FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2016
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

CHEMISTRY PAPER-I

TIME ALLOWED: THREE HOURS **PART-I(MCQS): MAXIMUM 30 MINUTES**	**PART-I (MCQS) MAXIMUM MARKS = 20** **PART-II MAXIMUM MARKS = 80**

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) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

PART-II

Q. No. 2. **(a)** What is Schrodinger wave equation? Discuss its importance in quantum chemistry. **(6)**
(b) Solve the Schrodinger wave equation for a particle in three-dimensional box and find the expression for the energy and wave function. **(8)**
(c) What is a well-behaved function? What are the requirements of a physically acceptable wave function? **(6)**

Q. No. 3. **(a)** What is Gibbs free energy? Discuss its significance in chemistry. **(6)**
(b) Give a brief account of transition state theory indicating its advantages over collision theory. **(8)**
(c) Explain 3rd law of thermodynamics. How this law is useful to determine the absolute value of entropy? **(6)**

Q. No. 4. **(a)** Define and explain Langmuir adsorption isotherm. What are its limitations? **(8)**
(b) What is acid-base catalysis? Discuss its significance in chemistry. **(6)**
(c) What is Phase rule? Discuss its application in one component system. **(6)**

Q. No. 5. **(a)** What are solubility product and common ion effect? Discuss their significance in chemical analysis **(8)**
(b) Valence shell electron pair repulsion theory can be used to predict the shapes of molecules. Using this theory explain the shapes acquired by BF_3 and IF_5. **(7)**
(c) Explain why HSH bond angle in H_2S is slightly less than the tetrahedral angle 109.5 **(5)**

Q. No. 6. **(a)** Describe main features of crystal field theory, How this theory explains colour of coordination complexes? **(10)**
(b) Write the electronic configuration for each of the following: **(4)**
Ni^{2+} , Cu, Mn^{2+} , Cr^{3+}
(c) What is John-Teller theorem? Explain its significance in coordination chemistry. **(6)**

Q. No. 7. **(a)** What are lanthanides? How are these extracted from their ores? **(10)**
(b) What is decay law? How half-life and decay constant are related with each **(5)**

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CHEMISTRY PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

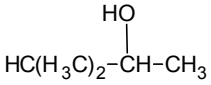
NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II. ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.
(vii) **Use of Calculator is allowed.**

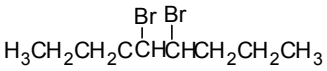
PART-II

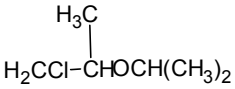
Q. No. 2. Write briefly on the following terms: **(2 each)** **(20)**

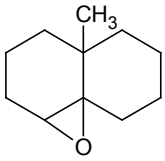
(i)	Hyper-conjugation	**(ii)**	Aromaticity
(iii)	Grignard's reagent	**(iv)**	S_N1 reaction
(v)	Molecular chirality	**(vi)**	Monosaccharides
(vii)	Chemical shift	**(viii**	Glycolysis
(ix)	Detergents	**(x)**	Friedal Craft alkylation

Q. No. 3. **(a)** How would you synthesize each of the following molecule from an alkene of appropriate structure (structure of your choice). **(8)**

(i) 

(iii) 

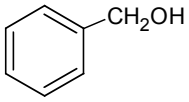
(ii) 

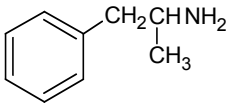
(iv) 

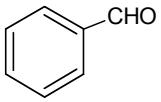
(b) Write the expected major product of the reaction of propyne with each of the following reagents. **(6)**

(i)	Cu_2Cl_2, O_2, pyridine	**(iv)**	H_2O, $HgSO_4$, H_2SO_4
(ii)	Na, ND_3	**(v)**	Di-isoamylborane, then NaOH, H_2O_2
(iii)	$[(CH_3)_2CHCH_2CH_2]_2BD$ then CH_3CO_2H	**(vi)**	Di-isoamylborane, then CH_3CO_2D

(c) Starting with benzene, design reasonable syntheses of each of the following compounds. **(6)**

(i) 

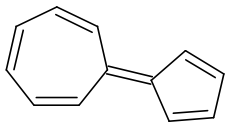
(iii) 

