S23 CHEM 1032 – *Bloom* Quiz 1 – Week 6 Circle Day and Time:

Name: Key

M		T		W		Tr		F	
8	9	10	11	12	1	2	3	4	5

Clearly write your letter answer <u>on the line</u>.

B 1. (Remember) When the number of microstates in a system increases, the _____ of the system _____.

A. enthalpy, increases
B. entropy, increases
C. enthalpy, decreases
D. entropy, decreases

$S = k \ln W$
↑ ↑

B 2. (Remember) For some reaction, the sign of ΔS_{univ} is positive; therefore the sign of $\Delta G°$ is _____.

ΔS_{univ} (+) = spontaneous
$\Delta G°$ (−) = spontaneous

A. positive.
B. negative.
C. these two variables are unrelated to one another.
D. there is not enough information.

A 3. (Understand) The value of K for a reaction is 8.2×10^{-13}. How would you characterize the reaction?

$K <<< 1$ ∴ reactants favored.

A. The reaction is reactants favored.
B. The reaction is products favored.
C. The reaction is equally favored between products and reactants.
D. More information is needed.

B 4. (Understand) What is the correct chemical equation based on the equilibrium expression below?

$$K = \frac{[CO_2][CF_4]}{[COF_2]^3}$$ ← products / ← reactants

A. $CO_2\ (g) + CF_4\ (g) \rightleftharpoons 3\ COF_2\ (g)$
B. $3\ COF_2\ (g) \rightleftharpoons CO_2\ (g) + CF_4\ (g)$
C. $COF_2\ (g) \rightleftharpoons CO_2\ (g) + CF_4\ (g)$
D. $CO_2\ (g) + CF_4\ (g) \rightleftharpoons COF_2\ (g)$

$3\ COF_2 \rightleftharpoons CO_2 + CF_4$

Note: based on what is provided B is correct answer but the overall reactions are not balanced, exponent was supposed to be 2

D 5. (Apply) The value of K for a reaction is 3.4×10^{13}, what is the value of standard free energy?

A. -0.762 kJ/mol
B. -6.48 kJ/mol
C. -63.9 kJ/mol
D. -77.2 kJ/mol

$\Delta G^\circ = -RT \ln K$

$\Delta G^\circ = -(8.314\ J/mol \cdot K)(298\ K) \ln 3.4 \times 10^{13}$

B 6. (Apply) Determine the equilibrium concentration of compound C. The equilibrium concentration of A is 0.145 M. The equilibrium concentration of B is 0.0125 M. The equilibrium constant is 2.6×10^4.

$$A\ (g) + 2\ B\ (g) \rightleftharpoons 3\ C\ (g)$$

A. 3.61 M
B. 0.838 M
C. 0.768 M
D. 9.55×10^{-4} M

$K = \frac{[C]^3}{[A][B]^2}$

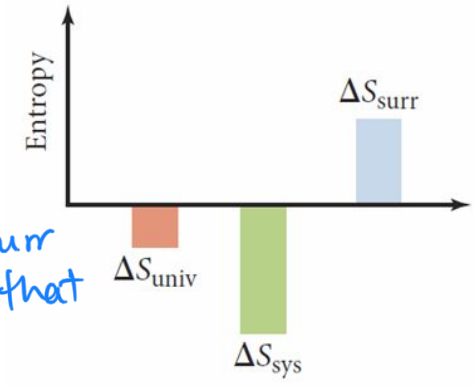
$2.6 \times 10^4 = \frac{[C]^3}{(0.145)(0.0125)^2}$

C 7. (Analyze) Put the standard molar entropy (S°) values in order from largest to smallest for the compounds Br_2 (ℓ), F_2 (g), and I_2 (s).

A. Br_2 (ℓ) > F_2 (g) > I_2 (s)
B. F_2 (g) > I_2 (s) > Br_2 (ℓ)
C. F_2 (g) > Br_2 (ℓ) > I_2 (s)
D. I_2 (s) > Br_2 (ℓ) > F_2 (g)

Entropy ↑ with ↑ disorder
Since all molecules are similar phase is used
gas > liquid > solid

A 8. (Analyze) The bar chart below represents a specific reaction, at a specific temperature. How would a decrease in temperature affect the spontaneity of the reaction?



ΔS_{univ} (−) non spont
$|\Delta S_{sys}| > |\Delta S_{surr}|$
For rxn to be spon ΔS_{surr} needs to get bigger... that will happen as T ↓

A. The reaction will be spontaneous at lower temperatures.
B. The reaction will be nonspontaneous at lower temperatures.
C. The reaction will not be affected by temperature, it is always spontaneous.
D. The reaction will not be affected by temperature, it is always nonspontaneous.

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A 9. (Evaluate) Using the table below determine which reaction you expect to produce the most products. Assume they are all occurring at 25 °C, at equivalent starting concentrations, and that the stoichiometries are equivalent.

$\Delta G^\circ = -143.3 - 298(0.0125)$
$\Delta G = -147.0$ kJ/mol ←

Reaction	ΔS°_{rxn} (J/mol)	ΔH°_{rxn} (kJ/mol)
1	12.5	-143.3
2	-10.5	98.0
3	51.4	-74.8

Can rule out w/o math $-\Delta S$ & $+\Delta H$ are never spon

$\Delta G^\circ = -74.8 - 298(0.0514)$
$\Delta G^\circ = -90.1$ kJ/mol

A. Reaction 1 ← largest (−) ΔG°
B. Reaction 2
C. Reaction 3
D. Reaction 1 and 3 will yield the same amount of products.

B 10. (Create) At standard conditions, you wish to generate NH_3 (g) with as little external intervention as possible. You have two options available, shown below. Using the table, choose an option and explain why it is the best choice.

	ΔS	ΔH
−	+	+
+	+	−

Option **X**: NH_4Cl (s) → HCl (g) + NH_3 (g)

Option **Y**: N_2H_4 (g) + H_2 (g) → 2 NH_3 (g)

Because ΔS + and ΔH − it is spon at all temp

Compound	S° (J/mol)	ΔH°_f (kJ/mol)
H_2 (g)	130.7	
HCl (g)	186.9	-92.3
N_2H_4 (g)	238.5	95.4
NH_4Cl (s)	94.6	-314.4
NH_3 (g)	192.8	-45.9

A. Option **X** is the better choice because it is spontaneous at all temperatures.
B. Option **Y** is the better choice because it is spontaneous at all temperatures.
C. Option **X** is the better choice because both options are nonspontaneous but **X** requires less external intervention.
D. Option **Y** is the better choice because both options are nonspontaneous but **Y** requires less external intervention.

X $\Delta S^\circ = (186.9 + 192.8) - 94.6 = 285.1$ J/K
$\Delta H^\circ = (-92.3 + -45.9) - -314.4 = 176.2$ kJ/mol

Y $\Delta S^\circ = (2(192.8)) - (238.5 + 130.7) = 16.4$ J/K
$\Delta H^\circ = (2(-45.9)) - (95.4 + 0) = -187.2$ kJ/mol

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Useful information:

1 atm = 760 mmHg 1 mmHg = 1 torr 0 ºC = 273 K

R = 8.314 J/(mol K) = 0.08206 (L atm)/(mol K)

$K_P = K_C(RT)^{\Delta n}$

$\Delta G° = \Delta H° - T\Delta S°$

$\Delta G^{o}_{rxn} = -RT\ln K$