CHEM1612 Problem Sheet 1 (Week 1)

There are a number of important learning resources available on your unit area on the First Year Chemistry website: http://firstyear.chem.usyd.edu.au/chem1612

Spend some time getting yourself familiar with this website and have a look at available resources, which include self help quizzes, games and calculators.

One of the most important resources is **ChemCAL,** an interactive tutorial/quiz program which covers most of the first year chemistry topics. Past students have found the program's interactive tutorials very useful. A link to ChemCAL is provided on the menu of all First Year Chemistry webpages. You log on to ChemCAL using your course code ('1612') as username, and *helium* as the password. (Note that none of the marks you receive in the various ChemCAL quizzes are ever recorded or assessed, and multiple attempts are OK!)

Work through the ChemCAL module "*Chemical Energy and Calorimetry*".

1. It takes 78.2 J to raise the temperature of 45.6 g of lead by 13.3 °C. What are the specific and molar heat capacities of lead?

2. In a coffee cup calorimeter, 100 mL of 1.0 M HCl and 100 mL of 1.0 M NaOH are mixed. Before mixing, both solutions are at 24.6 °C. After the reaction, the temperature is 31.3 °C. Assuming no density change, and that the heat capacity of the solution is that of water, calculate the standard enthalpy of neutralisation of H^+(aq) by OH^-(aq). (Assume a perfect calorimeter where no heat is lost to the surroundings.)

3. Urea, $(NH_2)_2CO$ (6.006 g) is burnt in excess oxygen to yield liquid water, CO_2(g) and N_2(g). 63.4 kJ of heat was liberated at 298 K and 101.3 kPa.

   $\Delta_f H°_{298}$, in kJ mol^{-1}: CO_2(g) –393; H_2O(l) –285

   (a) Write an equation for the combustion.
   (b) Calculate the heat energy released (in kJ) when 1.00 mol of urea is completely burnt.
   (c) Use your answer to (b) and the data above to calculate the enthalpy of formation of solid urea at 298 K and 101.3 kPa.

   The number of significant figures in your answer should always reflect those in the data provided. The sign (+ or -) of your answer is *very* important.

4. A 0.0100 mol sample of propane was placed into a bomb calorimeter with excess oxygen and ignited. The equation for the reaction is:

   $$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

   The initial temperature of the calorimeter was 25.000 °C and its total heat capacity was 96.5 kJ °C^{-1}. The reaction raised the temperature of the calorimeter to 27.828 °C. Calculate the energy (in kJ and in kJ mol^{-1}) liberated by the combustion of the propane.