## Announcements – Lecture XXII – Tuesday, June 23rd

1. **Final Lab:** Today, 1:30-4:30, ISB 155 B
   *(Pre-Lab Quiz – TA Evaluation in Class Owls)*

2. **Exam III:** Friday, June 26th, In Class
   3 or 4 questions will be taken from Lab Owls:-
   3.4 , 4.2 , 4.5 , 5.5 , 5.6

**Quiz 18 – Last One ☺** Class #: ____ Last Name: ______________________

Given the standard enthalpy changes for the following two reactions:

(1) $N_2(g) + O_2(g) = 2\ NO(g)$ $\Delta H^o = 181.8$ kJ

(2) $N_2(g) + 2\ O_2(g) = N_2O_4(g)$ $\Delta H^o = 9.2$ kJ

what is the standard enthalpy change for the reaction:

(3) $2\ NO(g) + O_2(g) = N_2O_4(g)$ $\Delta H^o = ?$

(1) Reversed: $2NO(g) = N_2(g) + O_2(g)$ $\Delta H^o = -181.8$

(2) as is : $N_2(g) + 2O_2(g) = N_2O_4(g)$ $\Delta H^o = 9.2$

$2NO(g) + O_2(g) = N_2O_4(g)$ $\Delta H^o = -172.6$

## 5.6 Standard Heats of Reaction

### A: Standard Heat of Formation

$\Delta H_f^o$: The standard molar enthalpy of formation is the enthalpy change for the formation of 1 mole of a compound from its elements in their standard states.

$\Delta H_f^o$ $CH_4(g)$ = -74.9 kJ.mol$^{-1}$     $C(gr) + 2H_2(g) = CH_4(g)$

$\Delta H_f^o$ $NiCl_2(s)$ = -305 kJ.mol$^{-1}$     $Ni(s) + Cl_2(g) = NiCl_2(s)$

$\Delta H_f^o$ $PbCl_2(s)$ = -359 kJ.mol$^{-1}$     $Pb(s) + Cl_2(g) = PbCl_2(s)$

$\Delta H_f^o$ $Cl_2(g)$ = 0     $Cl_2(g) = Cl_2(g)$

→ The $\Delta H_f^o$ for the formation of any element in its standard state is ZERO

# 5.6 Standard Heats of Reaction

## A: Standard Heat of Formation and Hess's Law

Given the standard enthalpy changes for the following two reactions:

(1) $Ni(s) + Cl_2(g) \longrightarrow NiCl_2(s)$ $\Delta H^\circ = -305.3$ kJ $\Delta H_f^\circ\ NiCl_2(s)$

(2) $Pb(s) + Cl_2(g) \longrightarrow PbCl_2(s)$ $\Delta H^\circ = -359.4$ kJ $\Delta H_f^\circ\ PbCl_2(s)$

what is the standard enthalpy change for the reaction:

(3) $Ni(s) + PbCl_2(s) \longrightarrow NiCl_2(s) + Pb(s)$ $\Delta H^\circ = ?$

(Ni(s): $\Delta H_f^\circ = 0$; Pb(s): $\Delta H_f^\circ = 0$)

1. As is
2. Reversed

$$Ni(s) + Cl_2(g) = NiCl_2(s) \qquad \Delta H^\circ = -305.3$$
$$PbCl_2(s) = Pb(s) + Cl_2(g) \qquad \Delta H^\circ = 359.4$$
$$Ni(s) + PbCl_2(s) = NiCl_2(s) + Pb(s) \qquad \Delta H^\circ = 54.1 \text{ kJ}$$

$$\Delta H^\circ_{RXN} = \Delta H^\circ_1 - \Delta H^\circ_2$$
$$\Delta H^\circ_{RXN} = \sum \Delta H_f^\circ \text{ Products} - \sum \Delta H_f^\circ \text{ Reactants ?}$$
$$\Delta H^\circ_{RXN} = \Delta H_f^\circ\ NiCl_2(s) + \Delta H_f^\circ\ Pb(s) - \Delta H_f^\circ\ Ni(s) - \Delta H_f^\circ\ PbCl_2(s)$$
$$\Delta H^\circ_{RXN} = \Delta H^\circ_1 + 0 - 0 - \Delta H^\circ_2$$
$$\Delta H^\circ_{RXN} = \Delta H^\circ_1 - \Delta H^\circ_2$$

$$\boxed{\Delta H^\circ_{RXN} = \sum \Delta H_f^\circ \text{ Products} - \sum \Delta H_f^\circ \text{ Reactants}}$$

# 5.6 Standard Heats of Reaction

## A: Standard Heat of Formation and Hess's Law

Using standard heats of formation, calculate the standard enthalpy change for the following reaction.

$$2CO_2(g) + 5H_2(g) \longrightarrow C_2H_2(g) + 4H_2O(g)$$

$$\Delta H^\circ_{RXN} = \Sigma \Delta H^\circ_f \text{ Products} - \Sigma \Delta H^\circ_f \text{ Reactants}$$

$$= \Delta H^\circ_f\, C_2H_2(g) + 4\,\Delta H^\circ_f\, H_2O(g) - 2\,\Delta H^\circ_f\, CO_2(g) - 5\,\Delta H^\circ_f\, H_2(g)$$

$\hookrightarrow = 0$

$$= \Delta H^\circ_f\, C_2H_2(g) + 4\,\Delta H^\circ_f\, H_2O(g) - 2\,\Delta H^\circ_f\, CO_2(g)$$

Simply look these values up!

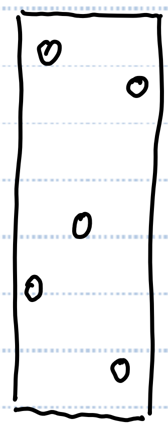
# 10.5 Kinetic Molecular Theory

## The Postulates

1) The volume occupied by the gas molecules is negligible in comparison to the volume of the container they are in.

2) Collisions between gas molecules are totally elastic ... no loss of energy ... no intermolecular force of attraction

3) $\overline{KE}$ is proportional to temperature ... at a given temperature all gases have the same average kinetic energy ($\overline{KE}$), regardless of their mass.



PRESSURE = Force per unit area

a) Energy of the collisions with the walls of the container.

b) The frequency of these collisions.