# Scratch paper

Do not write any answers you wish to be graded on this page

CAS CH 203 Organic Chemistry I
Exam 1 7 October 2010, 8:00 A.M.–9:20 A.M.

Name _____

ID Number _____

**Instructions**

(A) Make sure you have XX pages with XX questions.

(B) Write all answers on the pages provided.

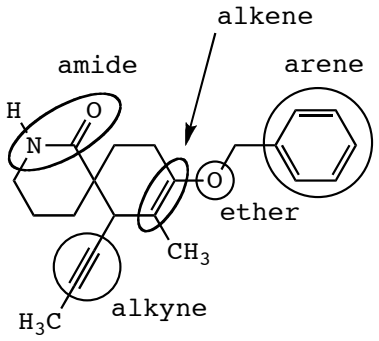
(C) Only answers written in ink will be considered for regrading.

(D) Good luck!

| **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** |
|---|---|---|---|---|---|---|---|
| H | | | | | | | He |
| Li | Be | B | C | N | O | F | Ne |
| Na | Mg | Al | Si | P | S | Cl | Ar |
| K | Ca | Ga | Ge | As | Se | Br | Kr |
| Rb | Sr | In | Sn | Sb | Te | I | Xe |

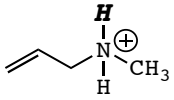
| **Page** | **Score** |
|---|---|
| 1 | /18 |
| 2 | /18 |
| 3 | /32 |
| 4 | /24 |
| 5 | /08 |
| | |
| **Total** | /100 |

**(1)** Circle and name the functional groups in this molecule. (10 points)

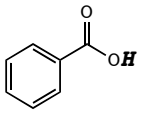



**(2)** Use the data in the table to answer the following questions.

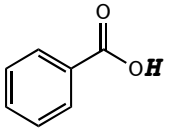
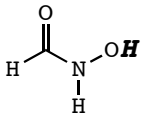
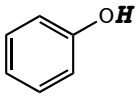
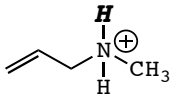
**(a)** Which compound has the strongest conjugate base? (2 points)

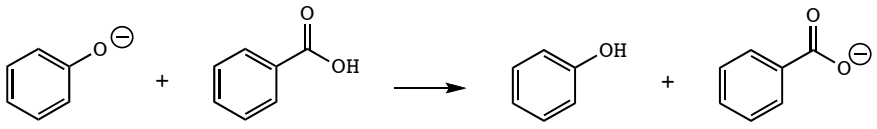


**(b)** Which compound is most extensively deprotonated by the strong base NaOH? (2 points)

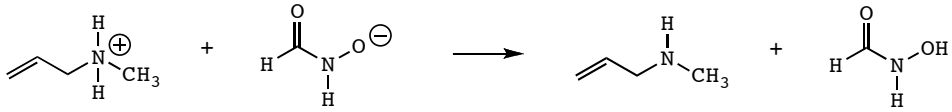


**(c)** Predict the products of these acid–base reactions and, by checking the appropriate box, indicate whether each reaction is or is not thermodynamically favorable. (4 points)

| **Compound** | **p$K_a$ of proton *in bold type*** |
|---|---|
|  | 4.2 |
|  | 8.6 |
|  | 9.9 |
|  | 10.1 |

