Chemistry 130, Midterm Exam 2

Instructor: Bergdahl

Spring 2019

Name:_____

Be prepared to show ID upon request.

****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:

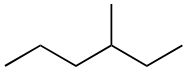
Good Luck!!

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

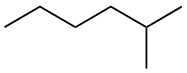
1) Constitutional isomers are
A) Molecules with the same molecular formula and the same connectivity but a different spatial arrangement of atoms in three-dimensional space
B) Molecules with the same connectivity but a different molecular formula
C) Molecules with the same molecular formula but different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

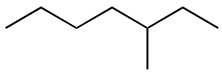
2) Which alkane molecular formula has the least number of constitutional isomers
A) C_2H_6
B) C_4H_{10}
C) $C_{10}H_{22}$
D) C_6H_{14}

3) Which of the following compounds is 3-methylheptane

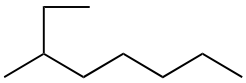
A) 

C) 

B) 

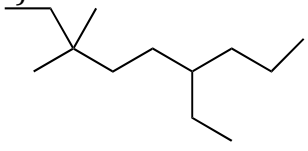
D) 

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



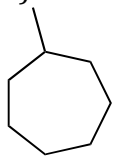
A) 5-Methylheptane
B) 3-Methyloctane
C) 2-ethylheptane
D) 2-methylhexane

5) Provide the IUPAC name of the molecule shown below

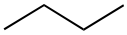


A) 2,2-dimethyl-5-ethyloctane
B) 3,3-dimethyl-6-ethylnonane
C) 6-ethyl-3,3-dimethylnonane
D) 2,2-dimethyl-5-propylnonane

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

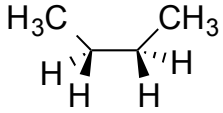


A) methylcyclohexane
B) methylhexane
C) methylcycloheptane
D) cyclohexylmethyl

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

A) Staggered
B) eclipsed
C) Gauche

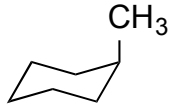
8) In the below representation of butane the 2,3 C-C bond is in the _____ conformation.

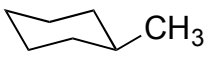


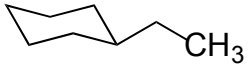
A) Staggered
B) eclipsed
C) Gauche

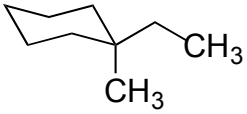
9) The most stable cyclohexane conformation is called the _____ conformation
A) Boat
B) Twist Boat
C) Half Chair
D Chair

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

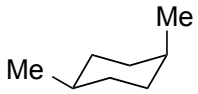
A) 

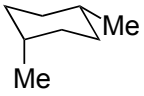
C) 

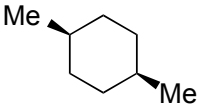
B) 

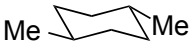
D) 

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

A) 

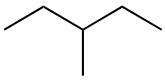
C) 

B) 

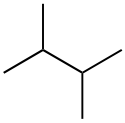
D) 

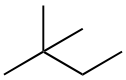
E) A, B&C

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

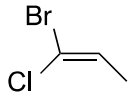
A) 

C) 

B) 

D) 

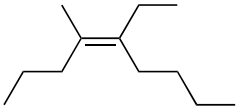
13) According to IUPAC rules the below alkene is

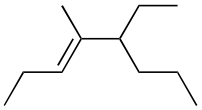


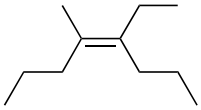
A) Cis
B) Trans
C) E
D) Z
E) Neither

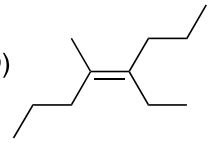
14) The name of the alkene from 13 (above) is
A) E-1-bromo-1-chloro-1-propene
B) Z-1-bromo-1-chloro-1-propene
A) E-1-chloro-1-bromo-1-propene
D) E-2-chloro-3-butene

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

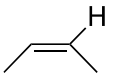
A) 

B) 

C) 

D) 

16) Which of the following hydrocarbons is least acidic?

A) 

B) 

C) 

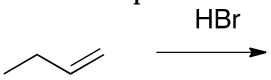
17) Why?

