

## Mole Worksheet

1. How many moles of  $\text{MgCO}_3$  are in 10.0 g of the substance?

$$n = \frac{m}{mm} = \frac{10.0 \text{ g}}{84.32 \text{ g/mol}} = 0.119 \text{ mol}$$

2. What is the mass of 0.70 mol of  $\text{Al}_2\text{O}_3$ ?

$$m = n \times mm = 0.70 \text{ mol} \times 69.96 \text{ g/mol} = 49 \text{ g}$$

3. How many moles of  $\text{NaOH}$  are in 300.0 g of the substance?

$$n = \frac{m}{mm} = \frac{300.0 \text{ g}}{40.00 \text{ g/mol}} = 7.500 \text{ mol}$$

4. How many molecules are in 25 g of  $\text{Mg}(\text{NO}_3)_2$ ?

$$n = \frac{m}{mm} = \frac{25 \text{ g}}{148 \text{ g/mol}} = 0.1685443113 \text{ mol} \times 6.02 \times 10^{23} \text{ molec} = 1.0 \times 10^{23} \text{ molecules}$$

5. How would you prepare 2.4 L of 0.50 M solution of  $\text{LiH}$ ?

$$m = n \times mm$$

$$1.2 \text{ mol} \times 7.95 \text{ g/mol} = 9.5 \text{ g}$$

$$n = c \times v = 0.50 \text{ mol/L} \times 2.4 \text{ L} = 1.2 \text{ mol}$$

1. Weigh 9.5 g of  $\text{LiH}$ .
2. Put solute in volumetric flask
3. Add water & swirl
4. Add water to line
5. check mixtures

6. How many molecules are in 1.0 L of water?

$$n = \frac{m}{mm} = \frac{1000 \text{ g}}{18.02 \text{ g/mol}} = 55.49389567 \text{ mol} \times 6.02 \times 10^{23} = 3.3 \times 10^{25} \text{ molecules}$$

7. What volume of a 2.0 M solution of  $\text{Na}$  contains 13 g of solute?

$$n = \frac{m}{mm} = \frac{13 \text{ g}}{22.99 \text{ g/mol}} = 0.565463245 \text{ mol} = \frac{0.565463245 \text{ mol}}{2.0 \text{ mol/L}} = 0.28 \text{ L}$$

8. What volume of a 1.5 M solution of KOH contains 2.24 g of solute?

$$n = \frac{m}{mm} = \frac{2.24g}{56.11g/mol} = 0.039921583mol = \frac{1.5mol}{L} = 0.027L$$

9. What is the molar mass of PF<sub>3</sub>?

$$87.97g/mol$$

10. How many moles are in 400 g of H<sub>2</sub>O?

$$n = \frac{m}{mm} = \frac{400g}{18.02g/mol} = 20mol$$

11. How many hydrogen atoms are in 13 g of H<sub>2</sub>SO<sub>4</sub>?

$$n = \frac{m}{mm} = \frac{13g}{98.08g/mol} = 0.132531349mol \times 6.02 \times 10^{23} \times 2 = 1.6 \times 10^{23} \text{ H atoms}$$

12. There are 200 g / 500 mL of sucrose C<sub>12</sub>H<sub>22</sub>O<sub>11</sub> in a Coke can. What is the molar concentration of the drink?

$$\frac{200g}{0.5L} = \frac{x}{1L} \quad n = \frac{m}{mm} = \frac{400g}{330g/mol} = 1mol/L$$

