CHEMISTRY

# HYDRATES

Some chemical reactions yield an insoluble precipitate. In order to remove this precipitate, you filter the solution. In some cases, the precipitate may have excess water bonded to it. These ***IONIC/POLYATOMIC*** compounds that have water molecules incorporated into their structure are called ***hydrates***.

The number of water molecules that are attached to the structure will be indicated with a prefix. Epsom salts, for example, consist of crystals of *magnesium sulfate heptahydrate*.

Compounds that have no water molecules incorporated in them are called ***anhydrous***.

This affects your molar calculations because you have to include the water molecules in the molar mass of your compound.

In order to calculate the molecular formula of a hydrate, one must calculate the percent composition of the hydrate in terms of the anhydrous compound, and the water.

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***Ex:*** What is the percent composition of calcium sulfate pentahydrate in terms of the anhydrous compound and water

***Ex:*** *A 50 g sample of a hydrate of barium hydroxide, $Ba(OH)_2 \cdot x\ H_2O$, contains 27.2 g of $Ba(OH)_2$.*

***a)*** *Calculate the percent composition of $Ba(OH)_2 \cdot x\ H_2O$.*

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***b)*** *Find the value of "x" in* $Ba(OH)_2 \cdot x\ H_2O$

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## Pg. 278 #51 - 60 Pg. 279 #9-11

### Practice Problems

For the compounds in questions 61 to 64, calculate the percent by mass of water.

**51.** $MgSO_3 \cdot 6H_2O(s)$

**52.** $LiCl_2 \cdot 4H_2O(s)$

**53.** $Ca(SO_4)_2 \cdot 2H_2O(s)$

**54.** $Na_2CO_3 \cdot 10H_2O(s)$

**55.** List the following hydrates in order, from greatest to least percent by mass of water: $CaCl_2 \cdot 2H_2O(s)$, $MgSO_4 \cdot 7H_2O(s)$, $Ba(OH)_2 \cdot 8H_2O(s)$, $Mn(SO_4)_2 \cdot 2H_2O(s)$.

**56.** A 3.34 g sample of a hydrate, $SrS_2O_3 \cdot xH_2O(s)$, contains 2.30 g of $SrS_2O_3(s)$. Find the value of $x$.

**57.** A hydrate of zinc chlorate, $Zn(ClO_3)_2 \cdot xH_2O(s)$, contains 21.5% zinc by mass. Find the value of $x$.

**58.** Determine the formula for the hydrate of chromium(III) nitrate that is 40.50% water by mass.

**59.** The mass of a sample of a hydrate of magnesium iodide is 1.628 g. It is heated until it is anhydrous and its mass is 1.072 g. Determine the formula for the hydrate.

**60.** A chemist needs 1.28 g of sodium hypochlorite, NaOCl(s), for an experiment, but she only has sodium hypochlorite pentahydrate, $NaOCl \cdot 5H_2O(s)$. How many grams of the hydrate should she use?

**9.** T/I Turquoise, $CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O(s)$, is one of the most valuable non-transparent gemstones. It is made from a hydrate of copper aluminum phosphate. What percent by mass is the anhydrous form of the mineral?

**10.** T/I The formula for a hydrate of zinc sulfate is $ZnSO_4 \cdot xH_2O(s)$. If 1 mol of anhydrous zinc sulfate is 56.14% of the mass of 1 mol of the hydrate, what is the value of $x$?

**11.** T/I Ikaite, $CaCO_3 \cdot xH_2O(s)$, is a hydrate of a calcium carbonate that is found in stalagmites and stalactites, the limestone pillar formations that often form in underground caves. If 1 mol of anhydrous calcium carbonate is 48.08% of the mass of ikaite, what is the value of $x$?

**51.** 50.88%
**52.** 48.08%
**53.** 13.43%
**54.** 62.97%
**55.** $MgSO_4 \cdot 7H_2O(s)$, $Ba(OH)_2 \cdot 8H_2O(s)$, $CaCl_2 \cdot 2H_2O(s)$, $Ca(SO_4)_2 \cdot 2H_2O(s)$, $Mn(SO_4)_2 \cdot 2H_2O(s)$
**56.** 5
**57.** 4
**58.** $Cr(NO_3)_3 \cdot 9H_2O$
**59.** $MgI_2 \cdot 8H_2O$
**60.** 2.83 g
**9.** 89.16%
**10.** 7
**11.** 6