

DAV BR PUBLIC SCHOOL**SESSION 2024-25****Half Yearly Examination****Class:XII****Subject: CHEMISTRY(043)****Time Allowed: 3hrs****MM: 70****GENERAL INSTRUCTIONS:**

Read the following instructions carefully.

- (a) There are 33 questions in this question paper with internal choice.*
- (b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.*
- (c) SECTION B consists of 5 short answer questions carrying 2 marks each.*
- (d) SECTION C consists of 7 short answer questions carrying 3 marks each.*
- (e) SECTION D consists of 2 case - based questions carrying 4 marks each.*
- (f) SECTION E consists of 3 long answer questions carrying 5 marks each.*
- (g) All questions are compulsory.*

Q.No**MM****SECTION A**

- | | | |
|-----------|--|----------|
| 1. | In which of the following cases blood cells will shrink:
(a) when placed in water containing more than 0.9% (mass/ volume) NaCl solution.
(b) When placed in water containing less than 0.9% (mass /volume) NaCl solution.
(c) When placed in water containing 0.9% (mass/volume) NaCl solution.
(d) When placed in distilled water. | 1 |
| 2. | Solubility of gases in liquids decreases with rise in temperature because dissolution is an:
(a)endothermic and reversible process
(b)exothermic and reversible process
(c)endothermic and irreversible process
(d) exothermic and irreversible process | 1 |

OR

Identify the law which is stated as:

“For any solution, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction.”

- (a)Henry’s law
- (b) Raoult’s law
- (c)Dalton’s law
- (d)Gay-Lussac's Law

3. Which cell will measure standard electrode potential of copper electrode? **1**
 (a) $\text{Pt(s)} | \text{H}_2 (\text{g}, 0.1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, \text{M}) | \text{Cu}$
 (b) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 2\text{M}) | \text{Cu}$
 (c) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 1\text{M}) | \text{Cu}$
 (d) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 0.1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 1\text{M}) | \text{Cu}$
4. Tert-butyl methyl ether on heating with HI gives a mixture of: **1**
 (a) tert –butyl alcohol and methyl iodide
 (b) tert –butyl iodide and methanol
 (c) Isobutylene and methyl iodide
 (d) Isobutylene and methanol
5. Which of the following isomer has the highest melting point: **1**
 (a) 1,2-dichlorobenzene
 (b) 1,3 -dichlorobenzene
 (c) 1,4-dichlorobenzene
 (d) all isomers have same melting points
6. Lower molecular mass alcohols are: **1**
 (a) miscible in limited amount of water
 (b) miscible in excess of water
 (c) miscible in water in all proportions
 (d) immiscible in water
7. For a reaction $p\text{A} + q\text{B} \rightarrow \text{Products}$. $R = k[\text{A}]^m[\text{B}]^n$ Then **1**
 (a) $(p+q) \neq (m+n)$ (b) $(p+q) > (m+n)$
 (c) $(p+q) = (m+n)$ or $(p+q) \neq (m+n)$ (d) $(p+q) = (m+n)$
8. Ethyl acetate is hydrolysed in alkaline medium, its order of reaction and molecularity is respectively **1**
 (a) 1 , 1 (b) 2 , 2 (c) 1 , 2 (d) 2 , 1
9. Which elements have low ionisation enthalpy as compare to their neighbour element in first transition element? **1**
 (a) Cr, Cu (b) Cr, Zn (c) Cr, Mn (d) Cu, Zn
10. Which of the following metal ions are colourless **1**
 (a) Ti^{4+} , Sc^{3+} (b) Ti^{4+} , Cu^{1+}
 (c) Cr^{2+} , Cu^{1+} (d) Ti^{4+} , Mn^{2+}
11. Lanthanide contraction is caused due to **1**
 (a) The appreciable shielding on outer electrons by 4f electrons from the nuclear

charge.

(b) The appreciable shielding on outer electrons by 5d electrons from the nuclear charge.

(c) The same effective nuclear charge from Ce to Lu.

(d) The poor shielding on outer electrons by 4f electrons from the nuclear charge.

12. Major product obtained on reaction of 3-Phenyl propene with HBr in presence of organic peroxide 1
- (a) 3-Phenyl 1-bromopropane
- (b) 1-Phenyl 3-bromopropane
- (c) 1-Phenyl 2-bromopropane
- (d) 3-Phenyl 2-bromopropane

In questions 13 to 16 Given below are two statements labelled as Assertion (A) and Reason (R) Select the most appropriate answer from the options given below:

(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

13. Assertion (A): C_2H_5OH is a weaker base than phenol but is a stronger nucleophile than phenol. 1

Reason(R): In phenol the lone pair of electrons on oxygen is withdrawn towards the ring due to resonance.

