

The Formula of a Hydrate (salt + H₂O) – Mole Ratio of Salt to Water Std 3

Purpose /Background: A hydrate is an inorganic salt that contains water. When heated, most or all of the water can be driven off (evaporated). The mass of water lost can be used to calculate moles of water and then compared to the calculated moles of dry salt (anhydrate, or salt without H₂O). This molar ratio gives the empirical formula (smallest mole ratio of dry salt to water). You will be able to calculate this ratio from your results!

Materials: Ring stand, evaporating dish, burner, tongs, an unknown hydrate, balance

Procedure:

1. Inspect your evaporating dish and be sure it is very dry. Heat if necessary and allow to cool.
2. Determine the weight of your evaporating dish.
3. Obtain a sample of magnesium sulfate (MgSO₄ • xH₂O) (salt + H₂O)
4. Fill the evaporating dish about 2 very full spoons of the hydrate (salt + H₂O) crystals.
5. Weigh the evaporating dish + hydrate (salt + H₂O).
6. Begin heating the evaporating dish **gently** to avoid spattering.
7. Continue heating for about 10 minutes or until the bottom is a dull red.
8. Allow the evaporating dish to cool about 5 minutes or until you can comfortably touch it.
9. Weigh the evaporating dish and dry salt (salt without H₂O).

Data/Calculations : **ALL MASSES ACCURATE TO 3 DECIMALS !!!**

Finding mass of hydrate (salt + H₂O)

Mass of evaporating dish _____ g
Mass of evaporating dish + hydrate (**MgSO₄ • xH₂O**) _____ g (before heating)
Calculate: mass of hydrate (salt + H₂O) _____ g

Finding moles of dry salt (MgSO₄)

Mass of evaporating dish + dry salt (**MgSO₄**) _____ g (after heating)
Calculate: mass of dry salt _____ g
Calculate: molar mass of dry salt (**MgSO₄**) _____ g/mole
Calculate : moles of dry salt = $\frac{\text{mass dry salt}}{\text{molar mass of dry salt}}$ _____ mole dry salt **(b)**

Finding moles of H₂O

Calculate: mass of water = (mass hydrate - mass dry salt) _____ g
Calculate: molar mass of water (**H₂O**) _____ g/mole
Calculate : moles of water = $\frac{\text{mass of water}}{\text{molar mass of water}}$ _____ moles of water **(a)**

Final Calculations

$$\frac{\text{moles of water}}{\text{moles of dry salt}} = \frac{(a)}{(b)} = \frac{\quad}{1} = \quad \# \text{ H}_2\text{O molecules around each molecule of salt}$$

Empirical formula of magnesium sulfate hydrate: **MgSO₄ • ___ H₂O** (calculated on last line)

Questions:

You are to write one paragraph for **EACH** of the following:

- What you determined to be the purpose of this lab
- Sources of error (at least 2 possible sources)
- What you learned