**BALANCING EQUATIONS: FORMULAS GIVEN Practice Sheet #1**

**Balance the following equations:**

1. Al + N2 → AlN

2. Fe + O2 → Fe3O4

3. CaCO3 → CaO + CO2

4. NH4NO3 → N2O + H2O

5. KI + Cl2 → KCl + I2

6. Pb(NO3)2 + HCl → PbCl2 + HNO3

7. BaO2 → BaO + O2

8. Al + H2SO4 → Al2(SO4)3 + H2

9. CH4 + Cl2 → CHCl3 + HCl

10. MgCl2 + NaOH → Mg(OH)2 + NaCl

11. AgNO3 + CuCl2 → AgCl + Cu(NO3)2

12. ZnS + O2 → ZnO + SO2

13. Na + H2O → H2 + NaOH

14. BaCl2 + (NH4)2CO3 → BaCO3 + NH4Cl

15. C6H6 + O2 → CO2 + H2O

16. Na + H2O → NaOH + H2

17. Fe + FeCl3  -→ FeCl2

18. Ba(OH)2 + AlCl3 → Al(OH)3 + BaCl2

19. H2C2O4 + KOH → K2C2O4  + H2O

20. C2H2Cl4 + Ca(OH)2 → C2HCl3 + CaCl2 + H2O

21. (NH4)2Cr2O7 → N2 + Cr2O3 + H2O

22. Zn3Sb2 + H2O -→ Zn(OH)2 + SbH3

23. HClO4 + P4O10 → H3PO4 + Cl2O7

24. C6H5Cl + SiCl4 + Na → (C6H5)4Si + NaCl

25. Sb2S3 + HCl → H3SbCl6 + H2S

26. IBr + NH3 → NI3  + NH4Br

27. KrF2 + H2O → Kr + O2 + HF

28. Na2CO3 + C + N2 → NaCN + CO

29. K4Fe(CN)6 + H2SO4 + H2O → K2SO4 + FeSO4 + (NH4)2SO4 + CO

**BALANCING CHEMICAL EQUATIONS - NAMES GIVEN Practice Sheet #2**

1. Potassium reacts with water yielding potassium hydroxide and hydrogen

2. Chlorine reacts with potassium bromide yielding potassium chloride and bromine

3. Zinc + hydrogen chloride yields zinc chloride and hydrogen

4. iron + water → Fe3O4 + hydrogen

5. zinc sulfide + oxygen → . zinc oxide + sulfur dioxide

6. C10H16  + Cl2 → C + HCl

7. Aluminum + sodium hydroxide → Na3AlO3 + hydrogen

8. C2H2  + O2 → CO2 + H2O

9. Ammonia + oxygen → nitrogen monoxide + water

10. Phosphorus + iron(III) oxide → tetra-phosphorus decoxide + iron

11. Cupric sulfide + oxygen → copper(I) oxide + sulfur dioxide

12. sodium bicarbonate + hydrogen sulfate → sodium sulfate + water + carbon dioxide

13. Sodium carbonate + silver nitrate → sodium nitrate + silver carbonate

14. Calcium + oxygen → calcium oxide

15. Zinc + ferric oxide → zinc oxide + iron

16. Magnesium bromide + chlorine → magnesium chloride + bromine

17. Sodium + water → sodium hydroxide + hydrogen

18. Potassium nitrate → potassium nitrite + oxygen

19. Calcium oxide + hydrochloric acid → calcium chloride + water

20. Magnesium + oxygen → magnesium oxide

21. Iron + oxygen → iron(II) oxide

22. Water + dinitrogen trioxide → nitrous acid

23. Sodium oxide + water → sodium hydroxide

24. Iron(III) oxide + carbon monoxide → iron + carbon dioxide

25. Methane (CH4) + oxygen → carbon dioxide + water

**EQUATIONS – PREDICTING BY TYPE OF REACTION**

**Part I: Complete the word equation and write the balanced chemical equation. Give the reason for the product(s) in each case. Consult the activity series and the solubility tables.**