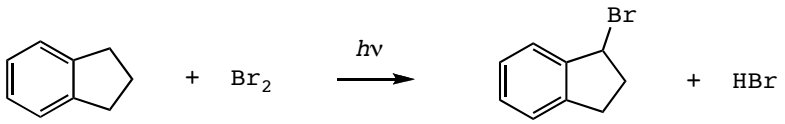


__**x**__ favorable _____ not favorable

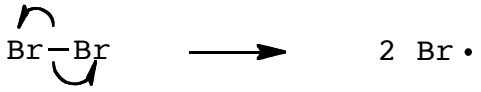


_____ favorable __**x**__ not favorable

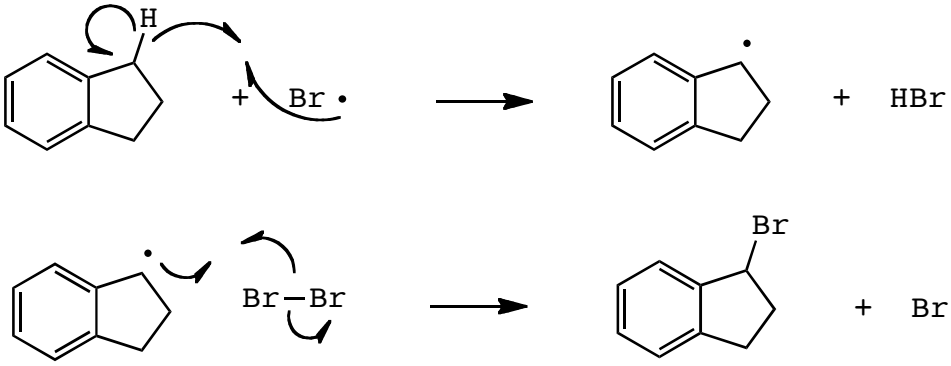
**(3)** The reaction shown below takes place by a radical mechanism. In the spaces provided present the mechanism, writing initiation, propagation, and termination steps. (18 points)



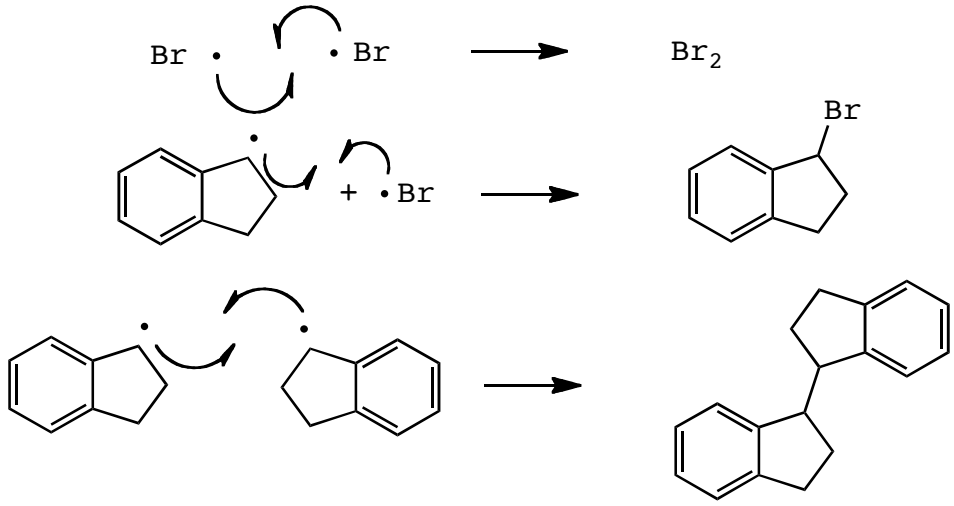

Initiation



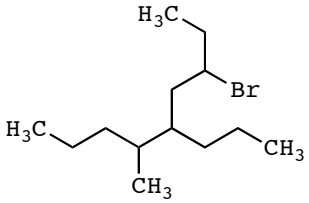

Propagation



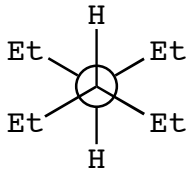

Termination



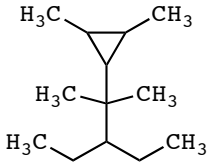
**(4)** Write the systematic name of these compounds. (12 points)