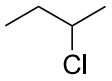
A) The conjugate base is less stabilized because the orbital that houses the lone pair has more P character.

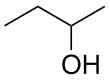
B) The conjugate base is stabilized because the orbital that houses the lone pair of electrons has more S character.

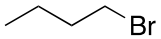
C) Because the atom with the negative charge is less electronegative

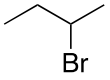
18) Predict the product of the below reaction



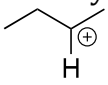
A) 

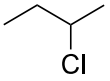
C) 

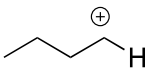
B) 

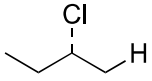
D) 

19) The key intermediate of the reaction above is

A) 

C) 

B) 

B) 

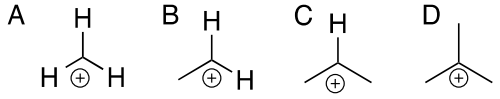
20) You get the 'markovnikov' regiochemistry (connectivity) of your product because

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



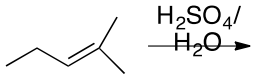
22) The hybridization of carbocations is

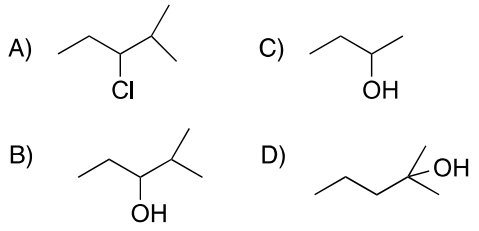
A) sp^3

A) sp^2

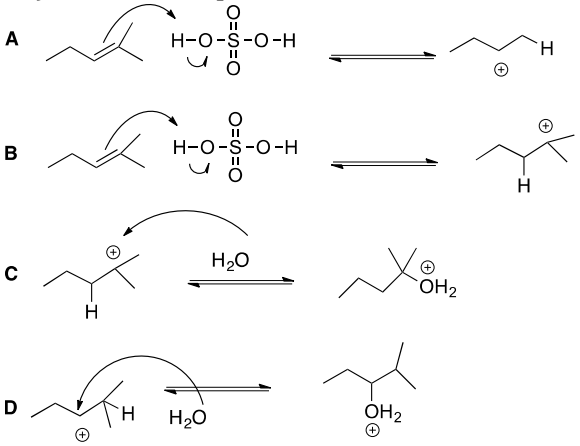
A) sp

23) Predict the product of the below reaction

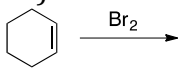


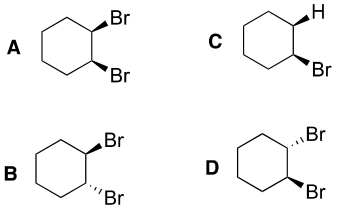


24) The 2nd step of the mechanism of the above reaction is



25) Predict the product of the below reaction

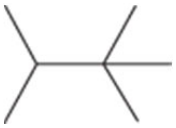




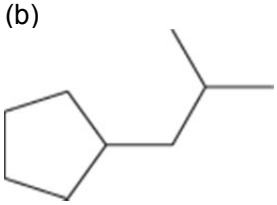
Part B. Short answer questions, 26-32, each problem is worth 5-12 points (total 61 points)

Problem 26. (9p)

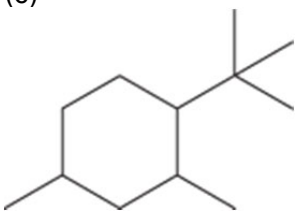
Write IUPAC names for the following hydrocarbons:
(a)



(b)

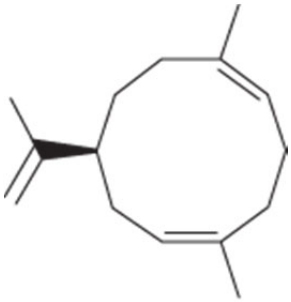


(c)



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°, 2°, 3°, or 4° (9p)

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

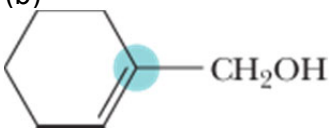


Germacrene A

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

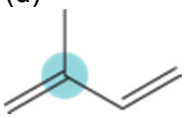
(a)

(b)



(c)

