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AP Chemistry Summer Readiness Review

**CHAPTER 1**

1. List two units used to measure each of the following:
  - a. Mass \_\_\_\_\_
  - b. Volume \_\_\_\_\_
  - c. Density \_\_\_\_\_
  - d. Temperature \_\_\_\_\_
  - e. Pressure \_\_\_\_\_
  - f. Length \_\_\_\_\_
  - g. Velocity \_\_\_\_\_
  
2. A student performed an analysis of a sample for its calcium content and got the following results: 14.92%, 14.91%, 14.88%, and 14.91% The actual amount of calcium in the sample is 15.70%. What conclusion can you draw about the accuracy and precision of these results?  
  
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\_\_\_\_\_  
  
\_\_\_\_\_
  
3. Calculate the percent error for the following measurements.
  - a. The density of an aluminum block determined in an experiment was 2.64 g/cm<sup>3</sup>. (Accepted value = 2.70 g/cm<sup>3</sup>)
  
  - b. The experimental determination of iron in ore was 16.48%. (Accepted value was 16.12%)

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4. How many significant figures are in each of the following?

- a. 12 \_\_\_\_\_
- b. 1098 \_\_\_\_\_
- c. 2001 \_\_\_\_\_
- d.  $2.001 \times 10^3$  \_\_\_\_\_
- e. 10 apples \_\_\_\_\_
- f. 0.0000101 \_\_\_\_\_
- g. 1000. \_\_\_\_\_
- h. 22.04030 \_\_\_\_\_
- i.  $1.00 \times 10^3$  \_\_\_\_\_
- j. 25,000 \_\_\_\_\_

5. Round each of the following numbers to three significant figures, and write the answers in scientific notation.

- a. 0.00031254 \_\_\_\_\_
- b. 31,154,000 \_\_\_\_\_
- c. 299.6 \_\_\_\_\_

6. Use scientific notation to express the number 480 to

- a. One significant figure \_\_\_\_\_
- b. Two significant figures \_\_\_\_\_
- c. Three significant figures \_\_\_\_\_

7. Perform the following mathematical operations, and express each result to the correct number of significant figures.

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- a.  $97.381 + 4.2502 + 0.99195$  \_\_\_\_\_
- b.  $171.5 + 72.915 - 8.23$  \_\_\_\_\_
- c.  $0.102 \times 0.0821 \times 273.5 / 1.2$  \_\_\_\_\_
- d.  $(9.04 - 8.23 + 21.954 + 81.0) / 3.1416$  \_\_\_\_\_
8. Precious metals and gems are measured in troy weights in the English system: 24 grains = 1 pennyweight (EXACT)  
20 pennyweights = 1 troy ounce (EXACT)  
12 troy ounces = 1 troy pound (EXACT)  
1 grain = 0.0648 gram (EXACT)  
1 carat = 0.200 gram (EXACT)
- a. Diamonds are measured in carats. If a lucky girl receives a 5 carat diamond how many pennyweights is it?
9. The world record for the hundred meter dash is 9.79 s.
- a. What is the corresponding speed in units of m/s,  $\mu\text{m/ns}$ , km/hr, ft/s, and mi/hr?
- b. At this speed how long would it take to run a mile (5,820 ft)?
10. Your parents planning to buy a new car. The Lexus 470 GX that your father is considering gets 22 miles per gallon of gasoline in highway travel. The GLK 350 that your mother likes gets 14 kilometers to the liter. Which car has the better gas mileage? (1 gal = 4 qt.; 1.057 qt = 1 L)

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11. You pass a road sign saying "New York – 112 km." If you drive at a constant speed of 65 mi/hr., how long should it take you to reach New York?

12. You have a 1.0 cm<sup>3</sup> sample of lead and a 1.0 cm<sup>3</sup> sample of glass. You drop each in separate beakers of water. How do the volumes of water displaced by each sample compare? Explain. Density of lead = 11.35 g/cm<sup>3</sup> Density of glass = 3.00 g/cm<sup>3</sup>

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13. The average daytime temperature on the Earth and Jupiter are 72 °F and 313 K, respectively. Calculate the difference in temperature between these two planets in °C.

