

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.

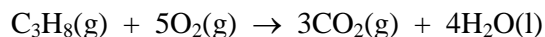
One of the most important resources is **ChemCAL**, an interactive tutorial/quiz program which covers most of the first year chemistry topics. Past students have found the program's interactive tutorials very useful. A link to ChemCAL is provided on the menu of all First Year Chemistry webpages. You 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, (NH₂)₂CO (6.006 g) is burnt in excess oxygen to yield liquid water, CO₂(g) and N₂(g). 63.4 kJ of heat was liberated at 298 K and 101.3 kPa.
 $\Delta_f H^\circ_{298}$, in kJ mol⁻¹: CO₂(g) -393; H₂O(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:



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.