Test #1 Summer 2011 Name: _____

Chemistry 303

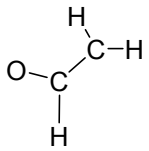
In putting my name on this test and turning it in I am certifying that it is my work alone.

1. Write the most stable Lewis structure for each of the following: (12pts)

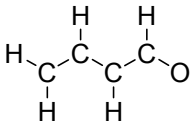
(a) $AlCl_3$

(b) CH_4O

(c) $C_2H_3O^{\oplus}$ *(skeletal structure provided below)*



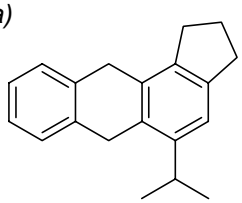
(d) $C_4H_5O^{\ominus}$ *(skeletal structure provided below)*



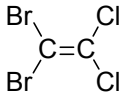
2. What is an "unsaturated" compound? (1pt)

3. Indicate whether each of the following molecules are polar or non-polar. (6pts)

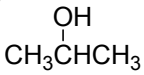
(a)



(b)

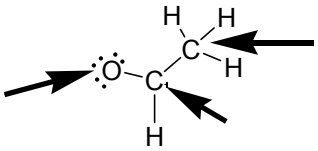


(c)

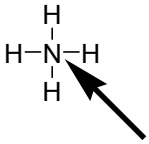


4. Calculate the formal charge on each carbon atom in the following Lewis structures: (8pts)

(a)

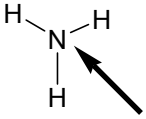


(b)

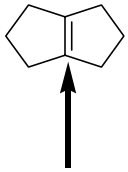


5. What is the hybridization (sp, sp^2, sp^3) at the atoms indicated in the following molecules? (8pts)

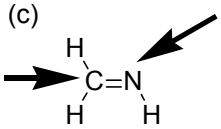
(a)



(b)

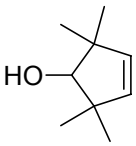


(c)

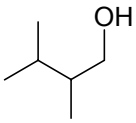


6. Classify the following alchols as primary, secondary, or tertiary. (6pts)

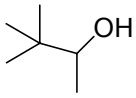
(a)



(b)

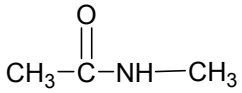


(c)

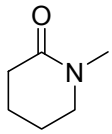


7. Classify the following amides as primary, secondary, or tertiary. (6pts)

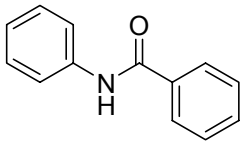
(a)



(b)

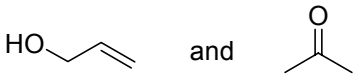


(c)

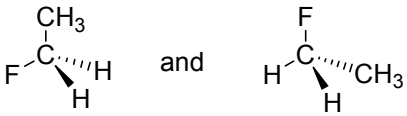


8. Consider each pair of structural formulas that follow and state whether the two formulas represent the same compound, constitutional isomers, stereoisomers, or different compounds that are not isomeric. (15pts)

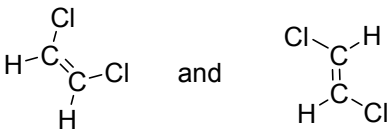
(a)



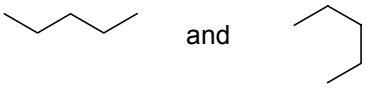
(b)



(c)



(d)

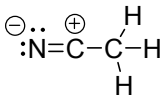


(e) condensed formulas

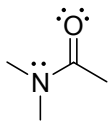
$CH_2BrCH_2CHBrCH_3$ and $CH_3CHBrCH_2CH_2Br$

9. Write the contributing resonance structures for each of the following: (12pts)

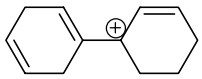
(a) (draw one resonance structure)



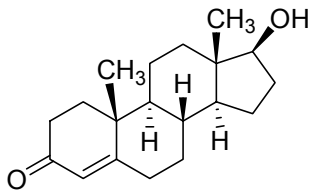
(b) (draw one resonance structure)



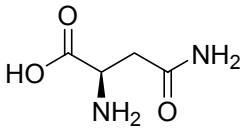
(c) (draw two resonance structures)



