

ANSWER KEY

BALANCING CHEMICAL EQUATIONS Name _____

Rewrite and balance the equations below.

(I)

- $N_2 + 3H_2 \rightarrow 2NH_3$
- $2KClO_3 \rightarrow 2KCl + 3O_2$
- $2NaCl + Fe \rightarrow 2NaF + Cl_2$
- $2H_2 + O_2 \rightarrow 2H_2O$
- $2AgNO_3 + MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$
- $2AlBr_3 + 3K_2SO_4 \rightarrow 6KBr + Al_2(SO_4)_3$
- $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- $C_2H_6 + 3.5O_2 \rightarrow 2CO_2 + 4H_2O$
- $C_2H_6 + 3.5O_2 \rightarrow 2CO_2 + 4H_2O$
- $FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$
- $4P + 5O_2 \rightarrow 2P_2O_5$
- $2Na + 2H_2O \rightarrow 2NaOH + H_2$
- $2Ag_2O \rightarrow 4Ag + O_2$
- $S_8 + 12O_2 \rightarrow 8SO_3$
- $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
- $2K + MgBr_2 \rightarrow 2KBr + Mg$
- $2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$

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WORD EQUATIONS Name _____

Write the word equations below as chemical equations and balance.

(I)

- zinc + lead (II) nitrate yield zinc nitrate + lead
 $Zn + Pb(NO_3)_2 \rightarrow Zn(NO_3)_2 + Pb$
- aluminum bromide + chlorine yield aluminum chloride + bromine
 $2AlBr_3 + 3Cl_2 \rightarrow 2AlCl_3 + 3Br_2$
- sodium phosphate + calcium chloride yield calcium phosphate + sodium chloride
 $2Na_3PO_4 + 3CaCl_2 \rightarrow Ca_3(PO_4)_2 + 6NaCl$
- potassium chlorate when heated yields potassium chloride + oxygen gas
 $2KClO_3 \rightarrow 2KCl + 3O_2(g)$
- aluminum + hydrochloric acid yield aluminum chloride + hydrogen gas
 $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2(g)$
- calcium hydroxide + phosphoric acid yield calcium phosphate + water
 $3Ca(OH)_2 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6H_2O$
- copper + sulfuric acid yield copper (II) sulfate + water + sulfur dioxide
 $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2$
- hydrogen + nitrogen monoxide yield water + nitrogen
 $2H_2 + 2NO \rightarrow 2H_2O + N_2$

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BALANCING EQUATIONS Name _____

Balance the following chemical equations.

(II)

- $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
- $2Na + I_2 \rightarrow 2NaI$
- $2N_2 + O_2 \rightarrow 2N_2O$
- $N_2 + 3H_2 \rightarrow 2NH_3$
- $2KI + Cl_2 \rightarrow 2KCl + I_2$
- $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$
- $2KClO_3 \rightarrow 2KCl + 3O_2$
- $K_3PO_4 + 3HCl \rightarrow 3KCl + H_3PO_4$
- $2S + 3O_2 \rightarrow 2SO_3$
- $2KI + Pb(NO_3)_2 \rightarrow 2KNO_3 + PbI_2$
- $3CaSO_4 + 2AlBr_3 \rightarrow 3CaBr_2 + Al_2(SO_4)_3$
- $2H_2O_2 \rightarrow 2H_2O + O_2$
- $2Na + 2H_2O \rightarrow 2NaOH + H_2$
- $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
- $3Mg(NO_3)_2 + 2K_3PO_4 \rightarrow Mg_3(PO_4)_2 + 6KNO_3$

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WORD EQUATIONS Name _____

Write and balance the following chemical equations.

