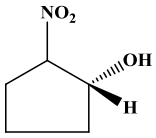
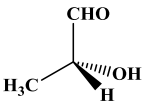
(3 Hours) **Total Marks: 80**

N.B.: 1. All questions are compulsory
2. Answer all sub questions together
3. Figures to right indicate full marks

Q.1 A) Assign R/ S, E/Z or D/L notations and nomenclate the following as per IUPAC rule. **[4M]**



(i)



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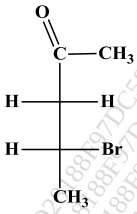

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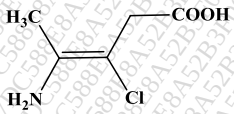


(iv)

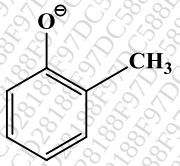
B) Give suitable structures for the following compounds. **[4M]**

i. (Z)-3-Chlorohex-3-en-1-yne
ii. (S)-Ethyl 4-cyano-3-oxopentanoate
iii. 3-Bromocyclohex-2,5-dienoic acid
iv. 4-Cyclopropyl-1-butene

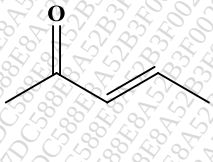
C) Answer the following questions **(ANY SIX)** **[12M]**

i. Draw and identify the HOMO and LUMO of **Formaldehyde**.

ii. Draw resonating structure of the following molecules



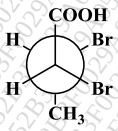
(i)



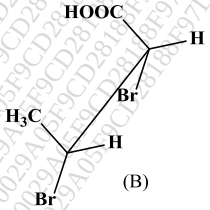
(ii)

iii. Represent 2(S)-2-Hydroxybutanoic acid using Fischer and Newmann projection formulae.

iv. Identify the relationship between following chiral structures



(A)



(B)

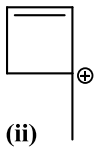
v. Write conjugate acid/base of the **N,N,N-trimethylamine** and **chloroacetic acid**

vi. Identify the electrophiles and nucleophiles in the given reaction.

$$CH_3COOH + CH_3OH \xrightarrow{H_2SO_4} CH_3COOCH_3 + H_2O$$

vii. Arrange the following carbocations in increasing order of stability & justify the same.


(i)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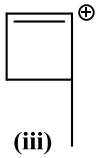
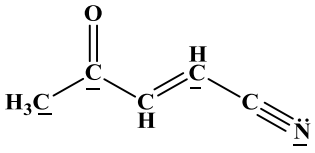
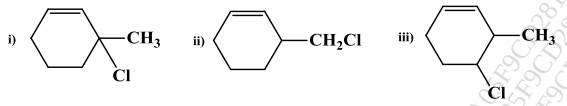

(iii)

Q.2. i. Draw the molecular orbital energy diagram for acetone & Label the orbitals. **[2M]**

ii. Identify the hybridization state of the underlined atom from the given molecule. **[2M]**

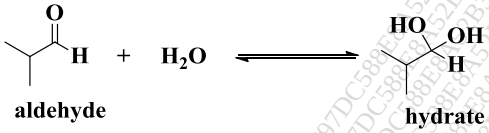


iii. List the following alkyl halides in decreasing order of S_N1 reactivity. Justify your answer.



Propose the mechanism of the most active compound with alcoholic NaOH. [**4M**]

iv. Draw the energy profile diagram to depict the following reactions and identify the transition states, identify whether the reaction is endothermic or exothermic. [**4M**]

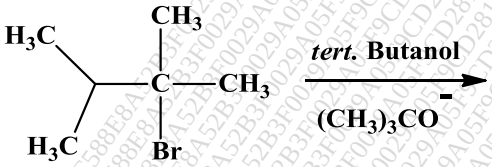


Q.3 i. Discuss Bayer strain in cycloalkane [**2M**]

ii. Arrange the order of reactivity of following nucleophiles [**2M**]

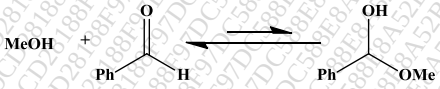
Sodium t-butoxide, Sodium methoxide, Sodium acetate

iii. What is Hoffmann rule? Complete the following reaction and suggest the mechanism (E1/ E2) [**4M**]



iv. Write a note on epoxidation of **trans 2-butene** and comment on the stereochemistry of the product. [**4M**]

Q. 4 i. Define Enthalpy. Comment on the ΔG, ΔH, ΔS of the given reaction. [**4M**]



ii. Which one of the following pair is expected to exhibit H-bonding and why. Justify your answer

Phenylethylamine and Anisole [**2M**]

iii. On the basis of solubility, justify the increasing order of logP for the following compounds [**2M**]

Benzene (logP= 2.13), **Bromobenzene** (logP= 2.99), **Chlorobenzene** (logP= 2.84), **Fluorobenzene** (logP= 2.27)

iv. Identify the best leaving group MeO^-, ^-OH, NH_2^- and justify. [**2M**]

v. Identify whether the given molecules are chiral or achiral and Justify. [**2M**]

Q.5 i. Arrange the following compounds in increasing order of acidity & Justify. [**2M**]

o-Nitrobenzoic, p-Nitrobenzoic acid and m-Nitrobenzoic acid

ii. Arrange the following compounds in increasing order of basicity & Justify. [**2M**]

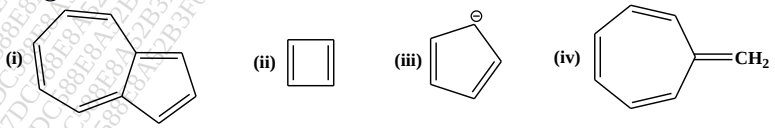
Aniline, Cyclohexylamine, Hexanamine

iii. With the help of energy profile diagram draw various conformers of **n-butane**. Comment on their relative stability. [**4M**]

iv. Give the scheme for acid degradation/ base degradation of Paracetamol. [**4M**]

Q.6 i. Distinguish between the terms - intermediates and transition states giving suitable examples and support your answer by drawing energy profile diagram. [**4M**]

ii. Identify whether the given molecules are aromatic, nonaromatic or antiaromatic. [**4M**]



iii. Give the product [**4M**]