**Composition reactions:**

1. sodium + iodine →

2. calcium + oxygen →

3. hydrogen + chlorine →

4. calcium oxide + water →

5. dinitrogen pentoxide + water →

**Decomposition reactions:**

6. nickel(II) chlorate →

7. barium carbonate →

8. zince hydroxide →

9. mercury(II) oxide →

10. copper (II) carbonate →

**Replacement reactions:**

11. aluminum + sulfuric acid →

12. potassium iodide + chlorine→

13. iron + copper (II) nitrate →

14. zinc + hydrochloric acid →

15. magnesium + silver nitrate →

**Double Replacement (ionic reactions)**

16. silver nitrate + zinc chloride →

17. copper(II) hydroxide + acetic acid →

18. iron(II) sulfate + ammonium sulfide →

19. ammonium chloride + sodium hydroxide →

20. hydrochloric acid + potassium hydroxide →

**TYPES OF CHEMICAL EQUATIONS (IDENTIFICATION)**

**State whether each of the following equations represents a synthesis (s) , decomposition(d), single replacement (sr), double replacement (dr), or combustion reaction (c).**

\_\_\_\_\_\_\_\_\_\_\_\_\_ 1. CO2 → C + O2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. NaCl + AgNO3 → NaNO3 + AgCl

\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. S + Cl2 → SCl2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. BaCl2 + 2NaOH -→ 2NaCl + Ba(OH)2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 5. 2C2H2 + 5O2  → 4CO2 + 2 H2O

\_\_\_\_\_\_\_\_\_\_\_\_\_ 6. Zn + CuSO4 → ZnSO4  + Cu

\_\_\_\_\_\_\_\_\_\_\_\_\_ 7. CH4 → C + 2H2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 8. Pb(NO3)2 + Mg → Pb + Mg(NO3)2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 9. Mg + 2 HCl → MgCl2 + H2

\_\_\_\_\_\_\_\_\_\_\_\_ 10. H2SO4 → H2 + S + 2O2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 11. 2O2 + N2 → N2O4

\_\_\_\_\_\_\_\_\_\_\_\_\_ 12. 3CaBr2 + 2Na3P → Ca3P2 + 6NaBr

\_\_\_\_\_\_\_\_\_\_\_\_\_ 13. 2KI + Br2 → 2KBr + I2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 14. C6H12O6 → 6C + 6H2O

\_\_\_\_\_\_\_\_\_\_\_\_\_ 15. 2NaF → 2Na + F2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 16. Si + O2 → SiO2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 17. 2NaI + Pb(NO3)2 →2NaNO3 + PbI2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 18. H2 + CO + O2 → H2CO3

\_\_\_\_\_\_\_\_\_\_\_\_\_ 19. C3H8 + 5O2 → 3CO2 + 4H2O

\_\_\_\_\_\_\_\_\_\_\_\_\_ 20. Li3PO4 → 3Li + P +2O2

\_\_\_\_\_\_\_\_\_\_\_\_\_ 21. CS2 + 2F2 → CF4 + 2S

\_\_\_\_\_\_\_\_\_\_\_\_\_ 22. NaI + Cs → CsI + Na

**REACTION PREDICTION (Set #1)**

**If the word equation is complete, write and balance the chemical equation. If the word equation is incomplete, complete it and write the balanced chemical equation. Tell the type of reaction. Give reason(s) for the product(s)**

1. barium chloride + sodium sulfate →

2. calcium + hydrochloric acid →

3. iron(II) sulfide + hydrochloric acid → hydrogen sulfide (g) +

4. zinc chloride + ammonium sulfide →

5. ammonia + oxygen → nitric acid + water

6. magnesium + nitric acid →

7. potassium + water →

8. sodium iodide + bromine →

9. silver + sulfur→

10. sodium chlorate →

11. carbon + steam (H2O) → carbon monoxide(g) + hydrogen (g)

12. zinc + lead(II) acetate →

13. iron (II) hydroxide →

14. iron(II) oxide + carbon monoxide → iron + carbon dioxide (g)

15. lead (II) acetate + hydrogen sulfide →

16. aluminum bromide + chlorine →

17. magnesium carbonate →

18. iron(II) chloride + sodium hydroxide →

19. calcium oxide + diphophorus pentoxide →

20. chromium + oxygen →

21. sodium + water →

22. calcium carbonate + hydrochloric acid →

23. calcim hydroxide + phophoric acid →

24. sodium carbonate + nitirc acid →

25. aluminum hydroxide + sulfuric acid →

26. sodium sulfite + sulfuric acid →

27. copper + sulfuric acid → copper (II) sulfate + water + sulfur dioxide (g)

