Please check the examination details below before entering your candidate information

Candidate Name	Class	Section

BLOOM Chemistry Olympiad (BCO)

Question Paper 2024-25

Class 12

Total Questions: **50 + 5** (Tie-Breaking Section)

Total Time Allotted : 60 minutes	**Total Marks** 60

Instructions

1. There are **50 Multiple Choice Questions** in this booklet having 4 options out of which **ONLY ONE** is correct.
2. There are two sections in the Question Paper ; Section A having 40 Questions carrying 1 Mark each & Section B having 10 Higher Difficulty Order Questions carrying 2 Marks each.
3. All questions are compulsory. There is **NO negative** marking for incorrect answers.
4. Total time allotted to complete the paper is 60 minutes.
5. Please fill in your details in the space provided on this page before attempting the paper.

OMR Sheet Instructions

1. Before starting the paper, fill in all the details in the OMR Sheet.
2. Additional 10 minutes will be provided to fill up the OMR sheet, before the start of the exam.
3. Use HB Pencil to darken the circle of the correct Option in OMR sheet. The correct way to darken the circle in OMR sheet is shown below

4. Use black or blue ball point pen/HB pencil to fill the information in the OMR sheet. Partially filled OMR sheet will not be checked.
5. Return the OMR sheet to the invigilator after the exam.

CODE#213

C12

BLOOM CAP
Founded by | arihant

Section A (1 Mark)

1. In the reaction given below, the rate of the reaction is highest for

$$\text{Carbonyl compound} + \text{MeOH} \overset{\text{HCl}}{\rightleftharpoons} \text{Acetal}$$

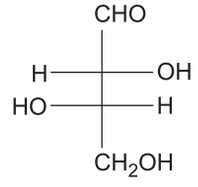
(a) acetone as substrate and methanol in stoichiometric amount.

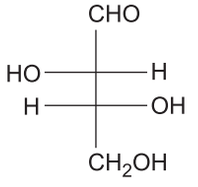
(b) acetone as substrate and methanol in excess.

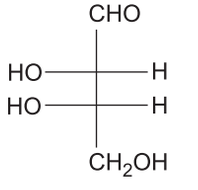
(c) propanal as substrate and methanol in stoichiometric amount.

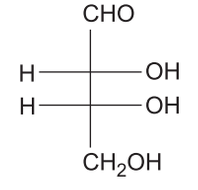
(d) propanal as substrate and methanol in excess.

2. *L*-isomer of compound (*X*) ($C_4H_8O_4$) gives a positive test with $[Ag(NH_3)_2]^+$. Further, treatment of *X* with acetic anhydride gives triacetate derivative. Compound (*X*) on reaction with bromine water yields an optically active compound (*Y*) while on reaction with HNO_3 yields an optically inactive compound (*Z*). Identify the compound (*X*).

(a) 

(b) 

(c) 

(d) 

3. *A* and *B* are two substances undergoing radioactive decay in a container. The half-life of *A* is 20 mins and that of *B* is 5 mins. If the initial concentration of *B* is 8 times that of *A* and they both start decaying at the same time, then the time taken for the concentration of both of them to be same will be

(a) 15 mins (b) 10 mins

(c) 20 mins (d) 25 mins

4. Arrange the following coordination compounds in the increasing order of magnetic moments. (Atomic numbers, Mn = 25, Fe = 26)

I. $[FeF_6]^{3-}$ II. $[Fe(CN)_6]^{3-}$ III. $[MnCl]^{3-}$ IV. $[Mn(CN)_6]^{3-}$

Choose the correct order from the options given below.

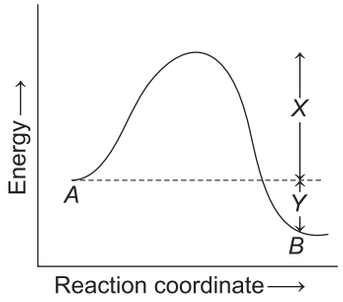
(a) I < II < IV < III

(b) II < IV < III < I

(c) I < III < IV < II

(d) II < IV < I < III

5. The energy diagram of reaction $A + B \rightarrow C + D$ is given below. What are X and Y in the graph?



(a) $X \rightarrow$ Potential energy, $Y \rightarrow$ Heat of reaction
(b) $X \rightarrow$ Activation energy, $Y \rightarrow$ Heat of reaction
(c) $X \rightarrow$ Threshold energy, $Y \rightarrow$ Heat of reaction
(d) $X \rightarrow$ Heat of reaction, $Y \rightarrow$ Activation energy

6. An organic compound 'X' on heating with NH_3 yields 'Y'. Which on heating gives 'Z'. 'Z' further in the presence of KOH reacts with Br_2 to give $CH_3CH_2NH_2$. The compound 'X' is

(a) CH_3COOH
(b) CH_3CH_2COOH
(c) $CH_3CH_2CH_2CH_2COOH$
(d) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

7. Which of the following statement is incorrect for (+) lactose ?

(a) (+) lactose, contains 8—OH groups.
(b) (+) lactose do not reduce Fehling's solution and Tollen's reagent.
(c) (+) lactose is a β-glucoside formed by a glycosidic linkage between C-1 of galactose and C-4 of glucose.
(d) On hydrolysis,(+) lactose gives equal amount of D (+) glucose and D (+) galactose.

