

# Chemistry 240 Semester 01-2009

## Homework for Submission #4

Answer the following questions and submit them for marking on or before 16th March 2009. If any answers show evidence of copying, the whole exercise will attract zero marks. Careful setting out of your answers is essential for full marks.

- 1) Calculate the work done on the system and on the surroundings when
  - a) 1 mol of  $\text{KClO}_3$  decomposes at 1 atm and a constant temperature of 300K.
  - b) 1 kg of ice melts at  $0^\circ\text{C}$  and 5 atm pressure. The densities of ice and water at these temperatures is  $0.915\text{ gcm}^{-3}$  and  $1.000\text{ gcm}^{-3}$ .
- 2) Look up and tabulate the standard enthalpies of combustion of ethanol, hexane and octane. Compare them as possible fuels by
  - a) Calculating the heat produced per kilogram for each of these substances under standard conditions.
  - b) Use your result from (a) to determine the heat produced per litre of each substance under standard conditions.
  - c) Find the lowest prices you can for each of the above substances using the internet or a chemical catalogue (the lowest quality grade is acceptable) and by determining the heat produced per dollar's worth, rank the fuels in order of economy.
- 3) Look up and tabulate the standard enthalpies of combustion of carbon and hydrogen, and use them together with the standard enthalpy of combustion of ethanol to determine the standard enthalpy of formation of ethanol.
- 4) Calculate the molar values of  $H$ ,  $C_p$ , and  $C_v$  for an ideal gas at 300 K.
- 5)
  - a) Explain the meaning of term *entropy*. Illustrate your answer by referring to, and explaining, the relative amounts of entropy in water and steam at  $100^\circ\text{C}$ , both at 1 atmosphere pressure. Which of the three states of matter has the lowest entropy at a given temperature? Why?
  - b) Look up and tabulate the boiling point and standard enthalpy of vaporisation for ethanol, and then calculate the entropy change of the system when 1.00 mol of ethanol is vaporized at its boiling point and 1 atm pressure
  - c) One criterion of the feasibility of a change is that the total entropy of the system and its surroundings increases if the change is feasible.
    - i) Show that for the vaporization of water at  $100^\circ\text{C}$  and 1 atmosphere pressure, when the surroundings are at a higher temperature than the system, the total entropy of system and surroundings increases. (Assume the process is carried out reversibly.)
    - ii) Not all feasible reactions will actually occur even when the correct reactants are mixed. Give a chemical example to illustrate this and explain why it is so.