

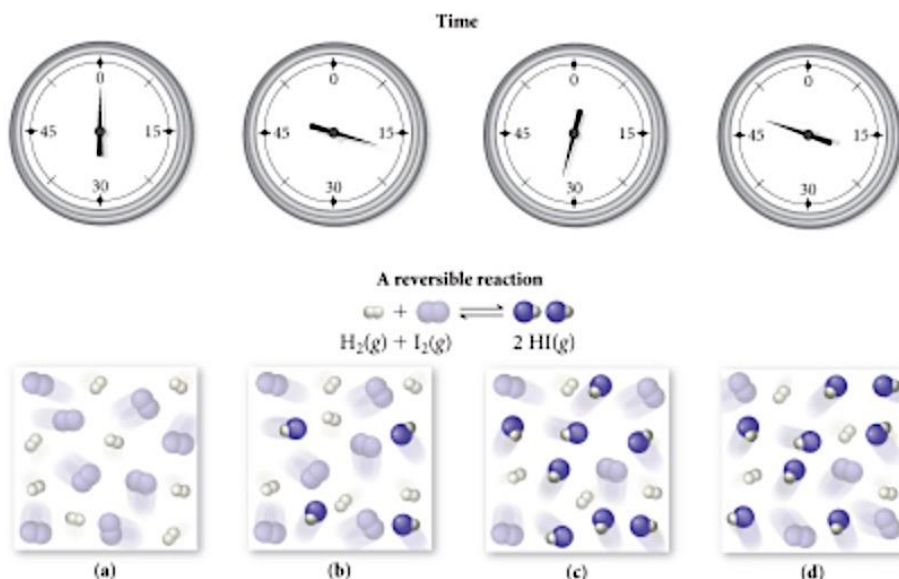
The material in this chapter is the focus of big Idea 6 on equilibrium in the AP curriculum. Equilibrium is one of the five most pervasive processes in chemistry. The concepts of a dynamic equilibrium, equilibrium constants, and Le Châtelier's principle are concepts to master.

14.1 Fetal Hemoglobin and Equilibrium

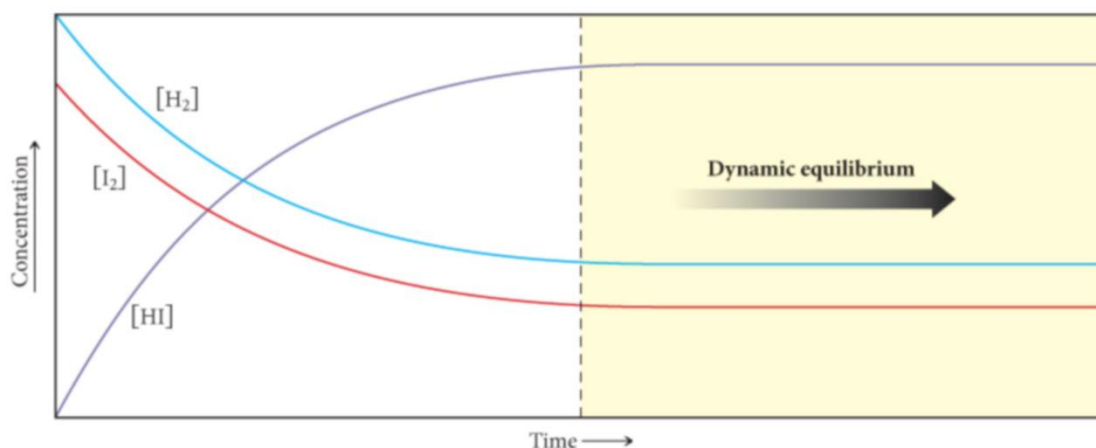
1. What does a large value of K indicate? What does a small value of K indicate?
2. For a system at equilibrium, if the concentration of reactants or products changes, what happens to the reaction?

14.2 The Concept of Dynamic Equilibrium

3. What does it mean when a reaction is reversible?
4. What is a dynamic equilibrium for a chemical reaction?
5. Is the reaction still occurring at equilibrium? Explain your answer.
6. Explain what is occurring in the reaction below, as it proceeds from (a) to (d)? How can you tell when equilibrium is reached?

