CH302H – Principles of Chemistry II: Honors
Fall 2016 Unique 49420

Homework, Week 1

1. 10 g of water at 35˚C is added to 10 g of ice at 0˚C and sealed in a thermos. Describe what happens to the system using any tools you need (i.e. words, equations, or diagrams).

2. A 1 L sample of 2.00 mol Ar gas (C_V = 3/2 R, C_P = 5/2 R) is expanded isothermally at 0˚C to a final volume of 5 L against a constant external pressure equal to the final pressure of the gas. Determine q, w, ΔU, and ΔH for this three process. How would this answer change if the gas expanded into a vacuum (i.e. against P = 0)?

3. A toy truck running 1.3 kg is run off a battery. As it partially discharges, the battery moves the truck a total of 10 m. As it does so, it heats the air around the battery compartment 5˚C. Determine q, w, and ΔU for this change, and be particularly careful with signs.

4. 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.

5. When a single cylinder of an automobile internal combustion engine expands 650 mL against an external pressure of 1.0 atm, the cylinder does 65.7 J of work. (Make sure you know how to find this result.)

    a) Assuming the engine is running on pure octane (C_8H_{18}), how much gas does this cylinder expansion stroke use?

    b) How far does this single cylinder expansion stoke move the car? Be careful to state your assumptions.

    c) If the car ran on jelly-filled donuts instead of octane, how many jelly-filled donuts would be necessary to perform this work? Be careful to state your assumptions.

6. Calculate the standard enthalpy of solution of AgCl(s) in water from the enthalpies of formation of the solid and aqueous ions.

7. A gas microbalance is a device for measuring the molecular weight of gasses. In a gas microbalance, a glass bulb containing a standard gas sits on one end of a beam, which itself sits on a fulcrum. The beam is enclosed in a vessel with rigid walls, and when the vessel is evacuated the end of the beam containing the glass bulb rests on the bottom of the vessel. As the gas being measured is slowly introduced into the vessel, the buoyancy of the glass bulb increases, and the beam pivots on the fulcrum until it reaches a level balance point.

    a) Draw the initial and final states of the gas microbalance described above.

b) To calibrate the balance, CHF_3 gas was pumped into the vessel until the balance point was reached at 0.557 atm. An unknown fluorocarbon gas ($C_xH_yF_z$) gas was then pumped into the vessel, and the balance point of the beam was reached at a pressure of 0.430 atm. What is the molar mass of the unknown fluorocarbon gas and what is a possible molecular formula?