

**FS – 10 / 15-16**

**Chemistry**

**Paper – II**

*Time : 3 hours*

*Full Marks : 200*

*The figures in the right-hand margin indicate marks.*

*Candidates should attempt Q. No. 1 from  
Section – A and Q. No. 5 from Section – B  
which are compulsory and any **three** of  
the remaining questions, selecting  
at least **one** from each Section.*

**SECTION – A**

1. Answer any **two** of the following questions :

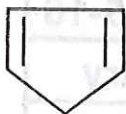
20×2 = 40

- (a) Label the following compounds as aromatic, non-aromatic or anti-aromatic with justification :

(i)

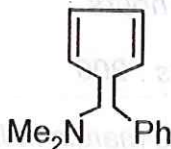


(ii)



(+)

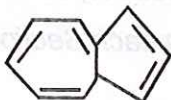
(iii)



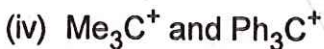
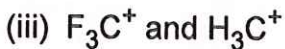
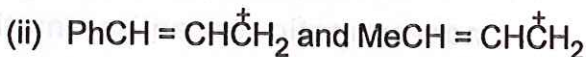
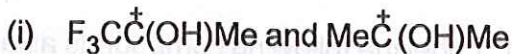
(iv)



(v)



(b) Which one in each of the following pairs is more stable and why?

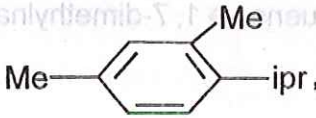
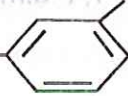


(c) Give reasonable explanations to the following observations :

(i) 2,6-dideuteriobromobenzene reacts with  $\text{NaNH}_2$  more slowly than bromobenzene.

(ii) O-deuteriofluorobenzene exchanges its 'D' for H rapidly with  $\text{KNH}_2$  in liquid ammonia, but forms aniline more slowly.

(iii) Benzyne generated by thermal decomposition of the diazonium carboxylate salt,  $\text{O} - \text{N}_2^+ \text{C}_6\text{H}_4 \text{CO}_2^-$ , dimerizes.

(iv)  Me—  —iPr, on treatment with mixed acid, a product of molecular formula,  $\text{C}_8\text{H}_8\text{N}_2\text{O}_5$  is formed.

(v) The reaction of ethyl vinyl ether with dilute aqueous acid takes place at  $10^3$  times faster rate than that of the reaction of diethylether with the same acid.

2. (a) State the product(s) and give the mechanisms including stereochemical features of the following reactions: 15

(i) trans-2-butene with aqueous alkaline  $\text{KMnO}_4$ .

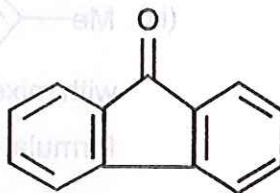
(ii) (z)-2-butene with aqueous  $\text{H}_2\text{O}_2$  containing catalytic amount of  $\text{OsO}_4$ .

(iii) (z)-2-pentene with perbenzoic acid in chloroform solvent.

(b) Carry out the following conversions: 15

(i) Toluene  $\rightarrow$  1,7-dimethylnaphthalene

(ii) Phenanthrene  $\rightarrow$



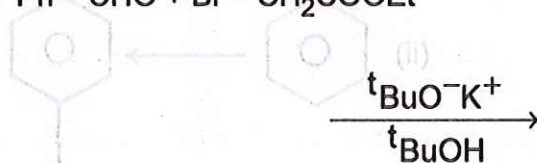
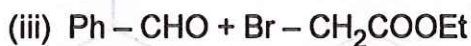
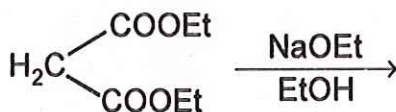
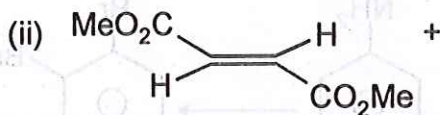
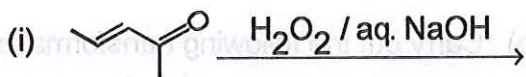
(iii) Phthalic acid  $\rightarrow$  9-methylantracene

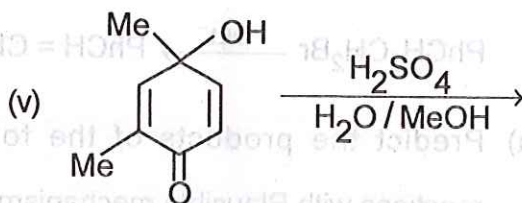
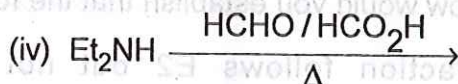
(c) Outline Bardhan-Sengupta synthesis of phenanthrene. 5

- (d) How would you establish that the following reaction follows E2 but not E1cB mechanism ? 5

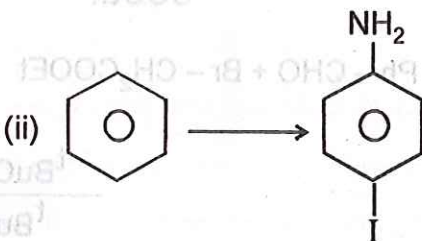
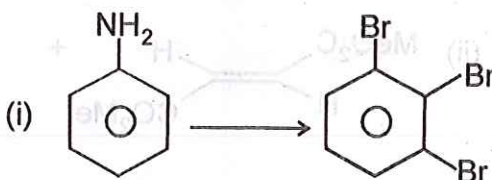