8. Among the given reactions, which one will not form acetaldehyde?

(a) $CH_3CH_2OH \xrightarrow[573K]{Cu}$
(b) $CH_3CN \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL\text{-}H}$
(c) $CH_3CH_2OH \xrightarrow{CrO_3 - H_2SO_4}$
(d) $CH_2=CH_2 + O_2 \xrightarrow[H_2O]{Pd\ (II)\ /\ Cu\ (II)}$

9. Three Faraday's of electricity is passed through molten Al_2O_3, aqueous solution of $CuSO_4$ and molten NaCl taken in different electrolytic cells. The amount of Al, Cu and Na deposited at the cathodes will be in the ratio (in terms of moles) of

(a) 3 : 2 : 1
(b) 1 : 15 : 3
(c) 1.5 : 2 : 3
(d) 1 : 2 : 3

10. For an experiment on depression in freezing point, two isomers *X* and *Y* with the formula $Cr(H_2O)_5ClBr_2$ give the following observation.

It was found that 1 mole of *X* gave depression corresponding to 2 moles of particles and 1 mole of *Y* gave depression due to 3 moles of particles. The structural formula of *X* and *Y* respectively are

(a) $[Cr(H_2O)_5Cl]Br_2$, $[Cr(H_2O)_4ClBr]Br \cdot H_2O$

(b) $[Cr(H_2O)_5Cl]Br_2$, $[Cr(H_2O)_3ClBr_2] \cdot 2H_2O$

(c) $[Cr(H_2O)_4Br_2]Cl$, $[Cr(H_2O)_5Cl]Br_2 \cdot H_2O$

(d) $[Cr(H_2O)_5Cl]Br_2$, $[Cr(H_2O)_4Br_2]Cl \cdot H_2O$

11. A solution of potassium permanganate is reduced to various products depending upon its pH. At pH = 7, it forms a brown precipitate (*X*) and at pH > 7, it gives a green solution (*Y*).

Identify *X* and *Y*.

(a) $X \rightarrow Mn^{2+}$, $Y \rightarrow MnO_4^{2-}$

(b) $X \rightarrow MnO_2$, $Y \rightarrow MnO_4^{2-}$

(c) $X \rightarrow MnO_4^{2-}$, $X \rightarrow MnO_2$

(d) $X \rightarrow MnO_4^{2-}$, $Y \rightarrow Mn^{2+}$

12. A cell is constructed by coupling the two electrodes Zn^{2+}/Zn and Ag^+/Ag. If E° (Zn^{2+}/Zn), E° (Ag^+/Ag) and E°_{cell} are –0.76 V, 0.80 V and 1.56 V, respectively. The correct representation of the cell is

(a) $Zn(s)|Zn^{2+}(aq)\,||\,Ag^+(aq)|Ag(s)$

(b) $Zn^{2+}(aq)|Zn(s)\,||\,Ag(s)|Ag^+(aq)$

(c) $Zn(aq)|Zn^{2+}(s)\,||\,Ag^+(s)|Ag(aq)$

(d) $Ag(s)|Ag^+(aq)\,||\,Zn^{2+}(aq)|Zn(s)$

13. Which among the following products does not correctly matched with the corresponding reaction?

(a) $CH_3CH_2CH{=}CH_2 + HBr \xrightarrow{\text{Peroxide}} CH_3CH_2{-}\underset{\displaystyle Br}{\underset{|}{C}}HCH_3$

(b) $(CH_3)CBr + KOH \xrightarrow[\Delta]{\text{Ethanol}} CH_3{-}\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CH_2 + H_2O + KBr$

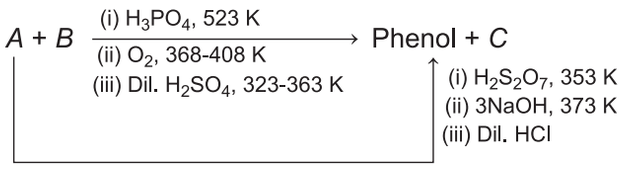
(c) $CH_3{-}\underset{\displaystyle OH}{\underset{|}{C}}H{-}CH_2CH_3 + NaOH \xrightarrow{H_2O} CH_3{-}\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_3 + NaBr + H_2O$

