Year 12 Science: Qualitative analysis: which ions are in the sample?

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A solution gives a white precipitate with NaOH that dissolves in excess, and a white precipitate with NH_3 that also dissolves in excess. Which cation is present?

2. Write the ionic equation for a few drops of NaOH added to a solution of Cu^{2+} ions.

3. Excess ammonia then turns that precipitate into a deep blue solution. Write the equation.

4. A white precipitate with NaOH dissolves in excess. With NH_3 the white precipitate stays, and with KI a bright yellow precipitate forms. Name the cation and write the equation for the yellow precipitate.

5. Why is the sample acidified with dilute nitric acid before silver nitrate is added?

6. Tank water from an old house contains 3 mg/L of copper. Is it within the drinking water standard?

Fix the mistake

7. Correct this statement: "White precipitate with NaOH, so it is Zn^{2+}."

8. Correct this statement: "$2NaOH + CuSO_4 \rightarrow Cu(OH)_2 + Na_2SO_4$ is my ionic equation."

9. Correct this statement: "I tipped in lots of NaOH at once and saw a clear solution, so there was no precipitate."

10. Correct this statement: "The green precipitate went brown on top, so the ion is Fe^{3+}."

Answer key (for parents and tutors)

1. A solution gives a white precipitate with NaOH that dissolves in excess, and a white precipitate with NH_3 that also dissolves in excess. Which cation is present?
   Zn^{2+}: only zinc hydroxide redissolves in excess NaOH and in excess NH_3.
2. Write the ionic equation for a few drops of NaOH added to a solution of Cu^{2+} ions.
   $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2(s)$, a blue precipitate.
3. Excess ammonia then turns that precipitate into a deep blue solution. Write the equation.
   $Cu(OH)_2(s) + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+} + 2OH^-$.
4. A white precipitate with NaOH dissolves in excess. With NH_3 the white precipitate stays, and with KI a bright yellow precipitate forms. Name the cation and write the equation for the yellow precipitate.
   Pb^{2+}; $Pb^{2+} + 2I^- \rightarrow PbI_2(s)$.
5. Why is the sample acidified with dilute nitric acid before silver nitrate is added?
   The acid removes carbonate and hydroxide ions, which would also precipitate with Ag^+, so a precipitate can only be a halide.
6. Tank water from an old house contains 3 mg/L of copper. Is it within the drinking water standard?
   No: 3 mg/L is above the maximum acceptable value of 2 mg/L.
7. Correct this statement: "White precipitate with NaOH, so it is Zn^{2+}."
   Mg^{2+}, Al^{3+}, Zn^{2+} and Pb^{2+} all give white precipitates; only the tests in excess NaOH, then NH_3, then KI tell them apart.
8. Correct this statement: "$2NaOH + CuSO_4 \rightarrow Cu(OH)_2 + Na_2SO_4$ is my ionic equation."
   Leave out the spectator ions: $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2(s)$.
9. Correct this statement: "I tipped in lots of NaOH at once and saw a clear solution, so there was no precipitate."
   Add a drop at a time first; an amphoteric hydroxide forms and then redissolves, so pouring in excess hides it.
10. Correct this statement: "The green precipitate went brown on top, so the ion is Fe^{3+}."
    Fe^{3+} gives orange-brown at once; green turning brown on top is $Fe(OH)_2$ being oxidised by air, so the ion is Fe^{2+}.