

J.B. ACADEMY, AYODHYA
HALF YEALRY EXAMINATION 2025-26
CLASS-XII, SUB : CHEMISTRY

Max Mark:70

Time:3 Hours

General Instructions:

Read the following instructions carefully.

- (a) There are 33 questions in this question paper with internal choices.
- (b) Section-A consists of 16 multiple-choice questions carrying 1 mark each.
- (c) Section-B consists of 5 short answer questions carrying 2 mark each.
- (d) Section-C consists of 7 short answer questions carrying 3 mark each.
- (e) Section-D consists of 2 case- based questions carrying 4 mark each.
- (f) Section-E consists of 3 long answer questions carrying 5 mark each.
- (g) All questions are compulsory.
- (h) Use of log table and calculator is not allowed.

SECTION - A

The follwing questions are multiple choice questions with one correct answer. Each question carry one mark. There is no internal choice in this section.

Q.1- Relative lowering of vapour pressure is a colligative property because _____.

- (a) It depends on the concentration of a non electrolyte solute in solution and does not depend on the nature of the solute molecules.
- (b) It depends on number of particles of electrolyte solute in solution and does not depend on the nature of the solute particles.
- (c) It depends on the concentration of a non electrolyte solute in solution as well as on the nature of the solute molecules.
- (d) It depends on the concentration of an electrolyte or nonelectrolyte solute in solution as well as on the nature of solute molecules.

Q.2- K_H value for Ar(g) , $\text{CO}_2\text{(g)}$, HCHO(g) and $\text{CH}_4\text{(g)}$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility.

- (a) $\text{HCHO} < \text{CH}_4 < \text{CO}_2 < \text{Ar}$
- (b) $\text{HCHO} < \text{CO}_2 < \text{CH}_4 < \text{Ar}$
- (c) $\text{Ar} < \text{CO}_2 < \text{CH}_4 < \text{HCHO}$
- (d) $\text{Ar} < \text{CH}_4 < \text{CO}_2 < \text{HCHO}$

Q.3- Which of the following binary mixtures will have same composition in liquid and vapour phase?

- (a) Benzene-Toluene
- (b) Water-Nitric acid
- (c) Water-Ethanol
- (d) n-Hexane - n-Heptane

Q.4- A new galvanic cell of E°_{cell} more than E°_{cell} of Daniel cell is connected to Daniel cell in a manner that new cell gives electrons to cathode, what will happen

- (a) E_{cell} will increase
- (b) E_{cell} will decrease
- (c) No change will take place
- (d) Daniel cell will work as electrolytic cell where Zn will be deposit on zinc rod and copper will dissolve from copper rod.

Q.5- $\text{X(s)} + 2\text{Y}^+(\text{aq}) \rightleftharpoons \text{X}^{2+}(\text{aq}) + 2\text{Y(s)}$; ($E^\circ_{\text{cell}} = 0.059 \text{ V}$) What is the value of 'K' for above reaction?

- (a) 1×10^8
- (b) 1×10^2
- (c) 4×10^3
- (d) 3×10^4

Q.6-The positive value of the standard electrode potential of Cu^{2+}/Cu indicates that

- (a) this redox couple is a stronger reducing agent than the H^+/H_2 couple.
- (b) this redox couple is a stronger oxidising agent than H^+/H_2 .
- (c) Cu can displace H_2 from acid.
- (d) Cu cannot displace H_2 from acid.

Q.7- The half life period of first order reaction is 1386 seconds. The specific rate constant of the reaction is

- (a) $0.5 \times 10^{-2} \text{ s}^{-1}$ (b) $0.5 \times 10^{-3} \text{ s}^{-1}$ (c) $5.0 \times 10^{-2} \text{ s}^{-1}$ (d) $5.0 \times 10^{-3} \text{ s}^{-1}$

Q.8- The activation energy of a reaction can be determined from the slope of which of the following graph:



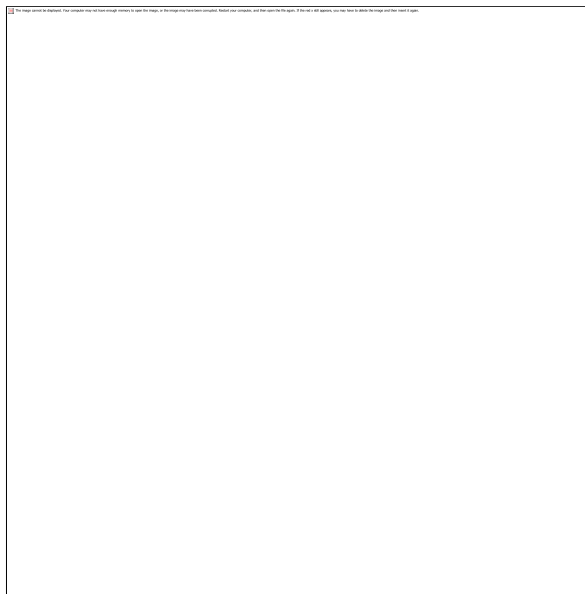
Q.9- Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2 \times Y$ is given below:

- (a) $2X + X \rightarrow X_3$ (fast) (b) $X + Y_2 \rightarrow XY + Y$ (slow) (c) $X + Y \rightarrow XY$ (fast)

The overall order of reaction is

- (a) 2 (b) 0 (c) 1.5 (d) 1

Q.10- m-Xylene reacts with Br_2 in presence of $FeBr_3$, what are products formed



Q.11- $CH_3CH_2CH_2Br + NaCN \rightarrow CH_3CH_2CH_2CN + NaBr$, will be fastest in

- (a) ethanol (b) methanol
(c) N, N dimethyl formamide (d) Water

Q.12- A dihalogen derivative 'X' of a hydrocarbon with three carbon atoms react with alc. KOH and produces hydrocarbon which forms red ppt. with ammonical Cu_2Cl_2 . 'X' gives an aldehyde on reaction with aq. KOH. The compound 'X' is

- (a) 1, 3-Dichloropropane (b) 1, 2-Dichloropropane
(c) 2, 2-Dichloropropane (d) 1, 1-Dichloropropane

In the following questions (Q.13-Q.16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

Q.13-(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 wrong statement.

(d) Assertion and reason both are incorrect statements.

(e) Assertion is wrong statement but reason is correct statement.

Assertion: When a solution is separated from the pure solvent by a semipermeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

Q.14-(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 wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

Assertion: Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason: For weak electrolytes degree of dissociation increases with dilution of solution.

Q.15-(a) Both assertion and reason are correct and the reason is correct explanation of assertion.

(b) Both assertion and reason are correct but reason does not explain assertion.

(c) Assertion is correct but reason is incorrect.

(d) Both assertion and reason are incorrect.

(e) Assertion is incorrect but reason is correct.

Assertion: Order and molecularity are same.

Reason: Order is determined experimentally and molecularity is the sum of the stoichiometric coefficient of rate determining elementary step.

Q.16-(a) Assertion and reason both are correct and reason is correct explanation of assertion.

(b) Assertion and reason both are wrong statements.

(c) Assertion is correct but reason is wrong statement.

(d) Assertion is wrong but reason is correct statement.

(e) Assertion and reason both are correct statements but reason is not correct explanation of assertion.

Assertion: KCN reacts with methyl chloride to give methyl isocyanide.

Reason: CN^- is an ambident nucleophile.

SECTION - B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type contain only 2 marks each.

Q.17- Write the structural formulae of the organic compounds 'A', 'B', 'C' and 'D' in the following sequence of reaction:

Or

Write the structure of the major organic product in each of the following reactions:

Q.18-(i) If half life period of a first order reaction is x and  life period of same reaction is y , how are x and y related to each other?

(ii) In some cases, it is found that a large number of colliding molecules have energy more than threshold energy but yet the reaction is slow. Why?

Q.19- Zinc rod is dipped in 0.1 M solution of ZnSO_4 . The salt is 95% dissociated at this dilution at 298 K.

Calculate the electrode potential. Given  $= -0.76 \text{ V}$. $\log 1000 = 3.0000$, $\log 95 = 1.9777$

Q.20- Define the following terms:

(i) Non-ideal solution

(ii) Cryoscopic constant

Q.21- Write chemical equation when

(i) methyl chloride is treated with AgNO_2 .

(ii) bromobenzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 .

SECTION - C

This section contains 7 questions with internal choice in one question. The following questions are very short answer type contain only 3 marks each.

Q.22- Consider the three types of replacement of group X by group Y as shown here.



This can result in giving compound (A) or (B) or both. What is the process called if

(i) (A) is the only compound obtained?

(ii) (B) is the only compound obtained?

(iii) (A) and (B) are formed in equal proportions?

Q.23-(a) Write a chemical test to distinguish between :

(i) Chlorobenzene and Benzyl chloride.

(ii) Chloroform and Carbon tetrachloride.

(b) Why is methyl chloride hydrolysed more easily than chlorobenzene?

OR

Give reasons:

(a) n-Butyl bromide has higher boiling point than t-butyl bromide.

(b) Racemic mixture is optically inactive.

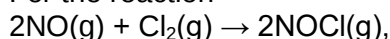
(c) The presence of nitro group ($-\text{NO}_2$) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions.