(d) $CH_3CH{=}C(CH_3)_2 + HBr \longrightarrow CH_3{-}CH_2{-}C\begin{matrix}CH_3\\ \diagup\\ -Br\\ \diagdown\\ CH_3\end{matrix}$

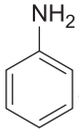
14. Two solutions *X* and *Y* are prepared by dissolving 2 g of non-volatile solute *A* and *B*, respectively in 2 kg of water. The ratio of elevation in boiling points for *X* and *Y* is found to be 1 : 5. The ratio of molar masses of *A* and *B* is

(a) 1 : 5 (b) 1 : 0.25 (c) 1 : 4 (d) 1 : 0.20

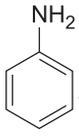
15. Identify the products *A*, *B* and *C* respectively in the following reaction sequence.



(a) A ⇒  , B ⇒ $CH_3CH=CH_2$, C ⇒ CH_3COCH_3

(b) A ⇒  , B ⇒ $CH_3CH_2CH=CH_2$, C ⇒ CH_3CHO

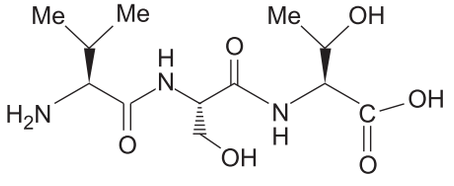
(c) A ⇒  , B ⇒ $CH_3CH_2CH=CH_2$, C ⇒ CH_3COCH_3

(d) A ⇒  , B ⇒ $CH_3CH=CH_2$, C ⇒ CH_3CHO

16. A sweet smelling organic compound (*A*) is slowly oxidised by air in presence of light to a highly poisonous gas. On warming with silver powder, it forms a gaseous substance, *B* which is also produced by the action of calcium carbide on water. The compound *A* and *B* respectively are

(a) CCl_4, $HC\equiv CH$
(b) $CHCl_3$, $CH_2=CH_2$
(c) CCl_4, $CH_2=CH_2$
(d) $CHCl_3$, $HC\equiv CH$

17. Peptides are written with *N*-terminal amino acid (with free —NH_2 group) on the left and *C*-terminal amino acid (with free —COOH group) on the right. The *X*-ray studies of dipeptides and polypeptides shows that the peptide linkage is flat. In the given tripeptide below, the correct sequence of amino acids present is



(a) Thr-Ser-Val
(b) Val-Ser-Thr
(c) Leu-Ser-Thr
(d) Thr-Ser-Leu

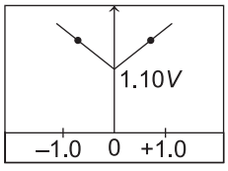
18. A transition metal '*M*' among Sc, Ti, V, Cr, Mn and Fe has the highest second ionisation enthalpy. Which of the following spin-only magnetic moment values correctly represent the value of M^+ ion?

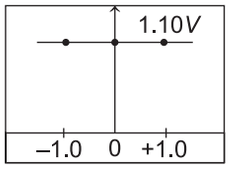
(a) 4.87 BM
(b) 5.92 BM
(c) 2.86 BM
(d) 1.73 BM

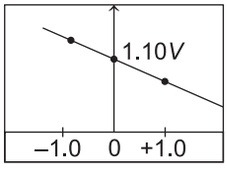
19. Which of the following graph correctly correlates E_{cell} as a function of concentrations for the cell (for different values of *M* and *M′*)?

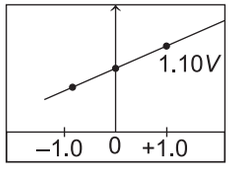
$$Zn(s) + Cu^{2+}(M) \longrightarrow Zn^{2+}(M') + Cu(s) \; ; E^{\circ}_{cell} = 1.10 \text{ V}$$

X-axis : $\log_{10} \dfrac{[Zn^{2+}]}{[Cu^{2+}]}$, *Y*-axis : E_{cell}

(a) 

(b) 

(c) 

(d) 

20. A lead storage cell is discharged which causes the sulphuric acid electrolyte to change from a concentration of 34.6% by mass (density 1.261 g/mL at 25°C) to one of 27% by mass. If the original volume of electrolyte is one litre, then the amount of faraday that have left the anode of battery will be

[**Note** : The overall reaction is $Pb(s) + PbO_2 + 2H_2SO_4(s) \longrightarrow 2PbSO_4(s) + 2H_2O$]

