Significant Figures

Practice Problems (Level 3)

1. How many significant figures are there in each of the following measurements?

a. 307 g
b. 1.40082 cm
c. 0.00058900 g
d. 0.00300900870 mm
e. 4500 km
f. 350,$\bar{0}$00 cm
g. 180.00 s
h. 3.50×10^3 cm
i. 1.604×10^{-4} m
j. 0.0459×10^3 g

2. Express the answer to each of the following calculations with the correct number of significant figures.

a. 80 cm + 13.0 cm
b. 72.60 m + 0.0950 m
c. 13.89 cm + 6.8932 cm
d. 1.30×10^{-2} cm + 2.4×10^{-4} cm
e. 8.99×10^3 m + 1.400×10^4 m
f. 750. cm − 677.4 cm
g. 10,000 m − 940 m
h. 0.0890 cm − 0.0666 cm
i. 0.340×10^{-1} g − 1.20×10^{-2} g
j. 4.5×10^5 km − 3.00×10^3 km

3. Express the answer to each of the following calculations with the correct number of significant figures.

a. 3.0 cm × 4.000 cm
b. 2.005 cm × 5.0 cm
c. 400 m × 87,488 m
d. 2.3×10^{-6} m × 1.45×10^{-2} m
e. 8.70×10^{-2} mm × $40. \times 10^{-1}$ mm
f. 0.0045 mm^2 ÷ 0.90 mm
g. 120 km^2 ÷ 8.56 km
h. 0.7600 mm^3 ÷ 1.50 mm
i. 4.80×10^5 m^2 ÷ 8.5×10^3 m
j. 0.630×10^{-1} m^3 ÷ 0.0804×10^2 m

Dimensional Analysis
(Factor-Label Method)
Practice Problems (Level 3)

16 oz = 1 pound
2.2 pounds = 1 kg
36 inches = 1 yd
2.54 cm = 1 inch
1.61 km = 1 mile
12 inches = 1 foot
~~453g = 1 pound~~

Use dimensional analysis in solving each of the following problems.

→ **1.** Convert 32.5 oz to its equivalent measurement in cg.

→ **2.** Convert 3.55 yd to its equivalent measurement in cm.

~~**3. Convert 143.55 mL to its equivalent in pints.**~~

→ **4.** Convert a speed of 35.8 mi/hr to its equivalent in m/s.

~~**5. Convert a density of 13.6 g/mL to its equivalent in lb/ft^3.**~~

6. A mole of hydrogen atoms contains 6.02×10^{23} atoms and occupies 22.4 L. How many hydrogen atoms are contained in 25.00 mL of this gas?

7. What volume of hydrogen would contain 4.5×10^{18} hydrogen atoms? How many moles of hydrogen would this be?

8. A molecule of hydrogen moves at a speed of 115 cm/s. How long will it take to travel the length of a football field (100 yd long)?

9. The speed of light is 3.0×10^{10} cm/s. Express this speed in mi/hr.

10. A sample of seawater contains 0.075 g of sodium chloride per mL of solution. How many moles of sodium chloride are there per L of this solution? A mole of sodium chloride is equivalent to 58.5 g of sodium chloride.

11. A doctor orders that a patient receive 1.5×10^{-3} mole of sodium chloride. The only solution available contains 1.00 g per 100 mL of solution. How much of this solution should the nurse give the patient?

12. A sample of air contains 2.33×10^{-4} mg of lead per mL of gas. This air passes through an office, the volume of which is 3.25×10^{4} L. Seven people normally work in this office. How many μg of lead will each person in the office receive from this sample of air?

Exponential Notation

Practice Problems (Level 3)

1. Express each of the following numbers in exponential notation.

a. 75,890
b. 1
c. 0.000,189
d. 0
e. −45,000,000
f. 8.75
g. −0.000,006,895
h. 100,500,500
i. 0.000,000,609,866
j. 12,500,000,000,000,000,000

2. Express each of the following numbers in the long form.

a. 3.907×10^{-15}
b. 18.89×10^{5}
c. 577.8×10^{-6}
d. 125.5×10^{-2}
e. 0.00854×10^{-5}
f. 0.00387×10^{5}
g. 0.0000552×10^{2}
h. 555.5×10^{-8}
i. 35.882×10^{-6}
j. 477.8×10^{7}

