

1. A sample consisting of 1 mol of a monatomic perfect gas (for which $C_V=1.5R$) is taken through the cycle shown in Fig. 1. (a) Determine the temperatures at 1, 2, and 3. (6%) (b) Calculate q , w , ΔU , ΔH for each step and for the overall cycle. (12%)

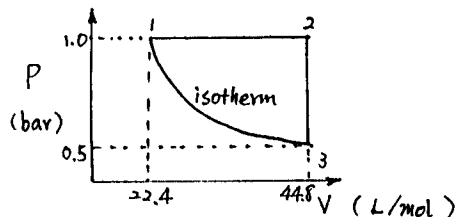


Fig. 1. P - V diagram of a monatomic perfect gas.

2. One mole of water at 20°C is evaporated to a water vapor of 120°C . Derive the equation for calculation of ΔH° , and write the data you need. (6%)
3. For the reaction $\text{C}(\text{diamond}) = \text{C}(\text{graphite})$, at what pressure are the two forms of carbon in equilibrium at 25°C ? (12%)

Given the following properties of graphite and diamond at 25°C and 1.013 bar.

	ΔH° (kJmol^{-1})	ΔS° ($\text{Jmol}^{-1}\text{K}^{-1}$)	density (gcm^{-3})
graphite	0	5.6940	2.25
diamond	1.8962	2.4389	3.50

4. The surface energy of periclase (MgO) is 1000 ergs/cm^2 . How much energy is required to crush one gram of MgO to a powder whose particles each have a dimension of one micron (10^{-6} m)? Assuming MgO is cubic before and after crushing. The density of MgO is 3.65 g/cm^3 . (12%)
5. Answer the belows briefly:
- (a) A phase transition, such as the melting of a solid, can occur reversibly and therefore $\Delta S = 0$. But it is often stated that melting involves an entropy increase. Are the two statements contradictory each other? (6%)
- (b) A gas expands reversibly and adiabatically to a larger volume, its volume is smaller than it would be after an isothermal expansion to the same final pressure. Why? (6%)