

Chemistry 30

Unit 3: Chemical Equilibrium

Assignment 2 2-1 to 2-2

The Equilibrium Constant

1.
 - a) What is meant by a reversible reaction?

 - b) Are all chemical reactions reversible?

 - c) Are all reversible reactions always at equilibrium?

 - d) Does a reaction have to be reversible in order to reach equilibrium?

 - e) What, exactly, is equal at equilibrium? (define equilibrium)

 - f) How is equilibrium different from a steady state system?

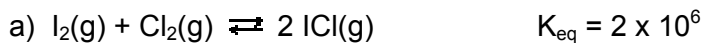
2. Write the equilibrium expression for each of the following reactions. Be sure to pay attention to physical states:
 - a) $\text{Br}_2(\text{g}) + 5 \text{F}_2(\text{g}) \rightleftharpoons 2 \text{BrF}_5(\text{g})$

 - b) $4 \text{HCl}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{H}_2\text{O}(\text{g}) + 2 \text{Cl}_2(\text{g})$

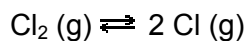
 - c) $5 \text{Fe}^{+2}(\text{aq}) + \text{MnO}_4^{-}(\text{aq}) + 8 \text{H}^{+}(\text{aq}) \rightleftharpoons 5 \text{Fe}^{+3}(\text{aq}) + \text{Mn}^{+2}(\text{aq}) + 4 \text{H}_2\text{O}(\text{l})$

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3. For each of the following reactions, state whether the value of the equilibrium constant favours the formation of reactants, products, or both sides equally.



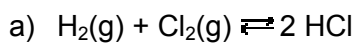
4. Molecular chlorine decomposes into atoms according to the reaction:



The equilibrium constant for the reaction at 25°C is 1.4×10^{-38} . Would many chlorine atoms be present at this temperature? How do you know?

5. Calculate K_{eq} for each of the following. Be sure to set up the equilibrium constant expression first, before substituting in the values.

Show your work! Pay attention to exponents!

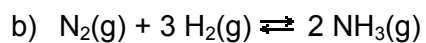


$$[\text{H}_2] = 1.0 \times 10^{-2} \text{ M}$$

$$[\text{Cl}_2] = 1.0 \times 10^{-2} \text{ M}$$

$$[\text{HCl}] = 1.0 \times 10^{-2} \text{ M}$$

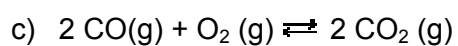
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$$[\text{N}_2] = 4.4 \times 10^{-2} \text{ M}$$

$$[\text{H}_2] = 1.2 \times 10^{-1} \text{ M}$$

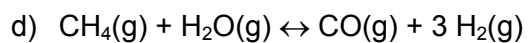
$$[\text{NH}_3] = 3.4 \times 10^{-3} \text{ M}$$



$$[\text{CO}] = 2.5 \times 10^{-3} \text{ M}$$

$$[\text{O}_2] = 1.6 \times 10^{-3} \text{ M}$$

$$[\text{CO}_2] = 3.2 \times 10^{-2} \text{ M}$$



$$[\text{CH}_4] = 2.97 \times 10^{-3} \text{ M}$$

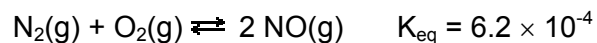
$$[\text{H}_2\text{O}] = 7.94 \times 10^{-3} \text{ M}$$

$$[\text{CO}] = 5.45 \times 10^{-3} \text{ M}$$

$$[\text{H}_2] = 2.1 \times 10^{-3} \text{ M}$$

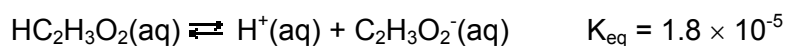
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6. For the following reaction at equilibrium at 2000°C, the concentration of N₂ and O₂ are both 5.2 M.



Calculate the concentration of NO at equilibrium. Show your work; pay careful attention to exponents.

7. Acetic acid, HC₂H₃O₂, is in equilibrium with its ions:



At equilibrium, the concentration of the ions are:

$$[\text{H}^+] = 1.33 \times 10^{-3} \text{ M}$$

$$[\text{C}_2\text{H}_3\text{O}_2^-] = 1.33 \times 10^{-3} \text{ M}$$

Calculate the concentration of the acid, HC₂H₃O₂.