



4. what is the change in internal energy of an isolated system when the volume increases by 50 % at constant pressure of 1atm.

5. (from a old problem set - 2000)

The bulk modulus,  $K$ , of an isotropic linear elastic solid is defined by the dialation,  $\Delta V/V_0$ , response to hydrostatic pressure  $P$ :

$$(1) \quad \frac{\Delta V}{V_0} = \frac{V - V_0}{V_0} = - \frac{P}{K}$$

Typical values of  $K$  for an ionic crystal are about 100 GPa. (GPa = 1 Gigapascal, 1 atm  $\approx 10^{-1}$  MPa)

The permittivity of vacuum,  $k_0$  is  $8.85 \times 10^{-12} \text{C}^2/\text{J m}$ . Typical values of the dielectric susceptibility,  $\chi$  ( $\vec{P} = k_0 \chi \vec{E}$ ), of an ionic crystal are about 50 (unitless).

The permittivity of vacuum,  $\mu_0$ , is  $4 \times 10^{-7} \text{T}^2 \text{m}^3/\text{J}$  (T is a tesla). The magnetic susceptibility,  $\psi$  ( $\vec{I} = \mu_0 \psi \vec{H}$ ), of a typical paramagnetic ionic crystal is about 10 (unitless).

Calculate all the ratios of: stored elastic energy, stored polarization energy, and stored magnetic energy in a typical ionic crystal at 1 atm, 220 volts/m, and in the earth's magnetic field.

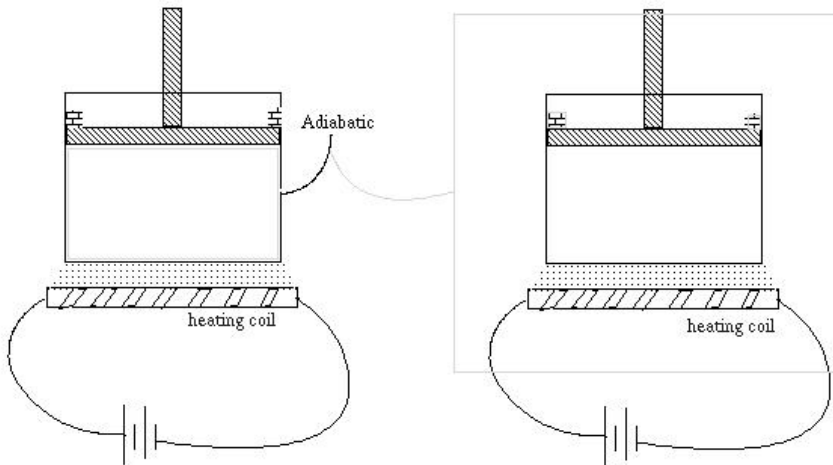


Figure 1.