Q.24- One half-cell in a voltaic cell is constructed from a silver wire dipped in silver nitrate solution of unknown concentration. Its other half-cell consists of a zinc electrode dipping in 0.1 M solution of $\text{Zn}(\text{NO}_3)_2$. A voltage of 1.48 V is measured for this cell. Use this information to calculate the concentration of silver nitrate solution used. (Given: $E^\circ_{\text{Zn}^{2+}|\text{Zn}} = -0.76\text{V}$, $E^\circ_{\text{Ag}^+|\text{Ag}} = +0.80\text{V}$) [Antilog $2.7072 = 5.095 \times 10^2$]

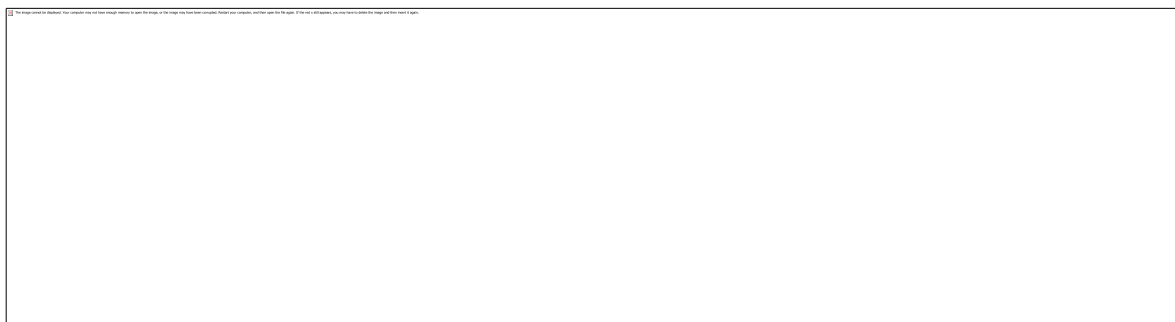
Q.25- Conductivity of $2.5 \times 10^{-4}\text{ M}$ methanoic acid is $5.25 \times 10^{-5}\text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

Given: $\lambda_0(\text{H}^+) = 349.5\text{ S cm}^2\text{ mol}^{-1}$ and $\lambda_0(\text{HCOO}^-) = 50.5\text{ S cm}^2\text{ mol}^{-1}$.

Q.26- For the reaction



the following data were collected. All the measurements were taken at 263 K:



(a) Write the expression for rate law.

(b) Calculate the value of rate constant and specify its units.

(c) What is the initial rate of disappearance of Cl_2 in experiment no. 4?

Q.27- Calculate the rate constant at 400 K for the following reaction:



Arrhenius factor is $4.3 \times 10^{10} \text{ s}^{-1}$ and activation energy is $103.344 \text{ kJ mol}^{-1}$.

Q.28- 0.6 mL of acetic acid (CH_3COOH), having density 1.06 g mL^{-1} , is dissolved in 1 litre of water. The depression in freezing point observed for this strength of acid was 0.0205°C . Calculate the van't Hoff factor and the dissociation constant of acid.

SECTION - D

The following questions are case-based questions. Each question has an internal choice and carries 4(1+1+2) Marks each. Read the passage carefully and answer the questions that follow.

Q.29- Read the passage given below and answer the questions that follow:

The rate law for a chemical reaction relates the reaction rate with the concentrations or partial pressures of the reactants. For a general reaction $a\text{A} + b\text{B} \rightarrow \text{C}$ with no intermediate steps in its reaction mechanism, meaning that it is an elementary reaction, the rate law is given by $r = k[\text{A}]^x[\text{B}]^y$, where $[\text{A}]$ and $[\text{B}]$ express the concentrations of A and B in moles per litre. Exponents x and y vary for each reaction and are determined experimentally. The value of k varies with conditions that affect reaction rate, such as temperature, pressure, surface area, etc. The sum of these exponents is known as overall reaction order. A zero order reaction has a constant rate that is independent of the concentration of the reactants. A first order reaction depends on the concentration of only one reactant. A reaction is said to be second order when the overall order is two. Once we have determined the order of the reaction, we can go back and plug in one set of our initial values and solve for k .

(a) Calculate the overall order of a reaction which has the following rate expression: $\text{Rate} = k[\text{A}]^{1/2}[\text{B}]^{3/2}$

(b) What is the effect of temperature on rate of reaction?

(c) What is meant by rate of a reaction?

