Key

# Moles Worksheet #2

1. 8.00 kg of calcium chloride, $CaCl_2$, is dissolved in 1.000 kg of water.
   a. How many moles of $CaCl_2$ are in solution?

$8.00\,kg \times \frac{1000\,g}{1\,kg} \times \frac{1\,mol}{110\,g} = 72.7\,mol\ CaCl_2$

Ca 40 = 40
Cl 2(35) = + 70
110

   b. How many moles of water are present?

$1.000\,kg \times \frac{1000\,g}{1\,kg} \times \frac{1\,mol}{18\,g} = 55.56\,mol\ H_2O$

   c. Assume that the ionic compound, $CaCl_2$, separates completely into $Ca^{2+}$ and $Cl^{-1}$ ions when it dissolves in water. How many moles of each ion are present in the solution, using the moles calculated in question "a"?

$72.7\,mol\ CaCl_2 \times \frac{1\,mol\ Ca^{+2}}{1\,mol\ CaCl_2} = 72.7\,mol\ Ca^{+2}$

$72.7\,mol\ CaCl_2 \times \frac{2\,mol\ Cl^{-1}}{1\,mol\ CaCl_2} = 145.4\,mol\ Cl^{-1}$

2. When the ionic compound $NH_4Cl$ dissolves in water, it breaks into one ammonium ion, $NH_4^{+1}$, and one chloride ion, $Cl^{-1}$. If you dissolved 10.7 g of $NH_4Cl$ in water, how many moles of ions would be in solution?

$10.7\,g \times \frac{1\,mol\ NH_4Cl}{53\,g} \times \frac{2\,mol\ ions}{1\,mol\ NH_4Cl} = 0.404\,mol\ ions$

N = 14
H = 4
Cl = + 35
53

3. What is the total amount of moles of atoms in a jar that contains $2.41 \times 10^{24}$ atoms of chromium, $1.51 \times 10^{23}$ atoms of nickel, and $3.01 \times 10^{23}$ atoms of copper?

$2.862 \times 10^{24}\,atoms\ total \times \frac{1\,mol}{6.022 \times 10^{23}\,atoms} = 4.75\,moles$

4. The density of liquid water is 0.997 g/ml at 25°C.
   a. Calculate the mass of 250.0 mL of water.

$250.0\,mL \times \frac{0.997\,g}{1\,mL} = 249.25\,g = 249.3\,g\ H_2O$

b. How many moles of water are in 250.0 mL of water? Hint: Use the result of (a).

$249.3\text{ g } H_2O \times \frac{1\text{ mol } H_2O}{18\text{ g } H_2O} = 13.85\text{ mol } H_2O$

c. What is the mass in grams of 2.000 moles of water?

$2.000\text{ mol} \times \frac{18\text{ g}}{1\text{ mol}} = 36.00\text{ g } H_2O$

d. Calculate the volume that would be occupied by 2.000 moles of water at 25°C.

$D = 0.9979\text{ mL}$ $\qquad 36.00\text{ g} \times \frac{1\text{ mL}}{0.997\text{ g}} = 36.11\text{ mL}$

5. Calculate the mass of aluminum that would have the same number of atoms as 6.35 g of cadmium.

$6.35\text{ g Cd} \times \frac{1\text{ mol}}{112\text{ g Cd}} \times \frac{6.022\times10^{23}\text{ atoms}}{1\text{ mol}} = 3.414\times10^{22}\text{ atoms}$

$3.414\times10^{22}\text{ atoms} \times \frac{1\text{ mol}}{6.022\times10^{23}\text{ atoms}} \times \frac{27\text{ g Al}}{1\text{ mol}} = 1.53\text{ g Al}$

6. A chemist weighs a steel cylinder of compressed oxygen, $O_2$, and finds that it has a mass of 1027.8 g. After some of the oxygen is used in an experiment, the cylinder has a mass of 1023.2 g. How many moles of oxygen gas are used in the experiment?

$1027.8\text{ g} - 1023.2\text{ g} = 4.6\text{ g}$

$4.6\text{ g} \times \frac{1\text{ mol}}{32\text{ g}} = 0.14375$

$0.14\text{ mol } O_2$

7. 0.250 moles of $Ag_2S$ decomposes into its elements.

a. How many moles of silver would you have?

$0.250\text{ mol} \times \frac{2\text{ mols Ag atoms}}{1\text{ mol } Ag_2S} = 0.500\text{ mols Ag atoms}$

b. How many moles of sulfur would you have?

$0.250\text{ mol} \times \frac{1\text{ mol S}}{1\text{ mol } Ag_2S} = 0.250\text{ mol S atoms}$

c. How many moles of $Ag_2S$ are there in 38.8 g of $Ag_2S$?

Ag 2(108) = 216
S 32 = 32
248

$38.8\text{ g } Ag_2S \times \frac{1\text{ mol}}{248\text{ g}} = 0.156\text{ mol } Ag_2S$

d. How many moles of elemental silver and elemental sulfur would be produced from the amount of $Ag_2S$ in question (c)?

$Ag = 0.156 \times 2 = 0.313\text{ mol}$

$S = 0.156\text{ mol}$

e. Calculate the masses of silver and sulfur produced in (d).

$0.313\text{mol Ag} \times \frac{108\text{ g}}{1\text{ mol}} = 34.8\text{ g Ag}$

$0.156\text{ mol S} \times \frac{32\text{ g}}{1\text{ mol}}$ 4.99 g S

8. A piece of calcium weighing 2.16 g was exposed to the air until oxidation was complete.

a. Write a chemical formula equation for the combustion of calcium.

$2Ca + O_2 \rightarrow 2CaO$

b. How much oxygen (in moles) combined with the calcium?

$2.16\text{g} \times \frac{1\text{mol}}{40\text{g Ca}} = 0.054\text{ mol Ca}$

$\frac{2\text{ Ca}}{1\text{ O}_2} = \frac{0.054\text{ mol Ca}}{x\text{ mol O}_2}$

$x = 0.027\text{ mol}$

c. What was the mass of the calcium oxide formed?

$0.054\text{ mol Ca} = 0.054\text{ mol CaO}$

Ca 40
O 16
56

$0.054\text{mol} \times \frac{56\text{g}}{1\text{ mol}} = 3.02\text{ g CaO}$