

CH353 – Physical Chemistry I
Spring 2015, Unique 51170

Homework, Week 2

1. Calculate the work (in Joules) done for each of the following examples:
 - a) McQuarrie and Simon 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.
 - c) HCl gas, behaving as a van der Waals gas, is compressed isothermally and reversibly from 1.9 L to 1.0 L at 25°C at an initial pressure of 14.0 atm. (For $\text{HCl}_{(g)}$, $a = 5.536 \text{ atm L}^2 \text{ mol}^{-2}$ and $b = 3.049 \times 10^{-2} \text{ L mol}^{-2}$.)

2. 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 $(w_1 + w_2)$.

3. 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.

For each of the following transformations, determine whether q , w , ΔU , and ΔH of the system are greater than zero, less than zero, or equal to zero.

4.
 - a) Air is sealed in a container with rigid walls and then heated from room temperature to 90°C.

 - b) Gas in a cylinder 5.0 L in volume is compressed by a constant external pressure of 4.0 atm to a final volume of 1.0 L.

 - c) Water is heated in an open beaker in a laboratory from room temperature to 100°C.

 - d) The battery of your laptop discharges completely, performing 100 J of electrical work and releasing 25 J of heat into the room.