28. calcium hydroxide + ammonium sulfate → calcium sulfate + water + ammonia

**REACTION PREDICTION (Set #2)**

**In each of the following examples:**

 **a. State what type of reaction is expected.**

 **b. Write the balanced equation for those reaction that do take place.**

1. aluminum plus hydrochloric acid

2. calcium hydroxide plus nitric acid

3. magnesium plus zinc nitrate

4. mercury plus oxygen

5. zinc chloride plus hydrogen sulfide

6. dinitrogen pentoxide plus water

7. sodium chlorate heated to high temperature

8. barium nitrate plus sodium chromate

9. sodium bromide plus silver nitrate

10. zinc carbonate strongly heated

11. potassium plus fluorine

12. potassium nitrate plus zinc phosphate

13. lithium oxide plus water

14. sodium chloride molten electrolyzed

15. iron(iii) hydroxide plus phosphoric acid

16. sodium plus nitric acid

17. sulfur dioxide plus water

18. oxygen plus sulfur

19. sodium sulfate plus barium chloride

20. hydrogen plus oxygen

21. sodium oxide plus water

22. mercury(I) nitrate plus sodium carbonate

23. magnesium plus hydrochloric acid

24. lead(II) nitrate and sodium iodide

25. chromium(II) perchlorate and sodium sulfide

**REACTION PREDICTION (Set #3)**

Write a balanced chemical equation for each of the following reacions. Classify the reation type.

1. iron(III) oxide + hydrogen →
2. bismuth(V) oxide →
3. Manganeese (II) chlorate + potassium phosphate →
4. Lead (II) acetate + sodium chromate →
5. potassium + iodine →
6. ammonium sulfate + barium nitrate →
7. zinc oxide →
8. gold(III) chloride + sodium sulfide →
9. magnesium + hydrochloric acid →
10. calcium hydroxide + iron (II) nitrate →
11. C4H10 + O2 →
12. tin(IV) sulfide →
13. silver nitrate + zinc →
14. potassium carbonate + lead (II) nitrate →
15. ammonium chloride + mercury(II) acetate →
16. iron + hydrochloric acid →
17. sodium iodide + chlorine →
18. aluminum + oxygen →
19. barium chloride + lithium sulfate →
20. sulfuric acid + calcium hydroxide →
21. iron (II) nitrate + sodium sulfite →
22. C5H12 + O2 →

**REACTION PREDICTION (Set #4)**

Write a balanced chemical equation for each of the following reacions. Classify the reation type.

1. zinc chloride + ammonium sulfide →
2. zinc + copper (II) sulfate →
3. magnesium bromide + chlorine →
4. aluminum oxide →
5. silver nitrate + sodium chloride →
6. magnesium + copper (II) nitrate →
7. sodium hydroxide + sulfuric acid →
8. lead (II) nitrate + potassium bromide →
9. copper + tin (IV) chloride →
10. C10H22 + O2 →
11. potassium sulfide + iron (III) nitrate →
12. zinc + silver nitrate →
13. silver + oxygen →
14. tin(IV) chloride →
15. calcium hydroxide + phophoric acid →
16. magnesium iodide + chlorine →
17. barium nitrate + sodium phophate →
18. manganeese(IV) oxide →
19. nitrogen + hydrogen → ammonia
20. C11H22 + O2 →
21. aluminum chloride + potassium sulfide →

22. sodium sulfite + hydrochloric acid

**REVIEW OF WRITING CHEMICAL EQUATIONS**

For each of the following equations write a formula equation.

YOU DO NOT HAVE TO BALANCE IT.

When applicable, write a net ionic equation.

