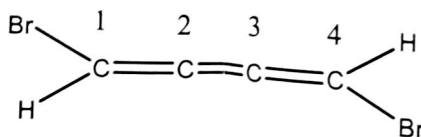


**Subject Code(s): CHS1201**  
**Time Allotted: 2 h**

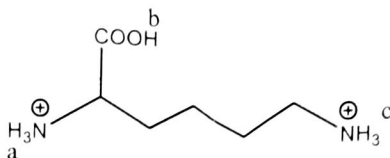
- ✓1. In vibrational spectroscopy, what is a) fundamental transition and b) hot band transition? How can you differentiate between the two in a spectrum. [2.5]
- ✓2. Calculate the ratio,  $N_1/N_0$ , of molecules in the  $v = 1$  and  $v = 0$  vibrational states for CO, at 25.0 °C. Assume a harmonic oscillator with  $\omega_e = 2169.8 \text{ cm}^{-1}$   
[Hint: at 25.0 °C,  $kT = 207.2 \text{ cm}^{-1}$ ] [1.5]
- ✓3. Explain predissociation with diagram. [2.5]
- ✓4. Discuss the basic principles of LASER operation. [3.5]
- ✓5. The microwave spectrum of a molecule yields 3 rotational constants, such that:  $A \neq B \neq C \neq 0$ . The molecule(s) is/are:  
a)  $\text{CO}_2$     b) CO    c)  $\text{CH}_4$     d)  $\text{BCl}_3$     e)  $\text{CH}_2=\text{CHCl}$   
Justify your choice with proper explanation. [2.5]

1. Consider the following molecule and answer the subsequent questions [5x0.5]

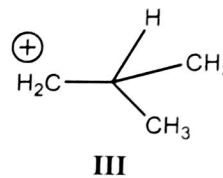
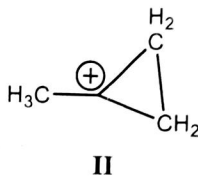
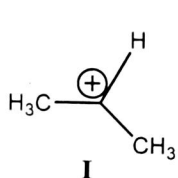


- i) Identify the state of hybridization of the carbon atoms (C1 to C4)  
 ii) Find the maximum number of atoms lying in one plane  
 a. iii) Can this molecule show stereoisomerism? If yes, indicate the type of stereoisomerism (enantiomerism or diastereomerism)?  
 a. iv) Is this molecule resolvable?  
 Provide reasons for your answers to iii) and iv)

- ✓2. The structure of amino acid lysine when kept at pH 2 is shown below. Indicate the order of removal of the acidic hydrogens when the pH is gradually raised. [2]

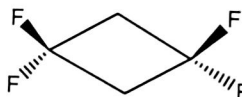
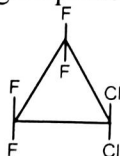


- ✓3. Draw the possible canonical forms for E-2-methoxy-1-nitroethylene and identify the most stable structure(s) citing reasons. [2]
- ✓4. Which one amongst the following carbocations will have the highest hyperconjugative stabilization? Justify. [2]



5. Answer the following questions: [4]

- ✓A) Explain the difference between asymmetric and dissymmetric molecules
- ✓B) in terms of symmetry elements, what is the minimum condition for chirality for a molecule?
- ✓C) Find the number of sigma planes in the following structures



- ✓D) Define a stereogenic center. Identify the stereogenic centres in the following molecules:

