CEN 207 Physical Chemistry

Text book:

Atkins' Physical Chemistry, Peter Atkins, Julio de Paula, James Keeler, 11th Edition, Oxford University Press.

Reference books

. Physical Chemistry, Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi

. Physical Chemistry, Ira N. Levine

Physical Transformation of Pure Substance

The slopes of phase boundaries;

At equilibrium,

$$\boldsymbol{d\mu(\alpha) = d\mu(\beta)}$$

$$\boldsymbol{dG(\alpha) = dG(\beta)}$$

$$\boldsymbol{V_m(\alpha)dp - S_m(\alpha)dT = V_m(\beta)dp - S_m(\beta)dT}$$

V_m and S_m: molar volume and entropy. From this equation

$$[S_m(\beta) - S_m(\alpha)]dT = [V_m(\beta) - V_m(\alpha)]dp$$

$$\Delta_{trs}SdT = \Delta_{trs}Vdp$$

Physical Transformation of Pure Substance

$$\frac{dp}{dT} = \frac{\Delta_{trs}S}{\Delta_{trs}V}$$ Clapeyron equation

$$\frac{dT}{dp} = \frac{\Delta_{trs}V}{\Delta_{trs}S}$$

The Clapeyron equation is an exact expression for the slope of tangent to the phase boundary ant any point and applies to any phase equilibrium of any pure substance.

Remember $\Delta_{trs}S = \frac{\Delta_{trs}H}{T_{trs}}$

Physical Transformation of Pure Substance

The liquid-vapour boundary

$$\frac{dp}{dT} = \frac{\Delta_{trs}S}{\Delta_{trs}V} \qquad \Delta_{trs}S = \frac{\Delta_{trs}H}{T_{trs}}$$

$$\frac{dp}{dT} = \frac{\Delta_{trs}H}{T\Delta_{trs}V} \rightarrow \underbrace{\frac{dp}{dT} = \frac{\Delta_{vap}H}{T\Delta_{vap}V}}_{\textbf{slope of liquid-vapour boundary}}$$

$\Delta_{vap}V \cong V_m(g) = \frac{RT}{p}$ (perfect gas)

$$\frac{dp}{dT} = \frac{\Delta_{vap}H}{T\left(\frac{RT}{p}\right)} = \frac{p\Delta_{vap}H}{RT^2}$$

Physical Transformation of Pure Substance

Remember: dx/x = dlnx; dp/p=dlnp

$$\frac{dlnp}{dT} = \frac{\Delta_{vap}H}{RT^2} \quad Clasius - Clapeyron\ equation$$

$$\int_{p^*}^{p} dlnp = \frac{\Delta_{vap}H}{R}\int_{T^*}^{T}\frac{dT}{T^2}$$

$$\boldsymbol{ln\frac{p}{p^*} = -\frac{\Delta_{vap}H}{R}\left(\frac{1}{T} - \frac{1}{T^*}\right)}$$

Text book: Atkins' Physical Chemistry, Peter Atkins, Julio de Paula, James Keeler, 11th Edition, Oxford University Press.

To start the topic “Chemical equilibrium”:

In this context; The topics to be taught are as follows:

- ❑ The equilibrium constant,
- ❑ The response of equilibria to conditions,
- ❑ Electrochemical cells,
- ❑ Electrode potentials

Text book: Atkins’ Physical Chemistry, Peter Atkins, Julio de Paula, James Keeler, 11th Edition, Oxford University Press.