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:

[greater, lesser, pigment, tin, (+1), ($\sqrt{1}$), (–1), unity, tin, negative, positive, lead, copper]   [4]

  (i) The buffer capacity of a solution is maximum when the molar ratio of salt to acid is _____.

  (ii) Standard reduction potential = _____ × Standard oxidation potential.

  (iii) The more _____ the standard reduction potential, the _____ is the ability to displace hydrogen from acids.

  (iv) _____ is the only metal which is used to make protective coatings against radiation protection. Its oxides are also used as _____ in paints.

(b) Match each part in column A with the correct part in column B: [4]

Column A	Column B
(i) Fluoro carbon	(a) copper
(ii) Colour of solid alkyl halide	(b) alpha hydrogen atom
(iii) Peptides	(c) Fe_3O_4
(iv) Optically active	(d) air pollutant
(v) Face centred cubical structure	(e) amino acids
(vi) sp hybridisation	(f) molecular disymmetry
(vii) Magnetite	(g) F-centre
(viii) Aldol condensation	(h) silver nitrate

(c) Correct the following statements: [4]

  (i) If two compounds have the same crystal structure and analogous formulae, they are called isotopes.

  (ii) Cannizzaro's reaction can be given by any aldehyde.

(iii) Molecularity and order of a reaction can be 0, 1, 2, 3 etc.

(iv) When acetaldehyde is heated with Fehling's solution, it gives a precipitate of CuO.

(d) (i) Write the structures of four compounds that can have a molecular formula $C_5H_{10}O_2$.

(ii) What is observed when benzaldehyde is warmed in a water bath with Tollen's reagent?

(iii) Name the reactants and write the balanced chemical equation for the preparation of acetamides.

(iv) Write balanced chemical equation for the reaction taking place when chlorine is passed through benzene in presence of iodine. [4]

(e) (i) How do starch and cellulose differ with respect to their bonding pattern?

(ii) Distinguish between functional isomerism and positional isomerism.

(iii) What is observed when bromine water is added to phenol? Give chemical equation for the reaction.

(iv) What is the monomer used to prepare benzene? Mention the type of polymerisation reaction taking place. [4]

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) Show that the relative lowering of vapour pressure of a solution containing a non-volatile solute is equal to the mole fraction of the solute in the solution.

(ii) Dilute equimolal aqueous solutions of three substances X, urea and Y have vapour pressures in the order X < urea < Y. Suggest a reason for this observation. [4]

(b) (i) If a mixture of 3 moles of hydrogen and one mole of nitrogen is completely converted into ammonia, what would be the ratio of the initial and final volume at same temperature and pressure?

(ii) Mention the factors that may cause a shift of equilibrium. [3]

(c) (i) What does the negative value of E^o_{cell} indicate?

(ii) What do you understand by co-ordination number of a crystalline solid?

(iii) What is the shape of graph between log K vs $\frac{1}{T}$? What is the relationship between its slope and activation energy? [3]

QUESTION 3

(a) (i) The half-life of a first order reaction is 29.362 sec. If the value of frequency factor is 1.97×10^{12} sec^{-1}, calculate its activation energy.

(ii) What type of detector is used to detect hydrocarbons in gas chromatography?

(iii) What are the differences between sigma and pi molecular orbitals? [3]

(b) (i) The solubility product of ferrous hydroxide is 1.64×10^{-14} mol^{-1} and

that of magnesium hydroxide is 1.2×10^{-11} mol^{-1} at 18°C. If sodium hydroxide solution is added to an aqueous equimolal solution of ferrous sulphate and magnesium sulphate dropwise, which will precipitate first–ferrous hydroxide or magnesium hydroxide, why?

(ii) What will be the dissociation constant of 0.1M aqueous solution of ammonia if the dissociation of ammonium hydroxide is 1.37%? [4]

(c) (i) A current of 0.2 ampere is passed through a solution of cupric sulphate for 10 minutes, using platinum electrodes. Calculate the number of atoms of copper deposited on cathode.

(ii) What will be the pH value of 0.01 M metal hydroxide whose molecular formula is $M(OH)_2$? The metal hydroxide dissociates completely at any dilution. [3]

QUESTION 4

(a) (i) How are the copper atoms arranged in a crystal of copper? How many closest neighbours copper atoms have? What is the kind of lattice arrangement copper atoms taken independently?

