Molarity Homework #1 with answers

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?

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.

The equations I will use are:

\[
M = \text{moles of solute} / \text{liters of solution}
\]

and

\[
MV = \text{grams} / \text{molar mass}.
\]

Typically, the solution is for the molarity (M).

Note: Make sure you pay close attention to multiply and divide. For example, look at answer #8. Note that the 58.45 is in the denominator on the right side and in the final answer you will have 0.2 times 0.1 times 58.45.

1. (x) (1.00 L) = 28.0 g / 58.45 g mol⁻¹; x = 0.479 M  
2. (x) (1.00 L) = 245.0 g / 98.08 g mol⁻¹; x = 2.498 M  
3. (x) (0.4000 L) = 5.30 g / 106.0 g mol⁻¹; x = 0.125 M  
4. (x) (0.7500 L) = 5.00 g / 40.00 g mol⁻¹; x = 0.167 M
5. \(2.0 \, \text{M} = \frac{x}{10.0 \, \text{L}}\)
6. \(2.0 \, \text{M} = \frac{x}{0.0100 \, \text{L}}\)
7. \(0.20 \, \text{M} = \frac{x}{0.1000 \, \text{L}}\)
8. \((0.20 \, \text{mol L}^{-1}) (0.100 \, \text{L}) = \frac{x}{58.45 \, \text{g mol}^{-1}}\)
9. \((2.00 \, \text{mol L}^{-1}) (0.7500 \, \text{L}) = \frac{x}{98.08 \, \text{g mol}^{-1}}\)
10. \((18.0 \, \text{mol L}^{-1}) (x) = \frac{2.45 \, \text{g}}{98.08 \, \text{g mol}^{-1}}\)

This calculates the volume in liters. Multiplying the answer by 1000 provides the required mL value.

11. \(12.0 \, \text{M} = \frac{3.00 \, \text{mol}}{x}\)

This calculates the volume in liters. Multiplying the answer by 1000 provides the required mL value.

12. \((0.250 \, \text{mol L}^{-1}) (0.100 \, \text{L}) = \frac{x}{74.1 \, \text{g mol}^{-1}}\)
13. \((x) (0.050 \, \text{L}) = \frac{20.0 \, \text{g}}{97.99 \, \text{g mol}^{-1}}\)
14. \((0.50 \, \text{mol L}^{-1}) (2.50 \, \text{L}) = \frac{x}{74.55 \, \text{g mol}^{-1}}\)
15. \((x) (0.2500 \, \text{L}) = 12.0 \, \text{g} / 40.00 \, \text{g mol}^{-1}\)

16. Determine the molarity of these solutions:
   a) \(x = 4.67 \, \text{mol} / 2.04 \, \text{L}\)
   b) \(x = 0.629 \, \text{mol} / 1.500 \, \text{L}\)
   c) \((x) (10.00 \, \text{L}) = 4.783 \, \text{g} / 106.0 \, \text{g mol}^{-1}\)
   d) \((x) (0.250 \, \text{L}) = 0.897 \, \text{g} / 96.09 \, \text{g mol}^{-1}\)
   e) \((x) (0.0450 \, \text{L}) = 0.0348 \, \text{g} / 278.1 \, \text{g mol}^{-1}\)

17. Determine the number of moles of solute to prepare these solutions:
   a) \(x = (2.00 \, \text{mol L}^{-1}) (2.35 \, \text{L})\)
   b) \(x = (0.415 \, \text{mol L}^{-1}) (0.01600 \, \text{L})\)
   c) \(x = (0.500 \, \text{mol L}^{-1}) (3.00 \, \text{L})\)
   d) \(x = (3.76 \, \text{mol L}^{-1}) (6.20 \, \text{L})\)

18. Determine the grams of solute to prepare these solutions:
a) \((0.00300 \text{ mol L}^{-1}) \times (0.289 \text{ L}) = \frac{x}{187.56 \text{ g mol}^{-1}}\)
b) \((5.90 \text{ mol L}^{-1}) \times (0.01600 \text{ L}) = \frac{x}{331.2 \text{ g mol}^{-1}}\)
c) \((2.75 \text{ mol L}^{-1}) \times (0.508 \text{ L}) = \frac{x}{41.99 \text{ g mol}^{-1}}\)
d) \((3.76 \text{ mol L}^{-1}) \times (6.20 \text{ L}) = \frac{x}{61.98 \text{ g mol}^{-1}}\)
e) \((1.00 \text{ mol L}^{-1}) \times (0.500 \text{ L}) = \frac{x}{74.55 \text{ g mol}^{-1}}\)
f) \((3.50 \text{ mol L}^{-1}) \times (4.35 \text{ L}) = \frac{x}{110.99 \text{ g mol}^{-1}}\)

19. Determine the final volume of these solutions:

a) \(x = \frac{4.67 \text{ mol}}{3.89 \text{ mol L}^{-1}}\)
b) \(x = \frac{4.907 \text{ mol}}{0.500 \text{ mol L}^{-1}}\)
c) \((0.348 \text{ mol L}^{-1}) \times (x) = \frac{0.783 \text{ g}}{105.99 \text{ g mol}^{-1}}\)
d) \((0.250 \text{ mol L}^{-1}) \times (x) = \frac{8.97 \text{ g}}{96.01 \text{ g mol}^{-1}}\)
e) \((5.00 \text{ mol L}^{-1}) \times (x) = \frac{48.0 \text{ g}}{278.1 \text{ g mol}^{-1}}\)