(a) 1.34 F (b) 1.26 F

(c) 2.89 F (d) 2.05 F

21. A polysaccharide '*A*' (containing β-glycosidic linkages only) on boiling with the dilute sulphuric acid at 393 K under 2-3 atm pressure gives '*B*'. '*B*' on treatment with Br_2 / H_2O yields gluconic acid. The compound '*A*' is

(a) amylopectin (b) amylose

(c) starch (d) cellulose

22. The lanthanoids are characterised by the filling up of the antipenultimate 4*f* energy levels. The 4*f*-electrons in the antipenultimate shell are neither removed to produce ions nor do they take any significant part in the crystal field stabilisation of complexes. On the basis of the given information, the number of electrons present in 4*f* orbital of HO^{3+} ion is

(a) 12 (b) 11

(c) 10 (d) 13

23. A complex (*X*) having a composition of $H_{12}O_6Cl_3Cr$ on treatment with conc. H_2SO_4 loses 13.5% of its original mass. The correct molecular formula of (*X*) will be

[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]

(a) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$ (b) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

(c) $[Cr(H_2O)_6]Cl_3$ (d) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

24. The plots of $\frac{1}{X_A}$ *vs* $\frac{1}{Y_A}$ (where X_A and Y_A are the mole fraction of liquid *A* in liquid and vapour phase respectively) is linear. The slope and intercepts of the plot mentioned respectively is

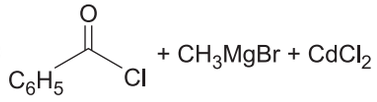
(a) $\frac{p_B^\circ}{p_A^\circ}$ and $\frac{p_A^\circ - p_B^\circ}{p_B^\circ}$

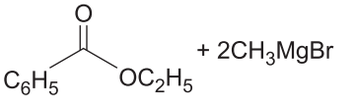
(b) $\frac{p_A^\circ}{p_B^\circ}$ and $\frac{p_B^\circ - p_A^\circ}{p_B^\circ}$

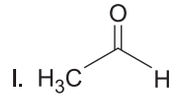
(c) $\frac{p_A^\circ}{p_B^\circ}$ and $\frac{(p_A^\circ - p_B^\circ)}{p_B^\circ}$

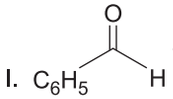
(d) $\frac{p_B^\circ}{p_A^\circ}$ and $\frac{(p_B^\circ - p_A^\circ)}{p_B^\circ}$

25. Which of the following reaction sequene will not give acetophenone as the major product?

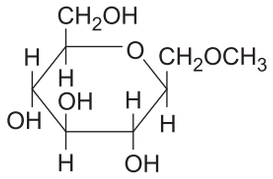
(a)  + CH_3MgBr + $CdCl_2$

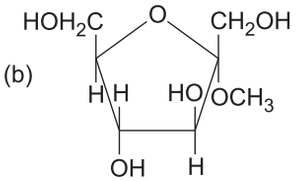
(b)  + $2CH_3MgBr$

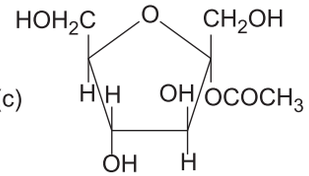
(c)  I. H_3C + C_6H_5MgBr II. PCC, DCM

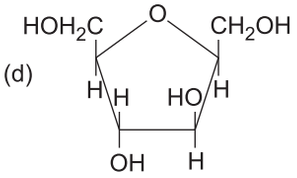
(d)  I. C_6H_5 + CH_3MgBr II. $Na_2Cr_2O_7$, H^+

26. Which among the following compounds will behave as a reducing sugar in an aqueous KOH solution?

(a) 

(b) 

(c) 

(d) 

27. Consider the following reaction,

$$RCH_2Br + I^- \xrightarrow{\text{Acetone}} \underset{\text{Major}}{RCH_2I} + Br^-$$

Mark the correct statement pertaining to the above given reaction.

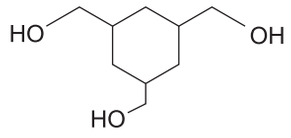
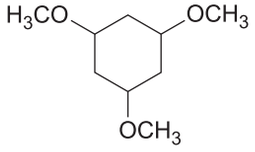
(a) The reaction can occur in acetic acid also.

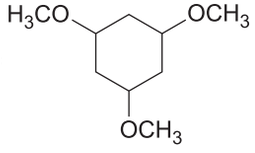
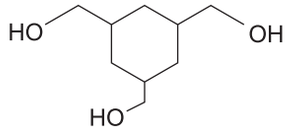
(b) The transition state formed in the above reaction is less polar than localised form.