**(a)** 

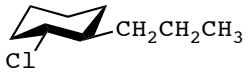
**3-bromo-6-methyl-5-propylnonane**

**(b)** 

**3,4-diethylhexane**

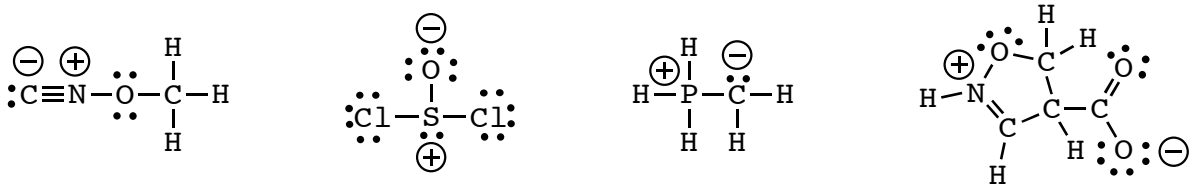
**(c)** 

**2-(2,3-dimethylcyclopropyl)-3-ethyl-2-methylpentane**

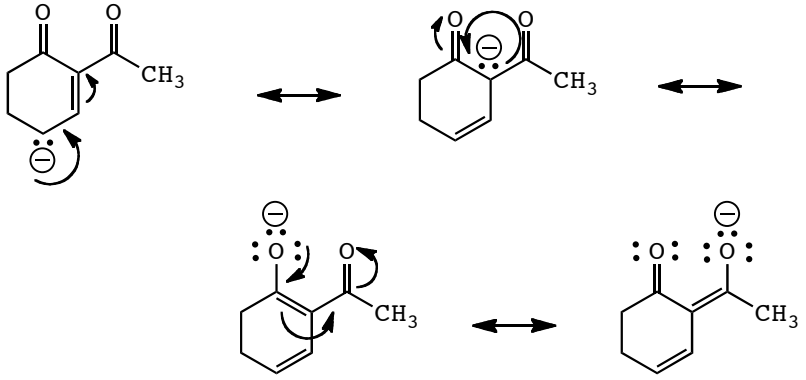
**(d)** 

***trans*-1-chloro-2-propylcyclohexane**

**(5)** All of the atoms in these molecules have an octet of valence electrons, except the hydrogens, which all have a duet of valence electrons: unshared electron pairs have not been shown. Write the formal charge on the atoms that require them. (8 points)



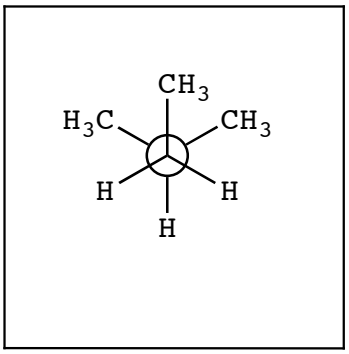
**(6)** Write three additional resonance structures of the ion shown below. (12 points)



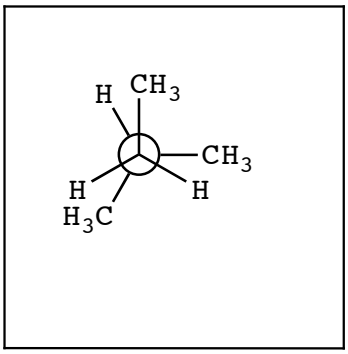
**(7)** In the appropriate box draw a Newman projection showing
**(a)** the **least stable** staggered (4 points)
**(b)** the **most stable** eclipsed (4 points)
conformation of 2-methylbutane with respect to rotation about the C2–C3 bond.
**(c)** Using data in the table calculate the strain energy ($E_{strain}$) of both conformations; write your answers in the space provided. (6 points)

| **Interaction** | ***E*<sub>strain</sub> [kcal/mol]** |
|---|---|
| H,H eclipse | 1.0 |
| $CH_3$,H eclipse | 1.4 |
| $CH_3$,$CH_3$ eclipse | 2.6 |
| $CH_3$,$CH_3$ *gauche* | 0.9 |

least stable staggered




most stable eclipsed

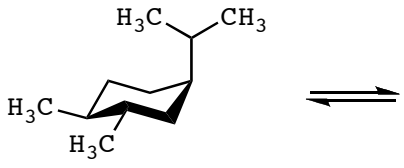


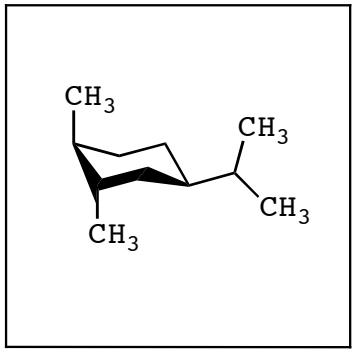

$E_{strain}$ = **1.8** kcal/mol

$E_{strain}$ = **4.2** kcal/mol

**(8)** The chair conformation shown below is in equilibrium with a second chair.
**(a)** In the box provided draw the second chair. (4 points)
**(b)** Using data in the table calculate the strain energy ($E_{strain}$) of both chairs; write your answers in the space provided. (6 points)

| **Interaction** | ***E*<sub>strain</sub> [kcal/mol]** |
|---|---|
| $CH_3$,$CH_3$ *gauche* | 0.9 |
| $CH_3$,H 1,3-diaxial | 0.9 |
| $CH(CH_3)_2$,H 1,3-diaxial | 1.1 |




$E_{strain}$ = **3.1** kcal/mol

$E_{strain}$ = **3.6** kcal/mol

**(9)** Draw a three-dimensionally accurate picture of the bonding sigma ($\sigma$) molecular orbitals, bonding pi ($\pi$) molecular orbitals, and non-bonding atomic orbitals of 2-iminoacetaldehyde (shown below). Place a pair of dots in the appropriate orbitals in which unshared pairs of electron reside. (8 points)

HN=CH-CHO
2-iminoacetaldehyde