Chemistry 2007
Paper I

Q.1. (a) What is hydrogen spectrum? How does it help in understanding the structure of atom? (10)
(b) Write comprehensive notes on hydrogen and metallic bonding. (10)

Q.2. (a) What do you understand by Ionic Equilibria? (7)
(b) Discuss buffer solutions and their mechanism. (7)
(c) Discuss the principle and working of Glass Electrode. (6)

Q.3. (a) Classify Silicates into different types. Give the composition and structure of atleast two types of silicates. (6)
(b) Give the preparation, properties and structure of Phosphorus Penta oxide. (5)
(c) Describe the preparation and properties of Nitrogen Dioxide (NO2). (5)
(d) Write a note on Interhalogen Compounds. (4)

Q.4. (a) What are the principal ores of Silver? How Silver is extracted from its ores?(8)
(b) Discuss the metallurgy of copper. (6)
(c) Give the names of Iron Ores. (6)

Q.5. (a) Describe the contact process for the manufacture of sulphuric acid. (8)
(b) What are the different types of Fertilizers? Give their chemical formula. (5)
(c) Discuss the measures for the control of CO (Carbon mono-oxide) pollutionin air. (7)

Q.6. (a) Discuss the general characteristics of transition elements based on theirelectronic configuration. (10)
(b) How free energy and chemical equilibrium are related to each other? (10)

Q.7. Write notes on any FOUR of the following: (5 each)
(a) Fixation of Nitrogen
(b) Semiconductivity Devices
(c) Metallurgy of Aluminium
(d) Crystal field theory
(e) Entropy and second law of thermodynamics
(f) Water Pollution

COMPULSORY QUESTION

Q.8. Write only the correct answer in the Answer Book. Do not reproduce the question.
(1) Which element has the highest Iomization Energy:
(a) Sodium (b) Aluminium
(c) Calcium (d) Phosphorus

(2) Given the reaction 2CO(g) + O 2 (g) 2CO2(g) when the reaction is subjected to stress, a change will occur in the concentration of:

(a) reactants only
(b)products only
(c) both reactants and products
(d)neither reactants nor products

(3) Which type of reaction is occurring when a metal undergoes corrosion:
(a) Oxidation-reduction (b) Neutralization
(c) Polymerization (d) Saponification
(e) None of these

(4) What is the pH of 0.00001 Molar HCl solution:
(a) 1 (b)9 (c)5
(d) 4 (e) None of these

(5) What is the total number of atoms contained in 2 moles of nickel?
(a) 58.9 (b) 118 (c) 6.02 ´1023
(d) 1.2 ´1024 (e) None of these

(6) What is the percent by mass of oxygen in magnesium oxide (MgO):
(a) 20 % (b) 40 % (c) 50 %
(d) 60 % (e) None of these

(7) Which halogens are gases at STP?
(a) Chlorine and Bromine (b) Chlorine and Fluorine
(c) Iodine and Fluorine (d) Iodine and Bromine

(8) The internal resistance of a liquid to flow is called:
(a) Surface tension (b) Capillary action
(c) Viscosity (d) Van der waals alteraction
(e) None of these

(9) Two Cu Cu2+ couples, A and B are prepared with Cu2+ concentration of exactly twice that of B. If these two couples are joined to make a cell:
(a) No current will flow (b) Current will flow from A to B
(c) Current will flow from B to A (d) The system will be in equilibrium

(10) The valence of an element:
(a) Always equals the oxidation number
(b) Never equals the oxidation number
(c) Is unrelated to the oxidation number
(d) May be numerically equal to the oxidation number

(11) The basic raw materials used in a Blast furnace to produce Iron are Iron ore, Coke, Air and:
(a) Scrap Iron (b) Sulphur (c) Sand
(d) Limestone (e) None of these

(12) In contrast to the carbonates of the alkali metals, the alkaline earth carbonates:
(a) Are more soluble
(b) Cannot be isolated
(c) Decompose on heating metal and CO2
(d) Decompose on heating forming oxide and CO2
(e) None of these

(13) Coustic Soda is the common name for:
(a) KOH (b) Na2CO3 (c) K2CO3
(d) NaOH (e) None of these