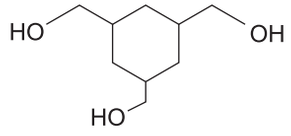
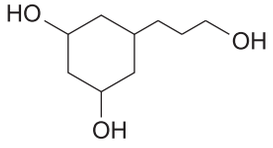
(c) Br^- can acts as competing nucleophile.

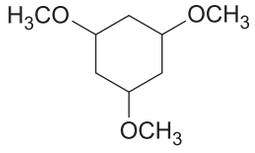
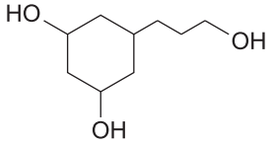
(d) The solvent used in the reaction solvates the ions formed in rate determining step.

28. Consider the two compounds *A* and *B* having molecular formula $C_9H_{18}O_3$. If compound *A* has higher boiling point than compound *B*, then the possible structures of *A* and *B* are

(a) A =  ; B = 

(b) A =  ; B = 

(c) A =  ; B = 

(d) A =  ; B = 

29. Which of the following statement is incorrect regarding the reaction given below ?

$$C_6H_5\underset{(X)}{N}(CH_3)_2 + NaNO_2 + HX \longrightarrow (Y)$$

(a) The reaction occurs at low temperature.

(b) The product '*Y*' formed in the above reaction is *p*-nitroso compound at low temperature.

(c) '*Y*' is N-nitroso ammonium compound.

(d) The electrophile involved in the reaction is NO^+.

30. Air is bubbled through CH_3OH and is saturated with vapours of CH_3OH after passing 1 L air through CH_3OH, mass of CH_3OH decreases by 0.201 g. If the total pressure of system is invariable and is equal to 1 atm, then the saturated vapour pressure of CH_3OH (considering temperature remains constant, i.e., 294.4 K) will be

(a) 0.842 atm (b) 0.1315 atm

(c) 0.248 atm (d) 0.435 atm

31. Standard electrode potential data are useful for understanding the suitability of an oxidation in a redox titration. The standard reduction potentials at 298 K for the following half-cells are given below.

$$V^{2+}(aq) + 2e^- \longrightarrow V\ ;\ E^\circ = -1.19\ V$$

$$NO_3^- + 4H^+ + 3e^- \longrightarrow NO(g) + 2H_2O\ ;\ E^\circ = 0.91\ V$$

$$Fe^{3+}(aq) + 3e^- \longrightarrow Fe\ ;\ E^\circ = -0.04\ V$$

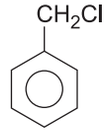
$$Ag^+(aq) + e^- \longrightarrow Ag(s)\ ;\ E^\circ = 0.80\ V$$

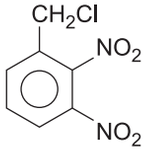
$$Au^{3+}(aq) + 3e^- \longrightarrow Au(s)\ ;\ E^\circ = 1.40\ V$$

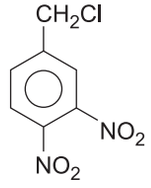
The number of metal(s) which will be oxidised by NO_3^- in aqueous solution is

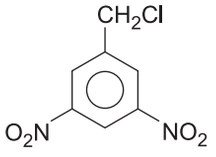
(a) 2 (b) 3 (c) 1 (d) 4

32. Consider the following compounds.

I. 

II. 

III. 

IV. 

The correct decreasing order of reactivity of the above given compounds towards S_N2 reaction is

(a) II > III > I > IV (b) II > III > IV > I

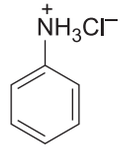
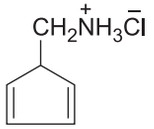
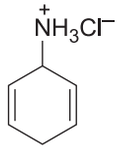
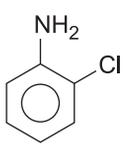
(c) IV > II > III > I (d) III > II > IV > I

33. If $[Cu(H_2O)_4]^{2+}$ absorbs a light of wavelength 600 nm for *d-d* transition, then the value of octahedral crystal field splitting energy for $[Cu(H_2O)_6]^{2+}$ will be

(a) 766×10^{-21} J (b) 809×10^{-23} J

(c) 684×10^{-21} J (d) 438×10^{-23} J

34. An organic compound '*X*' containing nitrogen and chlorine dissolves readily in water to give a solution which turns litmus red. Titration of compound '*X*' with standard base indicates that the molecular weight of '*X*' is 131 ± 2. On treatment of aqueous NaOH with a sample of '*X*', a liquid separates which contains N but not Cl. Further, treatment of the obtained liquid with HNO_2 followed by C_6H_5OH yields orange precipitate. The compound '*X*' is

