

Names of all students (please print) _____

Answer Key

CHEM 243 Organic Chemistry I

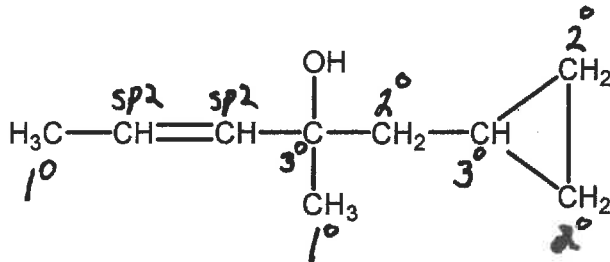
Points _____ (10 max)

Worksheet #2: September 8, 2021. Complete the following worksheet by collaborating with a group of 3-4 students. You can use a text book or your lecture video notes. You must work together, with the names of all students included on ONE sheet and turned in for a group grade.

(1) Characterizing sp³ carbons.

(a) In the molecule drawn at the right, indicate the **total number** of 1° (primary), 2° (secondary) and 3° (tertiary) carbons.

NOTE: The 1°, 2°, 3° designations only apply to sp³ carbons.



1° carbons 2 2° carbons 3 3° carbons 2 -OH (alcohol) carbon is: 1° 2° **3°** (CIRCLE)

(b) For the structure drawn above: (i) How many pi bonds are there? 1 HD = 2
 (ii) How many rings are there? 1 HD = 2 } sum = molecule HD
 (iii) Based on your answers to (i) & (ii), what is the Hydrogen Deficiency? 4
 (HINT: It is not necessary to calculate the HD)

$$HD = (2n + 2) - H_{\text{actual}}$$

$$= 10 - 8$$

$$HD = 2$$

(2) Hydrogen Deficiency. An unknown has the formula C₄H₈.

(a) Calculate the Hydrogen Deficiency (HD): 2

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

| | | | | | |
|-----------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------|
| alkene <small>(C=C double bond)</small> HD=2 | carbonyl <small>(C=O double bond)</small> No oxygen | alkyne <small>(C≡C triple bond)</small> HD=4 | alcohol <small>(R-OH)</small> No oxygen | ether <small>(R-O-R)</small> No oxygen | cycloalkyl <small>(C atoms form a ring)</small> HD=2 |
|-----------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------|

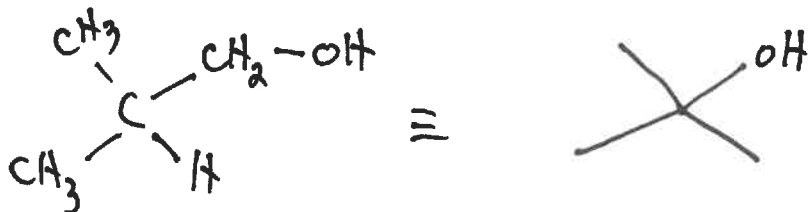
(3) Drawing Structures. An unknown compound has a formula C₄H₁₀O.

(a) Calculate the Hydrogen Deficiency (HD): 0

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

| | | | | | |
|--------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|-----------------------------------------|----------------------------------------|----------------------------------------------------------------|
| alkene <small>(C=C double bond)</small> X | carbonyl <small>(C=O double bond)</small> X | alkyne <small>(C≡C triple bond)</small> X | alcohol <small>(R-OH)</small> | ether <small>(R-O-R)</small> | cycloalkyl <small>(C atoms form a ring)</small> X |
|--------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|-----------------------------------------|----------------------------------------|----------------------------------------------------------------|

(c) The unknown has one 3° carbon, three 1° carbons, and the oxygen is bonded to a 1° carbon. In the space at the right, draw an accurate structure that fits these data (bond-line or zig-zag).



(4) **Basic Calculations.** The purpose of these calculations is to help prepare you for the laboratory. The compound you drew in problem #3 above, $C_4H_{10}O$, has a **molecular mass of 74.12 g/mole**. Answer the following questions using correct significant figures and units.

(a) If you had 0.01389 moles of this compound, how many grams would you have? 1.030 g

(b) Assuming this compound is a liquid, based on your answer to (a), how many mL would you have if the density is 0.8994 g/mL? Answer: 1.145 mL

Use this space for your calculations:

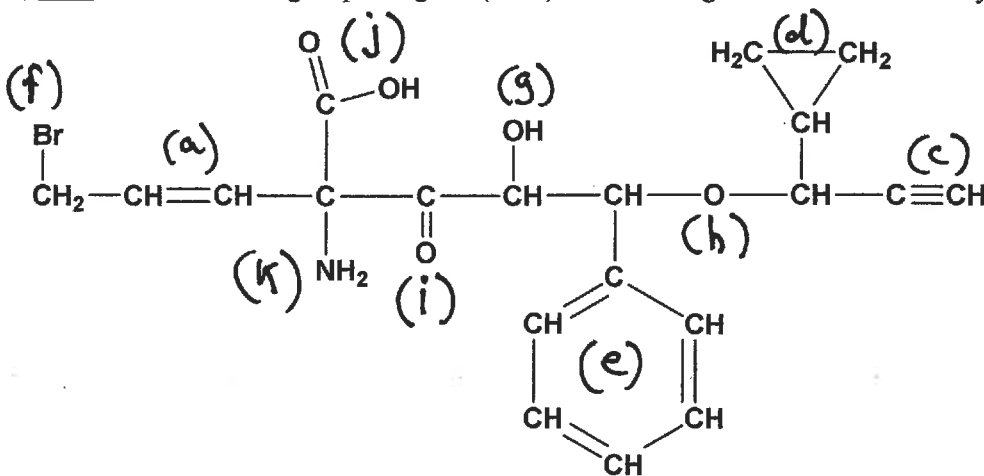
$$(a) \quad 0.01389 \text{ moles} \times 74.12 \text{ g/mole} \\ = 1.030 \text{ g}$$

$$(b) \quad \frac{1.030 \text{ g}}{0.8994 \frac{\text{g}}{\text{mL}}} = 1.145 \text{ mL}$$

(5) **Functional Groups.**

(a) In the molecule drawn below, label each functional group using the (a – k) letter codes given. Some codes may be used once, others not at all.

- (a) alkene
- ~~(b) internal alkyne~~
- (c) terminal alkyne
- (d) cycloalkyl
- (e) benzene
- (f) halogen
- (g) alcohol
- (h) ether
- (i) carbonyl
- (j) carboxylic acid
- (k) amine



(b) For the structure drawn above:

(i) How many pi bonds are there? 8 HD = 16

(ii) How many rings are there? 2 HD = 4

(iii) Based on your answers to (i) & (ii), what is the Hydrogen Deficiency? 20
(HINT: It is not necessary to calculate the HD)

When your group has completed this Worksheet.....

- Copy your best answers to a fresh worksheet with the names of all students from your group.
- Hand in to Dr. Brush.
- You are free to leave!