FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2011

Roll Number

CHEMISTRY, PAPER-II

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

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

(PART-I MCQs) (COMPULSORY)

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

(i) Carbon atoms in p-xylene are:
(a) sp^2 hybridized (b) sp^3 hybridized (c) Sp hybridized (d) Both (a) and (b)

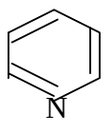
(ii) Which of the following sugars is found in milk?
(a) Lactose (b) Sucrose (c) Maltose (d) Fructose

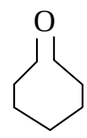
(iii) Glucose when heated with Benedict's reagent ($CuSO_4$, NaOH, and tartaric acid) forms a brick red precipitate due to formation of:
(a) Cu_2O (b) $Cu(OH)_2$ (c) Copper tartrate (d) None of these

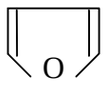
(iv) Which of the following can not be used as solvent in polarimetry?
(a) Methanol (b) Ethanol (c) 1-butanol (d) 2-butanol

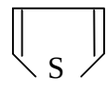
(v) Polarimetry is a technique to analyze:
(a) Chiral compounds (b) Unsaturated compounds (c) Polar compounds (d) All of these

(vi) Which of the following is not an aromatic compound?
(a) Pyrrole (b) Pyridine (c) Furan (d) Piperidine

(vii) Which of the following is not a heterocyclic compound?
(a) 

(b) 

(c) 

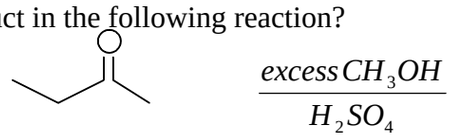
(d) 

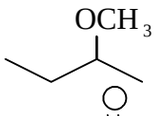
(viii) Which of the following will show optical isomerism?
(a) 2,3-dimethylbutane (b) 3,4-dimethylhexane
(c) 3,4-diethylhexane (d) 1,4-dimethylcyclohexane

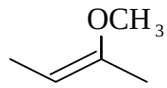
(ix) What type of reaction takes place when a ketone is treated with HCN?
(a) Electrophilic substitution (b) Nucleophilic substitution
(c) Nucleophilic addition (d) Electrophilic addition

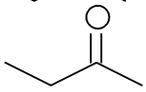
CHEMISTRY, PAPER-II

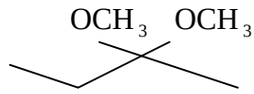
(x) What is the major product in the following reaction?



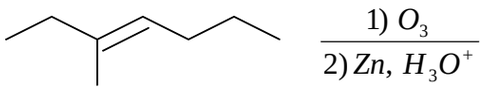
(a) 

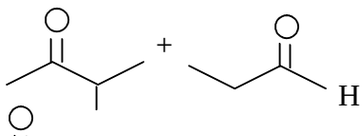
(b) 

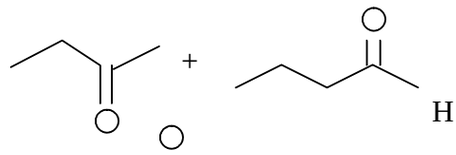
(c) 

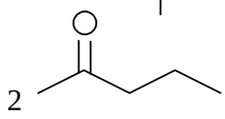
(d) 

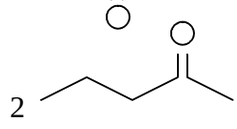
(xi) What are the expected products from the following reactions?



(a) 

(b) 

(c) 

(d) 

(xii) Which of the following will undergo Aldol condensation?

(a) Formaldehyde (b) Acetaldehyde (c) Benzaldehyde (d) All of these

(xiii) Which of the following is the most acidic?

(a) Ethanol (b) Butanol (c) Cyclohexanol (d) Phenol

(xiv) Which of the following is the most basic?

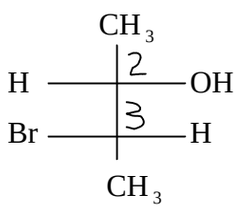
(a) Aniline (b) m-chloroaniline

(c) N,N-dimethylaniline (d) m-nitroaniline

(xv) Which of the following are correctly matched?

	Reagent	**Reaction**
(a)	Na Metal	Witting reaction
(b)	$(C_6H_5)_3P = C(C_2H_5)_2$	Wurtz reaction
(c)	$KOH/NH_2\text{-}NH_2$	Wolff-Kishner reduction
(d)	Se + Δ 250 °C	Birch reduction

(xvi) What is the correct configuration at chiral centers in the following molecule?



(a) 2R, 3R (b) 2R, 3S (c) 2S, 3R (d) 2S, 3S

(xvii) The reaction acetone with phosphonium ylide $[(C_6H_5)_3P = C(CH_3)_2]$ produces:

(a) 2,3-dimethyl-2-butanol (b) 2,3-dimethyl-2-butene

(c) 2-chloro-2,3-dimethylbutane (d) Both (a) and (b)

(xviii) Which of the following reactions are used to prepare amines:

(a) Gabrial synthesis (b) Hofmann reaction (c) Reductive amination (d) All of these

(xix) The active agent in the nitration of benzene is:

(a) NO_2^- (b) NO_2^+ (c) NO (d) HNO_2

(xx) The most probable intermediate in Favorskii rearrangement is:

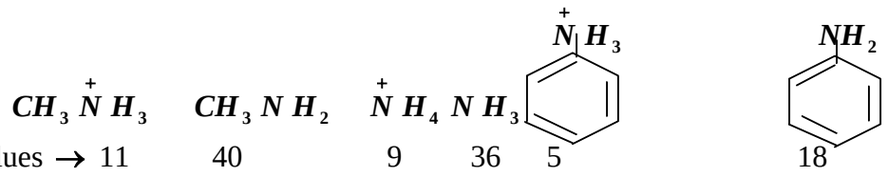
(a) Lactone (b) Lactam (c) Cycloprapanone (d) None of these

PART-II

NOTE:(i) **PART-II** is to be attempted on 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) Differentiate between Inter-molecular and Intra-molecular hydrogen bonding. Discuss effects of hydrogen bonding on any two properties of organic compounds. Support your answer with suitable examples. **(08)**

(b) Arrange following compounds in decreasing order of their base strength (strongest first). Give a brief explanation in support of your answer: **(03)**



pK_a values → 11 40 9 36 5 18

(c) How would you account for the following: **(06)**

i. Picric acid (2,4,6-trinitrophenol) liberates CO_2 from aqueous soulution of Na_2CO_3 but phenol does not?

ii. Benzene undergo Friedel Craft alkylation in the presence of Lewis acid while pyridine does not?

iii. Benzene is an aromatic compound while cyclooctatraene is nonaromatic?

Q.3. (a) Discuss how a catalyst changes the rate and path of the reaction? **(06)**

(b) Reaction of 1, 3-butadiene with HBr gives two products, draw reaction coordinate diagram to illustrate thermodynamic and kinetic products of the reaction. **(07)**

(c) For the following reaction: **(07)**

$CH_3(CH_2)_3Br + OH^- \rightarrow CH_3(CH_2)_3OH + Br^-$

Discuss rate law and various factors that affect the rate of reaction.

Q.4. (a) Starting from benzene how would you prepare the following compounds: **(06)**
Benzoic acid, 4-Bromonitobenzene, Maleic anhydride

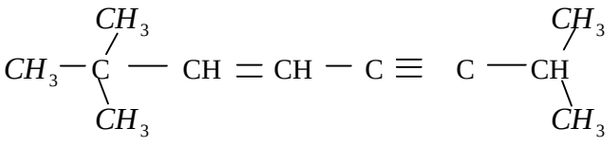
(b) Show reaction of C_2H_5MgBr with each of the following: **(06)**

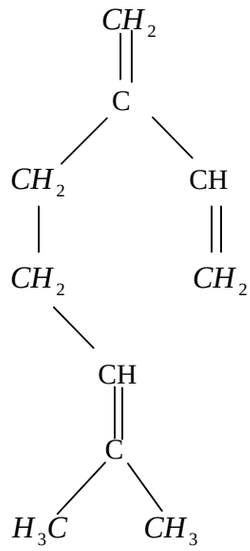
i. CH_3CHO followed by hydrolysis

ii. $CH_3C \equiv C—H$ followed by reaction with $CH_3—I$

iii. $CH_3COOC_2H_5$ followed by hydrolysis.

(c) Assign hybridization at each carbon in the following compound: **(04)**





(d) Suggest two methods to prepare aromatic amines. **(04)**

Q.5. (a) Discuss stereoisomerism in compounds having 2-similar asymmetric carbon atoms. **(06)**

(b) Draw Fisher projection formulae for the following compounds: **(08)**

i. R and S 2 - bromopentane
ii. R and S 3 - chloro-1-pentene
iii. R and S 3 - chloro-3-methyloctane
iv. R and S 2 - pentanol

(c) What do you understand by the terms Z and E isomer? Illustrate your answer by quoting suitable examples. **(06)**

Q.6. (a) Illustrate giving suitable examples the difference between Homogenous and Heterogeneous catalysis. **(06)**

(b) Outline synthesis of azo dye starting with phenol and a suitable aromatic amine. **(04)**

(c) Write notes on the following: **(05+ 05 = 10)**

i. Octane number ii. Catalytic cracking

Q.7. Write structure of product(s) obtained from each of the following reactions: **(2 x 10 =20)**

i. $CH_3CH_2COOH + CH_3CH_2OH + H_2SO_4 \rightarrow$

ii. $C_6H_5COCH_3 + LiAlH_4 \rightarrow$

iii. $C_6H_5COOH + SOCl_2 \rightarrow$

iv. $(CH_3)_3CBr + NaOH(aq) \rightarrow$

v. $C_6H_5NH_2 + NaNO_2 + HCl\ (conc) \rightarrow$

vi. $CH_3CH_2COCH_3 \xrightarrow[2)\ H_3O^+]{1)\ C_2H_5MgBr}$

vii) $C_6H_5NO_2 + Sn/HCl \rightarrow$

viii) $C_6H_6 + Na/NH_3 \rightarrow$

ix) $CH_3CH = CH_2 + HBr \rightarrow$

x) $CH_3COCH_3 + NH_2OH \rightarrow$

Q.8. (a) Write main steps in the formation of following polymers: **(03 + 03 = 06)**

i. Nylon 6,6 and Polyester via Condensation Polymerization.
ii. Polyethlene via Free Radical Polymerization.

(b) What are alkaloids, describe chemical properties and structure of any two alkaloids. **(07)**

(c) Differentiate between oil, fat and wax. Draw structure of triglyceride containing oleic acid $[CH_3(CH_2)_7CH = CH(CH_2)_7COOH]$ as fatty acid and write reaction triglyceride with H_2/Ni followed by NaOH(aq). **(06)**

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