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

35. Consider the following reactions,

$$P \xrightarrow{4KOH,\ O_2} \underset{(Green)}{2Q} + 2H_2O$$

$$3Q \xrightarrow{4HCl} \underset{(Purple)}{2R} + MnO_2 + 2H_2O$$

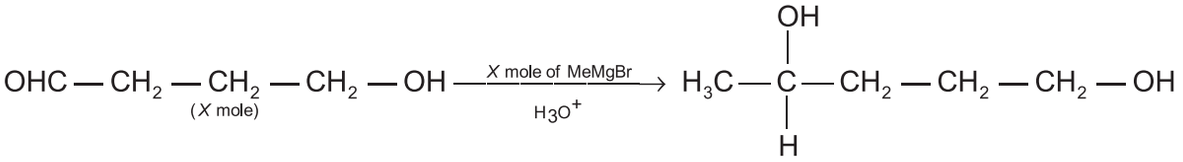
$$2R \xrightarrow{H_2O,\ KI} 2P + 2KOH + S$$

In the above given sequence of reactions, *P* and *S* respectively are

(a) KIO_3 and MnO_2 (b) KI and K_2MnO_4

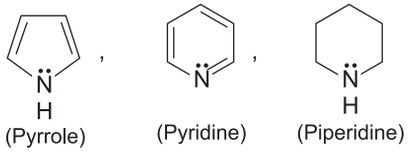
(c) KI and $KMnO_4$ (d) MnO_2 and KIO_3

36. The ratio $\frac{X}{Y}$ on completion of the reaction given below is



(a) 0.5 (b) 2 (c) 3 (d) 1

37. Among the given compounds, the correct order of basic strength is



(a) Pyrrole > Pyridine > Piperidine (b) Pyrrole > Piperidine > Pyridine
(c) Piperidine > Pyridine > Pyrrole (d) Pyridine > Piperidine > Pyrrole

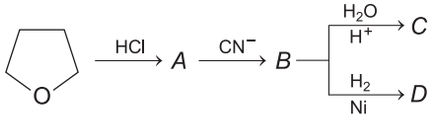
38. The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{M_1} and that with 20 moles of another identical cell having 80 mL NaCl solution is Λ_{M_2}. The conductivities exhibited by these two cells are same. Which of the given relationship correctly represents the relation between Λ_{M_2} and Λ_{M_1}?

(a) $\Lambda_{M_2} = 4\Lambda_{M_1}$ (b) $\Lambda_{M_2} = \Lambda_{M_1}$
(c) $\Lambda_{M_2} = \Lambda_{M_1/2}$ (d) $\Lambda_{M_2} = 2\Lambda_{M_1}$

39. The freezing point of pure benzene is 5.3°C. A solution of 0.223 g of phenylacetic acid in 4.4 g of benzene ($K_f = 5.12\ \text{K kg mol}^{-1}$) freezes at 4.47°C. The conclusion from above observation is

(a) Phenylacetic acid dimerizes in benzene.
(b) Phenylacetic acid undergoes complete ionisation in benzene.
(c) Phenylacetic acid undergoes partial ionisation in benzene.
(d) Phenylacetic acid exists as such in benzene.

40. Consider the following reaction,



In the above reaction series the product *C* and *D* are

(a) $HOOC(CH_2)_3COOH$; $H_2N(CH_2)_4NH_2$
(b) $HOOC(CH_2)_4COOH$; $H_2NCH_2(CH_2)_4CH_2NH_2$
(c) $HOOC(CH_2)_4CH_2NH_2$; $H_2N(CH_2)_4NH_2$
(d) $HOOC(CH_2)_4COOH$; $H_2NC(=O)(CH_2)_4—C(=O)NH_2$

Section B (2 Marks)

41. Consider the following statements.

I. Dissolving a non-volatile solute in a liquid solvent cause a lowering of freezing point.
II. K_f is called cryoscopic constant or normal freezing point depression.
III. Two sucrose solutions of same molality prepared in different solvents will have same freezing point depression.
IV. In countries nearer to polar region, the roads are sprinkled with $CaCl_2$ to minimise the snowfall.

Choose the correct statement and select the correct option.

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

42. Consider the following reaction sequence,

$$CH_3-CH=CH-CH_3 \xrightarrow{\text{Ozonolysis}} A \xrightarrow[\text{(ii) } H_2O^+]{\text{(i) } CH_3MgBr} B \xrightarrow[573\ K]{Cu} C$$

The correct statements about *C* are

I. It forms red precipitate with Fehling's solution.
II. It undergoes Wolff-Kishner reduction.
III. It gives yellow precipitate with I_2 and NaOH solution.
IV. It undergoes disproportionation reaction in the presence of concentrated NaOH solution.

