**Study questions for Chapter 18 – Thermodynamics**

*Test 6*

1. Which of the following will have the greatest entropy (S°)?

a. NH3 (g) b. He (g) c. C (s) d. H2O (l) e. CaCO3 (s)

A gas has the most disorder, compared to liquids and solids. So does a compound compared to an element.

2. Indicate which of the following would have the lowest entropy (S°).

 a. CH4 (g) b. CH3CH2OH (l) c. H2O (s) d. Na (s) e. He (g)

Na, because it is a solid and an element – opposite reasoning of Q1

3. Determine ΔS° for H2(g) + I2(g) → 2HI(g) given the following information:

 Substance S° (J/mol · K)

 H2(g) 130.58

 I2(g) 116.73

 HI(g) 206.3

a. –41.10 J/mol · K

b. –165.29 J/mol · K

c. +398.75 J/mol · K

d. +165.29 J/mol · K

e. +41.10 J/mol · K

4. A chemical reaction will always be spontaneous, regardless of temperature, when

a. ΔH > 0 and ΔS < 0

b. ΔH < 0 and ΔS < 0

c. ΔH > 0 and ΔS > 0

d. ΔH < 0 and ΔS > 0

e. None of these is true, as temperature must always be taken into account

ΔG will always be (-) and hence spontaneous in d

5. Hydrogen reacts with nitrogen to form ammonia (NH3) according to the reaction

 3H2(g) + N2(g) → 2NH3(g)

The value of ΔH° is –92.38 kJ/mol, and that of ΔS° is –198.2 J/mol · K. Determine ΔG° at 25°C.

a. +5.897 × 104 kJ/mol

b. +297.8 kJ/mol

c. –33.32 kJ/mol

d. –16.66 kJ/mol

e. +49.5 kJ/mol

*use G*o = *H*o - *TS*o

6. Calculate ΔG° for a reaction that has Keq = 3.96 x 10-9 at 373K

+60.0 kJ mol-1 use

7. Can you predict if a reaction is spontaneous if only ΔH for that reaction is known?

No, but probably spontaneous if exothermic (if ΔH is - )

8. Can you predict if a reaction is spontaneous if only ΔS for that reaction is known?

No, but probably spontaneous if entropy increases (if ΔS is + )

9. Can you predict if a reaction is spontaneous if only ΔG for that reaction is known?

Yes, always spontaneous if ΔG is -

10. What are units for ΔH, ΔS, and ΔG?

ΔH: kJ/mol ΔS: J/mol·K ΔG: kJ/mol