1. One mole of an ideal gas underwent a reversible isothermal expansion until its volume was doubled. If the gas performed 1 kJ of work, what was it temperature? (10%)

2. One mole of gas that behaves ideally was allowed to expand reversibly and adiabatically to twice its volume. Its initial temperature 25.00°C, $C_v = \frac{5}{2}R$. Calculate the ΔU and ΔH for the expansion process. (10%)

3. Derive the relationship $\left(\frac{\partial S}{\partial V}\right)_U = \frac{P}{T}$ and confirm that it applies to an ideal gas. (15%)

4. At 25°C the equilibrium

   $$2NOBr(g) = 2NO(g) + Br_2(g)$$

   is rapidly established. When 0.01 mol of NOBr is present in a 1.0-dm³ vessel at 25.0°C the pressure is 0.35 atm. Calculate the equilibrium constant K_c, K_p and K_x. (15%)

5. The vapor pressure of n-propanol is 1.94 kPa at 293 K and 31.86 kPa at 343 K. What is the enthalpy of vaporization? (10%)

6. A substance decomposes at 600 K with a rate constant of $3.72 \times 10^{-5} s^{-1}$

   a. Calculate the half-life of the reaction.
   b. What the fraction will remain undecomposed if the substance is headed for 3 h at 600 K?
   c. How long it will take if the rate of decomposition decreased to 1/3 of initial rate? (15%)

7. An electron is confined in a one-dimensional box 1 nm long. How many energy levels are there with energy less than 10 eV? How many levels are there with energy between 10 and 100 eV? (15%)

8. The standard electrode potentials are

   $Ni^{2+} + 2e^- \longrightarrow Ni \quad E° = -0.25V$

   $Co^{2+} + 2e^- \longrightarrow Co \quad E° = -0.28V$

   Calculate the emf of the cell $Co|Co^{2+}(0.1m)\|Ni^{2+}(1m)|Ni$. (10%)