14. Convert the following Celsius temperatures to Kelvin and to Fahrenheit degrees.

a. The boiling-point temperature of ethyl alcohol, 78.1°C

b. A cold winter day, -25°C

c. The lowest possible temperature, -273°C

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- d. The melting-point temperature of sodium chloride,  $801^{\circ}\text{C}$
15. At what temperature is the temperature in degrees Fahrenheit equal to twice the temperature in degrees Celsius?
16. The density of diamond is  $3.51\text{ g/cm}^3$ . What is the volume of a 4.5 carat diamond? 1 carat = 0.200 g
17. The volume of a diamond is found to be 2.8 mL. What is the mass of the diamond in carats? (See question #16)
18. A sample containing 33.42 g of metal pellets is poured into a graduated cylinder initially containing 12.7 mL of water, causing the water level in the cylinder to rise to 21.6 mL. Calculate the density of the metal.
19. Two spherical objects have the same mass. One floats on water; the other sinks. Which object has the greater diameter? Explain your answer.

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20. What are some of the differences between a solid, a liquid, and a gas?

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21. What is the difference between homogeneous and heterogeneous matter?

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22. Classify each of the following as homogeneous or heterogeneous mixtures.

- a. soil \_\_\_\_\_
- b. the atmosphere \_\_\_\_\_
- c. a carbonated soft drink \_\_\_\_\_
- d. gasoline \_\_\_\_\_
- e. Koolaid \_\_\_\_\_
- f. ethanol and water \_\_\_\_\_

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23. Classify each of the following as a mixture or a pure substance. Of the pure substances, which are elements and which are compounds?

a. Water \_\_\_\_\_

b. Blood \_\_\_\_\_

c. The oceans \_\_\_\_\_

d. Iron \_\_\_\_\_

e. Brass \_\_\_\_\_

f. Uranium \_\_\_\_\_

g. Wine \_\_\_\_\_

h. Leather \_\_\_\_\_

i. Table salt (NaCl) \_\_\_\_\_

24. Distinguish between physical and chemical changes.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

25. List four indications that a chemical change (reaction) has occurred.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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26. If you place a glass rod over a burning candle, the glass appears to turn black. What is happening to each of the following (physical change, chemical change, both, or neither) as the candle burns? Explain each answer

a. the wax

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b. the wick

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c. the glass rod

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27. The properties of a mixture are typically averages of the properties of its components. The properties of a compound may differ dramatically from the properties of the elements that combine to produce the compound. For each process described below, state whether the material being discussed is most likely a mixture or a compound, and state whether the process is a chemical change or a physical change.

a. An orange liquid is distilled, resulting in the collection of a yellow liquid and a red solid.

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- b. A colorless, crystalline solid is decomposed, yielding a pale yellow-green gas and a soft, shiny metal.

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- c. A cup of tea becomes sweeter as sugar is added to it.

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## CHAPTER 2

1. Describe Dalton's atomic theory.

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2. What discoveries were made by J.J. Thomson, Henri Becquerel, and Lord Rutherford? How did Dalton's model of the atom have to be modified to account for these discoveries?

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3. What is the distinction between atomic number and mass number?

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4. What is the difference between atomic mass and average atomic mass?

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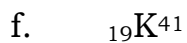
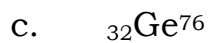
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5. What is an isotope?

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6. How many protons and neutrons are contained in the nucleus of each of the following atoms?



