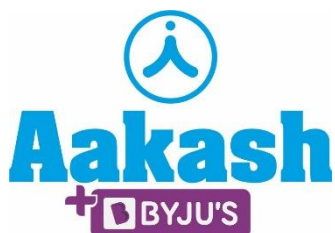


Date: 26/11/2023



Question Paper Code

34

Corporate Office: Aakash Tower, 8, Pusa Road, New Delhi-110005 | Ph.: 011-47623456

Answers & Solutions

Time : 120 Minute

for

Max. Marks : 216

National Standard Examination in Chemistry (NSEC) 2023

INSTRUCTIONS TO CANDIDATES

- (1) There are 60 questions in this paper.
- (2) Question paper has two parts. In **Part A1** (Q. No. 1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q. No. 12 a b c d

In **Part A2** (Q. No. 49 to 60) each question has four alternatives, out of which **any number of alternative (s)** (1, 2, 3 or 4) may be correct. You have to choose ALL correct alternative(s) and fill the appropriate bubble(s), as shown.

Q. No. 52 a b c d

- (3) For **Part A1**, each correct answer carries **3 marks** whereas 1 mark will be deducted for each wrong answer. In **Part A2**, you get **6 marks** if all the correct alternatives are marked. No negative marks in this part.

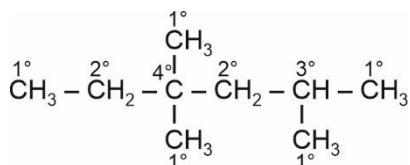
A - 1 (Attempt All Sixty Questions)

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION

1. An alkane [X] contains five 1°, two 2°, one 3° and one 4° carbon atoms. The IUPAC name of [X] is
- (a) 2,4,4-trimethylhexane (b) 3,5-dimethylheptane
(c) 2,4-dimethylheptane (d) 4,4-dimethylheptane

Answer (a)

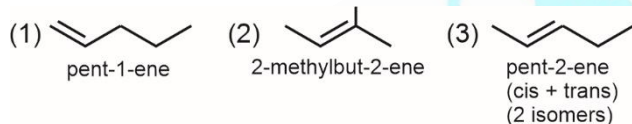
Sol. 2,4,4-trimethylhexane



2. The number of isomeric alkenes with molecular formula C₅H₁₀ is (taking stereoisomers into account)
- (a) 4 (b) 5
(c) 6 (d) 7

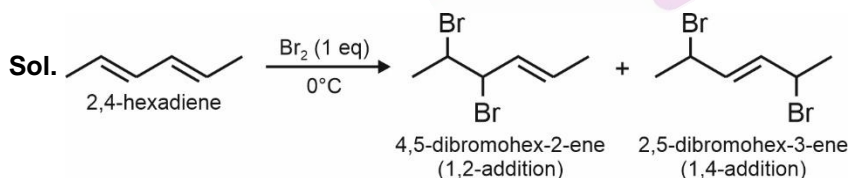
Answer (c)

Sol. Total 6 isomeric alkenes are possible for C₅H₁₀.



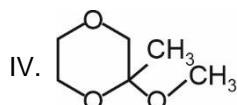
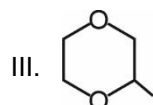
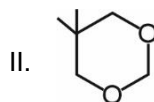
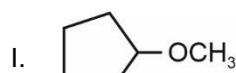
3. At 0°C, 1 equivalent bromine is added to 2,4-hexadiene to produce 4,5-dibromo-2-hexene and its isomer 'X'. 'X' is
- (a) 5,5-dibromo-2-hexene (b) 2,5-dibromo-3-hexene
(c) 2,2-dibromo-3-hexene (d) 2,3-dibromo-4-hexene

Answer (b)



∴ Isomer X is 2,5-dibromo-3-hexene.

4. Which of the following is/are example/s of an acetal?



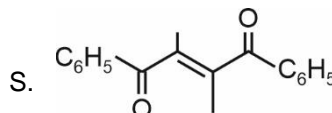
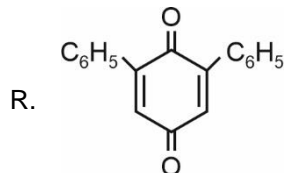
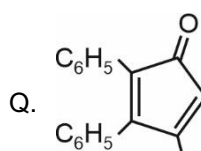
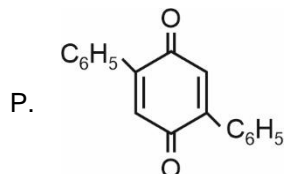
- (a) I and II (b) III and IV
(c) Only IV (d) I, II and III

Answer (a)

Sol. Acetal is a functional group with the connectivity $\text{RHC}(\text{OR}')_2$, where R group can be alkyl or hydrogen atom.

Compound I and compound II are examples of acetals.

5. The compound which can be produced by double aldol condensation of 1-phenyl-1,2-propanedione



(a) P

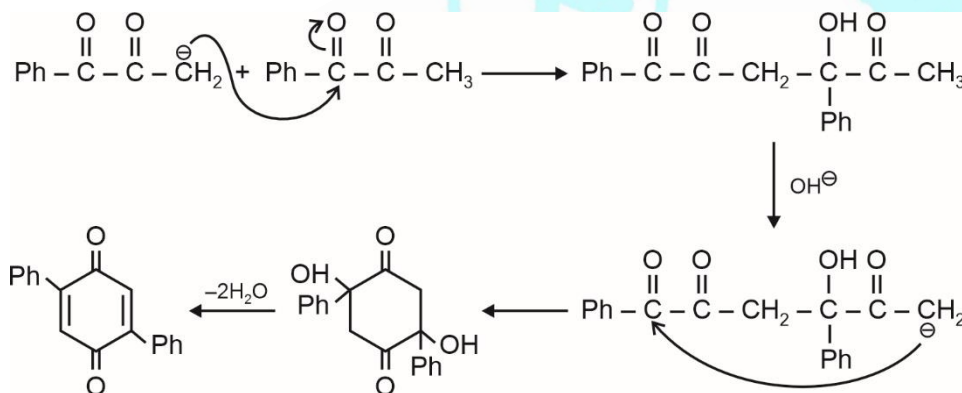
(b) Q

(c) R

(d) S

Answer (a)

Sol. Aldol reaction



So, option (a) is correct.

