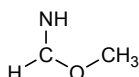


Multiple Choice Questions. 60 points

1. Draw the two best contributing structures for methylimidate.
To get you started a partial structure is given.



Choose the *incorrect* statement.

- (A) Both contributing structures have the same number of electrons.
(B) Both contributing structure have exactly the same geometry.
(C) One of the contributing structures has a negative charge on the nitrogen atom.
(D) One of the contributing structures has a positive charge on the oxygen atom.
(E) A double bond exists between the carbon and nitrogen atoms in both structures.
2. The carbon frame work of the molecule adamantane, $C_{10}H_{16}$, is shown below.

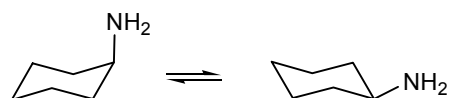


Choose the correct number of bromoadamantanes ($C_{10}H_{15}Br$) that are possible.

- (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
3. From a consideration of the molecular orbital treatment of the hydrogen molecule, choose from the following statement that is *incorrect*.
- (A) The molecular orbitals are formed from combinations of the 1s orbitals from each of the two hydrogen atoms.
(B) The lower molecular orbital is a σ (sigma) bonding orbital.
(C) The higher molecular orbital is a σ (sigma*) antibonding orbital.
(D) Each of the two molecular orbitals will be occupied electrons fifty percent of the time.
(E) The electron density on each of the two hydrogen atoms is equal.

Form 0

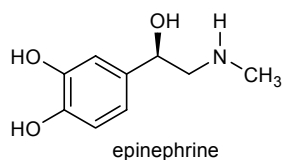
4. Estimate the equilibrium constant for the following transformation.



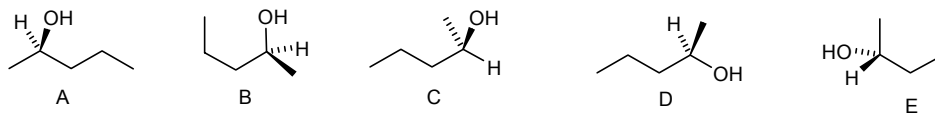
$$\Delta G^\circ = -RT \ln K_{\text{eq}}$$

$$= -5.72 \text{ J mol}^{-1} \log K_{\text{eq}} \text{ (at room temperature)}$$

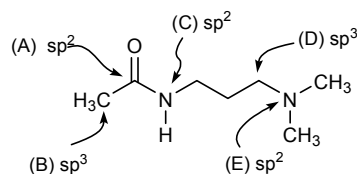
- (A) 0.01 (B) 0.1 (C) 1 (D) 10 (E) 100
5. Epinephrine is a hormone and neurotransmitter produced by the adrenal medulla and has the following structure. Choose the statement that correctly identifies some of the functional groups present in epinephrine.



- (A) alcohol, ester, aromatic (B) amine, alcohol, amide (C) amide, aromatic, alkane
 (D) amine, alcohol, aromatic (E) alkane, ether, aromatic
6. Which of the following structures would not have a dipole moment in its most stable conformation.
- (A) 1,1-dichlorocyclohexane (B) *cis*-1,2-dichlorocyclohexane (C) *trans*-1,2-dichlorocyclohexane
 (D) *cis*-1,4-dichlorocyclohexane (E) *trans*-1,4-dichlorocyclohexane
7. Which of the following structures does not represent the same compound as the other four.



8. Given that the amide functionality is planar, choose the atom that is identified with the incorrect hybridization.

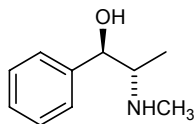


Form 0

9. Choose the statement that is incorrect about rings.

- (A) The chair conformation of cyclohexane has no angle or torsional strain.
- (B) Cyclopropane has the greatest angle strain.
- (C) Planar cyclobutane is its most stable conformation.
- (D) Planar cyclopentane would have small angle strain but severe torsional strain.
- (E) The chair conformation has less torsional strain and fewer nonbonded interactions than the twist boat conformation.

10. Ephedrine is chiral compound isolated from the plant *ephedra sinica* and has the following molecular structure.



Choose the incorrect statement about ephedrine.

- (A) The mirror image structure of ephedrine is its enantiomer.
- (B) The ephedrine shown above has two diastereomers.
- (C) Ephedrine and all of its diastereomers must have the same melting point.
- (D) Ephedrine and its enantiomer have the same melting point.
- (E) Ephedrine and enantiomer are stereoisomers.

11. Choose the incorrect statement about ephedrine and its enantiomer. (see above question for the structure of ephedrine)

- (A) The molecular weights of both enantiomers are the same.
- (B) The melting points of both enantiomers are the same.
- (C) Both enantiomers rotate the plane of polarized light the same number of degrees but in opposite directions.
- (D) The color of the two enantiomers must be the same.
- (E) The toxicity of the two enantiomers must be equal.

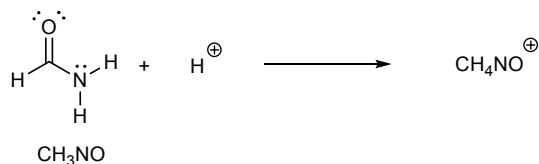
12. Choose the correct molecular formula for ephedrine.

- (A) $C_{10}H_{15}NO$ (B) $C_{11}H_{15}NO$ (C) $C_{10}H_{16}NO$ (D) $C_{10}H_{14}NO$ (E) $C_9H_{15}NO$

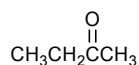
Form 0

Short Answer Questions. 40 points.

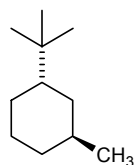
13. Formamide undergoes protonation on oxygen when treated with strong acid. Draw the two best contributing structures for this cation, identify the major contributor and, using the curved arrow formalism, show the bond making and bond breaking that occurs to interconvert these two structures.



- 14a. Give the correct structure for compound with the name (3*R*, 5*S*)-3,5-dimethyloctane.
 14b. Give the correct name for the following structure.



15. The following cyclohexane derivative is rapidly interconverting between two chair conformations. Draw these two chair conformations and identify the more stable structure.



16. The treatment of hydrocarbons with chlorine in the presence of an initiator involves the substitution of a C-H by a C-Cl. This reaction will be discussed further in Chapter 8.

The chlorination of a hydrocarbon **A** (C_6H_{14}) gives a complex mixture from which can be separated five different compounds with the formula $\text{C}_6\text{H}_{13}\text{Cl}$. On further study it is observed that three of these five compounds are actually racemic mixtures.

Give the structure of hydrocarbon **A** and draw one chiral and one achiral $\text{C}_6\text{H}_{13}\text{Cl}$ derivative of hydrocarbon **A**.

