

### 8.3 The Phase Rule

- 3 phases  $\alpha$ ,  $\beta$ , and  $\gamma$  exist in equilibrium you get:

$$M_{\alpha}(T, P) = M_{\beta}(T, P) = M_{\gamma}(T, P)$$

- degrees of freedom - a system of substance has two
- phase rule for a pure substance takes the form:

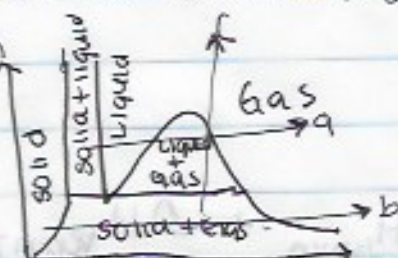
$$F = 3 - P$$

$F$  = # of degrees of freedom

$P$  = # phases.

### 8.4 The Pressure-Volume and Pressure-Volume-Temperature Phase Diagrams

- $P$ - $V$  phase diagrams used for seeing the complement of information contained in the  $P$ - $T$  phase diagram



- $V_m^{\text{solid}} < V_m^{\text{liquid}} < V_m^{\text{gas}}$
- in the figure process b is Freeze drying
- $P$ - $V$ - $T$  phase diagram - 3 dimensional diagram displaying all  $P$ - $T$ ,  $P$ - $V$ , etc.