DAY THIRTY NINE

Mock Test 2

Instruction

- This question paper contains of 50 Multiple Choice Questions of Chemistry, divided into two Sections; section A and section B.
- Section A contains 35 questions and all questions are compulsory.
- Section B contains 15 questions out of which only 10 questions are to be attempted.
- Each question carries 4 marks.

Section-A

1 Which of the following is the strongest Lewis acid?

(a) BI_3 (b) BBr_3
(c) BCl_3 (d) BF_3

2 **Assertion** Zn^{2+} is diamagnetic.
Reason The electrons are lost from 4*s* orbital to form Zn^{2+}.

(a) Assertion and Reason are true and Reason is the correct explanation for Assertion.
(b) Assertion and Reason are true and Reason is not the correct explanation for Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

3 The correct order of acidic strength of the following compounds is

(a) $Cl_2O_7 > SO_2 > P_4O_{10}$ (b) $K_2O > CaO > MgO$
(c) $CO_2 > N_2O_5 > SO_3$ (d) $Na_2O > MgO > Al_2O_3$

4 Which of the following iron salts exists as a dimer?

(a) Ferric chloride (b) Ferrous chloride
(c) Ferrous sulphate (d) Mohr's salt

5 At high pressure, the compressibility factor *Z* is equal to

(a) unity (b) $1-\frac{pb}{RT}$ (c) $1+\frac{pb}{RT}$ (d) zero

6 The equilibrium constants of the following are

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1
$N_2 + O_2 \rightleftharpoons 2NO$; K_2
$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$; K_3

The equilibrium constant (*K*) of the reaction

$$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O, \text{ will be}$$

(a) $K_1K_3^3 / K_2$ (b) $K_2K_3^3 / K_1$
(c) K_2K_3 / K_1 (d) $K_2^3K_3 / K_1$

7 In which of the following group, all do not have sp^3d hybridisation?

(a) ClF_3, IF_3, XeF_3^+ (b) ICl_2^-, ClF_2^-, I_3^-
(c) ClF_3, BrF_3, IF_3 (d) $PCl_3, AsCl_3, PF_5$

8 Nascent hydrogen consists of

(a) hydrogen atoms with excess of energy
(b) hydrogen molecules with excess of energy
(c) hydrogen ions in excited state
(d) solvated protons

9 In which of the following compounds, iron has the lowest oxidation number?

(a) $Fe(CO)_5$ (b) Fe_2O_3
(c) $K_4[Fe(CN)_6]$ (d) $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

10 The solubility of silver bromide in hypo solution is due to the formation of

(a) $[Ag(S_2O_3)_2]^{3-}$ (b) Ag_2SO_3
(c) $[Ag(S_2O_3)]^-$ (d) $Ag_2S_2O_3$

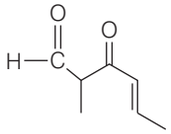
11 α and β-glucose differ in the orientation of —OH group around

(a) C_1 (b) C_2 (c) C_3 (d) C_4

12 A common metal that is used for the extraction of some metals from their oxides is

(a) Cr (b) Fe (c) Mn (d) Al

13 The IUPAC name of the following compound is



(a) 3-keto-2-methylhex-4-enal
(b) 5-formylhex-2-en-3-one
(c) 5-methyl-4-oxohex-2-en-5-al
(d) 3-keto-2-methylhex-5-enal

14 Match the reaction (in Column I) with relation between ΔH and ΔE (in Column II) and choose the correct codes.

	Column I		Column II
A.	$C(s) + O_2(g) \longrightarrow CO_2(g)$	1.	$\Delta H = \Delta E + RT$
B.	$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$	2.	$\Delta H = \Delta E - RT$
C.	$PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$	3.	$\Delta H = \Delta E$
D.	$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$	4.	$\Delta H = \Delta E - 2RT$

Codes

	A	B	C	D
(a)	3	4	1	2
(c)	3	1	4	2

	A	B	C	D
(b)	2	3	1	4
(d)	4	2	3	1

15 Which one of the following pairs of elements is called 'chemical twins' because of their very similar chemical properties?
(a) Mn and W (b) Mo and Tc
(c) Fe and Re (d) Hf and Zr

16 Which among the following will show maximum osmotic pressure?
(a) 1 M NaCl (b) 1 M $MgCl_2$
(c) 1 M $(NH_4)_3PO_4$ (d) 1 M Na_2SO_4

