CHM 1020 **HOUR TEST 2** **Name _____**
March 4, 1999 **(please print)**
Soc. Sec. Num. _____

This exam consists of four pages. Make sure you have one of each. Print your name at the top of each page now. A fifth page contains a **periodic chart**, a table of **bond energies**, and a table of **electronegativities**. You may tear this sheet off and use it for scratch paper. Show your work on calculations, be sure to include units in the calculations, and give answers to the correct number of significant figures. For two points extra credit, put the symbol for magnesium at the top of page 2. You may use atomic weight values rounded to the nearest 0.1 amu.

Page	Points
1	_____
2	_____
3	_____
4	_____
Total	**_____**

If anything confuses you or is not clear, raise your hand and ask!

Points

(6) 1. Your text states that an energy consumption of 260,000 kcal per person per day is equivalent to an annual personal consumption of 65 barrels of oil. One barrel of oil contains 37 gallons. Calculate the heat energy (in kcal) available from one gallon of oil.

2. Acetylene (C_2H_2, structure below) is burned in acetylene torches to produce energy for welding.
(a) Complete and balance the equation for the complete combustion of acetylene:

(4) $H\text{-}C\equiv C\text{-}H + O_2 \rightarrow$

(8) (b) Using the bond energies on the last page, calculate the heat produced (in kilojoules) in burning **1.00 moles** of acetylene. (Show your work).

(4) (c) Calculate the heat produced (in kilojoules) in burning **1.00 kilograms** of acetylene.

3. You have an 85 Liter water tank, and you want to heat the water from room temperature (25 ^{o}C) to 55 ^{o}C. You remember that the density of water is 1.00 g/mL, and the specific heat of water is 1.00 cal/g-^{o}C.

(6) (a) How much heat energy is required, expressed in both **kilocalories** and in **kilojoules**? (1 calorie = 4.184 joules)

(3) (b) If you heat your tank with natural gas (primarily **propane**), which has a heat of combustion of 45.8 kJ/gram, what **mass** of propane will be required?

(3) (c) If you heat your tank with an electric heater, where one **kilowatt-hour** is equivalent to 3600 kilojoules, how many kilowatt-hours of electrical energy will be required? If electrical energy costs 8.5 cents per kilowatt-hour, how much will this electric energy cost?

(5) 4. Put a check mark in the blank next to each of the following statements which **true.**

_____ Water has a higher boiling point than does H_2S.

_____ Water expands when it melts from ice to liquid.

_____ Hydrogen bonds can form in NH_3.

_____ The heat of fusion of water is greater than its heat of vaporization.

_____ Ethyl alcohol can form hydrogen bonds with water

(6) 5. Diagram how water acts to **solvate** sodium ions and chloride ions when sodium chloride dissolves in water.

(16) 6. Give the **name**, the **Lewis dot structure**, and the **molecular geometry** of the following polyatomic anions. (If resonance structures are possible, only one resonance structure needs to be drawn). The oxygens are all attached to the non-oxygen atom.

CO_3^{2-} **ClO_3^-**

SO_3^{2-} **NO_3^-**

(8) 7. For the following molecular substances, draw a correct **Lewis dot structure**, indicate the **molecular geometry**, and use an **arrow** to indicate the direction of polarity of each polar bond in the molecule. Indicate whether the overall molecule will be **polar** or **non-polar**.

SO_3 (sulfur central atom) **NH_3** (nitrogen central atom)

(8) 8. For each of the following **pairs** of bonds, draw an arrow indicating the direction of polarity of the bond, and **circle** the bond that will be the **more polar** of the two in the pair.

(a) **C-H** and **S-H** (b) **N-H** and **N-O**

(c) **O-F** and **O-Cl** (d) **H-O** and **H-Cl**

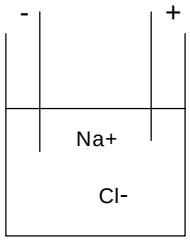
(6) 9. Circle the following fuel sources which are **renewable**.

alcohol, coal, oil, natural gas, wood, galoline

(5) 10. What causes water to be **hard**?

(5) 11. Explain how a soap is able to dissolve grease and dirt.

(4) 12. In the following diagram, label clearly the **cation**, the **anion**, the **cathode**, and the **anode**.



(3) 13. A power plant is designed to run at a temperature of 590 ^{o}C (863 K). If it discards its heat at 30 ^{o}C, what would be its maximum efficiency?