Worksheet #5: Double-Replacement Reactions

In these reactions, all you do is look at the names of the reactants, and "switch partners". Just be sure that the new pairs come out with the positive ion named first, and paired with a negative ion.

1. aluminum iodide + mercury(II) chloride $\rightarrow$ aluminum chloride + mercury(II) iodide
   \[ 2AlI_3 + 3HgCl_2 \rightarrow 2AlCl_3 + 3HgI_2(ppt) \]

2. silver nitrate + potassium phosphate $\rightarrow$ silver phosphate + potassium nitrate
   \[ 3AgNO_3 + K_3PO_4 \rightarrow Ag_3PO_4(ppt) + 3KNO_3 \]

3. copper(II) bromide + aluminum chloride $\rightarrow$ copper(II) chloride + aluminum bromide
   \[ 3CuBr_2 + 2AlCl_3 \rightarrow 3CuCl_2 + 2AlBr_3 \]

4. calcium acetate + sodium carbonate $\rightarrow$ calcium carbonate + sodium acetate
   \[ Ca(C_2H_3O_2)_2 + Na_2CO_3 \rightarrow CaCO_3(ppt) + 2NaC_2H_3O_2 \]

5. ammonium chloride + mercury(I) acetate $\rightarrow$ ammonium acetate + mercury(I) chloride
   \[ 2NH_4Cl + Hg_2(C_2H_3O_2)_2 \rightarrow 2NH_4C_2H_3O_2 + Hg_2Cl_2(ppt) \]

6. calcium nitrate + hydrochloric acid $\rightarrow$ calcium chloride + nitric acid
   \[ Ca(NO_3)_2 + 2HCl \rightarrow CaCl_2 + 2HNO_3 \]

7. iron(II) sulfide + hydrochloric acid $\rightarrow$ iron(II) chloride + hydrogen sulfide (g)
   \[ FeS + 2HCl \rightarrow FeCl_2 + H_2S \]

8. copper(II) hydroxide + acetic acid $\rightarrow$ copper(II) acetate + water
   \[ Cu(OH)_2 + 2HC_2H_3O_2 \rightarrow Cu(C_2H_3O_2)_2 + 2H_2O \]

9. calcium hydroxide + phosphoric acid $\rightarrow$ calcium phosphate + water
   \[ 3Ca(OH)_2 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6H_2O \]

10. calcium bromide + potassium hydroxide $\rightarrow$ calcium hydroxide + potassium bromide
    \[ CaBr_2 + 2KOH \rightarrow Ca(OH)_2 + 2KBr \]

Examine the products of the reactions on this page, and determine in each whether a gas, water, or a precipitate is formed. Use solubility Table B.9 on page R54 at the back of your textbook to determine the solubilities of the reaction products. If there is no gas, water, or precipitate produced, put an "X" through the yield sign, because no reaction occurs.

\[ \text{ppt} = \text{solid}, \text{all others are aqueous} \]

* use your solubility guidelines to determine \((aq)\) or \((s)\)
Balance the reactions a to e and indicate which types of chemical reaction that are being represented:

a) \[ 2 \text{NaBr} + \text{Ca(OH)}_2 \rightarrow \text{CaBr}_2 + 2\text{NaOH} \] Reaction Type: double

b) \[ 2 \text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4 \] Reaction Type: synthesis

c) \[ 4 \text{C}_5\text{H}_9\text{O} + 27 \text{O}_2 \rightarrow 20 \text{CO}_2 + 18 \text{H}_2\text{O} \] Reaction Type: combustion

d) \[ 3 \text{Pb} + 2 \text{H}_3\text{PO}_4 \rightarrow 3 \text{H}_2 + \text{Pb}_3(\text{PO}_4)_2 \] Reaction Type: single

e) \[ \text{Li}_3\text{N} + 3\text{NH}_4\text{NO}_3 \rightarrow 3\text{LiNO}_3 + (\text{NH}_4)_3\text{N} \] Reaction Type: double
Indicate the type of reactions for letters g through t.

