FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR
RECRUITMENT TO POSTS IN BPS-17 UNDER
THE FEDERAL GOVERNMENT, 2009

CHEMISTRY, PAPER-I

S.No.	
R.No.	

TIME ALLOWED:	**(PART-I) 30 MINUTES**	**MAXIMUM MARKS:20**
	(PART-II) 2 HOURS & 30 MINUTES	**MAXIMUM MARKS:80**

NOTE: (i) **First** attempt **PART-I (MCQ)** on separate **Answer Sheet** which shall be taken back after **30 minutes.**
(ii) Overwriting/cutting of the options/answers will not be given credit.
(iii) Scientific calculator is allowed

PART – I (MCQ)
(COMPULSORY)

Q.1. Select the best option/answer and fill in the appropriate box on the Answer Sheet. (20)

(i) Which of the following ions can act as both a Bronsted acid and base in water?
(a) HCO_3^- (b) SO_4^- (c) NO_3^- (d) $\bar{C}N$

(ii) What is the bond order of F_2 according to the molecular orbital theory?
(a) 1 (b) 2 (c) 4 (d) 3

(iii) Brass is an alloy of:
(a) Copper and Zinc (b) Copper and Tin
(c) Aluminum and Zinc (d) Aluminum and Copper

(iv) A 0.1 N solution of Sodium bicarbonate has a pH value of:
(a) 5.6 (b) 7.0 (c) 8.4 (d) 13.0

(v) A perpetual motion machine capable of generating increasing amounts of energy without interacting with its surroundings can not exist. This is best explained by:
(a) First law of Thermodynamics (b) Third law of Thermodynamics
(c) Energy conservation principle (d) Gibbs-Helmholtz equation

(vi) The Schrodinger equation when solved for any system gives:
(a) The polarizability (b) The mean free path
(c) The wave function (d) The magnetogyric ratio

(vii) The number of molecules of water needed to convert one molecule of P_2O_5 into ortho phosphoric acid is:
(a) 1 (b) 2 (c) 3 (d) 4

(viii) In a galvanic cell the following reaction takes place: $2H_2O \rightleftharpoons O_2(g) + 4H^+ + 4e^-$
It occurs at
(a) Cathode (b) Anode (c) Cathode & Anode (d) External Conductor

(ix) For a reversible cycle, the entropy change is:
(a) Always +ve (b) Always –ve (c) Always zero (d) Dependent on the temperature

(x) In which of the following compounds Nitrogen has the highest oxidation state?
(a) NH_4Cl (b) Mg_3N_2 (c) $Na\ No_3$ (d) $Na\ No_2$

(xi) Which oxide is most acidic in the following?
(a) Chlorine (I) oxide (b) Phosphorous (V) oxide
(c) Sulfur (IV) oxide (d) Germanium (II) oxide

(xii) When Hydrogen ion unites with one molecule of water to form hydronium ion? Which type of bond is formed?
(a) Ionic (b) Non polar covalent (c) Coordinate covalent (d) Hydrogen bond

(xiii) The value of $[H^+][\bar{o}H]$
(a) 14 (b) 7 (c) 1×10^{-14} (d) 1×10^{-7}

(xiv) The addition of NH_4Cl to a 1.0 N solution of NH_4oH would have which one of the following effect?
(a) Lower the pH (b) Raise the pH (c) no effect on pH (d) Release NH_3 gas

(xv) Which one of the following is an ore of iron?
(a) Bauxite (b) Galena (c) Taconite (d) Smithsonite

(xvi) A sample of iron oxide contains 0.250 mole of iron atoms and 0.375 mole of oxygen atoms. What is the empirical formula of the compound?
At.wt; Fe = 56, O = 16;
(a) FeO (b) Fe_2O_3 (c) Fe_3O_4 (d) FeO_2

(xvii) At equilibrium the change in free energy (ΔG or ΔF) for any given reaction is:
(a) Positive and large (b) Positive and small
(c) Zero (d) Negative and small

(xviii) What is the Oxidation number of Si in $Si\,F_6^{2-}$?
(a) +2 (b) +4 (c) +6 (d) –6

(xix) Which element are more likely to form strong bases?
(a) s–block metals (b) p–block metals (c) p–block non metals (d) d–block metals

(xx) Which of the following statement is true?
(a) A catalyst modifies the enthalpy of a system
(b) A catalyst modifies the nature of the product of a reaction.
(c) A catalyst modifies the entropy of a system
(d) A catalyst modifies the activation energy of a system

PART – II

NOTE:	**(i)** **PART-II** is to be attempted on the separate **Answer Book.** **(ii)** Attempt **ONLY FOUR** questions from **PART-II**. All questions carry **EQUAL** marks. **(iii)** Extra attempt of any question or any part of the attempted question will not be considered.

