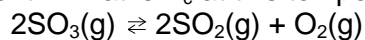


Quiz 9 – November 17, 2017

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

1. At 25°C, 0.760 mol SO₃ is placed in an otherwise empty 5.00 L container. When equilibrium is reached, 0.160 mol of O₂ is present. What is K_c at this temperature? (8 pts)



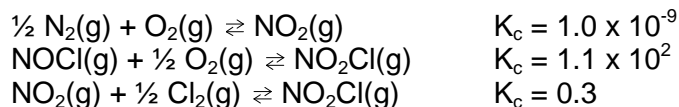
There are several ways to approach this. In the end, we need equilibrium concentrations of all species.

	2SO_3	\rightleftharpoons	2SO_2	+	O_2
I	0.760 mol/5 L = 0.152 M		0		0
C	-2x		+2x		+x
E	0.152-2(0.032) = 0.088 M		0+2(0.032) = 0.064 M		0.160 mol/5L = 0.0320 M = x

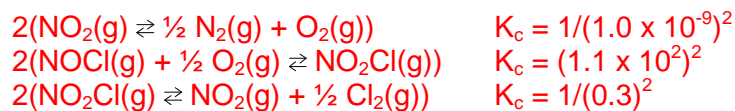
$$K_c = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2} = \frac{(0.0640)^2(0.0320)}{(0.088)^2} = 0.0169$$

Answer 0.0169

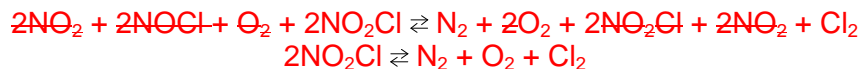
2. Determine K_c for the reaction: $2\text{NOCl}(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + \text{O}_2(\text{g}) + \text{Cl}_2(\text{g})$ from the following data at 298K: (8 points)



We need to rearrange reactions to make our target reaction:



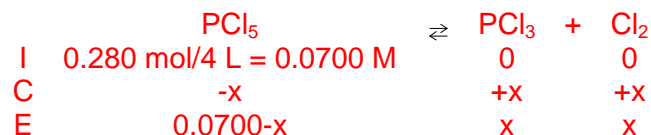
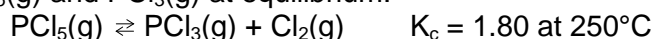
So, the sum of the reactions is:



$$K_c = \frac{(1.1 \times 10^2)^2}{(1.0 \times 10^{-9})^2(0.3)^2} = 1.3 \times 10^{23}$$

Answer 1.3 x 10²³

3. Phosphorus pentachloride decomposes according to the chemical equation below. A 0.280 mol sample of $\text{PCl}_5(\text{g})$ is injected into an empty 4.00 L reaction vessel held at 250°C . Calculate the concentrations of $\text{PCl}_5(\text{g})$ and $\text{PCl}_3(\text{g})$ at equilibrium.



$$K_c = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]} = \frac{(x)(x)}{0.0700-x}$$

$$K_c = \frac{x^2}{0.0700-x}$$

$$\begin{aligned} (0.0700-x)K_c &= x^2 \\ 0.0700K_c - xK_c &= x^2 \\ x^2 + K_cx - 0.0700K_c &= 0 \end{aligned}$$

Inserting 1.80 for K_c

$$x^2 + 1.80x - 0.126 = 0$$

Using the quadratic equation with $a = 1$, $b = 1.80$ and $c = -0.126$ gives:

$$x = 0.067 \text{ or } -1.87$$

Since we've defined x as a concentration, a negative value makes no chemical sense, therefore the appropriate value for x is 0.067 or $[\text{PCl}_3] = [\text{Cl}_2] = 0.0675 \text{ M}$ and $[\text{PCl}_5] = 0.0700 - 0.0675 = 0.0025 \text{ M}$

Answer_ $[\text{PCl}_3] 0.0675 \text{ M}$ and $[\text{PCl}_5] = 0.0025 \text{ M}$ _

Possibly Useful Information

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