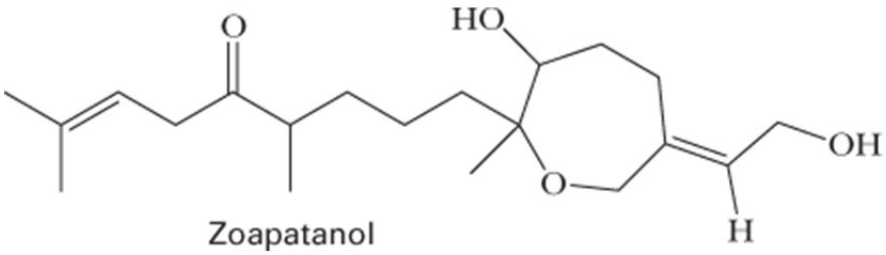
(d)



Problem 29. Which alkenes can exist as pairs of E/Z isomers? For each alkene that does, draw both isomers. (6p)

(a) $CH_2{=}CHBr$
(b) $CH_3CH{=}CHBr$
(c) $(CH_3)_2C{=}CHCH_3$
(d) $(CH_3)_2CHCH{=}CHCH_3$

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:



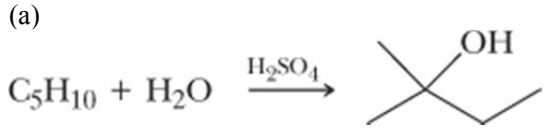
Zoapatanol

(a) Specify the configuration about the carbon-carbon double bond to the seven-membered ring, according to the E,Z system. (3p)

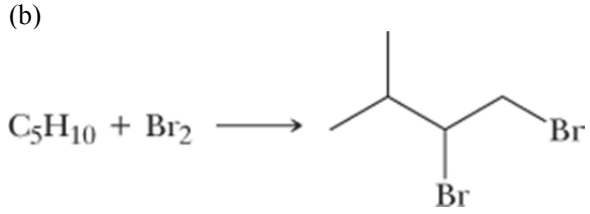
(b) How many *cis-trans* isomers are possible for zoapatanol? Consider the possibilities for *cis-trans* isomerism in cyclic compounds and about carbon-carbon double bonds. (2p)

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)

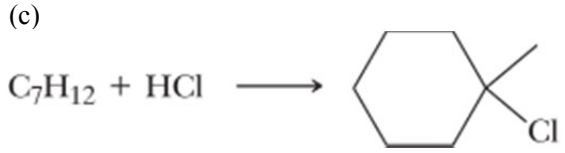
(a)



(b)

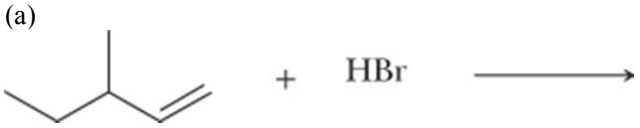


(c)

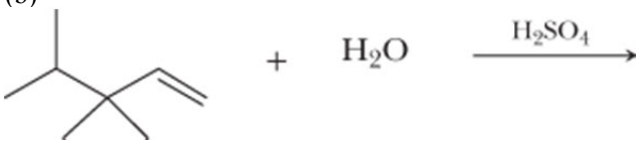


Problem 32. Complete these equations by predicting the major product formed in each reaction. (12p)

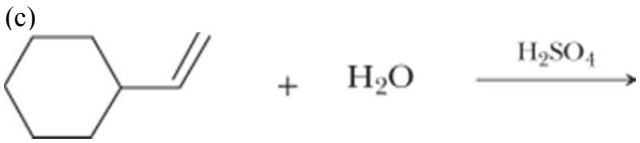
(a)



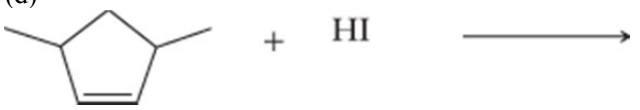
(b)



(c)

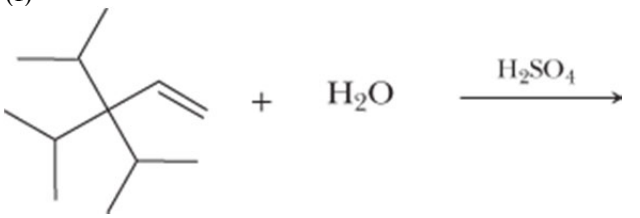


(d)

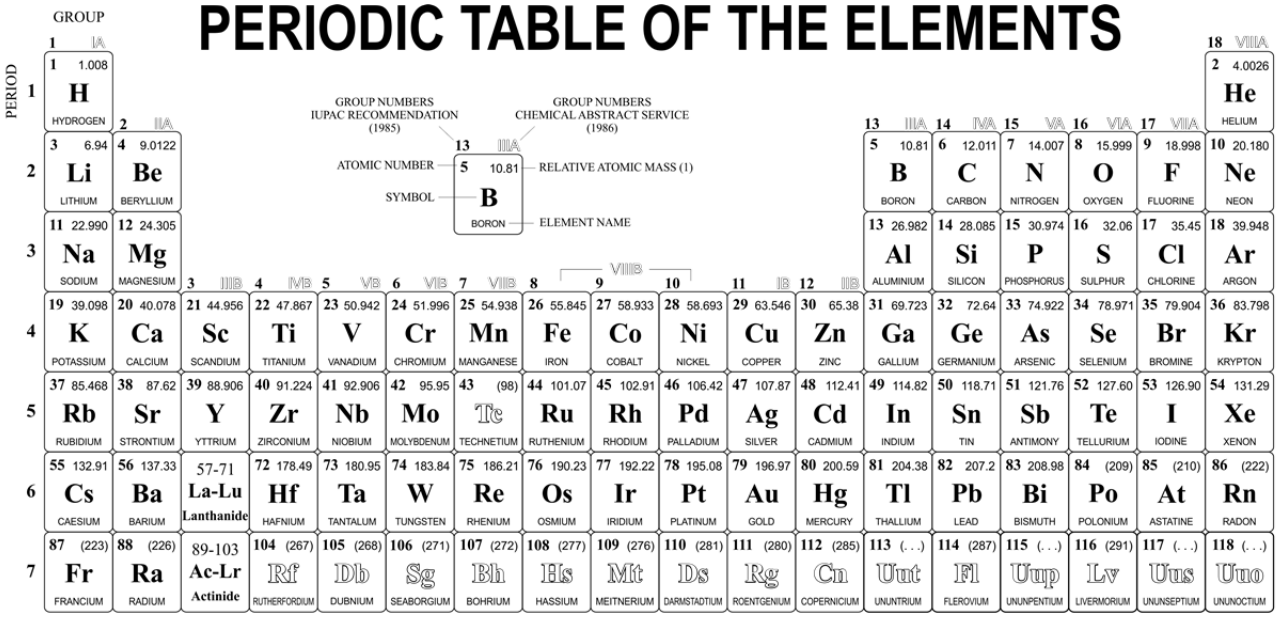


(e)

(f)



PERIODIC TABLE OF THE ELEMENTS



LANTHANIDE

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
138.91	140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.05	174.97
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
LANTHANUM	CERIUM	PRASEODYMIUM	NEODYMIUM	PROMETHIUM	SAMARIUM	EUROPIUM	GADOLINIUM	TERBIUM	DYSPROSIUM	HOLMIUM	ERBIUM	THULIUM	YTTERBIUM	LUTETIUM

ACTINIDE

89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
(227)	232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
ACTINIUM	THORIUM	PROTACTINIUM	URANIUM	NEPTUNIUM	PLUTONIUM	AMERICIUM	CURIUM	BERKELIUM	CALIFORNIUM	EINSTEINIUM	FERMIUM	MENDELEVIUM	NOBELIUM	LAWRENCIUM

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(1) Pure Appl. Chem., **88**, 265-291 (2016)

TABLE 1.4 Electronegativity Values and Trends for Some Atoms (Pauling Scale)

