

## Chemistry 30 – Organic Chemistry – Unit Homework

Topic	Textbook Reading	Textbook Questions
Alkanes	Section 22.1-22.2	#5, 8, 14, 15 Bonus: Try questions with naming and structural formulas
Alkenes and Alkynes	Section 22.3	#20, 22, 23
Isomers	Section 22.4	#25, 26
Petroleum	Section 22.5	#32-33, 35
Functional Groups	Section 23.1-23.3	#6, 8, 11 (name the functional group only), 12, 14, 15, 18, 36-40, 69, 70, 73

### Organic Chemistry

- Using your knowledge of elements and compounds, explain why carbon forms more compounds than all other elements combined.
- Draw the Lewis structures for  $H_2$ ,  $O_2$  and  $N_2$ .

### Alkanes

- Write the structural diagram, line diagram and name for each of the following straight-chain alkanes:
  - $C_4H_{10}$
  - $C_5H_{12}$
- Draw a line diagram for the following alkanes:
  - 4-ethyloctane
  - 2-methylnonane
  - 3,3-dimethylpentane
  - 3-ethylpentane
  - 3-ethyl-2-methylheptane
  - \*3-ethyl-4(1-methylpropyl)-2,2-dimethyloctane
- Draw the line diagram for each:
  - 2-methylpentane
  - 3-methylpentane
  - 2-methylhexane
  - 3,4-dimethylhexane
  - 3-ethyl-2-methylhexane
  - 3,3-dimethylpentane
  - 2,5-dimethyl-4-propyloctane
- Which of the following pairs represent structural isomers?
  - 2,3-dimethylbutane and 2,2-dimethylbutane
  - butane and 2-methylpropane
  - 2-methylpentane and 2,3-dimethylbutane
  - 3-methylpentane and 2,2-dimethylpropane
- Determine:
  - The intramolecular forces that form the bonds in alkanes
  - The intermolecular forces that hold alkane molecules together
  - What two factors affect how strong the intermolecular forces are for alkanes? (Hint: consider butane vs hexane, then consider butane vs 2-methylpropane)
- Which of pentane and octane has a higher boiling point? Why?

## Alkenes and Alkynes

9. Classify each of the following hydrocarbons as an alkane, alkene or alkyne.
  - a.  $C_2H_4$  (g)
  - b.  $C_3H_8$  (g)
  - c.  $C_4H_6$  (g)
  - d.  $C_5H_{10}$  (l)
10. Draw the following alkenes:
  - a. 2-ethyl-1-pentene
  - b. 2,3-dimethyl-1-butene
  - c. 2,3,4-trimethyl-1-heptene
  - d. 2,3,4-trimethyl-3-hexene
11. Draw the following alkynes:
  - a. 3-ethyl-1-pentyne
  - b. 3,3-dimethyl-1-butyne
  - c. 4,4,5-trimethyl-2-hexyne
  - d. 4-ethyl-4-methyl-2-pentyne
12. Classify each compound as an alkane, alkene or alkyne, and state whether it is saturated or unsaturated. (Bonus: draw the line diagram for each.)
  - a. 2-methylnonane
  - b. hex-3-yne
  - c. 1,2,4-trimethylpentane
  - d. 4-propyloctane
  - e. 3-methylpent-2-ene
  - f. 5-ethyl-2-methylhept-2-ene
  - g. 4-methylpent-2-yne
13. Write the chemical formula and line drawing for each. Why do these names not need a number?
  - a. propane
  - b. propene
  - c. propyne
14. Draw and name four structural formulas for isomers of  $C_6H_{14}$ . Why are these isomers soluble in each other?
15. Which would have a higher boiling point, ethane, ethene or ethyne? Why?

## Petroleum

16. Chemists have determined the boiling point of the compounds of natural gas. What is the trend in boiling point as the number of carbon atoms increases for the alkane family? Explain why this happens.
17. Oil spills in or near water cause a variety of environmental problems. Use your knowledge of alkanes to describe and explain what happens when oil is spilled from a tanker car into water.
18. Crude oil is a solution of many hydrocarbons, including ones that are solids, liquids and gases as pure substances.
  - a. Explain how this mixture can be a solution.
  - b. Water is part of the mixture when extracting crude oil from oil wells. Use intermolecular forces concepts to explain whether water would or would not be a solute (dissolving substance) in the crude oil solution.
19. Why do short-chain hydrocarbons come out the top of the distillation column?
20. Which would you expect to be in the residue at the bottom of a distillation column:  $CH_4$ ,  $C_8H_{18}$  or  $C_{20}H_{42}$ ? Why?
21. What happens to a compound in a distillation column when it reaches the height in the column that is at its boiling point?