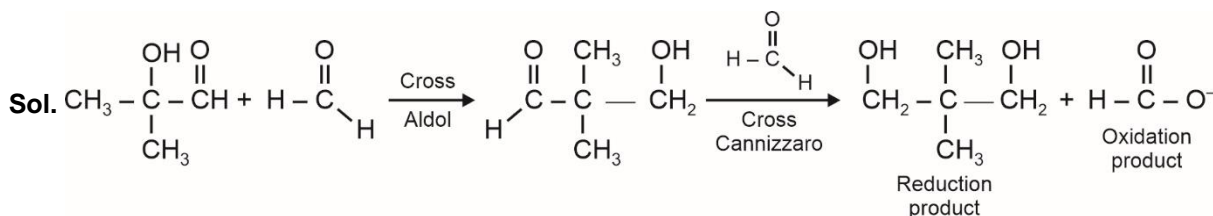
6. 2,2-Dimethyl-1,3-propanediol is formed by heating 2-methylpropanal with an excess of formaldehyde and $\text{Ca}(\text{OH})_2$. The sequence of reactions taking place in this synthesis is

(a) dehydrogenation to 2-methyl-2-propenal followed by addition of formaldehyde

(b) dehydrogenation to penta-2,3-diene followed by addition of formaldehyde

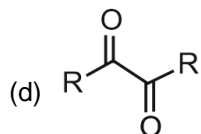
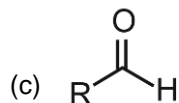
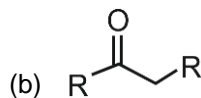
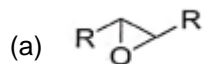
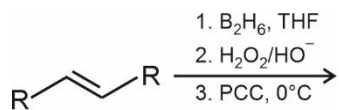
(c) a crossed aldol reaction followed by a crossed Cannizzaro reaction

(d) a crossed Cannizzaro reaction followed by a crossed aldol reaction

Answer (c)

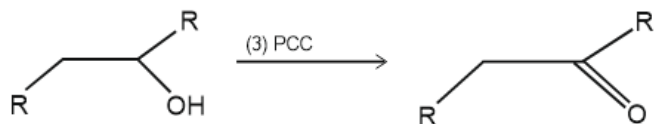
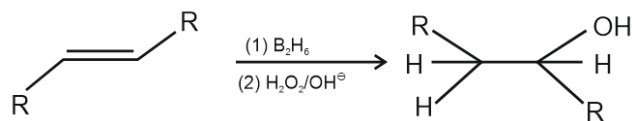
7. Predict the major product in the following reaction

PCC is Pyridinium chlorochromate

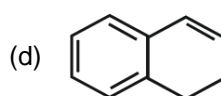
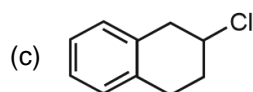
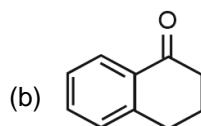
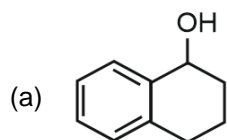
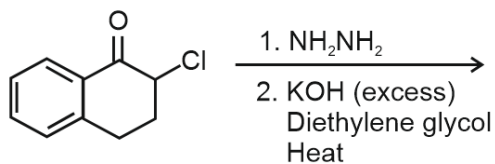


Answer (b)

Sol. First alkene undergo hydroboration oxidation further PCC converts alcohol into ketone.

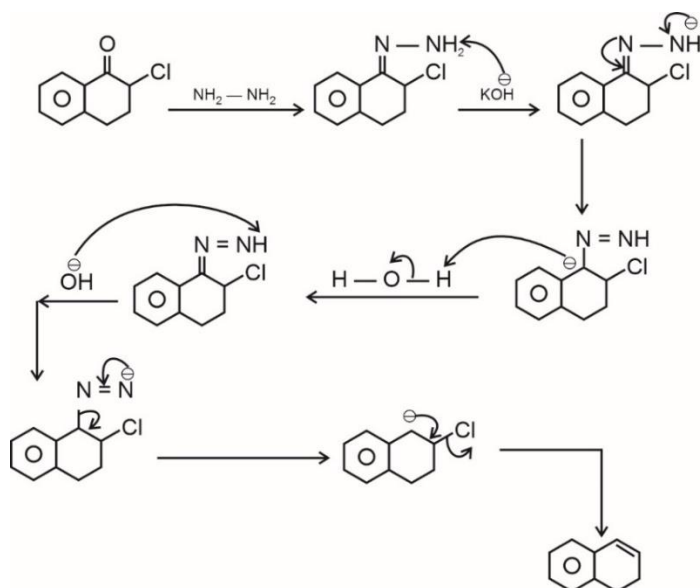


8. Find out the product in the following reaction.



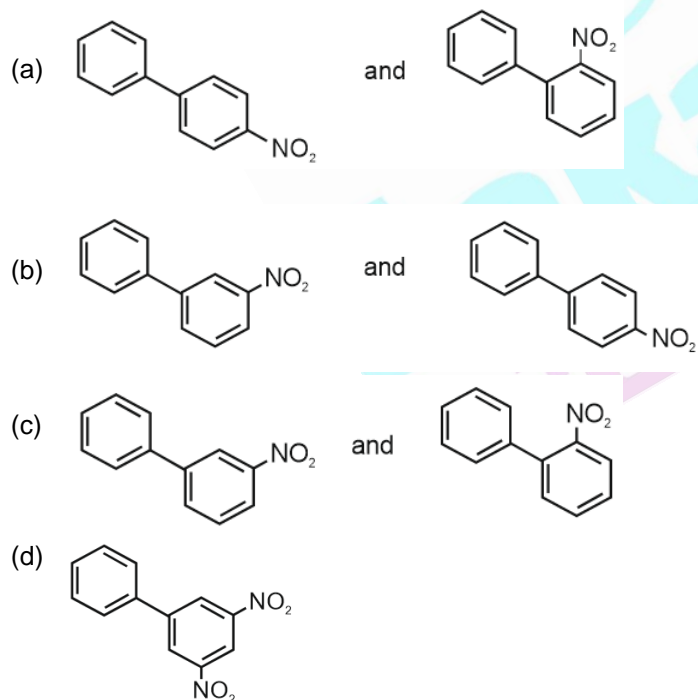
Answer (d)

Sol. The mechanism of reaction is :



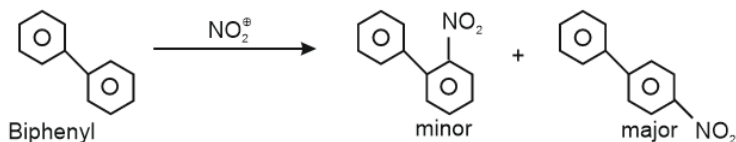
This is an example of Wolff-Kishner reduction. So option (d) is correct.

9. The product/s obtained on reaction of biphenyl (Ph-Ph) with nitrating mixture ($\text{HNO}_3 + \text{H}_2\text{SO}_4$) is/are



Answer (a)

Sol. Benzene ring act as electron donor which increase electron density at ortho and para position in another ring.