14. Assertion (A): Aryl halides do not undergo nucleophilic substitution reactions with ease. 1

Reason (R): The carbon halogen bond in aryl halides has partial double bond character.

15. Assertion (A): During electrolysis of aqueous copper sulphate solution using copper electrodes hydrogen gas is released at the cathode. 1

Reason (R): The electrode potential of Cu^{2+}/Cu is greater than that of H^+/H_2

16. Assertion (A): Alcohols react both as nucleophiles and electrophiles. 1
- Reason (R): The bond between C–O is broken when alcohols react as nucleophiles.

SECTION B

17. The rate of a reaction depends upon the temperature and is quantitatively expressed as 2
 $k = Ae^{-Ea/RT}$
- (i) If a graph is plotted between $\log k$ and $1/T$, write the expression for the slope of the reaction?
- (ii) If at under different conditions E_{a1} and E_{a2} are the activation energy of two reactions If $E_{a1} = 40 \text{ J / mol}$ and $E_{a2} = 80 \text{ J / mol}$. Which of the two has a larger value of the rate constant?
18. Calculate the emf of the cell in which the following reaction takes place: 2
 $\text{Ni(s)} + 2\text{Ag}^+ (0.002 \text{ M}) \longrightarrow \text{Ni}^{2+} (0.160 \text{ M}) + 2\text{Ag(s)}$
Given that $E^0(\text{cell}) = 1.05 \text{ V}$.
19. What are azeotropes? Give one example each of minimum boiling and maximum boiling azeotropes. 2
20. Write chemical equations involved in:- (Any two) 2
- a) Swarts Reaction
b) Finkelstein reaction
c) Wurtz reaction
- OR
- Arrange each set of compounds in order of reactivity towards S_N2 displacement.
- a) 2-bromo-2-methyl butane, 1 bromopropane, 2-bromopentane
b) 1-bromo-3-methyl butane, 2-bromo-2-methyl butane, 3-bromo-2-methyl butane
21. In a reaction, if the concentration of reactant A is tripled, the rate of reaction becomes twenty-seven times. What is the order of the reaction? 2
22. Account for the following: 3
- a) Ti(IV) is more stable than the Ti(II) or Ti(III).
b) In case of transition elements, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number.
c) Zinc is a comparatively a soft metal, iron and chromium are typically hard.
23. Give reasons for the following observations: 3
- (a) Alkyl halides, though polar are immiscible with water.
(b) Grignard reagents should be prepared under anhydrous conditions.

(c) The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohol but in the presence of alcoholic KOH, alkene is the major product,

24. Give equations of the following reactions : 3

(a) Treating phenol with chloroform in the presence of aq NaOH

(b) Oxidation of propane -1-ol with alkaline KMnO_4 solution

(c) Bromine in CS_2 with phenol

25. Give reasons for the following: 3

a) When 2g of benzoic acid is dissolved in 25 g of benzene, the experimentally determined molar mass is always greater than the true value.

b) Mixture of ethanol and acetone shows positive deviation from Raoult's Law.

c) The preservation of fruits by adding concentrated sugar solution protects against bacterial action.

OR

Calculate the freezing point of a solution containing 8.1 g of HBr in 100 g of water, assuming the acid to be 90 % ionized.

[Given: Molar mass Br = 80 g/mol, K_f water = 1.86 K kg / mol]

26. Write the mechanism of acid dehydration of ethanol to yield ethene 3

27. A first order reaction has a rate constant $1.15 \times 10^{-3} \text{ s}^{-1}$. How long will 5 g of this reactant take to reduce to 3 g? 3

28. Plot a graph of concentration versus time for zero order reaction and answer the following questions on the basis of this graph. 3

(i) What is the slope of the curve?

(ii) Write the unit of rate constant?

(iii) How does half-life of zero order reaction is dependent on initial concentration of reactants?

SECTION D

The following questions are case -based questions. Read the passage carefully and answer the questions that follow.