Choose correct answer from the options given below.

(a) I and II
(b) II and III
(c) I and IV
(d) I and III

43. **Assertion (A)** Central atom in $[CoCl(NH_3)_5]^{2+}$ and $[NiCl_2(H_2O)_4]$ behave as lewis acid.

Reason (R) Co^{3+} and Ni^{2+} have empty *d*-subshell and therefore, they can accept a lone pair of electron.

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

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

44. **Assertion (A)** A water molecule gets eliminated from acetic acid to form its anhydride.

Reason (R) Anhydride on reaction with benzene in presence of lewis acid gives $C_6H_5COCH_3$.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

45. Match List I with List II

	List I (Reactants)		**List II** (Product)
A.	Phenol, $Na_2Cr_2O_7$, H_2SO_4	I.	Benzene
B.	Phenol, NaOH, CO_2, HCl	II.	*p*-cresol
C.	Phenol, $CHCl_3$, anhy. $AlCl_3$	III.	*p*-benzoquinone
D.	Phenol, Zn/Δ	IV.	Salicylic acid

Choose the correct answer from the options given below.

(a) A-I, B-IV, C-III, D-II
(b) A-II, B-IV, C-III, D-I
(c) A-III, B-IV, C-II, D-I
(d) A-IV, B-III, C-I, D-II

46. Match List I with List II.

	List I (Chemical reactions)		**List II** (Reagents used)
A.	$R-\underset{\underset{O}{\|\|}}{C}-CH_3 \longrightarrow RCH_2CH_3$	I.	Cl_2/ Red P, H_2O
B.	$R-HC=NH \longrightarrow R-CHO$	II.	Zn(Hg)/conc. HCl
C.	$R-CH_2-COOH \longrightarrow R-\underset{\underset{Cl}{\|}}{CH}-COOH$	III.	H_2 / Pd-$BaSO_4$
D.	$R-COCl \longrightarrow R-CHO$	IV.	H_2O / H^+

Choose the correct answer from the options given below.

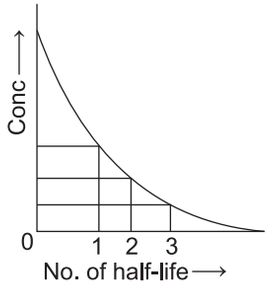
(a) A-III, B-IV, C-I, D-II
(b) A-IV, B-III, C-II, D-I
(c) A-II, B-IV, C-III, D-I
(d) A-I, B-II, C-IV, D-III

Case Study

Direction (Q. No. 47 to 50) The following reaction, $X(g) \longrightarrow P(g) + Q(g) + R(g)$

follows first order kinetics. The half-life period of the given reaction is 69.3 at 500°C.

The gas *X* is enclosed in a container at 500°C and at a pressure of 0.4 atm. It may be noted that though the major portion of the first order kinetics may over in a finite time, but the reaction will never cease as the concentration of the reactant will be zero at infinite time.

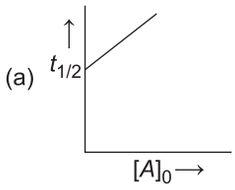


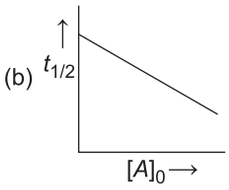
47. The total pressure of the system after 230 s will be

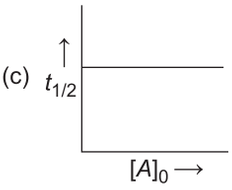
(a) 0.54 atm (b) 2.18 atm

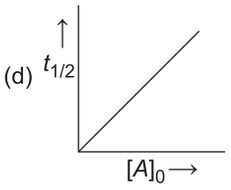
(c) 1.12 atm (d) 3.09 atm

48 Which of the following curve correctly represent the plot of $t_{1/2}$ *versus* $[A_0]$ (initial concentration)?

(a) 

(b) 

(c) 

(d) 

49. What will be the pressure of gas *A* after 230 s?

(a) 0.036 atm (b) 0.4 atm

(c) 0.36 atm (d) 0.04 atm

50. If the concentration of substance whose decomposition follows first order kinetics is reduced to $\frac{1}{8}$ of its initial value in 12 mins, then the rate constant of the decomposition of substance will be

(a) $\left(\frac{1}{12}\log 8\right)\text{min}^{-1}$ (b) $\left(\frac{0.693}{12}\right)\text{min}^{-1}$

(c) $\left(\frac{2.303}{12}\log 8\right)\text{min}^{-1}$ (d) $\left(\frac{2.303}{12}\log\frac{1}{8}\right)\text{min}^{-1}$

Tie-Breaking Section

Instructions

1. This section consists of 5 questions.
2. The score achieved in this section will not be included in the total marks.
3. If overall marks of two or more students are same, winner will be decided based on the score in this section.
4. Participation in this section is optional, and students may choose to attempt it or not.

