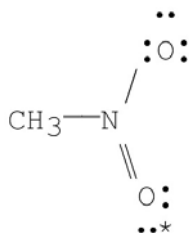


1. MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) When a small amount of hexanoic acid [$\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$, $\text{pK}_a \sim 4.8$], is added to a separatory funnel which contains the organic solvent diethyl ether and water with a pH of 2.0, it is found mainly in the _____ phase as _____.
- A) ether; $\text{CH}_3(\text{CH}_2)_4\text{CO}_2^-$
 B) water; $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$
 C) ether; $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{H}$
 D) water; $\text{CH}_3(\text{CH}_2)_4\text{CO}_2^-$
 E) none of the above
- 2) What is the conjugate base of CH_3NH_2 ?
- A) NH_4^+ B) NH_2^-
 C) CH_3NH^- D) CH_3NH_3^+
- 3) Which of the following is closest to the C-O-C bond angle in $\text{CH}_3\text{-O-CH}_3$?
- A) 180°
 B) 120°
 C) 90°
 D) 160°
 E) 109.5°
- 4) Which of the following ions is the strongest acid?
- A) HO^-
 B) HSO_4^-
 C) H_2O
 D) H_3O^+
 E) H^-
- 5) The lone-pair electrons of the methyl anion occupy a _____ orbital.
- A) s B) sp^3 C) sp^2 D) p E) sp

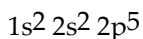
- 6) What are the formal charges on nitrogen and the starred oxygen atom in the following molecule? 6) _____



- A) N = +1, O = 0
 B) N = +1, O = -1
 C) N = -1, O = -1
 D) N = -1, O = 0
 E) N = +1, O = +1

- 7) What is the pH of a 0.1 M solution of HCl? (Note: pK_a for HCl is -6.) 7) _____
 A) -8 B) 6 C) -1 D) -6 E) 1

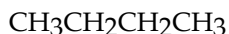
- 8) Which of the following elements does this electronic configuration represent? 8) _____



- A) N B) F C) O D) C E) Al

- 9) Which of the following covalent bonds has the largest dipole moment? 9) _____
 A) H-N B) C-H C) H-F D) C-C E) C-O

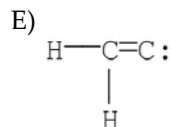
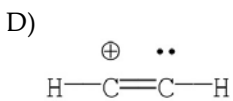
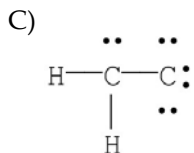
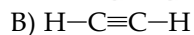
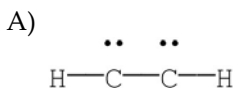
- 10) Choose the correct hybridization for the atom indicated in the molecule below. 10) _____



↑

- A) sp^3 B) sp^2
 C) sp D) none of the above

- 11) Which of the following is the most likely electronic structure for C_2H_2 ? 11) _____



12) Which of the compounds below bond predominantly via ionic bonding? 12) _____

- A) NH₃
- B) KCl
- C) CF₄
- D) both A and B
- E) both B and C

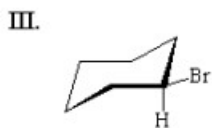
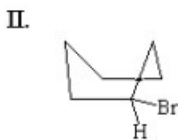
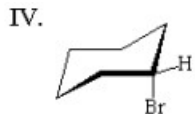
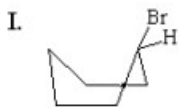
13) How many unpaired electrons are present in the isolated carbon atom (atomic number = 6)? 13) _____

- A) none
- B) one
- C) two
- D) three
- E) four

14) Among the butane conformers, which occur at energy minima on a graph of potential energy versus dihedral angle? 14) _____

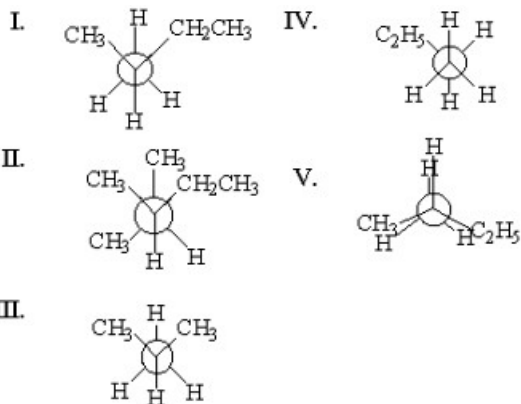
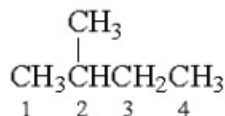
- A) eclipsed only
- B) anti only
- C) gauche and anti
- D) eclipsed and totally eclipsed
- E) gauche only