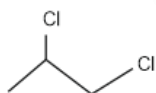
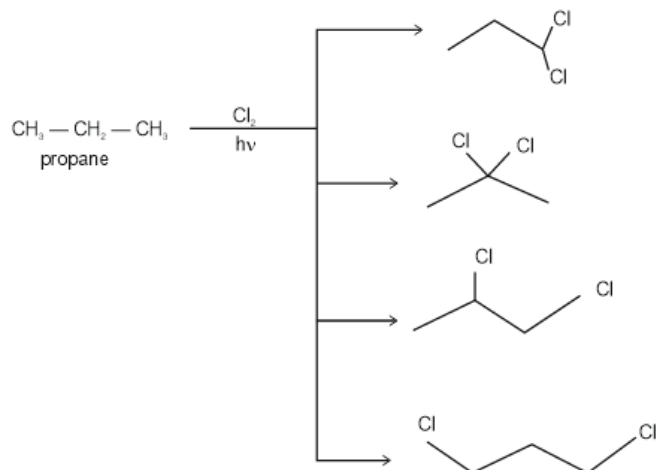


10. Chlorination of propane gives four dichloro products. One of them is optically active. The number of trichloro products possible from the optically active dichloro product is (excluding stereoisomers)

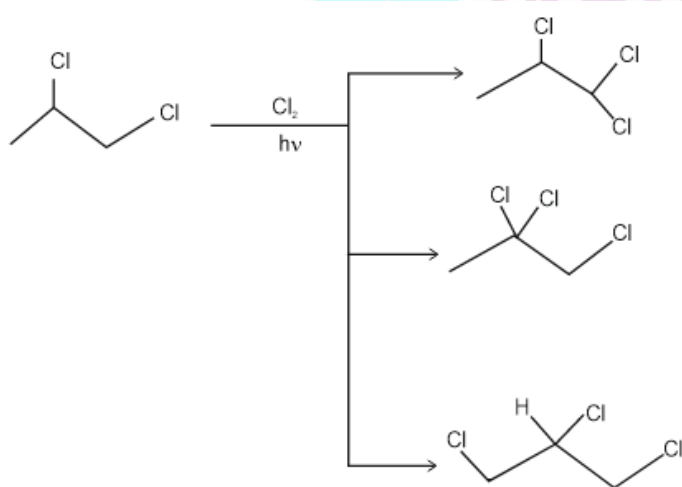
- (a) 1
- (b) 2
- (c) 3
- (d) 4

Answer (c)

Sol.



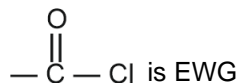
compound is optically active



The number of trichloro products possible from the optically active dichloro product of chlorination of propane is 3.

— CH₃ ⇒ activating

The given combination in option(b) is correct



— NH₂ is EDG, o/p directing and activating group.

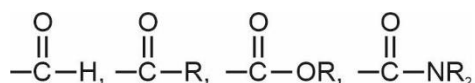
— SO₃H is deactivating group.

13. The correct order of reactivity of —CHO, —COR, —COOR, —CONR₂ groups toward MeMgI in ether is

- (a) —CONR₂ > —COOR > —COR > —CHO (b) —CHO > —COR > —COOR > —CONR₂
 (c) —CONR₂ > —CHO > —COR > —COOR (d) —CHO > —CONR₂ > —COOR > —COR

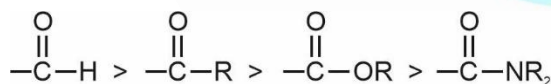
Answer (b)

Sol. We have given

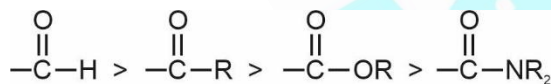


Addition of Grignard reagent (MeMgI) in ether to carbon of C = O is a nucleophilic addition reaction.

The order of reactivity of nucleophilic addition reaction depends on the magnitude of positive charge present in carbonyl carbon. The order of magnitude of positive charge on carbonyl carbon is

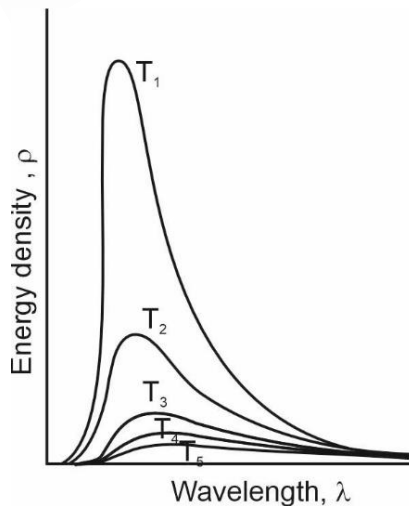


Hence order of addition of MeMgI in ether is



14. The plots of energy density (energy per unit area) vs wavelength for blackbody radiation at various temperatures is given below.

The correct option among the following is



16. Antacids are medicines that temporarily neutralize the acid in the stomach and prevent heartburns. The volume of an antacid syrup containing 2.9 g of $\text{Mg}(\text{OH})_2$ per 100 mL to be given to a patient whose stomach contains 2 L of gastric juice with HCl concentration of $6.0 \times 10^{-3} \text{ M}$ is

(Molar mass of $\text{Mg}(\text{OH})_2 = 58.0 \text{ g mol}^{-1}$)

- (a) 4.0 mL (b) 7.8 mL
(c) 12.0 mL (d) 120 mL

Answer (c)

Sol. We have given a antacid syrup containing

Mass of $\text{Mg}(\text{OH})_2 = 2.9 \text{ g}$

$$\text{mol of mg}(\text{OH})_2 = \frac{\text{mass of Mg}(\text{OH})_2}{\text{Molar mass of Mg}(\text{OH})_2}$$

Molar mass of $\text{Mg}(\text{OH})_2 = 58 \text{ g/mol}$

$$\text{mol of Mg}(\text{OH})_2 = \frac{2.9 \text{ g}}{58 \text{ g/mol}} = 0.05 \text{ mol}$$

$$\text{Molarity of Mg}(\text{OH})_2 = \frac{0.05}{100} \times 1000 \text{ M} = 0.5 \text{ M}$$

For complete neutralisation of gastric juice which contains $6.0 \times 10^{-3} \text{ M HCl}$

Gram equivalent of $\text{Mg}(\text{OH})_2 = \text{gram equivalent of HCl}$

$$(NV)_{\text{Mg}(\text{OH})_2} = (NV)_{\text{HCl}}$$

$$0.5 \text{ M} \times V \times 2 = 6 \times 10^{-3} \text{ M} \times 2 \text{ L} \times 1$$

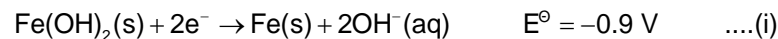
$$\text{Volume of Mg}(\text{OH})_2 (V) = \frac{6 \times 10^{-3} \times 2}{0.5 \times 2} = 0.012 \text{ L}$$

$$1 \text{ L} = 1000 \text{ mL}$$

$$\text{So, } 0.012 \text{ L} = 12 \text{ mL}$$

Volume of antacid syrup required = 12 mL

17. A half-cell reaction represented by (i) as given below



takes place in two different electrochemical cells, I and II, in which the other half cell reactions are (ii) and (iii) respectively:



The correct option that represents the redox reactions in cells I and II is

- (a) Fe is oxidised in cell I; Fe is oxidised in cell II (b) Fe is oxidised in cell I; Fe is reduced in cell II
(c) Fe is reduced in cell I; Fe is reduced in cell II (d) Fe is reduced in cell I; Fe is oxidised in cell II