3. Carry out each of the indicated operations, using exponential notation only.

a. $235{,}000 \times 0.00456 \times 20{,}000$
b. $137{,}500{,}000{,}000 \times 0.000{,}450 \times 0.002{,}000$
c. $0.000{,}005{,}80 \times 18{,}000{,}000{,}000 \times 38{,}000$
d. $54{,}000{,}000 \times 0.000{,}000{,}450 \times 167{,}000$
e. $809{,}000{,}000{,}000{,}000 \times 13{,}500{,}000{,}000{,}000 \times 0.000{,}000{,}000{,}067$
f. $\dfrac{75{,}000 \times 800{,}000 \times 0.000{,}000{,}045}{66{,}500 \times 85{,}000}$
g. $\dfrac{0.0045 \times 78{,}000 \times 132{,}000{,}000{,}000}{0.000{,}555 \times 0.00155 \times 82{,}500{,}000}$
h. $\dfrac{115{,}000{,}000{,}000 \times 0.00688 \times 0.009{,}000{,}000}{25{,}600{,}000 \times 75{,}000 \times 24{,}500 \times 0.00092}$

Writing Chemical Formulas

Practice Problems (Level 3)

Write the correct chemical formula for each of the following compounds.

1. lead (II) bicarbonate
2. manganous acetate
3. disodium hydrogen phosphate
4. perbromic acid
5. cupric sulfate pentahydrate
6. diphosphorus pentoxide
7. ammonium dichromate
8. sodium cyanate
9. hypochlorous acid
10. gold (III) sulfate
11. ferric ferrocyanide
12. potassium uranate
13. potassium aluminum sulfate
14. nitrous oxide
15. tin (II) permanganate
16. chromic acid
17. sodium dihydrogen phosphate
18. cadmium acetate
19. ammonium silicate
20. iodous acid

Chemical Nomenclature

Practice Problems (Level 3)

Give the correct names for each of the compounds listed below.

1. Hg_2Cl_2
2. N_2O_5
3. $CoSO_4 \cdot 6H_2O$
4. $FeSeO_4$
5. Er_2O_3
6. K_2Te
7. LiH
8. HFO_2
9. SnI_4
10. As_2O_5
11. $OsCl_4$
12. NaH_2PO_4
13. $Pb(C_2H_3O_2)_2$
14. $Cr_2(SO_3)_3$
15. $Al(MnO_4)_3$
16. Hg_3N_2
17. $KAl(SO_4)_2$
18. SiF_4
19. Au_3P_2
20. $Fe[Fe(CN)_6]$

Reaction Prediction

Practice Problems (Level 2)

For each of the following problems, tell

1. what type of reaction might be expected
2. whether the reaction will occur or not
3. if not, why it will not occur; then write the symbols and formulas for the reactants
4. if so, what the balanced equation for the reaction is
5. in the case of double replacement reactions, whether the reaction goes to completion or not

1. tin and copper (II) sulfate

2. iron (III) nitrate and sodium chromate

3. calcium and iodine

4. magnesium and hydrochloric acid

5. calcium oxide $\xrightarrow{\text{electrolyzed}}$

6. carbon and oxygen

7. sodium carbonate and sulfuric acid

8. iron (II) sulfide $\xrightarrow{\text{electrolyzed}}$

9. platinum and lead (II) nitrate

10. lithium oxide and water

Equation Writing

Practice Problems (Level 3)

Write and balance chemical equations for each of the following reactions.

1. nitrogen + hydrogen → ammonia ↑
2. butane (C_4H_{10}) + oxygen $\xrightarrow{\Delta}$ carbon dioxide ↑ + water ↑
3. aluminum oxide → aluminum + oxygen ↑
4. ethyl alcohol (C_2H_5OH) + oxygen $\xrightarrow{\Delta}$ carbon monoxide ↑ + water ↑
5. nitrogen + oxygen → dinitrogen pentoxide ↑
6. octane (C_8H_{18}) + oxygen $\xrightarrow{\Delta}$ carbon dioxide ↑ + water ↑
7. aluminum sulfate + phosphoric acid → aluminum phosphate + sulfuric acid
8. diphosphorus pentoxide + water → phosphoric acid
9. ammonia + nitric oxide → nitrogen ↑ + water
10. iron (III) oxide + carbon monoxide → iron + carbon dioxide ↑
11. copper + nitric acid → copper (II) nitrate + nitric oxide ↑ + water
12. iron (II) sulfide + oxygen → iron (III) oxide + sulfur dioxide ↑

Molecular Weight and Moles

Practice Problems (Level 3)

