

DAV PUBLIC SCHOOL, MCL, KALINGA AREA

PRACTICE PAPER - 05

CHEMISTRY

Max. Marks : 70

Time : 3 hrs

Instructions

1. There are 33 questions in this question paper. All questions are compulsory.
2. **Section A** : Q. no. 1-2 are case-based questions having four MCQs or Assertion-Reason type based on given passage each carrying 1 mark and Question 3 to 16 are MCQs and Assertion-Reason type questions carrying 1 mark each.
3. **Section B** : Q. no. 17 to 25 are short answer type I questions and carry 2 marks each.
4. **Section C** : Q. no. 26 to 30 are short answer type II questions and carry 3 marks each.
5. **Section D** : Q. no. 31 to 33 are long answer questions carrying 5 marks each.
6. There is no overall choice. However, an internal choices have been provided.
7. Use of calculators and log tables is not permitted.

SECTION A : Objective Questions

(1 Mark)

Passage Based Questions

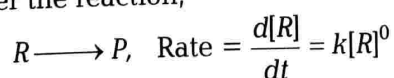
1. Read the passage given below and answer the following questions :

(1 × 4 = 4 Mark)

The instantaneous rate can be measured by determination of slope of the tangent at point 't' in concentration vs time plot. This makes it difficult to determine the rate law and hence the order of the reaction. In order to avoid this difficulty, we can integrate the differential rate equation to give a relation between directly measured experimental data, i.e. concentrations at different times and rate constant.

The integrated rate equation are different for the reactions of different reaction orders. We shall determine these equations only for zero and first order chemical reactions.

Zero order reaction means that the rate of the reaction is proportional to zero power of the concentration of reactants. Consider the reaction,



First order reaction means that, the rate of the reaction is proportional to the first power of the concentration of reactions, R . For the reaction, $R \longrightarrow P$, Rate = $\frac{d[R]}{dt} = k[R]$ and the integrating rate equation is $k = \frac{1}{t} \ln \frac{[R]_0}{[R]}$ where, $[R]$ is final concentration and $[R]_0$ is initial concentration of reactant, respectively.

The following questions (i-iv) are multiple choice questions. Choose the most appropriate answer :

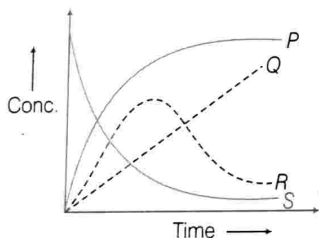
(i) For a hypothetical reaction, $R \longrightarrow$ products; rate = $-k[R]$. The negative sign used in the rate expression indicates.

- (a) Decrease in the concentration of reactants with time
- (b) Decrease in the rate with time
- (c) Reaction is reversible
- (d) None of the above

(ii) For a reaction,

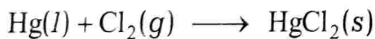


The curve which depicts the variation of the concentration of products is



- (a) P (b) Q (c) R (d) S

(iii) For the reaction,



The rate of reaction is given as

- (a) $\frac{\Delta[\text{HgCl}_2]}{\Delta t}$
- (b) $-\frac{\Delta[\text{Hg}]}{\Delta t}$
- (c) $-\frac{\Delta[\text{Cl}_2]}{\Delta t}$
- (d) All of these

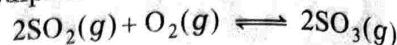
(iv) For the reaction, $2X + Y \longrightarrow X_2Y$

What will be the expression for instantaneous rate of the reaction?

- (a) $\frac{-d[X]}{2dt}$
- (b) $+\frac{1}{2} \frac{d[Y]}{dt}$
- (c) $-\frac{1}{2} \frac{d[X_2Y]}{dt}$
- (d) None of these

Or

Contact process is used in the formation of sulphur trioxide,



The rate of reaction can be expressed as

$$\frac{-\Delta[\text{O}_2]}{\Delta t} = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

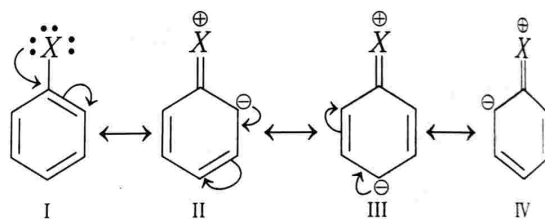
Then rate of disappearance of $[\text{SO}_2]$ will be

