Molarity – another mole concept

Molarity is a way of measuring how much solute is dissolved in a unit volume of solvent

= mol/L = M

Molarity = mol/dm^3

Eg. 25.0g of sodium hydroxide (NaOH) is dissolved in 2.00 dm^3 of water. What is the molarity of the solution?

conc. $C = \frac{n}{V}$ ← # mol / ← volume

NaOH – molar mass = 40.00g

$$25.0\,g \times \frac{1\,mol}{40.00\,g} = 0.625\,mol$$

$$\frac{0.625\,mol}{2.00\,dm^3} = 0.313\ mol/dm^3$$

What mass of NaCl is needed to make 250.0 mL of a solution with a concentration of 1.00 mol/dm^3?

$$\frac{1.00\,mol}{1\,dm^3} \times 0.2500\,dm^3 = 0.2500\,mol$$

molar mass = 58.44g

$$0.2500\,mol \times \frac{58.44\,g}{1\,mol} = 14.6\,g$$

A student is asked to prepare a 0.100 mol/dm^3 solution of $Ca(NO_3)_2$. If the student is provided with 25.0g of $Ca(NO_3)_2$, what volume of solution can he prepare?

$$25.0\,g\ Ca(NO_3)_2 \times \frac{1\,mol}{164.10\,g} = 0.1523\,mol$$

$$0.1523\,mol \times \frac{1\,dm^3}{0.100\,mol} = 1.52\,dm^3$$

1.52 dm^3

Molarity Worksheet #1

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 H_2SO_4 dissolved in 1.00 L of solution?

3. What is the molarity of 5.30 g of Na_2CO_3 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 Na_2CO_3 are there in 10.0 L of 2.0 M soluton?

6. How many moles of Na_2CO_3 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 H_2SO_4 would be needed to make 750.0 mL of 2.00 M solution?

10. What volume (in mL) of 18.0 M H_2SO_4 is needed to contain 2.45 g H_2SO_4?

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 H_3PO_4 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 Li_2SO_3 dissolved to make 2.04 liters of solution.
b) 0.629 moles of Al_2O_3 to make 1.500 liters of solution.
c) 4.783 grams of Na_2CO_3 to make 10.00 liters of solution.
d) 0.897 grams of $(NH_4)_2CO_3$ to make 250 mL of solution.
e) 0.0348 grams of $PbCl_2$ 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 $Cu(NO_3)_2$ solution.
b) 16.00 mL of a 0.415-molar $Pb(NO_3)_2$ solution.
c) 3.00 L of a 0.500 M $MgCO_3$ solution.
d) 6.20 L of a 3.76-molar Na_2O solution.

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

a) 0.289 liters of a 0.00300 M $Cu(NO_3)_2$ solution.
b) 16.00 milliliters of a 5.90-molar $Pb(NO_3)_2$ solution.
c) 508 mL of a 2.75-molar NaF solution.
d) 6.20 L of a 3.76-molar Na_2O solution.
e) 0.500 L of a 1.00 M KCl solution.
f) 4.35 L of a 3.50 M $CaCl_2$ solution.

19. Determine the final volume of these solutions:

a) 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution.
b) 4.907 moles of Al_2O_3 to make a 0.500 M solution.
c) 0.783 grams of Na_2CO_3 to make a 0.348 M solution.
d) 8.97 grams of $(NH_4)_2CO_3$ to make a 0.250-molar solution.
e) 48.00 grams of $PbCl_2$ to form a 5.0-molar solution

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 M = x / 10.0 L

6. 2.0 M = x / 0.0100 L

7. 0.20 M = x / 0.1000 L

8. (0.20 mol L^{-1}) (0.100 L) = x / 58.45 g mol^{-1}

9. (2.00 mol L^{-1}) (0.7500 L) = x / 98.08 g mol^{-1}

10. (18.0 mol L^{-1}) (x) = 2.45 g / 98.08 g mol^{-1}

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

11. 12.0 M = 3.00 mol / x

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

12. (0.250 mol L^{-1}) (0.100 L) = x / 74.1 g mol^{-1}

13. (x) (0.050 L) = 20.0 g / 97.99 g mol^{-1}

14. (0.50 mol L^{-1}) (2.50 L) = x / 74.55 g mol^{-1}

15. (x) (0.2500 L) = 12.0 g / 40.00 g mol^{-1}

16. Determine the molarity of these solutions:

a) x = 4.67 mol / 2.04 L
b) x = 0.629 mol / 1.500 L
c) (x) (10.00 L) = 4.783 g / 106.0 g mol^{-1}
d) (x) (0.250 L) = 0.897 g / 96.09 g mol^{-1}
e) (x) (0.0450 L) = 0.0348 g / 278.1 g mol^{-1}

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

a) x = (2.00 mol L^{-1}) (2.35 L)
b) x = (0.415 mol L^{-1}) (0.01600 L)
c) x = (0.500 mol L^{-1}) (3.00 L)
d) x = (3.76 mol L^{-1}) (6.20 L)

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

a) (0.00300 mol L^{-1}) (0.289 L) = x / 187.56 g mol^{-1}
b) (5.90 mol L^{-1}) (0.01600 L) = x / 331.2 g mol^{-1}
c) (2.75 mol L^{-1}) (0.508 L) = x / 41.99 g mol^{-1}
d) (3.76 mol L^{-1}) (6.20 L) = x / 61.98 g mol^{-1}
e) (1.00 mol L^{-1}) (0.500 L) = x / 74.55 g mol^{-1}
f) (3.50 mol L^{-1}) (4.35 L) = x / 110.99 g mol^{-1}

c) (0.348 mol L^{-1}) (x) = 0.783 g / 105.99 g mol^{-1}
d) (0.250 mol L^{-1}) (x) = 8.97 g / 96.01 g mol^{-1}
e) (5.00 mol L^{-1}) (x) = 48.0 g / 278.1 g mol^{-1}

19. Determine the final volume of these solutions:

a) x = 4.67 mol / 3.89 mol L^{-1}
b) x = 4.907 mol / 0.500 mol L^{-1}

REGULAR WORKSHEET 9c: Molarity

REMEMBER:

Show ALL working CLEARLY. A few words often help to explain the mass of numbers on the page
Molarity means concentration
Express all units carefully and think about significant figures
1cm^3 = 1 mL and 1000cm^3 = 1000mL = 1L = 1dm^3

1. Calculate the molarity when 5.0 grams of $SrCl_2$ is dissolved in 50.0 mL of water.
2. 230.0 grams of sucrose ($C_{12}H_{22}O_{11}$) is dissolved in 11.50 L of water. What is the molarity?
3. 4.8 grams of KBr is dissolved in enough water to make 5.00 L of solution. What is the molarity?
4. How many grams of $KMnO_4$ are needed to make 5.0 mL of a 0.400 M solution?
5. How many mL of solution will result when 1500.0 g of H_2SO_4 is dissolved to make a 1.2 M solution?