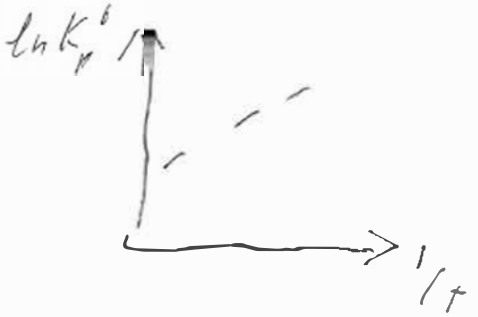
CHEM 3423 001 Spring 2026 **Name:**

ID:

Worksheet # 9(Total number of points you can get is **3 pts**)

1. Assume that in a chemical reaction ΔH^0 does not depend on temperature.
   a. **(0.75pt)** Draw a van't Hoff plot, i.e ln K_p^0 over 1/T. What thermodynamic quantity can be obtained from the slope, and what quantity from the intercept?



slope : $-\Delta H/R$

intercept : $\Delta S^0/R$

   b. **(0.75pt)** If the temperature is increased from T_1 = 20°C to T_2 = 60°C, what is the ratio between the equilibrium constants K_1^0 and K_2^0? (ΔH^0 = 100J).

$$\ln K_1^0 = -\frac{\Delta H^0}{RT_1} + \frac{\Delta S^0}{R}, \quad \ln K_2^0 = -\frac{\Delta H^0}{RT_2} + \frac{\Delta S^0}{R}$$

$$\Rightarrow \ln K_2^0 - \ln K_1^0 = -\frac{\Delta H^0}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) = \frac{\Delta H^0}{R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

$$\Rightarrow \frac{K_2^0}{K_1^0} = \exp\left(\frac{\Delta H}{R}\frac{T_2 - T_1}{T_1 T_2}\right) = \exp\left(\frac{100}{8.3145}\frac{40}{243.15 \cdot 333.15}\right) = 1.005$$

2. **(1.5pts)** At 2500 K the equilibrium partial pressures of three gases A, B, and C are 0.6, 0.4, and 0.2 bar, respectively. Calculate ΔG_p^0 at 2500 K for the reaction $2A(g) \Leftrightarrow 2B(g)+C(g)$.

$$K_p^0 = \frac{(0.4)^2 \cdot 0.2}{(0.6)^2} = 0.089$$

$$\Delta G^0 = -RT \ln K_p^0 = -8.3145 \cdot 2500 \cdot \ln 0.089 \text{ J}$$

$$= 8.3145 \cdot 2500 \cdot 2.42 \text{ J}$$

$$= 50,310 \text{ J} = 50.3 \text{ kJ}$$

3. (Bonus question, **0.5 pts**) Assume dissociation of chlorine into atoms according to $Cl_2 \Leftrightarrow 2Cl$. How does the degree of dissociation changes if the volume is doubled ? Why?

$$K_c = \text{const} \frac{[Cl]^2}{[Cl_2]} = \frac{n_{Cl}^2}{n_{Cl_2}} \cdot \frac{1}{V} \Rightarrow V \uparrow \Rightarrow \frac{n_{Cl}}{n_{Cl_2}} \uparrow$$

degree of dissociation doubles