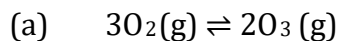


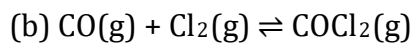
ICHO PRACTICE EXERCISE SOLUTIONS

GAS AND SOLUTION EQUILIBRIUM

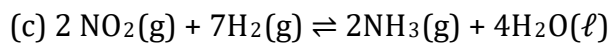
1. Write the equilibrium constant expression, K_c and K_p for the following reactions (if applicable):



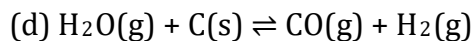
$$K_p = \frac{P_{\text{O}_3}^2}{P_{\text{O}_2}^3}$$



$$K_p = \frac{P_{\text{COCl}_2}}{P_{\text{CO}} P_{\text{Cl}_2}}$$

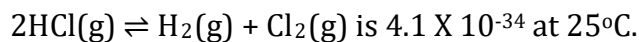


$$K_p = \frac{P_{\text{NH}_3}^2}{P_{\text{NO}_2}^2 P_{\text{H}_2}^7}$$

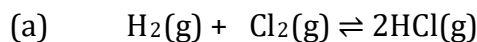


$$K_p = \frac{P_{\text{CO}} P_{\text{H}_2}}{P_{\text{H}_2\text{O}}}$$

2. The equilibrium constant (K_c) for the following reaction

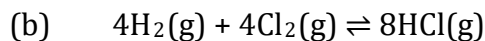


Calculate the equilibrium constant for the reaction:



Note: When the equation for a reversible reaction is written in the opposite direction, the equilibrium constant becomes the reciprocal of the original equilibrium constant

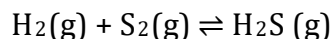
$$K_c = \frac{1}{4.1 \times 10^{-34}} = 2.44 \times 10^{33}$$



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$$K_c = [2.44 \times 10^{34}]^4$$

3. Consider the following equilibrium process:



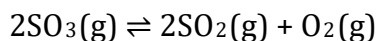
Analysis shows that there are 2.5 mols of H_2 and 1.35×10^{-5} moles of S_2 , and 8.70 moles of H_2S in a 12.0L flask Calculate the equilibrium constant K_c for the reaction.

$$[\text{H}_2] = \frac{2.5 \text{ mols}}{12.0 \text{ L}} = 0.2083 \text{ M}, [\text{S}_2] = \frac{1.35 \times 10^{-5} \text{ mols}}{12.0 \text{ L}} = 1.125 \times 10^{-6} \text{ M}$$

$$[\text{H}_2\text{S}] = \frac{8.70 \text{ mols}}{12.0 \text{ L}} = 0.725 \text{ M}$$

$$K_c = \frac{[0.725 \text{ M}]}{[0.2083 \text{ M}][1.125 \times 10^{-6} \text{ M}]} = \frac{[0.725 \text{ M}]}{[2.343 \times 10^{-7} \text{ M}]} = 3.094 \times 10^6$$

4. The equilibrium constant K_p for the reaction,



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is 1.8×10^{-5} at 350°C . What is the K_c for this reaction.

$$K_p = K_c (RT)^{\Delta n}$$

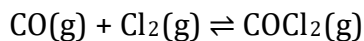
$$K_c = \frac{K_p}{(RT)^{\Delta n}} = \frac{1.8 \times 10^{-5}}{(0.0821 \times (350 + 273)K)^1} = \frac{1.8 \times 10^{-5}}{0.0821 \times 623K} = \mathbf{3.617 \times 10^{-7}}$$

5. What is the K_p at 1273°C for the reaction $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{CO}_2(\text{g})$ if K_c is 2.24×10^{22} . Comment on the extent of the equilibrium.

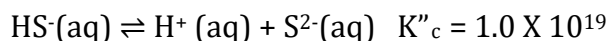
$$\begin{aligned} K_p &= K_c (RT)^{\Delta n} \\ &= (2.24 \times 10^{22})[(0.0821)(1273 + 273)K^{(2-3)}] \\ &= (2.24 \times 10^{22})[(0.0821)(1546K)^{-1}] \\ &= (2.24 \times 10^{22})(7.879 \times 10^{-3}) \\ &= \mathbf{1.765 \times 10^{20}} \end{aligned}$$

The reaction goes 100% to completion

6. Pure phosgene gas (COCl_2), 3.00×10^{-2} mol, was placed in a 1.5 L container. It was heated to 800K, and at equilibrium the pressure of CO was found to be 0.497 atm. Calculate the equilibrium concentration, K_p for the reaction:

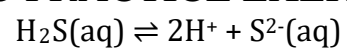


7. The following equilibrium constants were calculated for hydrosulfuric acid at 25°C :



Calculate the equilibrium constant for the following reaction:

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$$\begin{aligned} K_c &= K'_c \times K''_c \\ &= (9.5 \times 10^{-8})(1.0 \times 10^{19}) = \mathbf{9.5 \times 10^{11}} \end{aligned}$$