



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

Roll Number

CHEMISTRY PAPER-II

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

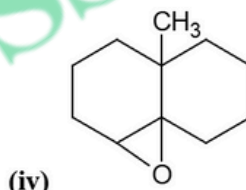
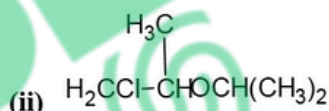
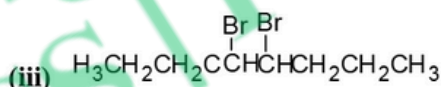
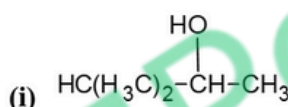
**NOTE:** (i) Part-II is to be attempted on the separate Answer Book.  
(ii) Attempt **ONLY FOUR** questions from PART-II. ALL questions carry **EQUAL** marks.  
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.  
(iv) Candidate must write Q. 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 <sub>N</sub> 1 reaction |
| (v) Molecular chirality  | (vi) Monosaccharides           |
| (vii) Chemical shift     | (viii) Glycolysis              |
| (ix) Detergents          | (x) Friedal Craft alkylation   |

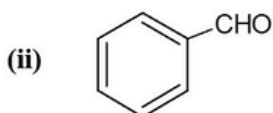
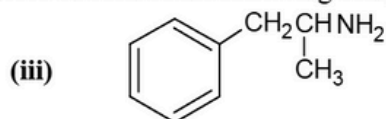
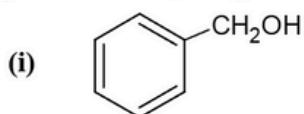
Q. No. 3. (a) How would you synthesize each of the following molecule from an alkene of appropriate structure (structure of your choice). (8)



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

- |   |   |
|---|---|
| (i) $\text{Cu}_2\text{Cl}_2, \text{O}_2, \text{pyridine}$   | (iv) $\text{H}_2\text{O}, \text{HgSO}_4, \text{H}_2\text{SO}_4$ |
| (ii) $\text{Na}, \text{ND}_3$   | (v) Di-isoamylborane, then $\text{NaOH}, \text{H}_2\text{O}_2$  |
| (iii) $[(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2]_2\text{BD}$<br>then $\text{CH}_3\text{CO}_2\text{H}$ | (vi) Di-isoamylborane, then $\text{CH}_3\text{CO}_2\text{D}$    |

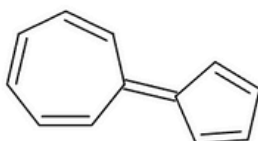
(c) Starting with benzene, design reasonable syntheses of each of the following compounds. (6)



CHEMISTRY PAPER-II

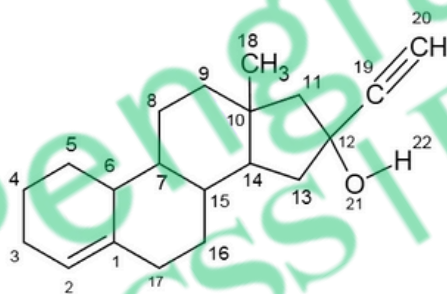
- (b) Draw the structures of the following molecules: (10)
- |  |  |
|--|--|
| (i) 5-(2,2-Dimethylpropyl)nonane                   | (vi) 4-(2-Ethylbutyl)decane                      |
| (ii) 2,3-Dimethylhept-3-ene                        | (vii) 5-Ethyl-4,6-dimethylhept-4-en-2-yne        |
| (iii) 1-Chloro-1-methoxy-2-methylbut-1-ene         | (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)



(i)



(ii)



(iii)



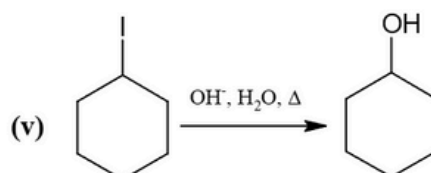
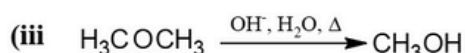
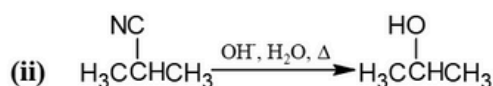
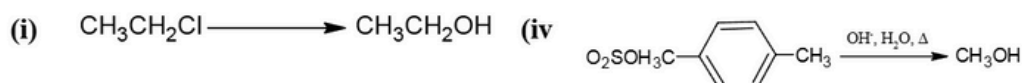
(iv)

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

- (ii) Which reagent gives the most elimination product?