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1. The molar volume of liquid benzene (density = 0.877 g/mL) increases by a factor of 2750 as it vaporises at 20°C and that of liquid toluene (density = 0.867 g/mL) increases by a factor of 7720 at 20°C. A solution of benzene and toluene at 20°C has a vapour pressure of 45 torr. The mole fraction of benzene in the vapour above the solution will be

(a) 0.84 (b) 0.43

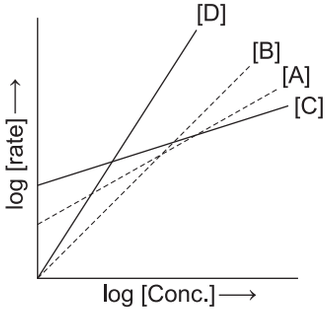
(c) 0.71 (d) 0.52

---

2. Consider the following reactions,

$$A \rightarrow P_1\ ,\ B \rightarrow P_2,\ C \rightarrow P_3,\ D \rightarrow P_4$$

The order of the above reactions are *A*, *B*, *C* and *D* respectively. On plotting log [rate] *versus* log [conc.], following graph is obtained.



Which of the following sequence correctly represent the order of the reaction?

(a) *D* > *B* > *A* > *C* (b) *C* > *A* > *B* > *D*

(c) *A* > *B* > *C* > *D* (d) *D* > *A* > *B* > *C*

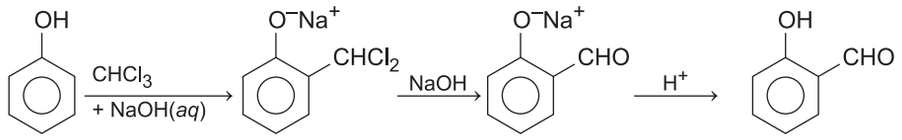
---

3. A test for complete removal of Cu^{2+} ions from a solution of $Cu^{2+}(aq)$ is to add $NH_3(aq)$. A blue colour signifies the formation of complex $[Cu(NH_3)_4]^{2+}$ having $K_f = 1.1 \times 10^{13}$ and thus confirms the presence of Cu^{2+} in solution. 250 mL of 0.1 M $CuSO_4(aq)$ is electrolysed by passing a current of 3.512 ampere for 1368 seconds. After passage of this charge sufficient quantity of $NH_3(aq)$ is added to electrolysed solution maintaining $[NH_3] = 0.1$ M. If $[Cu(NH_3)_4]^{2+}$ is detectable upto its concentration as low as 1×10^{-5} M, then the amount of $[Cu^{2+}]$ left is

(a) 2.08×10^{-4} M (b) 4.28×10^{-4} M

(c) 1.46×10^{-4} M (d) 3.12×10^{-4} M

4. In Reimer-Tiemann reaction,



Mark the incorrect statement about the mechanism of the above reaction?

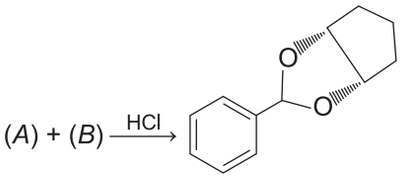
(a) The reaction undergoes S_N1 mechanism.

(b) The electrophile generated is carbene in the mechanism.

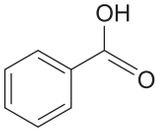
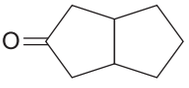
(c) In this reaction, a mixture of both *ortho* and *para* isomer is obtained.

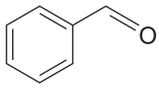
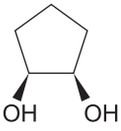
(d) It is a type of electrophilic substitution reaction.

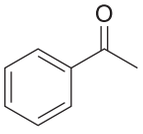
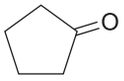
5. Consider the following reaction,

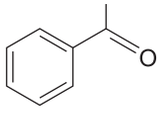


In the above given reaction, the starting material needed for the reactions, i.e., (*A*) and (*B*) respectively are

(a) A ⇒  ; B ⇒ 

(b) A ⇒  ; B ⇒ 

(c) A ⇒  ; B ⇒ 

(d) A ⇒  ; B ⇒