

S23 CHEM 1032 – Bloom Quiz 1 – Week 6

Circle Day and Time:

Name: Key

M	T	W	Tr	F
8	9	10	11	12

Clearly write your letter answer on the line.

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 ΔG° is _____.

$$\Delta S_{\text{univ}} (+) = \text{spontaneous}$$

$$\Delta G^\circ (-) = \text{spontaneous}$$

- 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?

$$K \ll 1 \therefore \text{reactants favored.}$$

- 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?

$$K = \frac{[\text{CO}_2][\text{CF}_4]}{[\text{COF}_2]^3}$$

← products
← reactants

- A. $\text{CO}_2(g) + \text{CF}_4(g) \rightleftharpoons 3 \text{COF}_2(g)$
- B. $3 \text{COF}_2(g) \rightleftharpoons \text{CO}_2(g) + \text{CF}_4(g)$
- C. $\text{COF}_2(g) \rightleftharpoons \text{CO}_2(g) + \text{CF}_4(g)$
- D. $\text{CO}_2(g) + \text{CF}_4(g) \rightleftharpoons \text{COF}_2(g)$



* 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

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

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

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. 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 $\text{Br}_2(l)$, $\text{F}_2(g)$, and $\text{I}_2(s)$.

Entropy ↑ with ↑ disorder

Since all molecules are similar
phase is used

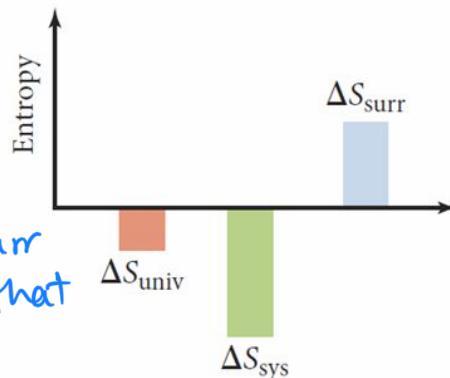
gas > liquid > solid

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?

$\Delta S_{\text{univ}} (-)$ non spontaneous

$|\Delta S_{\text{sys}}| > |\Delta S_{\text{surr}}$

For rxn to be spont ΔS_{surr}
needs to get bigger... that
will happen as $T \downarrow$



- 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.

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.

$$\Delta G^\circ = -143.3 - 298(0.0125)$$

$$\Delta G = -147.0 \text{ kJ/mol}$$

Reaction	$\Delta S^\circ_{\text{rxn}}$ (J/mol)	$\Delta H^\circ_{\text{rxn}}$ (kJ/mol)
1	12.5	-143.3
2	-10.5	98.0
3	51.4	-74.8

can rule out w/o
math $-\Delta S \not\equiv +\Delta H$
are never spont

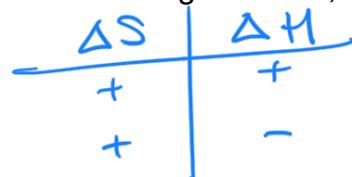
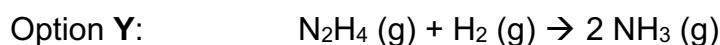
$$\Delta G^\circ = -74.8 - 298(0.0125)$$

$$\Delta G^\circ = -90.1 \text{ kJ/mol}$$

- 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 NH₃ (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.



Because $\Delta S > 0$
 and $\Delta H < 0$ it
 is spontaneous at
 all temps

Compound	S° (J/mol)	ΔH_f° (kJ/mol)
H ₂ (g)	130.7	
HCl (g)	186.9	-92.3
N ₂ H ₄ (g)	238.5	95.4
NH ₄ Cl (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.

$$X \Delta S^\circ = (186.9 + 192.8) - 94.6 = 285.1 \text{ J/K}$$

$$\Delta H^\circ = (-92.3 + -45.9) - -314.4 = 176.2 \text{ kJ/mol}$$

$$Y \Delta S^\circ = (2(192.8)) - (238.5 + 130.7) = 16.9 \text{ J/K}$$

$$\Delta H^\circ = (2(-45.9)) - (95.4 + 0) = -187.2 \text{ kJ/mol}$$

Useful information:

$$1 \text{ atm} = 760 \text{ mmHg} \quad 1 \text{ mmHg} = 1 \text{ torr} \quad 0^\circ \text{C} = 273 \text{ K}$$

$$R = 8.314 \text{ J/(mol K)} = 0.08206 \text{ (L atm)/(mol K)}$$

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

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$\Delta G_{rxn}^\circ = -RT\ln K$$

