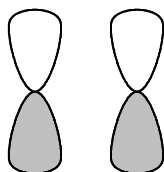


Practice Questions for 32-235 Exam 1

Note these are for reviews only. Make sure that you can do all homework without consulting the Solutions Manual and that you can complete them in a reasonable amount of time (speed of essence).

Multiple Choices (Choose only **ONE** answer !)

1. What kind of molecular orbital results when the two atomic orbitals shown below interact in the manner indicated?

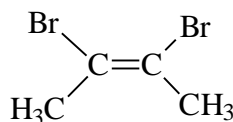
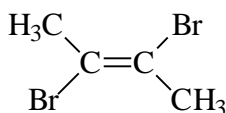


- (a) σ^* (b) σ (c) π^* (d) π (e) none of the above
2. Which of the following matches of names and molecules are correct ?
- | | |
|-------------|---------------------------------|
| A. Alcohol | I. HCOOH |
| B. Aldehyde | II. $(\text{CH}_3)_3\text{COH}$ |
| C. Ketone | III. CH_3OCH_3 |
| D. Acid | IV. CH_3COCH_3 |
- (a) C and III, D and IV (b) A and II, C and IV
(c) A and III, B and IV (d) B and II, D and I
(e) none of the above

3. The number of π bonds in the molecule shown below is

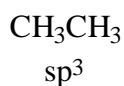


- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5
4. The relationship of the following two structures is

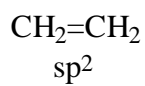


- (a) structural isomers (b) geometric isomers (c) the same
(d) not isomeric (e) conformational isomers

5. Which are the correct orbital hybridizations for the carbon atoms in the following structures ?



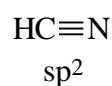
I



II



III



IV



V

- (a) I, II, III (b) I, II, IV (c) II, III, V (d) III, IV, V
 (e) I, III, V

6. Which of the following compounds is nonpolar (dipole moment = 0) ?



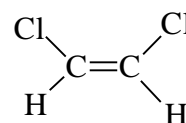
(a)



(b)



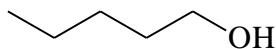
(c)



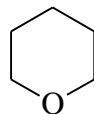
(d)

(e) none of the above

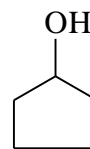
7. Which compound would have the lowest boiling point ?



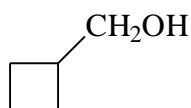
(a)



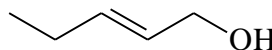
(b)



(c)



(d)

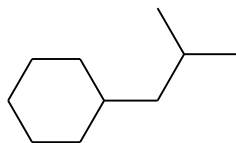


(e)

8. Consider the three isomeric alkanes n-hexane, 2,3-dimethylbutane, and 2-methylpentane. Which of the following correctly lists these compounds in order of increasing boiling point?

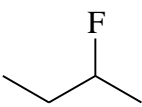
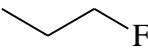
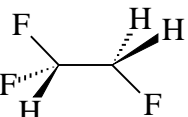
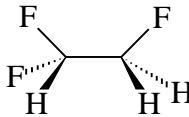
- a) 2,3-dimethylbutane < 2-methylpentane < n-hexane
 b) 2-methylpentane < n-hexane < 2,3-dimethylbutane
 c) 2-methylpentane < 2,3-dimethylbutane < n-hexane
 d) n-hexane < 2-methylpentane < 2,3-dimethylbutane
 d) n-hexane < 2,3-dimethylbutane < 2-methylpentane

9. How many tertiary hydrogens are there in the following structure:

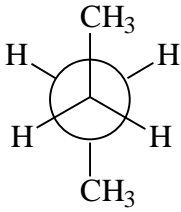
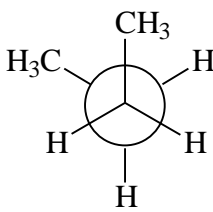
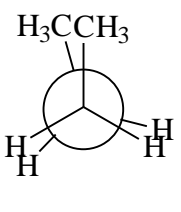
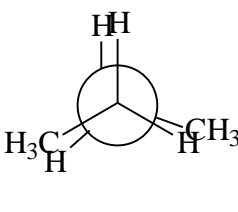


- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5

10. Which of the following pairs of formula represent structural isomers ?

- (a)  and 
- (b)  and 
- (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ and $(\text{CH}_3)_3\text{N}$
- d) More than one of these
- e) None of these

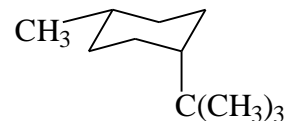
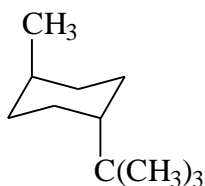
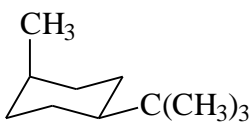
11. Which of the following is a representation of the gauche conformer of butane.

- (a) 
- (b) 
- (c) 
- (d) 
- (e) none of the above

12. Which of the above conformations is the least stable ?

- (a) (b) (c) (d) (e)

13. Which drawing represents the most stable conformation of *cis*-1-*tert*-butyl-4-methylcyclohexane.

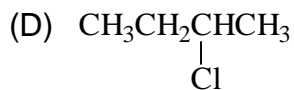
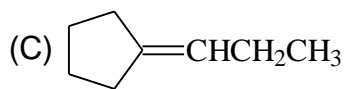
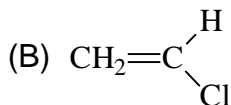
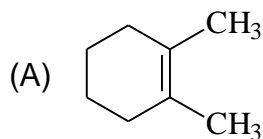


(e) none of the above

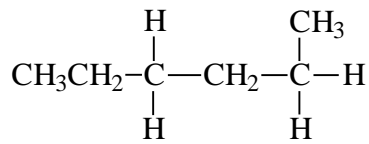
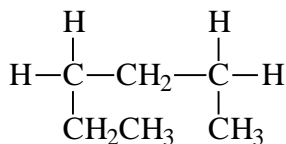
14. If stronger bonds are broken and weaker bonds are formed, then the reaction is

(a) is exothermic (b) is endothermic (c) has a positive ΔS°
 (d) has a negative ΔS° (e) is spontaneous

15. Which of the following molecules can exist as geometric isomers?

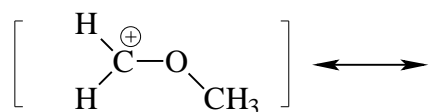


16. The relationship between the following two structures is



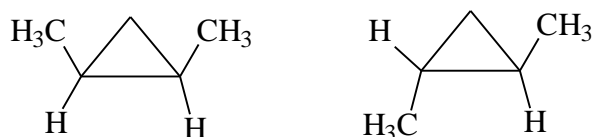
(A) same (B) constitutional isomers (C) geometric isomers
 (D) not isomers (E) structural isomers

17. Which is an acceptable resonance structure for the following drawing?



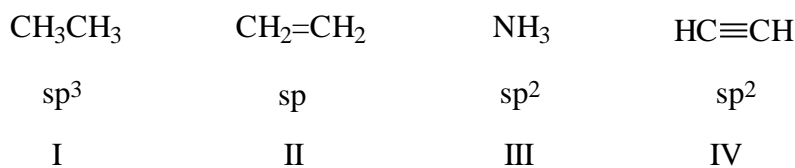
- (A) $\text{CH}_3\overset{\oplus}{\text{C}}\text{H}-\text{OH}$ (B) $\text{CH}_2=\overset{\oplus}{\text{O}}-\text{CH}_3$ (C) $\text{CH}_3\text{CH}_2\overset{\oplus}{\text{O}}$
 (D) $\text{CH}_3\text{CH}=\overset{\oplus}{\text{O}}\text{H}$ (E) None of the above

