

**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

**Chemistry Department**



**CHEM 201: Organic Chemistry I (Term 141)**

**Major Exam # 1**

Sunday, October 19, 2014

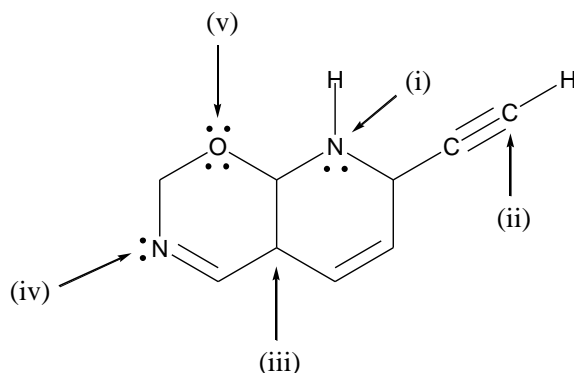
**Duration: 120 minutes**

Dr. Abdullah J. Hamdan (Sec. 1)  
Dr. Mohammad R. Imam (Sec. 2)  
Dr. Othman Al Hamouz (Sec. 3)  
Dr. M. Nahid Siddiqui (Sec. 5)

NAME \_\_\_\_\_ ANSWER KEY \_\_\_\_\_ ID \_\_\_\_\_ SEC. \_\_\_\_\_

Question	Value	Score
1 - 5	35	
6 - 10	40	
11 - 15	25	
Total	100	

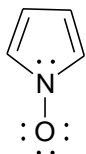
<sup>1</sup> H							<sup>2</sup> He
<sup>3</sup> Li	<sup>4</sup> Be	<sup>5</sup> B	<sup>6</sup> C	<sup>7</sup> N	<sup>8</sup> O	<sup>9</sup> F	<sup>10</sup> Ne
<sup>11</sup> Na	<sup>12</sup> Mg	<sup>13</sup> Al	<sup>14</sup> Si	<sup>15</sup> P	<sup>16</sup> S	<sup>17</sup> Cl	<sup>18</sup> Ar
						<sup>35</sup> Br	
						<sup>53</sup> I	

**(12 Points)****Q1.** Consider the following structure and answer to the questions below.**(a)** Identify the *hybridization* of the indicated atoms:

Hybridization	(i)	(ii)	(iii)	(iv)	(v)
	$sp^3$	$sp$	$sp^3$	$sp^2$	$sp^3$

**(b)** Specify the approximate *bond angles* around the indicated atoms:

Bond angle (approximate)	(i)	(ii)	(iii)	(iv)	(v)
	$109.5^\circ$	$180^\circ$	$109.5^\circ$	$120^\circ$	$109.5^\circ$

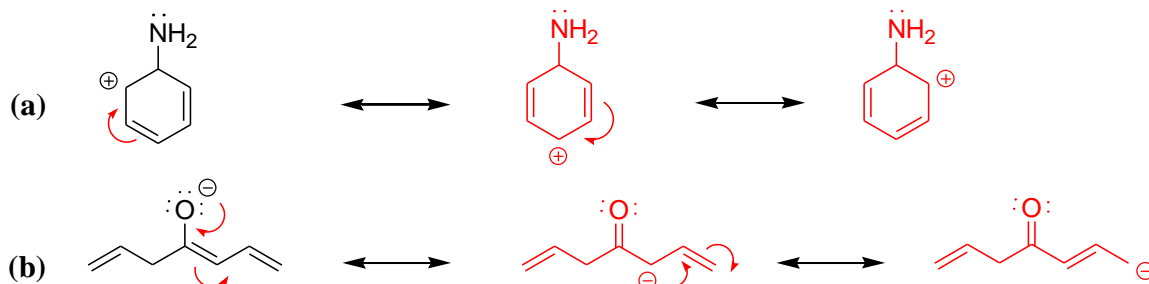
**(c)** The total number of  $\pi$  bonds in the molecule is 4.**(2 + 4 points)****Q2.****(A)** Draw an electron-dot structure (*Lewis structure*) for the following molecule.**(B)** Calculate **formal charges** for the nitrogen (N) and oxygen (O) atoms in the following molecule.

