

NAME (PRINT CLEARLY) _____

I am on my honor that I will not discuss the contents of this exam with anyone until after 6:00 pm on Monday, September 30, and will notify Dr. Brush if I am made aware of any cases of academic dishonesty.

I understand and agree to these conditions (signature) _____

CHEM 243 ORGANIC CHEMISTRY I
Exam I (version-1), Friday, September 27, 2024

Answer all questions in the space provided, continuing on the back if necessary. **Read each question carefully and be sure to answer all parts to each question!** This exam is worth a total of 150 points.

Exams will be returned within one week. An answer key to this exam will be linked to the course web page.

(37) 1. _____

(9) 2. _____

(20) 3. _____

(10) 4. _____

(10) 5. _____

(47) 6. _____

Sub-total = _____ (133) x 1.128 =

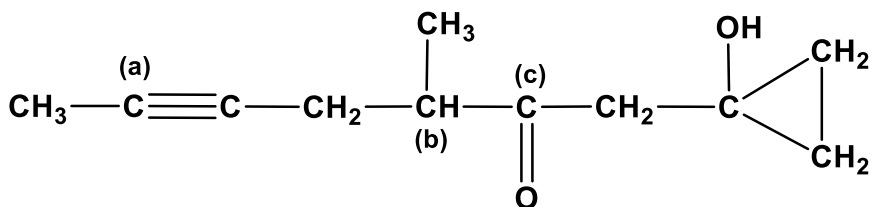
Total Points _____ (150) = _____ %

Total Worksheet Points to date _____ = _____ %

IF YOU DO NOT UNDERSTAND A QUESTION, PLEASE ASK FOR AN EXPLANATION!

1. (37 Points) Answer the following questions as indicated.

(a) Answer the following questions for the compound drawn at the right:



(i) What is the **Hybridization and Geometry** for atoms labeled (a) – (c):

(a) _____ and _____

(b) _____ and _____

(c) _____ and _____

(ii) Indicate the number of: 1° carbons _____ 2° carbons _____ 3° carbons _____

(iii) For the structure drawn above:

How many pi bonds are there? _____

How many rings are there? _____

Based only on pi bonds and rings, what is the Hydrogen Deficiency? _____

(iv) Based on the functional groups in the compound above, which of the following IR bands might be present (**circle**):

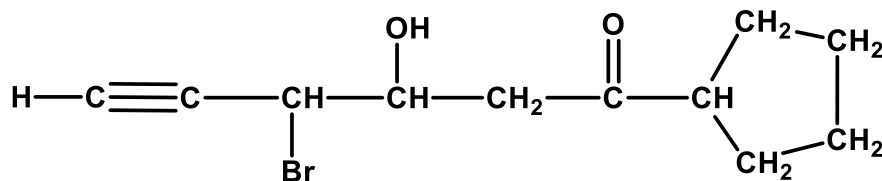
1700

2100

3300

3200-3600

(b) In the molecule drawn below, which of the following functional groups are present? **Circle your choice(s)**.



alkene

internal alkyne

terminal alkyne

cycloalkyl (ring)

alcohol

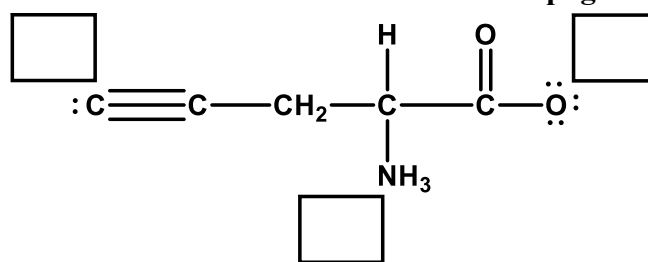
halogen (alkyl halide)

ether

carbonyl

amine

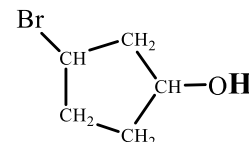
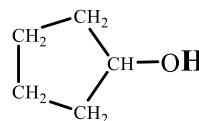
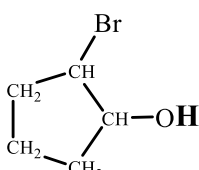
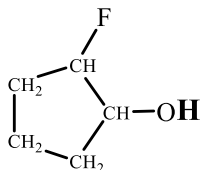
(c) For the compound drawn at the right, write the **Formal Charge** in the boxes for the indicated atoms (0 or -1 or +1). All necessary electron lone pairs are drawn.



