

Chapter 4

Displacement Reactions

Section 4.1 Single Displacement Reactions**Solutions for Practice Problems**

Student Edition page 169

1. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: Mg(s) and CrSO₄(aq)

Type of reaction: single displacement

Plan Your Strategy

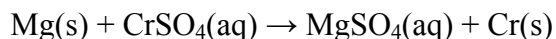
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Magnesium is above chromium in the activity series of metals. Magnesium will displace the chromium from chromium(II) sulfate to produce chromium solid and a solution of magnesium sulfate.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced.

Based on the activity series of metals, magnesium can displace chromium from chromium(II) sulfate.

2. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: $\text{Br}_2(\ell)$ and $\text{KF}(\text{aq})$

Type of reaction: single displacement

Plan Your Strategy

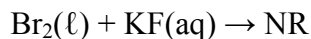
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Bromine is below fluorine in the activity series of halogens. Bromine will not displace fluorine. There is no reaction.

**Check Your Solution**

Based on the activity series of halogens, bromine cannot displace fluorine from potassium fluoride.

3. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: Zn(s) and H₂SO₄(aq)

Type of reaction: single displacement

Plan Your Strategy

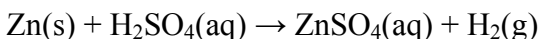
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Zinc is above hydrogen in the activity series of metals. Zinc will displace the hydrogen from sulfuric acid to produce hydrogen gas and a solution of zinc sulfate.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced.

Based on the activity series of metals, zinc can displace hydrogen from sulfuric acid.

4. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: F₂(g) and MgI₂(aq)

Type of reaction: single displacement

Plan Your Strategy

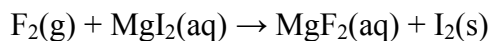
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

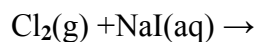
Fluorine is above iodine in the activity series of halogens. Fluorine will displace the iodine from magnesium iodide to produce solid iodine and a solution of magnesium iodide.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of halogens, fluorine can displace iodine from a solution of magnesium iodide.

5. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: $\text{Cl}_2(\text{g})$ and $\text{NaI}(\text{aq})$

Type of reaction: single displacement

Plan Your Strategy

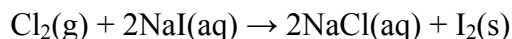
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

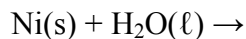
Chlorine is above iodine in the activity series of halogens. Chlorine will displace the iodine from sodium iodide to produce solid iodine and a solution of sodium chloride.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of halogens, chlorine can displace iodine from a solution of sodium iodide.

6. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: Ni(s) and H₂O(l)

Type of reaction: single displacement

Plan Your Strategy

Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

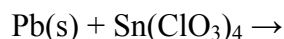
Nickel is above hydrogen in the activity series of metals but is not active enough to displace hydrogen to form water. There is no reaction.

**Check Your Solution**

Based on the activity series of metals, nickel will not react with water.

7. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: Pb(s) and Sn(ClO₃)₄

Type of reaction: single displacement

Plan Your Strategy

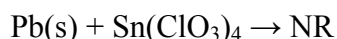
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

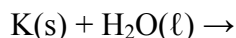
Lead is below tin in the activity series of metals. Lead will not displace tin. No reaction will occur.

**Check Your Solution**

Based on the activity series of metals, lead cannot displace tin from tin(IV) chlorate.

8. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: K(s) and H₂O(l)

Type of reaction: single displacement

Plan Your Strategy

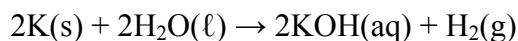
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Potassium is above hydrogen in the activity series of metals and is active enough to displace the hydrogen from water to produce a solution of potassium hydroxide and hydrogen gas.

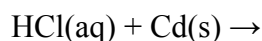


Check Your Solution

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of metals, potassium can displace hydrogen from water.

9. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: HCl(aq) and Cd(s)

Type of reaction: single displacement

Plan Your Strategy

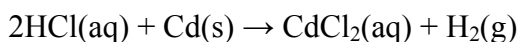
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

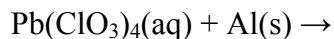
Cadmium is above hydrogen in the activity series of metals. Cadmium will displace the hydrogen from hydrochloric acid to produce hydrogen gas and a solution of cadmium chloride.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of metals, cadmium can displace hydrogen from hydrochloric acid.

