FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS–17, UNDER THE FEDERAL GOVERNMENT, 2005

CHEMISTRY, PAPER–I

TIME ALLOWED: THREE HOURS MAXIMUM MARKS: 100

NOTE: Attempt **FIVE** questions in all, including **QUESTION NO.8**, which is **COMPULSORY**. All questions carry **EQUAL** marks.

1. (a) Discuss the results of a particle in a box. (5)
   (b) Describe the main conditions of wave equation to understand the behaviour of hydrogen atom. (6)
   (c) What is meant by eigen function? How it can be used to represent an orbital hydrogen atom? (9)

2. (a) Derive an equation to determine the p H of dibasic acid. (6)
   (b) Discuss the chemical composition of glass membrane used in glass electrode. (3)
   (c) Write the chemical composition and reaction of dry cell used as power flash light. (5)
   (d) What are fuel cells? Discuss the chemistry of hydrogen oxygen fuel cell. (6)

3. (a) Give various methods for the determination of entropy and free energy of system. Discuss their importance in thermodynamics. (7 + 5)
   (b) For the general reaction, the standard free energy at 300^{0} C is 11004 J. Calculate the value for equilibrium constant. (8)

   $(R = 8.31\ J\ K^{-1} mol^{-1})$.

4. (a) What are Roasting and Smelting processes? Discuss the importance of carbon as a reducing agent for the production of metals. (7)
   (b) Differentiate between homocatenation and heterocatenation. Give suitable examples. (4)
   (c) Explain briefly invitro and invivo nitrogen fixation. Discuss the importance of molybdenum compounds in the process. (5)
   (d) Starting from silica, how will you prepare any two of the following: (4)
   (i) $SiCl_4$ (ii) Water glass (iii) Hydrofluoro silicic acid

5. (a) Describe the importance of Calcium Super phosphate as fertilizer. How it is prepared on commercial scale. (8)
   (b) What is the function of NO in the manufacture of H_2SO_4 by Chamber Process. (6)
   (c) Thermodynamic Stability is different from Kinetic stability. Comment on the above statement. (6)

6. (a) What is meant by Crystal Field Stabilization Energy? How it can be calculated? Give its applications. (5)
   (b) Explain briefly the spectrochemical series. (5)
   (c) Discuss various experimental evidences in favour of Werner's Theory. (5)
   (d) What is Chelate Effect? Explain. (5)

7. Write notes on any four of the following: (5 each)
   (1) Molecular Orbital Theory (2) Metallurgy of Aluminium
   (3) Semiconductors (4) Forms of Oxygen
   (5) Uses of Chlorine gas (6) Air Pollution

COMPULSORY QUESTION

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

   (1) An important characteristic of the Transition Elements is that:
   (a) They generally exhibit more than one valence. (b) They have identical chemical properties.
   (c) They are all amphoteric elements. (d) Their f subshells are partially filled.
   (e) They are magnetic

   (2) The elements of Group Ia are known as:
   (a) The halogens (b) The alkali metals
   (c) The alkaline earths (d) Transition elements

   (3) The elements which possess the property of ferromagnetism are (Identify the set of elements):
   (a) Fe, Co and Al (b) Os, Ir and Pt
   (c) Fe, Cu and Ni (d) Fe, Al and Ni

   (4) All the transition elements:
   (a) Are metals (b) have high melting points
   (c) have large atomic radii (d) form covalent bonds with non metals

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(5) The reaction of an acid with a base to form water and salt is called:
(a) Dissociation (b) Ionization
(c) Neutralization (d) Hydrolysis

(6) As a solution of weak acid becomes more dilute:
(a) The strength of the acid increases. (b) The concentration of the ions in solution increases.
(c) The percentage of the molecules that ionize increases.

