1. Consider the following monatomic ideal gas process described by a reversible path in the p-V plane. There are 5 moles of gas.

The path marked A is a parabola \( P = \frac{10^5 \text{ Pa}}{L^2} V^2 \). How much work must be done on the gas to traverse this path? What is the change in the entropy of the gas?

2. What is the maximum amount of work that can be extracted from a tank containing 100 kg of water initially at 100°C if a giant reservoir of water at 20°C is available?

3. Prove that \( \frac{C_p}{C_v} = \frac{k_I}{k_s} \) where \( k_s \) is the adiabatic compressibility, \( \frac{1}{v} \left( \frac{\partial v}{\partial p} \right)_s \).

4. The equipartition theorem says that ideal gases have a molar specific constant volume heat capacity of \( R/2 \) for each degree of freedom. Explain qualitatively why diatomic gases have a \( c_v \) of \( 3R \) at high temperatures, \( 5R/2 \) at intermediate temperatures and \( 3R/2 \) at low temperatures?