17 The ratio of coefficients of HNO_3, $Fe(NO_3)_2$ and NH_4NO_3 in the following redox reaction, in the balanced form, will be

$$Fe + HNO_3 \longrightarrow Fe(NO_3)_2 + NH_4NO_3 + H_2O,$$

(a) 10 : 1 : 4 (b) 10 : 4 : 1
(c) 4 : 10 : 1 (d) 4 : 1 : 10

18 A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be
(a) 1136.25 J (b) – 500 J (c) – 505 J (d) + 505 J

19 Enthalpy of sublimation of a substance is equal to **[NCERT Exemplar]**
(a) enthalpy of fusion + enthalpy of vaporisation
(b) enthalpy of fusion
(c) enthalpy of vaporisation
(d) twice the enthalpy of vaporisation

20 A dextrorotatory optically active alkyl halide undergoes hydrolysis by S_N2 mechanism. The resulting alcohol is
(a) dextrorotatory
(b) laevorotatory
(c) optically inactive due to racemisation
(d) may be dextro or laevorotatory

21 One gram of a monobasic acid when dissolved in 100 g of water lowers the freezing point by 0.186°C. Now, 0.25 g of the same acid is dissolved and titrated with 15.1 mL of *N*/10 alkali. The degree of dissociation of the acid is (K_f for $H_2O = 1.86$)
(a) 1.66 (b) 0.66 (c) 0.11 (d) 0.060

22 The oxide which is the anhydride of orthophosphoric acid, is
(a) P_4O_{10} (b) P_2O_5 (c) P_4O_6 (d) P_2O_3

23 Pick out the correct statement with respect to $[Mn(CN)_6]^{3-}$.
(a) It is sp^3d^2 hybridised and octahedral
(b) It is sp^3d^2 hybridised and tetrahedral
(c) It is d^2sp^3 hybridised and octahedral
(d) It is dsp^2 hybridised and square planar

24 $[Ag^+]$ in saturated AgCl in the presence of 1 M KCl $[K_{sp}(AgCl) = 1 \times 10^{-10}]$ is
(a) 1×10^{-5} M (b) 1×10^{-20} M
(c) 1×10^{-10} M (d) 2×10^{-10} M

25 The pair of compounds having metals in their highest oxidation state is
(a) MnO_2, $FeCl_3$ (b) $[MnO_4]^-$, CrO_2Cl_2
(c) $[Fe(CN)_6]^{3-}$, $[Co(CN)_3]$ (d) $[NiCl_4]^{2-}$, $[CoCl_4]^-$

26 Which of the following compound will not undergo Cannizzaro reaction on heating with an alkali solution?
(a) CCl_3CHO (b) $(CH_3)_3CCHO$
(c) HCHO (d) C_6H_5CHO

27 Among the following compounds, the most susceptible to nucleophilic attack at the carbonyl group, is
(a) MeCOCl (b) MeCHO
(c) MeCOOMe (d) MeCOOCOMe

28 For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the standard free energy is $\Delta G° > 0$. The equilibrium constant (K) would be
(a) $K = 0$ (b) $K > 1$
(c) $K = 1$ (d) $K < 1$

29 If 5.85 g of NaCl is dissolved in 90 g of water, the mole fraction of NaCl is
(a) 0.1 (b) 0.01
(c) 0.2 (d) 0.0196

30 Which sequence correctly describes the relative bond strength of oxygen molecule, superoxide ion, peroxide ion and unipositive oxygen molecule?

(a) $O_2^+ > O_2^- > O_2^{2-} > O_2$ (b) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(c) $O_2^{2-} > O_2^- > O_2 > O_2^+$ (d) $O_2^{2-} > O_2^- > O_2^+ > O_2$

31 When an ideal gas undergoes unrestrained expansion, no cooling occurs because the molecules

(a) are above the inversion temperature

(b) exert no attractive force on each other

(c) do work equal to loss in kinetic energy

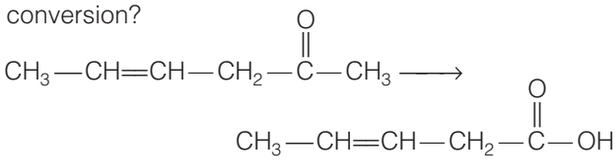
(d) collide without loss of energy

32 A gas is heated in such a way so that its pressure and volume both become double. Again, by lowering the temperature, one fourth of initial number of moles of air has been taken in, to maintain the double volume and pressure. By what fraction, the temperature must have been raised finally?

