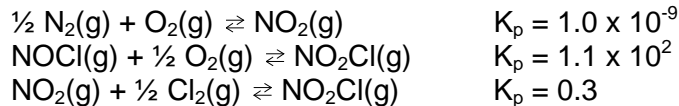


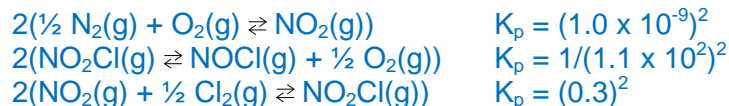
Quiz 10 – December 2, 2016

Complete the following problems. Write your final answers in the blanks provided.

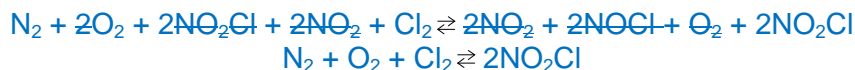
1. Determine K_c for the reaction: $N_2(g) + O_2(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ from the following data at 298K: (8 points)



We need to rearrange reactions to make our target reaction:



So, the sum of the reactions is:



$$K_p = \frac{(1.0 \times 10^{-9})^2 (0.3)^2}{(1.1 \times 10^2)^2} = 7.4 \times 10^{-24}$$

$$K_c = \frac{K_p}{(RT)^{\Delta n}} = \frac{7.4 \times 10^{-24}}{(0.08206 \times 298)^{-1}} = 1.81 \times 10^{-22}$$

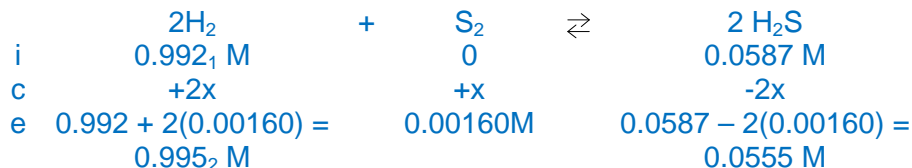
2. You have been tasked with determining the equilibrium constant for the reaction of H_2 and S_2 gases to produce hydrogen sulfide. In a 0.500 L flask, a mixture that initially contains no S_2 and is 0.992 M H_2 and 0.0587 M H_2S comes to equilibrium at 1670 K. At equilibrium, there is 8.00×10^{-4} mol of S_2 present. What are the values for K_c and K_p at this temperature? (9 points)

Start with a balanced chemical reaction:



The equilibrium concentration of $S_2 = (8.00 \times 10^{-4} \text{ mol}) / 0.5 \text{ L} = 0.00160 \text{ M } S_2$

We need to determine equilibrium concentrations for the other two species. Mapping out the chemistry:

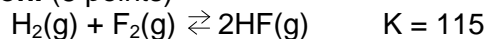


Plugging in to K_c :

$$K_c = \frac{[H_2S]^2}{[H_2]^2[S_2]} = \frac{(0.0555)^2}{(0.995_2)^2(0.0016)} = 1.94$$

$$K_p = K_c(RT)^{\Delta n} = 1.94(0.08206 \times 1670)^{-1} = 0.0142$$

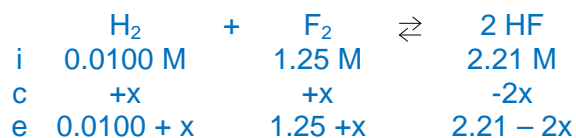
3. Consider the reaction below. If the initial concentrations of H₂, F₂, and HF are 0.0100M, 1.25 M, and 2.21 M, respectively, is the system at equilibrium? If not, which way will the reaction go to achieve the equilibrium condition? Set up, but do not complete the calculation you would use to determine the equilibrium concentrations of each of the species in the reaction. You DO NOT need to arrive at a numerical answer, just get to the point where you have one algebraic expression you could solve, given additional time. **Be sure to tell me what you would do with the result of your calculation.** (8 points)



Since we have initial concentrations of all species, we need to calculate Q first to determine the direction the reaction must go to get to equilibrium.

$$Q = \frac{[\text{HF}]^2}{[\text{H}_2][\text{F}_2]} = \frac{(2.21 \text{ M})^2}{(0.0100 \text{ M})(1.25 \text{ M})} = 390$$

Since $Q > K$, the reaction is product heavy and more reactants will be formed on the way to equilibrium.



Insert these values into the equilibrium constant expression:

$$K = \frac{[\text{HF}]^2}{[\text{H}_2][\text{F}_2]} = \frac{(2.21 - 2x)^2}{(0.0100 + x)(1.25 + x)} = 115$$

The boldface expression can now be solved for x, giving two possible solutions (quadratic). After choosing the chemically sensible solution, equilibrium concentrations can be calculate: [HF] = (2.21 - 2x)M, [H₂] = (0.0100 + x)M, [F₂] = (1.25 + x)M

Possibly Useful Information

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

18																8A
2																He
4																Be
6.941																9.01218
3																Li
11																12
22.9898																24.3050
19																20
39.0983																40.078
37																38
85.4678																87.62
55																56
132.905																137.327
87																88
226.025																227.028
1																2
1A																2A
1																2
1.00794																4.00260
3																4
6.941																9.01218
11																12
22.9898																24.3050
19																20
39.0983																40.078
37																38
85.4678																87.62
55																56
132.905																137.327
87																88
226.025																227.028
5																6
10.811																12.011
13																14
26.9815																28.0855
31																32
69.723																72.61
49																50
114.818																118.710
81																82
204.383																207.2
80																81
200.59																204.383
79																80
196.967																200.59
78																79
195.08																196.967
77																78
192.22																195.08
76																77
190.23																192.22
108																109
266																268
107																108
264																266
75																76
186.207																190.23
74																75
183.84																186.207
106																107
266																268
105																106
262																266
104																105
261																262
72																73
178.49																180.948
71																72
176.93																178.49
70																71
174.967																176.93
69																70
173.04																174.967
68																69
171.036																173.04
67																68
169.93																171.036
66																67
167.26																169.93
65																66
166.25																167.26
64																65
164.930																166.25
63																64
162.50																164.930
62																63
160.925																162.50
61																62
159.806																160.925
60																61
158.925																159.806
59																60
157.25																158.925
58																59
156.908																157.25
57																58
156.008																156.908
56																57
155.036																156.008
55																56
154.098																155.036
54																55
153.036																154.098
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128.451																128.906
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128.000																128.451
16																17
127.545																128.000
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76.130																76.585
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75.220																75.675
74.765																75.220
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73.400																73.855
72.945																73.400
72.490																72.945
72.035																72.490
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