(II)

- Hydrogen plus oxygen yields water.
 $2H_2 + O_2 \rightarrow 2H_2O$
- Nitrogen plus hydrogen yields ammonia.
 $N_2 + 3H_2 \rightarrow 2NH_3$
- Aluminum bromide plus chlorine yields aluminum chloride and bromine.
 $2AlBr_3 + 3Cl_2 \rightarrow 2AlCl_3 + 3Br_2$
- Hydrochloric acid plus sodium hydroxide yields sodium chloride plus water.
 $HCl + NaOH \rightarrow NaCl + H_2O$
- Iron plus lead (II) sulfate react forming iron (II) sulfate plus lead.
 $Fe + PbSO_4 \rightarrow FeSO_4 + Pb$
- Potassium chlorate when heated produces potassium chloride plus oxygen gas.
 $2KClO_3 \rightarrow 2KCl + 3O_2$
- Sulfuric acid decomposes to form sulfur trioxide gas plus water.
 $H_2SO_4 \rightarrow SO_3 + H_2O$
- Sodium oxide combines with water to make sodium hydroxide.
 $Na_2O + H_2O \rightarrow 2NaOH$
- Potassium iodide reacts with bromine forming potassium bromide plus iodine.
 $2KI + Br_2 \rightarrow 2KBr + I_2$
- Sodium phosphate reacts with calcium nitrate to produce sodium nitrate plus calcium phosphate.
 $2Na_3PO_4 + 3Ca(NO_3)_2 \rightarrow 6NaNO_3 + Ca_3(PO_4)_2$
- Zinc reacts with iron (III) chloride yielding zinc chloride plus iron precipitate.
 $3Zn + 2FeCl_3 \rightarrow 3ZnCl_2 + 2Fe$
- Ammonium carbonate and magnesium sulfate react to yield ammonium sulfate plus magnesium carbonate.
 $(NH_4)_2CO_3 + MgSO_4 \rightarrow (NH_4)_2SO_4 + MgCO_3$
- Phosphoric acid plus calcium hydroxide react forming solid calcium phosphate plus water.
 $2H_3PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 6H_2O$
- Aluminum plus oxygen gas form aluminum oxide under certain conditions.
 $4Al + 3O_2 \rightarrow 2Al_2O_3$
- Nitrogen gas plus oxygen gas react and form dinitrogen pentoxide.
 $2N_2 + 5O_2 \rightarrow 2N_2O_5$

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PREDICTING PRODUCTS OF CHEMICAL REACTIONS

Name _____

Predict the products of the reactions below. Then, write the balanced equation and classify the reaction.

1. magnesium bromide + chlorine

2. aluminum + iron (III) oxide

3. silver nitrate + zinc chloride

4. hydrogen peroxide (catalyzed by manganese dioxide)

5. zinc + hydrochloric acid

6. sulfuric acid + sodium hydroxide

7. sodium + hydrogen

8. acetic acid + copper

CLASSIFYING CHEMICAL REACTIONS

Classify the following reactions as synthesis, decomposition, single replacement or double replacement.

- $2KClO_3 \rightarrow 2KCl + 3O_2$ decomposition
- $HCl + NaOH \rightarrow NaCl + H_2O$ double replacement
- $Mg + 2HCl \rightarrow MgCl_2 + H_2$ single replacement
- $2H_2 + O_2 \rightarrow 2H_2O$ synthesis
- $2Al + 3H_2S \rightarrow 2AlH_3 + 3H_2$ single replacement
- $4Al + 3O_2 \rightarrow 2Al_2O_3$ synthesis
- $2HCl \rightarrow 2H_2 + Cl_2$ decomposition
- $CaCl_2 + F_2 \rightarrow CaF_2 + Cl_2$ single replacement
- $AgNO_3 + KCl \rightarrow AgCl + KNO_3$ double replacement
- $N_2 + 3H_2 \rightarrow 2NH_3$ synthesis
- $2KClO_3 \rightarrow 2KCl + 3O_2$ decomposition
- $(NH_4)_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2NH_3 + 2H_2O$ double replacement
- $Mg + Fe \rightarrow MgFe + Fe$ single replacement
- $SO_2 + H_2O \rightarrow H_2SO_3$ synthesis
- $2KCl + 2H_2PO_4 \rightarrow 2KCl + 2H_2PO_4$ double replacement

PREDICTING PRODUCTS OF CHEMICAL REACTIONS

Predict the products of the reactions below. Then, write the balanced equation and classify the reaction.