29. Nucleophilic substitution reaction of haloalkane can be conducted according to both SN_1 and SN_2 mechanisms. However, which mechanism it is based on is related to such factors as the structure of haloalkane, and properties of leaving group, nucleophilic reagent and solvent. 4

Influences of halogen : No matter which mechanism the nucleophilic substitution reaction is based on, the leaving group always leave the central carbon atom with electron pair. This is just the opposite of the situation that nucleophilic reagent attacks the central carbon atom with electron pair. Therefore, the weaker the

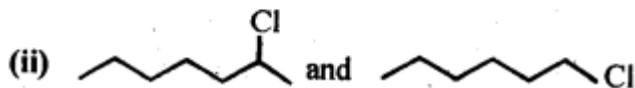
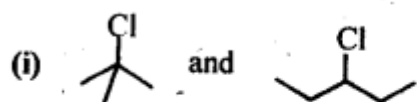
alkalinity of leaving group is , the more stable the anion formed is and it will be more easier for the leaving group to leave the central carbon atom; that is to say, the reactant is more easier to be substituted. The alkalinity order of halogen ion is $I^- < Br^- < Cl^- < F^-$ and the order of their leaving tendency should be $I^- > Br^- > Cl^- > F^-$. Therefore, in four halides with the same alkyl and different halogens, the order of substitution reaction rate is $RI > RBr > RCl > RF$. In addition, if the leaving group is very easy to leave, many carbocation intermediates are generated in the reaction and the reaction is based on S_N1 mechanism. If the leaving group is not easy to leave, the reaction is based on S_N2 mechanism.

Influences of solvent polarity: In S_N1 reaction, the polarity of the system increases from the reactant to the transition state, because polar solvent has a greater stabilizing effect on the transition state than the reactant, thereby reduce activation energy and accelerate the reaction. In S_N2 reaction, the polarity of the system generally does not change from the reactant to the transition state and only charge dispersion occurs. At this time, polar solvent has a great stabilizing effect on Nu than the transition state, thereby increasing activation energy and slow down the reaction rate. For example, the decomposition rate (S_N1) of tertiary chlorobutane in 25°C water (dielectric constant 79) is 300000 times faster than in ethanol (dielectric constant 24). The reaction rate (S_N2) of 2-bromopropane and NaOH in ethanol containing 40% water is twice slower than in absolute ethanol. In a word, the level of solvent polarity has influence on both S_N1 and S_N2 reactions, but with different results. Generally speaking, weak polar solvent is favourable for S_N2 reaction, while strong polar solvent is favorable for S_N1 reaction, because only under the action of polar solvent can halogenated hydrocarbon dissociate into carbocation and halogen ion and solvents with a strong polarity is favourable for solvation of carbocation, increasing its stability. Generally speaking, the substitution reaction of tertiary haloalkane is based on S_N1 mechanism in solvents with a strong polarity (for example, ethanol containing water).

(Ding, Y. (2013). A Brief Discussion on Nucleophilic Substitution Reaction on Saturated Carbon Atom. In Applied Mechanics and Materials (Vol. 312, pp. 433-437). Trans Tech Publications Ltd.)

1. What is racemic mixture? Explain with example
2. Polar solvents make the reaction faster as they:
 - (a) destabilize transition state and decrease the activation energy
 - (b) destabilize transition state and increase the activation energy
 - (c) stabilize transition state and increase the activation energy
 - (d) stabilize transition state and decrease the activation energy

3. In the following pairs of halogen compounds, which compound undergoes faster S_N1 reaction? Explain your answer.



OR

In which option the S_N1 reaction will be fastest. Give reason for your selection

(a) 1-Chloro-2-methyl propane

(b) 1-Iodo-2-methyl propane

(c) 1-Chlorobutane

(d) 1-Iodobutane

30. The study of the conductivity of electrolyte solutions is important for the development of electrochemical devices, for the characterization of the dissociation equilibrium of weak electrolytes, and for the fundamental understanding of charge transport by ions. The conductivity of the electrolyte is measured for electrolyte solution with concentrations in the range of 10⁻³ to 10⁻¹ mol L⁻¹, as a solution in this range of concentrations can be easily prepared. The molar conductivity (Λ_m)

4

of strong electrolyte solutions can be nicely fit by the Kohlrausch equation.

$$\Lambda_m = \Lambda_m^\circ - K \sqrt{C} \dots (i)$$

Where Λ^o_m is the molar conductivity at infinite dilution and C is the concentration of the solution. K is an empirical proportionality constant to be obtained from the experiment. The molar conductivity of weak electrolytes, on the other hand, is dependent on the degree of dissociation of the electrolyte. At the limit of a very dilute solution, the Ostwald dilution law is expected to be followed,

$$\frac{1}{\Lambda_m} = \frac{1}{\Lambda_m^\circ} + \frac{\Lambda_m C_A}{(\Lambda_m^\circ)^2 K_d} \dots (ii)$$

where C_A is the analytical concentration of the electrolyte and K_d is the dissociation constant. The molar conductivity at infinite dilution can be decomposed into the contributions of each ion.

$$\Lambda_m^\circ = v_+ \lambda_+^\circ + v_- \lambda_-^\circ \dots (iii)$$

Where, λ⁺ and λ⁻ are the ionic conductivities of positive and negative ions, respectively and v₊ and v₋ are their stoichiometric coefficients in the salt molecular formula.

