Removing Magnesium from Ceramic Rinsewater

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A ceramics class studies a simplified rinsewater model containing dissolved Mg^{2+} and Cl^-. When hydroxide ions are added, Mg^{2+} and OH^- can form solid $Mg(OH)_2$. The class separates this solid from the water by filtration. In the model, chloride ions stay dissolved. Each 1.00 L starting sample contains 0.0040 mol of dissolved Mg^{2+}.

$Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$

1 Which observation is consistent with chloride acting as a spectator ion in this model?

(1) Cl^- remains dissolved as $Mg(OH)_2$ forms.

(2) Cl^- becomes part of solid $Mg(OH)_2$.

(3) Cl^- is converted to neutral chlorine atoms as the solid forms.

(4) Cl^- replaces all the hydroxide ions in the solid.

2 Use the net equation to calculate the minimum amount of OH^- needed to react with all 0.0040 mol of Mg^{2+} in the ideal model. Show the mole ratio. [1]

Answer and work

3 Show how the charges of the ions in the net equation account for the neutral formula $Mg(OH)_2$. [1]

Answer and work

Comparing the filtered samples

After filtration, the class measures the dissolved magnesium and pH in three model trials. Their assignment requires a final dissolved magnesium concentration of at most 10 mg/L and a pH no higher than 10.5. These are classroom model constraints.

Trial	OH^- added (mol)	Dissolved magnesium (mg/L)	Final pH
P	0.0060	25	9.9
Q	0.0080	3.0	10.3
R	0.0100	0.04	11.3

4 Which trial meets both classroom model constraints?

(1) P only

(2) Q only

(3) R only

(4) Q and R

5 A 0.500 L portion of Q's filtered sample is poured into a clean container. Calculate the mass of dissolved magnesium in that portion. [1]

Answer and work

6 A student concludes that the trial with the least dissolved magnesium is the best choice. Use the data to explain why the assignment calls for a different choice. [1]

Answer and work