(7) Which one is the principal quantum number?
(a) *l* (b) s
(c) n (d) m

(8) The energy change in a chemical reaction at constant pressure is known as:
(a) Δ S (b) Δ H
(c) Δ G (d) Δ E

(9) Chlorine heptoxide (Cl_2O_7) reacts with water to form:
(a) A mixture of hypochlorous acid and chloric acid. (b) Hypochlorous acid
(c) Chloric acid (d) Perchloric acid

(10) The formula of cryolite is:
(a) Al_2O_3 (b) $Na_3 Al F_6$
(c) $K_2 Cr_2O_7$ (d) $Al F_3$

(11) An anhydride of nitric acid is:
(a) NO_2 (b) N_2O_3
(c) N_2O_4 (d) N_2O_5

(12) The thermodynamic systems that have high stability tend to demonstrate:
(a) minimum ΔH, minimum ΔS (b) minimum ΔH, maximum ΔS
(c) maximum ΔH, minimum ΔS (d) maximum ΔH, maximum ΔS

(13) In electrolysis, $E^{\ominus}$ tends to be:
(a) negative (b) positive
(c) neutral (d) zero

(14) When an excited electron tends to return to the ground state, it releases:
(a) Alpha particles (b) Beta particles
(c) Protons (d) Protons

(15) A non-metallic oxide which reacts with water to form an acid is often called:
(a) Basic oxide (b) Hydroxide
(c) Acid Hydrate (d) Acid Anhydride

(16) When Phosphorus is burned in oxygen, the product is:
(a) Red Phosphorus (b) P_4O_6
(c) P_4O_{10} (d) H_3PO_4

(17) If ΔH and ΔS are both positive:
(a) ΔF is always positive (b) ΔF is always negative
(c) The reaction becomes spontaneous at low temperatures
(d) The reaction becomes spontaneous at high temperatures

(18) Chalcocite is an ore of:
(a) Aluminium (b) Copper
(c) Zinc (d) Iron

(19) Transition metal, Zinc exhibits oxidation states of:
(a) +2 only (b) +1 only
(c) +2 & +4 (d) +2 & +3

(20) A gas which when present in air causes acid rain:
(a) Nitrogen (b) Ammonia
(c) Sulphur dioxide (d) Carbon monoxide

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CHEMISTRY, PAPER-II

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NOTE: Attempt **FIVE** questions in all, including **QUESTION NO.8**, which is **COMPULSORY**. All questions carry **EQUAL** marks.

1. (a) Discuss the principles involved in the Valence Bond Theory. How this theory is applied to explain the formation of Chemical bonds in, NH_3, HCl & N_2 molecules. (11)

   (b) Predict the shape of the following molecules: (6)

   ClF_3, SF_6, ClO_2^- and NO_3^-

   (c) Write the structural formula of: (3)

   (i) Blood Sugar (ii) Table Sugar (iii) Milk Sugar

2. (a) Distinguish between the Moleculasity and the Order of reaction. Explain with examples (8)

   (b) In Thermal Decomposition of benzene diazonium Chloride (6)

   $$C_6H_5N^+NCl \xrightarrow[50^\circ c]{H_2O} C_6H_5Cl + N_2$$

Time (min.)	5	10	15	20	∞
Volume of N_2 (ml)	17.5	29.7	38.2	44.3	58.3

   From the give data show that this is first order reaction.

   (c) Describe the synthesis of "DDT" from Trichloro-acetaldehyde. (6)

3. (a) How Aromatic amino compounds are converted to diazonium salts. (5)

   (b) What happens when Benzene diazonium salt is treated with (12)

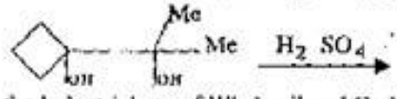
   (1) H_3PO_2 (2) H_2O/Δ (3) ROH

   (4) RCOOH (5) NaCN + CuCN (6) $\dfrac{NaOAc + H_2O}{C_6H_6}$

   (c) Give structures of three alkaloids obtained from opium (3)

4. (a) Explain Cahn-Ingold-Prelog rules. Where are they applied in Chemistry. Give examples. (8)

   (b) Predict the Product of the following reaction and explain its formation: (6)

   (c) Give the Industrial use of Whale oil and Cod-Liver oil. (6)

5. (a) How Primary, Sec., Tertiary alcohols; Carboxylic acids; Aldehydes; Ketones and Hydroperoxide are synthesized from Grignard's reagent. (12)

   (b) Explain, why Halogens' are Ortho, para directors and are deactivating. (5)

   (c) Give the decreasing order of reactivity of alkyl halides in reactions with metals to give Organometallics. (3)

6. (a) One mole of benzene is mixed with 1 mole of nitrobenzene and ½ mole of bromine. Some $FeBr_3$ is added and the mixture is heated to reflux. What is the major reaction product? Explain your answer giving full reaction. (6)

   (b) Explain: (2)

   (i) Why Dimethyl amine has higher boiling point than trimethylamine? (2)

   (ii) Carbonyl compounds are more soluble in water than the corresponding alkanes but less than the corresponding alcohols.

