Read Chapter 1 of Thermodynamics (2nd Ed.) by Callen, and read the tables of contents of the Thermodynamics and Physical Chemistry textbooks on the reserve book list, and skim through some of the chapters about the first and second laws of Thermodynamics in one or more of the above books.

1. Calculate ∆U, Q and W, for the isothermal expansion of an ideal monatomic gas, carried out by the following two paths (express your results as a function of T, P₁, P₂ and n):

   Path A) Sudden decrease in pressure from P₁ to P₂ (where P₂ < P₁).

   Path B) Gradual decrease in pressure from P₁ to P₂, such that the internal and external pressures remain in equilibrium at every step along the path.

   Note: For an ideal monatomic gas, P = nRT/V and U = (3/2) nRT

2. Calculate the final temperature of a monatomic ideal gas which undergoes an adiabatic (Q=0) expansion along path A (above), as a function of T₁, P₁ and P₂.

3. Derive an expression for the relationship between T₂/T₁ and V₂/V₁ in a reversible (equilibrium) adiabatic expansion of an ideal monatomic gas. [If you get stuck consult an undergraduate P. Chem. Text book, such as those by W. J. Moore or Q. W. Castellan or P. Atkins].

4. Calculate the final temperature of an ideal monatomic gas which undergoes a reversible adiabatic expansion from P₁ to P₂ along path B (above), as a function of T₁, P₁ and P₂?

   Answer each of the following two questions in words using well formed paragraph(s) with complete sentences and no equations or technical terms (which would not be understood by a freshman chemistry student); use a word processor with a standard (12pt) font and double spaced lines.

5. What is the physical reason for the different final temperatures attained in the adiabatic expansion along paths A and B?

6. Where did the energy required to maintain a constant temperature in the two isothermal expansions (in problem 1) come from?