Chem	130	Name
Exam 100 Po	4 sints	December 6, 2017
Please probler discuss	follow the instructions for each section of the ex- ms. Provide answers with the correct units and s- sion questions.	xam. Show your work on all mathematical ignificant figures. Be concise in your answers to
Part I: 1. For init by a. b. c. d.	 Complete all of problems 1-3. 4 points each. r the reaction CO (g) + H₂O (g) imed H₂ (g) + CO₂ tial equilibrium is established in a 1.00 L contai adding a catalyst. decreasing the temperature. transferring the mixture to a 10.0 L container Decreasing the pressure 	(g) at 1000K, $K_c = 0.66$ and $\Delta H^0 = -42$ kJ. After an ner, the equilibrium amount of H_2 can be increased
2. Ex a. b. c. d.	 pansion of a valence shell to accommodate mor carbon. nitrogen. phosphorous. oxygen. 	e than eight electrons is possible with: Answer
3. For mo	r the reaction $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) K_c$ ol of CH_3OH are brought together and allowed to mposition of the system at equilibrium?	= 14.5. If 5.00 mol CO, 2.00 mol H_2O and 3.00 o react, which of the following describes the
a. b.	 Some CO and H₂O will have been consumed CH₃OH. Some CH₃OH will have been consumed to m The amounts of CO. H.O. and CH OH will have been consumed to m 	to make more Answer

- c. The amounts of CO, H_2O , and CH_3OH will be unchanged from their initial values.
- d. There is not enough information to determine the equilibrium composition.

Part II. <u>Equilibrium</u>. Answer <u>four (4)</u> of problems 4-8. Clearly mark the problems you do not want graded. 15 points each.

4. What do we mean when we say a system has *come to equilibrium*? Describe the equilibrium condition and why we don't use a single headed arrow when we write equilibria. What does a small equilibrium constant mean in terms of thermodynamics?

- 5. Suppose the reaction system below has already reached equilibrium. Predict the effect of the following changes on the system. Justify your predictions with a brief statement. $UO_2(s) + 4HF(g) \rightleftharpoons UF_4(g) + 2H_2O(g)$
 - a. More UO_2 is added to the system.
 - b. The reaction is performed in a glass reaction vessel and the HF reacts with the glass.
 - c. Water vapor is removed.
 - d. The volume is increased.
- 6. You have been tasked with determining the equilibrium constant for the reaction of H_2 and S_2 gases to produce hydrogen sulfide. A mixture of 1.00 g H_2 and 1.00 g H_2S in a 0.500 L flask comes to equilibrium at 1670 K. At equilibrium, there is 8.00 x 10⁻⁶ mol of S_2 present. What are the values for K_c and K_p at this temperature?

7. At a certain temperature, the equilibrium constant, K_c , for this reaction is 53.3. At this temperature, 0.800 mol of H₂ and 0.400 mol of HI were placed in a 0.50 L container to react. What concentration of HI is present at equilibrium?

 $H_{2}\left(g\right)+I_{2}\left(g
ight) \rightleftharpoons 2HI\left(g
ight)$

Answer_____

Answer_____

Part III. <u>Bonding</u>. Answer <u>two (2)</u> of problems 9-11. Clearly mark the problem you do not want graded. 15 points each.

9. Complete the table for <u>three (3)</u> of the species below.

Specie s	Lewis Structure (indicate resonance if necessary)	Species	Lewis Structure (indicate resonance if necessary)
H ₂ O		NO ₂ -	
CIF ₃		CS ₂	

10. The Lewis structure for the thiocyanate ion (a polyatomic anion comprised of one atom each of C, N, and S) could be drawn in several ways, three of which are shown below. Which of these structures is more likely to be representative of the real structure of thiocyanate? Justify your answer.

$$\begin{bmatrix} \ddot{\mathbf{S}} = \mathbf{C} = \ddot{\mathbf{N}} \end{bmatrix}^{-} \qquad OR \qquad \begin{bmatrix} \ddot{\mathbf{C}} = \mathbf{S} = \ddot{\mathbf{N}} \end{bmatrix}^{-} \qquad OR \qquad \begin{bmatrix} \ddot{\mathbf{C}} = \mathbf{N} = \ddot{\mathbf{S}} \end{bmatrix}^{-}$$

11. Drawing the Lewis structure for carbonate ion (CO_3^{2-}) requires the use of the concept of *resonance*. Draw Lewis structures of carbonate and explain why resonance is necessary and how multiple resonance structures can be a better representation of the true structure than a single Lewis structure alone.

Possibly Useful Information

$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$ $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$	K = °C + 273.15	slope = m = $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$
$\Delta G = \Delta H - T \Delta S$	$^{\circ}C = K - 273.15$	$K_p = K_c (RT)^{\Delta n}$
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	pV = nRT	$\Delta G = -RTlnK$

1																	10
1A																	10
1 H 1.00794	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24,3050	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 	10	11 1B	12 2B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65,39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88,9059	40 Zr 91,224	41 Nb 92,9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102,906	46 Pd 106.42	47 Ag 107,868	48 Cd	49 In 114.818	50 Sn 118,710	51 Sb	52 Te 127.60	53 I 126,904	54 Xe 131,29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*Lanthanide series	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	140.115	140.908	144.24	(145)	150.36	151.965	157.25	158.925	162.50	164.930	167.26	168.934	173.04	174.967
⁺ Actinide series	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	232.038	231.036	238.029	237.048	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)

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