   (c) What makes azo compounds so suitable as dyes? (3)

   (d) Describe the preparation of Streptomycin by Fermentation. (7)

7. (a) Prove the nucleophilicity and basicity are fundamentally different properties. Prove with special reference to Aromatic amines. (4)

   (b) Discuss importance of Alkylation, Hydroalkylation and cracking in the manufacture of petrochemicals. (8)

   (c) Write note on Homogeneous and Heterogeneous Catalysis. (8)

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COMPULSORY QUESTION

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

(A) Choose the suitable answer from the given options. (10)

(1) Perspex belongs to which class:

(a)	Alkaloid	(b)	Anti-biotic	(c)	Polymer
(d)	Organic Solvent	(e)	Alkylhalide	(f)	None of these

(2) The formula of "Laughing Gas" is:

(a)	CH_3COCl	(b)	Ph–N=N–Ph	(c)	N_2O
(d)	HNO_2	(e)	CH_2O	(f)	None of these

(3) "PbS" is also called:

(a)	Gallic acid	(b)	Galena	(c)	Alum
(d)	Pyrogallol	(e)	Sulphonamide	(f)	None of these

(4) Which of the following is not an Alkaloid:

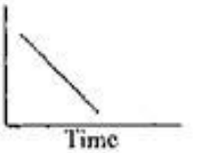
(a)	Atropine	(b)	Nicotine	(c)	Piperine
(d)	Hygrine	(e)	Piperitone	(f)	None of these

(5) Aqua Regia is also known as:

(a)	Aq. $AgNo_3$	(b)	Royal Water	(c)	Carborundum
(d)	Argentite	(e)	Aragonite	(f)	None of these

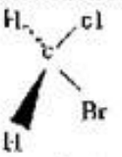
(6) In the given reaction $2N_2O_5 \longrightarrow 4NO_2 + O_2$

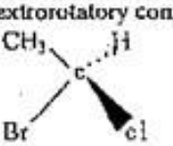
What is the order of this reaction from the following straight line plot?

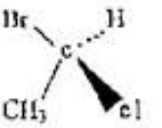


(a)	Third	(b)	Fourth	(c)	Zero
(d)	Second	(e)	First	(f)	None of these

(7) Which of the following is a dextrorotatory compound?

(a) 

(b) 

(c) 

(d) Can't be decided by structure alone. (e) None of these

(8) A person unable to see in the dark or dim light due to deficiency of:

(a)	Ascorbic acid	(b)	Vitamin D	(c)	Vitamin A
(d)	Vitamin E	(d)	Thiamine	(f)	None of these

(9) What is the bond order of F_2, according to Molecular Orbital Theory:

(a)	1	(b)	2	(c)	4
(d)	3	(e)	2 ½	(f)	None of these

(10) Which of the following compounds has most likely been formed by Covalent bonding of atoms?

(a)	CaF_2	(b)	SiH_4	(c)	NaCl
(d)	MgO	(e)	RbCl	(f)	None of these

(B) Write only True or False in the Answer Book. Do not reproduce the statements. (6)

(11) Octane number for heptane is zero.
(12) Grignard's reagent can be prepared from alkyl halide containing acidic hydrogen.
(13) Lower the Pka higher will be acid strength.
(14) Drying oil contains saturated fatty acids which polymerize on oxidation.
(15) Glucose on acetylation forms penta acetate derivative.
(16) NO_2^+ has a linear structure.

(C) Suggests the most suitable word for each of the following statement. (4)

(17) Hardening of rubber by heating it with sulphur is called ———.
(18) Used as an explosive and formed by the nitration of Tolvene.
(19) A reaction between a compound and its solvent is named ———.
(20) Isomers obtained by rotation about a single bond are called ———.

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