Q.2. (a) How Schrodinger wave equation is applied to understand the motion of the particle in the box? **(8)**

(b) Define Hydrogen Bonding. Draw the structure showing hydrogen bonding in the following pure liquids wherever possible.
(i) Hydrozine (ii) Methylalcohol (iii) Sulphuric acid **(6)**

(c) Write a brief note on metallic bonding **(6)**

Q.3. (a) Define enthalpy and discuss its relationship with internal energy. **(5)**
(b) Give various definitions of Second Law of Thermodynamics. **(6)**
(c) Write a comprehensive note on entropy. **(6)**
(d) Define and explain Thermochemistry. **(3)**

Q.4. (a) What are various allotropic forms of Carbon. Give their structures and properties. **(6)**
(b) Discuss role of Nitrogen Oxides in Environmental pollution. **(3)**
(c) Given structures of (i) PF_5 (ii) PCl_6^- (iii) $\left(SiO_4^{4-}\right)$ $\left(4\frac{1}{2}\right)$
(d) How nitrogen is produced industrially. $\left(6\frac{1}{2}\right)$

Q.5. (a) How Iron is produced on Industrial Scale using “Blast Furnance”. **(8)**
(b) Discuss metallurgy of Aluminum. **(6)**
(c) Write a note on “Water pollution”. **(6)**

Q.6. (a) What is “Fiber Glass”. **(2)**
(b) Describe wet process for the manufacture of cement. What do you mean by setting of cement. **(10+2)**
(c) Give the manufacture of Ammonium Nitrate. **(6)**

Q.7. (a) Discuss the principle involved in MO Theory. How this theory is applied to explain the formation of a bond. **(10)**
(b) Compare MO Theory with Valence Bond Theory. **(8)**
(c) Draw the structure of $[Co(NH_3)_6]Cl_3$ and $K_2[Ni(CN)_4)]$ **(2)**

Q.8. (a) Discuss various theories of Acids and Bases. **(9)**
(b) Write a note on Glass electrode. **(7)**
(c) Calculate pH of the following solutions. **(4)**
(i) 0.037 M HCl (ii) 0.33 M NaOH.

****

FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR
RECRUITMENT TO POSTS IN BPS-17 UNDER
THE FEDERAL GOVERNMENT, 2009

CHEMISTRY, PAPER-II

S.No.	
R.No.	

TIME ALLOWED:	**(PART-I) 30 MINUTES**	**MAXIMUM MARKS:20**
	(PART-II) 2 HOURS & 30 MINUTES	**MAXIMUM MARKS:80**

NOTE: (i) **First** attempt **PART-I (MCQ)** on separate **Answer Sheet** which shall be taken back after **30 minutes.**
(ii) Overwriting/cutting of the options/answers will not be given credit.
(iii) Scientific Calculator is allowed.

PART – I (MCQ)
(COMPULSORY)

Q.1. Select the best option/answer and fill in the appropriate box on the Answer Sheet. (20)

(i) The orbitals providing the most efficient overlap are:
(a) s–s (b) p–p (c) sp–sp (d) sp^2–sp^2

(ii) Nylon is a copolymer of:
(a) Urea and Formaldehyde (b) Phenol and Formaldehyde
(c) Hexamethylenediamine and adipic acid (d) Vinyl Chloride and Vinylalcohol

(iii) Which of the following would react with one mole of Grignard's reagent to yield a ketone?
(a) RCONR′R″ (b) RCONHR′ (c) $RCONH_2$ (d) RCOOH

(iv) Glyceraldehyde has one of the following properties:
(a) One asymmetric carbon atom (b) Two asymmetric carbon atoms
(c) A meso compound (d) Four asymmetric carbon atoms

(v) The antifreeze compound ethylene glycol has the formula:
(a) C_2H_5OH (b) CH_3OH (c) $C_2H_4(OH)_2$ (d) $C_3H_5(OH)_3$

(vi) Distillation is the best method for separating the two substances in which of the following:
(a) Water and salt dissolved
(b) water and a substance which does not dissolve in it
(c) Two liquids that have different boiling points
(d) Two solids that have different melting points.

(vii) Which of the following describes "Amino" group as a substituent in electrophilic aromatic substitution.
(a) Weakly activating and O/P – directing (b) Strongly activating and O/P – directing
(c) Weakly deactivating, meta-directing (d) Strongly activating, meta-directing

(viii) Which would be the best solvent to conduct this reaction.

$$CH_3CH_2Br + Mg \longrightarrow BrMgCH_2CH_3$$

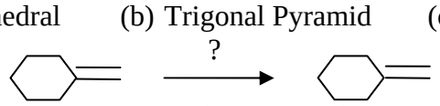
(a) Acetone (b) Acetonitrile (c) Diethylether (d) Ethylacetate

(ix) If $K_1<K_2$ which of the following rate laws is consistent with the mechanism proposed for the conversion of $NO_3+NO \rightarrow 2NO_2$?