18. The relationship of the following two structures is



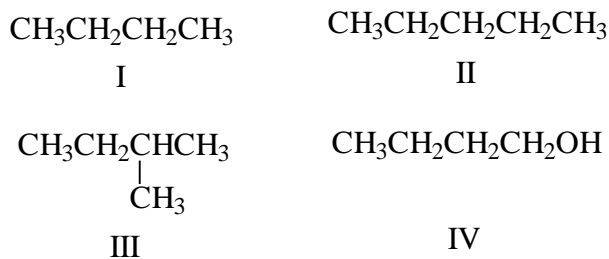
- (A) structural isomers (B) conformational isomers (C) the same
 (D) not isomeric (E) stereoisomers

19. Which is(are) the correct orbital hybridization(s) for the C and N atoms in the following structures ?



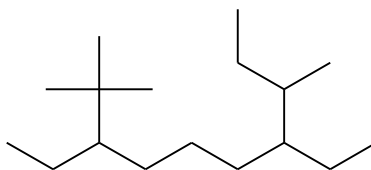
- (A) I (B) II, III (C) III, IV (D) I, III (E) II

20. The b.p. of the following compounds is expected to decrease in this order (highest b.p. first):



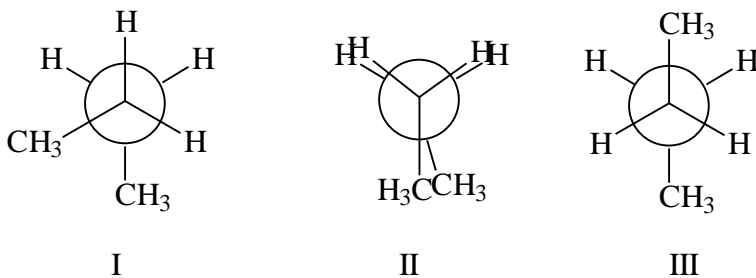
- (A) II > III > IV > I (B) III > I > II > IV (C) III > II > IV > I
 (D) IV > II > III > I (E) I > II > III > IV

21. An acceptable name for the following structure is



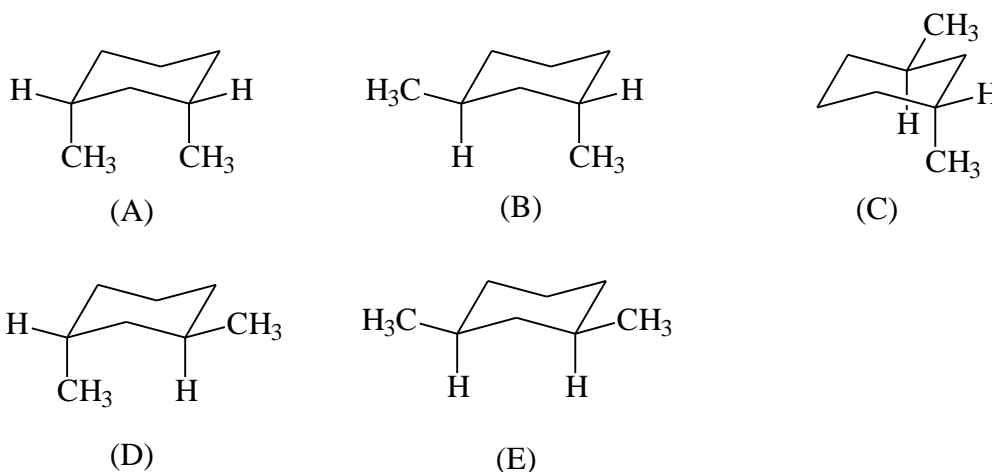
- (A) 8-*t*-Butyl-4-ethyl-3-methyldecane (B) 3-*sec*-Butyl-7-*tert*-butylnonane
(C) 3,7-Diethyl-2,2,8-trimethyldecane (D) 4,8-Diethyl-3,9,9-trimethyldecane
(E) none of the above

22. Which statement is true regarding the following conformations for butane?

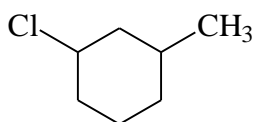


- (A) I is less stable than II because of steric strain
(B) III is less stable than I due to its torsional strain
(C) III is called gauche conformation
(D) The steric strain in II is greater than in I
(E) III has more energy than II