Formal charge for N =  $5 - 1/2 \times 6 - 2 = 0$

Formal charge for O =  $6 - 1/2 \times 2 - 6 = -1$

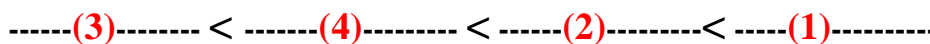
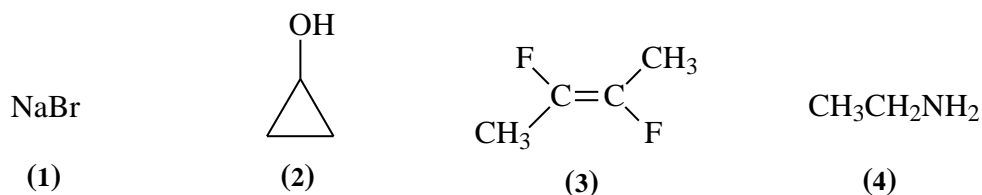
(8 points)

Q3. Draw **two** important **resonance** forms for each of the following structures. Use curved arrows to indicate the electron movement.



(4 points)

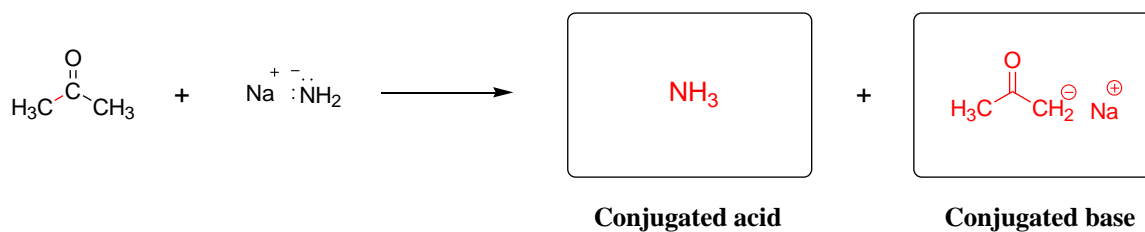
Q4. Arrange the following compounds in order of **increasing polarity** (least polar first).



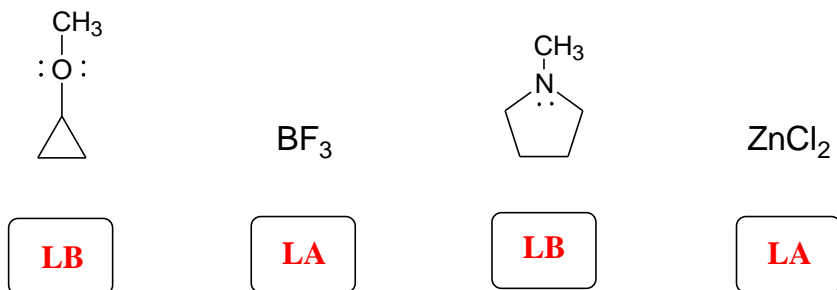
(3 + 2 points)

Q5.

(A) Complete the following acid-base reaction and identify the conjugated acid and the conjugated base in the reaction. ( $pK_a$  of  $\text{NH}_3 = 36$ ,  $pK_a$  of  $\text{CH}_3\text{COCH}_3 = 19$ ).