g) \( \text{Na}_3\text{PO}_4 + 3 \text{ KOH} \rightarrow 3 \text{ NaOH} + \text{K}_3\text{PO}_4 \) \hspace{1cm} \text{Reaction Type \underline{d}ouble}

h) \( \text{MgCl}_2 + \text{Li}_2\text{CO}_3 \rightarrow \text{MgCO}_3 + 2 \text{ LiCl} \) \hspace{1cm} \text{Reaction Type \underline{d}ouble}

i) \( \text{C}_6\text{H}_{12} + 9 \text{ O}_2 \rightarrow 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \) \hspace{1cm} \text{Reaction Type \underline{c}omb.}

j) \( \text{Pb} + \text{FeSO}_4 \rightarrow \text{PbSO}_4 + \text{Fe} \) \hspace{1cm} \text{Reaction Type \underline{s}ingle}

k) \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \) \hspace{1cm} \text{Reaction Type \underline{d}ecomp}

l) \( \text{P}_4 + 3 \text{ O}_2 \rightarrow 2 \text{ P}_2\text{O}_3 \) \hspace{1cm} \text{Reaction Type \underline{s}ynthesis}

m) \( 2 \text{RbNO}_3 + \text{BeF}_2 \rightarrow \text{Be(NO}_3)_2 + 2 \text{ RbF} \) \hspace{1cm} \text{Reaction Type \underline{d}ouble}

n) \( 2 \text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu(NO}_3)_2 + 2 \text{ Ag} \) \hspace{1cm} \text{Reaction Type \underline{s}ingle}

o) \( \text{C}_6\text{H}_6\text{O} + 4 \text{ O}_2 \rightarrow 3 \text{ CO}_2 + 3 \text{ H}_2\text{O} \) \hspace{1cm} \text{Reaction Type \underline{c}omb}

p) \( 2 \text{C}_6\text{H}_5 + \text{Fe} \rightarrow \text{Fe(C}_6\text{H}_5)_2 \) \hspace{1cm} \text{Reaction Type \underline{s}ynthesis}

q) \( \text{SeCl}_6 + \text{O}_2 \rightarrow \text{SeO}_2 + 3\text{Cl}_2 \) \hspace{1cm} \text{Reaction Type \underline{s}ingle}

r) \( 2 \text{Mgl}_2 + \text{Mn(SO}_3)_2 \rightarrow 2 \text{MgSO}_3 + \text{MnI}_4 \) \hspace{1cm} \text{Reaction Type \underline{d}ouble}

s) \( \text{O}_3 \rightarrow \text{O}^- + \text{O}_2 \) \hspace{1cm} \text{Reaction Type \underline{d}ecomp}
Worksheet #4: Single-Replacement Reactions

Step 1 - Write the formulas of the reactants on the left of the yield sign
Step 2 - Look at the Activity Series on page 333 to determine if the replacement can happen
Step 3 - If the replacement can occur, complete the reaction and balance it. If the reaction cannot happen, write N.R. (no rxn) on the product side.

1. lead + zinc acetate →
   \[ \text{Pb} + \text{Zn(C}_2\text{H}_3\text{O}_2)_2 \rightarrow \text{NR} \]

2. iron + aluminum oxide →
   \[ \text{Fe} + \text{Al}_2\text{O}_3 \rightarrow \text{NR} \]

3. silver nitrate + nickel →
   \[ \text{AgNO}_3 + \text{Ni} \rightarrow \text{NiNO}_3 + \text{Ag} \]

4. sodium bromide + iodine →
   \[ \text{NaBr} + \text{I}_2 \rightarrow \text{NR} \]

5. aluminum bromide + chlorine →
   \[ \text{AlBr}_3 + \text{Cl}_2 \rightarrow \text{AlCl}_3 + \text{Br}_2 \]

6. sodium iodide + bromine →
   \[ \text{NaI} + \text{Br}_2 \rightarrow \text{NaBr} + \text{I}_2 \]

7. calcium + hydrochloric acid →
   \[ \text{Ca} + \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2 \]

8. magnesium + nitric acid →
   \[ \text{Mg} + \text{HNO}_3 \rightarrow \text{Mg(NO}_3)_2 + \text{H}_2 \]

9. silver + sulfuric acid →
   \[ \text{Ag} + \text{H}_2\text{SO}_4 \rightarrow \text{NR} \]

10. potassium + water →
    \[ \text{K} + \text{H}_2\text{O} \rightarrow \text{KOH} + \text{H}_2 \]

11. sodium + water →
    \[ \text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2 \]
Single Replacement Reaction Worksheet

For each reaction use the activity series to complete the reaction. If no reaction will occur, write "no reaction". Make sure you balance your final answer.

1. Ag + KNO₃ → NR
2. Zn + AgNO₃ → Ag + Zn(NO₃)₂
3. Cl₂ + KI → KCl + I₂
4. Cu + FeSO₄ → NR
5. Fe + Pb(NO₃)₂ → Pb + Fe(NO₃)₂
6. Cu + Al₂(SO₄)₃ → NR
7. Al + Pb(NO₃)₂ → Pb + Al(NO₃)₃
8. Cl₂ + NaI → NaCl + I₂
9. Fe + AgC₂H₃O₂ → Ag + Fe(C₂H₃O₂)₃
10. Al + CuCl₂ → Cu + AlCl₃
11. Br₂ + CaI₂ → CaBr₂ + I₂
12. Fe + CuSO₄ → FeSO₄ + Cu
13. Cl₂ + MgI₂ → MgCl₂ + I₂

Activity Series
Metals Nonmetals
Li F₂
Rb Cl₂
K Br₂
Cs I₂
Ba
Sr
Ca
Na
Mg
Al
Ti
Mn
Zn
Cr
Fe
Co
Ni
Sn
Pb
H₂
Cu
Ag
Au

Least

Most
Name: ____________ Date: ____________
Period: ____________ Measurement Review Sheet #1

1. How many significant figures are there in each of the following values?
   a. 6.07 \times 10^{11} \quad 3
   b. 0.003840 \quad 4
   c. 17.00 \quad 4
   d. 8 \times 10^1 \quad 1
   e. 463.8052 \quad 7
   f. 300. \quad 3
   g. 301 \quad 3
   h. 300. \quad 3

2. Use scientific notation to express the number 480 to
   a. one significant figure \quad 5 \times 10^2
   b. two significant figures \quad 4.8 \times 10^2
   c. three significant figures \quad 4.80 \times 10^2
   d. four significant figures \quad 4.800 \times 10^2

3. Report the proper number of significant figures: \((6.404 \times 2.91)(18.7 - 17.1)\)
   \(\left(\frac{12}{1.6}\right)\)

4. Use the following exact conversion factors to perform the stated calculations:
   \[5 \frac{1}{2} \text{ yards} = 1 \text{ rod}\]
   \[40 \text{ rods} = 1 \text{ furlong}\]
   \[8 \text{ furlongs} = 1 \text{ mile}\]
   \[1.25 \text{ miles} \times \frac{1609 \text{ m}}{1 \text{ mile}} = 2010 \text{ m} = 2.01 \text{ km}\]
   a. The Kentucky Derby race is 1.25 miles. How long is the race in rods, furlongs, meters, and kilometers?
   b. A marathon race is 26 miles, 385 yards. What is this distance in rods, furlongs, meters, and kilometers?

3 ft = 1 yd
60 in = 1 ft
5280 ft = 1 mile
1760 yd = 1 mile

385 yd \times \frac{1 \text{ mile}}{1760 \text{ yd}} = 0.219 \text{ mile}

26.219 mile \times \frac{8 \text{ furlong}}{1 \text{ mile}} \times \frac{40 \text{ rod}}{1 \text{ furlong}} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{0.609 \text{ km}}{1 \text{ m}}

26.219 \text{ mile} \times 1.609 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{0.609 \text{ km}}{1 \text{ m}}

\[209.75\text{ km} \times 18,390 \text{ rods} \]

50

Name: ____________ Date: ____________
Period: ____________ Measurement Review #2 - Honors

1. 1.2 mg \quad \boxed{0.00012}\ g
2. 6.3 cm \quad \boxed{6.3}\ mm
3. 5.12 m \quad \boxed{5.12}\ cm
4. 6.111 mL \quad \boxed{0.00611}\ L

5. The density of CCl₄ (carbon tetrachloride) is 1.58 grams/milliliter. What will 100. milliliters of CCl₄ weight?
   \[1.58\ \frac{g}{mL} \times 100.\ mL = 158\ g\]

6. A piece of sulfur weighs 227 grams. When it was submerged in a graduated cylinder containing 80. milliliters of H₂O, the level rose to 150. milliliters. What is the density (g/mL) of the sulfur?
   \[\frac{227\ g}{80.\ mL} = \boxed{2.8\ g/mL}\]

7. a) A box 20.0 centimeters x 20.0 centimeters x 5.08 inches has what volume in cubic centimeters?
   b) What weight, in grams, of H₂O @ 4°C will the box hold?
   \[20.0 \times 20.0 \times 129 = 51600\ cm^3 \times \frac{1}{1000} = 51.6\ g\]
   \[5.08\ in \times 2.54\ cm = 12.9\ cm\]

8. Set up the following using the factor-label method:
   \[\frac{5\ cm}{8\ in} \times \frac{60.8\ mm}{1\ mm} \times \frac{1\ km}{1000\ cm} = 0.0006\ km\]

9. How many significant figures are in each of the following?
   a) 1.01 \quad 3
   b) 200.0 \quad 4
   c) 0.021 \quad 2
   d) 0.0230 \quad 3
1. What Greek philosopher was the first person to propose the idea that matter is made of tiny individual particles called atoms?
   A) Democritus  
   B) Bohr  
   C) Dalton  
   D) Rutherford

2. In ancient Greece, it was proposed that matter is composed of earth, air, water, and fire, and that these elements
   A) have similar physical properties  
   B) have similar chemical properties  
   C) are in continual motion  
   D) are stationary

3. In the early 1900's, it was proposed that energy may be absorbed or released from atoms in small, indivisible packets named
   A) orbitals  
   B) nucleons  
   C) quanta  
   D) protons

4. The development of the cathode ray tube led to the discovery of what subatomic particle?
   A) proton  
   B) positron  
   C) electron  
   D) neutron

5. Experimental evidence indicates that the nucleus of an atom
   A) has a negative charge  
   B) contains most of the mass of the atom  
   C) has no charge  
   D) contains a small percentage of the mass of the atom

6. When alpha particles are used to bombard gold foil, most of the alpha particles pass through undeflected. This result indicates that most of the volume of a gold atom consists of
   A) unoccupied space  
   B) neutrons  
   C) deuterons  
   D) protons

7. Compared to the entire atom, the nucleus of the atom is
   A) larger and contains little of the atom's mass  
   B) smaller and contains little of the atom's mass  
   C) smaller and contains most of the atom's mass  
   D) larger and contains most of the atom's mass

8. Which particle has the least mass?
   A) a neutron  
   B) a proton  
   C) a deuterium  
   D) an electron

9. Which of the following statements best describes an electron?
   A) It has a smaller mass than a proton and a positive charge.  
   B) It has a greater mass than a proton and a positive charge.  
   C) It has a greater mass than a proton and a negative charge.  
   D) It has a smaller mass than a proton and a negative charge.

10. What particle has a mass of approximately one atomic mass unit and a unit positive charge?
    A) a neutron  
    B) a beta particle  
    C) an alpha particle  
    D) a proton

11. What is the nuclear charge of an atom with a mass of 23 and an atomic number of 11?
    A) 23+  
    B) 3+  
    C) 12+  
    D) 31+

12. As an Na atom forms an Na⁺ ion, the number of protons in its nucleus
    A) decreases  
    B) increases  
    C) remains the same

13. A particle of matter contains 6 protons, 7 neutrons, and 6 electrons. This particle must be a
    A) neutral carbon atom  
    B) positively charged carbon ion  
    C) neutral nitrogen atom  
    D) positively charged nitrogen ion

14. What is the symbol for an atom containing 20 protons and 22 neutrons?
    A) 40Ca  
    B) 42Ca  
    C) 42Ti  
    D) 41Ca

15. Compared to an atom of C-12, an atom of C-14 has
    A) more protons  
    B) more neutrons  
    C) fewer protons  
    D) fewer neutrons

16. What is the mass number of the atom below?
    A) 1  
    B) 2  
    C) 3  
    D) 4

17. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?
    A) 39  
    B) 20  
    C) 19  
    D) 58

18. An atom of carbon-14 contains
    A) 8 protons, 6 neutrons, and 6 electrons  
    B) 6 protons, 6 neutrons, and 8 electrons  
    C) 6 protons, 8 neutrons, and 6 electrons  
    D) 6 protons, 8 neutrons, and 8 electrons

19. How many protons and neutrons is the nucleus of the atom below composed of?
    A) 27  
    B) 53  
    C) 53  
    D) 55

20. The atomic mass of an element is defined as the weighted average mass of that element's
    A) least abundant isotope  
    B) most abundant isotope  
    C) naturally occurring isotopes  
    D) radioactive isotopes

21. A sample of element X contains 90 percent 35X atoms, 8.0 percent 37X atoms, and 2.0 percent 39X atoms. The average isotopic mass is closest to
    A) 38  
    B) 35  
    C) 37  
    D) 32