10. Practice Problem (page 169)

Using the appropriate activity series, write a balanced chemical equation for the single displacement reaction. If you predict that no reaction will occur, write “NR.”

**What Is Required?**

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: $\text{Pb}(\text{ClO}_3)_4(\text{aq})$ and $\text{Al}(\text{s})$

Type of reaction: single displacement

Plan Your Strategy

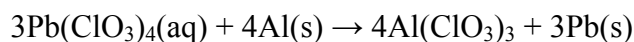
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Aluminum is above lead in the activity series of metals. Aluminum will displace the lead from lead(IV) chlorate to produce lead solid and a solution of aluminum chlorate.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of metals, aluminum can displace lead from lead(IV) chlorate.

Section 4.1 Single Displacement Reactions
Solutions for Selected Review Questions
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5. Review Question (page 170)

For each pair of reactants, write a balanced chemical equation if a single displacement reaction will occur. If you predict that no reaction will occur, write “NR.”

- a. copper and magnesium sulfate
- b. zinc and iron(II) chloride
- c. magnesium and aluminum sulfate
- d. zinc and hydrochloric acid
- e. copper and zinc nitrate
- f. magnesium and sulfuric acid

a. copper and magnesium sulfate

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: copper and magnesium sulfate

Type of reaction: single displacement

Plan Your Strategy

Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Copper is below magnesium in the activity series of metals. Copper will not displace magnesium. No reaction will occur.



Check Your Solution

Based on the activity series of metals, copper cannot displace magnesium from magnesium sulfate.

b. zinc and iron(II) chloride

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: zinc and iron(II) chloride

Type of reaction: single displacement

Plan Your Strategy

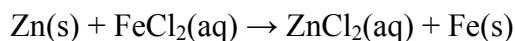
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Zinc is above iron in the activity series of metals. Zinc will displace the iron from iron(II) chloride to produce iron solid and a solution of zinc chloride.



Check Your Solution

Based on the activity series of metals, zinc can displace iron from iron(II) chloride.

c. magnesium and aluminum sulfate

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: magnesium and aluminum sulfate

Type of reaction: single displacement

Plan Your Strategy

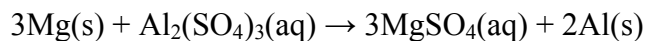
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Magnesium is above aluminum in the activity series of metals. Magnesium will displace the aluminum from aluminum sulfate to produce aluminum solid and a solution of magnesium sulfate.

**Check Your Solution**

Based on the activity series of metals, magnesium can displace aluminum from aluminum sulfate.

d. zinc and hydrochloric acid

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: zinc and hydrochloric acid

Type of reaction: single displacement

Plan Your Strategy

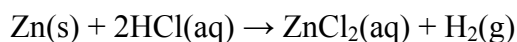
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Zinc is above hydrogen in the activity series of metals. Zinc will displace the hydrogen from hydrochloric acid to produce hydrogen gas and a solution of zinc chloride.

**Check Your Solution**

Based on the activity series of metals, zinc can displace hydrogen from hydrochloric acid.

e. copper and zinc nitrate

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: copper and zinc nitrate

Type of reaction: single displacement

Plan Your Strategy

Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Copper is below zinc in the activity series of metals. Copper will not displace zinc. No reaction will occur.

**Check Your Solution**

Based on the activity series of metals, copper cannot displace zinc from zinc nitrate.

f. magnesium and sulfuric acid

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: magnesium and sulfuric acid

Type of reaction: single displacement

Plan Your Strategy

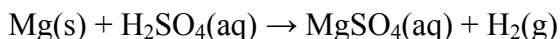
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Magnesium is above hydrogen in the activity series of metals. Magnesium will displace the hydrogen from sulfuric acid to produce hydrogen gas and a solution of magnesium sulfate.



Check Your Solution

Based on the activity series of metals, magnesium can displace hydrogen from sulfuric acid.

8. Review Question (page 170)

Describe two methods you could use to produce hydrogen with a single displacement reaction.

Hydrogen gas can be produced from the reaction of a metal above sodium in the activity series with cold water or from the reaction of a metal above hydrogen gas in the activity series with a dilute acid.

12. Review Question (page 170)

If the liquid in the photograph is water, could the metal be zinc? If the liquid is an acid, could the metal be zinc? Explain your reasoning.