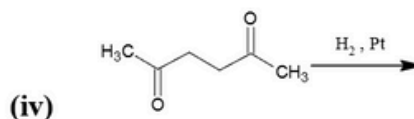
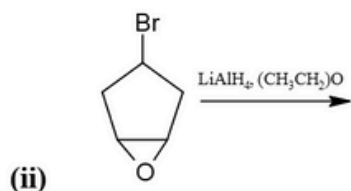
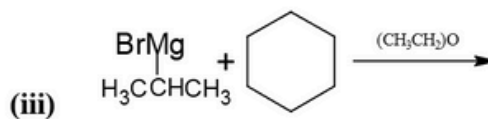
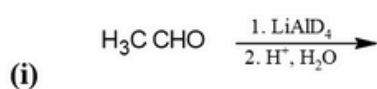
- (iii) Which reagent is most useful in synthesizing the alcohol?

- (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)

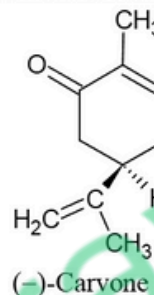
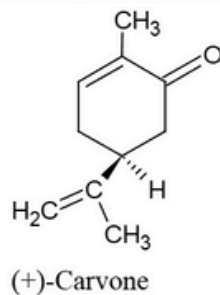


CHEMISTRY PAPER-II

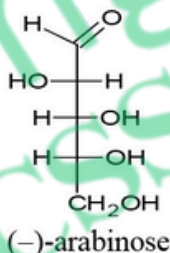
- (c) Write the major product(s) of each of the following reactions. It is implied that aqueous work-up has taken place in all those cases that require it to obtain the organic product. (8)



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

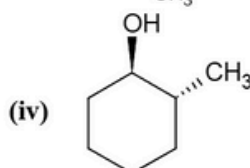
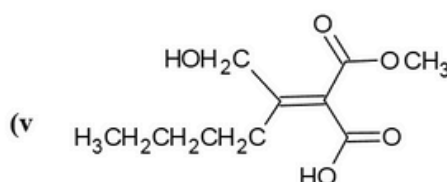
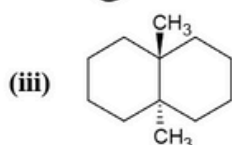
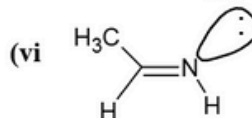
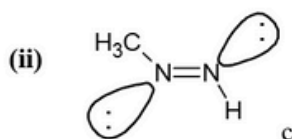
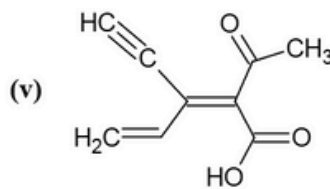
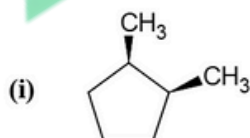


- (b) The structure of compound given below is a sugar called (-)-arabinose. Its specific rotation is  $-105^\circ$ . (3)



- (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)



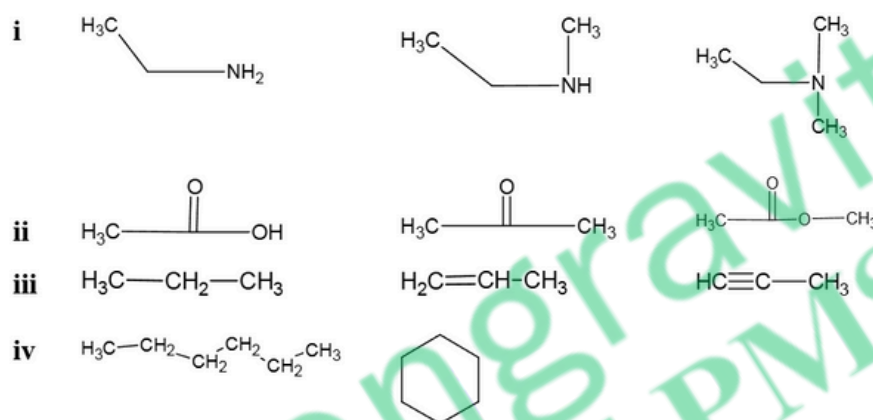
CHEMISTRY PAPER-II

- (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% from the exo face.

