CHM 1045 (8:00 am Lecture) **HOUR TEST 3** **Name _____**
November 2, 2001 **(please print)**
Recitation: Section ____ Meeting Time_____

This exam consists of 4 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, some physical constants, and thermochemical data which you will need for some of the problems. You may tear it off and use it for scratch paper. Show your work on calculations, including unit conversions, and give answers in the correct units and appropriate number of significant figures.
In problems involving molecular and formula weights, you may use values rounded to the nearest 0.1 amu.
If anything confuses you or is not clear, raise your hand and ask!

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

(3) 1. In thermodynamics, an **open** system is one which (check correct definition):

____ Exchanges only matter with its surroundings.
____ Exchanges only heat with its surroundings.
____ Exchanges only work with its surroundings.
____ Exchanges only heat and work with its surroundings.
____ Exchanges only heat and matter with its surroundings.
____ Exchanges only work and matter with its surroundings.
____ Exchanges heat, work, and matter with its surroundings.
____ Exchanges nothing with its surroundings.

(6) 2. The **calorie** and the **Joule** are both units of energy.

(a) Which is the fundamental SI unit? _____

(b) Which is the **larger** unit? _____

(c) Which of the following are the correct **dimensions** of energy? (Check correct answer)

_____ kg-m _____ $kg\text{-}m^2\text{-}s^{-2}$ _____ $kg\text{-}m\text{-}s^{-2}$

_____ $kg\text{-}m^2\text{-}s^2$ _____ $kg\text{-}m\text{-}s^2$ _____ $kg^{-1}\text{-}s^2$

(12) 3. An unknown metal weighing 33.7 g is heated to a temperature of 98.5 ^oC and placed in an insulated cup containing 95.5 g of water at a temperature of 22.1 ^oC. After the metal cools, the final temperature of the metal and the water is 24.5 ^oC.

(a) How much heat has the metal lost?

(b) What is the specific heat of the metal?

(12) 4. A 200 mL solution of 0.250 M HCl is mixed with a 200 mL solution of 0.250 M NaOH in a coffee cup calorimeter. Both solutions are at 25.01 ^{o}C in the beginning, and the temperature in the calorimeter rises to 26.61 ^{o}C. Assume that the calorimeter does not absorb any heat, and that the specific heats of the solutions are the same as that for water, and that the density of each solution is 1.00 g/mL.

(a) How much heat does the solution mixture gain?

(b) This heat comes from the reaction of HCl and NaOH as follows:

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Calculate the ΔH of this reaction in kJ/mol (i.e. the heat produced **per mole** of HCl reacting)

(c) Is the ΔH of this reaction **positive** or **negative**?

(12) 5. A 5.26 g sample of glucose ($C_6H_{12}O_6$) is burned in a constant-pressure calorimeter whose total heat capacity is 13.99 kJ/^{o}C. The temperature of the calorimeter increased from 25.14 ^{o}C to 30.01 ^{o}C:

(a) What is the heat evolved per gram of glucose combusted?

(b) What is **molar** heat of combustion of glucose?

(10) 6. Following is the equation for the combustion of glucose discussed in question 5:

$$C_6H_{12}O_{6\,(s)} + 6\,O_{2\,(g)} \rightarrow 6\,CO_{2\,(g)} + 6\,H_2O_{(l)}$$

Use the heat of formation data from page 5 to **calculate** ΔH for this reaction. (Show your work).

(10) 7. Use the heat of formation data from page 5 to calculate ΔH for the following reaction in which lime (CaO) is made by heating limestone ($CaCO_3$). (Show your work).

$$CaCO_{3\,(s)} \rightarrow CaO_{(s)} + CO_{2\,(g)}$$

(12) 8. Calculate the **wavelength (l)** and **Energy** of a photon of radio waves carrying the signal for WFSQ-FM at 91.5 MHz. (This is $9.15 \times 10^7\ s^{-1}$).

(10) 9. Calculate the **wavelength** of light emitted by an excited hydrogen atom when the electron falls from the **third** Bohr orbit (n=3) to the **first** Bohr orbit (n=1).

Is this wavelength in the **visible**, the **ultraviolet** or the **infrared**?

(10) 10. At the right is an alphabetical list of many of the scientists who made important contributions to our understanding of the structure of the atom. For each of the statements, accomplishments, or equations below, identify the scientist associated with it by placing the letter from the key list in the blank.

____ $E=mc^2$

____ Energy is found in packages called **quanta**, which are some multiple of $h\nu$.

____ The charge on the electron is -1.602×10^{-19} coulomb.

____ One cannot tell accurately both the position and momentum of an electron.

____ Light is composed of particles, whose energy is given by $h\nu$.

(a) Bohr
(b) De Broglie
(c) Einstein
(d) Heisenberg
(e) Millikan
(f) Planck
(g) Rutherford
(h) Schrödinger
(i) Thomson

(3) 11. What are the values of the following quantum numbers associated with a **2s** orbital (i.e. an s orbital in the second shell)?

n = _____ l = _____ m = _____