23. Which of the following molecules is the least stable ?

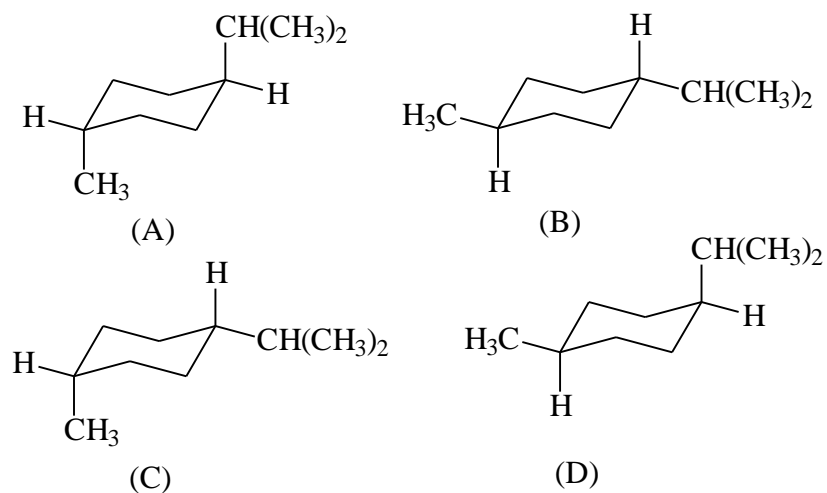


24. Which name(s) is(are) acceptable for the following compound?



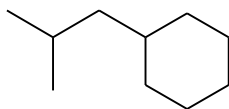
- (A) 5-chloro-2-methylcyclohexane
- (B) 4-chloro-2-methylcyclohexane
- (C) 1-chloro-3-methylcyclohexane
- (D) 2-chloro-5-methylcyclohexane
- (E) More than one of these

25. Which of the following represents the most stable conformation of cis-1-isopropyl-4-methylcyclohexane?



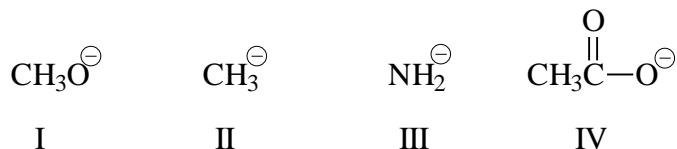
(E) None of these fits the name given

26. How many tertiary hydrogen(s) are(is) there in the following structure?



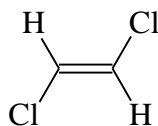
- (A) 1 (B) 2 (C) 3 (D) 6 (E) 10

27. The strength of the following bases decreases in the order of (strongest first):



- (A) I > IV > III > II (B) III > IV > I > II (C) II > I > III > IV
 (D) IV > I > II > III (E) II > III > I > IV

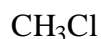
28. Which molecule is expected to have the largest molecular dipole moment ?



(A)



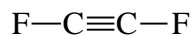
(B)



(C)

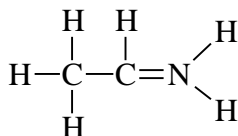


(D)



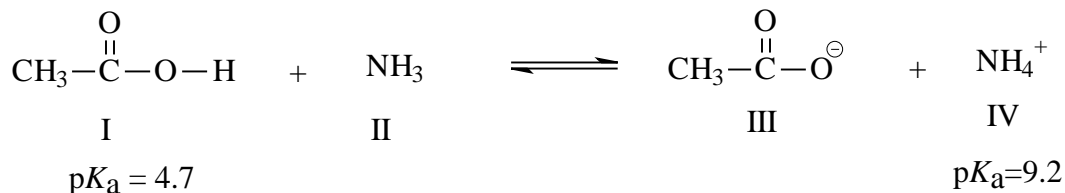
(E)

29. The formal charge on nitrogen in the Lewis structure below is



- (A) +2 (B) +1 (C) 0 (D) -1 (E) -2

30. Considering the following acid-base reaction, which statement is NOT true?

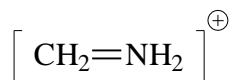


- (A) I is more acidic than IV
 (B) II is more basic than III
 (C) The equilibrium favors the right
 (D) The two C-O bonds in III are of different length.
 (E) more than one of the above

31. When the 1s orbitals of two hydrogen atoms combine to form a hydrogen molecule, how many molecular orbitals are formed ?