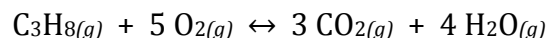


7. Identify on the graph when equilibrium is reached. Explain what data you are using to make this claim.



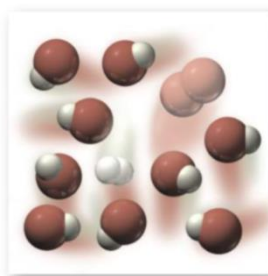
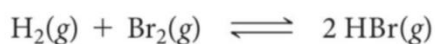
14.3 The Equilibrium Constant

8. What is the law of mass action? What does it represent?
9. Explain how to write an equilibrium expression. Use the equation below as an example along with your explanation.



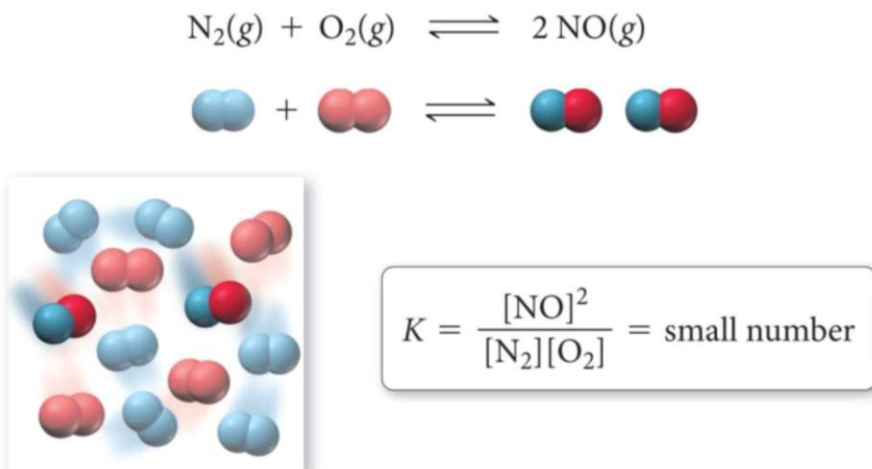
10. What does the size of the equilibrium constant indicate about a reaction?

11. If this figure represents equilibrium, would this example have a small or large equilibrium constant? What evidence supports your claim?



$$K = \frac{[\text{HBr}]^2}{[\text{H}_2][\text{Br}_2]} = \text{large number}$$

12. If this figure represents equilibrium, would this example have a small or large equilibrium constant? What evidence supports your claim?

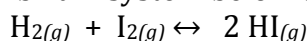


13. Explain what happens to the value of the equilibrium constant and why in each of the following situations:

- The chemical equation is reversed:
- The coefficients are changed:
- Two or more equations are added together to get a balanced overall reaction:

14.4 Expressing the Equilibrium Constant in Terms of Pressure

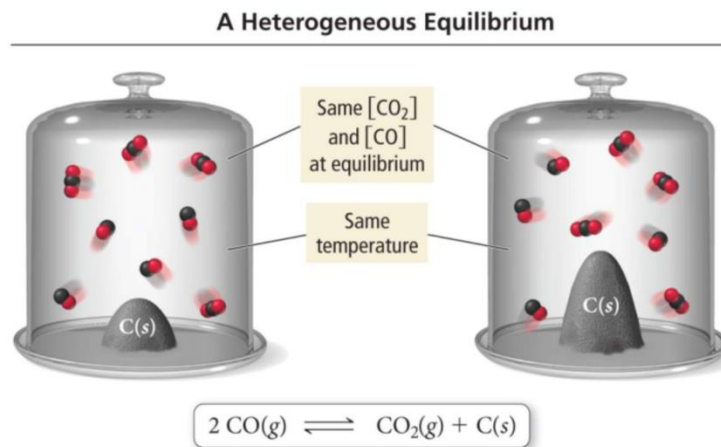
14. How is writing a pressure equilibrium expression different than writing a concentration equilibrium expression? Use the equilibrium system below to illustrate your answer:



14.5 Heterogeneous Equilibria: Reactions Involving Solids and Liquids

15. What is a heterogeneous equilibrium?

16. Why are solids and pure liquids ignored in equilibrium expressions?



17. What evidence supports the claim that the above figure is an example of a heterogeneous equilibrium?

14.6 Calculating the Equilibrium Constant from Measured Equilibrium Concentrations

18. Do initial concentrations affect the value of K ? Explain your answer.

19. What is an ICE table? What is it used for?

20. Why are coefficients important to analyze when using an ICE table?

14.7 The Reaction Quotient: Predicting the Direction of Change

21. What is Q and why is it important in equilibrium systems?

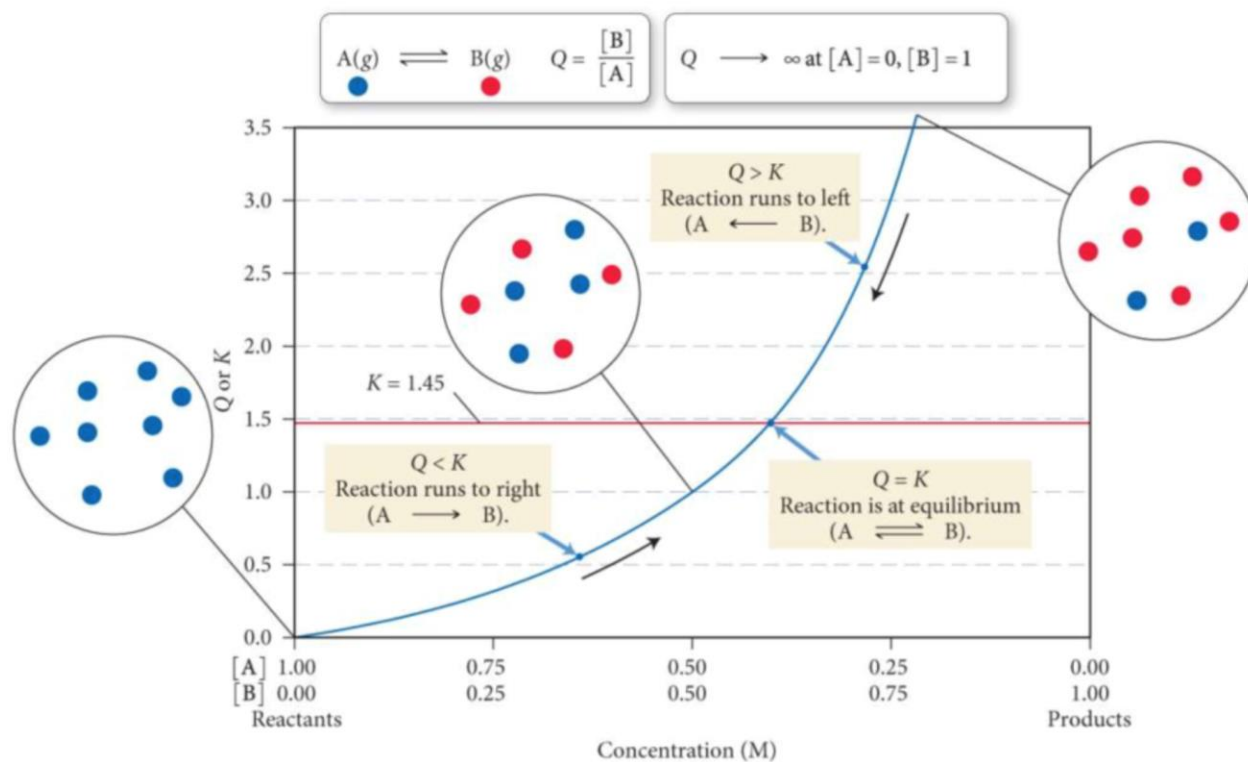
22. Explain what will occur if:

a. $Q > K$

b. $Q = K$

c. $Q < K$

Q, K, and the Direction of a Reaction



23. On the above figure, indicate where the following are located: $Q < K$, $Q = K$, $Q > K$. Explain what evidence supports your choice.

14.8 Finding Equilibrium Concentrations

24. What is the 5% rule? When is it used?

25. When does a quadratic equation need to be used when solving for an equilibrium concentration or pressure in an equilibrium system?

14.9 Le Châtelier's Principle: How a System at Equilibrium Responds to Disturbances

26. What is the concept behind Le Châtelier's Principle?

27. Explain how to analyze what will happen to a chemical system at equilibrium if more of a species is added to a system.

28. Explain how to analyze what will happen to a chemical system at equilibrium if pressure is added to the system?
29. Explain how to analyze what will happen to a chemical system at equilibrium if the temperature of the system is increased. How will the equilibrium value change?
30. Explain how to analyze what will happen to a chemical system at equilibrium if the temperature of the system is decreased. How will the equilibrium value change?
31. How does adding a catalyst affect a system at equilibrium?
32. How does adding an inert gas affect a system at equilibrium?