1. Solutions of sodium fluoride and dilute hydrochloric acid are mixed.

2. A saturated solution of barium hydroxide is mixed with a solution of iron(III) sulfate.

3. A solution of ammonium sulfate is added to a potassium hydroxide solution.

4. Carbon dioxide gas is bubbled through a concentrated solution of sodium hydroxide.

5. Solid copper is added to a dilute nitric acid solution.

6. Magnesium metal is burned in nitrogen gas.

7. Sulfur dioxide gas is passed over solid calcium oxide.

8. Lead foil is immersed in silver nitrate solution.

9. A solution of ammonium sulfate is added to a saturated solution of barium hydroxide.

10. Acetic acid solution is added to a solution of sodium hydrogen carbonate.

11. Hydrogen gas is passed over hot iron(III) oxide.

12. Dilute hydrochloric acid is added to a dilute solution of mercury (I) nitrate.

 13. Sodium metal is added to water.

14. Dilute sulfuric acid is added to a solution of lithium hydrogen carbonate.

15. A piece of lithium metal is dropped into a container of nitrogen gas.

16. Dilute hydrochloric acid is added to a solution of potassium sulfite.

17. Solid sodium oxide is added to water.

18. A solution of sodium sulfide is added to a solution of zinc nitrate.

19. A solution of ammonia is added to a dilute solution of acetic acid.

20. Solid calcium is added to warm water.

21. Powdered magnesium oxide is added to a container of carbon dioxide gas.

22. Gaseous hydrogen sulfide is bubbled through a solution of nickel(II) nitrate.

23. A strip of magnesium is added to a solution of silver nitrate.

24. Solid potassium chlorate is heated in the presence of manganese dioxide as a catalyst.

25. Dilute hydrochloric acid is added to a solution of potassium carbonate.

26. Sulfur trioxide gas is added to excess water.

27. Dilute sulfuric acid is added to a solution of barium chloride.

28. Solutions of zinc sulfate and sodium phosphate are mixed.

29. Solutions of silver nitrate and lithium bromide are mixed.

30. Excess hydrochloric acid solution is added to a solution of potassium carbonate.

31. Ethanol (C2H5OH) is burned in excess oxygen gas.

**OXIDATION /REDUCTION REACTIONS**

1. Assign oxidation number to each element in the following compounds:

a. PbSO4 b. H2O2 c. K2Cr2O7 d. K2SiO3

2. Which of the following are oxidation-reduction reactions?

a. 2Na + Cl2 → 2NaCl

 b. C + O2 → CO2

 c. 2H2O ↔ 2H2 + O2

 d. NaCl + AgNO3 → AgCl + NaNO3

 e. NH3 + HCl → NH4+1 + Cl-1

 f. 2KClO3 → 2KCl + O2

 g. H2 + Cl2 → 2HCl

 h. 2H2 + O2 → 2H2O

 i. H2SO4 + 2KOH →K2SO4 + 2H2O

 j. Zn + CuSO4 →ZnSO4 + Cu

3. For each oxidation-reduction in Question 2 identify the:

a. substance oxidized

 b. substance reduced

c. the oxidizing agent

d. the reducing agent

 e. write the oxidation and reduction half-reactions

**OXIDATION REDUCTION REACTIONS – BALANCING: Set #1**

Balance the following equations using the ion-electron method.

1. H2S + O2 → SO2 + H2O

2. MnO2 + HCl → H2O + MnCl2 + Cl2

3. zinc + hydrochloric acid → zinc chloride + hydrogen

4. iron + copper(II) sulfate → iron (II) sulfate + copper

5. copper + sulfuric acid → copper (II) sulfate + hydrogen

6. potassium dichromate + sulfur + water → sulfur dioxide + potassium hydroxide + chromium (III) oxide

7. bromine + water → hydrobromic acid + hypobromous acid

8. HCl + KMnO4 → H2O + KCl + MnCl2 + Cl2

9. K2Cr2O7 + HCl → KCl + CrCl3 + H2O + Cl2

10. Cu2O + SO2 → CuS + O2

11. CS2 + SCl2 → CCl4 + S

12. NaAu(CN)2 + Zn → Na2Zn(CN)4 + Au

13. FeSO4 + O2 + H2O → FeOHSO4

14. HBr + Ca(BrO)2 → CaBr2 + Br2 + H2O

15. Ca3(PO4)2 + SiO2 → P4O10 + CaSiO3

16. The oxidation-reduction reaction between copper and concentrated nitric acid yields the following products: copper(II) nitrate, water and nitrogen dioxide. Write a balanced equation for this reaction.

17. The reaction between copper and dilute nitric acid yields the following products: copper (II) nitrate, water and nitrogen monoxide. Write the balanced equation.