- magnesium + chlorine
 $Mg + Cl_2 \rightarrow MgCl_2$ single replacement
- aluminum + iron (III) oxide
 $Al + Fe_2O_3 \rightarrow Fe + Al_2O_3$ single replacement
- silver nitrate + zinc chloride
 $2AgNO_3 + ZnCl_2 \rightarrow 2AgCl + Zn(NO_3)_2$ double replacement
- hydrogen peroxide (catalyzed by manganese dioxide)
 $2H_2O_2 \xrightarrow{MnO_2} 2H_2O + O_2$ decomposition
- zinc + hydrochloric acid
 $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ single replacement
- sulfuric acid + sodium hydroxide
 $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$ double replacement (neutralization)
- sodium + hydrogen
 $2Na + H_2 \rightarrow 2NaH$ synthesis
- acetic acid + copper
 $CH_3COOH + Cu \rightarrow$ no reaction
(or $CH_3COOH + Cu \rightarrow$ single replacement)

CLASSIFICATION OF CHEMICAL REACTIONS

Classify the reactions below as synthesis, decomposition, single replacement (cathodic or anodic) or double replacement.

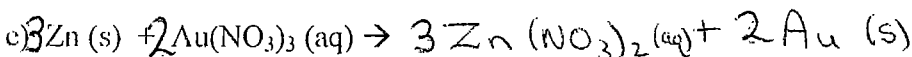
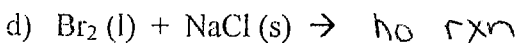
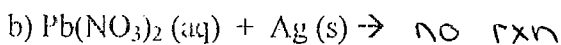
- $2H_2 + O_2 \rightarrow 2H_2O$ synthesis
- $2KClO_3 \rightarrow 2KCl + 3O_2$ decomposition
- $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ cationic single replacement
- $2CO + O_2 \rightarrow 2CO_2$ synthesis
- $2H_2O \rightarrow 2H_2 + O_2$ decomposition
- $2KBr + Cl_2 \rightarrow 2KCl + 2Br_2$ anionic single replacement
- $CaO + H_2O \rightarrow Ca(OH)_2$ synthesis
- $AgNO_3 + HCl \rightarrow AgCl + HNO_3$ double replacement
- $2H_2O \rightarrow 2H_2 + O_2$ decomposition
- $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$ double replacement

Key

Single Replacement Reactions and the Activity Series

*A cation will replace any less reactive cation in a cationic single replacement reaction.
An anion will replace any less reactive anion in an anionic single replacement reaction*

Use the chart to predict if the following will occur. If it does, predict the products and complete the balanced equation.



Precipitation Reactions

A low solubility compound will not dissolve in water, and will form a solid called a precipitate if it is created in a reaction. A soluble compound will dissolve in water and will be in the aqueous phase if in the presence of water in a reaction.

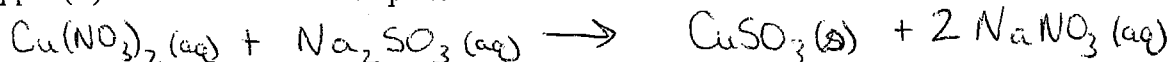
A) Using the chart provided in the data book, decide if each of the following compounds will dissolve in water:

a) calcium chloride ^{yes} b) calcium sulphide ^{yes} c) calcium sulphate ^{no} d) cesium hydroxide ^{yes}

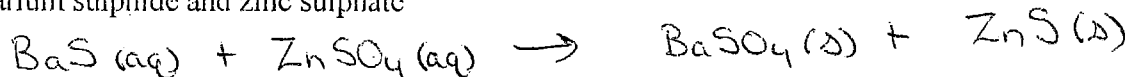
e) copper (I) phosphate ^{no} f) copper (II) phosphate ^{no} g) ammonium carbonate ^{yes}