1. Which statement about the term infinite dilution is correct?

(a) Infinite dilution refers to a hypothetical situation when the ions are infinitely

far apart.

(b) The molar conductivity at infinite dilution of NaCl can be measured directly in solution.

(c) Infinite dilution is applicable only to strong electrolytes.

(d) Infinite dilution refers to a real situation when the ions are infinitely far apart.

2. Apply Kohlrausch law of independent migration of ions, write the expression to determine the limiting molar conductivity of calcium chloride?

3. If the molar conductivities at infinite dilution for NaI, CH₃COONa and (CH₃COO)₂Mg are 12.69, 9.10 and 18.78 S cm² mol⁻¹ respectively at 25°C, then the molar conductivity of MgI₂ at infinite dilution is

(a) 25.96 S cm² mol⁻¹

(b) 390.5 S cm² mol⁻¹

(c) 189.0 S cm² mol⁻¹

(d) 3.89×10^{-2} S cm² mol⁻¹

OR

Given are the conductivity and molar conductivity of NaCl solutions at 298K at different concentrations:

Concentration M	Conductivity Scm ⁻¹	Molar conductivity S cm ² mol ⁻¹
0.100	106.74×10^{-4}	106.7
0.05	55.53×10^{-4}	111.1
0.02	23.15×10^{-4}	115.8

Compare the variation of conductivity and molar conductivity of NaCl solutions on dilution. Give reason.

SECTION E

31. (a) A cell is prepared by dipping a zinc rod in 1M zinc sulphate solution and a silver electrode in 1M silver nitrate solution. The standard electrode potential given: $E^0 \text{ Zn}^{2+} / \text{Zn} = -0.76 \text{ V}$, $E^0 \text{ Ag}^+ / \text{Ag} = +0.80 \text{ V}$

5

What is the effect of increase in concentration of Zn²⁺ on the E_{cell}?

(b) Write the products of electrolysis of aqueous solution of NaCl with platinum electrodes.

(c) Calculate e.m.f. of the following cell at 298 K:

Ni(s) / Ni²⁺(0.01 M) // Cu²⁺ (0.1M) / Cu (s)

[Given $E^0 \text{ Ni}^{2+} / \text{Ni} = -0.25 \text{ V}$, $E^0 \text{ Cu}^{2+} / \text{Cu} = +0.34 \text{ V}$)

Write the overall cell reaction.

OR

(a) Suggest two materials other than hydrogen that can be used as fuels in the fuel cells.

(b) Explain how rusting of iron is envisaged as setting up of an electrochemical cell.

(c) Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging.

32. (a) Define Reverse osmosis.

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(b) Derive the relationship between the osmotic pressure of solution and molar mass of the solute.

(c) The vapour pressures of pure liquids A and B are 450 mm and 700 mm of Hg respectively at 350 K. Calculate the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also find the composition in the vapour phase.

OR

(a) Define colligative property.

(b) Cryoscopic constant is used to define which colligative property? Write its unit.

(c) The vapour pressure of pure water at a certain temperature is 23.80 mm Hg. If 1 mole of a non-volatile non-electrolytic solute is dissolved in 100g water, Calculate the resultant vapour pressure of the solution.

33. (a) When a chromite ore (A) is fused with an aqueous solution of sodium carbonate in free excess of air, a yellow solution of compound (B) is obtained. This solution is filtered and acidified with sulphuric acid to form compound (C). Compound (C) on treatment with solution of KCl gives orange crystals of compound (D). Write the chemical formulae of compounds A to D.

(b) Describe the cause of the following variations with respect to lanthanoids and actinoids:

(i) Greater range of oxidation states of actinoids as compared to lanthanoids.

(ii) Greater actinoid contraction as compared to lanthanoid contraction.

(iii) Lower ionisation enthalpy of early actinoids as compared to the early lanthanoids.

OR

(a) What happens when :

(i) Manganate ions (MnO_4^{2-}) undergoes disproportionation reaction in acidic medium?

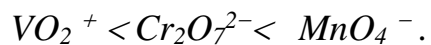
(ii) Lanthanum is heated with Sulphur?

(b) Explain the following trends in the properties of the members of the First series of transition elements:

(i) $E^\circ (M^{2+}/M)$ value for copper is positive (+0.34 V) in contrast to the other members of the series.

(ii) Cr^{2+} is reducing while Mn^{3+} is oxidising, though both have d^4 configuration.

(iii) The oxidising power in the series increases in the order ;



*******END*******