

Preparation of salt

1 Soluble salt

ACID - BASE → EXCESS INSOL. BASE + ACID

Required: prepare $\text{ZnSO}_4(\text{s})$

Excess when:

- 1) no colourless gas bubbles
- 2) no longer dissolves

Why is excess insol. base required?

- If $\text{ZnCO}_3(\text{s})$ is limited, the solⁿ contains $\text{H}_2\text{SO}_4(\text{aq})$.
- It is hard to separate H_2SO_4 from mixture, even by fractional distillation (fractional distillation cannot obtain pure H_2SO_4).
- Resulting crystal will contain impurities (H_2SO_4).

Crystallisation

1. Heat until saturated
2. Cool solⁿ (time is allowed for crystal to form)
3. Filter the solⁿ and obtain crystal as residue
4. Wash w/ small amt. of ice-cold distilled water
5. Dry crystal in filter paper

ACID - BASE → TITRATION OF SOL. BASE + ACID

Required: prepare $\text{NaCl}(\text{s})$

Why can't we use the above method?

- Na^+ 不管配什么 -ve ion, compound 也溶于水
- 没有 insol. base

Titration

- 1a. Titrate known vol & known molarity $\text{NaOH}(\text{aq})$ against $\text{HCl}(\text{aq})$
- 1b. Use methyl orange as indicator
- 1c. Record vol. of $\text{HCl}(\text{aq})$ used when end pt. is reached (yellow → orange)
2. Repeat exp. w/o indicator w/ same vol. of acid

Crystallisation

1. Heat until saturated
2. Cool solⁿ (time is allowed for crystal to form)
3. Filter the solⁿ and obtain crystal as residue
4. Wash w/ small amt. of ice-cold distilled water
5. Dry crystal in filter paper

2 Insoluble salt

PRECIPITATION

Required: prepare $\text{PbSO}_4(\text{s})$

Mix equal volume & equal molarity of $\text{Pb}(\text{NO}_3)_2(\text{aq})$, $\text{Na}_2\text{SO}_4(\text{aq})$

depends on salt to prepare

- eg. $\text{PbCl}_2(\text{s})$
- $\text{Pb}(\text{NO}_3)_2 + 2\text{NaCl} \rightarrow \text{PbCl}_2 + 2\text{NaNO}_3$
- $\text{Pb}(\text{NO}_3)_2$ mol : NaCl mol = 1 : 2

Filtration

1. Filter mixture & collect $\text{PbSO}_4(\text{s})$ as residue
2. Wash w/ large amt. of distilled water
3. Dry w/ filter paper

SPECIAL CASE: prepare $\text{NaHSO}_4(\text{s})$

- H_2SO_4 的 ionization 其实有两个步骤:
 - a. $\text{H}_2\text{SO}_4 \rightarrow \text{H}^+ + \text{HSO}_4^-$
 - b. $\text{HSO}_4^- \rightarrow \text{H}^+ + \text{SO}_4^{2-}$
- 如何逼使 H_2SO_4 只 ionize 一次?
 - > 只提供 complete rx 所需 mole 一半的 $\text{H}_2\text{SO}_4(\text{aq})$.
 - > 本来: $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$, $\text{NaOH} : \text{H}_2\text{SO}_4 = 2 : 1$
 - > 如果变成: $\text{NaOH} : \text{H}_2\text{SO}_4 = 1 : 1 \Rightarrow \text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{H}_2\text{O}$
- 如何确保 $\text{NaOH} : \text{H}_2\text{SO}_4 = 1 : 1$? → Procedure
 - > Mix equal volume & equal molarity of $\text{NaOH}(\text{aq})$ and $\text{H}_2\text{SO}_4(\text{aq})$.
 - > Heat solⁿ until saturated then cool solⁿ.
 - > Time is allowed for crystal to form.
 - > Filter the solⁿ, obtain crystal as residue.
 - > Wash crystal w/ little amt. of ice-cold distilled water.
 - > Dry crystal in filter paper.
- Tip: 其他同类型的 salt 也能通过控制 mole ratio 而获得.
 - > $\text{H}_3\text{PO}_4 \rightleftharpoons \text{H}^+ + \text{H}_2\text{PO}_4^-$ ——— 1 $\text{NaOH} + 1 \text{H}_3\text{PO}_4 \rightarrow \text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$
 - $\text{H}_2\text{PO}_4^- \rightleftharpoons \text{H}^+ + \text{HPO}_4^{2-}$ ——— 2 $\text{NaOH} + 1 \text{H}_3\text{PO}_4 \rightarrow \text{Na}_2\text{HPO}_4 + 2\text{H}_2\text{O}$
 - $\text{HPO}_4^{2-} \rightleftharpoons \text{H}^+ + \text{PO}_4^{3-}$ ——— 3 $\text{NaOH} + 1 \text{H}_3\text{PO}_4 \rightarrow \text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$