B) Assume that the following solid compounds are mixed together in the presence of water (so the reactants could be dissolved). Complete the chemical equations, including phases and balancing:

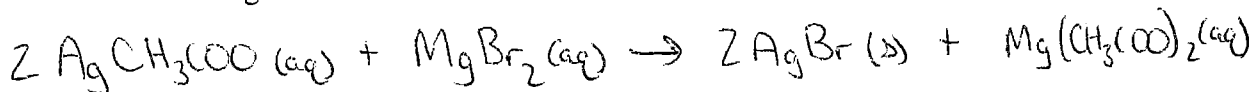
a) copper (II) nitrate and sodium sulphite



b) Barium sulphide and zinc sulphate



c) silver acetate and magnesium bromide



Answers

- (a) $\text{H}_2\text{SO}_4 + 2 \text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O}$
 (b) $\text{H}_3\text{PO}_4 + 3 \text{KOH} \longrightarrow \text{K}_3\text{PO}_4 + 3 \text{H}_2\text{O}$
 (c) $3 \text{H}_2\text{SO}_4 + 2 \text{Fe}(\text{OH})_3 \longrightarrow \text{Fe}_2(\text{SO}_4)_3 + 6 \text{H}_2\text{O}$
- (a) $2 \text{C}_2\text{H}_2 + 5 \text{O}_2 \longrightarrow 4 \text{CO}_2 + 2 \text{H}_2\text{O}$ (combustion)
 (b) $\text{Mg} + \text{CuSO}_4 \longrightarrow \text{MgSO}_4 + \text{Cu}$ (single replacement)
 (c) $4 \text{Na} + \text{O}_2 \longrightarrow 2 \text{Na}_2\text{O}$ (synthesis)
 (d) $2 \text{Fe}(\text{NO}_3)_3 + 3 \text{MgS} \longrightarrow \text{Fe}_2\text{S}_3 + 3 \text{Mg}(\text{NO}_3)_2$ (double replacement)
 (e) $2 \text{N}_2\text{O} \longrightarrow 2 \text{N}_2 + \text{O}_2$ (decomposition)
 (f) $\text{Sn}(\text{OH})_4 + 4 \text{HBr} \longrightarrow 4 \text{H}_2\text{O} + \text{SnBr}_4$ (neutralization)
 (g) $\text{Cl}_2 + 2 \text{KI} \longrightarrow 2 \text{KCl} + \text{I}_2$ (single replacement)
 (h) $2 \text{Al} + 3 \text{S} \longrightarrow \text{Al}_2\text{S}_3$ (synthesis)
 (i) $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \longrightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$ (combustion)
 (j) $3 \text{HF} + \text{Fe}(\text{OH})_3 \longrightarrow \text{FeF}_3 + 3 \text{H}_2\text{O}$ (neutralization)
 (k) $2 \text{H}_2\text{O}_2 \longrightarrow 2 \text{H}_2\text{O} + \text{O}_2$ (decomposition)
 (l) $\text{FeCl}_2 + \text{K}_2\text{S} \longrightarrow \text{FeS} + 2 \text{KCl}$ (double replacement)
 (m) $2 \text{Ca} + \text{O}_2 \longrightarrow 2 \text{CaO}$ (synthesis)
 (n) $\text{H}_2\text{SO}_4 + 2 \text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O}$ (neutralization)
 (o) $\text{C}_2\text{H}_5\text{OH} + 3 \text{O}_2 \longrightarrow 2 \text{CO}_2 + 3 \text{H}_2\text{O}$ (combustion)
 (p) $4 \text{Cr} + 3 \text{SnCl}_4 \longrightarrow 4 \text{CrCl}_3 + 3 \text{Sn}$ (single replacement)
 (q) $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{CrO}_4 \longrightarrow \text{PbCrO}_4 + 2 \text{KNO}_3$ (double replacement)
 (r) $\text{Fe} + \text{I}_2 \longrightarrow \text{FeI}_2$ (synthesis)
