Following Calcium Through a Resin

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

A model water softener contains a resin with four charged sites. Each site starts with two Na^+ ions and can hold one Ca^{2+} or one Mg^{2+} ion in their place. The model passes two equal water portions through the same resin. The entering water contains no sodium. Ions missing from the water stay on the resin, and ions added to the water come from the resin.

Portion	**Ion**	**Units entering**	**Units leaving**
1	Ca^{2+}	4	0
1	Mg^{2+}	0	0
1	Na^+	0	8
2	Ca^{2+}	0	2
2	Mg^{2+}	4	2
2	Na^+	0	0

1 Which ion occupies sites on the resin after the first portion that it did not occupy before?

(1) Ca^{2+}

(2) Mg^{2+}

(3) Na^+

(4) Neither Ca^{2+} nor Mg^{2+}

2 Complete the table with the units of each ion held by the resin at the end of each water portion. Show how you used the water readings. [1]

After portion	**Ca^{2+}**	**Mg^{2+}**
1		
2		

Use of the water readings

3 A technician says the resin no longer exchanged ions in portion 2 because no sodium appeared. Evaluate that claim using the charges and both divalent ion records. [1]

Answer and work

A sensor can report only the total number of Ca^{2+} and Mg^{2+} units in a water portion. It cannot distinguish calcium from magnesium.

4 Compare this sensor’s entering and leaving readings for portion 2. Identify one ion the technician could measure separately to reveal the exchange. [1]

Answer and work