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

Worksheet # 5 (Total number of points you can get is 3 **pts**)

1. At what temperature T and pressureP will H_2 bein a corresponding state with CH_4 at 600 K and 2.5 bar pressure? The critical temperatures are T_c = 33.2 K for H_2 and T_c=190.6 K for CH_4; the critical pressures P_c= 13.0 bar for H_2 and P_c=46.0 bar for CH_4.

$$P_R = \frac{P}{P_c} = \frac{2.5}{46.0} = 0.054 \Rightarrow P_{H_2} = P_R \cdot P_c = 0.702 \text{ bar}$$

$$T_R = \frac{T}{T_c} = \frac{600}{190.6} = 3.149 \Rightarrow T_{H_2} = T_R \cdot T_c = 104.52 \text{ K}$$

1. In an open beaker at 400 K and 1 bar pressure, 1 mol of zinc are caused to react with dilute sulfuric acid: $Zn + H_2SO_4 \Rightarrow ZnSO_4 + H_2$. Calculate the work done by the produced hydrogen gas, assuming it behaves as an ideal gas and T=const. P =const.

$$W = -P\Delta V = -\Delta n_{H_2} \cdot RT \qquad (PV = nRT)$$

$$= -1 \text{ mol} \cdot 8.3145 \frac{J}{K \cdot mol} \cdot 400 K$$

$$= -3325.8 J$$

2. n mole of gas N_2 occupy a volume of V_1=1.00 l at temperature T_1=200 K and pressure P_1=1000 KPa. Determine the volume V_2 of the same amount n of N_2 at T_2=400K and P_2=250 KPa. The compressibility factor for N_2 is z_1=2.0 at T_1= 200 K and P_1=1000 KPa; and z_2=1.0 at T_2=400K and P_2=250 KPa

$$Z_1 = \frac{P_1 V_1}{n R T_1} \Rightarrow n = \frac{P_1 V_1}{Z_1 R T_1}$$

$$Z_2 = \frac{P_2 V_2}{n R T_2} \Rightarrow V_2 = \frac{Z_2 n R T_2}{P_2}$$

$$V_2 = \frac{Z_2}{Z_1} \frac{T_2}{T_1} \frac{P_1}{P_2} V_1$$

$$= \frac{1.0 \cdot 400 \cdot 1000 \cdot 10^3}{2.0 \cdot 200 \cdot 250 \cdot 10^3} \cdot 1.00 \text{ l}$$

$$= 4.0 \text{ l}$$