

Time: 3hrs.

M.M.70

General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. Section A consists of 16 multiple-choice questions carrying 1 mark each.
3. Section B consists of 5 short answer questions carrying 2 marks each.
4. Section C consists of 7 short answer questions carrying 3 marks each.
5. Section D consists of 2 case-based questions carrying 4 marks each.
6. Section E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

Section - A

- Q1. 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
- Q2. 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
- Q3. An electrochemical cell can behave like an electrolytic cell when _____
a) $E_{cell} = 0$ b) $E_{cell} > E_{ext}$ c) $E_{ext} > E_{cell}$ d) $E_{cell} = E_{ext}$
- Q4. $\Delta_m^0(NH_4OH)$ is equal to _____
a) $\Delta_m^0(NH_4OH) + \Delta_m^0(NH_4Cl) - \Delta_m^0(HCl)$ b) $\Delta_m^0(NH_4Cl) + \Delta_m^0(NaOH) - \Delta_m^0(NaCl)$
c) $\Delta_m^0(NH_4Cl) + \Delta_m^0(NaCl) - \Delta_m^0(NaOH)$ d) $\Delta_m^0(NaOH) + \Delta_m^0(NaCl) - \Delta_m^0(NH_4Cl)$
- Q5. Which of the following is not correct about order of a reaction?
a) The order of a reaction can be a fractional number
b) Order of a reaction is experimentally determined quantity
c) The order of a reaction is always equal to the sum of the stoichiometric coefficients of reactants in the balanced chemical equation for a reaction.
d) The order of a reaction is the sum of the powers of molar concentration of the reactants in the rate law expression.
- Q6. The unit of the rate of reaction is the same as that of the rate constant for a
a) First order reaction b) zero order reaction
c) second order reaction d) half-order reaction
- Q7. Which of the following is affected by catalyst?
a) ΔH b) ΔG c) E_a d) ΔS

A-1

Q8. Which of the following is the reason for Zinc not exhibiting variable oxidation state?

- a) Inter pair effect b) Completely filled 3d subshell
c) Completely filled 4s subshell d) Common ion effect

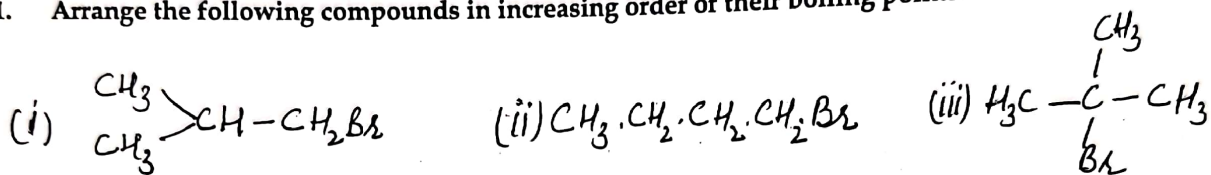
Q9. On addition of small amount of KMnO_4 to concentrated H_2SO_4 , a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.

- a) Mn_2O_7 b) MnO_2 c) MnSO_4 d) Mn_2O_3

Q10. Which of the following reactions are feasible?

- a) $\text{CH}_3\text{CH}_2\text{Br} + \text{Na}^+\text{O}^-\text{C}(\text{CH}_3)_3 \rightarrow \text{CH}_3\text{CH}_2-\text{O}-\text{C}(\text{CH}_3)_3$
b) $(\text{CH}_3)_3\text{C}-\text{Cl} + \text{Na}^+\text{O}^-\text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2-\text{O}-\text{C}(\text{CH}_3)_3$
c) Both (a) and (b)
d) Neither (a) nor (b)

Q11. Arrange the following compounds in increasing order of their boiling points.



- a) (ii) < (i) < (iii) b) (i) < (ii) < (iii) c) (iii) < (i) < (ii) d) (iii) < (ii) < (i)

Q12. Racemisation occurs in

- a) $\text{S}_\text{N}1$ reaction b) $\text{S}_\text{N}2$ reaction
c) Neither $\text{S}_\text{N}1$ nor $\text{S}_\text{N}2$ reaction d) $\text{S}_\text{N}2$ reaction as well as $\text{S}_\text{N}1$ reaction

In the following questions, two statements are given - one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to the questions from the codes (a), (b), (c) and (d) as given below:

- a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
b) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is not the correct explanation of the Assertion (A).
c) Assertion (A) is correct, but Reason (R) is incorrect statement.
d) Assertion (A) is incorrect, but Reason (R) is correct statement.

Q13. Assertion (A) : Nitric acid and water form maximum boiling azeotrope.

Reason (R) : Azeotropes are binary mixture having the same composition in liquid and vapour phase.

Q14. Assertion (A) : Copper sulphate cannot be stored in zinc vessel.

Reason (R) : Zinc is less reactive than copper.

Q15. Assertion (A) : Hydrolysis of an ester follows first order kinetics.

Reason (R) : Concentration of water remains nearly constant during the course of the reaction.

Q16. Assertion (A) : Transition metals show variable oxidation states.

Reason (R) : The involvement of greater number of (n - 1) d and ns electrons in the interatomic metallic bonding.

Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80% .

OR

Determine the amount of CaCl_2 ($i = 2.47$) dissolved in 2.5 litre of water such that its osmotic pressure is 0.75 atm at 27°C .

Q18. What is salt bridge? Write its two functions.

Q19. For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

Q20. a) How would you account for the irregular variation of ionisation enthalpies (first and second) in first series of the transition elements?
b) Explain why Cu^+ ions are not stable in aqueous solutions?

Q21. Write following name reactions:

- Wurtz reaction
- Markownikoff's reaction (for preparation of Bromopropane)

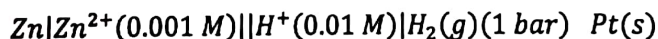
Section - C

Q22. Calculate (i) molality (ii) molarity and (iii) mole fraction of KI if the density of 20% (mass/mass) aqueous KI is 1.202 g mL^{-1} . (At. mass: $K = 39$, $I = 127$)

Q23. a) Define Colligative property.

b) Henry's law constant for the molality of methane in benzene at 298 K is $4.27 \times 10^5 \text{ mm Hg}$. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg .

Q24. a) Suggest two materials other than hydrogen that can be used as fuels in fuel cells.
b) Write the Nernst equation and calculate the emf of the following cell at 298 K .



Given: $E_{\text{Zn}^{2+}/\text{Zn}}^0 = 0.76 \text{ V}$, $E_{\text{H}^+/\text{H}_2}^0 = 0.00 \text{ V}$, $[\log 10 = 1]$

Q25. Using the standard electrode potentials given below, predict if the reaction between the following is feasible:

- $\text{Fe}^{3+}(\text{aq})$ and $\text{Ag}(\text{s})$
- $\text{Ag}^+(\text{aq})$ and $\text{Cu}(\text{s})$
- $\text{Fe}^{3+}(\text{aq})$ and $\text{Br}^-(\text{aq})$

Given standard electrode potentials:

$$E_{\text{Cu}^{2+}/\text{Cu}}^0 = 0.34 \text{ V}, E_{\text{Ag}^+/\text{Ag}}^0 = +0.80 \text{ V}, E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 = +0.77 \text{ V}, E_{1/2 \text{ Br}_2/\text{Br}^-}^0 = +1.090 \text{ V}$$

OR

Predict the products of electrolysis in each of the following:

- An aqueous solution of AgNO_3 with silver electrodes.
- A dilute solution of H_2SO_4 with platinum electrodes.
- An aqueous solution of CuCl_2 with platinum electrodes.

Q26.

- State Rate Law
- The following result have been obtained during the kinetic studies of the reaction:

$2A + B \rightarrow C + D$			
Experiment	[A] mol L ⁻¹	[B] mol L ⁻¹	Initial rate of formation of D/mol L ⁻¹ min ⁻¹
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Determine the rate law and the rate constant for the reaction.

Q27.

Give example and suggest reasons for the following features of the transition metal chemistry :

- The lowest oxide of transition metal is basic, the highest is amphoteric/ acidic
- A transition metal exhibits higher oxidation states in oxides and fluorides
- The highest oxidation state is exhibited in oxo - anions of a metal

Q28.

i) Write the structure of the following compounds:

- 1 - Chloro - 4 - ethylcyclohexane
 - 1 - Bromo, 4 - sec - butyl, 2 - methylbenzene
- ii) What are ambident nucleophiles? Explain with an example.

Section - D

Q29.

Read the passage given below and answer the following questions:

A solution which obeys Raoult's law strictly is called an ideal solution, while a solution which shows deviation from Raoult's law called a non-ideal solution or real solution. Suppose the molecules of the solvent and solute are represented by A and B respectively, and let Y_{AB} , Y_{AA} and Y_{BB} are the attractive forces between A - B, A - A and B - B respectively. An ideal solution of the components A and B is defined as the solution in which the intermolecular interactions between the components A and B are of the same magnitude as the intermolecular interactions found in the pure components A - A and B - B. Similarly, a non - ideal solution of the components A and B is defined as the solution in which the intermolecular interactions between the components A - A and B - B are of intermolecular interactions between the components A - B are of the different magnitude as the intermolecular interactions found in the pure components A - A and B - B.

- Which type of deviation will be shown by the solution, if $Y_{AB} < Y_{AA}$.
- On mixing liquid A and liquid B, volume of the resulting solution decreases, what type of deviation from Raoult's law is shown by?
- Write two characteristics of non - ideal solution.

OR

- What type of liquids form the ideal solution?
- Give one example of an ideal solution.

Q30

Read the following passage and answer the questions that follow:

Temperature has a marked effect on the rate of reaction. For most of the reactions, the rate of reaction becomes nearly double for every 10 degree rise in temperature. The effect of temperature is usually expressed in terms of temperature coefficient. The quantitative dependence of reaction rate on temperature was first explained by Swante Arrhenius. Arrhenius proposed a simple equation known as Arrhenius equation $k = Ae^{-E_a/RT}$

This equation provides a relationship between the rate constant (k) of a reaction and the temperature of the system. A is the Arrhenius factor or pre-exponential factor. E_a is a activation energy and R is the gas constant.

- The plot of $\log k$ vs X is linear with slope = $-E_a/2.303R$. What is X ?
- What is effect of temperature on rate of reaction?
- Can a reaction have zero activation energy? Justify.

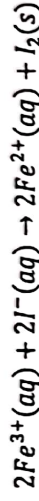
OR

How does a catalyst affect the rate of reaction? Explain with respect to Arrhenius equation.

A-4

(3+2)

a) The cell in which the following reaction occurs :



has $E_{cell}^0 = 0.236 V$ at 298 K. Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

Given : Anti log 7.983 = 9.616×10^7

b) Why does the conductivity of a solution decrease with dilution?

OR

(2+3)



What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2-}$?

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

(2+3)

Q32. a) Indicate the steps in the preparation of $KMnO_4$ from pyrolusite ore

b) Compare the chemistry of the actinoids with that of lanthanoids with reference to :

- (i) electronic configuration (ii) oxidation states and (iii) chemical reactivity

(2+3)

Q33. a) How the following conversions can be carried out?

- (i) Propane to propan - 1 - ol (ii) Ethanol to but - 1 - yne

b) Explain why

- (i) the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride?

- (ii) Alkyl halides, though polar, are immiscible with water?

- (iii) Grignard reagents should be prepared under anhydrous conditions.

OR

(2+3)

a) Arrange the compounds of each set in order of reactivity towards S_N2 displacement :

- (i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane

- (ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane

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