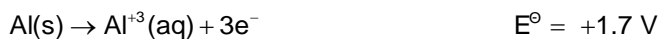
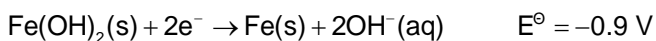
Answer (d)

Sol. For the cell to be feasible ΔG° should be negative

$$\Delta G^\circ = -nFE_{\text{cell}}^\circ$$

So E_{cell}° must be positive

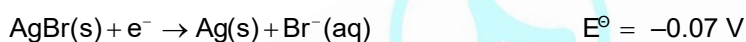
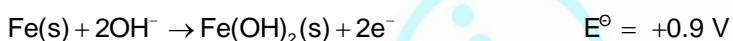
For cell I



$$\begin{aligned} E_{\text{cell}}^\circ &= 1.7 \text{ V} - 0.9 \text{ V} \\ &= 0.8 \text{ V} \end{aligned}$$

Fe is reduced in cell I

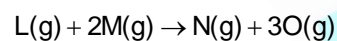
For cell II



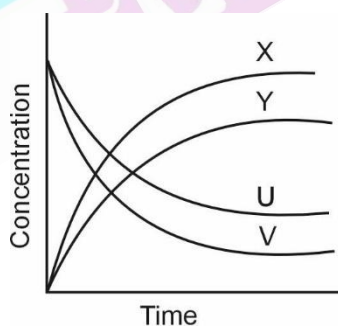
$$\begin{aligned} E_{\text{cell}}^\circ &= 0.9 \text{ V} + (-0.07) \text{ V} \\ &= 0.83 \text{ V} \end{aligned}$$

Fe is oxidised in cell II

18. The following are the concentration vs time plots of the reactants and products represented by the reaction

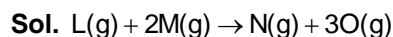


The curves that represent M(g) and N(g) qualitatively are respectively

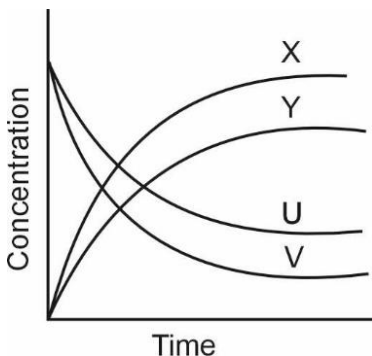


- (a) X, Y
- (b) Y, U
- (c) V, Y
- (d) U, X

Answer (c)



Concentration of L and M will decrease but coefficient of M is larger, so it will decrease more.



Similarly concentration of N and O will increase but coefficient of N is lesser, so 'N' will increase less.

Hence curve V represents [M] and curve Y represents [N]

19. The current produced due to photoelectric effect

- (a) increases with the increase of frequency of the incident radiation
- (b) increases with the increase in intensity of the incident radiation
- (c) decreases with time of irradiation
- (d) is independent of the intensity of incident radiation

Answer (b)

Sol. The photoelectric current increases proportionally with the increase in intensity of incident radiation. Larger the intensity of incident radiation, larger is the number of incident photons and hence larger is the number of electron ejected from the photosensitive surface.

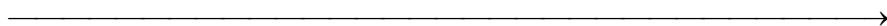
20. The property of radiation that is not different at various regions of the electromagnetic spectrum is :

- (a) energy
- (b) frequency
- (c) velocity
- (d) wavelength

Answer (c)

Sol. The electromagnetic spectrum as

Cosmic ray, Gamma ray, X-rays, UV, Visible, IR, Microwave, Radio wave



Wavelength increases

Energy decreases

Frequency decreases

Velocity remains constant

Velocity of radiation is not different at various region of electromagnetic spectrum but wavelength, energy and frequency are different in different region.

21. The ligand with which the homoleptic octahedral complex of Co^{3+} will be most stable is :
- (a) Ethylenediamine tetra acetate ion (b) Dien (N-(2-aminoethyl)-1,2-ethanediamine)
- (c) Ethane-1,2-diamine (d) Ammonia

Answer (a)

Sol. EDTA has highest denticity among the given ligands and more number of chelate ring is formed. Greater the chelate ring greater will be stability.

22. Which of the following properties may have positive values of ΔH ?
- (i) Lattice enthalpy (ii) Hydration enthalpy
- (iii) Electron gain enthalpy for noble gases (iv) Ionisation enthalpy
- (a) (i) and (ii) (b) (iii) and (iv)
- (c) Only (iv) (d) (ii), (iii) and (iv)

Answer (b)

Sol. Electron gain enthalpy for noble gases is positive

Ionisation energy is positive for neutral atoms.

23. The correct IUPAC name of potassium permanganate is :
- (a) potassium tetraoxomanganate(VI) (b) potassium tetraoxidopermanganate(VII)
- (c) potassium tetraoxidomanganese(VII) (d) potassium tetraoxidomanganate(VII)

Answer (d)

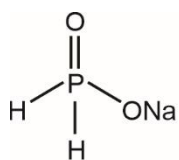
Sol. The IUPAC name of KMnO_4 is potassium tetraoxidomanganate(VII)

24. Which of the following statements is true with respect to sodium salts of oxoanions of phosphorus NaH_2PO_2 and Na_2HPO_3
- (a) NaH_2PO_2 is reducing and Na_2HPO_3 is oxidizing
- (b) NaH_2PO_2 is more reducing than Na_2HPO_3
- (c) NaH_2PO_2 is more oxidizing than Na_2HPO_3
- (d) NaH_2PO_2 is oxidizing and Na_2HPO_3 is reducing

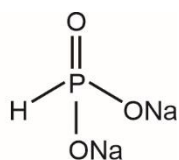
Answer (b)

Sol. NaH_2PO_2 is more reducing than Na_2HPO_3

Reducing ability of sodium salt of oxoanions are depend on number of P-H bond more the number of P-H more will be reducing power.



2 P-H bond



1 P-H bond

NaH_2PO_2 is more reducing than Na_2HPO_3 .

25. The fluoride/s of xenon, XeF_n ($n = 2$ or 4 or 6), which on complete hydrolysis gives back xenon as one of the products, is/are _____.

I. XeF_2

II. XeF_4

III. XeF_6

(a) II only

(b) I and II

(c) III only

(d) I, II and III

Answer (b)

Sol. $2\text{XeF}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Xe} + 4\text{HF} + \text{O}_2$

$6\text{XeF}_4 + 12\text{H}_2\text{O} \rightarrow 4\text{Xe} + 2\text{XeO}_3 + 24\text{HF} + 3\text{O}_2$

26. If an element after oganesson (Og, atomic number 118 and electronic configuration $[\text{Rn}] 5f^{14} 6d^{10} 7s^2 7p^6$) was discovered, in which of the following orbital, will the 119th electron be accommodated?

(a) 7d

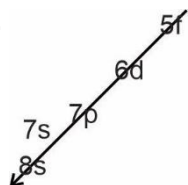
(b) 6f

(c) 8s

(d) 5g

Answer (c)

Sol.