- (a) $50.0 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$
- (b) $3.75 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- (c) $2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$
- (d) $4.12 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

2. Read the passage given below and answer the following questions : (1×4=4 Marks)

Haloarenes undergo the usual electrophilic reactions of the benzene ring such as halogenation, nitration, sulphonation and Friedel-Crafts reactions. Halogen atom besides being slightly deactivating is *o*, *p*-directing; therefore, further substitution occurs at *ortho*- and *para*-positions with respect to the halogen atom.

The *o*, *p*-directing influence of halogen atom can be easily understood if we consider the resonating structures of halobenzene as shown :



Due to resonance, the electron density increases more at *ortho*- and *para*-positions than at *meta*-positions. Further, the halogen atom because of its $-I$ effect has some tendency to withdraw electrons from the benzene ring.

As a result, the ring gets somewhat deactivated as compared to benzene as hence the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

On halogenation, chlorobenzene gives 1, 4-dichlorobenzene (major) and 1, 2-dichlorobenzene (minor) and upon nitration, chlorobenzene gives 1-chloro-2-nitrobenzene and 1-chloro-4-nitrobenzene. Similarly, on sulphonation, chlorobenzene give 2-chlorobenzene sulphonic acid and 4-chlorobenzene sulphonic acid.

In these questions (i-iv) a statement of Assertion followed by a statement of Reason is given. Choose the correct answer out of the following choices :

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
 (b) Assertion and Reason both are correct statements but Reason is not correct explanation for Assertion.
 (c) Assertion is correct statement but Reason is incorrect statement.
 (d) Assertion is incorrect statement but Reason is correct statement.
- (i) **Assertion** Bond cleavage in haloarene is difficult than haloalkane.

Reason Phenyl carbocation is more stable.

- (ii) **Assertion** Presence of nitro group at *ortho* or *para* position increases the reactivity of haloarene towards nucleophilic substitution.

Reason Nitro group being an electron withdrawing group decreases the electron density over the benzene ring.

- (iii) **Assertion** Electrophilic substitution reactions in haloarene occur slowly and under drastic conditions.

Reason Haloarene are activated as compared to benzene.

- (iv) **Assertion** Nitration of chlorobenzene leads to the formation of *ortho* and *para* nitro chloro benzene.

Reason $-\text{NO}_2$ group is *o*, *p*-directing group.

Or

Assertion Chlorine is an *ortho-para* directing group in electrophilic aromatic substitution reaction.

Reason Chlorine is an electron withdrawing group.

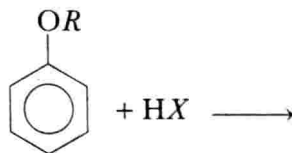
Multiple Choice Questions

Following questions (No. 3-11) are multiple choice questions carrying 1 mark each

3. Which of the following ions will exhibit colour in aqueous solutions ?
 (a) Sc^{3+} ($Z = 21$) (b) La^{3+} ($Z = 57$)
 (c) Ti^{3+} ($Z = 22$) (d) Lu^{3+} ($Z = 71$)
4. Benzoic acid reacts with LiAlH_4 to give
 (a) ethylbenzene (b) methylbenzene
 (c) phenol (d) benzyl alcohol
5. Which of the following method is used for the preparation of symmetrical and unsymmetrical ether?
- (a) Williamson's synthesis
 (b) Riemer-Tiemann reaction
 (c) Kolbe's reaction
 (d) None of the above

Or

In the given reaction,



The product is/are

- (a) + RX
- (b) + RX
- (c) + ROH
- (d) + ROX

6. The molar mass of a few compounds are given below :

Compounds	Molar mass
$n\text{-C}_4\text{H}_9\text{NH}_2$	73
$(\text{C}_2\text{H}_5)_2\text{NH}$	73
$\text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$	73

The boiling point would be maximum for

- (a) $n\text{-C}_4\text{H}_9\text{NH}_2$
 (b) $(\text{C}_2\text{H}_5)_2\text{NH}$
 (c) $\text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$
 (d) boiling would be almost same

7. Which among the following metals is considered as transition metal?

- (a) Zinc (b) Cadmium
(c) Mercury (d) Scandium

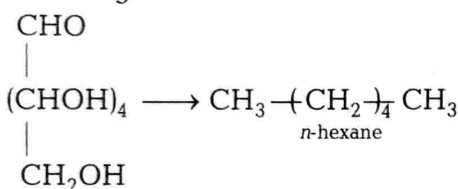
Or

For the four successive transition elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order?

