



## Molarity Problems

### FORMULAS

$$\text{Molarity: } M = \frac{\text{moles of solute}}{\text{litres of solution}} \text{ (mol/L)}$$

$$\text{Dilution problems: } M_1V_1 = M_2V_2$$

$$\text{Molar mass: } n = \frac{m}{MW}, \text{ where } n = \text{number of moles}$$

$$m = \text{mass}$$

$$MW = \text{molecular weight (g/mol)}$$

*Example 1:* Determine the molarity of 3.72 moles of NaBr in 575 mL of solution.

$$\text{Solution: } [\text{NaBr}] = \frac{3.72 \text{ mol}}{0.575 \text{ L}} = 6.47 \text{ mol/L}$$

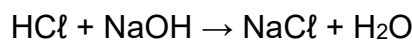
*Example 2:* How many millilitres of concentrated H<sub>2</sub>SO<sub>4</sub> (16.0 M) is required to prepare 250 mL of 6.00 M H<sub>2</sub>SO<sub>4</sub> solution?

$$\text{Solution: } \begin{array}{l} \text{desired: } M_1 = 6.00 \text{ M; } V_1 = 250 \text{ mL} \\ \text{on hand: } M_2 = 16.0 \text{ M; } V_2 = ? \end{array}$$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{(6.00 \text{ M})(250 \text{ mL})}{16.0 \text{ M}} = 93.8 \text{ mL H}_2\text{SO}_4$$

*Example 3:* 15.32 mL of 0.5250 M HCl is required to titrate 17.50 mL of a NaOH solution. Determine the concentration of the NaOH solution.

*Solution:* Because we have a titration, we need the formula equation for the reaction:



$$\text{moles of acid: } 0.5250 \text{ mol/L} \times (15.32 \times 10^{-3} \text{ L}) = 8.043 \times 10^{-3} \text{ mol HCl}$$

$$8.043 \times 10^{-3} \text{ mol HCl reacts with } 8.043 \times 10^{-3} \text{ mol NaOH}$$

$$\text{concentration (molarity): } \frac{8.043 \times 10^{-3} \text{ mol NaOH}}{1.750 \times 10^{-2} \text{ L NaOH}} = 0.4596 \text{ mol/L}$$

### EXERCISES

- Determine the molarity of a solution containing 2.58 mol NaCl in 455 mL of solution.
- Determine the number of moles of KOH present in 95.0 mL of 0.255 M solution.
- 12.5 g of Na<sub>2</sub>CO<sub>3</sub> is dissolved in water to make 325 mL of solution. What is the concentration?



- D. What volume of 0.500 M  $\text{BaCl}_2$  will contain 16.2 g  $\text{BaCl}_2$ ?
- E. How many grams of  $\text{BaCl}_2$  will be required to prepare 185 mL of 0.675 M solution?
- F. Determine the concentration of the following solutions when mixed:
- 1) 150 mL 0.550 M  $\text{HCl}$  + 250 mL  $\text{H}_2\text{O}$
  - 2) 100 mL 0.500 M  $\text{HCl}$  + 100 mL 0.750 M  $\text{HCl}$
  - 3) 300 mL 0.500 M  $\text{HCl}$  + 200 mL 0.750 M  $\text{HCl}$
- G. What volume of concentrated  $\text{H}_2\text{SO}_4$  (18.0 M) is required to prepare 550 mL of 4.00 M  $\text{H}_2\text{SO}_4$  solution?
- H. How much water must be added to 625 mL of solution containing 27.2 g  $\text{H}_2\text{SO}_4$  to make the final solution 0.325 M?
- I. Consider the reaction:
- $$\text{BaCl}_2 + \text{K}_2\text{CrO}_4 \rightarrow \text{BaCrO}_4\downarrow + 2 \text{KCl}$$
- 1) How many grams of barium chromate can be obtained from 75.0 mL of 0.150 M  $\text{BaCl}_2$  solution?
  - 2) What volume of 0.500 M  $\text{K}_2\text{CrO}_4$  solution is required to react with the 75.0 mL of 0.150 M  $\text{BaCl}_2$  solution?
- J. 15.3 mL of 0.100 M  $\text{NaOH}$  is required to titrate 15.0 mL of a  $\text{HCl}$  solution. Determine the concentration of the  $\text{HCl}$  solution.
- K. What volume of 0.325 M  $\text{NaOH}$  is required to titrate 25.7 mL of 0.462 M  $\text{HCl}$ ?
- L. Consider the reaction:
- $$\text{H}_2\text{SO}_4 + 2 \text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O}$$
- 1) 15.2 mL of 0.425 M  $\text{NaOH}$  solution is required to neutralize 25.0 mL of  $\text{H}_2\text{SO}_4$ . Determine the concentration of the sulphuric acid solution.
  - 2) What volume of 0.425 M  $\text{NaOH}$  is required to neutralize 12.5 mL of 0.275 M  $\text{H}_2\text{SO}_4$ ?

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## SOLUTIONS

- A. 5.67 M B.  $2.42 \times 10^{-2}$  mol C. 0.363 M D. 156 mL E. 26.0 g  
 F. (1) 0.206 M (2) 0.625 M (3) 0.600 M G. 122 mL H. 228 mL  
 I. (1) 2.85 g (2) 22.5 mL J. 0.102 M K. 36.5 mL L. (1) 0.129 M (2) 16.2 mL

