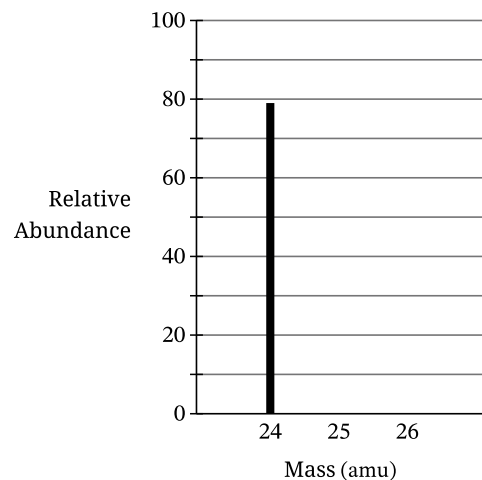


1. Answer the following questions about magnesium.

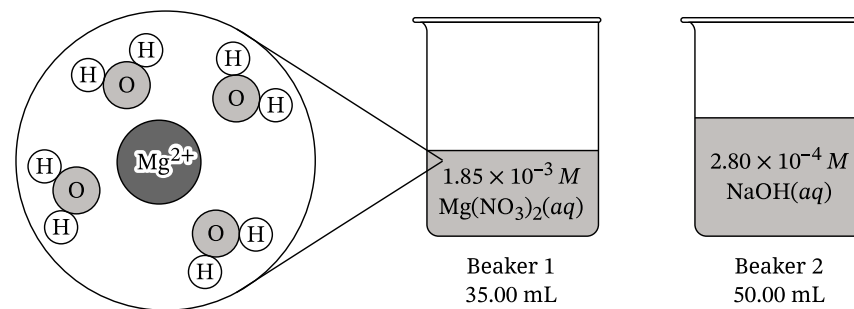
A. An incomplete mass spectrum for magnesium is shown in the diagram.



The percent abundance of magnesium-24 is 79%. The percent abundances of the other two natural isotopes of magnesium, magnesium-25 and magnesium-26, are approximately equal.

- Complete the mass spectrum in part A by drawing thick lines in the appropriate locations to represent the percent abundance of magnesium-25 and magnesium-26.
- Describe the difference in atomic structure that accounts for the difference in mass between magnesium-25 and magnesium-26.

A student prepares a  $1.85 \times 10^{-3} M$  solution of  $\text{Mg}(\text{NO}_3)_2(aq)$  in beaker 1 and a  $2.80 \times 10^{-4} M$  solution of  $\text{NaOH}(aq)$  in beaker 2, as shown.

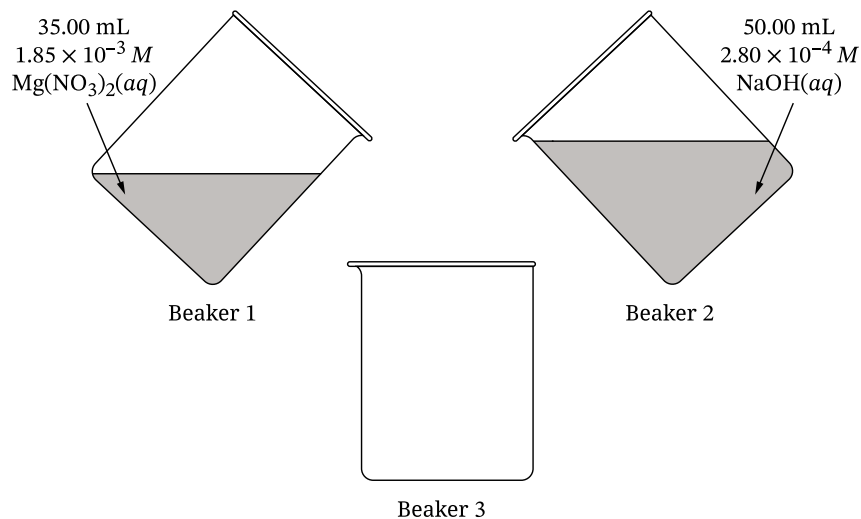


B. The particle diagram shown represents a magnesium ion,  $\text{Mg}^{2+}$ , in beaker 1. A sodium ion,  $\text{Na}^+$ , in beaker 2 has a weaker attraction to water than the  $\text{Mg}^{2+}$  does. Explain this phenomenon using Coulomb's law and each of the following.

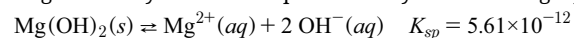
- The relative charge of the ions
- The relative radii of the ions

C. Calculate the pH of the solution in beaker 2.

- D. A student combines 35.00 mL of  $1.85 \times 10^{-3} M \text{Mg}(\text{NO}_3)_2(aq)$  with 50.00 mL of  $2.80 \times 10^{-4} M \text{NaOH}(aq)$ , as shown in the diagram. Calculate  $[\text{Mg}^{2+}]$  after the two solutions are combined but before any reaction takes place. (Assume that volumes are additive.)



- E. The dissolution of magnesium hydroxide is represented by the following equation.



- Write the expression for the solubility product constant,  $K_{sp}$ .
  - After the two solutions are combined in beaker 3 as described in part D, but before any reaction takes place,  $[\text{OH}^{-}] = 1.65 \times 10^{-4} M$ . Using your answer to part D, calculate the value of the reaction quotient,  $Q$ .
  - Using the reaction quotient,  $Q$ , predict whether a precipitate should form as the mixture in beaker 3 approaches equilibrium. Justify your answer.
- F. In a separate experiment, the student adds  $\text{HNO}_3(aq)$  to decrease the pH of a saturated solution containing undissolved  $\text{Mg}(\text{OH})_2(s)$ . Does the amount of undissolved  $\text{Mg}(\text{OH})_2(s)$  increase, decrease, or remain the same as the  $\text{HNO}_3(aq)$  is added? Justify your answer.