CHEM 3423 001 Spring 2024 **Name:**
ID:

Worksheet # 6 (Total number of points you can get is **3 pts**)

1. Assume **adiabatic** reversible compression of 1 mol of an ideal gas from (P_1,V_1,T_1) to (P_2,V_2,T_2). (Draw P-V diagram!)

a. Does the temperature T increase or decrease? Why?

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}; \quad V_1 > V_2 \text{ and } \gamma > 1 \Rightarrow T_2 > T_1$$

b. Write down the reversible work in terms of heat capacity and temperature.

$$W_{rev} = \Delta U - Q = \Delta U = C_V (T_2 - T_1)$$

c. Compare with reversible **isothermal** compression from the same starting conditions (P_1,V_1,T_1) to a new state (P_2^*,V_2,T_1). Is P_2^* larger or smaller than P_2? Why?

isothermal: $P_1 V_1 = P_2^* V_2$
adiabatic: $P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$

$$P_2^* = P_2 \left(\frac{V_2}{V_1}\right)^{\gamma-1}$$

$\gamma > 1,\ V_2 < V_1 \Rightarrow P_2^* < P_2$

2. One mol of an ideal gas is reversibly expanded at constant temperature until $V_2 = 3\ V_1$. If the gas performed 3 kJ of work, what is its temperature?

$$W = RT \ln\frac{V_1}{V_2} \Rightarrow T = \frac{W}{R \ln \frac{V_1}{V_2}}$$

$$= \frac{-3 \cdot 10^3\ J}{-8.3145\ J/K \cdot \ln 3}$$

$$= \frac{3 \cdot 10^3}{8.3145 \cdot 1.099} = 328.4\ K$$

3. Why is the energetics of chemical reactions often described by enthalpy differences ΔH, instead of internal energy differences ΔU?

Experimental condition is usually P = const