(ii) 

(b) Draw the structures of the following molecules: **(10)**

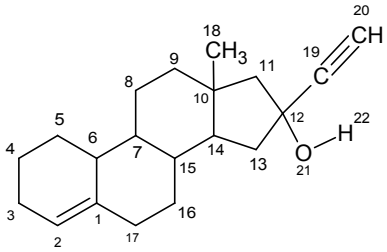
(i)	5-(2,2-Dimethylpropyl)nonane	**(vi)**	4-(2-Ethylbutyl)decane
(ii)	2,3-Dimethylhept-3-ene	**(vii)**	5-Ethyl-4,6-dimethylhept-4-en-2-yne
(iii)	1-Chloro-1-methoxy-2-methylbut-1-ene	**(viii**	5,5-Dichloro-3-methylhepta-3,6-dien-1-yne
(iv)	6-Chloro-2-nitrooct-1-en-3-yne	**(ix)**	6-bromo-5-chloro-9-nitropentadecane
(v)	8-Chloro-7-methoxy-5-methyl-4-nitroundec-5-ene	**(x)**	6-chloroocta-1,3-diyne

(c) **(i)** The structure**(I)** given below has significant dipole moment. Which end of the molecule would you expect to owe positive charge, and which tend to be negative. **(2)**



(I)

(ii) The structure**(II)** given below is a component of certain oral contraceptives: **(3)**



(II)

Locate in this structure an example of each of the following bonds or atoms

- A highly polarized covalent bond
- Sp-hybrid carbon atoms
- A nearly unpolarized covalent bond

Q. No. 5. **(a)** Consider the reaction of bromocyclohexane with each of the four reagents below, and answer the questions below. Also write down the reaction mechanism in each case. **(7)**

H_2O	OH^-	CH_3COOH	CH_3COO^-
(i)	***(ii)***	***(iii)***	***(vi)***

(i) What is the most important type of reaction mechanism in each case?

(ii) Which reagent gives the most elimination product?

(iii) Which reagent is most useful in synthesizing the alcohol?

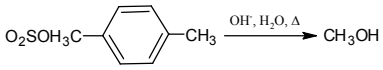
(b) Evaluate each of the possible alcohol syntheses below as being good (the desired alcohol is major or only product), not so good (the desired alcohol is a minor product, or worthless). **(5)**

(i) $CH_3CH_2Cl \longrightarrow CH_3CH_2OH$

(ii) $H_3C\overset{NC}{\overset{|}{C}}HCH_3 \xrightarrow{OH^-,\ H_2O,\ \Delta} H_3C\overset{HO}{\overset{|}{C}}HCH_3$

(iii $H_3COCH_3 \xrightarrow{OH^-,\ H_2O,\ \Delta} CH_3OH$

(iv



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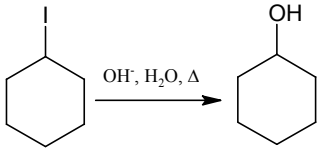
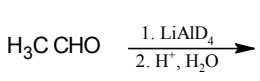


(c) Write the major product(s) of each of the following reactions. It is implied that aqueous work-up has taken place in all those cases that require it to obtain the organic product. **(8)**

(i)



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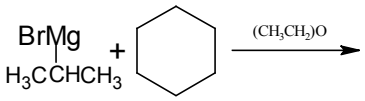

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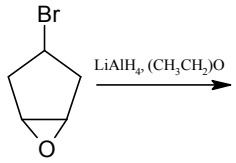

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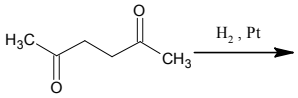
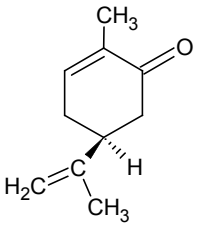
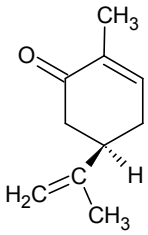


Q. No. 6. **(a)** The two isomers of carvone are given below. Which is ***R*** and which is ***S***? **(2)**

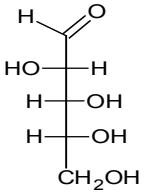


(+)-Carvone



(–)-Carvone

(b) The structure of compound given below is a sugar called (–)-arabinose. Its specific rotation is –105˚. **(3)**

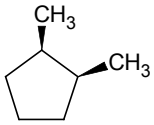


(–)-arabinose

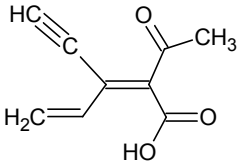
(i) Draw enantiomer(s) of (–)-arabinose
(ii) Draw diastereomer(s) of (–)-arabinose
(iii) Does (–)-arabinose have any optically inactive diastereomers? If it does, draw one.

