

9.5 - Formulas of Hydrates



Gypsum - Called Desert Rose.

Hydrated Compounds

Hydrate: dry chemical with water molecules in it.

Formula Structure: $\text{ionic compound formula} \cdot \text{number of water molecules}$

The dot means "associated with", because the water molecules are NOT chemically connected to the ionic compound.

Prefix Resources
Page 7.

Water Molecules	Prefix	Water Molecules	Prefix
1	Mono	6	Hexa
2	Di	7	Hepta
3	Tri	8	Octa
4	Tetra	9	Nona
5	Penta	10	Deca

Hydrated Formulas

Name the following:

1. Gypsum is calcium sulfate dihydrate.

What's the formula? $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

2. $\text{FePO}_4 \cdot 4\text{H}_2\text{O}$ Iron (III) Phosphate Tetrahydrate

3. $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ Barium Hydroxide Octahydrate



More examples from stockroom.

Drying a Hydrate

Heating drives off the water from a hydrate.

Doing so makes it anhydrous - 'without water'.

Desiccants: anhydrous compounds that absorb water from the air, making a dry environment for water-sensitive chemicals, equipment, and food.

Some chemicals decompose (break down) if heated beyond losing water.



4. Guided Practice: Analyzing a Hydrate

You can determine the formula of a hydrate.
Watch this!! - Heating CuSO_4 demo.

2.50 g of hydrated copper (II) sulfate is heated until it is anhydrous. Its final mass = 1.59 g.

What is the formula of hydrated copper (II) sulfate?



4. Guided Practice

Step 1: Determine molar masses of water, and anhydrous copper (II) sulfate.

Molar mass water = 18.02 g/mol

Molar mass CuSO_4 = 159.62 g/mol

Step 2: Determine mass of water lost.

Starting mass – ending mass = mass of water.

$$2.50 \text{ g} - 1.59 \text{ g} = 0.91 \text{ g}$$

4. Guided Practice

Step 3: Convert mass to moles of water and copper (II) sulfate.

$$\text{Water: } 0.91 \text{ g } H_2O \cdot \frac{1 \text{ mol } H_2O}{18.02 \text{ g } H_2O} = 0.0505 \text{ mol } H_2O$$

Copper (II) sulfate:

$$1.59 \text{ g } CuSO_4 \cdot \frac{1 \text{ mol } CuSO_4}{159.62 \text{ g } CuSO_4} = 0.00996 \text{ mol } CuSO_4$$

4. Guided Practice: ADD THIS

Step 4: Divide both numbers by smallest:

$$\frac{0.0505 \text{ mol } H_2O}{0.00996} \approx 5 \text{ mol } H_2O$$

$$\frac{0.00996 \text{ mol } CuSO_4}{0.00996} = 1 \text{ mol } CuSO_4$$

For water, ROUND to nearest whole number.

So: 5 water molecules for every formula unit of anhydrous copper (II) sulfate.

Formula = $CuSO_4 \cdot 5H_2O$

5. Demo: Just Add Water!

What happens when the anhydrous compound is rehydrated?

It heats up, as water molecules (which are moving rapidly) are reunited with the dry copper sulfate, they slow down.

The Kinetic Energy (energy of motion) that they had must go somewhere, and it manifests as thermal (heat) energy in the solution.

Homework

9.5 Booklet Problems.

Due: Next Class.

Lab Next Class! Dress Appropriately!