Hydrate

\[
\text{mass \%} = \frac{\text{mass of substance}}{\text{total mass}} \times 100\% \\
\]

\[
\begin{align*}
\text{Cu} &= 63.55 \quad \text{S} &= 32.06 \quad \text{O} &= 16.00 \quad \text{H} &= 1.01 \\
\text{CuSO}_4 &= 63.55 + 32.06 + 4 \times 16.00 = (59.161 \text{ g/mol}) \\
\overset{5}{\text{H}_2\text{O}} &= 5 \times (18.02) = 90.10 \text{ g H}_2\text{O/mol} \\
\text{mass \%} &= \frac{90.10}{159.61 + 90.10} \times 100\% = 36.08\% \text{ H}_2\text{O}
\end{align*}
\]

hydrate + test tube 18.4597 g test tube 18.3365 g + test tube 18.4121

mass hydrate = 18.4597 g - 18.3365 g = 0.1232 g
mass water = 18.4597 g - 18.4121 g = 0.0476 g
mass \% = \frac{0.0476}{0.1232} \times 100\% = 38.64\%

\[
\begin{align*}
\text{3) mass of hydrate} &= \text{2) (mass Ti + hydrate)} - \text{1) (mass of Ti)} \\
\text{7) mass of salt} &= \text{4) (mass Ti + salt)} - \text{1) (mass of Ti)} \\
\text{6) mass of water} &= \text{3) (mass of hydrate)} - \text{5) (mass of salt)} \\
\text{7) moles of salt} &= \frac{\text{6) (mass of salt)} \div 159.61 \text{ g/mol}}{\text{molar mass of salt}} \\
\text{8) moles of water} &= \frac{\text{6) (mass of water)} \div 18.02 \text{ g/mol}}{\text{4) (moles of salt)}} \\
\text{9) CuSO}_4 \times \text{H}_2\text{O} &= \frac{\text{8) (moles of water)}}{\text{7) (moles of salt)}}
\end{align*}
\]

Unknowns: \text{CuSO}_4 \times 2\text{H}_2\text{O}, \text{MgSO}_4 \times 7\text{H}_2\text{O}, \text{ZnSO}_4 \times 7\text{H}_2\text{O}

The unknown is one of three possible compounds. If the calculations are performed using the molar mass of the correct compound, the correct molar ratio will be obtained. So, the calculations are performed three times, each time assuming the unknown is a different compound. The unknown is identified by whichever ratio is correct.
Molar Volume - The volume that one mole of an ideal gas will occupy at STP (standard temperature and pressure).

STP (old definition) - 0°C, 1 atm

1. Atomic mass of Mg = 24.31 g/mol
2. Moles of Mg = \( \frac{\text{mass Mg}}{24.31 \text{ g/mol}} \)
3. Mg(s) + 2 HCl(aq) → H₂(g) + MgCl₂(aq)
4. Moles of H₂ = \( \frac{3}{2} \) moles of Mg

5. Volume of H₂

6. Pressure (atm)

5. Temperature (K)

At any temperature, there will be a fraction of molecules of water with enough energy to evaporate. This gas generated is known as vapor pressure.

There is automatically water vapor present as soon as H₂ gas is collected.

\[ P_{\text{atm}} = P_{\text{H₂}} + P_{\text{H₂O}} + P_{\text{height}} \]

\( \text{Atm} \) if level inside is lower than the "true" pressure of H₂ in the eudiometer.

\( \text{barometric pressure} - \text{vapor pressure} \)

\( \text{level inside is lower} \)

7. "Corrected" "true" H₂ pressure = 760 torr (mm Hg)

8. The correction for the vapor pressure of water

9. The "true" pressure of H₂ in the eudiometer

10. STP adjusted volume = \( \frac{P_1 \cdot T_2}{T_1} \cdot V_1 \)

11. \( V_{\text{mol}} = \frac{10 V_{\text{adj}}}{\text{moles H₂}} \)

Accepted value = 22.4 L/mol
Electrolytes

- The amount of electricity water can conduct is based on the number of ions in it. Pure water is not a conductor.

**Molarity**

\[
\text{molarity} = \frac{\text{moles solute}}{\text{L solvent}}
\]

**Electrolytes** - a substance that can dissociate in water

**Strong electrolytes** - substances that completely or extensively dissociate in water

**Weak electrolyte** - a substance that only minimally dissociates in water

**Strong acid** - an acid that completely or dissociates to produce \( \text{H}^+ \)

**Weak acid** - an acid that minimally dissociates to produce \( \text{H}^+ \)

- Why do two solutions with the same concentrations have different conductivities? (different \# of ions)

- HCl is a strong acid, so it produces a larger number of ions at the same concentration because it completely dissociates. CH₃COOH is a weak acid, so it produces a smaller number of ions at the same concentration, because only about 10% dissociates. This is why the two solutions have different \# of ions even though they are the same concentrations.