

# Chemistry 130, Midterm Exam 2

Instructor: Bergdahl

**Spring 2019**

Name: \_\_\_\_\_

Be prepared to show ID upon request.

*Key*

**\*\*Any use of any electronic devices is prohibited during the test\*\* \*\***

Be prepared to show ID upon request.

My student I.D. (red I.D.) number is:

Good Luck!!

**Part A. 1-25 Questions. Each correct answer is 3 points. (Part 1 max 75 points)**

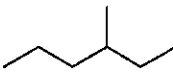
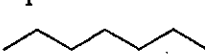
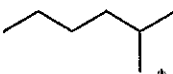
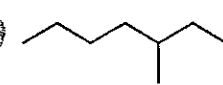
1) Constitutional isomers are

- A) Molecules with the same molecular formula and the same connectivity but a different spatial arrangement of atoms in three-dimensional space
- B) Molecules with the same connectivity but a different molecular formula
- ☒ C) Molecules with the same molecular formula but different connectivity of the atoms
- D) Molecules that have identical chemical properties

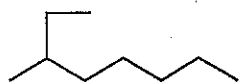
2) Which alkane molecular formula has the least number of constitutional isomers

- A)  $C_2H_6$
- ☒ B)  $C_4H_{10}$
- C)  $C_{10}H_{22}$
- D)  $C_6H_{14}$

3) Which of the following compounds is 3-methylheptane

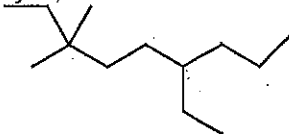
- A) 
- C) 
- B) 
- ☒ D) 

4) please provide the IUPAC name of the molecule shown below



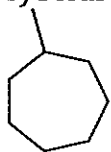
- A) 5-Methylheptane
- ☒ B) 3-Methyloctane
- C) 2-ethylheptane
- D) 2-methylhexane

5) Provide the IUPAC name of the molecule shown below



- A) 2,2-dimethyl-5-ethyloctane
- B) 3,3-dimethyl-6-ethylnonane
- ☒ C) 6-ethyl-3,3-dimethylnonane
- D) 2,2-dimethyl-5-propylnonane

6) Please provide the IUPAC name of the molecule shown below

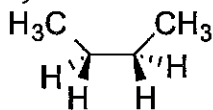


- A) methylcyclohexane
- B) methylhexane
- ☒ C) methylcycloheptane
- D) cyclohexylmethyl

7) In the highest energy conformation of butane the C-C bonds are in the \_\_\_\_\_ conformation. Butane:

- A) Staggered
- ☒ B) eclipsed
- C) Gauche

8) In the below representation of butane the 2,3 C-C bond is in the \_\_\_\_\_ conformation.

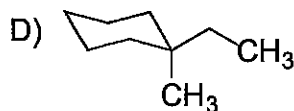
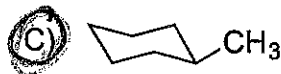
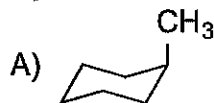


- A) Staggered
- ☒ B) eclipsed
- C) Gauche

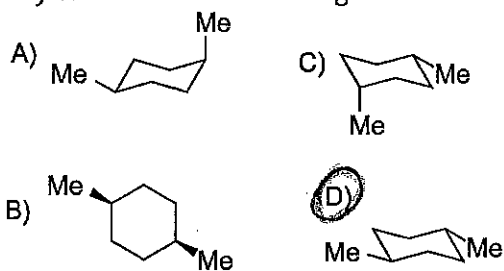
9) The most stable cyclohexane conformation is called the \_\_\_\_\_ conformation

- A) Boat
- B) Twist Boat
- C) Half Chair
- ☒ D) Chair

10) Which of the following is the lowest energy conformation of methylcyclohexane