We assume that a displacement reaction is shown in the diagram and the gas is hydrogen.

If the liquid is water, then the metal cannot be zinc, since zinc metal is below sodium in the activity series. Only metals from sodium and above will react with cold water.

If the liquid is an acid, then the metal can indeed be zinc, since zinc is above hydrogen in the activity series and can therefore displace the hydrogen from the acid to produce hydrogen gas.

13. Review Question (page 170)

Which halogens can be replaced by chlorine?

The bromine in the salt of a metal bromide, and the iodine in the salt of a metal iodide can be displaced by chlorine, $\text{Cl}_2(\text{g})$.

15. Review Question (page 170)

For each pair of reactants, write a balanced chemical equation if a single displacement reaction will occur. If you predict that no reaction will occur, write “NR.”

- a. iron and hydrobromic acid
- b. bromine and magnesium iodide
- c. potassium and aluminum sulfate
- d. lithium and water
- e. cobalt and water
- f. bromine and iron(II) chloride

- a. iron and hydrobromic acid

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: iron and hydrobromic acid

Type of reaction: single displacement

Plan Your Strategy

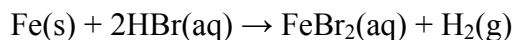
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Iron is above hydrogen in the activity series of metals. Iron will displace the hydrogen from hydrobromic acid to produce hydrogen gas and a solution of iron(II) bromide.

**Check Your Solution**

Based on the activity series of metals, iron can displace hydrogen from hydrobromic acid.

- b. bromine and magnesium iodide

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: bromine and magnesium iodide

Type of reaction: single displacement

Plan Your Strategy

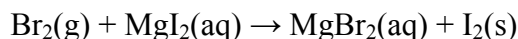
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Bromine is above iodine in the activity series of halogens. Bromine will displace the iodine from magnesium iodide to produce solid iodine and a solution of magnesium bromide.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of halogens, bromine can displace iodine from a solution of magnesium iodide.

c. potassium and aluminum sulfate

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: potassium and aluminum sulfate

Type of reaction: single displacement

Plan Your Strategy

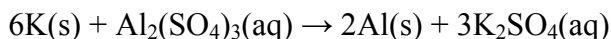
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Potassium is above aluminum in the activity series of metals. Potassium will displace the aluminum from aluminum sulfate to produce solid aluminum and a solution of potassium sulfate.



Check Your Solution

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of metals, potassium can displace aluminum from a solution of aluminum sulfate.

d. lithium and water

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: lithium and water

Type of reaction: single displacement

Plan Your Strategy

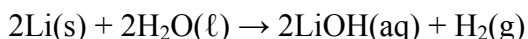
Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Lithium is above hydrogen in the activity series of metals and is active enough to displace the hydrogen from water to produce a solution of lithium hydroxide and hydrogen gas.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced. Based on the activity series of metals, lithium can displace hydrogen from water.

e. cobalt and water

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: cobalt and water

Type of reaction: single displacement

Plan Your Strategy

Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Cobalt is above hydrogen in the activity series of metals but is not active enough to displace hydrogen from water. There is no reaction.

**Check Your Solution**

Based on the activity series of metals, cobalt will not react with water.

f. bromine and iron(II) chloride

What Is Required?

If a single displacement reaction will occur, the chemical formulas for the products are required.

What Is Given?

Reactants: bromine and iron(II) chloride

Type of reaction: single displacement

Plan Your Strategy

Locate the elements involved in the activity series and determine if a reaction will occur.

Predict the products that will form if a reaction does occur and write the formulas for the products.

Write a balanced equation for the reaction.

Act on Your Strategy

Bromine is below chlorine in the activity series of halogens. Bromine will not displace chlorine.

There is no reaction.

**Check Your Solution**

Check to see that the formulas are correct and that the equation is balanced.

Based on the activity series of halogens, bromine cannot displace chlorine from a solution of iron(II) chloride.

16. Review Question (page 170)

Which halogen is capable of displacing only one halogen and is itself replaced by two halogens?

Bromine, $\text{Br}_2(\ell)$, will displace iodine and is itself displaced by fluorine and chlorine.

Section 4.2 Double Displacement Reactions**Solutions for Practice Problems****Student Edition page 175****11. Practice Problem (page 175)**

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Potassium sulfate and calcium chloride

What Is Required?