(ii) Carbon tetrachloride and carbon dioxide do not have dipole moment but water has. Explain. [3]

(b) (i) What is the relationship between pH and the dissociation constant of an acid in a buffer solution?

(ii) State three factors which influence the electrode potential of an electrode.

(iii) Define equivalent conductance. In what unit it is expressed?

(iv) What is electrochemical equivalent? [4]

(c) (i) If the radius of lithium ion is 60 pm and that of fluoride ion is 136 pm, what are the co-ordination number of lithium ion and fluoride ion in LiF?

(ii) The solubility of sodium chlorate in water is 89 gm at 10°C and 172 gm at 70°C. A saturated solution of sodium chlorate was prepared in 200 mL of water at 70°C. How many grams of sodium chlorate are precipitated on cooling at 10°C if no water evaporates during the process and there is no supersaturation? [3]
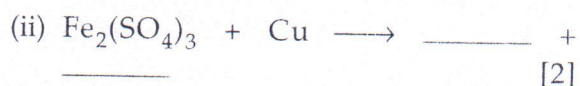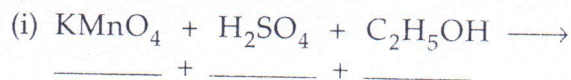
SECTION B

(Answer any two questions.)

QUESTION 5

(a) Outline the steps in the extraction of zinc from its sulphide ore. [3]

(b) Give one example each for the oxidising character of potassium permanganate in
  (i) alkaline medium
  (ii) acidic medium [2]

QUESTION 6

(a) Discuss the following properties of transition elements:
  (i) Ionization energy

(ii) Melting and boiling points
(iii) Magnetic behaviour [3]

(b) Complete and balance the following equations:

(i) $KMnO_4 + H_2SO_4 + C_2H_5OH \longrightarrow$ _____ + _____ + _____

(ii) $Fe_2(SO_4)_3 + Cu \longrightarrow$ _____ + _____ [2]

QUESTION 7

(a) How would you prepare hydrochloric acid from sodium chloride? [3]

(b) Explain the following:
   (i) During preparation of hydrogen chloride gas the reactants are not heated above 200°C.

(ii) Silver nitrate is kept in amber coloured bottle. [2]

SECTION C
*(Answer any **two** questions.)*

QUESTION 8

(a) (i) Aniline is converted into acetanilide before nitration. Explain.
   (ii) Give two chemical tests by which aniline can be distinguish from ethyl amine. [4]

(b) State, with balanced equations, what happens when
   (i) acetic anhydride reacts with phenol in presence of a base.
   (ii) calcium acetate is heated and the product is treated with phosphorous pentachloride.
   (iii) sodium formate is heated. [3]

(c) (i) What are the differences between monosaccharides, oligosaccharides and polysaccharides? Give one example for each class.
   (ii) What happens when fructose is heated with concentrated nitric acid? Give chemical equations for the reaction and name the products.
   (iii) Give balanced chemical equation for the reaction when cellulose is treated with dilute sulphuric acid. Name the products formed. [3]

QUESTION 9

(a) How is pure benzene isolated from coal-tar? [4]

(b) How will you differentiate between the following:
   (i) Glucose and fructose
   (ii) Diethyl ether and ethyl alcohol
   (iii) Nitro benzene and aniline. [3]

(c) An organic compound X of molecular mass 140.5 has 68.32% carbon, 6.4% hydrogen and 25.26% chlorine. On hydrolysis X gives Y of molecular formula $C_8H_{10}O$. The compound Y can be oxidised with potassium dichromate and dil. H_2SO_4 to give Z (C_8H_8O). The compound Z does not reduce Fehling's solution but gives a positive iodoform test. Identify X, Y and Z and write reactions involved. [3]

QUESTION 10

(a) Draw all possible stereoisomers for the following compounds and state which are optically active, inactive or which are meso form and geometrical isomers.
   (i) $CH_3CHOHCHOHCH_3$
   (ii) $CH_2 = CHCH_3$
   (iii) $CH_3CHBrCH = CH_2$ [3]

(b) Name the following reactions and give balanced chemical equations:
   (i) Benzaldehyde with concentrated sodium hydroxide solution.
   (ii) Chlorobenzene and methyl chloride are heated with sodium in presence of dry ether.
   (iii) Ethyl amine with chloroform in presence of alcoholic potassium hydroxide. [4]

(c) What is optical activity? What characteristics are required in an organic compound to exhibit optical activity? Explain with an example. [3]