CH301H – Principles of Chemistry I: Honors
Fall 2011, Unique 51040
Homework, Week 15

1. Nitrogen gas (N_2) is heated slowly at a constant pressure of 50.0 atm from an initial volume of 540 L to a final volume of 975 L. Determine the work performed by the system.

2. Calculate the work done for each of the following examples:

a) Our textbook (1.8 kg) is carried up three flights of stairs with a horizontal displacement of 10 m.

b) An ideal gas expands isothermally from 1.0 L to 1.9 L at 25˚C against a constant external pressure of 1.0 atm.

3. If you were on the surface of the moon you would need to wear a space suit with thermal insulation. In exploring the moon you might generate 4 kJ of heat per kg of mass per hour. If your body retains all of this heat because the insulation, how much would your temperature change per hour during this activity? How long would you recommend for such a moon walk? Assume you body mass is 65 kg and that your heat capacity is approximately that of water ($C_{p,m}(H_2O_{(l)}) = 75.29\ J\ K^{-1}\ mol^{-1}$).

4. A gas at room temperature is sealed in a container with strong rigid walls. It is then heated vigorously.

a) Determine whether ΔU, q, and w of the system are positive, negative, or zero during the heating.

b) The container is then cooled to its original temperature. Determine whether ΔU, q, and w of the system are positive, negative, or zero during the cooling.

c) If the heating is step 1 and the cooling is step 2, determine the signs of ($\Delta U_1 + \Delta U_2$), ($q_1 + q_2$), and ($w_1 + w_2$).

5. 0.500 mole of $N_2(g)$ at 1.00 atm and 273 K is expanded against a constant external pressure of 0.100 atm until the gas pressure reached 0.200 atm, at a temperature of 210 K. Determine the work done by the system, the change in internal energy, and heat absorbed by the system.

6. A chemical reaction takes place in a container with a cross-sectional area of 1 m^2. As a result of this reaction, a piston is pushed out 500 cm against an external pressure of 1.0 atm. Calculate the work done by the system.

7. The standard enthalpy of combustion of cyclopropane is -2091 kJ mol^{-1} at 25˚C. From this information and the enthalpy of formation for $CO_2(g)$ and $H_2O(g)$, calculate the enthalpy of formation of cyclopropane. The enthalpy of formation of propene is +20.4 kJ mol^{-1}. Calculate the enthalpy of isomerization of cyclopropane to propene.