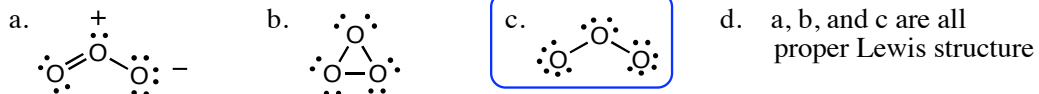


1-11. Multiple choice. Choose the best answer for the following questions (44 pts)

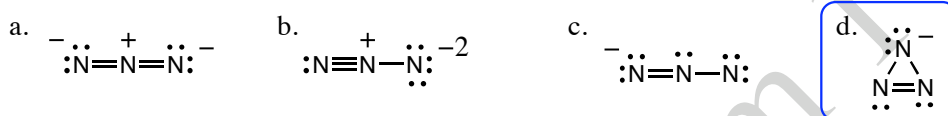
1. Which of the following is not a proper Lewis structure for ozone ( $O_3$ )?



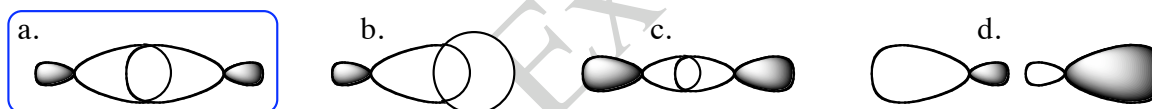
2. The geometry of an  $sp^3$  hybridized atom is . . .

- a. tetrahedral      b. linear      c. trigonal planar      e. dumbbell shaped.

3. Which of the following is not a resonance structure of azide ion ( $N_3^-$ )



4. Which of the following represents the molecular orbital of the C-C bond of ethane.



5. Which of the following acids would have the strongest conjugate base?

- a.  $NH_3$  (ammonia)  $K_a = 10^{-32}$   
 b.  $H_3COH$  (methanol)  $K_a = 10^{-18}$   
 c.  $H_3CCO_2H$  (acetic acid)  $K_a = 10^{-5}$   
 d.  $HCl$  (hydrochloric acid)  $K_a = 10^7$

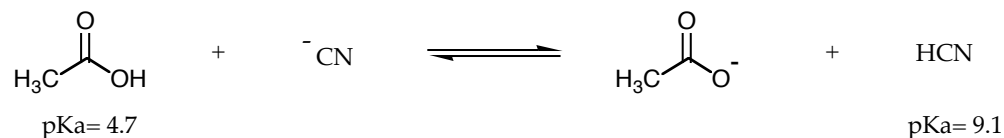
6. A primary carbon is . . .

- a. the most reactive carbon of a molecule.  
 b. always numbered as 1 in the IUPAC nomenclature system.  
 c. a carbon bonded to only one other carbon atom.  
 d. the carbon of a complex substituent that is the point of attachment to the parent chain.

7. Which of the following is a Lewis Acid, but not a Bronsted acid?

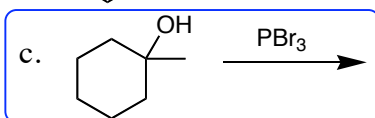
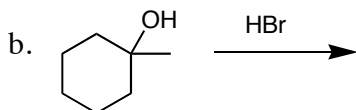
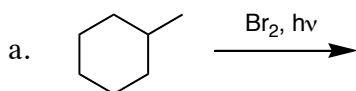
- a.  $^+NH_4$       b.  $(H_3C)_3C^+$       c.  $H_2O$       d.  $H_3C-OH$

8. Consider the following acid-base reaction. The equilibrium of the reaction . . .



- a. favors products.
- b. favors reactants.
- c. is approximately 1.
- d. can not be predicted based on the information given.

