

## Molarity Problems

Name \_\_\_\_\_

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

**Problem #2:** What is the molarity of 245.0 g of H<sub>2</sub>SO<sub>4</sub> dissolved in 1.000 L of solution?

**Problem #3:** What is the molarity of 5.30 g of Na<sub>2</sub>CO<sub>3</sub> dissolved in 400.0 mL solution?

**Problem #4:** What is the molarity of 5.00 g of NaOH in 750.0 mL of solution?

**Problem #5:** How many moles of Na<sub>2</sub>CO<sub>3</sub> are there in 10.0 L of 2.00 M solution?

**Problem #6:** How many moles of Na<sub>2</sub>CO<sub>3</sub> are in 10.0 mL of a 2.0 M solution?

**Problem #7:** How many moles of NaCl are contained in 100.0 mL of a 0.200 M solution?

**Problem #8:** What weight (in grams) of NaCl would be contained in problem #7?

**Problem #9:** What weight (in grams) of H<sub>2</sub>SO<sub>4</sub> would be needed to make 750.0 mL of 2.00 M solution?

**Problem #10:** What volume (in mL) of 18.0 M H<sub>2</sub>SO<sub>4</sub> is needed to contain 2.45 g H<sub>2</sub>SO<sub>4</sub>?

**Problem #11:** What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?

**Problem #12:** How many grams of Ca(OH)<sub>2</sub> are needed to make 100.0 mL of 0.250 M solution?

**Problem #13:** What is the molarity of a solution made by dissolving 20.0 g of H<sub>3</sub>PO<sub>4</sub> in 50.0 mL of solution?

**Problem #14:** What weight (in grams) of KCl is there in 2.50 liters of 0.500 M KCl solution?

**Problem #15:** What is the molarity of a solution containing 12.0 g of NaOH in 250.0 mL of solution?

**Problem #16:** Determine the molarity of these solutions:

- 4.67 moles of Li<sub>2</sub>SO<sub>3</sub> dissolved to make 2.04 liters of solution.
- 0.629 moles of Al<sub>2</sub>O<sub>3</sub> to make 1.500 liters of solution.
- 4.783 grams of Na<sub>2</sub>CO<sub>3</sub> to make 10.00 liters of solution.
- 0.897 grams of (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> to make 250 mL of solution.
- 0.0348 grams of PbCl<sub>2</sub> to form 45.0 mL of solution.

**Problem #17:** Determine the number of moles of solute to prepare these solutions:

- a) 2.35 liters of a 2.00 M  $\text{Cu}(\text{NO}_3)_2$  solution.
- b) 16.00 mL of a 0.415-molar  $\text{Pb}(\text{NO}_3)_2$  solution.
- c) 3.00 L of a 0.500 M  $\text{MgCO}_3$  solution.
- d) 6.20 L of a 3.76-molar  $\text{Na}_2\text{O}$  solution.

**Problem #18:** Determine the grams of solute to prepare these solutions:

- a) 0.289 liters of a 0.00300 M  $\text{Cu}(\text{NO}_3)_2$  solution.
- b) 16.00 milliliters of a 5.90-molar  $\text{Pb}(\text{NO}_3)_2$  solution.
- c) 508 mL of a 2.75-molar  $\text{NaF}$  solution.
- d) 6.20 L of a 3.76-molar  $\text{Na}_2\text{O}$  solution.
- e) 0.500 L of a 1.00 M  $\text{KCl}$  solution.
- f) 4.35 L of a 3.50 M  $\text{CaCl}_2$  solution.

**Problem #19:** Determine the final volume of these solutions:

- a) 4.67 moles of  $\text{Li}_2\text{SO}_3$  dissolved to make a 3.89 M solution.
- b) 4.907 moles of  $\text{Al}_2\text{O}_3$  to make a 0.500 M solution.
- c) 0.783 grams of  $\text{Na}_2\text{CO}_3$  to make a 0.348 M solution.
- d) 8.97 grams of  $(\text{NH}_4)_2\text{CO}_3$  to make a 0.250-molar solution.
- e) 48.00 grams of  $\text{PbCl}_2$  to form a 5.0-molar solution.

**Problem #20:** A student placed 11.0 g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) in a volumetric flask, added enough water to dissolve the glucose by swirling, then carefully added additional water until the 100. mL mark on the neck of the flask was reached. The flask was then shaken until the solution was uniform. A 20.0 mL sample of this glucose solution was diluted to 0.500L. How many grams of glucose are in 100. mL of the final solution?

**Problem #21:** Commercial bleach solution contains 5.25% (by mass) of  $\text{NaClO}$  in water. It has a density of 1.08 g/mL. Calculate the molarity of this solution. (Hints: assume you have 1.00 L of solution; molar mass of  $\text{NaClO}$  74.4 g/mol).

**Problem #22:** What is the molality (and molarity) of a 20.0% by mass hydrochloric acid solution? The density of the solution is 1.0980 g/mL.

**Problem #23:** 25.0 mL of 0.250 M  $\text{KI}$ , 25.0 mL of 0.100  $\text{K}_2\text{SO}_4$ , and 15.0 mL of 0.100 M  $\text{MgCl}_2$  were mixed together in a beaker. What are the molar concentrations of  $\text{I}^-$ ,  $\text{Cl}^-$  and  $\text{K}^+$  in the beaker?

**Problem #24:** Calculate the total concentration of all the ions in each of the following solutions:

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**Problem #25:** A solution of calcium bromide contains  $20.0 \text{ g dm}^{-3}$ . What is the molarity of the solution with respect to calcium bromide and bromine ions.

**Problem #26:** What is the concentration of each type of ion in solution after 23.69 mL of 3.611 M NaOH is added to 29.10 mL of 0.8921 M  $\text{H}_2\text{SO}_4$ ? Assume that the final volume is the sum of the original volumes.

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**Problem #27:** Given 3.50 mL of sulfuric acid (98.0% w/w) calculate the number of mmols in the solution (density: 1.840 g/mL).

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**Problem #28:** Given 8.00 g of HBr calculate the volume (mL) of a 48.0% (w/w) solution. (MW HBr: 80.9119 g/mol, density: 1.49 g/mL). Then, calculate the molarity.

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**Problem #29:** A solution is made by dissolving 0.100 mol of NaCl in 4.90 mol of water. What is the mass % of NaCl?

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**Problem #30:** 2.00 L of HCl gas (measured at STP) is dissolved in water to give a total volume of  $250. \text{ cm}^3$  of solution. What is the molarity of this solution?

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**Bonus Problem:** How many milliliters of concentrated hydrochloric acid solution (36.0% HCl by mass, density = 1.18 g/mL) are required to produce 18.0 L of a solution that has a pH of 2.01?