

9.6 - Formulas of Hydrates



Gypsum - Called Desert Rose.

Hydrated Compounds

Many chemicals have water molecules in them - hydrates.

Ex: Gypsum is calcium sulfate dihydrate.

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

More examples.

Naming Hydrates

This is exactly like naming binary molecular compounds:
Resource P 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

Examples:

Name the following:

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

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



Analyzing a Hydrate

Heating will drive off the water from a hydrated formula.

Doing so makes it anhydrous - 'without water'.

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

Watch this!! - Heating CuSO_4 demo.

Analyzing a Hydrate

You can determine the formula for a hydrated chemical.

Ex: 2.50 g of hydrated copper (II) sulfate is heated until it loses its water. Its final mass = 1.59 g.

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

Example:

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

Molar mass water = 18.02 g/mol
Molar mass CuSO₄ = 159.62 g/mol

Step 2: Determine mass of water lost.

Starting mass – ending mass = mass of water.
2.50 g – 1.59 g = 0.91 g

Example:

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

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

Copper (II) sulfate:

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

Example:

Step 4: Divide both numbers by smallest:

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

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

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

Formula = CuSO₄·5H₂O

Homework

9.6 Booklet Problems.

Due: Next Class.