(14) When 2 g of Copper was heated with Sulphur 2.51 g of sulphide was produced. The empirical formula of the sulphide is:
(a) Cu S2 (b) Cu2 S
(c) Cu2 S3 (d) None of these

(15) The atomic number of an element is equal to the number of:
(a) Protons in the nucleus (b) Protons and neutrons in the nucleus
(c) Neutrons in the nucleus (d) None of these

(16) A liquid will boil at a given temperature provided the atmospheric pressure is equal to:
(a) The vapour pressure of the liquid (b) Zero
(c) One atmosphere (d) The critical pressure
(e) None of these

(17) When 12 g of magnesium are dissolved in acid, 1g of hydrogen is produced. What conclusion may correctly be drawn from this information:
(a) The atomic weight of magnesium is 12
(b) The atomic weight of magnesium is 24
(c) The equivale nt weight of magnesium is 24
(d) Not possible to obtain atomic weight from this information

(18) The more reactive a metal:
(a) The less easily it is oxidized
(b) The more easily it gains electrons
(c) The greater is its tendency to form positive ions
(d) The small is its ionization potential
(e) None of these

(19) Sulphure crystallizes in both monoclinic and rhombic forms. This is an exampleof:
(a) A morphism (b) Isomorphism (c) Allotropy
(d) Supercooling (e) None of these

(20) The oxidation number of sulphur in H_2SO_4 is:
(a) – 2 (b) +2 (c) + 5
(d) + 4 (e) None of these

Chemistry 2007
Paper II

Q.1. (a) In what respect are sigma (s) and pi (p) bonds different from each other? Explain. (7)
(b) What are H-bonds and how do they affect the properties of organic compounds?(6)
(c) Write an essay on hybridizatin and its significance in predicting the shape ofmolecules. (7)

Q.2. (a) Give a comparison of Valence Bond (VB) and Molecular Orbital (MO) theories of bonding highlighting their important features. (7)
(b) What are aromatic compounds? What is the role of resonance energy towardsstability of the aromatic compounds? (7)
(c) Write an essay on isomerism. Elaborate its various types giving suitableexamples. (6)

Q.3. (a) How can temperature affect the rate of a reaction? Also make a diagram to explain the energetics involved. (7)
(b) A ® product(s): is a second order reaction. Develop an integrated rate law for the reaction and suggest a method to confirm that the reaction is second order.(7)
(c) Reaction of sodium ethoxide (Na+-OCH 2 CH 3) with bromomethane (CH3Br) is about 10,000 times faster as compared to that with neopentyl bromide ((CH3)3 CCH2 Br). Explain with justification. (6)

Q.4. (a) Suggest one convenient method each for the preparation of RCHO (an aldehyde) and R2CO (a Ketone). How to establish that the compound formed is an aldehyde (or a Ketone) and not the Vice Versa? (7)
(b) Give a general explanation for the electrophilic substitution of benzene. Give chemical equations showing all steps (with reaction conditions) for bromination, nitration and alkylation of benzene. (7)
(c) Write an essay on the Grignard reagents. Give one example each in which the Grignard reagent acts as base and as nucleophile. (6)

Q.5. (a) Differentiate between physical adsorption and chemisorption. How can the nature of adsorption be established experimentally? (7)
(b) Explain the Langmuir adsorption isotherm and its applications. (6)
(c) Differentiate between molecularity and order of a reaction. Should they change if the reaction conditions are changed? (7)

Q.6. (a) Suggest a method for the synthesis of benzene-diazonium chloride (BDC) from nitrobenzene. Write down chemical equations for the reaction of BDC with7)
(a) KI (b) HBF4 (c) H3PO2 (d) C6H5NH2.
(b) Organic polymers have brought about a socio-economic revolution of present age. Justify by referring to three important organic polymers. (7)

(c) Write an essay on Vitamins. Why are the Vitamin-A and C important? (6)

Q.7. (a) What are sulpha drugs? Give their general formula and methods of preparation. Also write structures of two important sulpha drugs. (7)
(b) Write an essay on carbohydrates. What are special features of the monosaccharides? (7)
(c) What are amides? What make them different in chemical reactivity compared to aldehydes and Ketones? (6)

COMPULSORY QUESTION

Q.8. Write only the correct answer in the Answer Book. Do not reproduce the question.

