Precipitation Reactions

A precipitation reaction is a type of chemical reaction that happens when two solutions are mixed together, and they form a solid. This solid is called a precipitate.

How does it happen?

You start with two solutions (soluble salts dissolved in water).

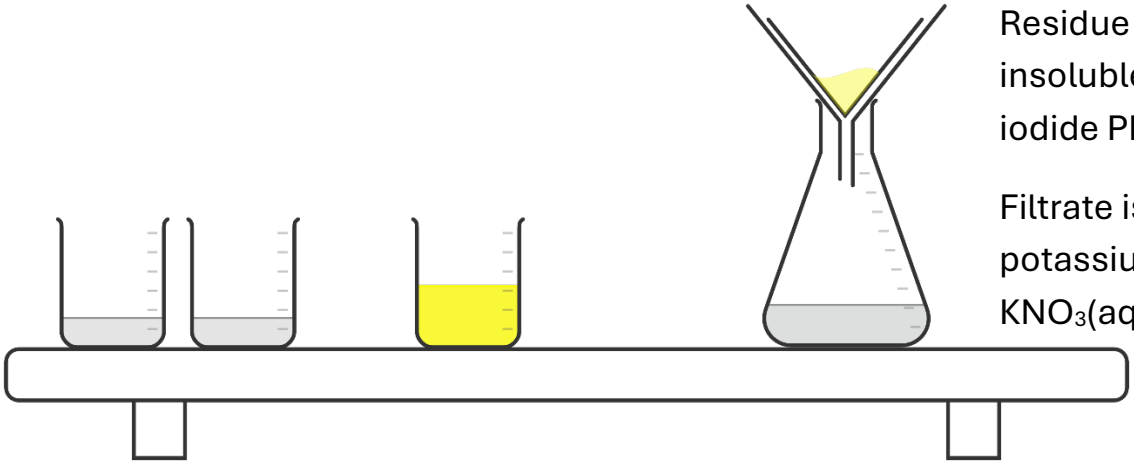
When you mix them, the ions in the solutions can react.

If the reaction forms a substance that is insoluble (does not dissolve in water), it forms as a solid. This solid falls to the bottom or makes the liquid go cloudy - this is the precipitate.

If the mixture is filtered, the solid will remain on the filter paper (the residue) and the soluble substances will pass through the filter paper dissolved in the water (the filtrate).

Example:

When you mix colourless lead nitrate solution and colourless potassium iodide solution, a yellow precipitate (solid) of lead iodide forms.



Residue is insoluble lead iodide $PbI_2(s)$

Filtrate is soluble potassium nitrate $KNO_3(aq)$

lead nitrate(aq) + potassium iodide(aq) → lead iodide(s) + potassium nitrate(aq)

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

where (aq) means it is dissolved in water, and (s) means it is a solid (the precipitate).

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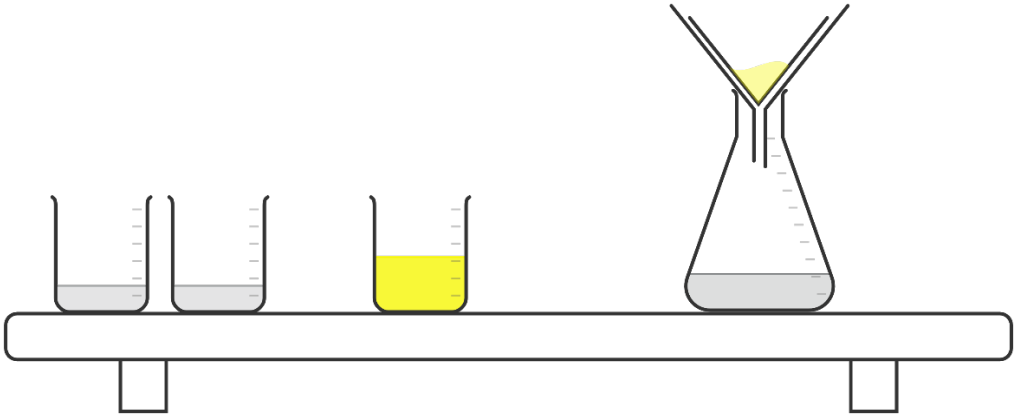
$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$



Lead nitrate solution $Pb(NO_3)_2(aq)$	Potassium iodide solution $KI(aq)$	Lead iodide solid $PbI_2(s)$ AND potassium nitrate solution $KNO_3(aq)$	Lead iodide solid residue in the filter paper AND potassium nitrate solution filtrate in the conical flask
All nitrate salts are soluble. Lead ions and nitrate ions are colourless.	All potassium salts are soluble. Iodide salts are soluble (except AgI and PbI_2).	A solid / precipitate forms. It is yellow because lead iodide is a yellow solid. The solid is suspended in a colourless potassium nitrate solution.	Iodide salts are soluble (except AgI and **PbI_2**); this is why the precipitate of lead iodide formed. All nitrate salts are soluble / all potassium salts are soluble, so potassium nitrate is soluble.

Solubility rules

sodium	All soluble
potassium	All soluble
nitrate	All soluble
chloride	Mostly soluble, except silver chloride and lead chloride
iodide	Mostly soluble, except silver iodide and lead iodide

Colours of selected ions and solids

Ions (aq)

Colourless ions	Most solutions such as chloride, bromide, iodide, fluoride, hydroxide, sulfide, sulfate, nitrate, carbonate, hydrogen carbonate, phosphate, sodium, calcium, barium, magnesium, zinc, lead, silver, ammonium.
Blue ions	copper(II)
Pale green ions	iron(II)

Solids (s)

Yellow solid	lead iodide
Pale yellow solid	silver iodide