## Combustion

22. Write and balance the combustion reactions for ethane, propane, ethene and propyne.

23. What does it mean to say a hydrocarbon goes through combustion? What is happening to the hydrocarbon?
24. Why do hydrocarbons make good fuels?
25. How does the combustion of methane compare to other hydrocarbon fuels, like butane, coal or oil?
26. Is combustion an endothermic or exothermic process?
27. Combustion is not always complete, usually because of an insufficient supply of oxygen. Write a hypothesis, including a chemical equation, to explain the following events:
  - a. When ethyne (acetylene) is burned in air, black soot appears.
  - b. Deaths have occurred when charcoal briquettes (pure carbon) are burned inside a tent to keep campers warm on cold nights.

### Functional Groups

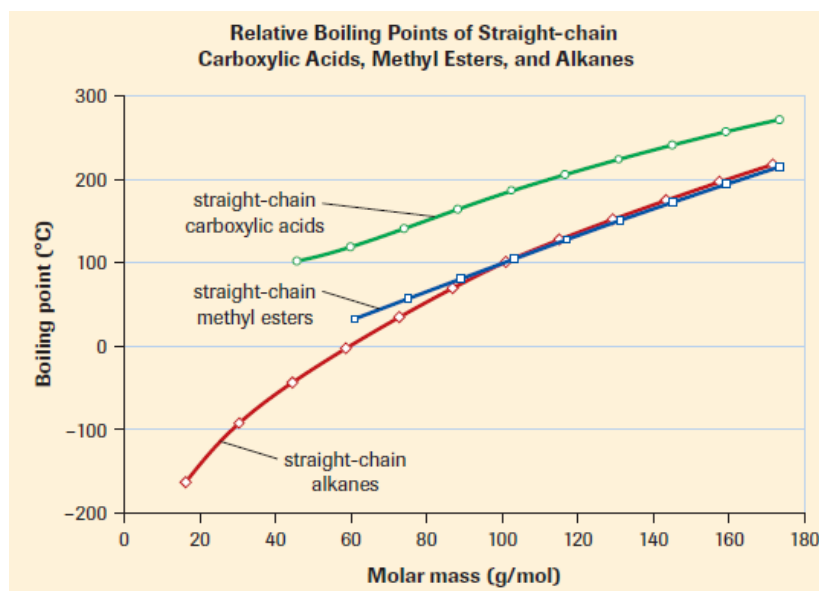
28. The relative boiling points of three halogen substituted ethane compounds are chloroethane (12.3°C), bromoethane (38.2°C) and iodoethane (72.3°C). Explain the relative boiling points of these organic halides.
29. Why does methanol have a higher boiling point than methane?
30. Predict the order of increasing boiling points for the following compounds, and explain your reasoning:
  - a. Ethane, methanol and fluoromethane
  - b. 1-butanol, pentane and 1-chlorobutane

**Table 1** Boiling Points and Solubilities of Various Alcohols

Alcohol	Boiling point (°C)	Solubility (mL/100 mL)
methanol	65	miscible
ethanol	78	miscible
propan-1-ol	97	miscible
butan-1-ol	117	9.1
pentan-1-ol	138	3.0
hexan-1-ol	157	slight

31. Why is propane a gas at room temperature, but 2-propanol (rubbing alcohol) is a liquid?
32. What happens to the boiling point and solubility of alcohols as they increase in length? Use the data table to explain.

33. The graph to the right shows the boiling points of straight-chain carboxylic acids, methyl esters and alkanes.
  - a. Explain the upward trend in boiling points for all three classes of compounds.
  - b. Explain why the alkanes and methyl esters have fairly similar boiling points.
  - c. Explain why the carboxylic acids have much higher boiling points than the other two compounds.



34. Use your understanding of intermolecular forces to explain why acetic acid can be a more versatile cleaner than water.