- (A) one (B) two (C) three (D) four (E) five

32. The nitrogen atom in the molecule below is sp^2 hybridized. What is the geometry of the atoms connected to nitrogen ?

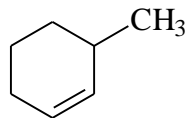
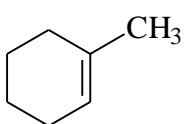


- (A) square (B) tetrahedral (C) trigonal planar
(D) linear (E) pyramidal

33. Which of the following is the best description for the C=N bond above?

- (A) It results from $sp^2(\text{C})-sp^2(\text{N})$ overlap
(B) It results from $sp^3(\text{C})-sp^2(\text{N})$ overlap
(C) The two bonds are of same property
(D) One bond is from $sp^2(\text{C})-sp^2(\text{N})$ and the other from 2 p orbitals
(E) None of the above

34. The relationship of the following two molecules is best described by



- (A) structural isomers (B) geometric isomers
(C) not isomers (D) homologous
(E) conformational isomers

35. Which of the following bonds can act to form hydrogen bonding

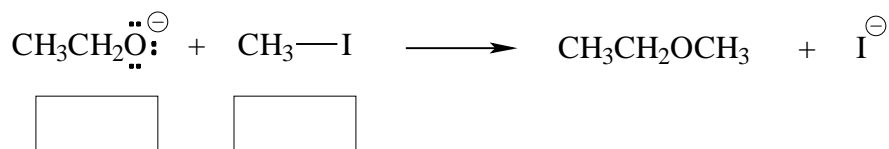
- (A) O-H (B) N-H (C) C-H (D) C-C
(E) more than one the above

36. The boiling point of straight chain alkanes increases as the number of carbons increases. This is because

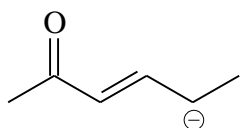
- (A) the larger the molecule, the greater the dipole moment
(B) Larger molecules usually can form hydrogen bonding better
(C) Larger molecules can pack tightly together
(D) Larger molecules have greater surface therefore stronger London Forces among them.
(E) None of the above

Essay Questions

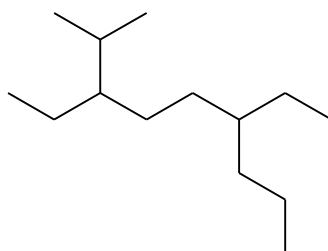
1. Use the curved arrow formalism (electron pushing) to indicate the movement of electron pairs in the following reaction. Indicate in the boxes which reactants are nucleophile (Nu) and/or electrophile (E).



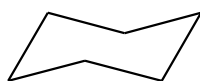
2. Draw the important resonance contributing forms for the structure shown below. (Use electron arrow pushing for help)



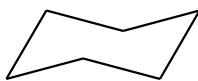
3. Give an acceptable IUPAC name for the following compound:



4. (A) Write the two chair conformations for cis-1-tert-butyl-2-ethylcyclohexane (the following two templates are drawn to help you)



A



B

- (B) In the above conformations, label the positions occupied by tert-butyl and ethyl groups by using "ax" for axial and "eq" for equatorial positions.

(C) Determine which conformation would have a higher energy and briefly explain the reason.

5. The three compounds below have identical or nearly identical molecular mass. Rank them in the increasing order (lowest first) of their boiling points, and briefly explain your reasoning.



A



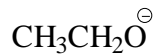
B



C

6. Draw the Lewis structures for three compounds with a formula of $\text{C}_3\text{H}_8\text{O}$. What is the relationship among these three compounds?

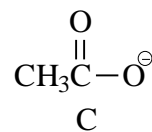
7. Redraw each molecule below to show lone pair electrons, then arrange them in the order of increasing basicity (lowest first, use <). Explain your reasoning for the order.



A



B



C

8. Draw the important resonance structures for the following molecule. (hint: try electron arrow pushing)