Periodic Table of the Elements

1 H Hydrogen 1.008	2 He Helium 4.003	18 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982
19 K Potassium 39.088	20 Ca Calcium 40.078	14 Si Silicon 28.086
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	15 P Phosphorus 30.974
55 Cs Cesium 132.905	56 Ba Barium 137.328	16 S Sulfur 32.066
87 Fr Francium 223.020	88 Ra Radium 226.025	17 F Fluorine 18.998
Lanthanide Series		18 Ar Argon 39.948
57 La Lanthanum 138.905	58 Ce Cerium 140.116	19 Ne Neon 39.948
89 Ac Actinium 227.028	90 Th Thorium 232.038	20 Br Bromine 79.904
Actinide Series		21 Kr Krypton 83.758
5 B Boron 10.811	6 C Carbon 12.011	22 Kr Krypton 83.758
11 IB Iodine 126.904	12 IB Iodine 126.904	23 Xe Xenon 131.234
13 III A Boron 10.811	14 VA Nitrogen 14.007	24 Po Polonium 208.982
15 VI A Oxygen 15.999	16 VI A Oxygen 15.999	25 At Astatine 209.987
17 VII A Fluorine 18.998	18 VII A Chlorine 35.453	26 Rn Radon 222.018
19 VA Nitrogen 14.007	20 VI A Oxygen 15.999	27 Tl Tellurium 127.6
21 IVB Boron 10.811	22 V Carbon 12.011	28 Te Tellurium 127.6
23 IVB Boron 10.811	24 Cr Chromium 51.996	29 Zn Zinc 65.38
25 VIB Boron 10.811	26 Mn Manganese 54.938	30 Ga Gallium 69.723
27 VIB Boron 10.811	28 Fe Iron 55.845	31 Ni Nickel 63.546
29 VII B Boron 10.811	30 Co Cobalt 58.933	32 Ge Germanium 72.631
31 VII B Boron 10.811	32 Rh Rhodium 103.906	33 As Arsenic 74.922
33 VII B Boron 10.811	34 Pd Palladium 106.442	34 Se Selenium 78.971
35 VII B Boron 10.811	36 Ag Silver 107.868	35 Br Bromine 79.904
37 VII B Boron 10.811	38 Cd Cadmium 112.414	36 Kr Krypton 83.758
39 V Boron 10.811	39 In Indium 114.818	37 Te Tellurium 127.6
40 Y Yttrium 88.906	41 Nb Niobium 92.906	40 Sn Antimony 121.760
42 Tc Technetium 98.907	43 Mo Molybdenum 95.963	41 Te Tellurium 127.6
44 Tc Technetium 98.907	45 Ru Ruthenium 101.07	42 Pb Lead 207.2
46 Pt Platinum 195.085	47 Au Gold 196.967	43 Bi Bismuth 208.980
48 Hg Mercury 200.592	49 Hg Mercury 200.592	44 Po Polonium 208.982
50 Hg Mercury 200.592	51 Sn Tin 118.711	45 At Astatine 209.987
52 Tl Thallium 204.383	53 Sn Tin 118.711	46 Rn Radon 222.018
54 Xe Xenon 131.234	55 Mc Moscovium [289]	47 Lv Livermorium [233]
56 Ba Barium 137.328	57 Tl Thallium 204.383	48 Yb Ytterbium 173.055
58 Fr Francium 223.020	59 Eu Europium 151.964	49 Lu Lutetium 174.967
60 Pr Praseodymium 144.913	61 Sm Samarium 150.36	50 No Nobelium 259.101
62 Sm Samarium 150.36	63 Eu Europium 151.964	51 Lr Lawrencium [262]
64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	52 Es Einsteinium [254]
66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	53 Fm Fermium 257.095
68 Er Erbium 167.539	69 Tm Thulium 168.934	54 Md Mendelevium 258.1
70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967	55 No Nobelium 259.101
72 Hf Hafnium 178.49	73 Ta Tantalum 183.84	73 Cf Curium 247.070
74 W Tungsten 183.84	75 Re Rhenium 186.207	74 Bk Berkelium 247.070
76 Os Osmium 190.23	77 Ir Iridium 192.217	75 Cm Curium 243.061
78 Pt Platinum 195.085	79 Au Gold 196.967	76 Am Americium 244.064
80 Hg Mercury 200.592	81 Tl Thallium 204.383	77 Fr Francium 223.020
82 Pb Lead 207.2	83 Sn Tin 118.711	78 Fr Francium 223.020
84 Bi Bismuth 208.980	85 Po Polonium 208.982	79 Fr Francium 223.020
86 At Astatine 209.987	87 Te Tellurium 127.6	80 Fr Francium 223.020
88 Ra Radium 226.025	89 Rf Rutherfordium [261]	81 Fr Francium 223.020
90 Ac Actinium 227.028	91 Pa Protactinium 231.036	82 Fr Francium 223.020
92 U Uranium 238.029	93 Np Neptunium 237.048	83 Fr Francium 223.020
94 Pu Plutonium 244.064	95 Am Americium 243.061	84 Fr Francium 223.020
96 Cm Curium 247.070	97 Bk Berkelium 247.070	85 Fr Francium 223.020
98 Cf Curium 247.070	99 Es Einsteinium [254]	86 Fr Francium 223.020
100 Fm Fermium 257.095	101 Md Mendelevium 258.1	87 Fr Francium 223.020
102 No Nobelium 259.101	103 Lr Lawrencium [262]	88 Fr Francium 223.020