Unit 6: Bonding & Intermolecular Forces

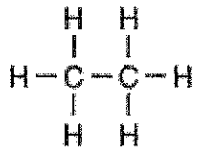
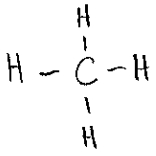
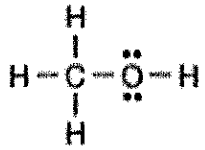
Free Response Review #2

Directions: The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

Question 1 [8 POINTS]

The formulas and the boiling points at standard pressure for ethane, ethyne, methane, and methanol are shown in the table below.

Information for Four Compounds

Name	Formula	Boiling Point (°C)
ethane		−88.6
ethyne		−119.2
methane		−161.5
methanol		64.6

A. Draw the complete Lewis electron-dot diagram for methane, CH_4, in the appropriate cell in the table above. **[1 POINT]**

i. Would you classify methane as a polar or nonpolar molecule? Justify your answer. **[1 POINT]**

Non-polar, b/c there is a symmetrical distribution of bonds.

B. Which of the four molecules contains the shortest carbon-to-carbon bond? Explain. **[1 POINT]**

Ethyne, b/c it is a triple bond, which has more e⁻ being shared than in the single C-C bonds in the other molecules, so the nuclei are more attracted to the bonded e⁻, so the bond takes more energy to break.

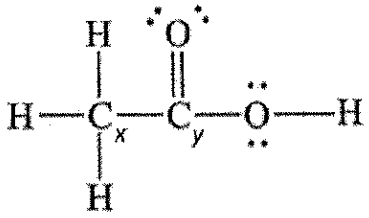
C. The normal boiling point of ethane is −88.6°C, whereas the normal boiling point of methanol is 64.6°C. Explain, in terms of the intermolecular forces present in each liquid, why the boiling point of methanol is so much higher than that of ethane. **[2 POINTS]**

The O-H bond in methanol results in hydrogen bonding IMFs, which are stronger than the LDFs in ethane. It takes more energy to overcome stronger IMFs, so methanol has a higher boiling point.

D. Energy is required to boil methanol. Consider the statement "As methanol boils, energy goes into breaking C–H bonds, C–O bonds, and O–H bonds." Is the statement true or false? Justify your answer. **[1 POINT]**

Epically false! Chemical bonds are <u>not</u> broken during boiling (a physical change), only the IMFs <u>between</u> separate methanol molecules.

E. A Lewis electron-dot diagram of a molecule of ethanoic acid is given below. The carbon atoms in the molecule are labeled x and y, respectively.



Identify the geometry of the arrangement of atoms bonded to each of the following.

i. Carbon x **[1 POINT]** tetrahedral

ii. Carbon y **[1 POINT]** trigonal planar