(a) $\frac{1}{5}$ time (b) $\frac{4}{5}$ time

(c) $\frac{16}{5}$ times (d) $\frac{8}{5}$ times

33 Which is the most suitable reagent for the following conversion?



[NCERT Exemplar]

(a) Tollen's reagent (b) Benzoyl peroxide

(c) I_2 and NaOH solution (d) Sn and NaOH solution

34 Nitroethane on treatment with excess of Cl_2 in the presence of NaOH gives

(a) $ClCH_2CH_2NO_2$ (b) $CH_3CHClNO_2$

(c) $Cl_2CHCH_2NO_2$ (d) $CH_3CCl_2NO_2$

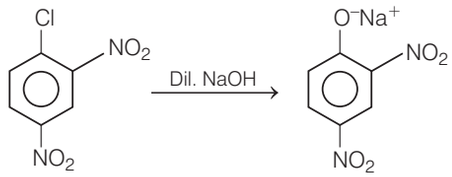
35 Temperature dependent equation can be written as

(a) $\ln k = \ln A - e^{-E_a/RT}$ (b) $\ln k = \ln A + e^{E_a/RT}$

(c) $\ln k = \ln A - e^{RT/E_a}$ (d) None of these

Section-B

36 The following transformation proceeds through



(a) electrophilic addition

(b) benzyne intermediate

(c) activated nucleophilic substitution

(d) oxirane

37 A sample of $CHCl_3$ before being used as an anaesthetic agent is tested by

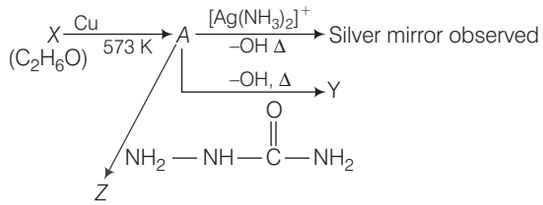
(a) Fehling's solution

(b) ammoniacal cuprous chloride

(c) silver nitrate solution in cold

(d) silver nitrate solution after boiling with alcoholic KOH

38 Consider the reactions,



Identify *A*, *X*, *Y* and *Z*.

(a) *A*-methoxymethane, *X*-ethanoic acid, *Y*-acetate ion, *Z*-hydrazine

(b) *A*-methoxymethane, *X*-ethanol, *Y*-ethanoic acid, *Z*-semicarbazide

(c) *A*-ethanal, *X*-Acetaldelyde, *Y*-but-2-enal, *Z*-semicarbazone

(d) *A*-ethanol, *X*-acetaldehyde, *Y*-butanone, *Z*-hydrazone

39 When benzaldehyde reacts with acetophenone in the presence of sodium hydroxide, then product is

(a) $C_6H_5CH{=}CHCOC_6H_5$ (b) $C_6H_5COCH_2C_6H_5$

(c) $C_6H_5CH{=}CHC_6H_5$ (d) $C_6H_5CH(OH)COC_6H_5$

40 An alkene on vigorous oxidation with $KMnO_4$ gives only acetic acid. The alkene is

(a) $CH_3CH_2CH{=}CH_2$ (b) $CH_3CH{=}CHCH_3$

(c) $(CH_3)_2C{=}CH_2$ (d) $CH_3CH{=}CH_2$

41 Which of the following has the maximum heat of hydrogenation?

(a)  (b)  (c)  (d) 

42 Phenol reacts with PCl_5 to give mainly

(a) *p*-chlorophenol (b) *o*- and *p*-chlorophenol

(c) chlorobenzene (d) triphenyl phosphate

43 An aromatic compound *X* with molecular formula C_8H_{10} produces one mononitro derivative on nitration and three dinitro derivatives. Compound *X* would be

(a) ethyl benzene (b) *m*-xylene

(c) *o*-xylene (d) *p*-xylene

44 The end product *C* in the following sequence of chemical reactions, is

$$CH_3COOH \xrightarrow{CaCO_3} A \xrightarrow{Heat} B \xrightarrow{NH_2OH} C$$

(a) acetaldehyde oxime (b) formaldehyde oxime

(c) methyl nitrate (d) acetoxime

45 **Assertion** Cyclobutane is less stable than cyclopentane.

Reason Presence of bent bonds causes loss of orbital overlap.

(a) Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true but Reason is false.

(d) Assertion is false but Reason is true.

46 The nucleus of an atom can be assumed to be spherical. The radius of the nucleus of mass number A is given by $1.25 \times 10^{-13} \times A^{1/3}$ cm. Radius of atom is 1 Å. If the mass number is 64, the fraction of the atomic volume that is occupied by the nucleus is

(a) 1.0×10^{-3} (b) 5.0×10^{-3}

(c) 2.5×10^{-2} (d) 1.25×10^{-13}

47 Carboxylic acids readily dissolve in aqueous sodium bicarbonate, liberating carbon dioxide. Which one of the following is correct statement?