11. Circle and name all of the functional groups that are present in the following compounds: (12pts)



Testosterone



Asparagine

12. Draw a bond-line formula for the following: (6pts)

(a) $CH_3CHClCH_2CH(CH_3)_2$

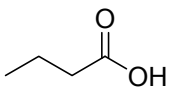
(b) $(CH_3)_2CH{=}CHCH_2CH_3$

(c) $CH_3OCH(CH_3)COOH$

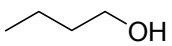
13. Draw three amines with the formula C_3H_9N (6pts)

14. Place the following molecules in order of increasing boiling points (lowest first). (2pts)

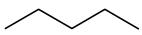
(a)



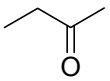
(b)



(c)

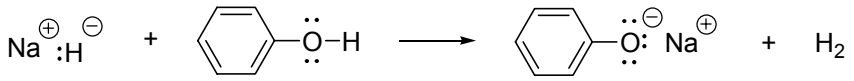


(d)



Test #2 Summer 2011 Name: _____(3pts)
Chemistry 303
In putting my name on this quiz and turning it in I am certifying that it is my work alone.

1. Draw the **mechanism** for the following acid-base reaction (in other words, supply the curved arrows that show the flow of electrons for the following reaction): (4pts)



2. Place the following compounds in order of increasing acidity (*least acidic first*): (4pts)

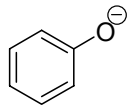
(a) $CH_3CH_2CH_3$

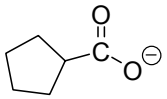
(b) $CH_3C(OH)(F)CH_3$

(c) $CH_3CH_2CH_2(NH_2)$

(d) $CH_3CH(OH)CH_2(F)$

3. Place the following compounds in order of increasing basicity (*least basic first*): (4pts)

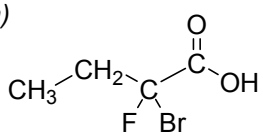
(a) 

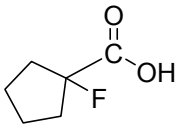
(b) 

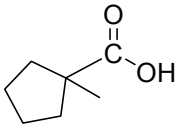
(c) $CH_3-C\equiv C:^{\ominus}$

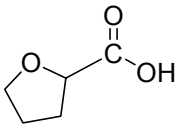
(d) $CH_3-CH(Br)-C(=O)O^{\ominus}$

4. Place the following carboxylic acids in order of increasing acidity (*least acidic first*): (4pts)

(a) 

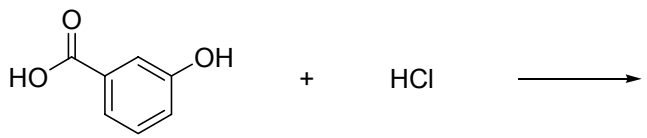
(b) 

(c) 

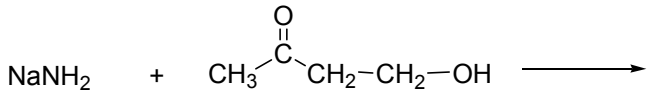
(d) 

5. Complete the following acid-base reactions: (20pts)

(a)

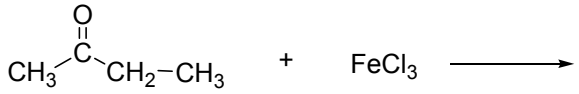


(b)



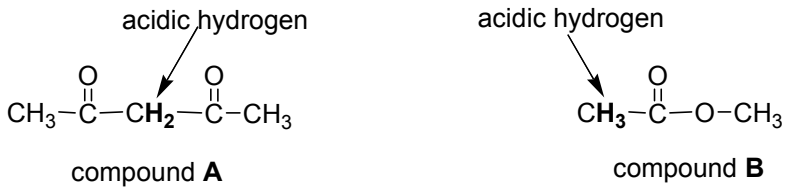
(c)

(d)

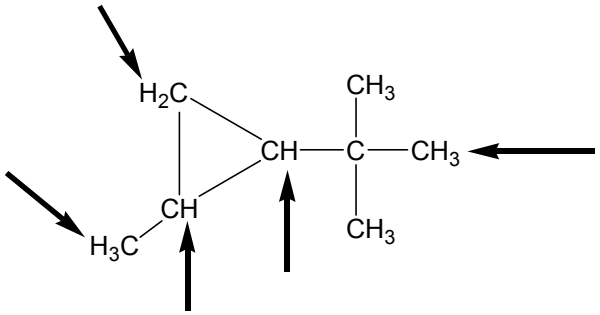


(e)