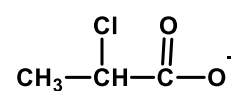
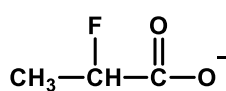
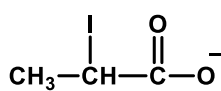
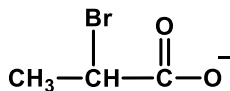
(d) Rank the following molecules in order of increasing acidity (1 = weakest.....4 = strongest).



(e) Rank the following molecules in order of increasing acidity (1 = weakest.....4 = strongest). The acid proton is in **bold** print.

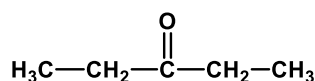


(f) Rank the following molecules in order of **base strength** (1 = weakest.....4 = strongest).

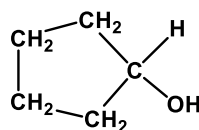


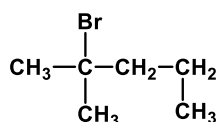
2. (9 Points) Comparing Organic Structures. Are the following pairs of compounds:

Identical or Different or Constitutional Isomers

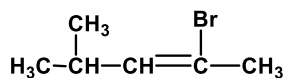


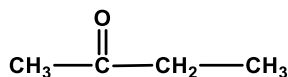
and



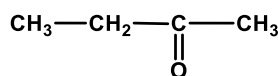


and

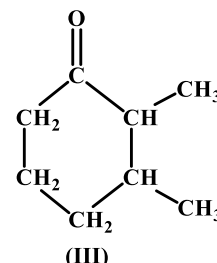
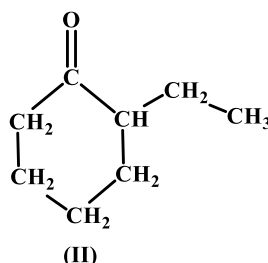
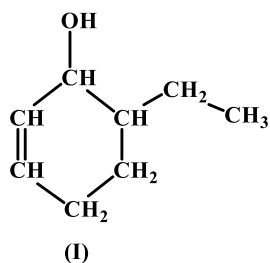




and



3. (20 Points) Organic Structure Identification. An unknown organic compound with a formula of $C_8H_{14}O$ is thought to be one of the three molecules drawn below (I, II, or III):



(a) Calculate the Hydrogen Deficiency (HD) for this unknown ($C_8H_{14}O$): _____

(b) Based on the **HD and Formula**, what type(s) of functional groups might be present? **CIRCLE all possibilities from the list below:**

alkene
(C=C double bond)

carbonyl
(C=O double bond)

alkyne
(C≡C triple bond)

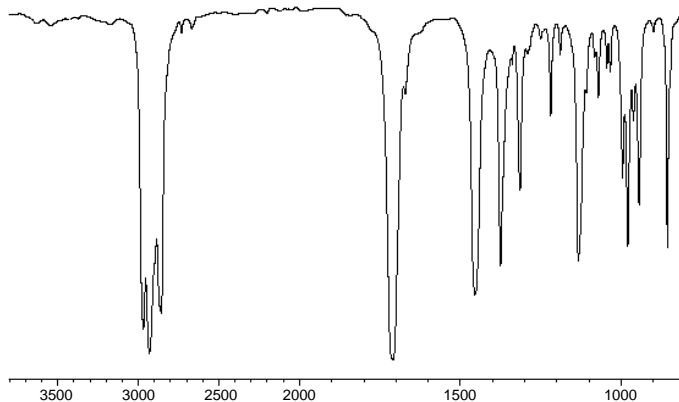
alcohol
(R-OH)

ether
(R-O-R)

cycloalkyl
(C atoms form a ring)