After 7p, 8s, is filled.

27. The number of 'two-center-two electron' and 'three-center-two electron' bonds in $[\text{Al}(\text{BH}_4)_3]$ are respectively

(a) twelve and zero

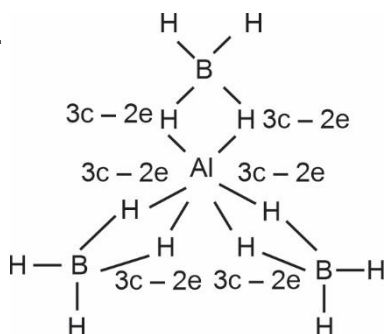
(b) twelve and three

(c) six and six

(d) nine and three

Answer (c)

Sol.



Total 3c - 2e⁻ bonds = 6

Total 2c - 2e⁻ bonds = 6

28. Identify the correct matching of the following oxides in column **M** with their property in column **N**:

M	N
(i) Aluminium trioxide	(p) Acidic oxide
(ii) Calcium oxide	(q) Basic oxide
(iii) Arsenic pentoxide	(r) Amphoteric oxide

(a) (i)-(p), (ii)-(q), (iii)-(r)

(b) (i)-(q), (ii)-(r), (iii)-(p)

(c) (i)-(r), (ii)-(q), (iii)-(p)

(d) (i)-(r), (ii)-(p), (iii)-(q)

Answer (c)

Sol. $\text{Al}_2\text{O}_3 \rightarrow$ amphoteric

$\text{CaO} \rightarrow$ basic

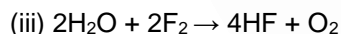
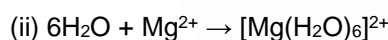
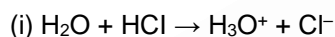
$\text{As}_2\text{O}_5 \rightarrow$ acidic

(i) \rightarrow (r)

(ii) \rightarrow (q)

(iii) \rightarrow (p)

29. In each of the following reactions, role of water is:



(a) (i) oxidant; (ii) reductant; (iii) base

(b) (i) reductant; (ii) oxidant; (iii) base

(c) (i) base; (ii) base; (iii) reductant

(d) (i) acid; (ii) base; (iii) reductant

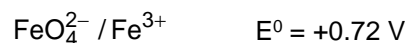
Answer (c)

Sol. In (i) water accepts H^+ thus it is a base

In (ii) water donates lone pair thus it is a base

In (iii) H_2O loses electrons to give O_2 , thus is oxidized, so it is a reductant

30. The correct order of the following oxidizing agents in basic aqueous medium is:



(a) $[\text{CrO}_4]^{2-} > [\text{FeO}_4]^{2-} > [\text{MnO}_4]^{2-}$

(b) $[\text{FeO}_4]^{2-} > [\text{MnO}_4]^{2-} > [\text{CrO}_4]^{2-}$

(c) $[\text{CrO}_4]^{2-} > [\text{MnO}_4]^{2-} > [\text{FeO}_4]^{2-}$

(d) $[\text{MnO}_4]^{2-} > [\text{FeO}_4]^{2-} > [\text{CrO}_4]^{2-}$

Answer (b)

Sol. Higher the reduction potential higher is the oxidizing ability.

35. In qualitative inorganic analysis of a water-soluble salt mixture (salt AB + salt XY) both the cations were identified as sulphides. In the tests for anions sodium carbonate extract when treated with AgNO_3 gave yellowish precipitate soluble with difficulty in NH_4OH while the other anion can be confirmed with brown ring test. (Given K_{sp} for AS = 1×10^{-44} and XS = 1.4×10^{-24}).

Identify the INCORRECT statement about the analysis.

- (a) H_2S can be used under appropriate conditions of pH to separate and identify the cations.
- (b) Cation A will be precipitated under acidic condition as the concentration of sulphides ions required is low.
- (c) The anions are NO_3^- and Cl^- .
- (d) Cation X will be precipitated as sulphides under alkaline condition, as the concentration of sulphides ions required is very high.

Answer (c)

- Sol.** (a) Since difference in K_{sp} is large, the cations can be separated and identified by using different concentrations of S^{2-} .
- (b) In acidic medium $[\text{S}^{2-}]$ will be low due to common ion of H^+ ion thus only sulphides with low K_{sp} can be precipitated.
- (c) Cl^- cannot be there as AgCl is white and soluble in NH_4OH .
- (d) XS has higher K_{sp} , thus $[\text{S}^{2-}]$ required will be higher.
36. The correct statement about the solubilities of Group 2 hydroxides is:
- (a) The solubilities increase because lattice energy increases as we go down Group 2
 - (b) The solubilities increase because lattice energy decreases as we go down Group 2
 - (c) The solubilities decreases because atomic size increases as we go down Group 2
 - (d) The solubilities decrease because lattice energy decreases as we go down Group 2

Answer (b)

Sol. The solubilities of group-2 hydroxides increase as we go down the group because decrease in lattice energy is more than decrease in hydration energy.

37. A solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in methanol has $[\text{Cu}^{2+}] = 1.00 \text{ mg per } 1000 \text{ g of methanol}$. The molarity of Cu^{2+} in this solution is $Y \times 10^{-5} \text{ mol L}^{-1}$. Y is:

(Given- density of methanol = 0.792 g mL^{-1})

- (a) 1.57
- (b) 5.04
- (c) 1.25
- (d) 3.99

Answer (c)

Sol. Volume of 1000 g methanol = $\frac{1000}{0.792} \text{ mL}$

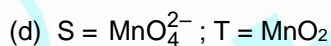
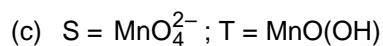
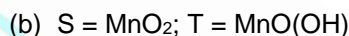
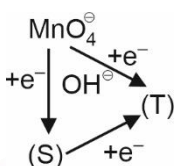
$$= \frac{1000}{792} L$$

$$\text{Number of moles of Cu}^{2+} \text{ ions} = \frac{1 \times 10^{-3}}{63.5}$$

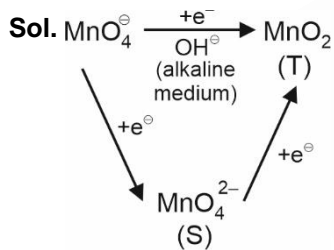
$$\begin{aligned} \text{Molarity of Cu}^{2+} \text{ ions} &= \frac{1 \times 10^{-3} \times 792}{63.5 \times 1000} \\ &= 1.25 \times 10^{-5} \text{ M} \\ &= Y \times 10^{-5} \text{ M} \end{aligned}$$

$$\Rightarrow Y = 1.25$$

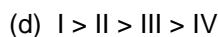
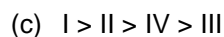
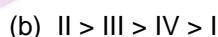
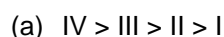
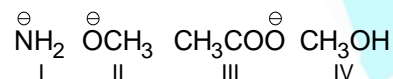
38. Following is the reaction flow chart for manganese oxidocomplexes under different alkaline pH conditions. Compounds (S) and (T) respectively are:



Answer (d)

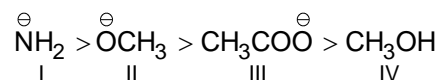


39. The correct order of relative strength for the following nucleophilic species is:

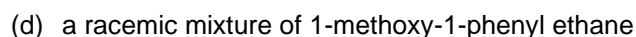
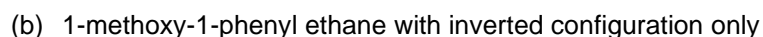


Answer (d)

Sol. The correct order of relative strength for the given nucleophilic species is

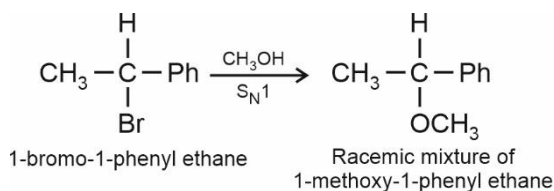


40. The product obtained on reaction of optically pure 1-bromo-1-phenyl ethane with CH₃OH, is:



Answer (d)

Sol. The given reaction proceeds through S_N1 mechanism



41. Among the following, the correct statements about the compressibility factor (Z) of real gases are:

- If $Z < 1$, intermolecular repulsive forces are more dominant.
 - If $Z < 1$, intermolecular attractive forces are more dominant.
 - If $Z > 1$, intermolecular repulsive forces are more dominant.
 - If $Z > 1$, intermolecular attractive forces are more dominant.
- (i) and (iv)
 - (i) and (iii)
 - (ii) and (iv)
 - (ii) and (iii)

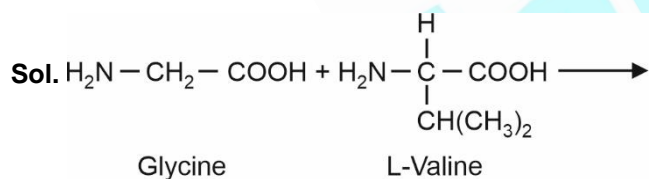
Answer (d)

Sol. If the compressibility factor (Z) for real gases is greater than one ($Z > 1$) then intermolecular repulsive forces are more dominant and if $Z < 1$ then intermolecular attractive forces are more dominant.

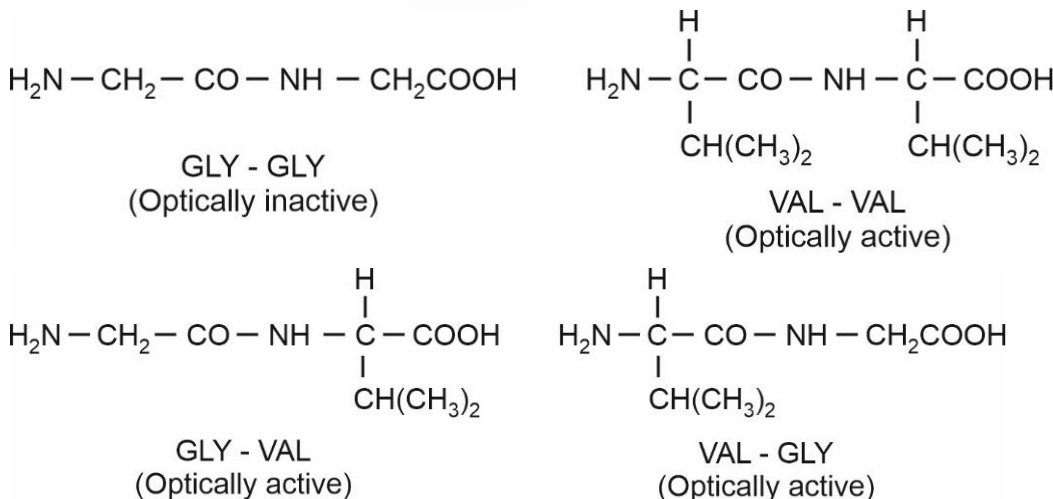
42. Number of different types of dipeptides produced using a mixture of glycine and L-valine, and number of optically active dipeptides formed in this mixture will be:

- Four dipeptides, all optically active
- Two dipeptides, all optically active
- Four dipeptides, three optically active
- Two dipeptides, none optically active

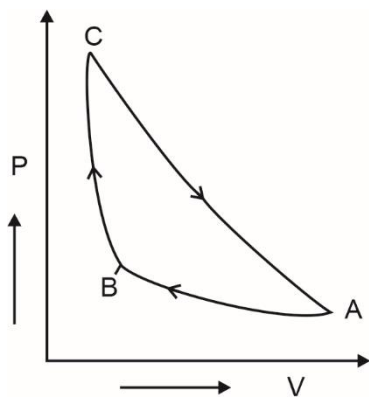
Answer (c)



In the above reaction, four dipeptides will be formed – two mixed dipeptides and two self-dipeptides. Out of them three will be optically active and one will be optically inactive.



43. The figure represents the processes AB, BC and CA undertaken by a certain mass of an ideal gas. Along the path AB, the gas is isothermally compressed with release of 800 J heat to the surroundings. It is then compressed adiabatically along the path BC and the work done is 500 J. The gas then returns to the state A along path CA and absorbs 100 J heat from the surroundings. The work done by the gas along the path CA is:



- (a) -300 J
- (b) -900 J
- (c) -600 J
- (d) -400 J

Answer (c)

Sol. Process AB : Isothermal process, so $\Delta T = 0$

Therefore, $\Delta U = 0$

Process BC : Adiabatic process, so $q = 0$

Therefore, from first law of thermodynamics,

$$\Delta U = q + W$$

$$\Rightarrow \boxed{\Delta U = 500 \text{ J}}$$

Given process is cyclic, therefore,

$$\Delta U_{AB} + \Delta U_{BC} + \Delta U_{CA} = 0$$

$$\Rightarrow 0 + 500 + \Delta U_{CA} = 0$$

$$\boxed{\Delta U_{CA} = -500 \text{ J}}$$

Now, work done by the gas along the path CA,

$$\Delta U = q + W$$

$$\Rightarrow -500 = 100 + W$$

$$\boxed{W = -600 \text{ J}}$$

Sol. The formula of relative lowering of vapour pressure

$$\frac{P^\circ - P_s}{P_s} = i \frac{n}{N} \quad \dots(i)$$

Here, P° = Vapour pressure of pure solvent

P_s = Vapour pressure of solution

n = Number of moles of non-volatile solute

N = Number of moles of solvent in solution

i = Van't Hoff factor

According to question, from equation (i)

$$\frac{3.55}{100} = \frac{2 \times w \times 18}{54 \times 100} \quad \left[\begin{array}{l} \text{for, } AB \rightarrow A^+ + B^- \\ i = 2 \text{ as } \alpha = 100\% \end{array} \right]$$

$$\Rightarrow w = 5.325 \text{ g}$$

$$\begin{aligned} \text{Therefore, molality} &= \frac{5.325 \times 1000}{54 \times 100} \\ &= 0.986 \\ &\approx 1 \text{ mol/kg} \end{aligned}$$