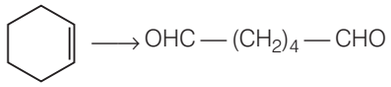
(a) Free carboxylic acid and its conjugate base are of comparable stability

(b) The free carboxylic acid is more stable than its conjugate base

(c) The conjugate base of the carboxylic acid is more stable than the free carboxylic acid

(d) The conjugate acid of the carboxylic acid is more stable than the free carboxylic acid

48 Select the reagent for the following reaction,



1. SeO_2 2. O_3, Zn/H_2O

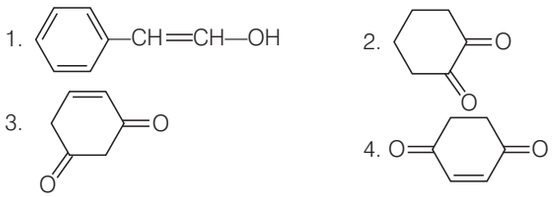
3. O_3, H_2O_2-CH_3COOH 4. PCC

Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct

(c) 2 and 4 are correct (d) 1 and 3 are correct

49 Tautomerism is exhibited by



Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct

(c) 2 and 4 are correct (d) 1 and 3 are correct

50 Transition elements form binary compounds with halogens, which of the following elements will form MF_3 type compounds?

1. Cr 2. Co 3. Cu 4. Ni

Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct

(c) 2 and 4 are correct (d) 1 and 3 are correct

Answers

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

Hints and Explanations

1 Larger the size of the halogen atom, lesser will be the back donation of electrons into empty $2p$ orbital of B, i.e. more deficient is the molecule.

2 Zn has outer electronic configuraton $3d^{10}4s^2$.

$\therefore$ $Zn^{2+} = 3d^{10}$, i.e. two electrons are removed from 4s orbital and it has zero unpaired electron. So, it is diamagnetic. The diamagnetic character is due to the pairing of all the electron spins, not due to the removal of electron.

3 Acidic nature of oxide is related to non-metallic nature of element. Non-metallic nature decreases in the order

Cl > S > P.

4 Fe_2Cl_6 is a covalent compound in which Fe has only 6 electrons and hence, completes its octet by forming a coordinate bond with the chlorine atom of other molecule. Hence, $FeCl_3$ exists as a dimer.

5 $\left(p + \frac{a}{V^2}\right)(V - b) = RT$

At high pressure, b cannot be neglected in comparison to V. Further, though V becomes small, a/V^2 is large but as p is very high, $\frac{a}{V^2}$ can be neglected in comparison to p. Hence,

$p(V - b) = RT$ or $pV = RT + pb$

(Dividing with RT in both sides)

or $\frac{pV}{RT} = 1 + \frac{pb}{RT}$ or $Z = 1 + \frac{pb}{RT}$

6 Given, $N_2 + 3H_2 \rightleftharpoons 2NH_3$, K_1 ...(i)

$N_2 + O_2 \rightleftharpoons 2NO$, K_2 ...(ii)

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$, K_3 ...(iii)

To calculate,

$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O$,

$K = ?$ ...(iv)

On reversing the equation (i) and multiplying the equation (iii) by 3, we get

$2NH_3 \rightleftharpoons N_2 + 3H_2, \frac{1}{K_1}$ ...(v)

$3H_2 + \frac{3}{2}O_2 \longrightarrow 3H_2O$, K_3^3 ...(vi)

Now, add equation. (ii), (v) and (vi), we get the resultant equation. (iv).

$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O$

$\therefore \quad K = \frac{K_2K_3^3}{K_1}$

7 PCl_3 and $AsCl_3$ have sp^3 hybridisation and PF_5 has sp^3d hybridisation. Hence, in group of PCl_3, $AsCl_3$ and PF_5 all do not have sp^3d hybridisation.

8 Nascent hydrogen is associated with chemical energy liberated in the reaction and hence, the molecules consist of excess energy.

9 In metal carbonyls, the oxidation number of metal is always zero.

(Charge on Fe) +5 (charge on CO) = 0

(Charge on Fe) +5 (0) = 0

Charge on Fe = 0

(a) Oxidation state of Fe in $Fe(CO)_5$ is zero.

Similarly,

(b) Oxidation state of Fe in Fe_2O_3 is +3.

(c) Oxidation state of Fe in $K_4[Fe(CN)_6]$ is +2.