(c) Based on the information in (a) and (b), the unknown could be: (I) (II) (III) (circle all that apply)

(d) The IR spectrum for this unknown is given below. Place an "X" for each functional group consistent with the IR data:



_____ alcohol _____ terminal alkyne

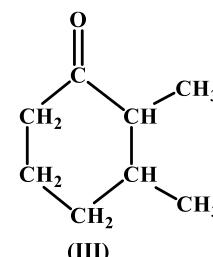
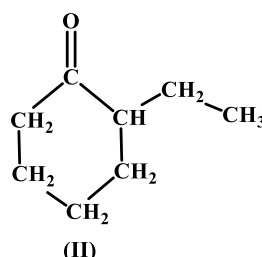
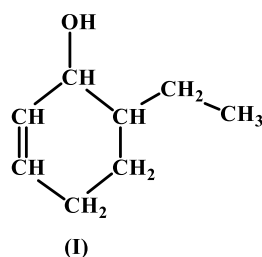
_____ internal alkyne _____ carbonyl

_____ none of these

If "none of these", is there a hidden functional group? HINT: Look at your answer to (b).

(e) Based on all the information above, the unknown could be: (I) (II) (III) (circle all that apply)

(f) The unknown has **one 1° carbon, five 2° carbons, and one 3° carbon**. Based on all the information above, identify the unknown by circling **ONE** structure at the right:



4. (10 Points) Basic Calculations (use correct significant figures and units).

The compound in problem #4 ($C_8H_{14}O$) has a molecular mass of: **126.2 g/mole**

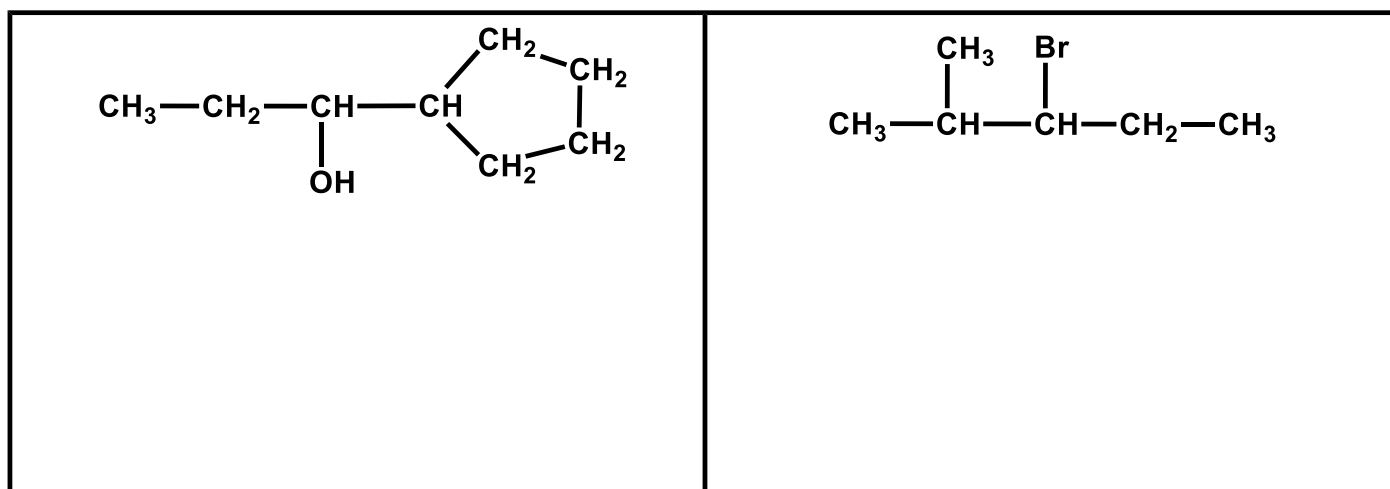
(a) If you had 0.2215 grams of this compound, how many moles would you have? _____

(b) You accidentally spilled this compound on the lab bench. You used a spatula to recover as much as possible. After re-weighing, you now have 0.1981 g.