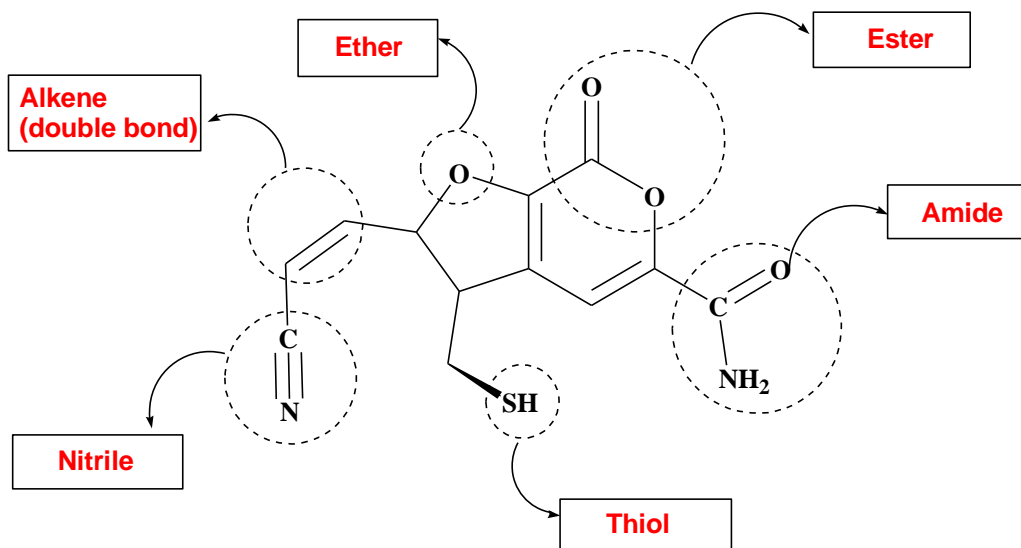


(B) Identify the **Lewis acid (LA)** and the **Lewis base (LB)** in the following series of compounds.



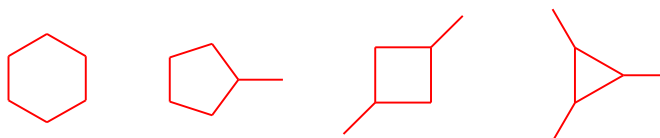
(6 points)

Q6. Write the name of the following **circled** functional groups:



(4 points)

Q7. Draw **four (4) cyclic constitutional isomers** of molecular formula  $\text{C}_6\text{H}_{12}$ .

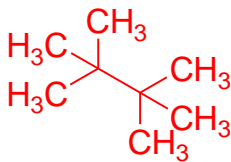


*(there are other possibilities)*

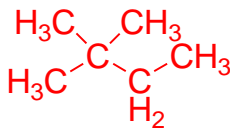
(2 + 2 points)

**Q8.** Draw the structure of alkane that meets the following descriptions:

(A) An alkane with six **primary** ( $1^0$ ) carbons and has the molecular formula of  $C_8H_{18}$ .



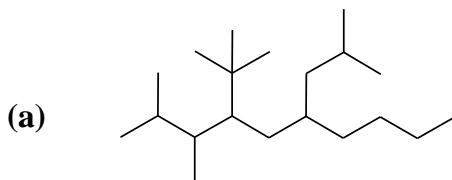
(B) An alkane with at least one **quaternary carbon** ( $4^0$ ) and one **secondary carbon** ( $2^0$ ) and has the molecular formula of  $C_6H_{14}$ .



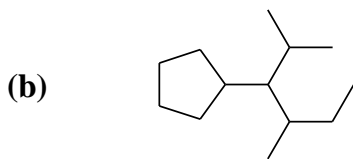
(6 + 6 points)

**Q9.**

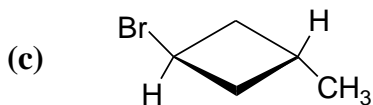
(A) Provide the **IUPAC** names for the following organic structures.



4-*tert*-Butyl-6-isobutyl-2,3-dimethyl-decane



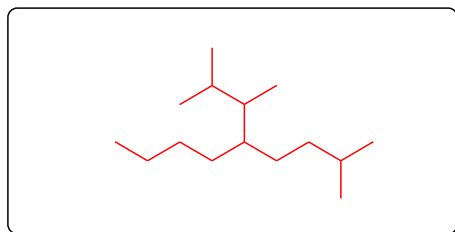
3-Cyclopentyl-2,4-dimethylhexane



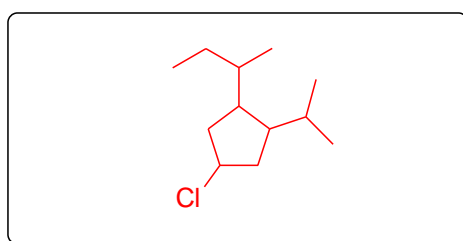
*trans*-1-Bromo-3-methyl-cyclobutane

(B) Draw the **correct** structure for each of the following names.