(d) (i) A first order reaction takes 77.78 minutes for 50% completion. Calculate the time required for 30% completion of this reaction. ($\log 10 = 1$, $\log 7 = 0.8450$)

OR

(ii) A first order reaction has a rate constant 1×10^{-3} per sec. How long will 5 g of this reactant take to reduce to 3 g? ($\log 3 = 0.4771$; $\log 5 = 0.6990$)

Q.30- Nucleophilic substitution reactions are of two types; substitution nucleophilic bimolecular ($\text{S}_{\text{N}}2$) and substitution nucleophilic unimolecular ($\text{S}_{\text{N}}1$) depending on molecules taking part in determining the rate of reaction. Reactivity of alkyl halide towards $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions depends on various factors such as steric hindrance, stability of intermediate or transition state and polarity of solvent. $\text{S}_{\text{N}}2$ reaction mechanism is favoured mostly by primary alkyl halide or transition state and polarity of solvent, $\text{S}_{\text{N}}2$ reaction mechanism is favoured mostly by primary alkyl halide then secondary and then tertiary. This order is reversed in case of $\text{S}_{\text{N}}1$ reactions.

Answer the following questions:

(i) Which of the following is most reactive towards nucleophilic substitution reaction?

- (a) $\text{C}_6\text{H}_5\text{Cl}$ (b) $\text{CH}_2=\text{CHCl}$ (c) $\text{ClCH}_2\text{CH}=\text{CH}_2$ (d) $\text{CH}_3\text{CH}=\text{CHCl}$

(ii) Isopropyl chloride undergoes hydrolysis by

- (a) $\text{S}_{\text{N}}1$ mechanism (b) $\text{S}_{\text{N}}2$ mechanism
(c) $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ mechanism (d) neither $\text{S}_{\text{N}}1$ nor $\text{S}_{\text{N}}2$ mechanism

(iii) The most reactive nucleophile among the following is

- (a) CH_3O^- (b) $\text{C}_6\text{H}_5\text{O}^-$ (c) $(\text{CH}_3)_2\text{CHO}^-$ (d) $(\text{CH}_3)_3\text{CO}^-$

(iv) Tertiary alkyl halides are practically inert to substitution by $\text{S}_{\text{N}}2$ mechanism because of

- (a) insolubility (b) instability (c) inductive effect (d) steric hindrance

OR

Which of the following is the correct order of decreasing $\text{S}_{\text{N}}2$ reactivity?

- (a) $\text{RCH}_2\text{X} > \text{R}_2\text{CHX} > \text{R}_3\text{CX}$ (b) $\text{R}_3\text{CX} > \text{R}_2\text{CHX} > \text{RCH}_2\text{X}$
(c) $\text{R}_2\text{CHX} > \text{R}_3\text{CX} > \text{RCH}_2\text{X}$ (d) $\text{RCH}_2\text{X} > \text{R}_3\text{CX} > \text{R}_2\text{CHX}$

SECTION - E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

Q.31-(a) For a reaction $A + B \rightarrow P$, the rate is given by

$$\text{Rate} = k[A][B]^2$$

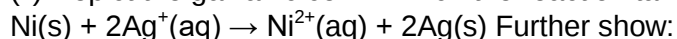
- (i) How is the rate of reaction affected if the concentration of B is doubled?
- (ii) What is the overall order of reaction if A is present in large excess?
- (b) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction. ($\log 2 = 0.3010$).

OR

- (a) What is rate of reaction? Write two factors that affect the rate of reaction.
- (b) The rate constant of a first order reaction increases from 4×10^{-2} to 8×10^{-2} when temperature changes from 27°C to 37°C . Calculate the energy of activation (E_a). $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$

Q.32-(i) The electrical resistance of a column of 0.02 M NaOH solution of diameter 1.40 cm and length 44 cm is 5.00×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity.

(ii) Depict the galvanic cell in which the reaction takes place:



- I. Which of the electrodes is positively charged ?
- II. The carriers of the current in the outer circuit.

OR

(a) A sample of water was found to contain dissolved oxygen (O_2) to the extent of 5 ppm and hardness due to Mg^{2+} is 15 ppm. Calculate the amount of O_2 and number of Mg^{2+} in 1 litre of water (density of water = 1g/mL).

(b) What volume of 98% sulphuric acid ($d = 1.84\text{ g cm}^{-3}$) and what mass of water must be required to prepare 500 cm³ of 15% solution of H_2SO_4 ($d = 1.10\text{ g cm}^{-3}$)? [$\text{H} = 1$, $\text{S} = 32$, $\text{O} = 16\text{ u}$]

Q.33- Explain the following with an example each

- a) Swarts reaction
- b) Finkelstein reaction
- c) Hunsdiecker reaction

OR

Write short notes on :

- a) Gatterman reaction
- b) Wurtz reaction
- c) Peroxide effect or Kharasch effect

ALL THE VERY BEST