**Balancing REDOX Reactions: Set #2**

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**Balancing Equations: Formulas Given, Page 1**

1) 2, 1, 2

2) 3, 2, 1

3) 1, 1, 1

4) 1, 1, 2

5) 2, 1, 2, 1

6) 1, 2, 1, 2

7) 2, 2, 1

8) 2, 3, 1, 3

9) 1, 3, 1, 3

10) 1, 2, 1, 2

11) 2, 1 ,2 , 1

12) 2, 3 ,2, 2

13) 2, 2, 1, 2

14) 1, 1, 1, 2

15) 2, 15, 12, 6

16) 2, 2, 2, 1

17) 1, 2, 3

18) 3, 2, 2, 3

19) 1, 2, 1, 2

20.) 2, 1, 2, 1, 2

21) 1, 1, 1, 4

22) 1, 6, 3, 2

23) 12, 1, 4, 6

24) 4, 1, 8, 1, 8

25) 1, 12, 2, 3

26) 3, 4, 1, 3

27) 2, 2, 2, 1, 4

28) 1, 4, 1, 2, 3

29) 1, 6, 6, 2, 1, 3, 6

**Balancing Equations – Names Given (pages 2/3)**

1. 2K + 2H2O → 2KOH + H2

2. Cl2 + 2KBr → 2KCl + Br2

3. Zn + 2HCl → ZnCl2 + H2

4. 3Fe + 4H2O → Fe3O4 + 4H2

5. 2ZnS + 3O2 → 2ZnO + 2SO2

6. C10 H16 + 8Cl2 → 10C + 16 HCl

7. 2Al + 6NaOH → 2Na3AlO3  + 3H2

8. 2C2H2 + 5O2 → 4CO2 + 2H2O

9. 4NH3 + 5O2 → 4NO + 6H2O

10. 12P + 10Fe2O3 → 3P4O10  + 20 Fe

11. 4CuS + 5O2 → 2Cu2O + 4SO2

12. 2NaHCO3 + H2SO4 → Na2SO4 + 2H2O + 2CO2

13. Na2CO3 + 2AgNO3 → 2NaNO3 + Ag2CO3

14. 2Ca + O2 → 2CaO

15. 3Zn + Fe2O3 → 3ZnO + 2Fe

16. HgBr2 + Cl2 → MgCl2 + Br2

17. 2Na + 2H2O → 2NaOH + H2

18. 2KNO3 → 2KNO2 + O2

19. CaO + 2HCl → CaCl2 + H2O

20. 2 MgO + O2 → 2MgO

21. 2Fe + O2 → 2FeO

22. H2O + N2O3 → 2HNO2

23. Na2O + H2O → 2NaOH

24. Fe2O3  + 3CO → 2Fe + 3CO2

25. CH4 + 2O2 → CO2 + 2H2O

**EQUATIONS – Predicting by type of reaction, page 4**

1. 2Na + I2 → 2NaI

2. 2Ca + O2 → 2CaO

3. H2 + Cl2 → 2HCl

4. CaO + H2O → Ca(OH)2

5. N2O5 + H2O → 2HNO3

6. Ni(ClO3)2 → NiCl2 + 3O2

7. BaCO3 → BaO + CO2

8. Zn(OH)2 → ZnO + H2O

9. 2HgO → 2Hg + O2

10. CuCO3 → CaO + CO2

11. 2Al + 3 H2SO4 → Al2(SO4)3 + 3H2O

12. 2KI + Cl2→ 2KCl + I2

13. 2 Fe + 3Cu(NO3)2 →2 Fe(NO3)3 + 3Cu

14. Zn + 2HCl → ZnCl2 + H2

15. Mg + 2AgNO3 → Mg(NO3)2 + 2Ag

16. 2AgNO3 + ZnCl2  → Zn(NO3)2 + 2AgCl(s)

