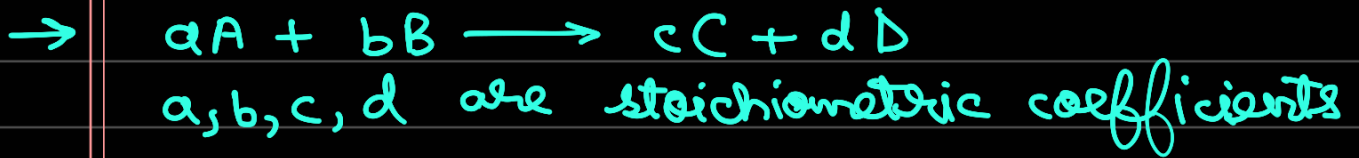


## Day-3



Criterion for chemical equilibrium

$$c\bar{g}_c + d\bar{g}_d - a\bar{g}_A - b\bar{g}_B = 0$$

Equilibrium constant for ideal gas mixtures

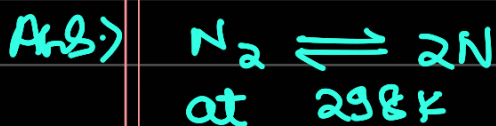
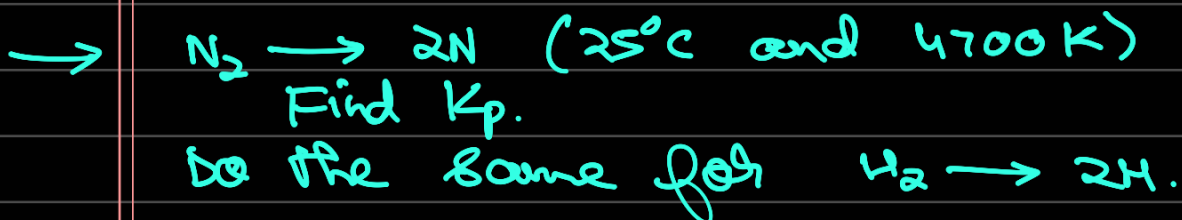
$$K_p = \frac{(P_c/P_0)^c (P_d/P_0)^d}{(P_a/P_0)^a (P_b/P_0)^b}$$

$$\Delta G^\circ = -R_u T \ln K_p$$

$$\Rightarrow K_p = \exp\left(\frac{-\Delta G^\circ(T)}{R_u T}\right)$$

$$= \exp\left(\frac{a\bar{g}_A^\circ(T) + b\bar{g}_B^\circ(T) - c\bar{g}_c^\circ(T) - d\bar{g}_d^\circ(T)}{R_u T}\right)$$

$$\Rightarrow K_p = \frac{N_c^c N_d^d}{N_A^a N_B^b} \left( \frac{P_{\text{mix}}}{P^\circ N_{\text{Total}}} \right)^{c+d-a-b}$$



$$K_p = \exp\left[\frac{1 \times 0 - 2 \times 455504}{8.314 \times 298}\right]$$

$$\approx 2.03 \times 10^{-160}$$

$$\approx 0$$

at 4700K

$$K_p = \exp\left(\frac{1 \times 0 - 2 \times 162730}{8.314 \times 4700}\right)$$

$$= 2.414 \times 10^{-4}$$



At 1000 K

$$K_p = \exp\left(\frac{1 \times 0 - 2 \times 165528}{8.314 \times 1000}\right)$$

$$= 5.091 \times 10^{-18}$$

At 4700 K

$$K_p = \exp\left(\frac{1 \times 0 - 2 \times -58545}{8.314 \times 4700}\right)$$

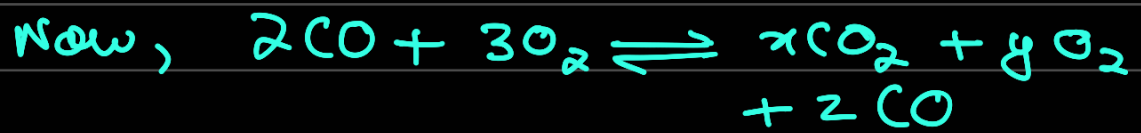
$$= 20.015$$

→ 2 kmol CO + 3 kmol O<sub>2</sub> heated to 2600K,  
p = 304 kPa. Find eq. comp., mixture  
has CO + CO<sub>2</sub> + O<sub>2</sub>.



$$K_p = \exp\left(\frac{1 \times -335389 + \frac{1}{2} \times 0 - 1 \times -396061}{8.314 \times 2600}\right)$$

$$= 16.5485$$



$$2 = x + z, \quad 2 + 3 \times 2 = 2x + 2y + z$$

$$\Rightarrow x + y + z/2 = 4$$

$$K_p = \frac{x^1}{(2-x)^1 (3-x/2)^{1/2}} \left( \frac{304 \times 10^3}{101.325 \times 10^3 \times (5-x/2)} \right)^{-0.5}$$

$$= 16.5485$$

$$\Rightarrow x = 1.906$$

