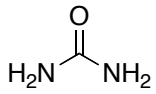
Organic Chemistry
CHM 223

Final Exam Review Questions

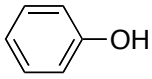
The structure of urea is shown below. The carbon atom in urea is:

a. sp^3 hybridized
b. sp^2 hybridized
c. *sp* hybridized
d. not hybridized



Draw two resonance structures for the species below. Of the three resonance contributors, circle which is the greater contributor to the overall structure.

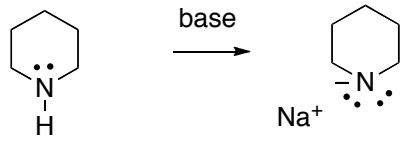
Refer to the following table to answer the following questions.

ACID	STRUCTURE	pKa
phenol		10.00
ethanol	CH_3CH_2-OH	16.00
water	HOH	15.74

a. Which acid above will be almost completely deprotonated by NaOH?

b. Which acid has the *strongest* conjugate base?

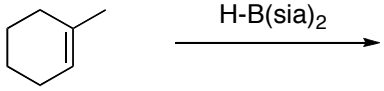
Refer to the pKa table at the end of this exam and suggest a base that would completely deprotonate the following cyclic amine, as shown below (don't forget about the counterion).



Draw the structure of (2*R*,3*S*)-dibromobutane. Make sure you make use of the appropriate wedges/dashes to indicate stererochemistry. Is this molecule optically active?

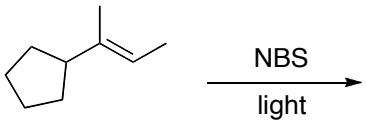
Draw a Newman projection of the most stable conformation of (2*R*,3*S*)-dibromobutane sighting down the C2-C3 bond.

PART I: Draw the product(s) of the reaction between 1-methylcyclohexene and diisoamylborane.



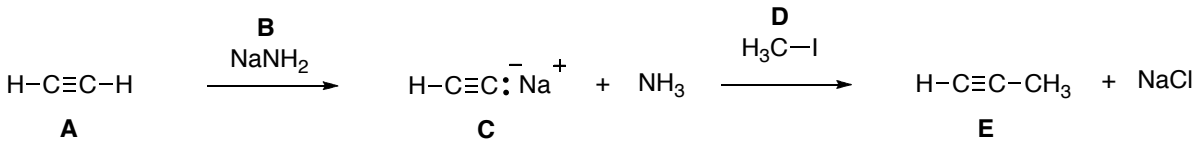
PART II: Draw the mechanism for the formation of your product(s). If there is more than one product that forms, support your claim by indicating which mechanistic route leads to which product.

Draw the six bromination products of the following material. Circle the *major* product.



Show how to prepare trans-2-octene from 1-heptene

Refer to the reaction below when answering the questions a and b:



a. For this reaction, which compound (enter the correct letter below) is acting as the:

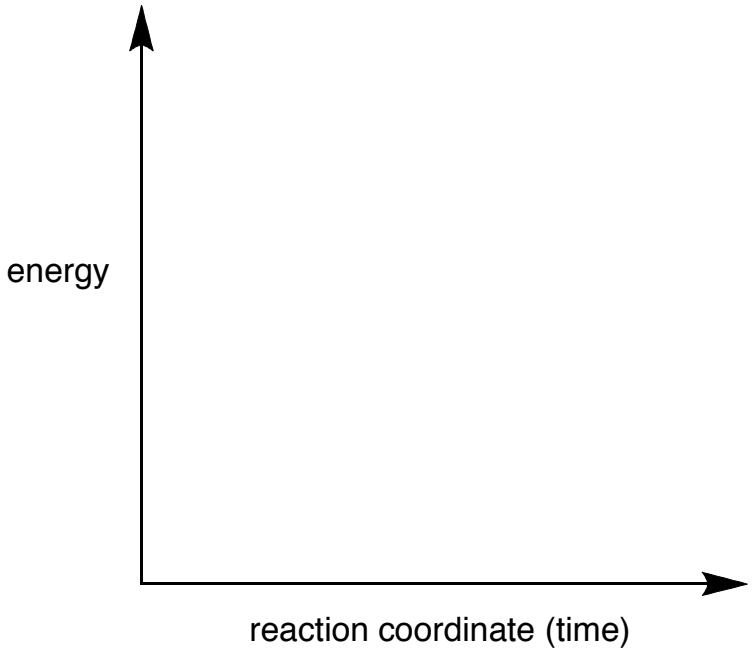
i. acid _____

ii. base _____

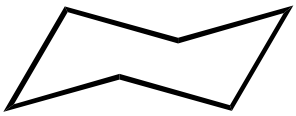
iii. nucleophile _____

iv. electrophile _____

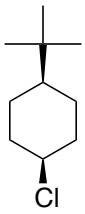
The conversion of **C** to **E** is an example of an SN_2 reaction (bimolecular substitution reaction). This type of mechanism is characterized by proceeding in a single concerted step, passing through a high-energy transition state (no isolatable intermediate). Given the assumption that this is an exergonic/exothermic reaction, draw a reaction energy diagram for the conversion of **C** to **E** within the axes below. . Make sure to label **C** and **E** on the diagram as well as the activation energy ($\Delta G^{\ddagger}$), transition state (‡), and reaction energy (ΔG).



Using the blank chair below, draw the conformation of 2,3-dimethyl-1-propylcyclohexane that has the least 1,3-diaxial strain energy.

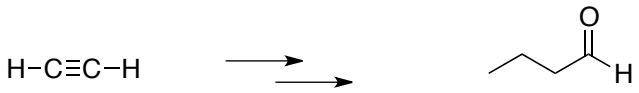


In it's most stable conformation, what are the orientation of the *tert*-butyl and chloro substituents, respectively, in the predominant conformation of the following compound? Choose from a through d, below.

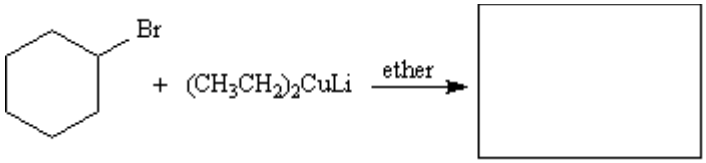


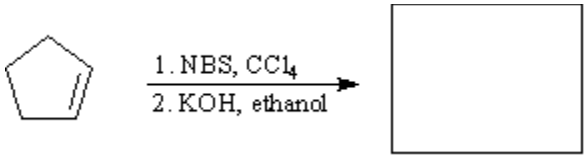
a. axial, axial
b. axial, equitorial
c. equitorial, axial
d. equitorial, equitorial

Starting with acetylene, propose a synthesis of 1-butanal (provide an ordered list of reagents).




NBS
CCl_4
+


Br
+ $(CH_3CH_2)_2CuLi$
ether


1. NBS, CCl_4
2. KOH, ethanol

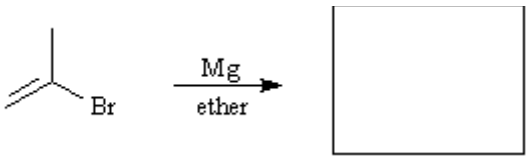

Mg
ether
Br

Table of Common pKa Values

	Acid	Formula	pK_a	Conjugate Base	
Weaker acid	Ethane	CH_3CH_3	51	$CH_3CH_2^-$	Stronger conjugate base
	Ethylene	$CH_2{=}CH_2$	44	$CH_2{=}CH^-$	
	Ammonia	NH_3	38	NH_2^-	
	Hydrogen	H_2	35	H^-	
	Acetylene	$HC{\equiv}CH$	25	$HC{\equiv}C^-$	
	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 sulfide	H_2S	7.04	HS^-	
	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^-	
	Hydrogen chloride	HCl	-7	Cl^-	Weaker conjugate base
Stronger acid	Hydrogen bromide	HBr	-8	Br^-	
	Hydrogen iodide	HI	-9	I^-	