(1) R -◊ Product(s): is a 1st order reaction with respect to the concentration [R]. To obtain a straight line with a slope equal to the rate constant k, which of thefollowings should be plotted against time?

(a) [R] (b) [R]2 (c) 1[R]
(d) ln[R] (e) None of these

(2) If the rate of a reaction does not change with time then the reaction should be:
(a) moderately slow (b) very fast (c) catalyzed
(d) zeroth order (e) None of these.

(3) If a chemical reaction reaches equilibrium state:
(a) its forward and backward rates are equal
(b) its overall free energy change becomes zero
(c) its equilibrium constant is the ratio of the two rate constants
(d) all of these (e) none of these

(4) PCl5(g) ® PCl3(g) +Cl2(g). The units of equilibrium constant, Kc for the reaction is:
(a) L mol–1 (b) mol L –1 (c) mol –1 L –1
(d) mol –2 L–2 (e) None of these

(5) Energy of a typical H – bond ranges between:
(a) 2 to 4 kJmol –1 (b) 5 to 10 kJmol –1
(c) 15 to 30 kJmol –1 (d) 40 to 80 kJmol –1
(e) None of these

(6) Which of the pairs makes an “ideal mixture”:
(a) benzene-methanol (b) benzene-toluene
(c) ethanol-methanol (d) ethanol-water
(e) None of these

(7) Which of the following concentration units depends on temperature?
(a) molarity (b) molality
(c) mole fraction (d) weight to weight (W/W) %
(e) None of these

(8) A 0.4% (W/V) aqueous solution of NaOH is nearly:
(a) 1 M (b) 0.5 M (c) 0.1 M
(d) 0.01 M (e) None of these

(9) Which of the followings is correct for the ground state of O2 molecule?
(a) bond order two and no unpaired electron
(b) bond order two and one unpaired electron
(c) bond order two and two unpaired electron in the bonding orbital
(d) bond order two and two unpaired electrons in the anti-bonding orbital
(e) None of these

(10) Which one should give the simplest proton NMR spectrum?
(a) CH3CH2OH (b) CH3OH (c) CH3OCH3
(d) CH3CHO (e) all are equally complicated

(11) Which group has the highest stretching frequency of IR-region in the gas phase?
(a) º C -H (b) = C -H (c) – O – H
(d) – N – H (e) all are equal

(12) Which of the following should not be formed according to the bonding theories?
(a) H +
2 (b) H -
2 (c) He 2
(d) He2
+ (e) None of these

(13) There remains no liquid-vapour boundary at:
(a) boiling point (b) critical temperature
(c) triple point (d) azeotrope composition
(e) None of these

(14) For a catalyzed reaction as compared to the uncatalyzed one:
(a) heat of reaction is higher (b) heat of reaction is lower
(c) heat of reaction is same (d) activation energy is same
(e) All above are correct

(15) When two ideal gases at the same temperature are mixed together:
(a) there is a negative heat of mixing
(b) there is a positive heat of mixing
(c) both heat and entropy of mixing are positive
(d) entropy of mixing alone is positive
(e) All above are correct

(16) Which of the series is present in the ultraviolet region for the H – atom?
(a) Layman (b) Balmer (c) Paschen
(d) Pfund (e) None of these

(17) pH of 0.01 M HCl solution should be:
(a) 3 (b)2 (c)1.5
(d) 1 (e) None of these

(18) Which of the ions should exhibit highest electrical mobility in aqueous solution? –
(a) Na+ (b) I (c) Cs+
(d) Cd++ (e) Li+

(19) H2 + Br2 ® 2HBr is a very famous gas phase reaction. The overall order of this reaction is:
(a) two (b) one (c) half
(d) one half in the beginning (e) All above are correct

(20) Presence of a chiral center in molecules makes them:
(a) absorb uv–radiation (b) absorb plane polarized light
(c) rotate plane polarized light (d) emit IR–radiation
(e) None of these