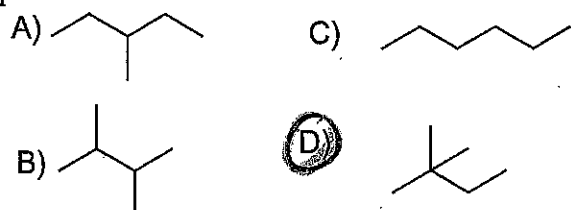


11) Which of the following structures is trans-1,4 dimethylcyclohexane

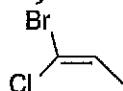


E) A, B&C

12) Which of the following 6 carbon constitutional isomers will have the lowest boiling point



13) According to IUPAC rules the below alkene is

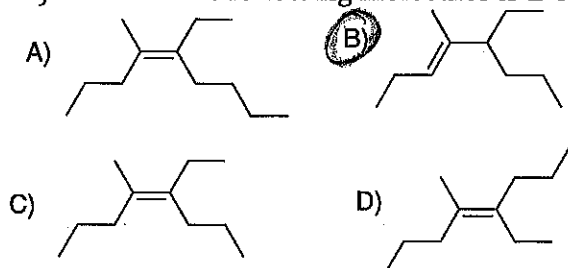


- A) Cis  
B) Trans  
C) E  
D) Z  
E) Neither

14) The name of the alkene from 13 (above) is

- A) E-1-bromo-1-chloro-1-propene  
B) Z-1-bromo-1-chloro-1-propene  
A) E-1-chloro-1-bromo-1-propene  
D) E-2-chloro-3-butene

15) Which of the following molecules is E-5-ethyl-4-methyl-3-octene



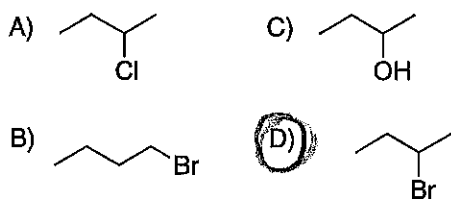
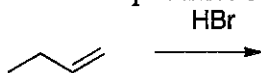
16) Which of the following hydrocarbons is least acidic?



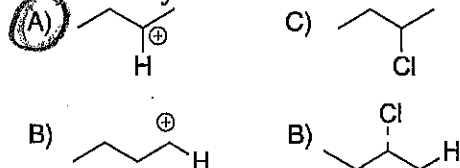
17) Why?

- A) The conjugate base is less stabilized because the orbital that houses the lone pair has more P character.
- B) The conjugate base is stabilized because the orbital that houses the lone pair of electrons has more S character.
- C) Because the atom with the negative charge is less electronegative

18) Predict the product of the below reaction



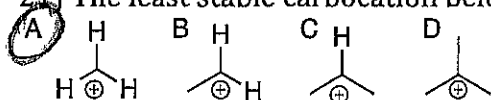
19) The key intermediate of the reaction above is



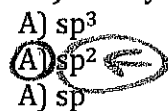
20) You get the 'markovnikov' regiochemistry (connectivity) of your product because

- A) The reaction proceeds via the least stable carbocation
- B) Alkenes are basic
- C) The reaction goes through via the more stable carbocation

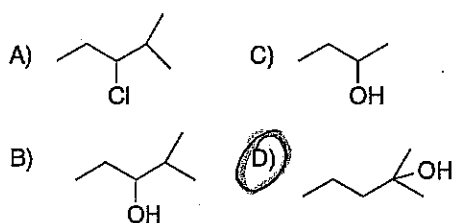
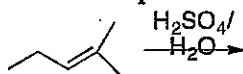
21) The least stable carbocation below is



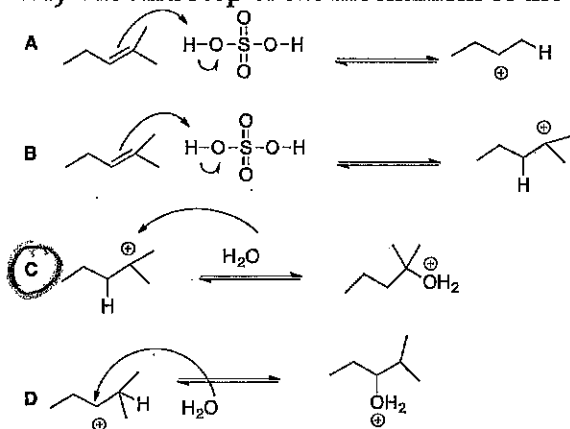
22) The hybridization of carbocations is