17. Cu(OH)2 + 2 CH3COOH → Cu(CH3COO) 2 + 2H2O

18. FeSO4 + (NH4)2S → FeS + (NH4)2SO4

19. NH4Cl + NaOH → NH3 + H2O + NaCl

20. HCl + KOH → KCl + H2O

**Types of Chemical Equations (Page # 5)**

1. d 2. dr 3. s 4. dr 5. c 6. sr 7. d

8. sr 10. d 11. s 12. s 13. dr 14. d 15. d

16. s 17. dr 18. s 19. c 20. d 21. sr 22. sr

**Reaction Prediction (Set #1) Page 6**

1. BaCl2 + Na2SO4 → BaSO4 (s) + 2NaCl

2. Ca + 2HCl → CaCl2 + H2

3. FeS + 2HCl → H2S + FeCl2

4. ZnCl2 + (NH4)2S → ZnS(s) + 2NH4Cl

5. NH3 + 2O2 → HNO3 + H2O

6. Mg + 2HNO3 → Mg(NO3)2 + H2

7. 2K + 2H2O → 2KOH + H2

8. 2NaI + Br2 → 2NaBr + I2

9. 2Ag + S → Ag2S

10. 2NaClO3 → 2NaCl + 3O2

11. C + H2O → CO + H2

12. Zn + Pb(C2H3O2)2 → H2 + Zn (C2H2O3)2

13. Fe(OH)2 → FeO + H2O

14. FeO + CO → Fe + CO2

15. Pb(C2H3O2)2 + H2S → PbS + 2HC2H3O2

16. 2AlBr3 + 3Cl2 → 2AlCl3 + 3 Br2

17. MgCO3 → MgO + CO2

18. FeCl2 + 2NaOH → Fe(OH)2(s) + NaCl

19. 6CaO + 2P2O5 → 2Ca3(PO4)2

20. 4Cr + 3O2 → 2Cr2O3

21. 2Na + 2H2O → 2NaOH + H2

22. CaCO3 + 2HCl → CaCl2 + CO2 + H2O

23. 3Ca(OH)2 + 2 H3PO4 → Ca3(PO4)2(s) + 6H2O

24. Na2CO3 + 2HNO3 → 2NaNO3 + H2O + CO2

25. 2Al(OH)3 + 3H2SO4 → Al2(SO4)3 + 6H2O

26. Na2SO3 + H2SO4 → Na2SO4 + SO2 + H2O

27. Cu + H2SO4 → CuSO4 + H2

28. Ca(OH)2 + (NH4)2SO4 → CaSO4 + 2NH3 + 2H2O

**Reaction Prediction (Set #2)*:* (Page 7).**

**In each of the following examples:**

 **a. State what type of reaction is expected.**

 **c. Write the balanced equation for those reaction that do take place.**

1. aluminum plus hydrochloric acid 2Al + 6HCl → 2AlCl3 + 3H2

2. calcium hydroxide plus nitric acid Ca(OH)2 + 2HNO3 → Ca(NO3)2 + 2H2O(l)

3. magnesium plus zinc nitrate Mg + Zn(NO3)2 → Mg(NO3)2 + Zn

4. mercury plus oxygen 2Hg + O2 → 2HgO

5. zinc chloride plus hydrogen sulfide ZnCl2 + H2S → ZnS(s) + 2HCl

6. dinitrogen pentoxide plus water N2O5 + H2O → 2HNO3

7. sodium chlorate heated to high temperature 2NaClO3 →2NaCl + 3O2

8. barium nitrate plus sodium chromate Ba(NO3)2 + Na2CrO4 → BaCrO4(s) + 2NaNO3

9. sodium bromide plus silver nitrate NaBr + AgNO3 → NaNO3 + AgBr(s)

10. calcium phosphate plus aluminum sulfate Ca3(PO4)2 + Al2(SO4)3 → 3CaSO4(s) + 2AlPO4(s)

11. zinc carbonate strongly heated ZnCO3 → ZnO + CO2

12. potassium plus fluorine 2K + F2 → 2KF

13. lithium oxide plus water Li2O + H2O → 2LiOH

14. sodium chloride molten electrolyzed 2NaCl ---electrolysis → 2Na + Cl2

15. iron(iii) hydroxide plus phosphoric acid Fe(OH)3 + H3PO4 → FePO4 + 3H2O(l)

16. sodium plus nitric acid 2Na + 2HNO3 → 2 NaNO3 + H2

17. sulfur dioxide plus water SO2 + H2O →H2SO3

18. oxygen plus sulfur O2 + S → SO2

19. sodium sulfate plus barium chloride Na2SO4 + BaCl2 → BaSO4(s) + 2NaCl

20. hydrogen plus oxygen 2H2 + O2 → 2H2O

21. sodium plus water 2Na + 2H2O → 2 NaOH + H2

22. mercury(I) nitrate plus sodium carbonate Hg2(NO3)2 + Na2CO3 →Hg2CO3(s) + NaNO3

23. magnesium plus hydrochloric acid Mg + 2 HCl → MgCl2 + H2

24. lead(II) nitrate and sodium iodide Pb(NO3)2 + 2NaI → PbI2(s) + 2NaNO3

25. chromium(III) perchlorate and sodium sulfide 2Cr(ClO4)3 + 3Na2S → 2Cr2S3(s) + 6NaClO4

**Reaction Prediction (Set #3)*:* (Page 8).**

1. Fe2O3 +3H2→ 3H2O + 5Fe
2. Bi2O5 → 4Bi + 5O2
3. 3Mn(ClO3)2 + 2K3PO4 → 6KClO3 + Mn3(PO4)2 (s)
4. Pb(CH3COO)2 + Na2CrO4 → PbCrO4(s) + 2NaCH3COO
5. 2K + I2 → 2KI
6. (NH4)2SO4 + Ba(NO3)2 → BaSO4(s) + 2NH4NO3
7. 2ZnO → 2Zn + O2
8. 2AuCl3 + 3Na2S → 6NaCl + Au2S3(s)
9. Mg + 2HCl → MgCl2 + H2
10. Ca(OH)2 + Fe(NO3)2 → Fe(OH)2 (s) + Ca(NO3)2
11. 2C4H10 + 13 O2 → 8CO2 + 10 H2O
12. SnS2 → Sn + 2S
13. 2AgNO3 + Zn → Zn(NO3)2 + 2Ag
14. K2CO3 + Pb(NO3)2 → 2KNO3 + PbCO3(s)
15. 2NH4Cl + Hg(C3H3O2)2 → 2NH4C2H3O2 + HgCl2(s)
16. Fe + 2HCl → FeCl2 + H2 or 2Fe + 6HCl → 2FeCl3 + 3H2
17. 2NaI + Cl2 → 2NaCl + I2
18. 4Al + 3O2 → 2Al2O3
19. BaCl2 + Li2SO4 → BaSO4(s) + 2 LiCl
20. H2SO4 + Ca(OH)2 → CaSO4 + 2H2O
21. Fe(NO3)2 + Na2S → FeS + 2NaNO3
22. C5H11 + 8O2 → 5CO2 + 6H2O

**Reaction Prediction (Set #4)*:* (Page 9).**

1. ZnCl2 + (NH4)2S → 2NH4Cl + ZnS(s)

2. Zn + CuSO4  → ZnSO4 + Cu

3. MgBr2 + Cl2 → MgCl2 + Br2

4. 2Al2O3 → 2Al + 3O=

5. AgNO3 + NaCl → AgCl(s) + NaNO=

6. Mg + Cu(NO3)2 → Mg(NO3)2 + Cu

7. 2NaOH + H2SO4 → Na2SO4 + 2H2O

8. Pb(NO3)2 + 2KBr → PbBr2(s) + 2KNO3

9. 2Cu + SnCl4 → 2CaCl2 + Sn

10. 2C10H22 + 31O2 → 20CO2 + 22H2O

11. 3K2S + 2Fe(NO3)3 → 6KNO3 + Fe2S3(s)

12. Zn + 2AgNO3 → Zn(NO3)2 + 2Ag

13. 4Ag + O2 → 2Ag2O

14. SnCl4 → Sn + 2Cl2

15. 3Ca(OH)2 + 2H3PO4 → Ca3(PO4)2(s) + 6H2O

16. MgI2 + Cl2 → MgCl2 + I2

17. 3Ba(NO3)2 + 2Na3PO4 → Ba3(PO4)2(s) + 6NaNO3

18. MnO2 → Mn + O2

19. N2 + 3H2 → 2NH3

20. 2C11H22 + 33O2 → 22CO2 + 22H2O

21. 2AlCl3 + 3K2S → 6KCl + Al2S3

22. Na2SO3 + 2HCl → 2NaCl + SO2(g) + H2O

**REVIEW OF WRITING CHEMICAL EQUATIONS: PAGE 10**

 Formula Equation Ionic Equation

1. NaF(aq) + HCl(aq) → NaCl + HF(g) H+ + F- → HF(g)

2. Ba(OH)2 + Fe2(SO4)3 → BaSO4 + Fe(OH)3

Ba+2 + OH- + Fe+3 + SO4-2 →BaSO4(s) + Fe(OH)3(s)

3. (NH4)2SO4 + KOH→ K2SO4 + NH3(g) + H2O NH4+ + OH- → NH3 + H2O

4. CO2(g) + NaOH(aq) → Na2CO3 + H2O CO2 + H2O → H2CO3

 H2CO3 + NaOH → Na2CO3 + H2O H+ + OH- → H2O

5. Cu + HNO3 → H2 + Cu(NO3)2 NO REACTION

6. Mg + N2 → Mg3N2

7. SO2(g) + CaO → CaSO3

8. Pb(s) + AgNO3 (aq) → Ag + Pb(NO3)2 Pb(s) + Ag+ → Pb+2 + Ag(s)

9. (NH4)2SO4 + Ba(OH) 2 → BaSO4(s) + NH4OH Ba+2 + SO4-2 → BaSO4(s)