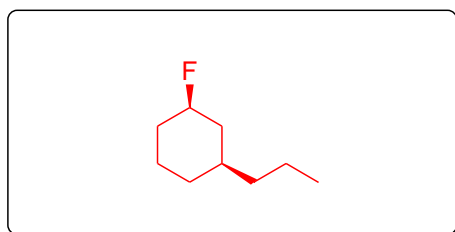
(a) 5-(1,2-Dimethylpropyl)-2-methylnonane.



(b) 1-*sec*-Butyl-4-chloro-2-isopropyl-cyclopentane.



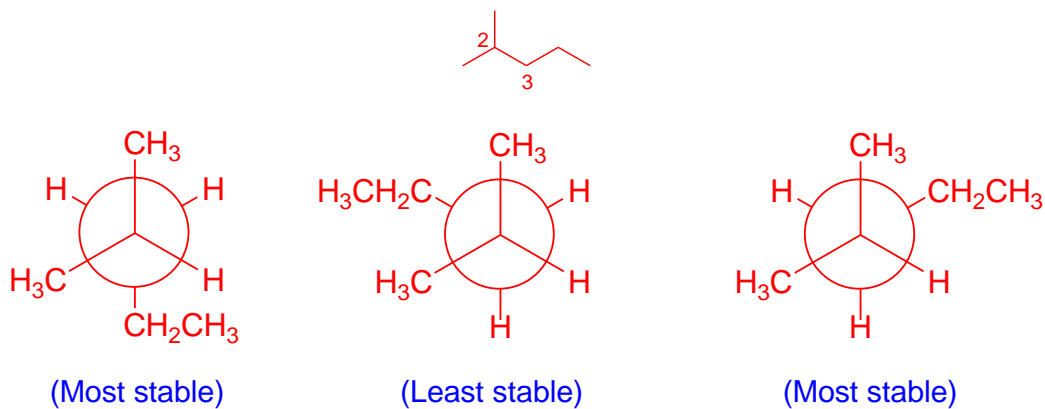
(c) *cis*-1-Fluoro-3-propyl-cyclohexane.



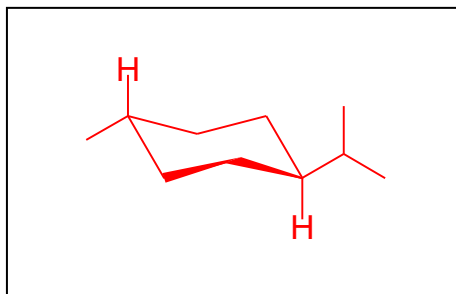
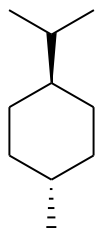
(8 + 3 + 3 points)

Q10.

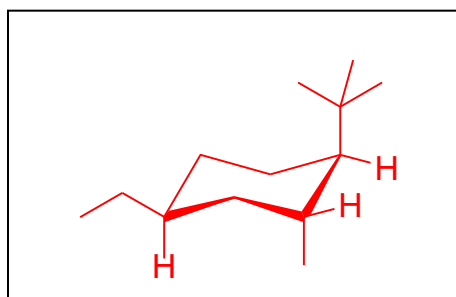
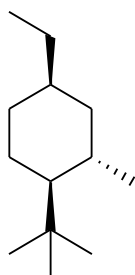
(A) Draw Newman projections for **three** possible **staggered** conformations around the C2-C3 bond in 2-methylpentane ( $C_6H_{14}$ ). Label the **most stable** and **least stable** staggered conformations.



(B) Draw the **most stable** chair conformation for the following compound.

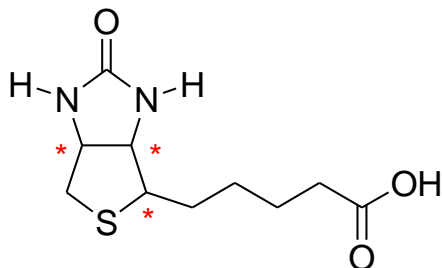


(C) Draw the **least stable** chair conformation for the following compound.