15) Which of the following is the most stable conformation of bromocyclohexane? 15) _____



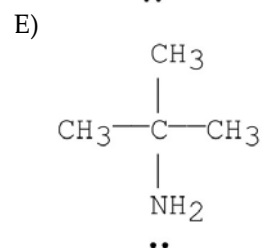
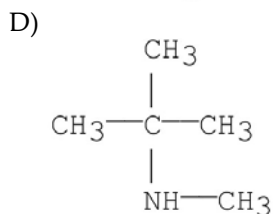
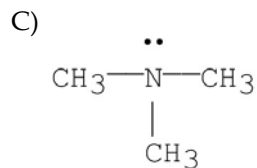
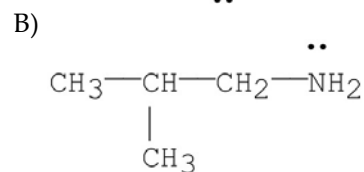
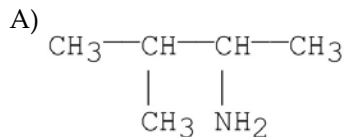
- A) I
- B) II
- C) III
- D) IV
- E) V

16) Which of the following is the staggered conformation for rotation about the C₁–C₂ bond in the following structure? 16) _____



A) I B) II C) III D) IV E) V

17) Which of the following is a tertiary amine? 17) _____



18) Which of the following has the greatest solubility in $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$? 18) _____

- A) CH_3OH
- B) CH_3NH_2
- C) $\text{CH}_3\text{O}^- \text{Na}^+$
- D) $(\text{CH}_3)_3\text{CH}$
- E) CH_3OCH_3

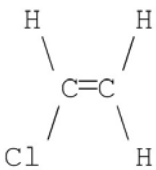
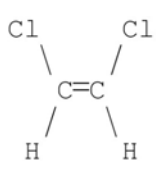
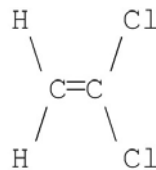
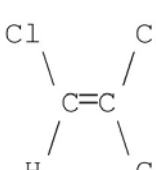
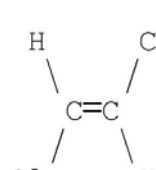
19) Which of the following statements about the conformers that result from rotation about the C2-C3 bond of butane is correct? 19) _____

- A) The highest energy conformer is one in which methyl groups are eclipsed by hydrogens.
- B) Torsional strain is absent in the eclipsed forms.
- C) The gauche conformer is an eclipsed one.
- D) Steric strain is absent in the eclipsed forms.
- E) none of the above

20) Which of the following is an sp^2 hybridized carbon? 20) _____

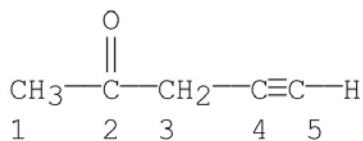
- A) \ominus
:CH₃
- B) \oplus
CH₃
- C) \cdot CH₃
- D) A and B
- E) A, B and C

21) Which of the following molecules has a net dipole moment of zero? 21) _____

- A)
 
- B)
 
- C)
 
- D)
 
- E)
 

- 22) Which of the following is the strongest acid? 22) _____
- A) CH_3OCH_3
 - B) $\text{CH}_3\text{CH}_2\text{OH}$
 - C) $\text{CH}_3\text{-NH-CH}_3$
 - D) $\text{CH}_3\text{-C}\equiv\text{CH}$
 - E) $\text{CH}_3\text{-CH=CH}_2$

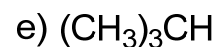
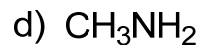
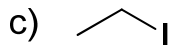
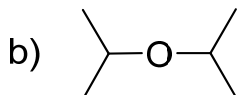
- 23) Which carbon(s) in the following molecule is (are) sp hybridized? 23) _____



