Chemical Thermodynamics

Problem

- Calculate the change in enthalpy for the isothermal compression of 5 moles of chloromethane, CH_3Cl, at 300 K from an initial pressure of 0.5 bar to 40.0 bar. The CH_3Cl can be described by the following equation of state

$$Z = \frac{P\overline{V}}{RT} = 1 + (b - \frac{a}{RT})\frac{P}{RT}$$

- A = 7.57 L^2bar/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

Carnot cycle

- 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

Problem

- 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 $NH_3(g)$ If the gas is initially at 308 K and Vo = 1.2 L/mol what will the molar volume be after an adiabatic reversible expansion to 263 K. Use vdW expression, a = 4.3 L^2bar/mol^2, b = 0.038 L/mol, Cp = 27.2 J/Kmol