Unit 4 Chemical Systems and Equilibrium

Solutions to Chapter 7 Chemical Equilibrium Practice Problems

Equilibrium Constant Expressions for Homogeneous Chemical Systems (Student textbook page 428)

1. Write the equilibrium constant expression for the reaction at 200°C between ethanol and ethanoic acid to form ethyl ethanoate and water:

$$CH_3CH_2OH(g) + CH_3COOH(g) \rightleftharpoons CH_3COOCH_2CH_3(g) + H_2O(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced chemical equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[CH_3COOCH_2CH_3][H_2O]}{[CH_3CH_2OH][CH_3COOH]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The products are in the numerator and the reactants are in the denominator and each is raised to the power of 1 which is each coefficient in the balanced equation.

2. Write the equilibrium constant expression for the reaction between nitrogen gas and oxygen gas at high temperatures is given by the following balanced chemical reaction:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced chemical equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[NO]^2}{[N_2][O_2]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The product is in the numerator, the reactants are in the denominator and each is raised to power of its coefficient in the balanced chemical equation.

3. Write the equilibrium constant expression for the reaction between hydrogen gas and oxygen gas to form water vapour:

$$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced chemical equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[H_2O]^2}{[H_2]^2[O_2]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The product is in the numerator and the reactants are in the denominator and each is raised to power of its coefficient in the balanced chemical equation.

4. Write the equilibrium constant expression for the oxidation of ammonia (one of the reactions in the manufacture of nitric acid):

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactants are in the denominator, and each is raised to power of its coefficient in the balanced chemical equation.

5. Write the equilibrium constant expression for the reaction in which hydrogen sulfide reacts with methane and forms hydrogen gas and carbon disulfide as represented by the following reaction:

$$2H_2S(g) + CH_4(g) \rightleftharpoons 4H_2(g) + CS_2(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[H_2]^4[CS_2]}{[H_2S]^2[CH_4]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactants are in the denominator, and each is raised to power of its coefficient in the balanced equation.

6. Write the equilibrium constant expression for the the reaction in which antimony pentachloride, $SbCl_5$ (g), decomposes into antimony trichloride, $SbCl_3$(g), and chlorine gas, Cl_2 (g), in an equilibrium reaction.

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the reactant is antimony pentachloride, $SbCl_5$ (g) and the products are antimony trichloride, $SbCl_3$(g), and chlorine gas, Cl_2(g).

Plan Your Strategy	Act on Your Strategy
Write the balanced equation for the reaction.	$SbCl_5(g) \rightleftharpoons SbCl_3(g) + Cl_2(g)$
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[SbCl_3][Cl_2]}{[SbCl_5]}$

Check Your Solution
The equation is balanced. The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactant is in the denominator, and each is raised to power of its coefficient in the balanced equation.

7. Write the equilibrium constant expression for the reaction in which hydrogen gas displaces nitrogen from nitrogen monoxide gas to form nitrogen gas and water vapour according to the following reaction:

$$2H_2(g) + 2NO(g) \rightleftharpoons N_2(g) + 2H_2O(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced equation.

Plan Your Strategy	Act on Your Strategy
The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[N_2][H_2O]^2}{[H_2]^2[NO]^2}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactants are in the denominator, and each is raised to power of its coefficient in the balanced equation.

8. Write the equilibrium constant expression for the reaction in which sulfur trioxide gas, $SO_3(g)$, decomposes into sulfur dioxide gas, $SO_2(g)$, and oxygen gas, $O_2(g)$, in an equilibrium reaction.
a. Write the balanced chemical equation for the equilibrium reaction.
b. Write the equilibrium constant expression.

What Is Required?
a. You need to write the balanced equation.
b. You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the reactant is sulfur trioxide gas, $SO_3(g)$, and the products are sulfur dioxide gas, $SO_2(g)$, and oxygen gas, $O_2(g)$.

Plan Your Strategy	Act on Your Strategy
a. Use the given reactant and products to write the balanced chemical equation for the reaction.	$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$
b. The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$

Check Your Solution
The equation is balanced. The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactant is in the denominator, and each is raised to power of its coefficient in the balanced equation.