9. Which of the following is not a viable method for the preparation of 1-bromo-1-methylcyclohexane?

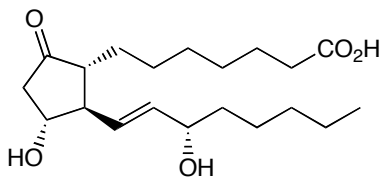


- d. none of the above; a, b, and c are all viable methods

10. Which reagent is best for the conversion of 1-butanol to 1-chlorobutane?

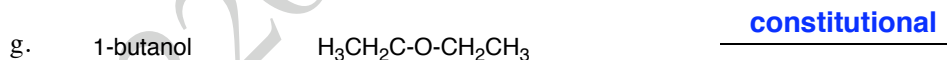
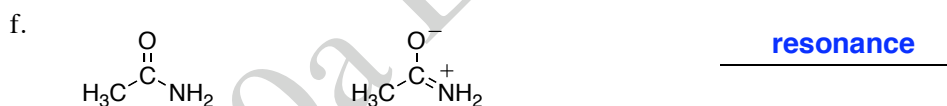
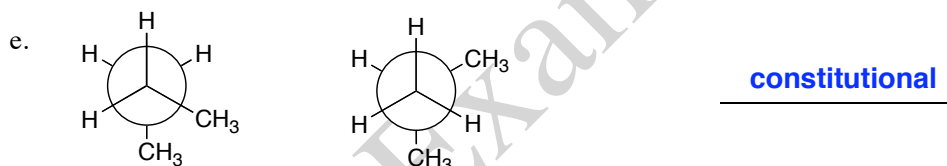
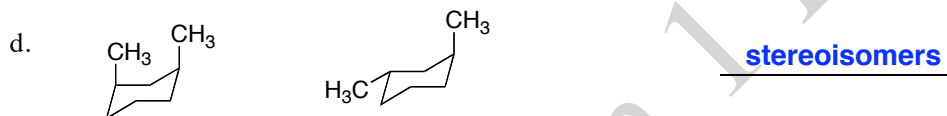
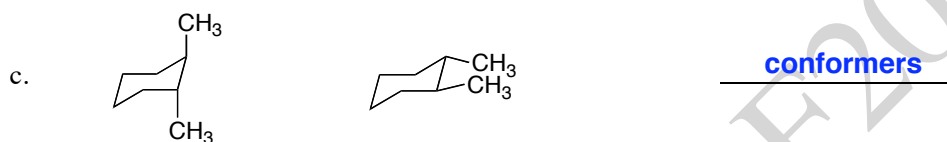
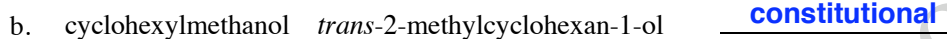
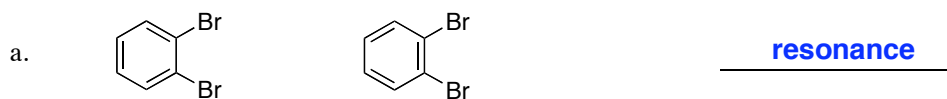
- a. HCl
- b.  $\text{Cl}_2, \text{h}\nu$
- c.  $\text{SOCl}_2$
- d. All of the above; a, b, and c will work equally well.

11. Which functional groups are part of the compound below.

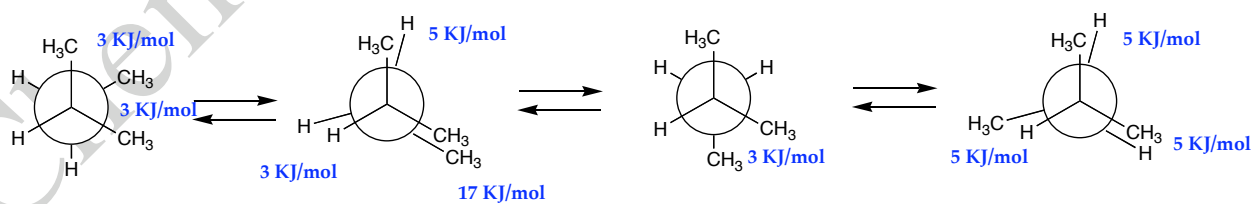


- a. alcohol, alkene, carboxylic acid, and ketone
- b. alcohol, aldehyde, alkene, and ketone
- c. alcohol, alkene, ketone, and ester
- d. alcohol, alkene, arene, and ketone

12. Identify each pair below as constitutional isomers, stereoisomers, conformers, resonance forms, or identical. (14 pts)



13. Consider the Newman projects of 2-methylbutane. Calculate the relative strain energy of each conformer. Show your work. (8 pts)



$$E_{\text{rel}} = \underline{6 \text{ KJ/mol}}$$

$$\underline{26 \text{ KJ/mol}}$$

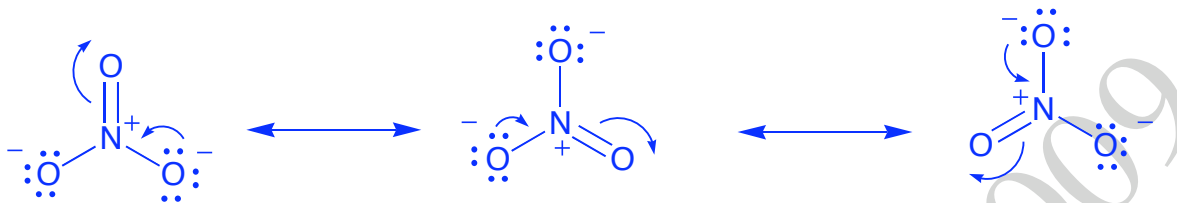
$$\underline{3 \text{ KJ/mol}}$$

$$\underline{15 \text{ KJ/mol}}$$

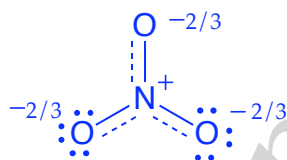
H - H eclipsed = 4.0 KJ/mol  
H - CH<sub>3</sub> eclipsed = 5.0 KJ/mol

CH<sub>3</sub> - CH<sub>3</sub> gauche = 3.0 KJ/mol  
CH<sub>3</sub> - CH<sub>3</sub> eclipsed = 17 KJ/mol

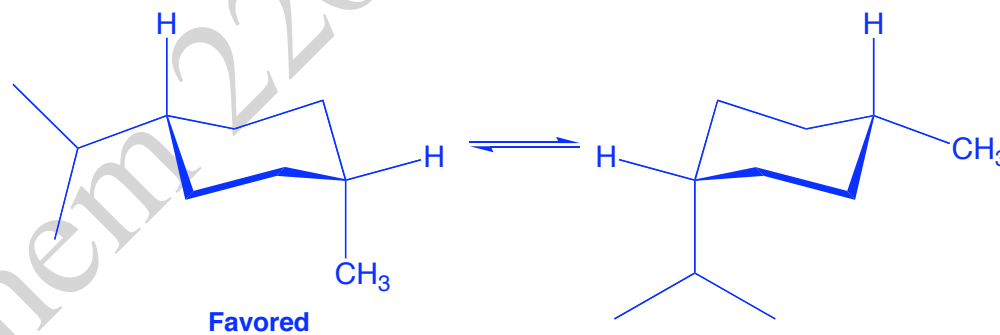
14. a. Draw all resonance forms of the nitrate ion ( $\text{NO}_3^-$ ). Show the interconversion of the resonance forms using curved arrows. (9 pts)



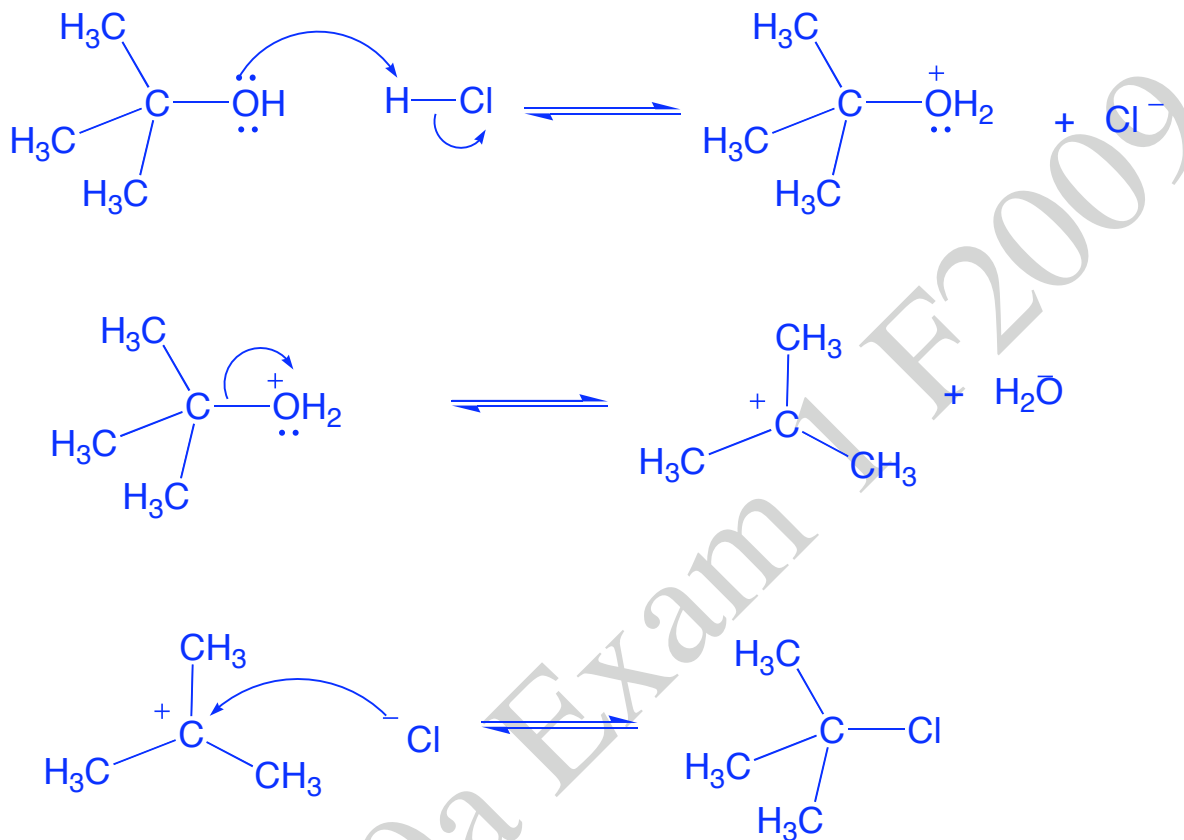
- b. Draw the resonance hybrid for the nitrate ion. (3 pts)



15. The equatorial conformation of methylcyclohexane is favored by 7 KJ/mol over the axial conformation; the equatorial conformation of 1-(1-methylethyl)cyclohexane is favored by 9 KJ/mol. Draw both chair conformations of *cis*-4-methyl-1-(1-methylethyl)cyclohexane. Which conformation is favored? (10 pts)



16. Provide a complete mechanism for the reaction of 2-methyl-2-propanol and HCl to afford 2-chloro-2-methylpropane. (12 pts)



Chem 220a Exam 1 F2009

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Problem	1-11: _____	(44 pts)	14: _____	(12 pts)
	12: _____	(14 pts)	15: _____	(10 pts)
	13: _____	(8 pts)	16: _____	(12 pts)

Total out of 100: \_\_\_\_\_