Calculate your % Recovery _____

You MUST show your work in the space below:

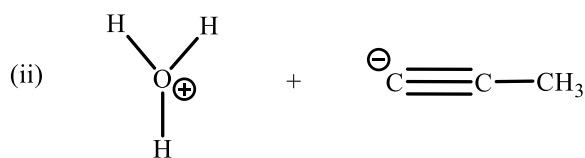
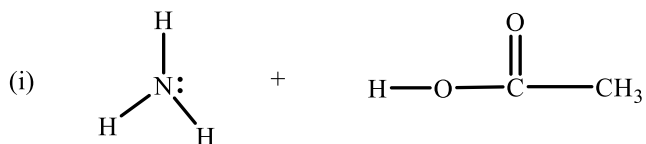
5. (10 Points) “Zig-Zag” structures. Re-draw each of the following compounds as “zig-zag” structures.



6. (47 Points) Acid/Base Questions.

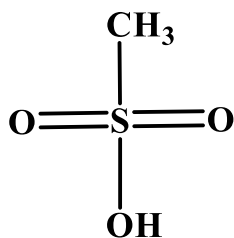
(a) **Acid/Base Reactions and Mechanisms.** Illustrate the complete mechanism for each of the acid-base reactions shown below. You must complete each of the following exercises:

- Label the Acid (A) and Base (B) on the reactant side of the equation;
- Use curved arrows to indicate the flow of electrons;
- Draw the products of the reaction, and make sure that the equation is balanced;
- Label the Conjugate Acid (CA) and Conjugate Base (CB);
- Assigning approximate pKa values to the reactant acid and product conjugate acid;
- Drawing equilibrium arrows that **clearly show** in which direction the reaction is favored.

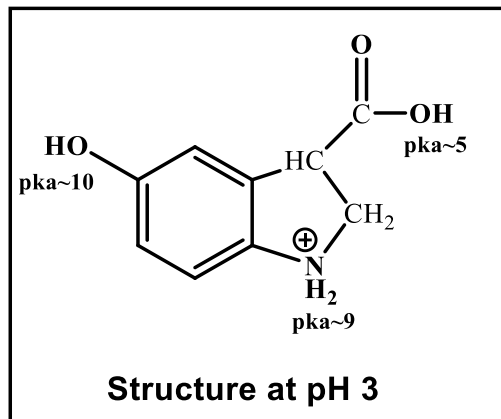


(b) **Resonance.** For the acid shown below, draw:

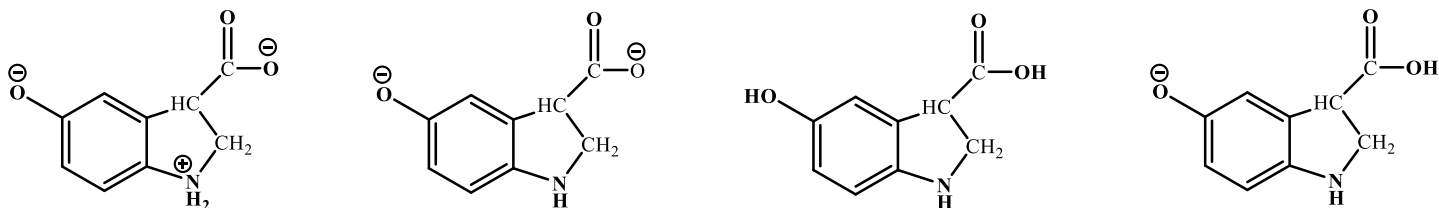
- the conjugate base
- all possible resonance structures and,
- a resonance hybrid



(c) **Effect of pH and pKa on Acid/Base Structure.** The compound drawn below is shown as it would exist at **pH 3**.



(i) Which is the correct chemical form of this compound at **pH 12**? **Circle your answer:**



(ii) Based on the structure in the box at pH 3, and the structure you circled at pH 12, would this compound be **more water soluble** at (CIRCLE):

pH 3 or pH 12 or equally soluble at either pH

(iii) **Briefly** explain your reasoning for your answer to (ii) above.

The End! Please hand your exam and scrap paper to Dr. Brush