|\\C-H\\|\\Cl\end{array}}{}} \rightarrow CH_2{=}CH_2 + H_2O + KCl$$

6.

$$E = 3 \times 10^{-12} \text{ erg}$$
$$\lambda = ?$$
$$h = 6.62 \times 10^{-27} \text{ erg-s}$$
$$c = 3 \times 10^{10} \text{ cm s}^{-1}$$
$$E = \frac{hc}{\lambda}$$
$$3 \times 10^{-2} = \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{\lambda}$$
$$\lambda = \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{3 \times 10^{-12}}$$
$$= 6.62 \times 10^{-5} \text{ cm}$$
$$= 662 \times 10^{-7} \text{ cm}$$
$$= 662 \times 10^{-9} \text{ m} = 662 \text{ nm}$$

7. Given, 125 mL of 1 M $AgNO_3$ solution. It means that

∵ 1000 mL of $AgNO_3$ solution contains
$$= 108 \text{ g Ag}$$
∴ 125 mL of $AgNO_3$ solution contains
$$= \frac{108 \times 125}{1000} \text{ g Ag}$$
$$= 13.5 \text{ g Ag}$$
∵ 108 g of Ag is deposited by $= 96500$ C
∴ 13.5 g of Ag is deposited by $= \frac{96500}{108} \times 13.5$
$$= 12062.5 \text{ C}$$

$$Q = it$$
or $$t = \frac{Q}{i} = \frac{12062.5}{241.25} = 50$$

8. Colloidal solution of gold is obtained when dispersed phase is solid and dispersion medium is liquid.

Substances like metals cannot be brought into the colloidal state simply by bringing them in contact with water and therefore, special methods are devised for the purpose. Hence, they are known as hydrophobic or lyophobic colloids.

9. Temperature coefficient $= \dfrac{k_{t+10}}{k_t}$

$$2 = \frac{10^{-3}}{k_t}$$
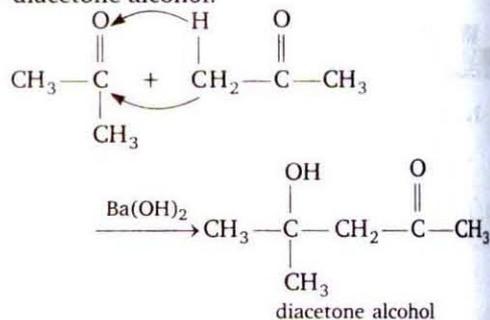$$k_t = \frac{10^{-3}}{2} = \frac{10 \times 10^{-4}}{2} = 5 \times 10^{-4}$$

10.
$$[H^+][OH^-] = K_w$$
$$2 \times 10^{-5} \times [OH^-] = 1 \times 10^{-14}$$
$$[OH^-] = \frac{1 \times 10^{-14}}{2 \times 10^{-5}}$$
$$= 0.5 \times 10^{-9}$$
$$= 5 \times 10^{-10}$$

11. Ethyl alcohol is used as a negative catalyst for the aerial oxidation of chloroform in presence of light. So, ethyl alcohol is added to chloroform.

12. When treated with $Ba(OH)_2$, acetone undergoes aldol condensation to form diacetone alcohol.

$$CH_3{-}\underset{\underset{CH_3}{|}}{\overset{\overset{O}{\|}}{C}} + CH_2{-}\overset{\overset{O}{\|}}{C}{-}CH_3$$

$$\xrightarrow{Ba(OH)_2} CH_3{-}\underset{\underset{CH_3}{|}}{\overset{\overset{OH}{|}}{C}}{-}CH_2{-}\overset{\overset{O}{\|}}{C}{-}CH_3$$
diacetone alcohol

13. When acetaldehyde is heated with Fehling solution, a red precipitate of Cu_2O is obtained.
$$CH_3CHO + 2Cu(OH)_2 + NaOH \longrightarrow$$
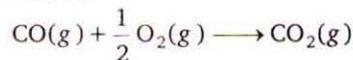$$CH_3COONa + \underset{red}{Cu_2O\downarrow} + 3H_2O$$
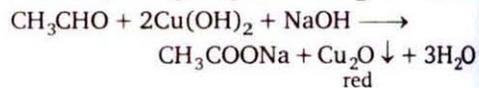
14. The correct order of occurrence in air is
$$Ar > Ne > Kr$$