9. Write the equilibrium constant expression for the reaction in which nitrogen monoxide gas reacts with oxygen gas in an equilibrium reaction where nitrogen dioxide gas forms.
a. Write the balanced chemical equation for the equilibrium reaction.
b. Write the equilibrium constant expression.

What Is Required?
a. You need to write the formulas for the reactants and product and write the balanced equation for the reaction.
b. You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the reactants are nitrogen monoxide gas and oxygen gas and the product is nitrogen dioxide gas.

Plan Your Strategy	Act on Your Strategy
a. Write the chemical formulas for the given reactants and product and write the balanced equation for the reaction.	$2NO(g) + O_2(g) \rightleftharpoons 2NO_2\ (g)$
b. The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[NO_2]^2}{[NO]^2[O_2]}$

Check Your Solution
The equation is balanced. The square brackets indicate the concentration in mol/L. The product is in the numerator, the reactants are in the denominator, and each is raised to power of its coefficient in the balanced equation.

10. Write the equilibrium constant expression for the reaction in which oxygen gas displaces chlorine from hydrogen chloride gas in an equilibrium reaction where chlorine gas and water vapour form.
a. Write the balanced chemical equation for the equilibrium reaction.
b. Write the equilibrium constant expression.

What Is Required?
a. You need to write the formulas for the reactants and product and write the balanced equation for the reaction.
b. You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know that oxygen gas reacts with hydrogen chloride gas to produce chlorine gas and water vapour.

Plan Your Strategy	Act on Your Strategy
a. Write the chemical formulas for the given reactants and products and write the balanced chemical equation for the reaction.	$4HCl(g) + O_2(g) \rightleftharpoons 2H_2O(g) + 2Cl_2(g)$
b. The expression for the equilibrium constant follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Follow this format using the reactants, products, and coefficients in the given equation.	$K_{eq} = \frac{[H_2O]^2[Cl_2]^2}{[HCl]^4[O_2]}$

Check Your Solution
The equation is balanced. The square brackets indicate the concentration in mol/L. The products are in the numerator, the reactants are in the denominator, and each is raised to power of its coefficient in the balanced equation.

Equilibrium Constant Expressions for Heterogeneous Chemical Systems
(Student textbook page 430)

11. Write the equilibrium constant expression. In the decomposition of solid ammonium chloride, $NH_4Cl(s)$, the products ammonia gas, $NH_3(g)$, and hydrogen chloride gas, $HCl(g)$, form:

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[NH_3(g)][HCl(g)]}{[NH_4Cl(s)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression	$K[NH_4Cl(s)] = [NH_3(g)][HCl(g)]$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = [NH_3][HCl]$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The products are in the numerator, and each is raised to power of its coefficient in the balanced equation.
There are no reactants in the denominator.

12. Write the equilibrium constant expression. Hydrogen gas and liquid sulfur react and form hydrogen sulfide gas:

$$H_2(g) + S(\ell) \rightleftharpoons H_2S(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[H_2S(g)]}{[H_2(g)][S(\ell)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K[S(\ell)] = \frac{[H_2S(g)]}{[H_2(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{[H_2S(g)]}{[H_2(g)]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The product is in the numerator, the reactant is in the denominator, and each is raised to power of its coefficient in the balanced equation.

13. Write the equilibrium constant expression. Barium oxide and carbon dioxide react:

$BaO(s) + CO_2(g) \rightleftharpoons BaCO_3(g)$
(NOTE: The state of $BaCO_3$ is given as a gas in this problem. However, this is not the case. It is a solid at room temperature. The problem will be shown for the solid state.
$BaO(s) + CO_2(g) \rightleftharpoons BaCO_3(s)$)

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[BaCO_3(s)]}{[BaO(s)][CO_2(g)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K\frac{[BaO(s)]}{[BaCO_3(s)]} = \frac{1}{[CO_2(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{1}{[CO_2]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. There are no products in the numerator. The reactant, $CO_2(g)$, is in the denominator raised to the power of its coefficient in the balanced equation.

14. Write the equilibrium constant expression. Solid carbon and carbon dioxide gas react and form carbon monoxide:

$$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[CO(g)]^2}{[C(s)][CO_2(g)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K[C(s)] = \frac{[CO(g)]^2}{[CO_2(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{[CO(g)]^2}{[CO_2(g)]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The product is in the numerator, the reactant is in the denominator, and each is raised to the power of its coefficient in the balanced equation.

