Key

Equilibrium Worksheet No. 1

1. Equilibrium is said to be dynamic. Explain why this is so and give an example of a dynamic equilibrium.

Both the forward and reverse reactions continue to occur, but at the same rate. eg. Saturated solution, both ions and crystal continue to form.

2. Indicate in each of the following reactions whether the tendency towards maximum entropy favors reactants or products.

a. $N_{2(g)} + 2O_{2(g)} + \text{heat} <===> 2NO_{2(g)}$ reactants
b. $N_{2(g)} + 3H_{2(g)} <===> 2NH_{3(g)} + \text{heat}$ reactants
c. $CH_{4(g)} + H_2O_{(g)} + \text{heat} <===> CO_{(g)} + 3H_{2(g)}$ products
d. $CS_{2(g)} + 4H_{2(g)} <===> CH_{4(g)} + 2H_2S_{(g)} + \text{heat}$ reactants

3. In each of the following reactions show the direction the reaction must proceed in to attain minimum enthalpy and maximum entropy.

a. $3O_{2(g)} ---> 2O_{3(g)}$ ▲H = +285 kJ ← ΔH ← ΔS
b. $1/2N_{2(g)} + O_{2(g)} ---> NO_{2(g)}$ ▲H = +34 kJ ← ΔH ← ΔS
c. $2\,H_2O_{(g)} ----> 2H_{2(g)} + O_{2(g)}$ ▲H = +484 kJ ← ΔH → ΔS
d. $P_{4(s)} + 6H_{2(g)} ---> 4PH_{3(g)}$ ▲H = +37 kJ ← ΔH ← ΔS

4. In which of the following reactions will the entropy favour the reactants while enthalpy favours the products?

a. $Cl_{2(g)} <=====> Cl_{2(aq)} + 25\text{ kJ}$
b. $P_{4(s)} + 6H_{2(g)} + 37\text{ kJ} <=====> 4PH_{3(g)}$
c. $PCl_{5(g)} <=====> PCl_{3(g)} + Cl_{2(g)}$; ▲H=+92.5 kJ
d. $NO_{2(g)} <=====> ½N_{2(g)} + O_{2(g)}$; ▲H=-33.8 kJ

5. For each of the following reactions determine the direction of the enthalpy drive and the direction of the entropy drive. Then determine which one factor is responsible for the forward reaction.

a. $\text{heat} + N_2O_{3(g)} <----> NO_{(g)} + NO_{2(g)}$ ← ΔH → ΔS entropy
b. $2H_{2(g)} + 2NO_{(g)} <---> N_{2(g)} + 2H_2O_{(g)} + \text{heat}$ → ΔH ← ΔS enthalpy
c. $CO_{(g)} + 1/2O_{2(g)} <--> CO_{2(g)}$ ▲H= - 283 kJ → ΔH ← ΔS enthalpy
d. $I_{2(g)} + Cl_{2(g)} <----> 2ICl_{(g)}$ ▲H= 35 kJ ← ΔH → ΔS entropy (if it is spon it must increase)
e. $H_2O_{(l)} <-------> H_2O_{(g)}$ ▲H= 41 kJ ← ΔH → ΔS entropy