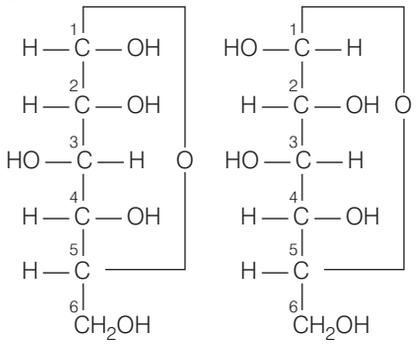
(d) Oxidation state of Fe in $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ is +2.

10 The solubility of silver bromide in hypo solution is due to the formation of $Na_3[Ag(S_2O_3)_2]$.

$AgBr + 2Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + 2NaBr$

Sodium argento thiosulphate (Colourless)

11

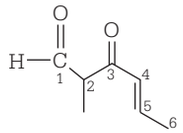


α-glucose β-glucose

The two cyclic hemiacetal forms of glucose differ only in the configuration of the hydroxyl group at C1, called anomeric carbon (the aldehyde carbon before cyclisation). Such isomers, i.e. α-form and β - forms are called anomers.

12 As aluminium has more affinity for oxygen, it is used as a reducing agent for the extraction of Cr, Fe, Mn, etc.

13



—CHO group gets higher priority over $>C=O$ and $>C=C<$ group in numbering of principal carbon chain.

IUPAC name

= 3-keto-2-methylhex-4-enal.

14 $\Delta H = \Delta E + \Delta n_g RT$

(A) $C(s) + O_2(g) \longrightarrow CO_2(g)$

$\Delta n_g = 1 - 1 = 0$

$\therefore \quad \Delta H = \Delta E$

(B) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

$\Delta n_g = 2 - (1 + 3) = -2$

$\therefore \quad \Delta H = \Delta E - 2RT$

(C) $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$

$\Delta n_g = (1 + 1) - 1 = 1$

$\therefore \quad \Delta H = \Delta E + RT$

(D) $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$

$\Delta n_g = 2 - (2 + 1) = -1$

$\therefore \quad \Delta H = \Delta E - RT$

15 Zr and Hf possess similar radii (Zr 160 pm, Hf 159 pm) and hence are called twins of periodic table. It is due to lanthanide contraction.

16 1 M NaCl, $NaCl \longrightarrow Na^+ + Cl^-$

1M $MgCl_2$, $MgCl_2 \longrightarrow Mg^{2+} + 2Cl^-$

1M $(NH_4)_3PO_4$, $(NH_4)_3PO_4 \longrightarrow 3NH_4^+ + PO_4^{3-}$

1M Na_2SO_4, $Na_2SO_4 \longrightarrow 2Na^+ + SO_4^{2-}$

$(NH_4)_3PO_4$ dissociates to give maximum number of particles. Hence, its osmotic pressure will be maximum.

17 The balanced redox equation is

$4Fe + 10HNO_3 \longrightarrow 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$

Thus, the correct ratio of coefficients of HNO_3, $Fe(NO_3)_2$ and NH_4NO_3 respectively is 10 : 4 : 1.

18 **Key concept** According to first law of thermodynamics,

$\Delta U = q + w$

where, ΔU = internal energy

q = heat absorbed or evolved, w = work done.

Also, work done against constant external pressure (irreversible process).

$w = -p_{ext}\,\Delta V$.

Work done in irreversible process,

$w = -p_{ext}\,\Delta V = -p_{ext}\,(V_2 - V_1)$

$= -2.5$ atm $(4.5\text{ L} - 2.5\text{ L})$

$= -5\text{ L atm} = -5 \times 101.3\text{ J} = -505\text{ J}$

Since, the system is well insulated, $q = 0$

$\therefore \quad \Delta U = w = -505\text{ J}$

Hence, change in internal energy, ΔU of the gas is – 505 J.

19 Sublimation is : Solid → Vapour. It can be written in two steps:

Solid → Liquid → Vapour

Solid → Liquid requires enthalpy of fusion

Liquid → Vapour requires enthalpy of vaporisation

20 In case of optically active alkyl halides, the product formed as a result of S_N2 mechanism which has the inverted configuration as compared to the reactant. This is because the nucleophile attached itself on the side opposite to the one where the halogen atom is present. Thus, S_N2 reaction of

optically active halides are accompanied by inversion of configuration.

If one of the enantiomer is dextro-rotatory the other will be laevorotatory. In case of dextro-rotatory optically active alkyl hydrolysis by S_N2 mechanism the resulting alcohol will be laevorotartory.

21 $w = \frac{ENV}{1000}$ [For monobasic acid, $E = M$]

$$0.25 = \frac{M \times 1 \times 15.1}{1000 \times 10}$$

$$M = 165.56$$

$$\text{Molality } (m) = \frac{1 \times 1000}{165.56 \times 100} = 0.060$$

$$\Delta T_f = K_f \times m = 1.86 \times 0.060 = 0.1116$$

$$i = \frac{(\Delta T_f)_{\text{observed}}}{(\Delta T_f)_{\text{normal}}} = \frac{0.186}{0.1116} = 1.66$$

$$\underset{\text{At equilibrium,}}{} \underset{1-x}{HA} \rightleftharpoons \underset{x}{H^+} + \underset{x}{A^-}$$

$$i = \frac{(1-x) + x + x}{1}$$

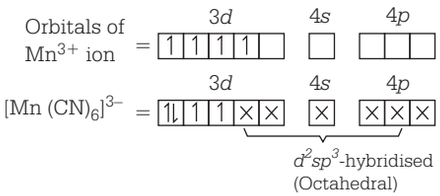
$$1.66 = 1 + x \Rightarrow x = 0.66$$

22 Both P_4O_{10} and P_2O_5 may be regarded as anhydrides of H_3PO_4 but since, P_2O_5 occurs as a dimer, the right answer is P_4O_{10} and not P_2O_5.

$$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$$

23 *(c)* $[Mn(CN)_6]^{3-}$ is d^2sp^3-hybridised and octahedral In $[Mn(CN)_6]^{3-}$, Mn is in +3 oxidation state

$Mn^{3+} = 3d^4\ 4s^0$



24 $AgCl \underset{(S)}{\rightleftharpoons} Ag^+ + Cl^-(g)$

Let solubility is S mol L^{-1} in 1 M KCl.

$$[Ag^+] = S$$

$$\therefore \quad [Cl^-] = S + 1 \approx 1 \text{ M}$$

[$\because$ For KCl, $[Cl^-] = 1$]

$$[Ag^+][Cl^-] = K_{sp}$$

$$(S \times 1) = K_{sp} = 1 \times 10^{-10}$$

or $\quad S = 1 \times 10^{-10}$ M

25 (a) In MnO_2 and $FeCl_3$, oxidation states of Mn and Fe are +4 and +3, respectively.

(b) In $[MnO_4]^-$,CrO_2Cl_2, oxidation states of Mn and Cr are +7 and +6, respectively.

(c) In $[Fe(CN)_6]^{3-}$,$[Co(CN)_3]$, oxidation states of Fe and Co are +3 and +3, respectively.

(d) $[NiCl_4]^{2-}$,$[CoCl_4]^-$, oxidation states of Ni and Co are +2 and +3, respectively.

Therefore, $[MnO_4]^-$, CrO_2Cl_2 have highest oxidation state pair of compounds.

26 Although, CCl_3CHO does not contain α-hydrogen yet it does not undergo Cannizzaro reaction, since attack of OH^- ion cleaves the molecule to give $CHCl_3$ and $HCOO^-$.

$$CCl_3—CHO \xrightarrow{OH^-} CCl_3—CH(O^-)(OH) \longrightarrow$$

$$[CCl_3^- + HCOOH] \longrightarrow CHCl_3 + HCOO^-$$

27 Amongst aldehydes and the acid derivatives, acid chlorides are the most susceptible to nucleophilic attack due to strong $-I$-effect and weak + R-effect of the Cl-atom, as a result of which carbonyl carbon has the highest electron deficiency. The actual order is

MeCOCl> MeCOOCOMe> MeCOOMe > MeCHO

28 As $\Delta G° > 0$, the equilibrium constant K would be less than1 ($\Delta G° = -RT\ln K$).

29 5.85 g NaCl $= \frac{5.85}{58.5}$ mol = 0.1 mol

90 g $H_2O = \frac{90}{18}$ mol = 5 mol

$\therefore$ Mole fraction of NaCl

$$= \frac{0.1}{5 + 0.1} = \frac{0.1}{5.1} = 0.0196$$

30 Bond order $= \frac{1}{2}(N_b - N_a)$

Bond order in $O_2 = \frac{1}{2}(10 - 6) = 2$

Bond order in $O_2^- = \frac{1}{2}(10 - 7) = 1.5$

Bond order in $O_2^+ = \frac{1}{2}(10 - 5) = 2.5$

Bond order in $O_2^{2-} = \frac{1}{2}(10 - 8) = 1$

As the bond order increases, the bond strength increases accordingly. Therefore, the correct order is

$$O_2^+ > O_2 > O_2^- > O_2^{2-}$$

31 When an ideal gas undergoes expansion, no work is done in overcoming attractive forces. Hence, internal energy does not fall and hence, temperature also does not fall.

