

Worksheet 8

March 4th, 2022

Collaborations are encouraged and students must report all collaborators on each assignment. All external sources (websites, books) must be cited. An *extra credit* (*EC*) problem will be available per assignment. Please submit a completed homework on-time to receive *EC* and no partial *EC* (all parts must be correct) will be given out. Additional problems are listed at the end of each assignment. This week's assignment is due *Tuesday, March 8th at 2:00pm*.

1. **Phase Diagram** The phase diagram for carbon is shown in Fig. 1. Answer the following questions:

- (a) At 3000K, what is the minimum pressure needed before graphite changes into diamond?
- (b) What is the minimum temperature at which liquid carbon exist at pressures below 10,000 atm?
- (c) Based on the phase diagram, are diamonds stable under normal conditions e.g. 1 atm and room temperature? If not, why are people able to wear diamonds without keeping them under high pressure?

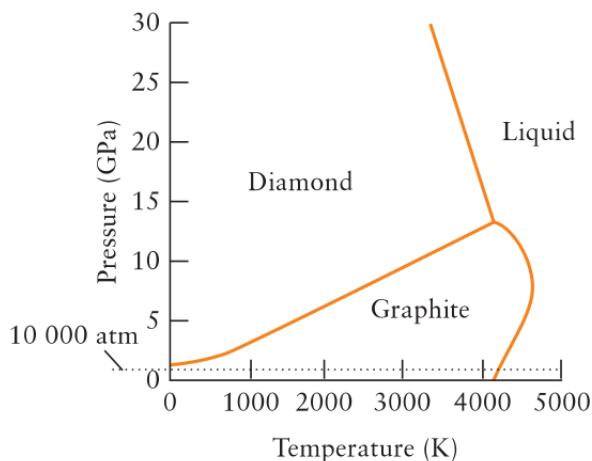


Figure 1: Phase diagram for carbon

2. Clausius–Clapeyron Equation The Clausius–Clapeyron equation relates the vapor pressure and temperature of the system given by

$$P_f = P_i e^{-\frac{\Delta H_{\text{vap}}^\circ}{R}(\frac{1}{T_2} - \frac{1}{T_1})} \quad (1)$$

where P is the vapor pressure, T is the temperature, and $\Delta H_{\text{vap}}^\circ$ is the enthalpy of vaporization.

(a) At ground level, the vapor pressure of water at 80°C is 355.26 Torr. Determine the $\Delta H_{\text{vap}}^\circ$ for water. *Hint: What is the vapor pressure of water at 100°C?*

(b) Using the $\Delta H_{\text{vap}}^\circ$ in part (a), determine the amount of energy needed to heat 1 L of water from 10°C to 120°C? Heat capacities of liquid water and water vapor are 4.184 J/(g °C) and 1.996 J/(g °C), respectively.

3.

Optional Additional Problems: Ch. 11 - odd problems 35 – 45, 53 – 89

Ch. 13 - odd problems 65 – 93

Ch. 12 - odd problems 27 – 51, 77 – 89