15. Diethyl ether when heated with CO at 150°C and 500 atm pressure in presence of BF_3 forms ethyl propionate.
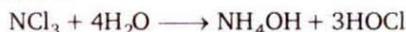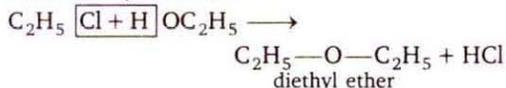
$$C_2H_5OC_2H_5 + CO \xrightarrow[500 \text{ atm}]{150°C\,\Delta} \underset{\text{ethyl propionate}}{C_2H_5COOC_2H_5}$$
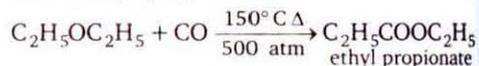
16. $\Delta H \neq \Delta E$ for
$$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$$
as $\Delta n \neq 0$

17. Hydrolysis of NCl_3 gives NH_3 or NH_4OH and $HClO$ as

$$NCl_3 + 4H_2O \longrightarrow NH_4OH + 3HOCl$$
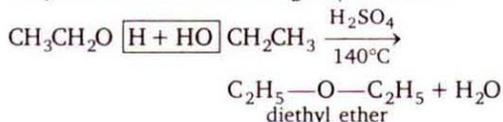
18. Formula of carnallite is $KCl \cdot MgCl_2 \cdot 6H_2O$, so carnallite contains K and Mg.

19. Ethyl chloride reacts with sodium ethoxide to form diethyl ether as

$$C_2H_5 \boxed{Cl + H} OC_2H_5 \longrightarrow$$
$$\underset{\text{diethyl ether}}{C_2H_5-O-C_2H_5} + HCl$$

Diethyl ether is also obtained by reaction of ethyl alcohol with conc H_2SO_4 at 140°C.

$$CH_3CH_2O \boxed{H + HO} CH_2CH_3 \xrightarrow[140°C]{H_2SO_4}$$
$$\underset{\text{diethyl ether}}{C_2H_5-O-C_2H_5} + H_2O$$

20. In benzene 12σ and 3π bonds are present. The structure of benzene is
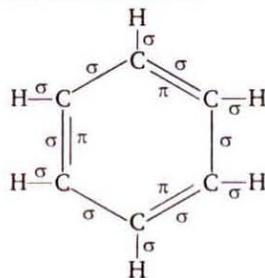
21. Length of body diagonal $= a\sqrt{3}$

where 'a' = edge length
$$= 400\sqrt{3}$$
$$= 692.82 \text{ pm}$$
$$\approx 693 \text{ pm}$$

22. Number of α-particles

$$= \frac{\text{change in atomic mass}}{4}$$
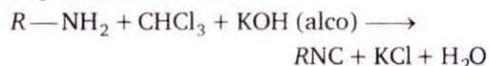$$= \frac{218 - 206}{4} = \frac{12}{4} = 3$$

23.

or
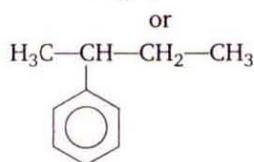
sec-butyl benzene

24. Primary amine reacts with chloroform and ethanolic solution of KOH to give respective isocyanides. This reaction is known as carbylamine reaction.
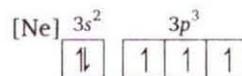
$$R-NH_2 + CHCl_3 + KOH \text{ (alco)} \longrightarrow$$
$$RNC + KCl + H_2O$$

25. Molality $(m) = \dfrac{\text{number of moles of solute}}{\text{weight of solvent in kg}}$

$$= \frac{0.01}{10 \times 10^{-3}}$$
$$= \frac{0.01 \times 10^3}{10}$$
$$= 1 \text{ m}$$

26. Isotopes have the same atomic number but different mass numbers eg, $_1H^1, _1H^2, _1H^3$ are the isotopes of hydrogen.