 (s) $\text{C}_3\text{H}_6\text{OS}_2 + 6 \text{O}_2 \longrightarrow 3 \text{CO}_2 + 3 \text{H}_2\text{O} + 2 \text{SO}_2$ (combustion)
 (t) $\text{MgCl}_2 \longrightarrow \text{Mg} + \text{Cl}_2$ (decomposition)
 (u) $\text{Co}(\text{NO}_3)_2 + \text{H}_2\text{S} \longrightarrow \text{CoS} + 2 \text{HNO}_3$ (double replacement)
 (v) $\text{H}_4\text{P}_2\text{O}_7 + 4 \text{KOH} \longrightarrow \text{K}_4\text{P}_2\text{O}_7 + 4 \text{H}_2\text{O}$ (neutralization)
 (w) $\text{Mg} + 2 \text{HCl} \longrightarrow \text{H}_2 + \text{MgCl}_2$ (single replacement)
 (x) $2 \text{HI} \longrightarrow \text{H}_2 + \text{I}_2$ (decomposition)
- (a) $2 \text{HNO}_3 + \text{Sr}(\text{OH})_2 \longrightarrow \text{Sr}(\text{NO}_3)_2 + 2 \text{H}_2\text{O}$ (neutralization)
 (b) $2 \text{C}_6\text{H}_4(\text{OH})_2 + 13 \text{O}_2 \longrightarrow 12 \text{CO}_2 + 6 \text{H}_2\text{O}$ (combustion)
 (c) $\text{Zn} + \text{Ni}(\text{NO}_3)_2 \longrightarrow \text{Ni} + \text{Zn}(\text{NO}_3)_2$ (single replacement)
 (d) $2 \text{AlCl}_3 + 3 \text{Na}_2\text{CO}_3 \longrightarrow \text{Al}_2(\text{CO}_3)_3 + 6 \text{NaCl}$ (double replacement)
 (e) $4 \text{Al} + 3 \text{O}_2 \longrightarrow 2 \text{Al}_2\text{O}_3$ (synthesis)
 (f) $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{BaSO}_4 + 2 \text{H}_2\text{O}$ (neutralization)
 (g) $2 \text{NO}_2 \longrightarrow \text{N}_2 + 2 \text{O}_2$ (decomposition)
 (h) $\text{Cl}_2 + \text{CaBr}_2 \longrightarrow \text{Br}_2 + \text{CaCl}_2$ (single replacement)
 (i) $\text{C}_9\text{H}_{20}\text{O}_4\text{S}_2 + 14 \text{O}_2 \longrightarrow 9 \text{CO}_2 + 10 \text{H}_2\text{O} + 2 \text{SO}_2$ (combustion)
 (j) $\text{ZnSO}_4 + \text{SrCl}_2 \longrightarrow \text{SrSO}_4 + \text{ZnCl}_2$ (double replacement)
 (k) $8 \text{Zn} + \text{S}_8 \longrightarrow 8 \text{ZnS}$ (synthesis)
 (l) $2 \text{NH}_3 \longrightarrow \text{N}_2 + 3 \text{H}_2$ (decomposition)
 (m) $\text{HCl} + \text{KOH} \longrightarrow \text{KCl} + \text{H}_2\text{O}$ (neutralization)
 (n) $2 \text{ICI} \longrightarrow \text{I}_2 + \text{Cl}_2$ (decomposition)
 (o) $2 \text{Na}_3\text{PO}_4 + 3 \text{Ca}(\text{OH})_2 \longrightarrow \text{Ca}_3(\text{PO}_4)_2 + 6 \text{NaOH}$ (double replacement)
 (p) $\text{C}_4\text{H}_8\text{S} + 7 \text{O}_2 \longrightarrow 4 \text{CO}_2 + 4 \text{H}_2\text{O} + \text{SO}_2$ (combustion)
 (q) $\text{Mg} + \text{ZnSO}_4 \longrightarrow \text{Zn} + \text{MgSO}_4$ (single replacement)
 (r) $4 \text{Li} + \text{O}_2 \longrightarrow 2 \text{Li}_2\text{O}$ (synthesis)