46. The rate constant values for the decay of radioisotopes X and Y, used in radio-medicine are 0.05 h^{-1} and 0.025 h^{-1} respectively. In a hospital, at a time ' t_0 ' the activity of a sample of X was found to be twice that of Y. The activities of the two radioisotopes will be approximately equal when the time elapsed is:

- Twice the half-life of Y
- Twice the half-life of X
- Equal to the half-life of X
- Equal $\frac{1}{2}$ the half-life of Y

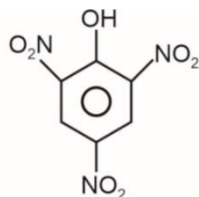
Answer (b)

Sol.

x (N_0) ↓ t_1 $\frac{N_0}{2}$ ↓ t_1 $\frac{N_0}{4}$	y (N_0) ↓ $2t_1$ $\frac{N_0}{2}$
--	---

Activity of x = Activity of y at $2t_1$ (i.e., 2 half-lives of x or say 1 half-life of y)

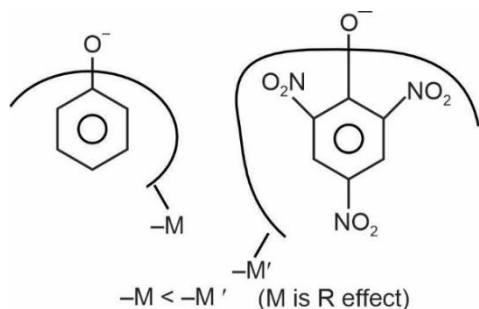
Sol.



pKa : >

Acidic strength : <

Stability of conjugate base <



50. The correct statements for 1,3-butadiene from following are:

- Molar addition of Br_2 yields only 1, 4-dibromo-2-butene as the major product when the reaction is performed for longer time period
- Molar addition of Br_2 yields only 1,2-dibromo-2-butene for longer time period
- $\text{C}_1 - \text{C}_2$ and $\text{C}_3 - \text{C}_4$ bonds are slightly longer than a $\text{C} = \text{C}$ bond
- $\text{C}_2 - \text{C}_3$ single bond is slightly shorter than a $\text{C} - \text{C}$ bond

Answer (a, c, d)

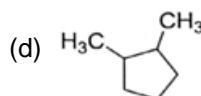
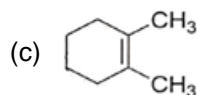
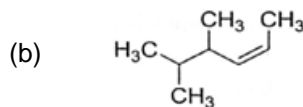
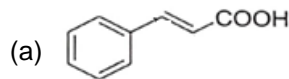
Sol.



Thermodynamic product is 1,4-addition product and the kinetic product is 1,2-addition product.

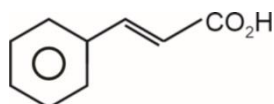
If the reaction is carried for longer time then the yield is defined thermodynamically means reaction will occur in the manner of higher the $K_{\text{equilibrium}}$.

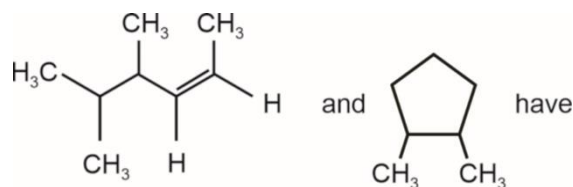
51. Which of the following representations will exhibit *cis-trans* isomerism?



Answer (a, b, d)

Sol. The structure





Suitable condition required to show geometrical isomerism as they have suitable pair of fixed centres.

52. For an elementary dimerization reaction of the type $2R \rightarrow R_2$, the value of the steric factor was found to be 2.5. This indicates that
- the experimentally obtained rate is 2.5 times faster than the theoretical rate.
 - ratio of the number of collisions calculated from collision theory and that actually take place is 1: 2.5.
 - the activation energy of the reaction is the same for both the experimental and calculated values.
 - the molecules of reactant R may be of some complex structure.

Answer (a, b, c, d)

Sol. Steric factor = $\frac{A_{\text{observed}}}{A_{\text{collision}}} = 2.5$

$$A_{\text{observed}} = (2.5) A_{\text{collision}}$$

$$\frac{\text{Number of collision calculated from collision theory}}{\text{Number of collisions that actually takes place}} = \frac{1}{2.5}$$

E_a will remain same.

It is possible that reactant R have some complex structure due to which theoretical and actual values are different.

53. The correct statement/s among the following is/are:
- The charge on the diffused layer of AgI colloidal solution by the addition of few drops of dilute aqueous solution of KI to an aqueous solution of AgNO_3 is negative.
 - The charge on the diffused layer of AgI colloidal solution by the addition of few drops of dilute aqueous solution of AgNO_3 to an aqueous solution of KI is positive.
 - When the ionic strength of a colloidal solution is increased, thickness of the double layer is increased, and the colloid gets precipitated.
 - When the ionic strength of a colloidal solution is increased, thickness of the double layer is decreased, and the colloid gets precipitated.

Answer (a, b, d)

- Sol.** (a) Charge on fixed layer is positive, so charge on diffused layer is negative
 (b) Charge on fixed layer is negative, so charge on diffused layer is positive
 (c) The higher is the ionic strength, the more compressed the double layer becomes.
 \Rightarrow Option (d) is correct
 Correct answer is a, b, d

54. In reverse osmosis the flow of solvent across semi permeable membrane occurs

- when hydrostatic pressure is greater than osmotic pressure
- when hydrostatic pressure is lower than osmotic pressure
- from higher concentrated solution to lower concentrated solution
- from lower concentrated solution to higher concentrated solution

Answer (a, c)

- Sol.** (a) Reverse osmosis takes place when hydrostatic pressure is greater than osmotic pressure.
 (b) Osmosis is movement of solvent particles from lower concentration to higher concentration.
 But reverse osmosis is movement of solvent particles from higher concentration to lower concentration.

55. Choose the correct statement(s) regarding zeolites:

- (a) Silicon atoms are replaced by aluminium atoms in the zeolites.
 (b) The pores and cavities of the zeolites as well as size and shape of reactant decides the reactions taking place in the zeolites.
 (c) The cracking of hydrocarbons and isomerisation reactions are catalyzed by zeolites in the petrochemical industries.
 (d) Zeolites act as molecular sieves and can separate the molecules of different sizes.

Answer (a, b, c, d)

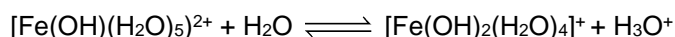
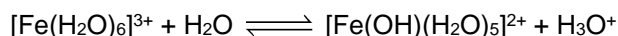
- Sol.** (a) Silicon atoms are replaced by aluminium atoms in the zeolites
 (b) The pores and cavities of zeolites as well as size and shape of reactant decides the reactions taking place in the zeolites.
 (c) Example is ZSM-5
 (d) Zeolites have small openings of fixed size, which allow small molecules to pass but large molecules can't pass through them. Hence they act as molecular sieves.
56. Crystalline iron(III) nitrate nonahydrate, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, has a very pale violet colour. When added to water, the crystals dissolve to form a brown solution. Treatment of this brown solution with concentrated nitric acid yields a very pale violet solution while treatment with HCl yields a yellow solution.