[Atomic number of Cr = 24, Mn = 25, Fe = 26 and Co = 27]

- (a) Cr > Mn > Co > Fe
(b) Mn > Fe > Cr > Co
(c) Fe > Mn > Co > Cr
(d) Co > Mn > Fe > Cr

8. Name the reagent and condition required for carrying out of the following reaction.



- (a) HF, Δ (b) HCl, Δ
(c) HBr, Δ (d) HI, Δ

9. For a zero order reaction a graph of concentration (along y-axis) and time (along x-axis) is linear with

- (a) a zero intercept and a +ve slope
(b) a zero intercept and a -ve slope
(c) a non-zero intercept and a -ve slope
(d) a non-zero intercept and a +ve slope

Or

The rate law expression for the reaction, $2\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_2$ is rate = $k[\text{NO}]^2[\text{O}_2]$

the unit of rate constant (k) is

- (a) $\text{mol L}^{-1} \text{s}^{-1}$ (b) s^{-1}
(c) $\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$ (d) mol L^{-1}

10. What would be the side products formed with primary amine in the Hofmann bormamide degradation reaction?

- (a) $\text{Na}_2\text{CO}_3 + \text{NaBr}$
(b) $\text{NaBr} + \text{H}_2\text{O} + \text{NaOH}$
(c) $\text{NaBr} + \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$
(d) $\text{Br}_2 + \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$

11. Which of the following is major component of the bar soaps?

- (a) $\text{CH}_3(\text{CH}_2)_{16}\text{COO}^- \text{Na}^+$
(b) $\text{CH}_3(\text{CH}_2)_{60}\text{COO}^- \text{Na}^+$
(c) $\text{CH}_3 - \text{CH}_2 - \text{COO}^- \text{Na}^+$
(d) $\text{CH}_3 - (\text{CH}_2)_{15}\text{CH} \begin{cases} \text{COO}^- \text{Na}^+ \\ \text{COO}^- \text{Na}^+ \end{cases}$

Or

For coagulation of a positive sol, the flocculating power of anions are in the order of

- (a) $\text{Cl}^- > \text{SO}_4^{2-} > \text{PO}_4^{3-}$ (b) $\text{PO}_4^{3-} > \text{Cl}^- > \text{SO}_4^{2-}$
(c) $\text{PO}_4^{3-} = \text{Cl}^- = \text{SO}_4^{2-}$ (d) $\text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$

Assertion-Reason

In the following questions (Q.No. 12-16) a statement of Assertion followed by a statement of Reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and Reason both are correct statements and Reason is correct explanation for Assertion.
(b) Assertion and Reason both are correct statements but Reason is not correct explanation for Assertion.
(c) Assertion is correct statement but Reason is incorrect statement.
(d) Assertion is incorrect statement but Reason is correct statement.

12. **Assertion** Hofmann bromamide reaction is given by primary amines.

Reason Primary amines are less basic than secondary amines.

Or

Assertion Fe + HCl is preferred as a reagent in the oxidation of nitroalkanes to alkanamines.

Reason Iron scrap and HCl is preferred in the reduction reaction of nitrobenzene.

13. **Assertion** Cr and Cu are extra stable elements in the 3d-series.

Reason Half and completely filled set of orbitals are relatively more stable.

14. **Assertion** *o*-nitrophenol is less volatile than *p*-nitrophenol.

Reason There is intramolecular hydrogen bonding in *o*-nitrophenol and intermolecular hydrogen bonding in *p*-nitrophenol.

15. **Assertion** Formaldehyde is a planar molecule.

Reason It contains sp^2 -hybridised carbon atom.

