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Chemistry Program, School of Natural Sciences and Mathematics
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CHEM 3410: Physical Chemistry I — Fall 2008

In-class Practice Problems

September 10, 2008

1. Suppose we have 1 mole of an ideal gas confined in a cylinder with a movable piston top, which allows the volume of the gas to be controlled. The gas starts at an initial volume $V_o = 10$ L at a pressure of 1 atm.

   We want to consider the amount of work done during three different processes, each of which starts with the gas in the same initial state and ends with the gas in the same final state:

   (a) (i) The gas is compressed to a volume of 1 L at constant pressure (P = 1 atm). (ii) The pressure is then slowly increased from 1 atm to 10 atm at constant volume.

   (b) (i) The pressure is slowly increased from 1 atm to 10 atm at constant volume ($V = V_o$). (ii) The gas is then compressed from 10 L to 1 L at constant pressure (P = 10 atm).

   (c) The gas is isothermally compressed from a volume of 10 L to 1 L.

   Assume the changes occur slowly enough for the gas to remain in equilibrium at all times (reversible processes).

2. One mole of a monatomic ideal gas, initially at 20.0°C and 1.00×10^6 Pa undegoes a two-stage transformation. For each stage calculate the final pressure, as well as, q, w, ΔU, and ΔH. Calculate q, w, ΔU, and ΔH for the complete process.

   (a) The gas is expanded isothermally and reversibly until the volume doubles.

   (b) Beginning at the end of the first stage, the temperature is raised to 80.0°C at constant volume.

3. A diatomic ideal gas is allowed to expand reversibly and adiabatically to twice its volume. Its initial temperature was 25.00°C . Calculate the change in internal energy and enthalpy for the expansion process.