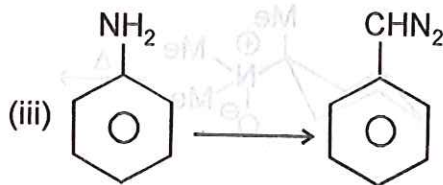
3. (a) Predict the products of the following reactions with Plausible mechanism : 25





(b) Carry out the following transformations : 15





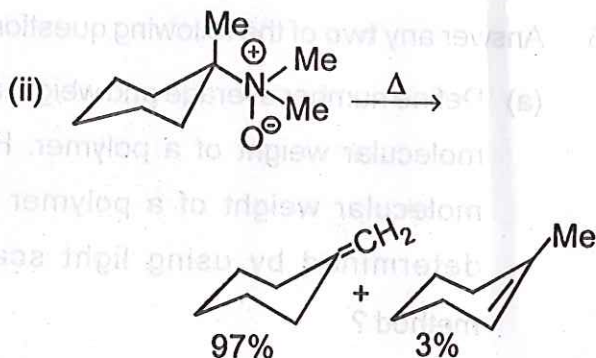
4. (a) Which of the following pairs of reactions will occur faster and why ? 10

(i) Oxidation of trans- and cis-4-t-butylcyclohexanol by chromic acid.

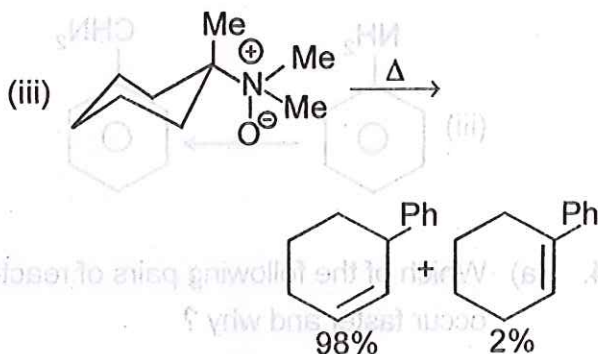
(ii) Base catalysed elimination of trans- and cis-4-t-butylcyclohexyl bromide.

(b) Explain the following : 15

(i) Stability of the two conformations of methylcyclohexane and their comparison.







(c) Give one example of each of the following and also their mechanisms : 15

- Wagner-Meerwein rearrangement
- Skraup synthesis
- Reformatsky reaction

### SECTION – B

5. Answer any **two** of the following questions :

- Define number average and weight average molecular weight of a polymer. How the molecular weight of a polymer can be determined by using light scattering method ? 20



- (b) (i) Write down the structures of pyrimidine and purine bases present in nucleic acid molecules. 10
- (ii) What is the 'linking number' for a super-coiled circular DNA ? Define B-DNA, A-DNA and Z-DNA. 10
- (c) (i) Define Primary, Secondary, Tertiary and Quaternary structures of a polypeptide molecule. 10
- (ii) Write the structures of an acidic amino acid, a basic amino acid, a neutral amino acid and an aromatic amino acid present in polypeptide molecules. 10
6. (a) Define sedimentation coefficient of a polymer. How can one determine the sedimentation average molecular weight of a polymer ?  $4+16 = 20$
- (b) Discuss the synthesis, properties and uses of Teflon. What is the scientific name of Teflon ?  $10+4+4+2 = 20$
7. (a) (i) How could the bond length of the heteronuclear diatomic molecule,  $\text{HCl}^{35}$ ,

be determined using microwave absorption spectroscopy ? 15

(ii) State the criteria for a molecule to be Raman active with respect to pure rotational and vibrational-rotational changes. 5

(b) (i) Rotational spectrum of  $^{79}\text{Br}^{19}\text{F}$  molecule consists of a series of equidistant lines,  $0.71433\text{ cm}^{-1}$  apart in wave numbers. Calculate the rotational constant, moment of inertia and bond length of the molecule. 15

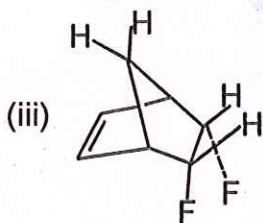
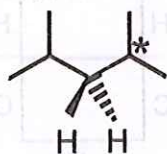
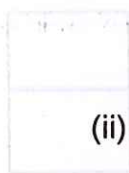
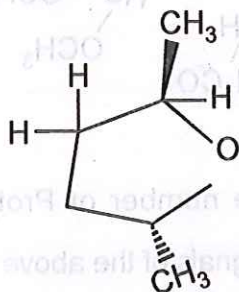
(ii) Find the wave number of the transition,  $J = 9 \rightarrow J = 10$  and indicate the transition that gives the most intense spectral line at 300 K. 5

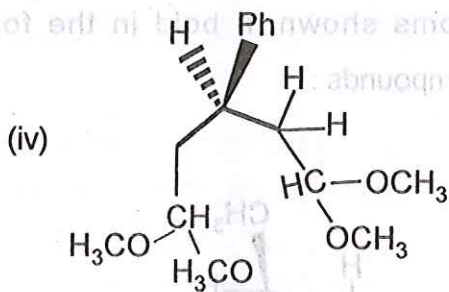
8. (a) Define Woodward-Fieser rule in UV-Vis spectroscopy. How the rule is employed for

- (i) Conjugated Dienes and Polyenes and
- (ii) Conjugated carbonyl compounds ?

4+16 = 20

- (b) Determine the topicity of the groups or atoms shown in bold in the following compounds : 20





Also give the number of Proton (H) and Carbon (C) signals of the above compounds in the boxes below :

H		H		H		H	
C		C		C		C	
(i)	(ii)	(iii)	(iv)				