(3 points)

Q11. The following compound *Biotin* (*Vitamin H*) is an important coenzyme involved in the synthesis of body fatty acids. How many chirality centers does this molecule have? Place **asterisks** (\*) at all the chirality centers in the molecule shown below.

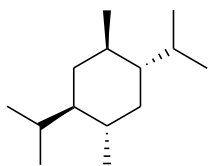


No. of chirality centers

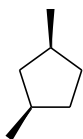
3

(4 points)

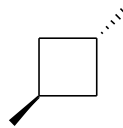
Q12. Identify the following compounds as **Chiral** or **Achiral**.



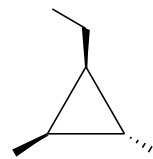
Chiral



Achiral



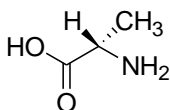
Achiral



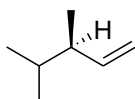
Chiral

(8 points)

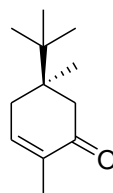
Q13. Assign (*R*) or (*S*) configurations to the chirality centers in the following molecules:



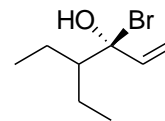
(*S*)



(*R*)



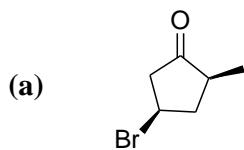
(*R*)



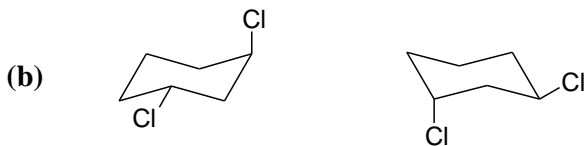
(*S*)

(3 points)

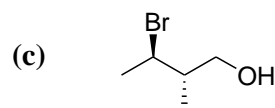
Q14. Identify each of the following pairs as **enantiomers**, **diastereomers** or **identical** compounds.



Diastereomers



Identical



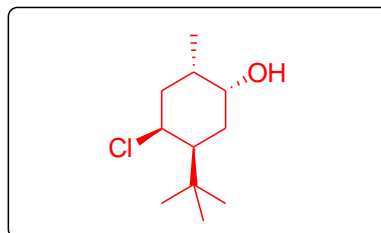
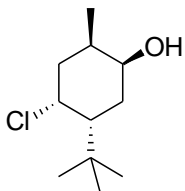
Enantiomers



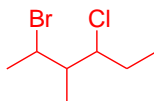
(2+ 3 + 2 points)

Q15.

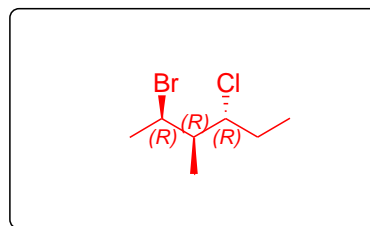
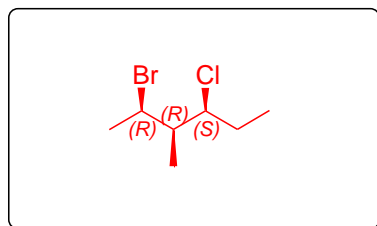
(A) Draw the structure of an **enantiomer** of the following compound.



(B) Draw a pair **diastereomers** of 2-bromo-4-chloro-3-methylhexane ( $C_7H_{14}BrCl$ ). Take particular attention to indicate **three dimensional** structures.



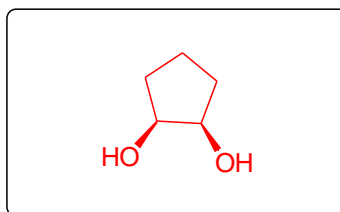
2-Bromo-4-chloro-3-methyl-hexane



Diastereomers

*(there are other possibilities)*

(C) Draw a **meso** structure of a **cyclic** compound with molecular formula  $C_5H_{10}O_2$ . (Show tetrahedral representation of all the chirality centers).



*(there are other possibilities)*