

5 • Reactions in Aqueous Solution

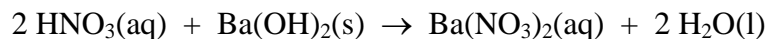
Molarity

Solution Concentration

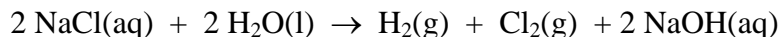
1. If 6.73 g of Na_2CO_3 is dissolved in enough water to make 250. mL of solution, what is the molarity of the sodium carbonate? What are the molar concentrations of the Na^+ and CO_3^{2-} ions?
2. Some potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$), 2.335 g, is dissolved in enough water to make exactly 500. mL of solution. What is the molarity of the potassium dichromate? What are the molar concentrations of the K^+ and $\text{Cr}_2\text{O}_7^{2-}$ ions?
3. What is the mass, in grams, of solute in 250. mL of a 0.0125 M solution of KMnO_4 ?
4. What is the mass, in grams, of solute in 125 mL of a 1.023×10^{-3} M solution of Na_3PO_4 ? What are the molar concentrations of the Na^+ and PO_4^{3-} ions?
5. What volume of 0.123 m NaOH, in milliliters, contains 25.0 g of NaOH?
6. What volume of 2.06 M KMnO_4 , in Liters, contains 322 g of solute?
7. If 4.00 mL of 0.0250 M CuSO_4 is diluted to 10.0 mL with pure water, what is the molarity of copper(II) sulfate in the diluted solution?
8. If you dilute 25.0 mL of 1.50 M hydrochloric acid to 500. mL, what is the molar concentration of the dilute acid?
9. If you need 1.00 L of 0.125 M H_2SO_4 , which of the following methods would you use to prepare this solution?
 - a) Dilute 20.8 mL of 6.00 M H_2SO_4 to a volume of 1.00 L.
 - b) Add 950. mL of water to 50.0 mL of 3.00 M H_2SO_4 .
10. If you need 300. mL of 0.500 M $\text{K}_2\text{Cr}_2\text{O}_7$, which of the following methods would you use to prepare this solution?
 - a) Add 30.0 mL of 1.50 M $\text{K}_2\text{Cr}_2\text{O}_7$ to 270. mL of water.
 - b) Dilute 250. mL of 0.600 M $\text{K}_2\text{Cr}_2\text{O}_7$ to a volume of 300. mL.
11. For each solution, identify the ions that exist in aqueous solution & specify the concentration of each.
 - a) 0.25 M $(\text{NH}_4)_2\text{SO}_4$
 - b) 0.056 M HNO_3
 - c) 0.123 M Na_2CO_3
 - d) 0.00124 M KClO_4
12. For each solution, identify the ions that exist in aqueous solution & specify the concentration of each.
 - a) 0.12 M BaCl_2
 - b) 0.0125 M CuSO_4
 - c) 0.146 M AlCl_3
 - d) 0.500 M $\text{K}_2\text{Cr}_2\text{O}_7$

Stoichiometry of Reactions in Solution

13. What volume of 0.125 M HNO₃, in milliliters, is required to react completely with 1.30 g of Ba(OH)₂?



14. One of the most important industrial processes in our economy is the electrolysis of brine solutions (aqueous solutions of NaCl). When an electric current is passed through an aqueous solution of salt, the NaCl and water produce H₂(g), Cl₂(g), and NaOH—all valuable industrial chemicals.



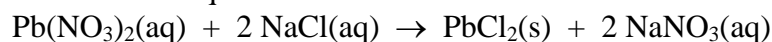
What mass of NaOH can be formed from 10.0 L of 0.15 M NaCl? What mass of chlorine can be obtained?

15. In the photographic developing process, silver bromide is dissolved by adding sodium thiosulfate:



If you want to dissolve 0.250 g of AgBr, what volume of 0.0138 M Na₂S₂O₃, in milliliters, should be used?

16. What volume of 0.750 M Pb(NO₃)₂, in milliliters, is required to react completely with 1.00 L of 2.25 M NaCl solution? the balanced equation is



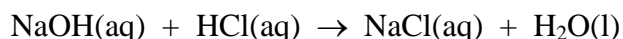
17. You place 2.56 g of CaCO₃ in a beaker containing 250. mL of 0.125 M HCl (Figure 5.13). When the reaction has ceased,



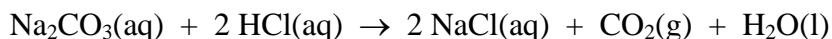
does any calcium carbonate remain? Explain your reasoning. What mass of CaCl₂ can be produced?

Titration

18. What volume of 0.812 M HCl, in milliliters, is required to titrate 1.33 g of NaOH to the equivalence point?



19. What volume of 0.955 M HCl, in milliliters, is needed to titrate 2.152 g of Na₂CO₃ to the equivalence point?



20. A noncarbonated soft drink contains an unknown amount of citric acid, H₃C₆H₅O₇. If 100 mL of the soft drink requires 33.51 mL of 0.0102 M NaOH to neutralize the citric acid completely, how many grams of citric acid does the soft drink contain per 100. mL? The reaction of citric acid and NaOH is