Determine the products that form when potassium sulfate and calcium chloride react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: potassium sulfate and calcium chloride

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Potassium sulfate: potassium ions, K^+ , and sulfate ions, SO_4^{2-}

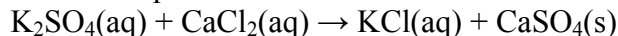
Calcium chloride: calcium ions, Ca^{2+} , and chloride ions, Cl^-

Products: potassium chloride is soluble and calcium sulfate, a compound of low solubility, is the precipitate

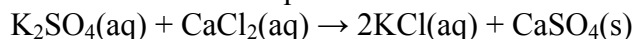
Word equation:

potassium sulfate + calcium chloride \rightarrow potassium chloride + calcium sulfate

Skeleton equation:



Balanced chemical equation:



Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

12. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Barium nitrate and sodium carbonate

What Is Required?

Determine the products that form when barium nitrate and sodium carbonate react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: barium nitrate and sodium carbonate

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Barium nitrate: barium ions, Ba^{2+} , and nitrate ions, NO_3^-

Sodium carbonate: sodium ions, Na^+ , and carbonate ions, CO_3^{2-}

Products: sodium nitrate is soluble and barium carbonate, a compound of low solubility, is the precipitate

Word equation:

barium nitrate + sodium carbonate \rightarrow sodium nitrate + barium carbonate

Skeleton equation:

$\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{BaCO}_3(\text{s})$

Balanced chemical equation:

$\text{Ba}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow 2\text{NaNO}_3(\text{aq}) + \text{BaCO}_3(\text{s})$

Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

13. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Iron(III) chloride and sodium hydroxide

What Is Required?

Determine the products that form when iron(III) chloride and sodium hydroxide react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: iron(III) chloride and sodium hydroxide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Iron(III) chloride: iron(III) ions, Fe^{3+} , and chloride ions, Cl^-

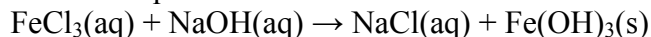
Sodium hydroxide: sodium ions, Na^+ , and hydroxide ions, OH^-

Products: sodium chloride is soluble and iron(III) hydroxide, a compound of low solubility, is the precipitate

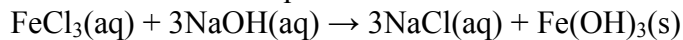
Word equation:

iron(III) chloride + sodium hydroxide \rightarrow sodium chloride + iron(III) hydroxide

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

14. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Rubidium sulfide and copper(II) iodide

What Is Required?

Determine the products that form when rubidium sulfide and copper(II) iodide react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: rubidium sulfide and copper(II) iodide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Rubidium sulfide: rubidium ions, Rb^+ , and sulfide ions, S^{2-}

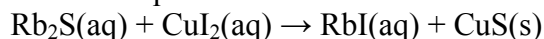
Copper(II) iodide: copper(II) ions, Cu^{2+} , and iodide ions, I^-

Products: rubidium iodide is soluble and copper(II) sulfide, a compound of low solubility, is the precipitate

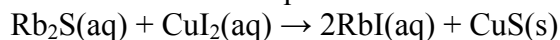
Word equation:

rubidium sulfide + copper(II) iodide \rightarrow rubidium iodide + copper(II) sulfide

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

15. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Zinc bromide and copper(I) acetate

What Is Required?

Determine the products that form when zinc bromide and copper(I) acetate react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: zinc bromide and copper(I) acetate

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Zinc bromide: zinc ions, Zn^{2+} , and bromide ions, Br^-

Copper(I) acetate: copper(I) ions, Cu^+ , and acetate ions, CH_3COO^-

Products: zinc acetate is soluble and copper(I) bromide, a compound of low solubility, is the precipitate

Word equation:

zinc bromide + copper(I) acetate \rightarrow zinc acetate + copper(I) bromide

Skeleton equation:

$$\text{ZnBr}_2(\text{aq}) + \text{CuCH}_3\text{COO}(\text{aq}) \rightarrow \text{Zn}(\text{CH}_3\text{COO})_2(\text{aq}) + \text{CuBr}(\text{s})$$

Balanced chemical equation:

$$\text{ZnBr}_2(\text{aq}) + 2\text{CuCH}_3\text{COO}(\text{aq}) \rightarrow \text{Zn}(\text{CH}_3\text{COO})_2(\text{aq}) + 2\text{CuBr}(\text{s})$$
Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

16. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Lithium hydroxide and magnesium chloride

What Is Required?

Determine the products that form when lithium hydroxide and magnesium chloride react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: lithium hydroxide and magnesium chloride

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Lithium hydroxide: lithium ions, Li^+ , and hydroxide ions, OH^-

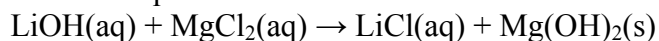
Magnesium chloride: magnesium ions, Mg^{2+} , and chloride ions, Cl^-

Products: lithium chloride is soluble and magnesium hydroxide is the precipitate

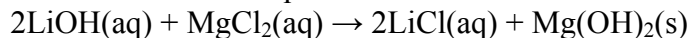
Word equation:

lithium hydroxide + magnesium chloride \rightarrow lithium chloride + magnesium hydroxide

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

17. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Aluminum sulfate and lead(II) nitrate

What Is Required?

Determine the products that form when aluminum sulfate and lead(II) nitrate react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: aluminum sulfate and lead(II) nitrate

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Aluminum sulfate: aluminum ions, Al^{3+} , and sulfate ions, SO_4^{2-}

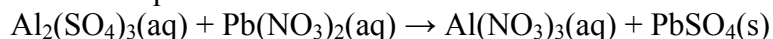
Lead(II) nitrate: lead(II) ions, Pb^{2+} , and nitrate ions, NO_3^-

Products: aluminum nitrate is soluble and lead(II) sulfate, a compound of low solubility, is the precipitate

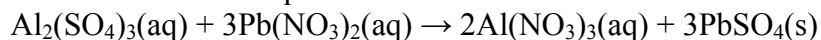
Word equation:

aluminum sulfate + lead(II) nitrate \rightarrow aluminum nitrate + lead(II) sulfate

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

18. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Lithium phosphate and magnesium chloride

What Is Required?

Determine the products that form when lithium phosphate and magnesium chloride react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: lithium phosphate and magnesium chloride

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Lithium phosphate: lithium ions, Li^+ , and phosphate ions, PO_4^{3-}

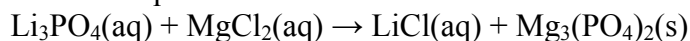
Magnesium chloride: magnesium ions, Mg^{2+} , and chloride ions, Cl^-

Products: lithium chloride is soluble and magnesium phosphate, a compound of low solubility, is the precipitate

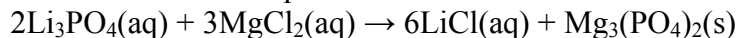
Word equation:

lithium phosphate + magnesium chloride \rightarrow lithium chloride + magnesium phosphate

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

19. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Calcium nitrate and magnesium sulfate

What Is Required?

Determine the products that form when calcium nitrate and magnesium sulfate react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: calcium nitrate and magnesium sulfate

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Calcium nitrate: calcium ions, Ca^{2+} , and nitrate ions, NO_3^-

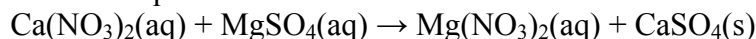
Magnesium sulfate: magnesium ions, Mg^{2+} , and sulfate ions, SO_4^{2-}

Products: magnesium nitrate is soluble and calcium sulfate, a compound of low solubility, is the precipitate

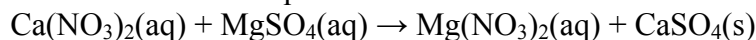
Word equation:

calcium nitrate + magnesium sulfate \rightarrow magnesium nitrate + calcium sulfate

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

20. Practice Problem (page 175)

Determine the products that form in the double displacement reaction and identify the precipitate. Write a balanced chemical equation.

Silver nitrate and magnesium chloride

What Is Required?

Determine the products that form when silver nitrate and magnesium chloride react, and write a balanced chemical equation that shows which product is the precipitate.

What Is Given?

Reactants: silver nitrate and magnesium chloride

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine products.

Use the solubility guidelines to determine the precipitate.

Write a word equation for the reaction.

Write a balanced chemical equation for the reaction.