6. Briefly explain why compound **A** is more acidic than compound **B**. (4pts)

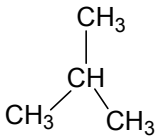


7. Classify the indicated hydrogen atoms in the following molecule as <u>primary</u> (1°), <u>secondary</u>(2°), or <u>tertiary</u>(3°). (5pts)

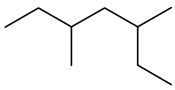


8. Give IUPAC names for the following alkanes: (12pts)

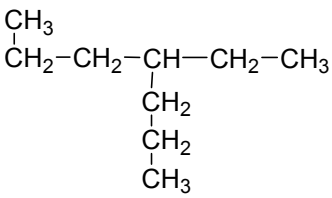
(*a*)



(*b*)

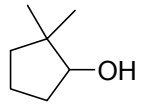


(*c*)

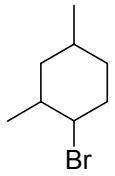


9. Give IUPAC names for the following molecules: (20pts)

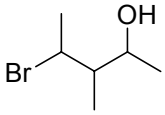
(a)



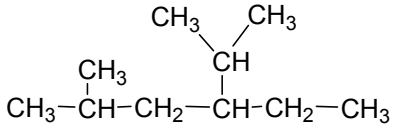
(b)



(c)



(d)



10. Draw structures for the following named compounds: (8pts)

(*a*) 1,3-dibromopentane

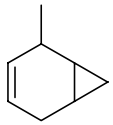
(*b*) 3-(2-bromoethyl)-2-heptanol

11. Match the following compounds with the corresponding IR spectrum. (12pts)

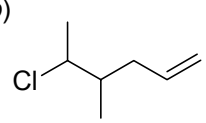
Test #3 Summer 2011 Name: _____(1pt)
Chemistry 303
In putting my name on this quiz and turning it in I am certifying that it is my work alone.

1. Give the IUPAC name for the following compounds: (3pts each)

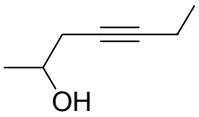
(*a*)



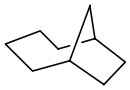
(*b*)



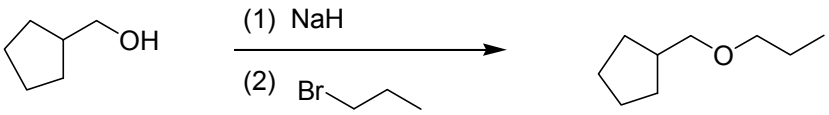
(*c*)



(*d*)



2. Using curved arrows, write the complete **mechanism** for the following two-step reaction: (show all steps involved) (4pts)



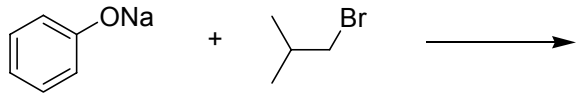
3. Draw the potential energy diagram for the bond rotation about the C1—C2 bond of propane. Also label the diagram with the appropriate Newman projections. (4pts)

4. (a) Draw the two possible chair conformations of ***cis*-2-iodocyclohexanol** (4pts)
   (b) Indicate which of these two conformations is more stable. (2pts)

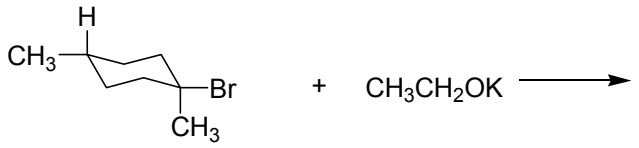
5. Calculate the Index of Hydrogen Deficiency for the molecular formula, C_6H_8O. (4pts)

6. Give structures for the major organic product(s) for each of the following reactions. Show stereochemistry where appropriate. (5pts each)

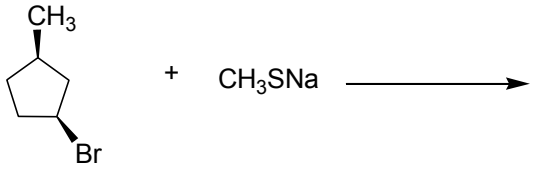
(*a*)