32 $p_1 = p, V_1 = V,\ p_2 = 2p,\quad V_2 = 2V$

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2},\ \frac{pV}{T_1} = \frac{2p \times 2V}{T_2},\ T_2 = 4T_1$$

When air has been taken in and p,V remains constant.

$$n_1 \cdot 4T_1 = n_2 \cdot T_2$$

$$n_1 = n$$

$$n_2 = n + \frac{1}{4}n = \frac{5}{4}n$$

$$n \cdot 4T_1 = \frac{5}{4}n \cdot T_2$$

$$T_2 = \frac{16}{5}T_1$$

33 $CH_3—CH=CH—CH_2—\overset{O}{\overset{\|}{C}}—CH_3$

Hex-4-en-2-one

$$\xrightarrow{I_2/NaOH}$$

$CH_3—CH=CH—CH_2—\overset{O}{\overset{\|}{C}}—OH$

Pent -3-en-1-oic acid

34 α-H atoms in nitroalkanes being acidic are successively replaced by Cl in the presence of NaOH.

$$CH_3CH_2NO_2 \xrightarrow[-HCl]{Cl_2/NaOH} CH_3CHClNO_2$$

$$\xrightarrow[-HCl]{Cl_2/NaOH} CH_3CCl_2NO_2$$

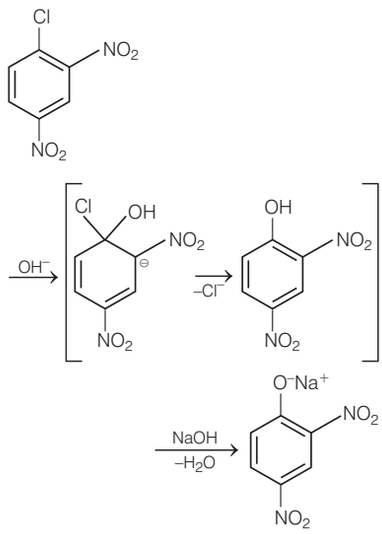
35 Arrhenius equation gives relation of rate constant with temperature.

$$k = A \cdot e^{-E_a/RT}$$

On taking logarithm, we get

$$\ln k = \ln A - \frac{E_a}{RT}\ln e \text{ or } \ln k = \ln A - \frac{E_a}{RT}$$

36



This reaction occurs by activated nucleophilic substitution.

37 If $CHCl_3$ sample contains phosgene ($COCl_2$), it will give a white precipitate when treated with $AgNO_3$ solution in cold. However, $AgNO_3$ solution after boiling with alcoholic KOH will always give white precipitate with $CHCl_3$, whether it contains $COCl_2$ or not.

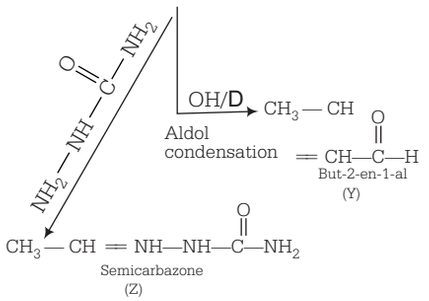
38 Aldehydes gives silver mirror test so, '*X*' may be alcohol which is oxidised by Cu gives aldehydes.

Therefore,

$C_2H_6O = C_2H_5—OH$] or $A = CH_3CHO$
(X)

$C_2H_5OH \xrightarrow[\text{oxidation}]{Cu/573\ K} CH_3CHO$ Acetaldehydol (*A*)

$\xrightarrow[OH/\Delta]{[Ag(NH_3)_2]}$ Silver monaobserved
Tollen's reagent



39 In the presence of sodium hydroxide, benzaldehyde reacts with acetophenone, to give phenyl cinnamate.

$C_6H_5CHO + CH_3COC_6H_5 \xrightarrow{NaOH\ (aq)} C_6H_5CH{=}CH—\overset{O}{\overset{\|}{C}}—C_6H_5$

40 Since, the alkene on oxidation gives only acetic acid, therefore the alkene must be symmetrical containing two carbon atoms on either side of the double bond, i.e. 2-butene.