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7. Write the isotopic symbol for each of the isotopes below.
- Atomic number = 8, number of neutrons = 9
  - The isotope of chlorine in which mass = 37
  - Atomic number = 27, mass = 60
  - Number of protons = 26, number of neutrons = 31
  - The isotope of I with a mass number of 131
  - Atomic number = 3, number of neutrons = 4
8. An element consists of 1.40% of an isotope with mass 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.
9. The element silver has two naturally occurring isotopes,  $^{109}\text{Ag}$  and  $^{107}\text{Ag}$  with a mass of 106.905 amu. Silver consists of 51.82%  $^{107}\text{Ag}$  and has an average atomic mass of 107.868 amu. Calculate the mass of  $^{109}\text{Ag}$ .
10. Distinguish between the terms *family* and *period* in connection to the periodic table. For which of these terms is the term *group* also used?

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11. In the periodic table, what is the name of the following groups:  
a) Group 2 b) Group 18 c) Groups 11-17 (above staircase)
12. For each of the following sets of elements, label each as either Noble Gas, Halogen, Alkali Metal, Alkaline Earth Metal, Nonmetal or Transition Metal:  
a. Ti, Fe, Ag                      b. Mg, Sr, Ba                      c. Li, K, Rb  
d. Ne, Kr, Xe                      e. F, Br, I                          f. S, P, Se
13. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol and charge? \_\_\_\_\_
14. Which of the following sets of elements are all in the same group in the periodic table?  
a. N, P, O    b. C, Si, Ge    c. Rb, Sn, I    d. Mg, Ca, Rn
15. Identify each of the following elements:
- a. A member of the same family as oxygen whose most stable ion contains 54 electrons
- b. A member of the alkali metal family whose most stable ion contains 36 electrons
- c. A noble gas with 18 protons in the nucleus
- d. A halogen with 85 protons and 85 electrons
16. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?
- a. Na            b. Sr            c. P            d. Ba            e. Al  
f. I            g. S            h. O            i. Zn            j. Cu
16. For each of the following ions, indicate the total number of protons and electrons in the ion. For the positive ions, predict the formula of the simplest compound formed between itself and oxide. For the negative ions predict the simplest compound formed between itself and aluminum.
- a.  $\text{Fe}^{+2}$                       b.  $\text{Fe}^{+3}$                       c.  $\text{Ba}^{+2}$                       d.  $\text{Cs}^{+1}$

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e.  $\text{Br}^{-1}$

f.  $\text{S}^{-2}$

g.  $\text{N}^{-3}$

h.  $\text{P}^{-3}$

17. An element's most stable ion forms an ionic compound with bromine, having the formula  $\text{XBr}_2$ . If the ion of element X has a mass number of 230 and 86 electrons, what is the identity of the element, and how many neutrons does it have?

### Writing Formulas and Naming Compounds –

Do WITHOUT an ion chart! You need to have these memorized.