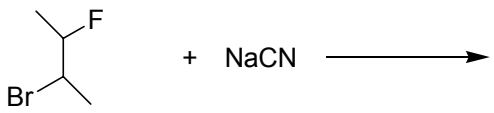
(*b*)



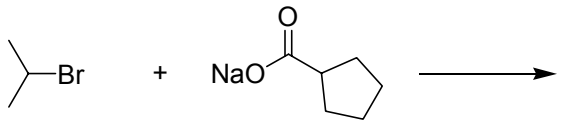
(*c*) show stereochemistry for product



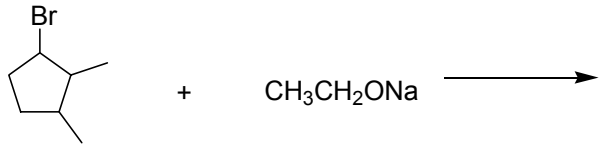
(*d*)



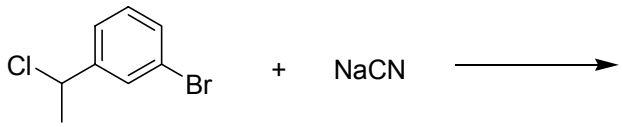
(*e*)



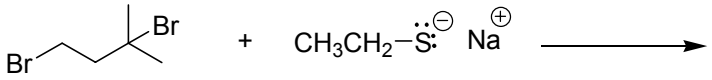
(f)



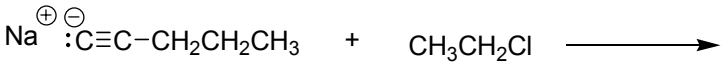
(*g*)



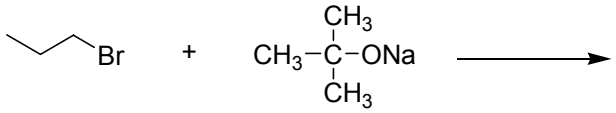
(*h*)


Br
Br
+
CH3CH2–S:
Na

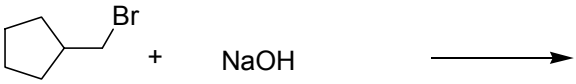
(i)


Na
:C≡C–CH2CH2CH3
+
CH3CH2Cl

(j)

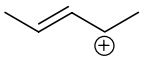

Br
+
CH3
CH3–C–ONa
CH3

(k)

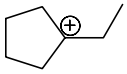

Br
+
NaOH

7. Place the following carbocations in order of increasing stability (least stable first): (4pts)

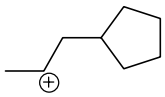
(a)



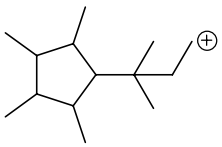
(b)



(c)



(d)



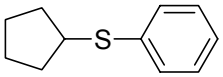
8. Place the following cyclic compounds in order of increasing stability (least stable first): (3pts)

(a)

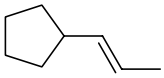
(b)

(c)

9. Using any reagents necessary, outline a synthesis of the following compound via S_N2 reaction: (4pts)



10. Starting with an alkyl halide and any other necessary reagents, outline a synthesis of the following compound via E2 reaction: (4pts)



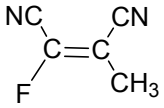
Test #4 Summer 2011 Name: _____

Chemistry 303

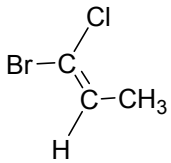
In putting my name on this quiz and turning it in I am certifying that it is my work alone.