1. Find the molecular weight or formula weight of each of the following compounds.
   a. dinitrogen pentoxide
   b. copper (II) sulfate pentahydrate
   c. stannic hydroxide
   d. iron (III) acetate
   e. potassium aluminum sulfate
   f. ammonium phosphate
   g. scandium sulfate
   h. calcium bicarbonate
   i. ammonium dichromate
   j. aluminum carbonate

2. Find the weight of each of the following, expressed in grams.
   a. 1.00 mol of calcium nitrate
   b. 0.593 mol of calcium chlorate
   c. 0.277 mol of ammonium acetate
   d. 3.552 mol of beryllium nitrate
   e. 1.04 mol of potassium aluminum sulfate
   f. 0.994 mol of zinc phosphate
   g. 1.24 mol of barium perbromate
   h. 0.756 mol of magnesium acetate
   i. 0.391 mol of cadmium bicarbonate
   j. 2.45×10^{-3} mol of iron (II) ferricyanide

3. Find the weight of each of the following, expressed in moles.
   a. 3.00 g of ammonium iodate
   b. 0.504 g of magnesium bicarbonate
   c. 15.88 g of ammonium phosphate
   d. 2.52×10^{-6} g of sucrose ($C_{12}H_{22}O_{11}$)
   e. 1.45×10^{3} g of lanthanum nitrate
   f. 2.957 of sodium acetate
   g. 0.852 g of calcium phosphate
   h. 32.75 g of iron (III) carbonate
   i. 6.02×10^{7} g of lead (II) phosphate
   j. 3.55×10^{-4} g of barium phosphate

Percentage Composition

Practice Problems (Level 2)

Find the percentage composition of each compound listed below. In the first eight problems, the correct formula or name is given. In the next six problems, laboratory data for the compound are presented.

1. KNO_2
2. NH_4Cl
3. $SrCl_2$
4. $KMnO_4$
5. sulfuric acid
6. potassium phosphate
7. ammonium bromide
8. barium hydroxide
9. Analysis of a compound shows that it consists of 43.40 g of copper and 10.95 g of sulfur. What is the percentage composition of this compound?
10. A sample of benzene is analyzed and found to consist of 13.74 g of carbon and 1.15 g of hydrogen. What is the percentage composition of benzene?
11. Analysis of an unknown compound shows that it consists of 21.8 g of oxygen, 4.09 g of aluminum, and 6.36 g of nitrogen. What is the percentage composition of this compound?
12. A compound consisting of carbon, hydrogen, and oxygen weighs 40.85 g. Analysis shows that the compound contains 10.90 g of carbon and 0.90 g of hydrogen. What is the percentage composition of the compound?
13. An organic compound consisting of carbon, hydrogen, and oxygen only weighs 13.669 g. Analysis shows that the compound contains 0.547 g and 8.707 g of the last two of these elements, respectively. What is the percentage composition of this compound?
14. Analysis of an ore of calcium shows it to contain 13.61 g of calcium and 21.77 g of oxygen in a sample weighing 46.28 g. What is the percentage composition of this compound?

Stoichiometry

Practice Problems (Level 3)

1. How much aluminum metal is needed to replace all of the iron from 27.8 g of iron (III) oxide?

2. What volume of chlorine gas will react with antimony in order to produce 58.9 g of antimony trichloride?

3. What weight of iron metal will be required to produce 20.8 g of iron (III) oxide in the reaction with pure oxygen?

4. What weight of aluminum bromide can be produced by the reaction of sufficient aluminum sulfate with 8.75 g of ammonium bromide?

5. What weights of water and diphosphorus pentoxide will be needed in order to produce 95.5 g of phosphoric acid?

6. 50.0 g of oxygen are available for the combustion of 25.0 g of carbon. Is this an adequate amount of oxygen? If so, by how much in excess is the oxygen? If not, by how much is the carbon in excess?

7. How many grams of carbon dioxide can be obtained from the reaction of 100.0 g of sulfuric acid and 100.0 g of calcium carbonate?

8. In testing for the efficacy of an antacid compound, 5.0 g of hydrochloric acid is mixed with 24.0 g of magnesium hydroxide. Is this enough base to react with all the acid?

9. In the human body, the toxic compound hydrogen cyanide is neutralized by the acid, $H_2S_2O_3$, according to the reaction: $HCN + H_2S_2O_3 \rightarrow HCNS + H_2SO_3$. If 1.000 mg of $H_2S_2O_3$ is available in the body, will this be enough to neutralize 2.000 mg of HCN swallowed by a person?

10. In the combustion of hydrogen sulfide with oxygen, will 45.0 L be enough oxygen to burn completely 35.0 g of hydrogen sulfide?