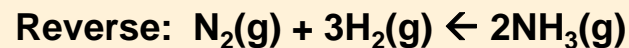
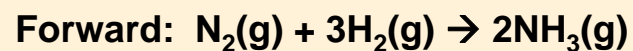
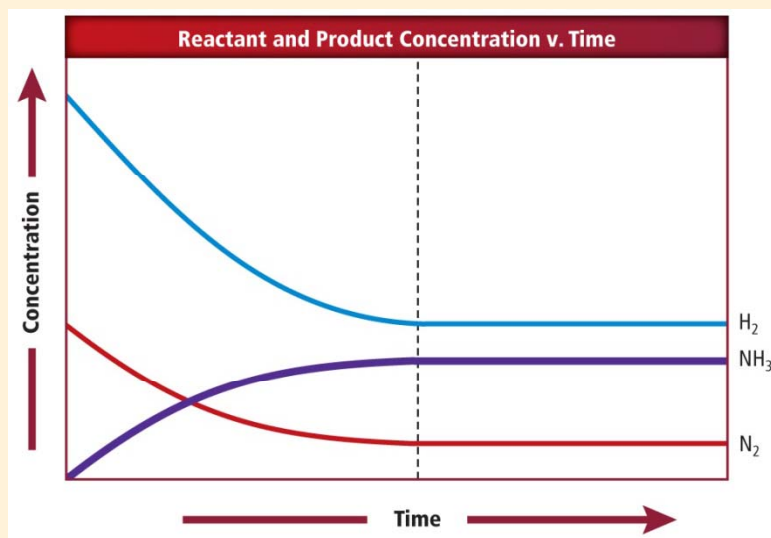


Notes 7 – Introduction to Chemical Equilibrium



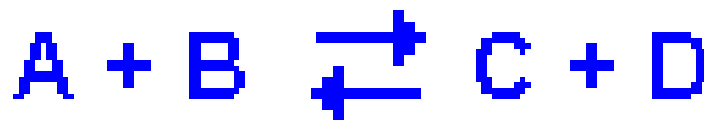
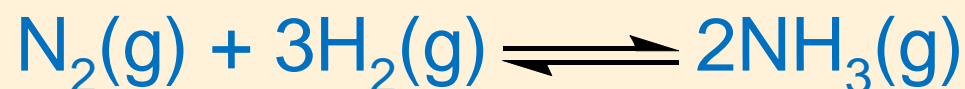
What is equilibrium?

- Chemical reactions often reach a balancing point, or equilibrium.



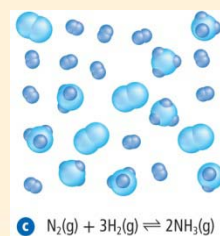
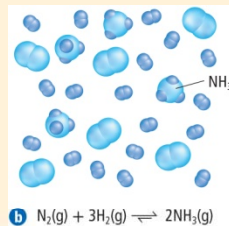
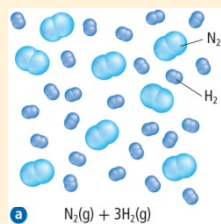
What is equilibrium? (cont.)

- A **reversible reaction** is a chemical reaction that can occur in both the forward and reverse directions, such as the formation of ammonia.



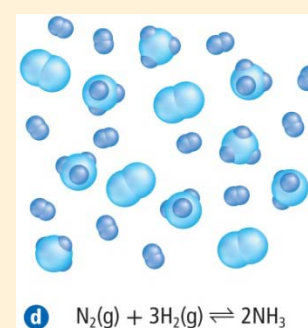
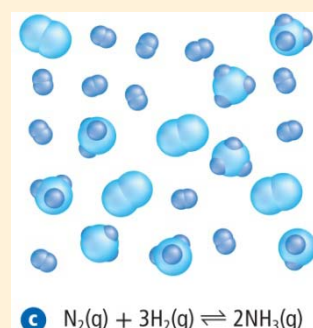
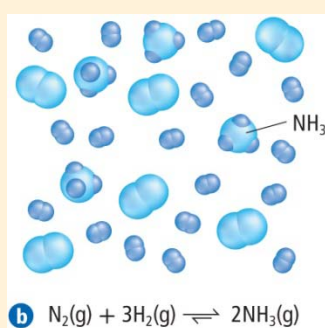
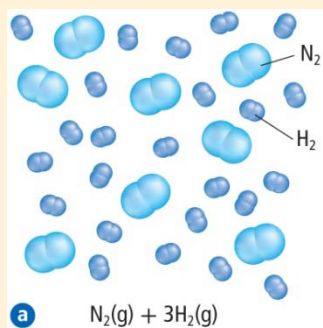
What is equilibrium? (cont.)

- How does reversibility affect the production of ammonia?
- Decreases in the concentrations of N_2 and H_2 cause the reaction to slow.
- As soon as ammonia is present, the reverse reaction can occur, slowly at first, but at an increasing rate as the concentration of ammonia increases.



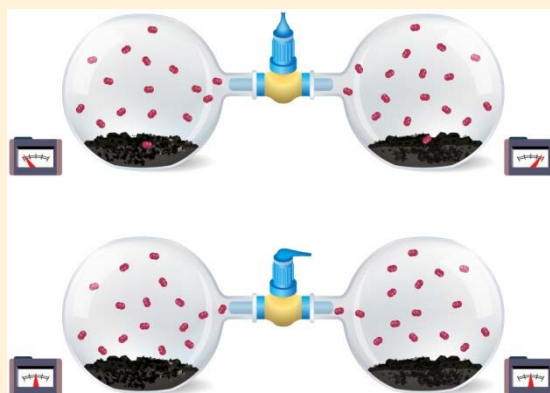
What is equilibrium? (cont.)

- This continues until the two rates, the forward slowing and reverse increasing, are equal
- At that point, the system has reached a state of equilibrium, figure *d*.



What is equilibrium? (cont.)

- Chemical equilibrium is a state in which the forward and reverse reactions balance each other because they take place at equal rates.
- Equilibrium is a state of action, not inaction.



Equilibrium Expressions

- Some chemical systems have little tendency to react, others go to completion.
- The majority reach a state of equilibrium with some of the reactants unconsumed.



Equilibrium Expressions (cont.)

- The law of chemical equilibrium states that at a given temperature, a chemical system might reach a state in which a particular ratio of reactant and product concentrations has a constant value.

The Equilibrium Constant Expression

$$K_{\text{eq}} = \frac{[\text{C}]^c [\text{D}]^d}{[\text{A}]^a [\text{B}]^b}$$

[A] and [B] are the molar concentrations of the reactants. [C] and [D] are the molar concentrations of the products.

The exponents *a*, *b*, *c*, and *d*, are the coefficients in the balanced equation.

The equilibrium constant expression is the ratio of the molar concentrations of the products to the molar concentrations of the reactants with each concentration raised to a power equal to its coefficient in the balanced chemical equation.