1. Designate the following alkenes as an (**E**) or (**Z**) isomer: (2pts each)

(*a*)

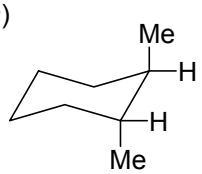


(*b*)

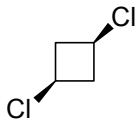


2. For the following molecules, indicate if they are <u>chiral</u> or <u>achiral</u>: (2pts each)

(*a*)



(*b*)

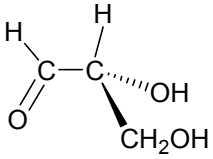


(*c*)

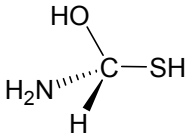
3-methyl-3-pentanol

3. Assign (*R*) or (*S*) designations to each of the following compounds: (2pts each)

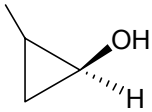
(*a*)



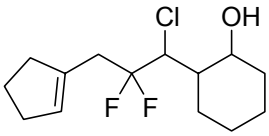
(*b*)



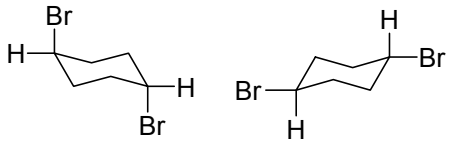
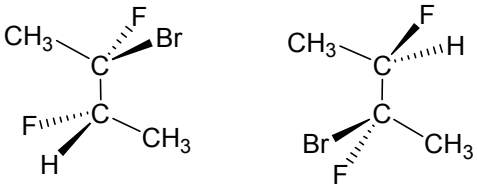
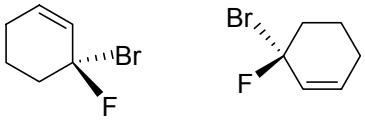
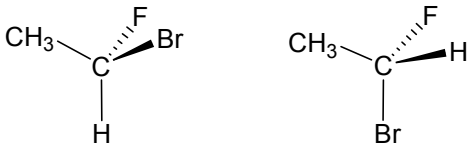
(*c*)



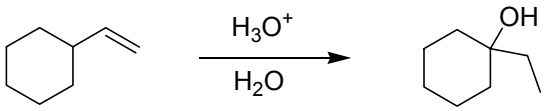
4. Calculate the maximum number of stereoisomers possible for the following molecule: (2 pts)



5. Circle the term that describes the relationship between the pairs of structures below. (2pts each)

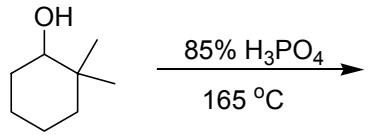
 same compound enantiomers diastereomers constitutional isomers	 same compound enantiomers diastereomers constitutional isomers
 same compound enantiomers diastereomers constitutional isomers	 same compound enantiomers diastereomers constitutional isomers

6. Using curved arrows, write a **mechanism** for the following reaction: (*show all steps*) (5pts)

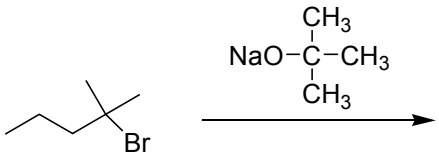


7. Give structures for the major organic product(s) for each of the following reactions. Show stereochemistry and regiochemistry where appropriate. (5pts each)

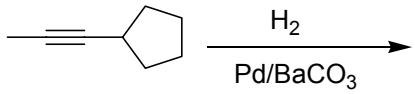
(*a*)



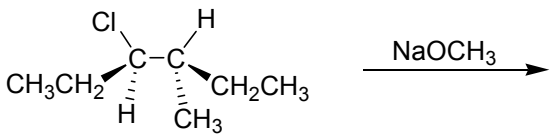
(*b*)



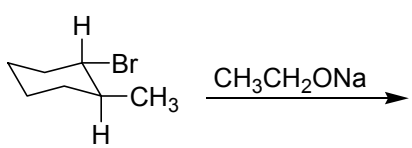
(*c*) (*show stereochemistry*)



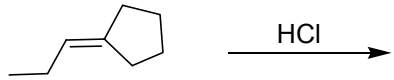
(*d*)


Cl
H
C
C
CH_3CH_2
CH_2CH_3
H
CH_3
$NaOCH_3$

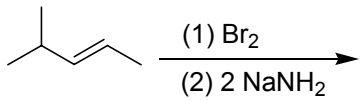
(*e*)


H
Br
CH_3
H
CH_3CH_2ONa

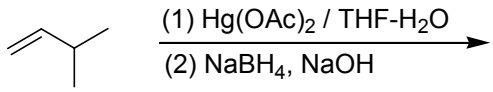
(*f*)


HCl

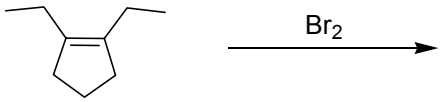
(*g*)