16. **Assertion** S_N1 mechanism is facilitated by polar protic solvents like water, alcohol etc.
Reason $C_6H_5CH_2C_6H_5Br$ is less reactive than $C_6H_5CH(CH_3)Br$ in S_N1 reactions.

SECTION B : Short Answer Type I Questions (2 Marks)

17. (i) The decomposition of dimethyl ether leads to the formation of CH_4 , H_2 and CO and the reaction rate is given by $rate = k[CH_3OCH_3]^{3/2}$. The rate of reaction is followed by increase in pressure in a closed vessel, so the rate can also be expressed in terms of the partial pressure of dimethyl ether, i.e. $rate = k[p_{CH_3OCH_3}]^{3/2}$.
If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constant?
- (ii) What is the order of a reaction that is 50% complete after 2h and 75% complete after 4h?

Or

During the kinetic study of the reaction $2A + B \longrightarrow C + D$, following result were obtained:

S.No.	[A]/mol ⁻¹	[B]/mol ⁻¹	Initial rate of formation of D/mol ⁻¹ min ⁻¹
1	0.1	0.1	60×10^3
2	0.3	0.2	72×10^{-2}
3	0.3	0.4	2.88×10^{-1}
4	0.4	0.1	2.40×10^{-2}

Based on the above data, find out the rate formula.

18. Justify the formation of a low spin complex and a high spin complex taking examples of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ respectively.
19. Express the relation among cell constant, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to its conductivity?

Or

The molar conductivity of a 1.5 M solution of an electrolyte is found to be $138.9 \text{ Scm}^2 \text{ mol}^{-1}$. Calculate the conductivity of this solution.

20. Specify the oxidation number of metals in the following coordination entities:
(i) $[Co(H_2O)(CN)(en)_2]^{2+}$
(ii) $[CoBr_2(en)_2]^+$
(iii) $[PtCl_4]^{2-}$
(iv) $[Cu(CN)_4]^{3-}$
21. Write the structure of the products formed:
(i) $SO_3^{2-}(aq) + 2H^+(aq) \longrightarrow$
(ii) $4FeS_2(s) + 11O_2(g) \longrightarrow$
22. Out of 2-chloroethanol and ethanol, which is more acidic and why?
23. Give reason for the following :
(i) The second and third rows of transition elements resemble each other much more than they resemble the first row.
(ii) Chromium has higher boiling point than zinc.
24. Preparation of ethers by acid dehydration of secondary or tertiary alcohols is not a suitable method. Give reasons.
- Or How will you convert?
(i) Propene to propan-2-ol
(ii) Benzyl chloride to benzyl alcohol
(iii) Ethyl magnesium chloride to propan-1-ol
25. Explain what is observed when
(i) an electric current is passed through a sol
(ii) a beam of light is passed through a sol

SECTION C : Short Answer Type II Questions (3 Marks)

26. Answer the following questions :
- Glycine exists as a Zwitter ion but *o*- and *p*-amino benzoic acids do not. Give reason.
 - What is a prosthetic group?
 - What are the two monosaccharides units present in the sugar in milk?
27. An element crystallises in fcc lattice having edge length 400 pm. Calculate the maximum diameter of atom which can be placed in interstitial site without distorting the structure.

Or

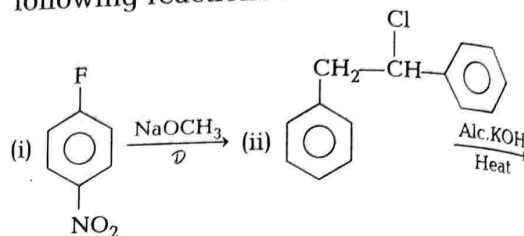
An antifreeze solution is prepared from 222.6 g of ethylene glycol $C_2H_4(OH)_2$ and 200 g of water calculate the molality of the solution. If the density of this solution be 1.072 g ml^{-1} . What will be the molarity of the solution?

28. An alkyl halide with molecular formula $C_6H_{13}Br$ on dehydrohalogenation gave two isomeric alkenes X and Y with molecular formula C_6H_{12} . On reductive ozonolysis,

X and Y gave four compounds CH_3COCH_3 , CH_3CHO , CH_3CH_2CHO and $(CH_3)_2CHCHO$. Name the alkyl halide and reaction involved in it.

