Chemical Thermodynamics
Problem

- Calculate the change in enthalpy for the isothermal compression of 5 moles of chloromethane, CH$_3$Cl, at 300 K from an initial pressure of 0.5 bar to 40.0 bar. The CH$_3$Cl can be described by the following equation of state

\[ Z = \frac{P \bar{V}}{RT} = 1 + \left( b - \frac{a}{RT} \right) \frac{P}{RT} \]

- A = 7.57 L$^2$bar/mol$^2$, b = 0.065 L/mol, C$_p$ = 40.7 J/Kmol
Heat Engines

- Use some of energy in heat flow to perform work
Cyclic Engines

- For an integral number of cyclic processes
- For a heat engine
- Define a maximum efficiency
Refrigerator

- A heat engine running in reverse.

- Refrigerators compared based on COP – coefficient of performance
An ideal engine that obtains maximum efficiency is one that follows the Carnot cycle.
Carnot cycle

- A four step cycle with all steps being reversible
  - Isothermal, reversible expansion
  - Adiabatic, reversible expansion
  - Isothermal, reversible compression
  - Adiabatic, reversible compression
A household runs between 35 oC and -10 oC. How many Joules of heat can be removed, in principle, per one 1 kWh of work?
Problem

The refrigerator in the previous problem is charged with \( \text{NH}_3(g) \). If the gas is initially at 308 K and \( V_0 = 1.2 \text{ L/mol} \) what will the molar volume be after an adiabatic reversible expansion to 263 K. Use vdW expression, \( a = 4.3 \text{ L}^2\text{bar/mol}^2, b = 0.038 \text{ L/mol}, C_p = 27.2 \text{ J/Kmol} \)