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SET 1:

**NB. Only two of the known solutions are required in this instance. Reason to follow in red and purple.**

As you can see chloride ions are mostly soluble with these two exceptions. Iodide ions allow us to tell the difference between the two metal anions of lead and silver and so this is more useful to us.

 ↑

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IONS ↓→ | OH- | NH3 | Cl- | I- |
| Fe2+ | Light green ppt. | Light green ppt. | n.v.r. | n.v.r. |
| Pb2+ | White ppt. | White ppt. | White ppt. | Yellow ppt. |
| Ag+ | Brown ppt. (Ag2O) | same ppt. | White ppt. | Creamy ppt. |
| Cu2+ | Blue ppt. | Blue ppt. | n.v.r. | n.v.r. |
| Mg2+ | White ppt. | White ppt. | n.v.r. | n.v.r. |

 ↓

This one is hard because ammonia makes OH- ions in solution. It interacts with water like this:

NH3 + H2O → NH4+ + OH-

As a result this means it is not necessary to use this solution. The presence of water means there will be an abundance of OH- ions to react with. So this in effect will repeat the NaOH run. You could do either.

SET 2:

In this one, it is easy to distinguish most of these solutions from one another. They all do something different by creating different coloured compound precipitates that are unique to the others.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| IONS ↓→ | CO32- | OH- | Cl- | SO42- | NO3- |
| Pb2+ | **White ppt.** | White ppt. | White ppt. | White ppt. | n.v.r. |
| Ag+ | **Yellow ppt.** | White ppt. | White ppt. | White ppt. | n.v.r. |
| Cu2+ | Green ppt. | **Blue ppt.** | n.v.r. | n.v.r. | n.v.r. |
| Fe2+ | Light green ppt. | **Light green ppt**. | n.v.r. | n.v.r. | n.v.r. |
| H+ | Gas bubbles off | **n.v.r.** | n.v.r. | n.v.r. | n.v.r. |

Chlorides, sulfates and nitrates in this example are useless in identifying the unknowns.

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Now that we know some solutions are no good at helping us identify some unknowns we can stay away from them and use only solutions that will help us identify our compounds.

**Set 1:**

The first solution to identify is copper as it will be blue… We can then use this to identify the another solution.

We will combine each of the solutions we have to see if this helps identify them… anions and cations are separated in the table below…

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Ba2+ | Cu2+ | H+ | Na+ |
| Cl- | n.v.r | n.v.r | n.v.r | n.v.r |
| SO42- | White ppt. | n.v.r | n.v.r | n.v.r |

This is ok. It only eliminates Barium Chloride from the list and the non-blue solution that it created the precipitate with must also be sulphuric acid which leaves only the sodium solution that never made a ppt.

**Set 2:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Ag+ | Zn2+ | Ba2+ | Na+ |
| NO3- | n.v.r | n.v.r | n.v.r | n.v.r |
| SO42- | White ppt. | n.v.r | White ppt. | n.v.r |
| Cl- | White ppt. | n.v.r | n.v.r | n.v.r |

So silver is identified as it makes two precipitates.

Barium because it makes only one.

Sodium and zinc are still to be identified. Sodium ions will remain in solution indefinitely as they are always soluble so all we have to pick is something else that will precipitate the zinc out like a hydroxide or a carbonate or once we have the known solutions perhaps they would precipitate with the unknown anions from the remaining liquid.

The only other way to identify Zinc solution from Barium is the mass of precipitate formed.

**Set 3:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | H+ | Ba2+ | Na+ | Pb2+ | K+ |
| SO42- | n.v.r | White ppt. | n.v.r | White ppt. | n.v.r |
| Cl- | n.v.r | n.v.r | n.v.r | White ppt. | n.v.r |
| CO32- | Bubbles of gas | White ppt. | n.v.r | White ppt. | n.v.r |
| NO3- | n.v.r | n.v.r | n.v.r | n.v.r | n.v.r |
| OH- | n.v.r | White ppt. | n.v.r | White ppt. | n.v.r |

All combinations of ions in this one are able to identify each and every solution presented. It is just a matter of picking the right solution to test for each one.

**Set 4:**

Firstly… calcium carbonate is insoluble in water. The solid that doesn’t dissolve is CaCO3.

You must then turn all the salts into solutions to perform precipitation reactions within the set.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Ba2+ | Zn2+ | Na+ | Ca2+ | H+ |
| Cl- | n.v.r | n.v.r | n.v.r | n.v.r | n.v.r |
| NO3- | n.v.r | n.v.r | n.v.r | n.v.r | n.v.r |
| CO32- | White ppt. | White ppt. | n.v.r | White ppt. | Bubbles of gas |
| OH- | n.v.r | White ppt. | n.v.r | White ppt. | n.v.r |

So sodium carbonate was identified using the hydrochloric acid.

Barium would not create a ppt. with limewater while zinc does.