Or

What are two major products of the following reactions :



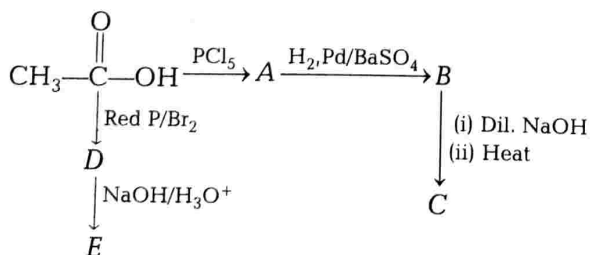
29. Calculate the amount of benzoic acid (C_6H_5COOH) required for preparing 250 mL of 0.15 M solution in methanol.
30. Answer the following questions :
- Why ClF_3 exists but FCl_3 does not ?
 - Out of H_2O and H_2S , which one has higher bond angle and why ?
 - Why is SF_6 known but not SCl_6 ?

SECTION D : Long Answer Type Questions (5 Marks)

31. An organic compound A ($C_7H_6Cl_2$) on treatment with NaOH solution gives another compound B (C_7H_6O). B on oxidation gives an acid C ($C_7H_6O_2$) which on treatment with a mixture of conc. HNO_3 and H_2SO_4 give a compound F ($C_7H_5NO_4$). B on treatment with conc. NaOH gives compounds D (C_7H_8O) and E (C_6H_5COONa). Deduce the structures of A, B, C, D and E.

Or

Identify A, B, C, D and E in the following sequence of reactions :



32. (i) The resistance of a conductivity cell filled with 0.1 M KCl solution is 100 Ω . R of the same cell when filled with 0.02 M KCl solution is 520 Ω . Calculate the conductivity and molar conductivity of 0.02M KCl solution. [Given, conductivity of 0.1 M KCl solution is 1.29 S m^{-1}].
- (ii) Equivalent conductance at infinite dilution of NH_4Cl , NaOH and NaCl are 129.8, 217.4 and 108.45 $\text{mho cm}^{-2} \text{ g}$ equivalent respectively. Calculate the equivalent conductance of NH_4OH at dilution.

Or

- (i) (a) Calculate $\Delta_r G^\circ$ for the reaction,
 $Mg(s) + Cu^{2+}(aq) \longrightarrow Mg^{2+}(aq) + Cu(s)$
 (Given, $E^\circ_{\text{cell}} = +2.71 \text{ V}$, $1F = 96500 \text{ C mol}^{-1}$)
- (b) What is the standard electrode potential of hydrogen electrode ?

- (ii) Arrange the following metals in the order in which they displace each other from the solution of their salts. Al, Cu, Fe, Mg and Zn.
33. (i) Although, Zr belongs to $4d$ and Hf belongs to $5d$ transition series but it is quite difficult to separate them, why?
- (ii) Which of the following has the maximum number of unpaired electrons?
 Ti^{3+} , V^{3+} , Fe^{2+} , Zn^{2+}
- (iii) Give two consequences of lanthanoid contraction.
- (iv) Based on the data, arrange Fe^{2+} , Mn^{2+} and Cr^{2+} in the increasing order of stability of +3 oxidation state.

$$[E_{Cr^{3+}/Cr^{2+}}^{\circ} = -0.4 \text{ V}; E_{Mn^{3+}/Mn^{2+}}^{\circ} = 1.5 \text{ V};$$

$$E_{Fe^{3+}/Fe^{2+}}^{\circ} = 0.8 \text{ V}]$$

Or

- (i) Name the members of the lanthanoid series which exhibit +4 oxidation states and those which exhibit +2 oxidation states. Try to correlate this type of behaviour with the electronic configuration of these elements.
- (ii) Give examples and suggest reasons for the following features of the transition metal chemistry.
- (a) The lowest oxide of transition metal is basic, the highest is acidic/amphoteric.
- (b) A transition metal exhibits highest oxidation state in oxides and fluorides.
- (c) The highest oxidation state is exhibited in oxoanions of a metal.