Act on Your Strategy

Silver nitrate: silver ions, Ag^+ , and nitrate ions, NO_3^-

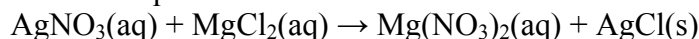
Magnesium chloride: magnesium ions, Mg^{2+} , and chloride ions, Cl^-

Products: magnesium nitrate is soluble and silver chloride, a compound of low solubility, is the precipitate

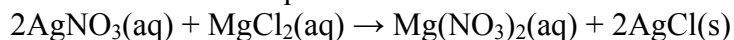
Word equation:

silver nitrate + magnesium chloride \rightarrow magnesium nitrate + silver chloride

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions in the reactants. The precipitate is correctly identified based on the solubility guidelines.

Section 4.2 Double Displacement Reactions
Solutions for Practice Problems
Student Edition page 179

21. Practice Problem (page 179)

Predict the products in the double displacement reaction between potassium carbonate and hydrochloric acid, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: potassium carbonate and hydrochloric acid

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Potassium carbonate: potassium ions, K^+ , and carbonate ions, CO_3^{2-}

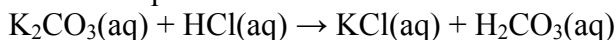
Hydrochloric acid: hydrogen ions, H^+ , and chloride ions, Cl^-

Products: potassium chloride and carbonic acid; carbonic acid breaks down into carbon dioxide and water

Word equation:

potassium carbonate + hydrochloric acid \rightarrow potassium chloride + water
+ carbon dioxide

Skeleton equation:



Balanced chemical equation:



Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

22. Practice Problem (page 179)

Predict the products in the double displacement reaction between sulfuric acid and sodium carbonate, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: sulfuric acid and sodium carbonate

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Sulfuric acid: hydrogen ions, H^+ , and sulfate ions, SO_4^{2-}

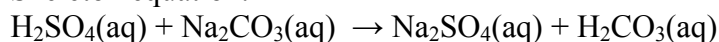
Sodium carbonate: sodium ions, Na^+ , and carbonate ions, CO_3^{2-}

Products: sodium sulfate and carbonic acid; carbonic acid breaks down into carbon dioxide and water

Word equation:

sulfuric acid + sodium carbonate \rightarrow sodium sulfate + water + carbon dioxide

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

23. Practice Problem (page 179)

Predict the products in the double displacement reaction between ammonium chloride and sodium hydroxide, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: ammonium chloride and sodium hydroxide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Ammonium chloride: ammonium ions, NH_4^+ , and chloride ions, Cl^-

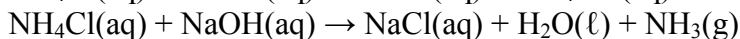
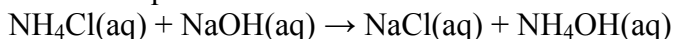
Sodium hydroxide: sodium ions, Na^+ , and hydroxide ions, OH^-

Products: sodium chloride and ammonium hydroxide; ammonium hydroxide breaks down into ammonia and water

Word equation:

ammonium chloride + sodium hydroxide \rightarrow sodium chloride + water + ammonia

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

24. Practice Problem (page 179)

Predict the products in the double displacement reaction between rubidium hydroxide and hydrochloric acid, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: rubidium hydroxide and hydrochloric acid

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Rubidium hydroxide: rubidium ions, Rb^+ , and hydroxide ions, OH^-

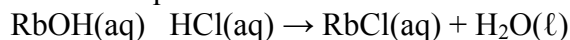
Hydrochloric acid: hydrogen ions, H^+ , and chloride ions, Cl^-

Products: rubidium chloride and water

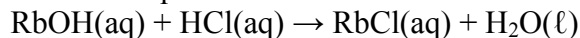
Word equation:

rubidium hydroxide + hydrochloric acid \rightarrow rubidium chloride + water

Skeleton equation:



Balanced equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

25. Practice Problem (page 179)

Predict the products in the double displacement reaction between calcium carbonate and acetic acid, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: calcium carbonate and acetic acid

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Calcium carbonate: calcium ions, Ca^{2+} , and carbonate ions, CO_3^{2-}

