LR

Recitation Quiz 1-26-04

1(a). A mole of each of these solids has the same number of atoms. There should therefore be the same number of degrees of freedom, each being allowed ½RT of energy. Therefore, they will have about the same molar heat capacity.

(b) To determine whether the system does work on the surroundings, we need to know the sign of ΔV -- does it expend or contract.

$$W = -P\Delta V = -P(V_f - V_i)$$

~~$V_f - V_i > 0$ it does work for us~~

~~$V_f - V_i < 0$ we do work on it~~

Since $N_2 + O_2 \rightarrow 2NO$ is endothermic,

~~$(\Delta H = \Delta H_f^\circ(NO) = 90\ kJ/mol$~~

the temperature would have to decrease and hence the volume at constant pressure decreases. We will do work on the system to compress it.

Recitation quiz 1-26-04

2. (a) $CH_3OH(g) + \frac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

(b) The pressure would be constant - the insulated room is like a coffee cup calorimeter.

We need $\Delta H = q_p$ to raise n moles of air ΔT

$\Delta H = q_p = nC_p \Delta T$. We want $\Delta T = 5C = 5K$

The number of moles of air is

$n = \frac{PV}{RT}$
$= 4063$ moles

$V = 4m \times 5m \times 5m = 100 m^3 \times \left(\frac{100 cm}{m}\right)^3 \times \frac{1 \text{ lit}}{1000 cm^3} = 10^5$ liters

$P = 1$ atm $T = 25C = 298K$

$R = 8.31$ J/mole-K $\times \frac{1 \text{ lit.-atm}}{101.3 J}$

Note that $C_v = 21$ J/mole-K but we need

$C_p = C_v + R = 29.31$ J/mol-K.

∴ We need $\Delta H = (4063 \text{ moles})(29.31 \frac{J}{mol\text{-}K})(5K) = 5.95 \times 10^5 J$

Burning one mole of $CH_3OH(g)$ gives in kJ/mol

~~$\Delta H = \Delta H_f(CO_2) + 2\Delta H_f(H_2O) - \frac{3}{2}\Delta H_f(O_2) - \Delta H_f(CH_3OH)$~~ (0)

$\Delta H = -394 + 2(-242) - (-201) = -677$ kJ/mol CH_3OH.

This much heat is released by the reaction per mole CH_3OH. and goes into heating the air

$\#$ moles CH_3OH to burn $= \frac{5.95 \times 10^5 J}{677 kJ} \times \frac{1 kJ}{1000 J} = 0.879$ moles

$\#$ gms $CH_3OH = 0.879$ moles $CH_3OH \times 32$ g/mole $= 28.1$ g