Identify the correct statements regarding the above observations.

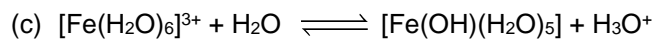
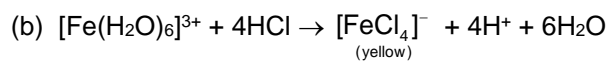
- (a) The brown colour is due to $[\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$, $[\text{Fe}(\text{OH})_2(\text{H}_2\text{O})_4]^+$
 (b) Violet colour is due to $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and yellow colour due to $[\text{FeCl}_4]^-$
 (c) Addition of HNO_3 shifts the equilibrium $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{H}_2\text{O} \rightleftharpoons [\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+} + \text{H}_3\text{O}^+$ to left giving pale violet colour
 (d) Addition of HNO_3 shifts the equilibrium $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{H}_2\text{O} \rightleftharpoons [\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+} + \text{H}_3\text{O}^+$ to right giving violet colour

Answer (a, b, c)

Sol. (a) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is pale violet

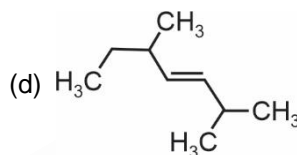
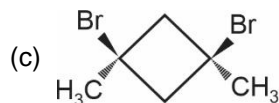
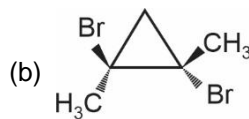
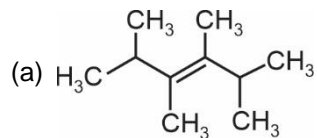


Brown color is due to formation of $[\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$ and $[\text{Fe}(\text{OH})_2(\text{H}_2\text{O})_4]^+$



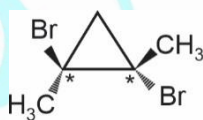
On addition of HNO_3 , reaction will shift in left side to give pale violet colour as per Le-Chatelier principle.

57. The optically active compounds from the following are:

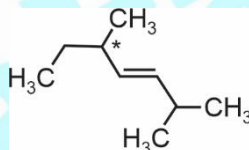


Answer (b, d)

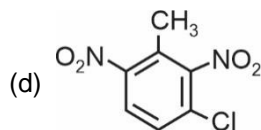
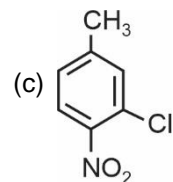
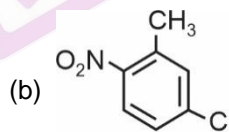
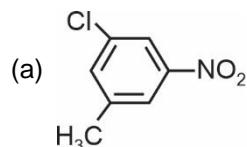
Sol. Compound (b) has two chiral centres but does not possess plane or centre of symmetry. It is optically active.



Compound (d) has one chiral centre and is optically active.

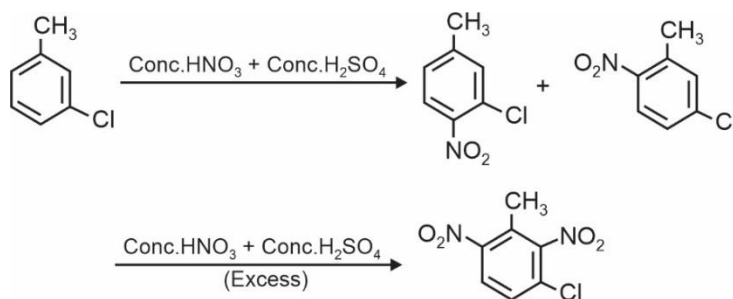


58. 3-chlorotoluene is reacted with a mixture of conc. H_2SO_4 and HNO_3 . The product(s) formed is/are

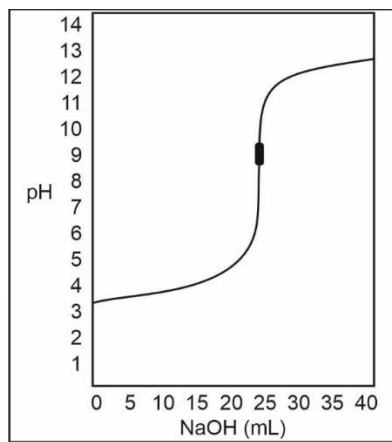


Answer (b, c, d)

Sol. Nitration of 3-chlorotoluene will result in substitution at the ortho as well as para positions with respect to CH_3 group because CH_3 group is activating. If the nitrating mixture is used in excess then disubstitution will take place.



59. Given below is the plot of pH vs volume of NaOH added in an acid-base titration. The correct statement/s among the following is/are



- (a) Before the equivalence point, a series of buffer solutions determine the pH
(b) The graph represents the titration of a strong acid with NaOH
(c) At the equivalence point, hydrolysis of the anion of the acid determines the pH
(d) After the equivalence point acid/salt buffer solution determines the pH

Answer (a, c)

Sol. From the plot of pH vs. volume of NaOH added in an acid-base titration, the pH at equivalence point is around 9. It implies that the given plot is for the titration of a weak acid with a strong base and not the titration of a strong acid with a strong base. Before the equivalence point the solutions will behave as an acidic buffer and its pH can be determined by using Henderson equation

$$\text{pH} = \text{pK}_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

At the equivalence point, the solution will have a salt of weak acid and strong base. The pH of solution at the equivalence point will be determined by using the hydrolysis of anion of weak acid

$$\text{pH} = \frac{1}{2} \text{pK}_w + \frac{1}{2} \text{pK}_a + \frac{1}{2} \log c$$

where c is the salt concentration.

After the equivalence point, the pH will be determined from the excess base present in solution. The solution will not behave like a buffer and the hydrolysis of anion of weak acid will be suppressed due to common ion effect.

60. The correct statement/s among the following is/are

- (a) The probability density (ψ^2) for a hydrogen atom is zero at $r = 0$
- (b) In an atom, orbitals with the same quantum number have different energies
- (c) The energy of a given orbital with same principal quantum number decreases as the atomic number 'Z', increases
- (d) For a given atomic number, the configuration having the maximum number of parallel spins is of the lowest energy than any other arrangement arising from the same configuration

Answer (c, d)

Sol. The probability density (ψ^2) for a hydrogen atom is not zero at $r = 0$. In fact, it is very large as r approaches zero. In an atom, orbitals with the same quantum numbers have same energy.

The energy of a given orbital with the same principal quantum number decreases as the atomic number 'Z' increases because as the charge on nucleus increases, all the electrons come closer to the nucleus resulting in decrease of their energy.

For a given atomic number, the configuration having maximum number of parallel spins is of lowest energy than any other arrangement arising from some configuration because the exchange energy is released.