1. Name each of the following compounds:

a.  $\text{NaCl}$

b.  $\text{Rb}_2\text{O}$

c.  $\text{FeBr}_3$

d.  $\text{Cr}_2\text{O}_3$

e.  $\text{CaBr}_2$

f.  $\text{CsF}$

g.  $\text{CaS}$

h.  $\text{NI}_3$

i.  $\text{PCl}_3$

j.  $\text{SO}_2$

k.  $\text{HCl}$

l.  $\text{H}_3\text{PO}_4$

m.  $\text{HIO}_3$

n.  $\text{HgO}$

o.  $\text{CuI}$

p.  $\text{CuI}_2$

q.  $\text{CoI}_2$

r.  $\text{Na}_2\text{CO}_3$

s.  $\text{NaHCO}_3$

t.  $\text{HC}_2\text{H}_3\text{O}_2$

u.  $\text{NH}_4\text{NO}_2$

v.  $\text{Co}_2\text{S}_3$

w.  $\text{AlI}_3$

x.  $\text{Al}_2\text{O}_3$

y.  $\text{ZnCl}_2$

z.  $\text{Li}_3\text{N}$

aa.  $\text{Ag}_2\text{S}$

ab.  $\text{KClO}_4$

ac.  $\text{Al}_2(\text{SO}_4)_3$

ad.  $\text{ICl}_3$

ae.  $\text{SF}_2$

af.  $\text{N}_2\text{F}_4$

ag.  $\text{ICl}$

ah.  $\text{Pb}_3(\text{PO}_4)_2$

ai.  $\text{KIO}_3$

aj.  $\text{Ca}(\text{OH})_2$

ak.  $\text{CoS}$

al.  $\text{S}_3\text{N}_4$

am.  $\text{SF}_6$

an.  $\text{NaClO}$

ao.  $\text{BaCrO}_4$

ap.  $\text{HNO}_2$

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aq. HI	ar. H <sub>2</sub> SO <sub>3</sub>	as. BaSO <sub>3</sub>
at. KMnO <sub>4</sub>	au. Sr <sub>3</sub> P <sub>2</sub>	av. Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>
aw. Pb(NO <sub>3</sub> ) <sub>2</sub>	ax. NaNO <sub>2</sub>	ay. K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>
az. P <sub>2</sub> S <sub>5</sub>	ba. N <sub>2</sub> O <sub>4</sub>	bb. NH <sub>4</sub> NO <sub>3</sub>
bc. H <sub>2</sub> SO <sub>4</sub>	bd. Sr <sub>3</sub> N <sub>2</sub>	be. Al <sub>2</sub> (SO <sub>3</sub> ) <sub>3</sub>
bf. SnO <sub>2</sub>	bg. Na <sub>2</sub> CrO <sub>4</sub>	bh. HClO

2. Write the chemical formula for the following compounds:

- a. Cesium bromide \_\_\_\_\_
- b. Barium sulfate \_\_\_\_\_
- c. Chlorine trifluoride \_\_\_\_\_
- d. Ammonium chloride \_\_\_\_\_
- e. Beryllium oxide \_\_\_\_\_
- f. Chlorine monoxide \_\_\_\_\_
- g. Magnesium fluoride \_\_\_\_\_
- h. Sulfur difluoride \_\_\_\_\_
- i. Sulfur hexafluoride \_\_\_\_\_
- j. Sodium dihydrogen phosphate \_\_\_\_\_
- k. sodium oxide \_\_\_\_\_
- l. Silicon tetrachloride \_\_\_\_\_
- m. Lithium nitride \_\_\_\_\_
- n. Chromium (III) carbonate \_\_\_\_\_
- o. Tin (II) fluoride \_\_\_\_\_
- p. Ammonium acetate \_\_\_\_\_
- q. Ammonium hydrogen sulfate \_\_\_\_\_
- r. Cobalt (III) nitrate \_\_\_\_\_
- s. Copper (I) sulfide \_\_\_\_\_

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- t. Potassium chlorate \_\_\_\_\_
- u. Lithium tartrate \_\_\_\_\_
- v. Zinc sulfide \_\_\_\_\_
- w. Ammonium hydrogen phosphate \_\_\_\_\_
- x. Hydrobromic acid \_\_\_\_\_
- y. Bromous acid \_\_\_\_\_
- z. Perchloric acid \_\_\_\_\_
- aa. Silicon dioxide \_\_\_\_\_
- bb. Sodium sulfate \_\_\_\_\_
- cc. Aluminum hydrogen sulfate \_\_\_\_\_
- dd. Sodium peroxide \_\_\_\_\_
- ee. Potassium cyanide \_\_\_\_\_
- ff. Copper (II) nitrate \_\_\_\_\_
- gg. Silicon tetrafluoride \_\_\_\_\_
- hh. Lead (II) sulfide \_\_\_\_\_
- ii. Lead (IV) sulfide \_\_\_\_\_
- jj. Copper (I) chloride \_\_\_\_\_
- kk. Cadmium selenide \_\_\_\_\_