27. For s, p, d and f orbitals, the value of l are respectively, 0, 1, 2 and 3. Thus,

If $l = 2$, then the orbital is d, which is dumb-bell shaped.

28.

Elements having half-filled or fully filled orbitals are more stable. Hence, much energy is required to remove an electron from the outermost orbit. So, the element with $[Ne] \, 3s^2 3p^3$ configuration has highest ionisation energy.

29. Bromine has zero oxidation state because it is in free state
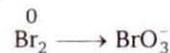
$$\overset{0}{Br_2} \longrightarrow BrO_3^-$$
$$BrO_3^-$$
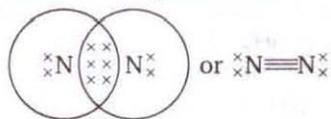$$x + (-2 \times 3) = -1$$
$$x + (-6) = -1$$
$$x = +6 - 1$$
$$= +5$$

So, oxidation number changes from 0 to +5.

30. Alkali metals have a tendency to lose the single valence electron and form positive ions and gain inert gas configuration but in case of cesium, the distance of the valence electron is maximum. So, force of attraction by the nucleus is least, hence it is more reactive.

31. Lewis structure of N_2 molecule is

32. When hydrogen forms hydrogen bond with fluorine, it will be strongest H-bonding because fluorine is strongest electronegative element.

33. We know that

$$pV = nRT$$

or

$$pV = \frac{w}{M} RT$$

or

$$M = \frac{w}{V} \frac{RT}{p}$$

or

$$M = d \frac{RT}{p}$$

$$d = 1.964 \, g/dm^3 = 1.964 \times 10^{-3} \, g/cc$$

$$p = 76 \, cm = 1 \, atm$$

$$R = 0.0821 \, L \, atm \, K^{-1} \, mol^{-1}$$

$$= 82.1 \, cc \, atm \, K^{-1} \, mol^{-1}$$

$$T = 273 \, K$$

$$M = \frac{1.964 \times 10^{-3} \times 82.1 \times 273}{1} = 44$$

The molecular weight of CO_2 is 44.
So, the gas is CO_2.

34.

$3bp + 1lp = sp^3$ hybridisation

pyramidal (due to presence of one lone pair of electron)

35.

$$k = \frac{2.303}{t} \log \frac{A_0}{A}$$

$$= \frac{2.303}{40} \log \frac{0.1}{0.005}$$

$$= \frac{2.303}{40} \log 20 = 0.075$$

Rate of reaction when concentration of X is 0.01 M will be

$$= 0.075 \times 0.01 = 7.5 \times 10^{-4} \, M \, min^{-1}$$

36. Solid NaCl does not conduct electricity due to absence of free ions.

37. A salt is precipitated only when the product of ionic concentration is more than its solubility product.

$$K_{sp} = 1 \times 10^{-8}$$

$$[A^+] = 10^{-3} \, M$$

$$[B^-] = \frac{1 \times 10^{-8}}{10^{-3}} = 10^{-5} \, M$$

So, AB will be precipitated only when the concentration of $[B^-]$ is more than 10^{-5} M.

38. From H_2O, $[H^+] = 1 \times 10^{-7}$ M
From HCl, $[H^+] = 1 \times 10^{-8}$ M

$$Total \, [H^+] = (1 \times 10^{-7} + 1 \times 10^{-8}) \, M$$

$$= (1 \times 10^{-7} + 0.1 \times 10^{-7}) \, M$$

$$= 1.1 \times 10^{-7} \, M$$

$$pH = -\log (1.1 \times 10^{-7})$$

$$= 6.9586$$

39. $\Delta G = \Delta H - T\Delta S$

For a reaction to be spontaneous ΔG must be negative. If ΔG and ΔH are negative, then reaction will be spontaneous at all temperature.

40. Flocculation value $\propto \dfrac{1}{coagulating \, power}$

$Fe(OH)_3$ is a positively charged sol.

