AP CHEMISTRY CHAPTER 17 SAMPLE PROBLEMS

Sample problem 1

For each of the following pairs, choose the substance with the higher positional entropy (per mole) at a given temperature.

1. Solid carbon dioxide and gaseous carbon dioxide
2. Nitrogen gas at 1 atm and nitrogen gas at 0.010 atm

Sample problem 2

Predict the sign of the entropy change for each of the following processes

1. Solid sugar is added to water to form a solution
2. Iodine vapor condenses on a cold surface to form crystals

Sample problem 3

In a living cell, large molecules are assembled from simple ones. Is this process consistent with the second law of thermodynamics?

Sample problem 4

In the metallurgy of antimony, the pure metal is recovered via different reactions, depending on the composition of the ore. For example, iron is used to reduce antimony in sulfide ores:

Sb2S3(s) + 3Fe(s) → 2Sb(s) + 3FeS(s) ΔH = -125 kJ

Carbon is used as the reducing agent for oxide ores:

Sb4O6(s) + 6C(s)  → 4Sb(s) + 6CO(g) ΔH = 778 kJ

Calculate ΔSsurr for each of these reactions at 25oC and 1 atm

Sample problem 5

At what temperatures is the following process spontaneous at 1 atm?

Br2(l) → Br2(g) ΔHo = 31.0 kJ/mol and ΔSo = 93.0 J/ K. mol

What is the normal boiling point of liquid bromine?

Sample problem 6

Predict the sign of ΔSo for each of the following reactions.

1. The thermal decomposition of solid calcium carbonate
2. The oxidation of SO2(g) in air

Sample problem 7

Calculate ΔSo at 25oC for the reaction

2NiS(s) + 3H2(g) → 2Al(s) + 3H2O(g)

See page 804 for the values of So

Sample problem 8

Calculate ΔSo for the reduction of aluminum oxide by hydrogen gas:

Al2O3(s) + 3H2(g) → 2Al(s) + 3H2O(g)

See page 804 for the values of So

Sample problem 9

Consider the reaction carried out at 25oC and 1 atm

2SO2(g) + O2(g) → 2SO3(g)

See page 806 for table of information and calculate ΔHo, ΔSo and ΔGo

Sample problem 10

Using the following data at 25oC

Cdiamond + O2(g) → CO2(g) ΔGo = -397 kJ

Cgraphite + O2(g) → CO2(g) ΔGo = -394 kJ

Calculate ΔGo for the reaction

Cdiamond → Cgraphite

Sample problem 11

Methanol is a high octane fuel used in high performance racing engines. Calculate ΔGo for the reaction.

2CH3OH(g) + 3O2(g) → 2CO2(g) + 4H2O(g)

See page 809 for the table of information

Sample problem 12

A chemical engineer wants to determine the feasibility of making ethanol (C2H5OH) by reacting ethylene (C2H4) with water.

C2H4(g) + H2O(l) → C2H5OH(l)

Is this reaction spontaneous under standard conditions?

Sample problem 13

One method for synthesizing methanol (CH3OH) involves reacting carbon monoxide and hydrogen gases:

CO(g) + 2H2(g) → CH3OH(l)

Calculate ΔG at 25oC for this reaction where carbon monoxide gas at 5.0 atm and hydrogen gas at 3.0 atm are converted to liquid methanol.

Sample problem 14

Consider the ammonia synthesis reaction where ΔGo = -33.3 kJ per mole of nitrogen consumed at 25oC. For each of the following mixtures of reactants and products at 25oC, predict the direction in which the system will shift to reach equilibrium.

1. Pammonia = 1.00 atm, Pnitrogen = 1.47 atm, Phydrogen = 0.0100 atm
2. Pammonia = 1.00 atm, Pnitrogen = 1.00 atm, Phydrogen = 1.00 atm

Sample problem 15

The overall reaction for the corrosion of iron by oxygen is

4Fe(s) + 3O2(g) → 2Fe2O3(s)

Using the data on page 816, calculate the equilibrium constant for this reaction at 25oC