### CHAPTER 3 – Stoichiometry

1. Balance the following equations:
- a. \_\_\_\_\_ CO + \_\_\_\_\_ O<sub>2</sub> → CO<sub>2</sub>
- b. \_\_\_\_\_ N<sub>2</sub>O<sub>5</sub> + \_\_\_\_\_ H<sub>2</sub>O → \_\_\_\_\_ HNO<sub>3</sub>
- c. \_\_\_\_\_ PCl<sub>5</sub> + \_\_\_\_\_ H<sub>2</sub>O → \_\_\_\_\_ H<sub>3</sub>PO<sub>4</sub> + \_\_\_\_\_ HCl
- d. \_\_\_\_\_ CH<sub>4</sub> + \_\_\_\_\_ Br<sub>2</sub> → \_\_\_\_\_ CBr<sub>4</sub> + \_\_\_\_\_ HBr
- e. \_\_\_\_\_ C<sub>5</sub>H<sub>10</sub>O<sub>2</sub> + \_\_\_\_\_ O<sub>2</sub> → \_\_\_\_\_ CO<sub>2</sub> + \_\_\_\_\_ H<sub>2</sub>O

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- f. \_\_\_\_\_  $\text{Cr(OH)}_3$  + \_\_\_\_\_  $\text{HClO}_4$   $\rightarrow$  \_\_\_\_\_  $\text{Cr(ClO}_4)_3$  + \_\_\_\_\_  $\text{H}_2\text{O}$
- g. \_\_\_\_\_  $\text{KNO}_3$   $\rightarrow$  \_\_\_\_\_  $\text{KNO}_2$  + \_\_\_\_\_  $\text{O}_2$
- h. \_\_\_\_\_  $\text{La}_2\text{O}_3$  + \_\_\_\_\_  $\text{H}_2\text{O}$   $\rightarrow$  \_\_\_\_\_  $\text{La(OH)}_3$
- i. \_\_\_\_\_  $\text{NCl}_3$  + \_\_\_\_\_  $\text{H}_2\text{O}$   $\rightarrow$  \_\_\_\_\_  $\text{NH}_3$  + \_\_\_\_\_  $\text{HOCl}$
- j. \_\_\_\_\_  $\text{Mg}_3\text{N}_2$  + \_\_\_\_\_  $\text{HCl}$   $\rightarrow$  \_\_\_\_\_  $\text{MgCl}_2$  + \_\_\_\_\_  $\text{NH}_4\text{Cl}$
- k. \_\_\_\_\_  $\text{AgNO}_3$  + \_\_\_\_\_  $\text{K}_2\text{SO}_4$   $\rightarrow$  \_\_\_\_\_  $\text{Ag}_2\text{SO}_4$  + \_\_\_\_\_  $\text{KNO}_3$
- l. \_\_\_\_\_  $\text{Al(OH)}_3$  + \_\_\_\_\_  $\text{H}_2\text{SO}_4$   $\rightarrow$  \_\_\_\_\_  $\text{Al}_2(\text{SO}_4)_3$  + \_\_\_\_\_  $\text{H}_2\text{O}$
- m. \_\_\_\_\_  $\text{CH}_3\text{NH}_2$  + \_\_\_\_\_  $\text{O}_2$   $\rightarrow$  \_\_\_\_\_  $\text{CO}_2$  + \_\_\_\_\_  $\text{H}_2\text{O}$  + \_\_\_\_\_  $\text{N}_2$
- n. \_\_\_\_\_  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$   $\rightarrow$  \_\_\_\_\_  $\text{Cr}_2\text{O}_3$  + \_\_\_\_\_  $\text{N}_2$  + \_\_\_\_\_  $\text{H}_2\text{O}$

2. Write balanced chemical equations to correspond to each of the following descriptions.

- a. When solid potassium chlorate is heated it decomposes to form solid potassium chloride and oxygen.
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- b. Solid zinc metal reacts with sulfuric acid it forms hydrogen gas and an aqueous solution of zinc sulfate.
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- c. When liquid phosphorous trichloride is added to water, it reacts to form aqueous phosphorous acid, and hydrochloric acid.
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- d. When hydrogen sulfide gas is passed over solid hot iron (III) hydroxide, the resultant reaction produces solid iron (III) sulfide and water vapor.
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3. The molecular formula of aspartame, the artificial sweetener marketed as Nutrasweet, is  $\text{C}_{14}\text{H}_{18}\text{N}_2\text{O}_5$ .

