1.

(a) Mg^{2+}

(c) K⁺ (d) O²⁻

(b) Cl⁻

2.

(e) CaF₂ insoluble

(h) BaSO₄ insoluble

(f) Pb(NO₃)₄ soluble

(i) Hg(OH)₂ insoluble

(g) AuI2 soluble

(j) Ag₂S insoluble

3.

- insoluble with hydroxide cannot be potassium, sodium, ammonium, barium, and might not be calcium
- insoluble with sulfate must be barium, lead(II), or maybe calcium or silver
- soluble with chromate must be magnesium or calcium

It is most likely to be calcium, since magnesium would be soluble with sulfate.

4.

(a)

(i) $Na_2CO_{3 (aq)} + CaI_{2 (aq)} \rightarrow NaI_{(aq)} + CaCO_{3 (s)}$

(ii) $Na^{+}_{(aq)} + CO_{3}^{2-}_{(aq)} + Ca^{2+}_{(aq)} + I^{-}_{(aq)} \rightarrow Na^{+}_{(aq)} + I^{-}_{(aq)} + CaCO_{3(s)}$

(iii) $Ca^{2+}_{(aq)} + CO_3^{2-}_{(aq)} \rightarrow CaCO_{3(s)}$

(b)

(i) $AgNO_{3 (aq)} + (NH_4)_3PO_{4 (aq)} \rightarrow Ag_3PO_{4 (s)} + NH_4NO_{3 (aq)}$

(ii) $Ag^{+}_{(aq)} + NO_{3(aq)} + NH_{4(aq)}^{+} + PO_{4(aq)}^{-3} \rightarrow Ag_{3}PO_{4(s)} + NH_{4(aq)}^{+} + NO_{3(aq)}^{-}$

(iii) $3Ag^{+}_{(aq)} + PO_{4}^{3-}_{(aq)} \rightarrow Ag_{3}PO_{4(s)}$

Bonus:

- A) We write it like (i). The formula $Cr_2(SO_4)_3$ shows it is made up of three times as many sulfate ions as chromium ions. The ions do not form molecules when the substance dissolves.
- B) NaCl is an ionic substance, so it already has ions that break apart in water. HCl is covalently bonded so its bond breaks and ions are formed.