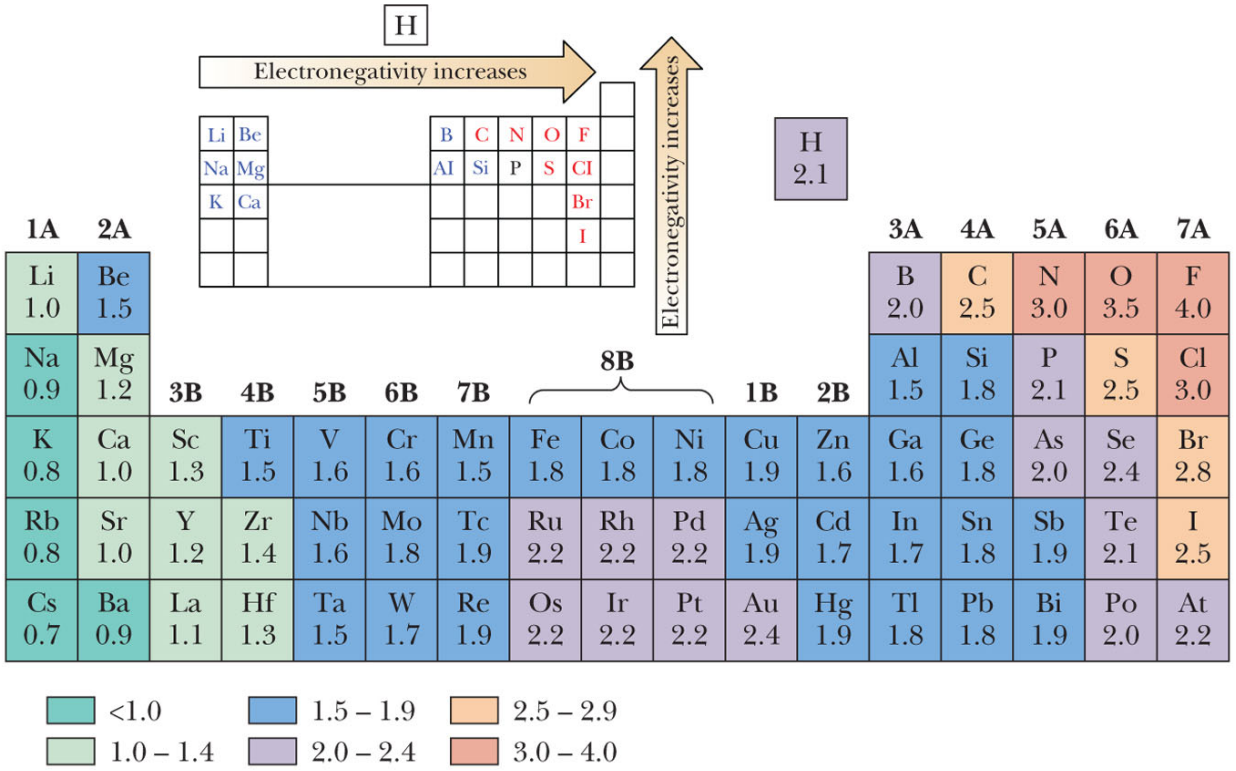

TABLE 2.2 pK_a Values for Some Organic and Inorganic Acids

the weaker the acid, the stronger is its conjugate base

the stronger the acid, the weaker is its conjugate base

	Acid	Formula	pK_a	Conjugate Base	
Weaker acid	ethane	CH_3CH_3	51	$CH_3CH_2^-$	Stronger base
	ammonia	NH_3	38	NH_2^-	
	ethanol	CH_3CH_2OH	15.9	$CH_3CH_2O^-$	
	water	H_2O	15.7	HO^-	
	methylammonium ion	$CH_3NH_3^+$	10.64	CH_3NH_2	
	bicarbonate ion	HCO_3^-	10.33	CO_3^{2-}	
	phenol	C_6H_5OH	9.95	$C_6H_5O^-$	
	ammonium ion	NH_4^+	9.24	NH_3	
	hydrogen cyanide	HCN	9.21	CN^-	
	carbonic acid	H_2CO_3	6.36	HCO_3^-	
	acetic acid	CH_3COOH	4.76	CH_3COO^-	
	benzoic acid	C_6H_5COOH	4.19	$C_6H_5COO^-$	
	phosphoric acid	H_3PO_4	2.1	$H_2PO_4^-$	
	hydronium ion	H_3O^+	−1.74	H_2O	
	sulfuric acid	H_2SO_4	−5.2	HSO_4^-	
Stronger acid	hydrogen chloride	HCl	−7	Cl^-	Weaker base
	hydrogen bromide	HBr	−8	Br^-	
	hydrogen iodide	HI	−9	I^-	

Grading: **Part A _____/75 points**

Part B_____/61 points

Total_____/136 points

Adjusted_____/150 points