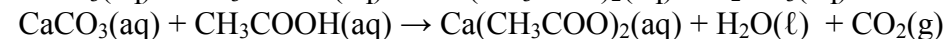
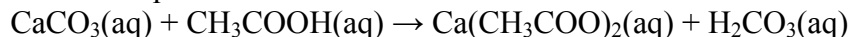
Acetic acid: hydrogen ions, H^+ , and acetate ions, CH_3COO^-

Products: calcium acetate and carbonic acid; carbonic acid breaks down into carbon dioxide and water

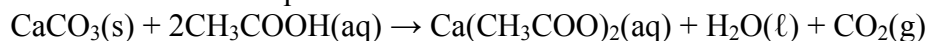
Word equation:

calcium carbonate + acetic acid \rightarrow calcium acetate + water + carbon dioxide

Skeleton equation:



Balanced chemical equation:



Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions of the reactants.

26. Practice Problem (page 179)

Predict the products in the double displacement reaction between lithium hydroxide and ammonium bromide, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: lithium hydroxide and ammonium bromide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Lithium hydroxide: lithium ions, Li^+ , and hydroxide ions, OH^-

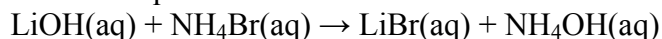
Ammonium bromide: ammonium ions, NH_4^+ , and bromide ions, Br^-

Products: sodium bromide and ammonium hydroxide; ammonium hydroxide breaks down into ammonia and water

Word equation:

lithium hydroxide + ammonium bromide \rightarrow lithium bromide + water + ammonia

Skeleton equation:



Balanced chemical equation:



Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions of the reactants.

27. Practice Problem (page 179)

Predict the products in the double displacement reaction between sulfuric acid and lithium hydroxide, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: sulfuric acid and lithium hydroxide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Sulfuric acid: hydrogen ions, H^+ , and sulfate ions, SO_4^{2-}

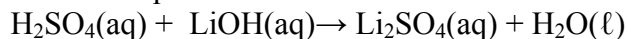
Lithium hydroxide: lithium ions, Li^+ , and hydroxide ions, OH^-

Products: lithium sulfate and water

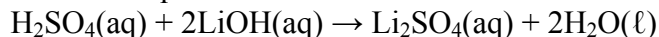
Word equation:

sulfuric acid + lithium hydroxide \rightarrow lithium sulfate + water

Skeleton equation:



Balanced equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

28. Practice Problem (page 179)

Predict the products in the double displacement reaction between lithium hydrogen carbonate and acetic acid, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: lithium hydrogen carbonate and acetic acid

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Lithium hydrogen carbonate: lithium ions, Li^+ , and hydrogen carbonate ions, HCO_3^-

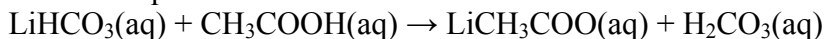
Acetic acid: hydrogen ions, H^+ , and acetate ions, CH_3COO^-

Products: lithium acetate and carbonic acid; carbonic acid breaks down into carbon dioxide and water

Word equation:

lithium hydrogen carbonate + acetic acid \rightarrow lithium acetate + water + carbon dioxide

Skeleton equation:



Balanced chemical equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.

The products are correctly formed by switching the ions of the reactants.

29. Practice Problem (page 179)

Predict the products in the double displacement reaction between calcium hydroxide and nitric acid, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: calcium hydroxide and nitric acid

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.
 Switch the pairs of ions to determine the products.
 Write a word equation for each reaction.
 Write and balance a chemical equation for each reaction.

Act on Your Strategy

Calcium hydroxide: calcium ions, Ca^{2+} , and hydroxide ions, OH^-

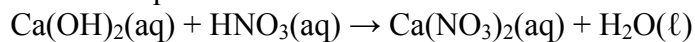
Nitric acid: hydrogen ions, H^+ , and nitrate ions, NO_3^-

Products: calcium nitrate and water

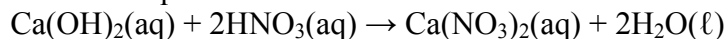
Word equation:

calcium hydroxide + nitric acid \rightarrow calcium nitrate + water

Skeleton equation:



Balanced equation:

**Check Your Solution**

All the chemical formulas are correct, and the chemical equation is balanced.
 The products are correctly formed by switching the ions of the reactants.

30. Practice Problem (page 179)

Predict the products in the double displacement reaction between ammonium chloride and magnesium hydroxide, and write and balance the chemical equation for this reaction.