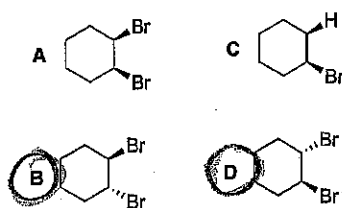
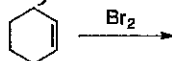
23) Predict the product of the below reaction



24) The 2nd step of the mechanism of the above reaction is



25) Predict the product of the below reaction



and/or

**Part B. Short answer questions, 26-32, each problem is worth 5-12 points (total 61 points)**

**Problem 26. (9p)**

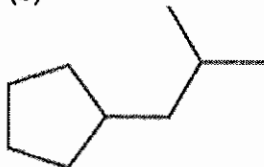
Write IUPAC names for the following hydrocarbons:

(a)



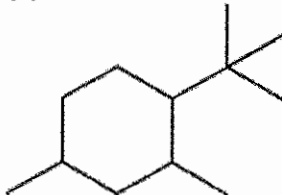
~~2,2-dimethyl-3-methylbutane~~  
Correct name: 2,2,3-Trimethylbutane

(b)



Isobutylcyclopentane or  
1-cyclopentyl-2-methylpropane

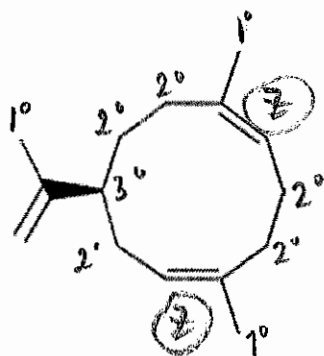
(c)



1-tert-butyl-2,4-dimethylcyclohexane

**Problem 27. (12p)** A) Following is the structure of Germacrene A, a hydrocarbon synthesized in plants and studied for its insecticidal properties. Classify each of the  $sp^3$  hybridized carbons on Germacrene A as  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$ , or  $4^\circ$  (9p)

B) Classify each alkene as E or Z respectively (3p)



Germacrene A

Problem 28. Use valence-shell electron-pair repulsion (VSEPR) to predict all bond angles about each of the following highlighted carbon atoms. (8p)

(a)  $109.5^\circ$



(b)



(c)



(d)



Problem 29. Which alkenes can exist as pairs of E/Z isomers?

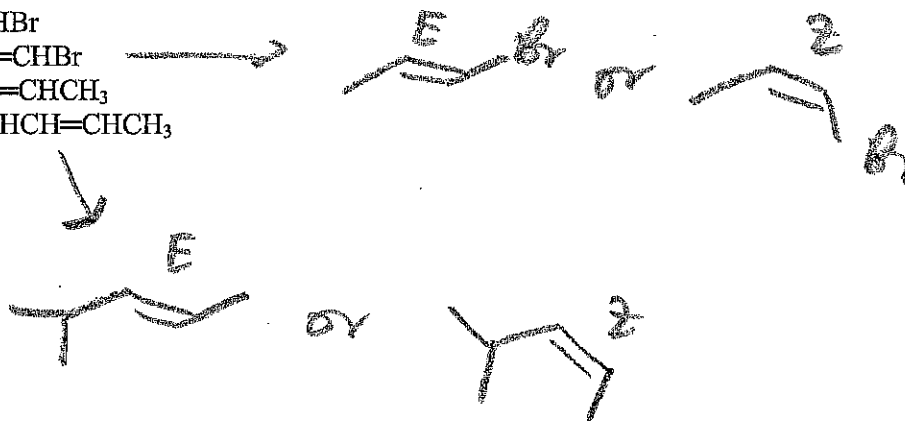
For each alkene that does, draw both isomers. (6p)

