

CHEMISTRY

First let's look at some solution molarity equations:

Remember from Practice I we discussed this example:

Suppose you had 29.22 grams of NaCl and you dissolved it in exactly enough water to make 2.00 L of solution. What would be the molarity of the solution?

The solution to this problem involved two steps:

Step One: convert grams to moles.

Step Two: divide moles by liters to get molarity.

Let's merge these ideas into the formation of a single equation containing four variables as follows:

$$\text{Equation \#1: } \text{moles} = \frac{\text{grams}}{\text{molar mass}}$$

$$\text{Equation \#2: } \text{molarity} = \frac{\text{moles}}{\text{volume(L)}}$$

Substituting for moles in Eq.#2, what a mole is equal to from Eq.#1 gives the following:

$$\text{Equation \#3: } \text{molarity} = \frac{\text{grams}}{(\text{molar mass})(\text{volume})}$$

Multiplying both sides of the Eq.#3 by

$$(\text{molar mass})(\text{volume}) \text{ gives}$$

Equation#4:

$$(\text{molarity})(\text{molar mass})(\text{volume}) = \text{grams}$$

MOLARITY (M) WORKSHEET II

Using some symbols in Eq. #4 gives this equation:

$$\text{Equation \#5: } (M)(GMM)(V) = \text{grams}$$

$$\begin{aligned} M &= (\text{molarity}) \text{ in moles/Liter} \\ GMM &= (\text{molecular mass}) \text{ in grams/mol} \\ V &= (\text{volume}) \text{ in Liters of solution} \\ \text{grams} &= (\text{mass of solute}) \text{ in grams} \end{aligned}$$

Examples:

1) When 2.00 grams of KMnO_4 (molec. wt = 158.0 g/mol) is dissolved into 100.0 mL of solution, what molarity results?

We are looking for M, molarity. We will solve Eq.#5 for M to give the following:

$$M = \frac{\text{grams}}{(GMM)(V)}$$

$$\begin{aligned} \text{grams} &= 2.00 \text{ g} \\ GMM &= 158 \text{ g/mol} \\ V &= 100 \text{ mL} = 0.100 \text{ L} \end{aligned}$$

$$\text{Therefore: } M = \frac{2.00 \text{ g}}{(158 \text{ g/mol})(0.100 \text{ L})}$$

$$\mathbf{M = 0.127 M}$$

2) How many grams of KMnO_4 are needed to make 500.0 mL of a 0.200 M solution?

$$\text{grams} = (M)(GMM)(V)$$

$$\begin{aligned} M &= 0.200 \text{ mol/L} \\ GMM &= 158 \text{ g/mol} \\ V &= 500.0 \text{ mL} = 0.500 \text{ L} \end{aligned}$$

$$\text{grams} = (0.200 \text{ mol/L})(158 \text{ g/mol})(0.500 \text{ L})$$

$$\mathbf{\text{grams} = 15.8 \text{ g KMnO}_4}$$

CHEMISTRY

PRACTICE PROBLEMS

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liters of solution}}$$
$$\text{grams} = (M)(GMM)(V)$$

1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?

2. What is the molarity of 245.0 g of H₂SO₄ dissolved in 1.00 L of solution?

3. What is the molarity of 5.30 g of Na₂CO₃ dissolved in 400.0 mL solution?

4. What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?

5. How many moles of Na₂CO₃ are there in 10.0 L of 2.0 M solution?

6. How many moles of Na₂CO₃ are in 10.0 mL of a 2.0 M solution?

7. How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?

8. What weight (in grams) of NaCl would be contained in problem 7?

9. What weight (in grams) of H₂SO₄ would be needed to make 750.0 mL of 2.00 M solution?

10. What volume (in mL) of 18.0 M H₂SO₄ is needed to contain 2.45 g H₂SO₄?

11. What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?

12. How many grams of Ca(OH)₂ are needed to make 100.0 mL of 0.250 M solution?

13. What is the molarity of a solution made by dissolving 20.0 g of H₃PO₄ in 50.0 mL of solution?

14. What weight (in grams) of KCl is there in 2.50 liters of 0.50 M KCl solution?

15. What is the molarity of a solution containing 12.0 g of NaOH in 250.0 mL of solution?

MOLARITY (M) WORKSHEET II

16. Determine the molarity of these solutions:

a) 4.67 moles of Li₂SO₃ dissolved to make 2.04 liters of solution.

b) 0.629 moles of Al₂O₃ to make 1.500 liters of solution.

c) 4.783 grams of Na₂CO₃ to make 10.00 liters of solution.

d) 0.897 grams of (NH₄)₂CO₃ to make 250 mL of solution.

e) 0.0348 grams of PbCl₂ to form 45.0 mL of solution.

17. Determine the number of moles of solute to prepare these solutions:

a) 2.35 liters of a 2.00 M Cu(NO₃)₂ solution.

b) 16.00 mL of a 0.415-molar Pb(NO₃)₂ solution.

c) 3.00 L of a 0.500 M MgCO₃ solution.

d) 6.20 L of a 3.76-molar Na₂O solution.

18. Determine the grams of solute to prepare these solutions:

a) 0.289 liters of a 0.00300 M Cu(NO₃)₂ solution.

b) 16.00 milliliters of a 5.90-molar Pb(NO₃)₂ solution.

c) 508 mL of a 2.75-molar NaF solution.

d) 6.20 L of a 3.76-molar Na₂O solution.

e) 0.500 L of a 1.00 M KCl solution.

f) 4.35 L of a 3.50 M CaCl₂ solution.

19. Determine the final volume of these solutions:

a) 4.67 moles of Li₂SO₃ dissolved to make a 3.89 M solution.

b) 4.907 moles of Al₂O₃ to make a 0.500 M solution.

c) 0.783 grams of Na₂CO₃ to make a 0.348 M solution.

d) 8.97 grams of (NH₄)₂CO₃ to make a 0.250-molar solution.

e) 48.00 grams of PbCl₂ to form a 5.0-molar solution.

20. 10.0 g of acetic acid (CH₃COOH) is dissolved in 500.0 mL of solution. What molarity results?

21. How many mL of solution will result when 15.0 g of H₂SO₄ is dissolved to make a 0.200 M solution?