What Is Required?

Determine the products that form from the given reactants, and write and balance a chemical equation for each reaction.

What Is Given?

Reactants: ammonium chloride and magnesium hydroxide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.
 Switch the pairs of ions to determine the products.
 Write a word equation for each reaction.
 Write and balance a chemical equation for each reaction.

Act on Your Strategy

Ammonium chloride: ammonium ions, NH_4^+ , and chloride ions, Cl^-

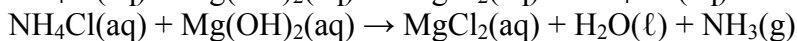
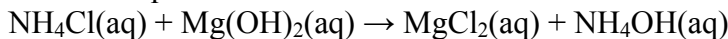
Magnesium hydroxide: magnesium ions, Mg^{2+} , and hydroxide ions, OH^-

Products: magnesium chloride and ammonium hydroxide; ammonium hydroxide breaks down into ammonia and water

Word equation:

ammonium chloride + magnesium hydroxide → magnesium chloride + water + ammonia

Skeleton equation:



Balanced chemical equation:



Check Your Solution

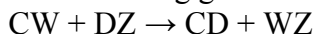
All the chemical formulas are correct, and the chemical equation is balanced. The products are correctly formed by switching the ions of the reactants.

Section 4.2 Double Displacement Reactions Solutions for Selected Review Questions

Student Edition page 180

1. Review Question (page 180)

The following general form of a double displacement reaction is incorrect:



- What is wrong with this general equation?
- Write a correct equation using the reactants shown.

- The error is that the products show two cations and two anions combining.
- $\text{CW} + \text{DZ} \rightarrow \text{CZ} + \text{DW}$

9. Review Question (page 180)

To determine whether a rock sample is limestone, a geologist places several drops of hydrochloric acid on it. Limestone is calcium carbonate, $\text{CaCO}_3(\text{s})$.

- What evidence is the geologist expecting to see if the rock sample is limestone?
 - Write a balanced chemical equation for the reaction between hydrochloric acid and calcium carbonate.
- The geologist is looking for bubbles of $\text{CO}_2(\text{g})$.
 - $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\ell) + \text{CO}_2(\text{g})$

12. Review Question (page 180)

What gas forms in the reaction between ammonium bromide and sodium hydroxide? Write a balanced chemical equation for this reaction.

The gas that forms is ammonia, $\text{NH}_3(\text{g})$.

Word equation: ammonium bromide + sodium hydroxide \rightarrow sodium bromide + water + ammonia

Balanced equation: $\text{NH}_4\text{Br}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaBr}(\text{aq}) + \text{H}_2\text{O}(\ell) + \text{NH}_3(\text{g})$

15. Review Question (page 180)

What products should form during the reaction between hydrochloric acid, $\text{HCl}(\text{aq})$, and a solution of calcium hydroxide, $\text{Ca}(\text{OH})_2(\text{aq})$? Write a balanced chemical equation for the reaction.

What is Required?

You need to find the products of a reaction between hydrochloric acid and calcium hydroxide.

What Is Given?

Reactants: hydrochloric acid and calcium hydroxide

Type of reaction: double displacement

Plan Your Strategy

Identify the ions that make up each reactant.

Switch the pairs of ions to determine the products.

Write a word equation for each reaction.

Write and balance a chemical equation for each reaction.

Act on Your Strategy

Hydrochloric acid: hydrogen ions, H^+ , and chloride ions, Cl^-

Calcium hydroxide: calcium ions, Ca^{2+} , and hydroxide ions, OH^-

Products: calcium chloride and water

Word equation:

calcium hydroxide + hydrochloric acid \rightarrow calcium chloride + water

Skeleton equation:

$\text{Ca}(\text{OH})_2(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\ell)$

Balanced chemical equation:

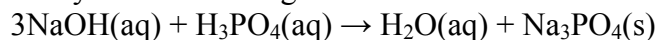
$\text{Ca}(\text{OH})_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\ell)$

Check Your Solution

All the chemical formulas are correct, and the chemical equation is balanced.

16. Review Question (page 180)

Analyze the following neutralization reaction:



In a brief paragraph, describe any errors you find and explain how you would correct them.

The states of the products are incorrect, and the equation is not balanced.

Balanced equation showing the correct phases of the products:

