

# CHEMISTRY FOR IIT-JEE

Conducted by:

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## Model Test Paper

### PART-I

(Answer all questions.)

#### QUESTION 1

- (a) Fill in the blanks choosing words from the following: [5]

[aqueous, calcium hydroxide, chlorine, fourteen, four, two, alcoholic, exceeds, ionic product, solubility product, calcium chloride, energy, heat, matter, calcium chlorate, Friedel Craft, toluene, decrease.]

- (i) Precipitation takes place when the product of the concentration of ions \_\_\_\_\_ its \_\_\_\_\_.
  - (ii) Ethyl iodide is converted to ethylene (ethene) by using \_\_\_\_\_ potassium hydroxide.
  - (iii) By \_\_\_\_\_ reaction \_\_\_\_\_ can be prepared from benzene.
  - (iv) The number of atoms per unit cell of face centred cube is \_\_\_\_\_.
  - (v) The precipitate of a salt takes place from a solution when the \_\_\_\_\_ exceeds the \_\_\_\_\_.
- (b) Are the following statements correct? If not, correct them (only the false or incomplete part need be corrected and rewritten, not the whole statement). [5]

- (i) Sulphur dioxide can act only as an oxidising agent and not as reducing agent.
  - (ii) pH of a buffer solution consisting of a mixture of weak acid and its salt is entirely determined by  $pK_a$  of the acid.
  - (iii) The composition of equilibrium mixture is not changed by the catalyst.
  - (iv) Combination of hydrogen and nitrogen in presence of iron catalyst is an example of homogeneous catalytic reaction.
  - (v) Water acts as a base when ammonia is dissolved in it.
- (c) (i) When benzene is refluxed with a mixture of concentrated nitric acid and concentrated sulphuric acid at  $60^\circ\text{C}$ , what is the type of reaction—substitution or addition that takes place? What is the type of intermediate involved?
- (ii) Name two different compounds that can be prepared from acetaldehyde without change in number of carbon



atoms. Mention the type of reaction used to produce them.

- (iii) What is formed when glucose is reacted with Tollen's reagent?
- (iv) Write balanced chemical equation for the reaction when diethyl ether reacts with phosphorous pentachloride.
- (v) Name the products formed when ammonium sulphate is heated with potassium cyanate. Write the balanced chemical equation for the reaction.

[5]

- (d) (i) What is the co-ordination number of atoms in body centred and face centred arrangement of crystal lattice?
- (ii) At room temperature in what physical states do bromine and iodine exist?
- (iii) For the decomposition of  $\text{N}_2\text{O}_5$  at 298K, the rate law is  $\text{Rate} = k[\text{N}_2\text{O}_5]$ . Starting with 2.5 moles of  $\text{N}_2\text{O}_5(\text{g})$  in a five litre container, how many moles per litre of  $\text{N}_2\text{O}_5$  would remain after 75 seconds if rate constant for the reaction is  $16.8 \times 10^{-3} \text{ s}^{-1}$ ?
- (iv) What is the percentage of free space in body centred cubic crystal? [5]

## PART-II

(Answer six questions choosing **two** from Section A, **two** from Section B and **two** from Section C.)

### SECTION A

(Answer any **two** questions.)

#### QUESTION 2

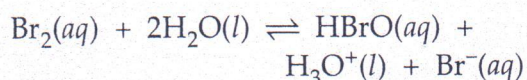
- (a) (i) What per cent of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) would have the same freezing point as a two per cent solution of urea ( $(\text{NH}_2)_2\text{CO}$ )?

[Atomic weights: C = 12, O = 16, N = 14]

- (ii) Solutions are made by dissolving one mole each of urea, aluminium chloride and sodium chloride in one litre of water. Will the osmotic pressure of these solutions be same? If not, arrange them in ascending order and give reasons for the arrangement you have given. [4]

- (b) (i) If the equilibrium constant value for the reaction  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$  is 60, what would be the value of equilibrium constant for the reaction  $\frac{1}{2} \text{H}_2(\text{g}) + \frac{1}{2} \text{I}_2(\text{g}) \rightleftharpoons \text{HI}(\text{g})$ ?

- (ii) Bromine water is brown and weakly acidic due to the following equilibrium:



When sodium hydroxide is added to the solution, the solution becomes colourless but the colour returns when hydrochloric acid is added. Explain this observation. [3]

- (c) (i) Calculate the value of Avogadro constant from the following data:  
Density of NaCl =  $2.165 \text{ g cm}^{-3}$   
Distance between  $\text{Na}^+$  and  $\text{Cl}^-$  in NaCl = 281 pm  
At. wt. Na = 23, Cl = 35.5
- (ii) Show that osmotic pressure is a colligative property. [3]

#### QUESTION 3

- (a) At  $90^\circ\text{C}$  the gaseous reaction  $\text{A} \longrightarrow \text{B} + 2\text{C}$  is found to be first order. On starting with pure A it is found that at the end of 10 minutes the total pressure of the reaction is 180 mm of Hg and at the end of the reaction 270 mm of Hg. Calculate the rate constant and the half-life period of the reaction. [3]



- (b) (i) Can liquid  $\rightleftharpoons$  gas equilibrium be attained in an open container? If not, give reason.
- (ii) How many electrons are lost by one gram of chloride ions as a result of electrolysis? [4]
- (c) Calculate the number of atoms per unit cell which is cube based. It has one atom on each of its corner and on each of its diagonals. It has one atom on its each face also. [3]

#### QUESTION 4

- (a) (i) Explain, why uncharged atoms or molecules never crystallise in simple cubic lattice.
- (ii) What is unit cell?
- (iii) Solubility product of silver chloride is  $3 \times 10^{-10}$  at  $25^\circ\text{C}$ . Calculate the solubility of silver chloride in

- (a) pure water
- (b) 0.05 M silver nitrate solution. [4]
- (b) (i) Calculate the electric charge carried by one electron.
- (ii) What mass of Zn ion will be reduced by one mole of electrons?
- (iii) The standard reduction potentials for the  $\text{Zn}^{+2}/\text{Zn(s)}$  electrode and  $\text{Pt}/\text{Cl}_2(\text{g})/\text{Cl}^-$  electrode are  $-0.76\text{ V}$  and  $+1.36\text{ V}$  respectively. Write the equation for the cell reaction. Calculate the e.m.f. of the cell. [3]
- (c) (i) How can you determine the atomic mass of an unknown metal if you know its density and the dimension of its unit cell? Explain your answer.
- (ii) What are the basic postulates of Werner's theory of co-ordination? In terms of Werner's postulates, explain the bonding in co-ordination compounds with example. [3]

#### SECTION B

(Answer any two questions.)

#### QUESTION 5

- (a) Outline the steps involved for the extraction of silver from its ore by cyanide process. Give balanced equations for important chemical reactions. [4]
- (b) Deep sea divers use a mixture of (80%) He and (20%) oxygen instead of air for breathing. Explain. [1]

#### QUESTION 6

- (a) Give balanced equations for the following chemical reactions:
- (i) Hydroiodic acid is added to copper sulphate solution.
- (ii) Sodium thiosulphate solution is treated separately with chlorine and iodine.

- (iii) Copper is heated with dilute nitric acid. [3]

- (b) (i) What is the shape of ozone molecule?
- (ii) What are the different commercial forms of iron? [2]

#### QUESTION 7

- (a) How would you prepare sulphur dioxide in the laboratory? [2]
- (b) (i) Illustrate with an example ionization isomerism in co-ordination compounds.
- (ii) Using valence bond approach, predict the shape and magnetic behaviour of  $[\text{CoCl}_4]^{-2}$ .
- (iii) Describe briefly the nature of bonding in a metal carbonyl. [3]



## SECTION C

(Answer any two questions.)

## QUESTION 8

- (a) The dissociation constant values of oxalic acid are as follows:

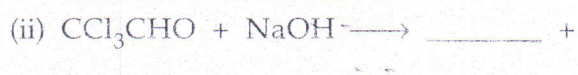
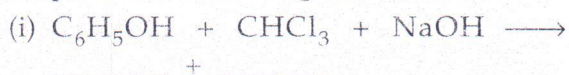
$$K_1 = 5.4 \times 10^{-2} \text{ and } K_2 = 5.4 \times 10^{-5}$$

Give the reason for the large difference in these two values. [3]

- (b) Explain the following:

- Phenol gets coloured on long standing.
- Ethers have low boiling point as compared to alcohols.
- Acetamide is not very reactive towards nucleophilic attack. [4]

- (c) Complete the following reactions:



## QUESTION 9

- (a) An organic compound A having molecular formula  $\text{C}_2\text{H}_3\text{N}_2$  on reduction gave another compound B. The compound B on treatment with nitrous acid gave ethyl alcohol. B on warming with chloroform and alcoholic potash gave an offensive smelling substance C. Identify A, B and C and also give the reactions involved. [4]

- (b) (i) Give all isomeric forms of the compound whose molecular formula is  $\text{C}_5\text{H}_{10}\text{O}$ .  
 (ii) Draw all possible stereoisomers for the following compounds:  
 (a)  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$   
 (b)  $\text{CH}_3\text{CHBrCOOH}$  [3]

- (c) (i) Name the reagents from which nitrobenzene is prepared in the laboratory.  
 (ii) Give the conditions for the reaction.  
 (iii) Why is it important to maintain the condition?  
 (iv) Write balanced chemical equation for the reaction. [3]

## QUESTION 10

- (a) (i) What is addition polymerisation?  
 (ii) What are the chemical characteristics of the monomer?  
 (iii) What is the type of catalyst used in addition polymerisation?  
 (iv) Name one catalyst used in this type of polymerisation.  
 (v) Mention the different steps involved in this type of polymerisation reaction.  
 (vi) Give one example for addition polymerisation. [3]
- (b) Convert  
 (i) formic acid to acetic acid.  
 (ii) acetylene to acetone.  
 (iii) nitrobenzene to ortho dinitrobenzene. [4]
- (c) (i) Suggest a structural formula for a compound  $\text{C}_6\text{H}_{11}\text{N}$ , that is optically active, dissolve in dilute hydrochloric acid and releases nitrogen with nitrous acid.  
 (ii) Why is it necessary to acetylate aniline before nitration?  
 (iii) What is obtained on strong heating of ammonium acetate? Give balanced chemical equation for the reaction. [3]