1. Calculate the value of \( q \), \( w \), \( \Delta E \) and \( \Delta H \) for the following:

a. heating 500. g of nitrogen gas from 50.0 °C to 75.0 °C in a rigid container (for \( N_2 \), \( C_v = 20.71 \) J/K mol and \( C_p = 29.03 \) J/K mol)

b. cooling 500 g of nitrogen gas from 75.0 °C to 50.0 °C at a constant pressure of 1.00 atm
2. For every gas, why is the value of $C_p$ greater than $C_v$? By what constant are they related?

3. Consider 2.00 mol of a monatomic ideal gas that is taken from state A (2.0 atm, 10.0 L) to state B (1.00 atm, 30.0 L) by two different pathways:

   Path 1: State A (2.0 atm, 10. L) $\rightarrow$ State C (2.0 atm, 30. L) $\rightarrow$ State B (1.0 atm, 30. L)

   Path 2: State A (2.0 atm, 10. L) $\rightarrow$ State D (1.0 atm, 10. L) $\rightarrow$ State B (1.0 atm, 30. L)

   Calculate $q$, $w$, $\Delta E$ and $\Delta H$ for both pathways.