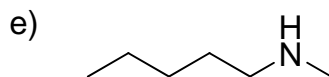
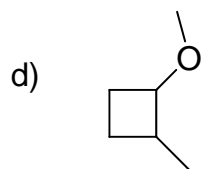
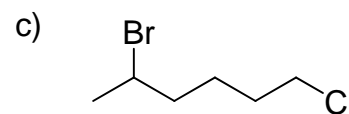
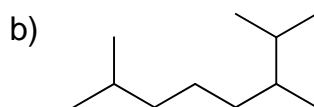
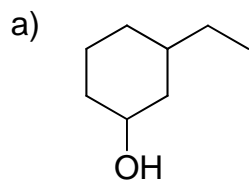
- A) carbon 4, 5
 - B) carbon 2
 - C) carbons 1, 3
 - D) carbons 4
 - E) carbon 1
- 24) Which of the compounds below will form hydrogen bonds between its molecules? 24) _____
- A) $\text{CH}_3\text{NHCH}_2\text{CH}_3$
 - B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{F}$
 - C) $\text{CH}_3\text{CH}_2\text{OCH}_3$
 - D) $(\text{CH}_3)_3\text{N}$
 - E) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- 25) Which of the following is not a conjugate acid-base pair? 25) _____
- A) -OH , O^{2-}
 - B) H_2O , HO^-
 - C) H_2O , H_3O^+
 - D) HSO_4^- , H_2SO_4
 - E) NO_3^- , NO_2^-

2. Nomenclature (20 pts)

1) Please provide common names for the following compounds (5 pts)



2) Please provide IUPAC names for the following structures (10)



3) Please indicate whether the following IUPAC name is correct or not. If incorrect, provide the correct name (5pts)

a) 3-methylbutane

b) 4-methoxy-3-chlorocycloheptane

c) hexan-2-ol

3. Rank according to the indicated properties using 1 for the most and 4 for the least (8 pts)

a) Acidity

HCl

HI

HF

HBr

b) solubility in H₂O

CH₃CH₂CH₂CH₂OH

CH₃CH₂OCH₂CH₃

CH₃CH₂CH₂CH₂CH₃

CH₃CH₂CH₂CH₂NH₂

c) boiling point (1 for the highest and 4 for the lowest)

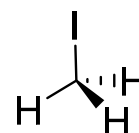
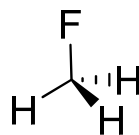
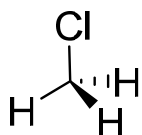
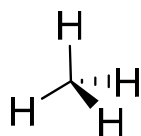
(CH₃)₂CHCH₂CH₂NH₂

(CH₃)₂CHN(CH₃)₂

(CH₃)₂CHCH₂NHCH₃

CH₃CH₂N(CH₃)₂

d) Bond polarity



4. SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question (.

1) Draw the Kekulé structure for each of the following:

a. CH₃CH₂OH

b. CH₃CHO

c. (CH₃)₃C⁺

1) _____

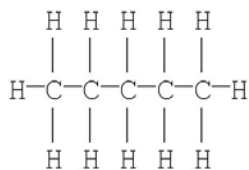
2) Would you predict trifluoromethanesulfonic acid, CF₃SO₃H, to be a stronger or weaker acid than methanesulfonic acid, CH₃SO₃H? Explain your reasoning.

2) _____

3) Why is the C–H bond in ethene ($\text{H}_2\text{C}=\text{CH}_2$) shorter and stronger than the C–H bond in ethane (CH_3CH_3)? 3) _____

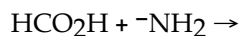
4) If H_2O has a pK_a value of 15.7 and HF has a pK_a value of 3.2, which is a stronger base, HO^- or F^- ? Explain. 4) _____

5) The Kekulé structure of pentane is shown below. Draw the condensed structural formula which corresponds to this Lewis structure. 5) _____



6) Provide a representation of the gauche conformer of butane. 6) _____

7) Write a completed equation for the acid–base pair shown below. 7) _____

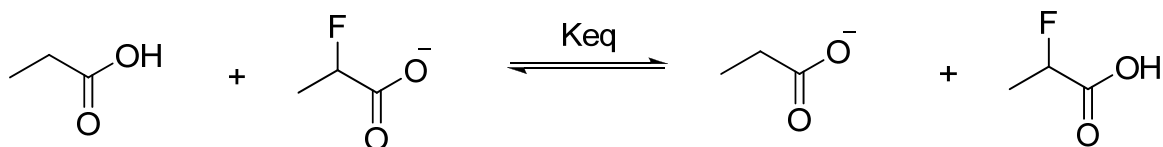


8) Covalent bonds may be polar or nonpolar. What property of the atoms forming a given bond determines this? please define the property 8) _____

9) Draw the most stable conformation of *cis*-1-isopropyl-2-methylcyclohexane.

9) _____

10) Estimate the equilibrium of the following acid and base reaction, 10) _____
 is it: (a) >1 b) <1 c) =1



Why?

11) Draw the Newman projection of the most stable conformation that results due to rotation about the C₂-C₃ bond in 2,3-dimethylbutane. 11) _____