- a. What is the molar mass of aspartame?

- b. How many moles of aspartame are present in 3769.4 grams of aspartame?



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- c. How many molecules of aspartame are present in 345.9 grams of aspartame?
- d. How many oxygen atoms are present in 23.6 grams of aspartame?
  
4. How many moles of ammonium ions are in 0.557 g of ammonium carbonate?
  
5. What is the mass, in grams, of 0.0438 moles of iron (III) phosphate?
  
6. What is the mass, in grams, of  $2.69 \times 10^{23}$  molecules of aspirin,  $C_9H_8O_4$ ?
  
7. What is the molar mass of diazepam (Valium) if 0.05570 mol has a mass of 15.86 g?
  
8. Determine the empirical formulas of the following compounds.
  - a. 10.4%C, 27.8%S, and 61.7%Cl

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- b. Monosodium glutamate (MSG), a flavor enhancer in certain foods, 35.51 g C, 4.77 g H, 37.85 g O, 8.29 g N, 13.60 g Na
9. Find the molecular formulas of the following compounds.
- a. 73.8% carbon, 8.7% hydrogen, 17.5% nitrogen, molar mass = 166.0 g/mol
- b. 80.0% carbon, 20.0% hydrogen, molar mass = 30.0 g/mol
10.  $4\text{FeCr}_2\text{O}_7 + 8\text{K}_2\text{CO}_3 + \text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{K}_2\text{CrO}_4 + 8\text{CO}_2$
- a. How many grams of  $\text{FeCr}_2\text{O}_7$  are required to produce 44.0 g of  $\text{CO}_2$ ?
- b. How many grams of  $\text{O}_2$  are required to produce 100.0 g of  $\text{Fe}_2\text{O}_3$ ?
- c. If 300.0 g of  $\text{FeCr}_2\text{O}_7$  react, how many grams of  $\text{O}_2$  will be consumed?
- d. How many grams of  $\text{Fe}_2\text{O}_3$  will be produced from 300.0 g of  $\text{FeCr}_2\text{O}_7$ ?

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- e. How many grams of  $K_2CrO_4$  are formed per gram of  $K_2CO_3$  used?

11. Given the reaction:  $S + O_2 \rightarrow SO_2$

- a. How many grams of sulfur must be burned to give 100.0 g of  $SO_2$ ?

- b. How many grams of oxygen must be required for the reaction in part (a)?

12.  $6 NaOH + 2Al \rightarrow 2 Na_3AlO_3 + 3H_2$

- a. How many grams of aluminum are required to produce 17.5 g of hydrogen?

- b. How many moles of  $Na_3AlO_3$  can be formed from 90.0 g of sodium hydroxide?

- c. How many milligrams of  $NaOH$  are required to produce 3.00 moles of hydrogen?

- d. What volume of hydrogen gas can be prepared from 5.40 gram of aluminum?

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13. The following **unbalanced** reaction takes place at high temperatures.  $\text{Cr}_2\text{O}_3(\text{s}) + \text{Al}(\text{l}) \rightarrow \text{Cr}(\text{l}) + \text{Al}_2\text{O}_3(\text{l})$

If 42.7 g  $\text{Cr}_2\text{O}_3$  and 9.8 g Al are mixed and reacted until one of the reactants is used up.

- What is the limiting reagent?
- How many grams of chromium should be formed?
- How many grams of the excess reagent will remain?
- If 16.72 g of Cr are formed, what is the percent yield?

14. Hydrogen cyanide gas and water vapor are produced commercially by the reaction of gaseous ammonia, oxygen and methane gas. If  $5.00 \times 10^3$  kg of each reactant are added together, what mass of each product is produced assuming a 72.5% yield?