(1) Br_2
(2) 2 $NaNH_2$

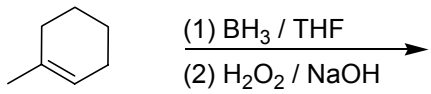
(*h*)



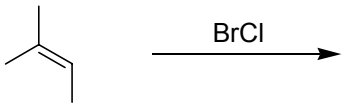
(*i*) (*show stereochemistry*)



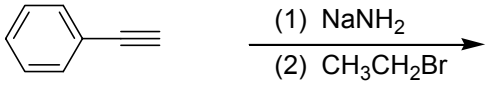
(*j*) (*show stereochemistry*)



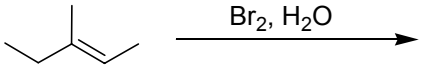
(*k*)



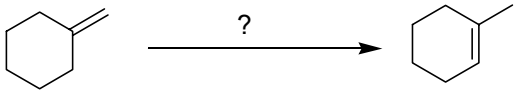
(*l*)



(*m*)



8. **<u>Synthesis</u>**. Give the reagent(s) necessary to accomplish the following transformation:
****Note--more than one step is needed**** (4pts)



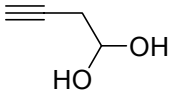
FINAL EXAM(**A**) Summer 2011 Name: _____

Chemistry 303 (**200 points**)

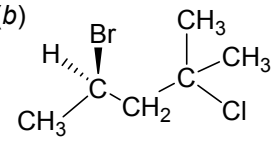
In putting my name on this exam and turning it in I am certifying that it is my work alone.

1. Give the IUPAC name for the following compounds: (5pts each)

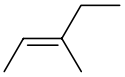
(*a*)



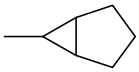
(*b*)



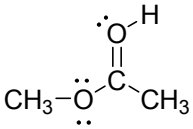
(*c*)



(d)

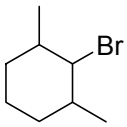


2. Calculate the formal charge on <u>each oxygen atom</u> in the structure given. (4 pts)



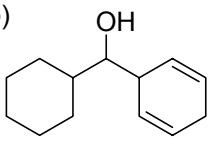
3. Classify each of the following functional groups as <u>primary</u>, <u>secondary</u>, or <u>tertiary</u>. (2pt each)

(a)



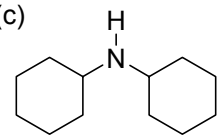
(an alkyl halide)

(b)



(an alcohol)

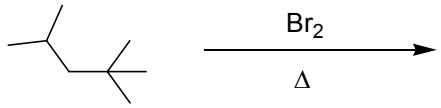
(c)



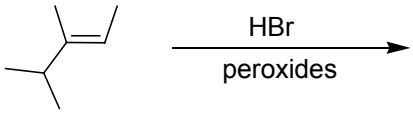
(an amine)

4. **REACTIONS**. Give the major organic product(s) for the following reactions: (112pts; 7pts each)

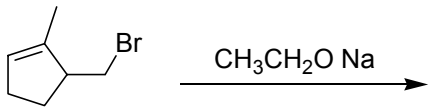
(*a*)



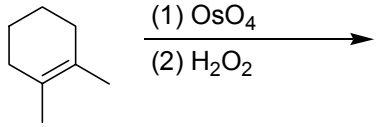
(*b*)



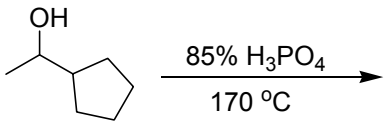
(*c*)



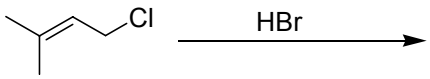
(*d*) (*show stereochem.*)



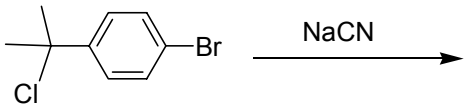
(*e*)


OH
85% H_3PO_4
170 ^oC

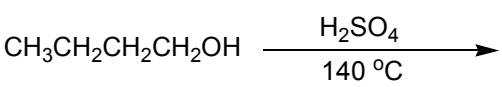
(*f*)