15. Write the equilibrium constant expression. Solid sodium hydrogen carbonate, $NaHCO_3(s)$, decomposes into solid sodium carbonate, $NaHCO_3(s)$, carbon dioxide gas, $CO_2(g)$, and water vapour, $H_2O(g)$:

$$2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[Na_2CO_3(s)][CO_2(g)][H_2O(g)]}{[NaHCO_3(s)]^2}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K \frac{[NaHCO_3(s)]^2}{[Na_2CO_3(s)]} = [CO_2(g)][H_2O(g)]$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = [CO_2(g)][H_2O(g)]$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The products that change in concentration are in the numerator and the denominator is 1 because no reactants remain in the denominator. There is no denominator in the final equation.

16. When ammonia gas reacts with water, ammonium ions, NH_4^+, and hydroxide ions, OH^-, form according to the following reaction:

$$NH_3(g) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[NH_4^+(aq)][OH^-(aq)]}{[NH_3(g)][H_2O(\ell)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K[H_2O(\ell)] = \frac{[NH_4^+(aq)][OH^-(aq)]}{[NH_3(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{[NH_4^+(aq)][OH^-(aq)]}{[NH_3(g)]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The products are in the numerator, the reactant that changes in concentration is in the denominator, and each is raised to the power of its coefficient in the balanced equation.

17. Solid iron reacts with water vapour as represented by the following reaction:

$$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$$

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the balanced chemical equation and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[Fe_3O_4(s)][H_2(g)]^4}{[Fe(s)]^3[H_2O(g)]^4}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K \frac{[Fe(s)]^3}{[Fe_3O_4(s)]} = \frac{[H_2(g)]^4}{[H_2O(g)]^4}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{[H_2(g)]^4}{[H_2O(g)]^4}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The product that changes in concentration is in the numerator, the reactant that changes in concentration is in the denominator, and each is raised to the power of its coefficient in the balanced equation.

18. In a closed container, solid magnesium and oxygen gas react to form magnesium oxide on the surface of the magnesium. This process is an equilibrium process. Write the equilibrium constant expression for this process.

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the reactants and the product and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
Write the chemical formulas of the reactants and the product and write the balanced chemical equation for the reaction.	$2Mg(s) + O_2(g) \rightleftharpoons 2MgO(s)$
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[MgO(s)]^2}{[Mg(s)]^2[O_2(g)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K \frac{[Mg(s)]^2}{[MgO(s)]^2} = \frac{1}{[O_2(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{1}{[O_2(g)]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. There are no products in the numerator. The reactant $O_2(g)$ is in the denominator raised to the power of its coefficient in the balanced equation.

19. In the synthesis of hydrogen iodide gas, HI(g), hydrogen gas reacts with solid iodine in an equilibrium process. Write the equilibrium constant expression.

What Is Required?
You need to write the expression for the equilibrium constant, K_{eq}.

What Is Given?
You know the reactants and the product and the physical state of each component.

Plan Your Strategy	Act on Your Strategy
Write the chemical formulas of the reactants and the product and write the balanced chemical equation for the reaction.	$H_2(g) + I_2(s) \rightleftharpoons 2HI(g)$
The equilibrium constant expression follows the form: $K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$ where [A], [B], [C], and [D] represent the concentrations of the reactants and products at equilibrium. The exponents a, b, c, and d are the stoichiometric coefficients from the balanced equation. Use this general form for K_{eq} to write a temporary equilibrium expression, K, for the reaction.	$K = \frac{[HI(g)]^2}{[H_2(g)][I_2(s)]}$
The expression for the equilibrium constant is affected only by the concentrations that change. Since the concentrations of pure substances in the liquid or solid state do not change, their constant concentration is incorporated into the temporary equilibrium expression.	$K[I_2(s)] = \frac{[HI(g)]^2}{[H_2(g)]}$
The terms on the left side of the equation are combined and become the K_{eq}.	$K_{eq} = \frac{[HI(g)]^2}{[H_2(g)]}$

Check Your Solution
The square brackets indicate the concentration in mol/L. The expression for K_{eq} contains only components of the system that undergo a change in concentration. The product is in the numerator, the reactant that changes in concentration is in the denominator, and each is raised to the power of its coefficient in the balanced equation.