Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Atomic Structure, bonding, general organic chemistry… (Elective paper) **Semester: I**
Program: B.Sc (Hons) Physics / Mathematics **Time 03 hrs.**
Course Code: CHEM 1007 **Max. Marks: 100**

Instructions: Attempt all the questions. Internal choices are given for question number 10 and 12.

SECTION A

S. No.		Marks	CO
Q 1	Draw the plot of ψ^2, and r for 1s, 2s and 2p orbitals.	**4**	**CO1**
Q 2	Which of the following orbitals are not possible? 1p, 2s, 2p, 3f Give reasons.	**4**	**CO1**
Q 3	What is radial probability distribution? How do you arrive at the shape of 1s orbital using radial probability distribution?	**4**	**CO2**
Q 4	The pH of 0.950 M solution of NH_3 is 11.612. Determine K_b for NH_3.	**4**	**CO1**
Q 5	Predict if the following compounds exhibit geometrical isomerism. If yes, draw the structures a. 2,3-dimethyl-2-butene b. 2-Hexene	**4**	**CO1**

SECTION B

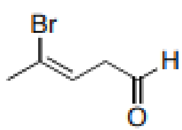
Q 6	Calculate the lattice energy of sodium chloride (in kJ/mol) from the following data A = 1.75, r_0 = 2.8 Å, n = 9, N = 6.023×10^{23} and e = 4.8×10^{-10} esu.	**8**	**CO2**
Q 7 (i) (ii)	On the basis of MO theory, explain why N_2 molecule is diamagnetic while O_2 is paramagnetic? Describe the shape of BF_3 based upon the hybridization.	**8**	**CO2**
Q 8 (i) (ii)	A compound C_4H_8 (A) reacts with Br_2 to form 'B', which on reaction with two equivalents of $NaNH_2$ forms 'C'. C reacts with ammonical Cu_2Cl_2 to form red precipitates. Deduce the structure and names of compounds 'A', 'B', 'C' and complete the reaction series. Match the following compounds with K_a values and support your answer with proper justification	**3+5**	**CO3** **CO1**

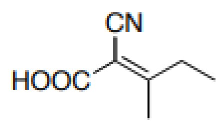
<table>
<tr><td></td><td>

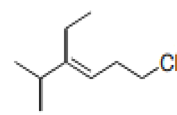
	Compounds		**K_a values**
A	p-methyl benzoic acid	i	3.3×10^{-5}
B	p-methoxy benzoic acid	ii	30.6×10^{-5}
C	p-chloro benzoic acid	iii	6.3×10^{-5}
D	p-nitro benzoic acid	iv	6.9×10^{-5}
E	benzoic acid	v	4.3×10^{-5}

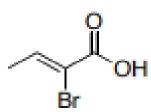
</td><td></td><td></td></tr>
<tr><td>Q 9</td><td>

Assign E,Z configuration to the following compounds:

a 

B 

c 

d 

</td><td>8</td><td>CO1</td></tr>
<tr><td>Q 10</td><td>

A radiation of wavelength 200 nm falls on a cesium metal surface. Calculate the velocity of the electron ejected from the metal surface given that the minimum energy required for such ejection is 8×10^{-19} J.

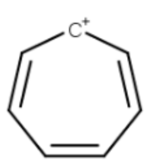
OR

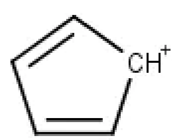
Discuss the mechanism and stereochemistry of addition of Br_2 on cis-2-butene.

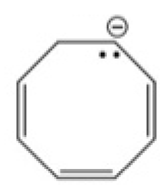
</td><td>8</td><td>CO1</td></tr>
<tr><td colspan="4">SECTION-C</td></tr>
<tr><td>Q11 (i)

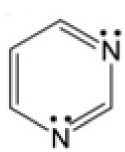
(ii)</td><td>

Classify the compounds into the category of aromatic, non-aromatic and anti-aromatic with reason:









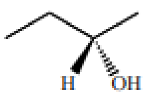
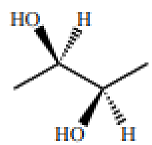
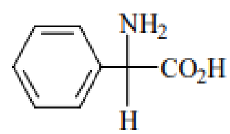
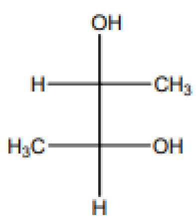
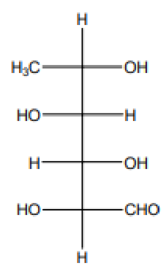
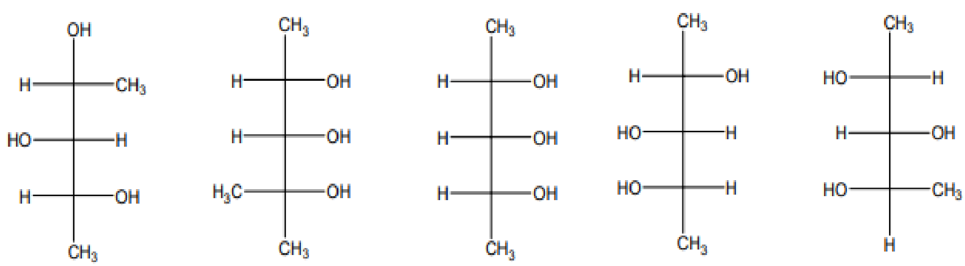
What happens when

a. Propene reacts with BH_3 followed by reaction with water in the presence of H_2O_2.
b. But-2-yne reacts with Lindlar catalyst.

</td><td>5

5</td><td>CO1

CO3</td></tr>
</table>

(iii)	Calculate the lattice energy of NaCl crystal from the following data by use of Born-Haber cycle: Sublimation energy (S) = 108.7 kJ/mol, Dissociation energy for Cl_2 (D) = 225.9 kJ/mol, Ionization energy for Na (g) = 489.5 kJ/mol, Electron affinity for Cl (g) E = −351.4 kJ/mol, Heat of formation of NaCl (ΔH) = −414.2 kJ/mol.	**10**	**CO2**
Q12 (i)	What are the factors that determine the shape of the molecules? Discuss the shape of SF_4 molecule. **OR** Discuss the shapes of CH_4, NH_3, PF_5 and H_2O molecule.		
(ii)	Label each sp^3 stereocenter as R or S a  B  c  d  E 	**10**	**CO2**
	OR For the following set of Fischer projections, answer each of the questions below:  A B C D E a. Which are optically active? b. Which forms are meso forms? c. Which pairs are enantiomers? d. Which pairs are diastereomers? e. Which, when mixed as a 50/50 mixture, will not rotate plane polarized light?	**10**	**CO1**