10. HC2H3O2 + NaHCO3 → NaC2H3O2 + H2O + CO2 H+ +HCO3-→ H2O + CO2

11. H2 + Fe2O3 → Fe + H2O H2 + Fe+3→ H+ + Fe

12. HCl + Hg2(NO3)2 → HNO3 + Hg2Cl2(s) Hg2+2 + Cl- → Hg2Cl2(s)

13. Na + H2O → NaOH + H2 Na + H+ → H2 + Na+

14. H2 SO4 + LiHCO3 → Li2SO4 + H2O + CO2 H+ +HCO3-→ H2O + CO2

15. Li + N2 → Li3N

16. HCl + K2SO3 → KCl + H2O + SO2 H+ + SO3-2 → H2O + SO2

17. Na2O + H2O → NaOH

18. Na2S + Zn(NO3)2 → ZnS(s) + NaNO3 Zn+2 + S-2 → ZnS(s)

19. NH4OH + HC2H3O2 → NH4C2H3O2 + H2O H+ + OH- → H2O

20. Ca + H2O → Ca(OH)2

21. MgO + CO2 → MgCO3

22. H2S(g) + Ni(NO3)2 → NiS(s) + HNO3 Ni+2 + S-2 → NiS(S)

23. Mg + AgNO3 → Ag + Mg(NO3)2 Mg + Ag+1 → Mg+2 + Ag

24. KClO3 → KCl + O2

25. HCl + K2CO3 → KCl + H2O + CO2 H+ CO3-2 → H2O + CO2

26. SO3(g) + H2O → H2SO3

27. H2SO4 + BaCl2 → BaSO4 + HCl Ba+2 + SO4-2 → BaSO4(s)

28. ZnSO4 + Na3PO4 → Zn3(PO4)2 (s) + Na2SO4 Zn +2 + PO4-3 → Zn3(PO4)2(s)

29. AgNO3 + LiBr → LiNO3 + AgBr Ag+ + Br- → AgBr

30. HCl + K2CO3 → KCl + H2O + CO2 H+ CO3-2 → H2O + CO2

31. C2H5OH + O2 → CO2 + H2O

Oxidation/Reduction Reactions: page 11

1. (a) +2, +6, -2 2. +1, -1 3. +1, +6, -2

2. (a), (b), (c), (f), (g) (h), (j) are oxidation/reduction reactions

3.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Question # | Substance oxidized | Substance reduced | Oxidizing agent | Reducing agent | Equation |
| (a) | Na0 | Cl2 | Cl2 | Na | Na0 → Na+1 + 1e; Cl2 + 2e → 2Cl- |
| (b) | C0 | O2 | O2 | C0 | C0 → C+4 + 4e; O2 +4e → 2c |
| (c) | O-2 | H+1 | H+1 | O-2  | 2O-2→ 3O2 +4e; 4e + 4 H+1 → H20  |
| (f) | O-2 | Cl+5 | Cl+5 | O-2 | 6 O-2→ 3O2 +12e; 2Cl+5 + 12 e → 2Cl-1 |
| (g) | H20 | Cl20 | Cl20 | H20 | H20 → 2H+1 + 2e; Cl20 + 2e → 2Cl-1 |
| (h) | H20 | O2 | O2 | H20 | O2 +4e O-2→ 2O-2 ; 2 H20 → 4H+1 + 4e |
| (j) | Zn0 | Cu+2 | Cu+2 | Zn0 | Zn0→ Zn+2 + 2e; Cu+2 + 2e → Cu0 |

**Oxidation/Reduction Reactions - Balancing: page 12**

1. 2, 2, 2
2. 1, 4, 2, 1, 1
3. 1, 2, 1, 2
4. 1, 1, 1, 1
5. 1, 2, 1, 1
6. 1, 2, 1, 2, 2, 2
7. 1, 1, 1, 1
8. 16, 2, 8, 2, 2, 5
9. 1, 14, 2, 2, 7,3
10. 2, 4, 4, 1
11. 1, 2, 1, 4
12. 2, 1, 1, 2
13. 4, 1, 2, 4
14. 4, 1, 1, 2, 2
15. 2, 6, 1, 6
16. 1, 4, 1, 2, 2
17. 3, 8, 3 ,4, 2

**Answers to Odd Numbered Exercises: page 13**

