**CHM 1045 (12:20 pm Lecture)** **HOUR TEST 3** **Name _____**
**November 1, 2002** **(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 | _____ |
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| **Total** | _____ |

(9) 1. Magnesium metal reacts with hydrochloric acid in an open container to produce magnesium chloride, hydrogen gas and heat according to the following equation:

$$Mg_{(s)} + 2\,HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)} + \text{heat}$$

Put a T in the blank by each of the following statements about this reaction which is **true.**

_____ The reaction is endothermic.
_____ ? U for the reaction is negative.
_____ ? H for the reaction is equal to ? U.
_____ ? H for the reaction is a smaller negative number than ? U.
_____ ? H for the reaction is a larger negative number than ? U.
_____ The reaction does work on the surroundings.
_____ The surroundings do work on the reaction.
_____ Work done by the reaction equals P? V, where ? V is the volume of the $H_2$ gas produced.
_____ Work done by the reaction equals -P? V, where ? V is the volume of the $H_2$ gas produced.

(12) 2. An unknown metal weighing 112 g is heated to a temperature of 99.5 $^oC$ and placed in an insulated cup containing 215 g of water at a temperature of 25.0 $^oC$. After the metal cools, the final temperature of the metal and the water is 32.5 $^oC$.

(a) How much heat has the metal lost?

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

(10) 3. When a 12.4 g sample of solid sodium hydroxide and 100.0 g of water, both at 22.3 $^{o}$C, are mixed in a coffee cup calorimeter, the temperature rises from 22.3 $^{o}$C to 53.0 $^{o}$C. Assume that the calorimeter does not absorb or lose any heat, and that the specific heat of the final solution is the same as that for water.

(a) How much heat does the solution mixture gain? (Hint: What is the mass of the final solution?)

(b) Calculate ? H (in kJ/mol for NaOH) for the solution process:

$$NaOH_{(s)} \rightarrow Na^{+}_{(aq)} + OH^{-}_{(aq)}$$

(3) 4. The specific heat of ethanol is 2.46 J/g-$^{o}$C. How much energy is required to heat 435 g of ethanol from 25.15 $^{o}$C to 34.91 $^{o}$C?

(12) 5. A 4.85 g sample of ethanol ($C_2H_5OH$) is burned in a constant-pressure calorimeter whose total heat capacity is 12.65 kJ/$^{o}$C. The temperature of the calorimeter increased from 20.14 $^{o}$C to 31.52 $^{o}$C:

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

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

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

$$C_2H_5OH_{(l)} + 3\,O_{2\,(g)} \rightarrow 2\,CO_{2\,(g)} + 3\,H_2O_{(l)}$$

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

(10) 7. Use the heat of formation data from page 5 to calculate $\Delta H$ for the following reaction in which lime (CaO) reacts with water to form slaked lime ($Ca(OH)_2$). (Show your work).

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2\,(s)}$$

(10) 8. (a) Calculate the **frequency (**n**)** and **Energy** of a photon of microwaves with a wavelength of 2.50 cm.
(b) What is the **energy** of a **mole** of these photons?

(9) 9. Calculate the **wavelength** of light emitted by an excited hydrogen atom when the electron falls from the **fifth** Bohr orbit (n=5) to the **third** Bohr orbit (n=3).

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

(12) 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.

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

____ He measured the charge to mass ratio of the electron.

____ $\lambda = h/mv$

____ The mass of the atom is concentrated in a very tiny nucleus.

____ The electron in the hydrogen atom moves in a circular orbit, and the energy of the hydrogen atom can be calculated from the kinetic and potential energy of the electron.

____ He developed an equation to describe the three-dimensional wave properties of the electron.

____ He used the photoelectric effect to show that light consists of particles.

(3) 11. Draw a representation of a **p** orbital lying along the x axis (i.e. a $\mathbf{p_x}$ orbital). What is the value of the quantum number **l** for this orbital?