(a)  $\text{CH}_2=\text{CHBr}$

(b)  $\text{CH}_3\text{CH}=\text{CHBr}$

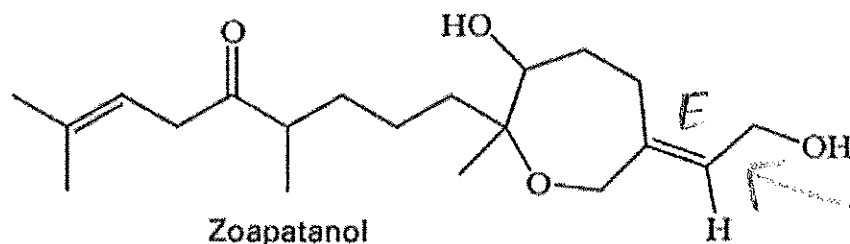
(c)  $(\text{CH}_3)_2\text{C}=\text{CHCH}_3$

(d)  $(\text{CH}_3)_2\text{CHCH}=\text{CHCH}_3$





Problem 30. In many parts of South America, extracts of the leaves and twigs of *Montanoa tomentosa* are used as a contraceptive, to stimulate menstruation, to facilitate labor, and as an abortifacient. The compound responsible for these effects is zoapatanol:

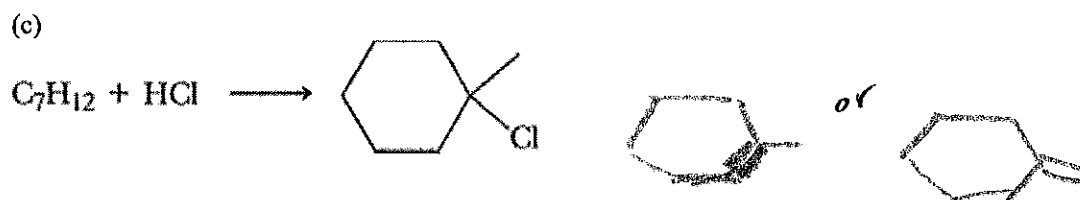
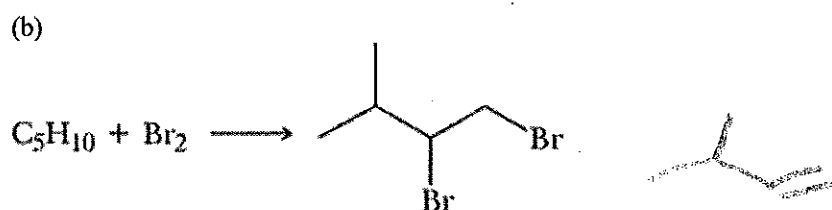
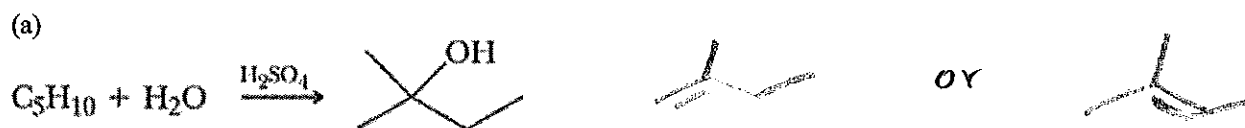


- (a) Specify the configuration about the carbon-carbon double bond to the seven-membered ring, according to the E,Z system. (3p)
- (b) How many *cis-trans* isomers are possible for zoapatanol? Consider the possibilities for *cis-trans* isomerism in cyclic compounds and about carbon-carbon double bonds. (2p)

The correct answer here is 4 isomers because one also has to consider the "cis-trans" possibility for the other substituents located in the ring. Two isomers is correct only if one consider the cis-trans of the alkene.

*2 isomers*

Problem 31. Draw a structural formula for an alkene with the indicated molecular formula that gives the compound shown as the major(!) product. Note that more than one alkene may give the same compound as the major product. (9p)



Problem 32. Complete these equations by predicting the major product formed in each reaction.  
(12p)