$CH_3CH{=}CHCH_3 \xrightarrow{KMnO_4} 2CH_3COOH$

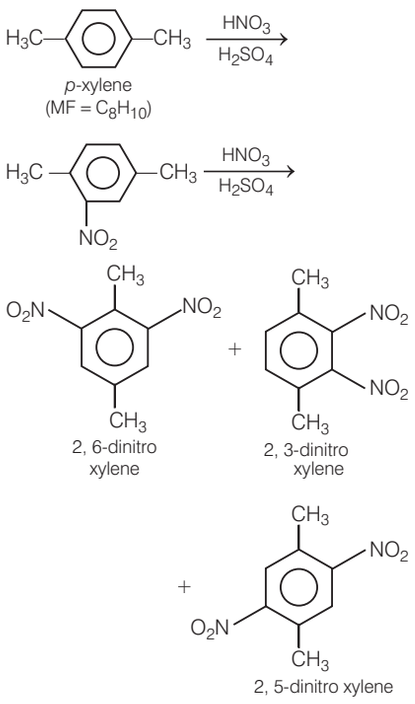
41 As the conjugation increases, heat of hydrogenation decreases. Thus, alkene (c) with two isolated double bonds has the highest heat of hydrogenation. Heat of hydrogenation is also an index of stability. The lower the heat of hydrogenation of an alkene the more stable it is.

42 Due to resonance, carbon-oxygen bond in phenol is quite stronger than in alcohols and hence, —OH group cannot be displaced by —Cl on treatment with PCl_5. Instead nucleophilic attack by —OH of phenol occurs on PCl_5 with displacement of three Cl-atoms. The resulting product on hydrolysis gives triphenyl phosphate.

$3C_6H_5OH + PCl_5 \xrightarrow[-3HCl]{\text{Nucleophilic attack}} (C_6H_5O)_3PCl_2$

$\xrightarrow[-2HCl]{H_2O} (C_6H_5O)_3PO$ Triphenyl phosphate

43 In *p*-xylene, the four nuclear H-atoms are equivalent and hence, only one mononitro derivative is formed. But it gives three dinitro derivatives (2, 3; 2, 6 and 2, 5) as shown below:



44 $CH_3COOH \xrightarrow{CaCO_3} (CH_3COO)_2Ca \xrightarrow[-CaCO_3]{\Delta} (CH_3)_2CO \xrightarrow[-H_2O]{NH_2OH} (CH_3)_2C{=}NOH$
A *B* Acetoxime *C*

45 For the stability of cycloalkanes, Baeyer's strain theory was given. According to this theory, if carbon atoms unit to form a closed chain, the valency angles are distorted their natural directions and a strain is set up in the molecules depending upon the extent of displacement of natural valency angles. The greater the strain, the greater is the unstability of the ring. The value of distortion of valency angle in cyclobutane and cyclopentane is +9°34' and +0°54' respectively. Hence, cyclobutane is less stable.

46 Radius of nucleus

$= 1.25 \times 10^{-13} \times A^{1/3}$cm

$= 1.25 \times 10^{-13} \times (64)^{1/3}$

$= 1.25 \times 10^{-13} \times 4$ cm

$= 5 \times 10^{-13}$ cm

Radius of atom = 1 Å = 10^{-8} cm

$$\frac{\text{Volume of nucleus}}{\text{Volume of atom}} = \frac{(4/3)\pi(5 \times 10^{-13})^3}{(4/3)\pi(10^{-8})^3}$$

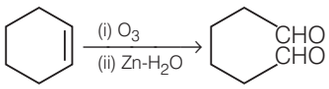
$$= \frac{125 \times 10^{-39}}{10^{-24}} = 125 \times 10^{-15}$$

$= 1.25 \times 10^{-13}$

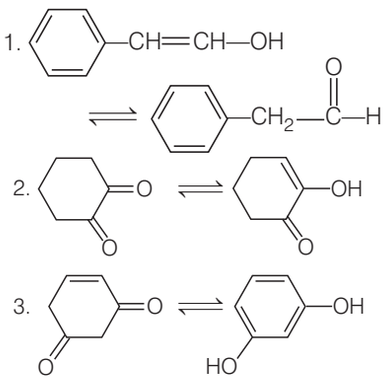
47 $RCOOH + NaHCO_3 \rightleftharpoons RCOONa + H_2O + CO_2$

or $RCOOH + HCO_3^- \rightleftharpoons RCOO^- + H_2O + CO_2$

Conjugate base, $RCOO^-$ is more stable due to resonance, than the free carboxylic acid. That's why, equilibrium shifts in the forward direction.

48 

$Zn\text{-}H_2O$ is the reagent for reductive work up of ozonide. $H_2O_2\text{-}CH_3COOH$ would give $HOOC{-}(CH_2)_4{-}COOH$.

49 

50 The +3 oxidation states is more stable only for Cr and Co. Cu exhibits only + 1 and + 2 oxidation states. Ni generally exhibits + 2 oxidation state. This is the reason for the fact that Cr and Co form MF_3 (where, M = Cr and Co) type compounds whereas Cu and Ni do not.