Proposed mechanism
$$NO_2 + NO_3 \xrightarrow{K1} N_2O_5$$
$$NO + N_2O_5 \xrightarrow{K2} 3NO_3$$

(a) $\frac{d[NO_3]}{dt} = K_1K_2[NO_2][NO_3]$ (b) $\frac{d[NO_3]}{dt} = -K_1K_2[NO_2][NO_3]$
(c) $\frac{d[NO_3]}{dt} = -K_1K_2[NO_3][NO]$ (d) $\frac{d[NO_3]}{dt} = -K_1[NO_2][NO_3]$

(x) Which of the following is the best description of the geometry of PCl_5?
(a) Tetrahedral (b) Trigonal Pyramid (c) Trigonal bipyramid (d) Square pyramid.

(xi) 

This reaction could successfully be performed using which one of the following reagents.
(a) Ph_3PCH_2 (b) $CH_3OCOCH_2COOCH_3$ (c) CH_2Br_2 (d) PCC

(xii) Which one of the following is not a petrochemical.
(a) Cumene (b) Paraffin (c) Aluminum Chloride (d) Epoxy resin

(xiii) The term syndiotactic is related to which one of the following?
(a) Synthetic detergents (b) Table Salt (c) Paraffin (d) Polyprophylene

(xiv) Which one of the following is used as an Antibiotic?
(a) Patulin (b) Insulin (c) Soserine (d) Trypsin

(xv) Heroin is diacetate of:
(a) Papaverine (b) Morphine (c) Codeine (d) Thebaine

(xvi) A reaction that practically is given by all organic compounds.
(a) Elimination (b) Friedel-Craft ecylation (c) Combustion (d) Rearrangement

(xvii) Which functional group is present in polyester shirt?
(a) Lactam (b) Acid Chloride (c) Ether (d) Ester

(xviii) Which statement is true for Halogen (Halo-group)?
(a) Activating and O, p–directing (b) Activating and m–directing
(c) Deactivating and O, p–directing (d) None of these.

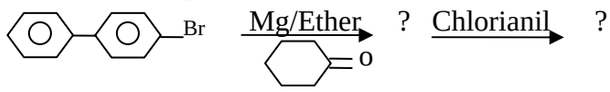
(xix) Which one of the following can be synthesized from Aryl Diazonium Salt?
(a) Furfural (b) Carbylamine (c) Biphenyl (d) THF

(xx) The Methyl group in Methyl Magnesium Iodide can act as:
(a) CH_3 Radical (b) CH_3 Carbonium ion (c) CH_3 Carbanion (d) Can react with a base

PART – II

NOTE:	**(i)** **PART-II** is to be attempted on the separate **Answer Book.** **(ii)** Attempt **ONLY FOUR** questions from **PART-II**. All questions carry **EQUAL** marks. **(iii)** Extra attempt of any question or any part of the attempted question will not be considered.

Q.2. (a) Explain the structure of Grignard's reagent. **(6)**
(b) How aldehydes, ketones, carboxylic acids, Hydrocarbons and alcohols can be synthesized from Grignard's reagent. **(10)**
(c) Complete the following reaction. **(4)**



Q.3. (a) How you will synthesize the following starting from benzene. **(2+5+3)**
(i) Acetophenone (ii) 1,3,5-tribromobenzene (iii) n–propyl benzene
(b) In electrophilic aromatic substitution "Halogens" are deactivating but O, p–directing. Explain. **(5)**
(c) Sulphonation is reversible reaction at high temperature. Discuss its merits.. **(5)**

Q.4. (a) Describe various methods to determine the order of reaction. **(9)**
(b) What is the third order reaction. Give examples. **(4)**
(c) Derive the Kinetic equation for 3rd order reaction. **(7)**

Q.5. (a) Can we prepare the Aliphatic diazonium salt. If yes, give examples. **(3)**
(b) How can the following prepared from benzene diazonium salt. **(3+5+4)**
(i) Benzene (ii) m-nitrophenol (iii) Biphenyl
(c) Write a note on Sandmeyer reaction. **(5)**

Q.6. (a) Describe the exact source of raw material used in Petrochemicals. **(3)**
(b) Give Industrial synthesis of vinylacetate. **(10)**
(c) Describe the production of Vitamin-C from Glucose. **(7)**

Q.7. (a) Describe the synthesis of streptomycin. **(6)**
(b) Discuss the role of Fermentation in Organic Synthesis. **(4)**
(c) Give synthesis of polypropylene and its uses. **(10)**

Q.8. (a) What is Margarine? How it is manufactured industrially? **(10)**
(b) Nicotine on Oxidation with $KMnO_4$ gave. Nicotinic acid. Write structures of nicotine, nicotinic acid and two other isomer of nicotinic acid. **(6)**
(c) Write a note on epimerization. **(4)**

****