To coagulate $Fe(OH)_3$, $-ve$ charged electrolyte is used and greater the value of $-ve$ charge, coagulating power will be strong. Among the given electrolytes, NaCl has lowest coagulating power, so its flocculation value will be maximum.
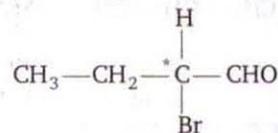
41. Rate $= k[A]^{3/2} [B]^{-1}$

Order $= \dfrac{3}{2} - 1 = \dfrac{1}{2}$

42. During inductive effect shifting of σ electrons takes place due to which partial charges are developed on the atom.
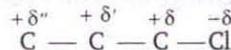

43. Compounds having asymmetric C-atom are optically active eg,
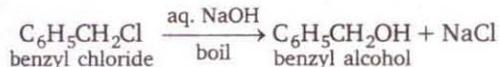

$(\overset{*}{C} = $ asymmetric C-atom$)$

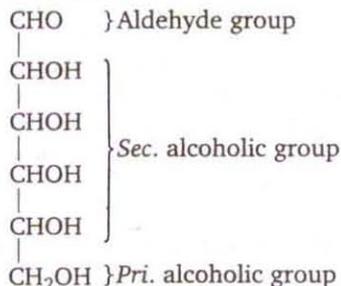The C-atom whose four valencies are satisfied by four different groups is called asymmetric C-atom.

44. —OH group is converted into —Cl group by $SOCl_2$ or anhy $ZnCl_2$/conc HCl or HCl etc.

45. **Reimer-Tiemann reaction :** In this reaction phenol reacts with chloroform and alkali to form salicylaldehyde.

salicylaldehyde
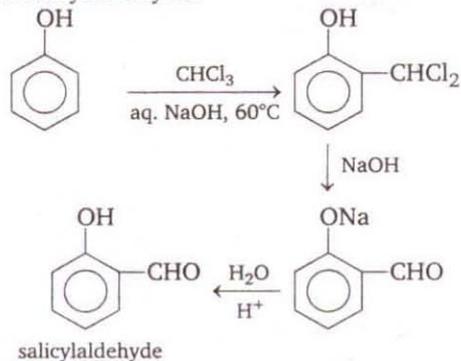
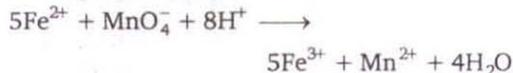46. Benzyl chloride on hydrolysis gives benzyl alcohol.

$$C_6H_5CH_2Cl \xrightarrow[\text{boil}]{\text{aq. NaOH}} C_6H_5CH_2OH + NaCl$$
benzyl chloride → benzyl alcohol

47. Structure of glucose is

CHO } Aldehyde group
|
CHOH ⎤
|
CHOH ⎥
| ⎬ Sec. alcoholic group
CHOH ⎥
|
CHOH ⎦
|
CH_2OH } Pri. alcoholic group

48. Mohr's salt is $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$.
The equation is :

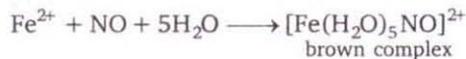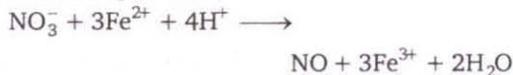$$5Fe^{2+} + MnO_4^- + 8H^+ \longrightarrow$$
$$5Fe^{3+} + Mn^{2+} + 4H_2O$$

Total change in oxidation number of iron
$$= (+3) - (+2)$$
$$= +1$$

So, equivalent wt. of Mohr's salt

$$= \frac{\text{Mol. wt. of Mohr's salt}}{1}$$
$$= \frac{392}{1}$$
$$= 392$$

49. The brown ring is obtained due to the formation of pentaaquanitrosonium ion. In this reaction reduction of nitrate ion by Fe^{2+} ion takes places as

$$NO_3^- + 3Fe^{2+} + 4H^+ \longrightarrow$$
$$NO + 3Fe^{3+} + 2H_2O$$

$$Fe^{2+} + NO + 5H_2O \longrightarrow [Fe(H_2O)_5NO]^{2+}$$
brown complex

50. Molecules having maximum number of ions will have maximum value of boiling point. In the given options, 0.01 M Na_2SO_4 contains maximum number of ions. So, 0.01 M Na_2SO_4 has highest boiling point.