Cl
HBr

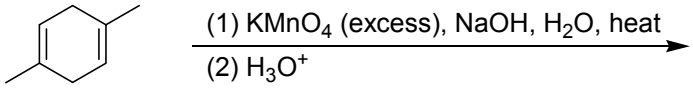
(*g*)


Br
Cl
NaCN

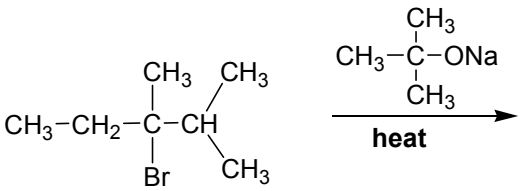
(*h*)


$CH_3CH_2CH_2CH_2OH$
H_2SO_4
140 ^oC

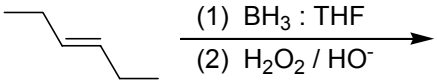
(*i*)



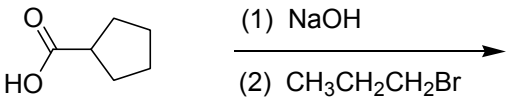
(*j*)



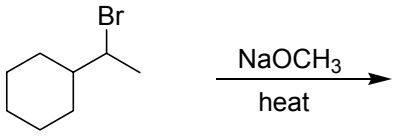
(*k*) (*show sterochem.*)



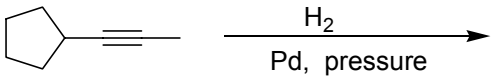
(*l*)



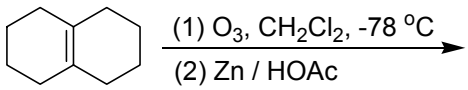
(*m*)


Br
NaOCH3
heat

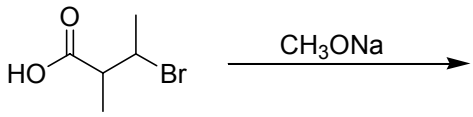
(*n*)


H2
Pd, pressure

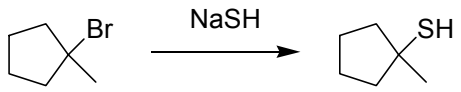
(*o*)


(1) O3, CH2Cl2, -78 °C
(2) Zn / HOAc

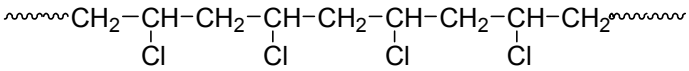
(*p*)


O
HO
Br
CH3ONa

5. Using curved arrows, draw the complete **mechanism** for the following substitution reaction (show all steps involved): (8pts)



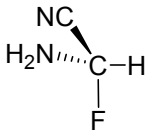
6. **Synthesis**. Give the alkene needed to make the following polymer: (4pts)



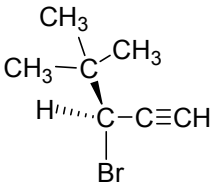
polyvinyl chloride (PVC; used to make water pipes)

7. Assign (*R*) or (*S*) designations to each of the following compounds: (4pts each)

(*a*)

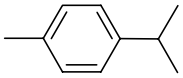


(*b*)

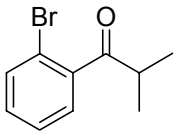


8. How many **carbon** peaks would you expect to see in the ^{13}C NMR spectra for each of the following molecules: (4pts each)

(a)

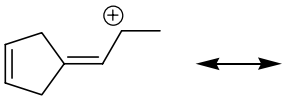


(b)



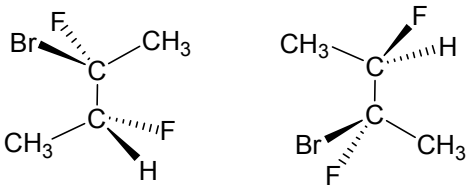
9. Draw all major contributing resonance structures for each of the following: (12pts)

(*a*)



(*b*)

10. Circle the term that describes the relationship between the pairs of structures below. (4pts each)

	
same compound	same compound
enantiomers	enantiomers
diastereomers	diastereomers
constitutional isomers	constitutional isomers

12. Determine the structure of the following unknown compound based on its molecular formula and its IR and ^{1}H NMR spectra. (5pts)

13. Determine the structure of the following unknown compound based on its molecular formula and its ^{1}H NMR spectrum. (5pts)