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

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

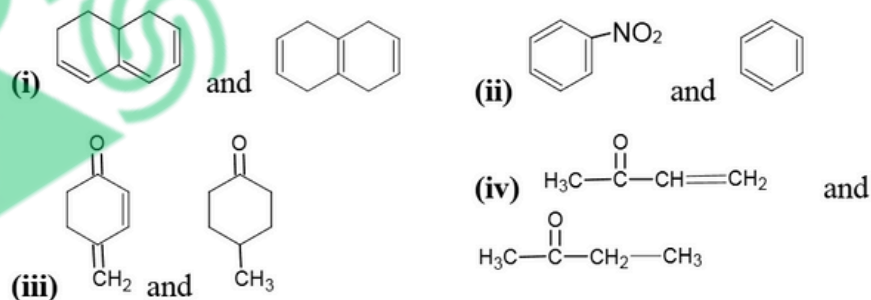
Q. No. 8. (a). Differentiate following using IR Spectroscopy? (4)



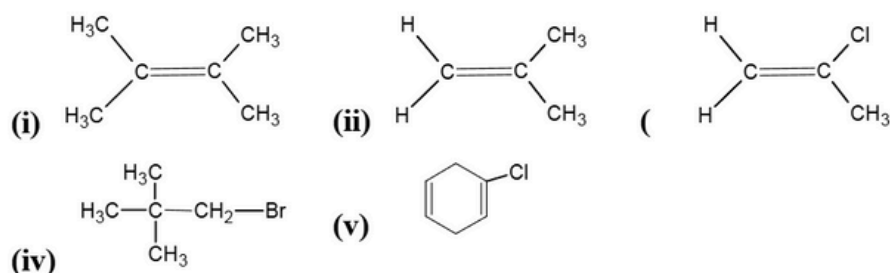
(b). What type of electronic transition are possible in the following compounds? (2)

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

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



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



(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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Roll Number

**PHYSICS, PAPER-I**

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**PART-II**

- Q. No. 2.** (a) State and prove Stoke's theorem. (8)  
(b) Prove that if the vector is the gradient of a scalar function then its line integral around a closed curve is zero. (4)  
(c) A particle moves along the curve  $x = 2t^2$ ,  $y = t^2 - 4t$ ,  $z = 3t - 5$  where  $t$  is the time. Find the components of its velocity and acceleration at time  $t=1$  in the direction  $2i-3j+2k$  (8)
- Q. No. 3.** (a) What is moment of inertia? State and prove parallel axis theorem. (12)  
(b) Calculate rotational inertia of a hollow cylinder about cylindrical axis. (8)
- Q. No. 4.** (a) State and prove the Kepler's law of areas and Kepler's law of periods of planetary motion. (8)  
(b) A satellite orbits at a height of 230km above the Earth surface. What is the period of satellite? (6)  
(c) At what altitude above the earth surface the value of 'g' is three quarters of its value at the surface of the earth. (6)
- Q. No. 5.** (a) What is diffraction grating? Explain how grating diffracts light. Derive relation for resolving power of grating. (12)  
(b) What is meant by polarization of light? How can we get a plane polarized light by a polarizing sheet? (8)
- Q. No. 6.** (a) Derive equation of Lorentz velocity transformations and show that speed of light is independent of the relative motion between the frames of reference. (12)  
(b) The siren of a police car emits a source tone at a frequency of 1125 Hz. Find the frequency that would you receive in your car under the following circumstances. (8)  
(i) Your car at rest, police car moving towards you at 29 m/s.  
(ii) Police car at rest, your car moving towards it at 29 m/s.  
(iii) Your and police car are moving towards one another at 14.5 m/s.  
(iv) Your car moving at 9 m/s, police car chasing behind you at 38 m/s.
- Q. No. 7.** (a) Define Entropy. State Second law of thermodynamics in terms of Entropy. (8)  
(b) Discuss applications of First Law of thermodynamics. (6)  
(c) Discuss briefly the Lissajous patterns. (6)
- Q. No. 8.** Explain any FOUR of the following terms. (05 each) (20)  
(a) Doppler's Effect  
(b) Bernoulli's theorem  
(c) Newton's rings  
(d) He-Ne Gas LASER  
(e) Brownian motion