(c) Assign E,Z designation to the following structures. **(7)**

(i)



(v)



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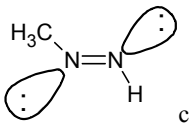

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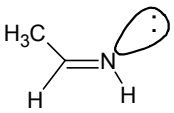

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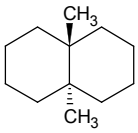

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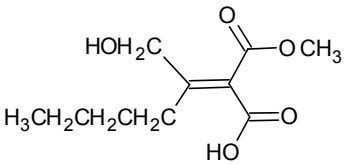

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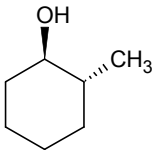


(d) Draw the structures of the product(s) described for each reaction. Specify all aspects of the stereochemistry. **(8)**

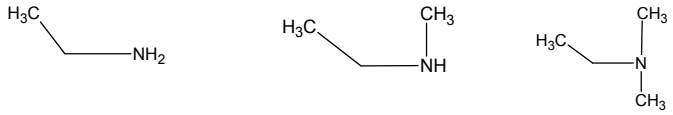
(i) Stereospecific anti addition of bromine to cis- and trans-cinnamic acid.
(ii) Methanolysis of S-3-bromooctane with 6% racemization.
(iii) Stereospecific syn thermal elimination of acetic acid from 1R,2S-diphenylpropyl acetate
(iv) Stereoselective epoxidation of bicyclo[2.2.1]hept-2-ene proceeding 94% fromtheexo face.

Q. No. 7. Write a brief account on the following: **(5 each)** **(20)**

(a) Biological importance of starch
(b) Classification of Amino acids
(c) Primary structure of Proteins
(d) Glycogenesis

Q. No. 8. **(a).** Differentiate following using IR Spectroscopy? **(4)**

i



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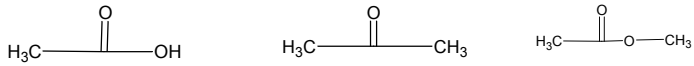
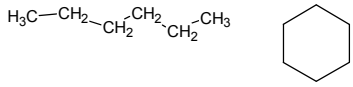


iii $H_3C—CH_2—CH_3$ $H_2C{=}CH-CH_3$ $HC{\equiv}C—CH_3$

iv

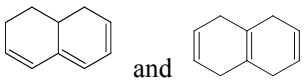


(b). What type of electronic transition are possible in the following compounds? **(2)**

(i) Butadiene
(ii) Diethyl ether
(iii) Acetaldehyde
(iv) Trimethylamine

(c). How will you distinguish the following compounds using UV/Visible spectrophotometer? **(4)**

(i)



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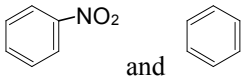

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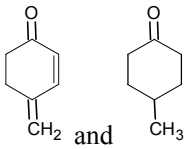

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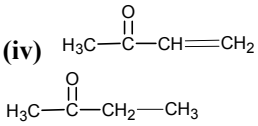
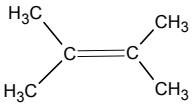
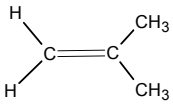


(d). Give the chemical shift of the following compounds for each proton **(5)**

(i)



(ii)



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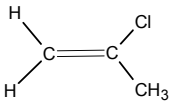

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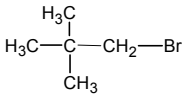

(v)

(e). The mass spectrum of compound shows following peaks: **(5)**
m/e= 120, relative intensity=20% (M^+ peak), m/e= 105, relative intensity=80%, m/e= 77, relative intensity=96%, m/e= 43, relative intensity=35%.
Assign the structure which would be expected.

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