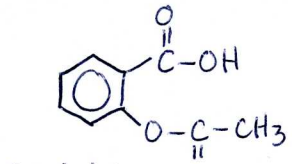
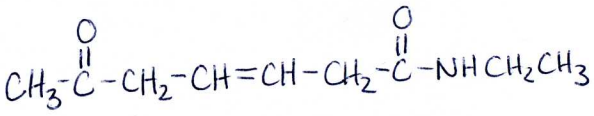
Homework Problems – Organic Chemistry

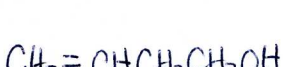
1. What special characteristic(s) of carbon make possible the existence of so many different organic compounds?
2. What are functional groups and why are they important?
3. If you were given two unlabeled bottles, one containing hexane and one containing water, how could you tell them apart?
4. Identify the functional groups in the following molecules.

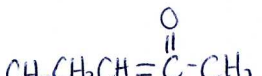


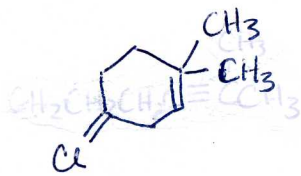
aspirin



5. Propose structures for molecules that fit the following descriptions:
   a. A ketone with the formula $C_5H_{10}O$
   b. An ester with the formula $C_6H_{12}O_2$
   c. A compound with the formula $C_2H_5NO_2$ that is both an amine and a carboxylic acid.
   d. An amide with the formula C_4H_9NO
   e. An aldehyde that has a ring of carbons and the formula $C_6H_{10}O$
   f. An aromatic compound that is also an ether, $C_8H_{10}O$
6. There are three isomers with the formula C_3H_8O. Draw their structures.
7. Draw all possible isomers that fit the following descriptions:
   a. Alcohols with the formula $C_4H_{10}O$
   b. Amines with the formula C_3H_9N
   c. Ketones with the formula $C_5H_{10}O$
8. What is wrong with the following structures?

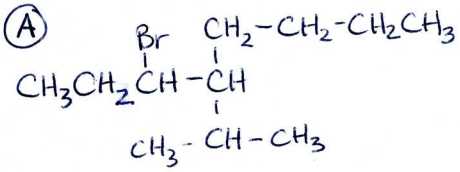




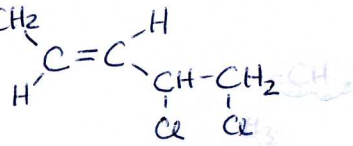


9. Give the IUPAC name of each of the following molecules.

(A)

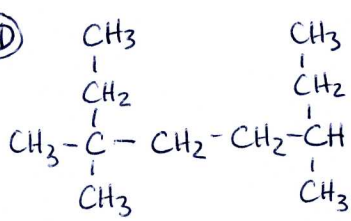


(B)

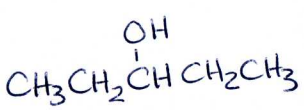


(C)

(D)



(E)



10. Write condensed structural formulas for each of the following compounds.
    a. 3-ethylhexane
    b. 2,2,3-trimethylpentane

c. 3-ethyl-3,4-dimethylheptane
d. 5-isopropyl-2-methyloctane
e. 1,1-dimethylcyclopentane
f. *trans*-4,5-dichloro-2-pentene
g. 3,3,4-tribromo-2-butanol
h. *cis*-4-methyl-2-pentene

11. The following names are incorrect. Write the structural formula that agrees with the apparent name, and then write the correct name of the compound.
a. 2-ethylbutane
b. 2-isopropyl-2-methylpentane
c. 5-ethyl-1,1-methylcyclopentane
d. 3-ethyl-3,5,5-trimethylhexane
e. 1,2-dimethyl-4-ethylcyclohexane
f. 2,4-diethylpentane
12. Draw structures and give IUPAC names for the nine isomers of C_7H_{16}.
13. Draw structures and name all cyclic isomers with the formula C_5H_{10}.
14. Why is cyclopropane unstable?
15. Explain the underlying reason behind the trend in the following boiling points.
Boiling point of methane = –164°C
Boiling point of ethane = –89°C
Boiling point of hexadecane ($C_{16}H_{34}$) = +287°C
16. Rank the following molecules in order of increasing boiling point, and explain your reasoning in terms of the types and strengths of the intermolecular forces involved.

(A) CH_3CH_2F (B) CH_3CH_2OH (C) $CH_3CH_2CH_3$

17. Rank the molecules above in order of increasing solubility in water, and explain your reasoning.
18. Rank the same molecules in order of increasing solubility in cyclohexane. Explain your reasoning.
19. Rank the following molecules in order of increasing boiling point, and explain your reasoning in terms of the types and strengths of the intermolecular forces involved.

(A) $CH_3CH_2NH_2$ (B) $CH_3CH_2CH_2CH_2OH$ (C) $CH_3CH_2CH_3$ (D) $CH_3(CH_2)_8CH_3$

20. Rank the molecules above in order of increasing solubility in water, and explain your reasoning.
21. Which of the following molecules should be more soluble in water? Explain your reasoning.

$CH_3CH_2CH_2CH_2OH$