EMPIRICAL FORMULA and HYDRATES

1) A hydrate of magnesium sulfate has a mass of 13.52 g. This sample is heated until no water remains. The $MgSO_4$ anhydrate has a mass of 6.6 g. Find the formula and name of the hydrate.

2) To drive off the water, a 15.67 g sample of a hydrate of magnesium carbonate was heated without decomposing the carbonate. The mass was reduced to 7.58 g. What is the formula of the hydrate?

3) A sample of copper (II) sulfate hydrate has a mass of 3.97 g. After heating, the $CuSO_4$ that remains has a mass of 2.54 g. Determine the correct formula and name the hydrate.

4) A hydrate of Na_2CO_3 has a mass of 4.31 g before heating. After heating, the mass of the anhydrous compound is found to be 3.22 g. Determine the formula of the hydrate and then write out the name of the hydrate.

EMPIRICAL FORMULA and HYDRATES

Answers

1) A hydrate of magnesium sulfate has a mass of 13.52 g. This sample is heated until no water remains. The $MgSO_4$ anhydrate has a mass of 6.6 g. Find the formula and name of the hydrate.

Mass of $MgSO_4 \cdot xH_2O$ = 13.52 g Mass of $MgSO_4$ = 6.6 g
Mass of H_2O = 13.52 g - 6.6 g = 6.92 g

Moles of $MgSO_4$ = 6.6 g/120.4 g/mol = 0.0548 mol/0.0548 mol = 1

Moles of H_2O = 6.92/18.015 g/mol = 0.384 mol/0.0548 mol = 7

The formula is $MgSO_4 \cdot 7H_2O$, and the name is magnesium sulfate heptahydrate.

2) To drive off the water, a 15.67 g sample of a hydrate of magnesium carbonate was heated without decomposing the carbonate. The mass was reduced to 7.58 g. What is the formula of the hydrate?

Mass of $MgCO_3 \cdot xH_2O$ = 15.67 g Mass of $MgCO_3$ = 7.58 g
Mass of H_2O = 15.67 g - 7.58 g = 8.09 g

Moles of $MgCO_3$ = 7.58 g/ 84.313 g/mol = 0.0899 mol/ 0.0899 mol = 1

Moles of H_2O = 8.09/18.015 g/mol = 0.449 mol/0.0899 mol = 5

The formula is $MgCO_3 \cdot 5H_2O$.

3) A sample of copper (II) sulfate hydrate has a mass of 3.97 g. After heating, the $CuSO_4$ that remains has a mass of 2.54 g. Determine the correct formula and name the hydrate.

Mass of $CuSO_4 \cdot xH_2O$ = 3.97 g Mass of $CuSO_4$ = 2.54 g Mass of H_2O = 3.97 g - 2.54 g= 1.43 g

Moles of $CuSO_4$ = 2.54 g/159.6 g/mol = 0.0159 mol/0.0159 mol = 1

Moles of H_2O = 1.43/18.015 g/mol = 0.0794 mol/0.0159 mol = 5

The formula is $CuSO_4 \cdot 5H_2O$, and the name is copper (II) sulfate pentahydrate.

4) A hydrate of Na_2CO_3 has a mass of 4.31 g before heating. After heating, the mass of the anhydrous compound is found to be 3.22 g. Determine the formula of the hydrate and then write out the name of the hydrate.

Mass of $Na_2CO_3 \cdot xH_2O$ = 4.31 g Mass of Na_2CO_3 = 3.22 g
Mass of H_2O = 4.31 g - 3.22 g = 1.09 g

Moles of Na_2CO_3 = 3.22 g/ 105.988 g/mol = 0.0304 mol/ 0.0304 mol = 1

Moles of H_2O = 1.09/18.015 g/mol = 0.0605 mol/0.0304 mol = 2

The formula is $Na_2CO_3 \cdot 2H_2O$, and the name is sodium carbonate dihydrate