13. What mass of solute must be used to prepare 350 mL of a HCl solution at a concentration of 0.75 mol/L?

$$m = n \times mm = 0.2625mol \times 36.46g/mol = 9.6g$$

$$\frac{0.75mol}{L} = \frac{x}{0.35L} = 0.2625mol$$

14. How many grams H<sub>2</sub>SO<sub>4</sub> are in 100 mL of a 0.3 M solution?

$$m = n \times mm = 0.03mol \times 98.09g/mol = 3g$$

$$\frac{0.3mol}{L} = \frac{x}{0.1L} = 0.03mol$$

15. How much HCH<sub>3</sub>CO<sub>2</sub> is required to make 500.0 mL of a 0.25 mol/L solution?

$$m = n \times mm = 0.125mol \times 60.06g/mol = 7.5g$$

$$n = C \times V = \frac{0.25mol}{L} \times 0.5000L = 0.125mol$$

16. Which of the following solutions has the lowest g/L concentration?

Solution 1- 1.5 moles of NaCl in 1.5 litres of solution

Solution 2- 4.4 moles of  $Al_2O_3$  in 30 mL of solution

Solution 3- 5.2 moles of NaF in 5.5 litres of solution

$$m = n \times mm$$

$\frac{1.5 \text{ mol} \times 58.44 \text{ g/mol}}{1.5 \text{ L}} = 58 \text{ g/L}$	$\frac{4.4 \text{ mol} \times 101.96 \text{ g/mol}}{0.03 \text{ L}} = 10000 \text{ g/L}$	$\frac{5.2 \text{ mol} \times 41.99 \text{ g/mol}}{5.5 \text{ L}} = 40 \text{ g/L}$
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17. How many moles of  $CaCO_3$  are in 4.0 L of a 1.5 M solution?

$$\frac{1.5 \text{ mol}}{1 \text{ L}} = \frac{x}{4.0 \text{ L}} = 6.0 \text{ mol}$$

18. Explain the procedure used to prepare 5.9 L of a 3.5 M solution of  $ZnSO_4$ ?

$$m = n \times mm$$

$\frac{3.5 \text{ mol} \times 161.46 \text{ g/mol}}{3.3 \times 10^3}$	$n = CV$ $\frac{3.5 \text{ mol} \times 5.9 \text{ L}}{1} = 20.65 \text{ mol}$	<p>5 steps</p>
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19. How many molecules are in 10 g of  $CaCl_2$ ?

$$n = \frac{m}{mm} = \frac{10 \text{ g}}{110.98 \text{ g/mol}} = 0.090106325 \text{ mol} \times 6.02 \times 10^{23} = 5 \times 10^{22} \text{ molecules}$$

20. There are 5 g / 1 L of salt KBr in a Gatorade drink. What is the molar concentration of the drink?

$$\frac{5 \text{ g}}{1 \text{ L}} = \frac{x}{1 \text{ L}} = 5 \text{ g/L}$$

$$n = \frac{m}{mm} = \frac{5 \text{ g}}{119.00 \text{ g/mol}} = 0.04 \text{ mol/L}$$

21. How many molecules are in 40.0 g of LiBr?

$$n = \frac{m}{mm} = \frac{40.00 \text{ g}}{86.84 \text{ g/mol}} = 0.460617227 \text{ mol} \times 6.02 \times 10^{23} \text{ molecules} = 2.77 \times 10^{23} \text{ molecules}$$

22. How many moles and molecules are in 10.0 g of  $\text{CaCO}_3$ ?

$$n = \frac{m}{m_m} = \frac{10.0 \text{ g}}{100.09 \text{ g/mol}} = 0.0999 \text{ mol} \times 6.02 \times 10^{23} \text{ molecules} = 6.01 \times 10^{22} \text{ molecules}$$

23. What mass of NaCl must be used in order to make 100.0 mL of a 0.2 M solution?

$$m = n \times m_m = 0.02 \text{ mol} \times 58.44 \text{ g/mol} = 1.17 \text{ g} \approx 1 \text{ g}$$

$$\frac{0.2 \text{ mol}}{\text{L}} = \frac{x}{0.1000 \text{ L}} = 0.02 \text{ mol}$$

24. How many chlorine atoms are in 14 g of NaCl?

$$n = \frac{m}{m_m} = \frac{14 \text{ g}}{58.44 \text{ g/mol}} = 0.239561944 \text{ mol} \times 6.02 \times 10^{23} \text{ molecules} \times 1 \text{ Cl atom} = 1.4 \times 10^{23} \text{ Cl atoms}$$

25. Calculate the mass of  $\text{NH}_3\text{OH}$  in 200.0 mL of a 0.40 M solution.

$$m = n \times m_m = 0.08 \text{ mol} \times 34.05 \text{ g/mol} = 2.72 \text{ g} \approx 2.7 \text{ g}$$

$$n = C \times V = 0.40 \text{ mol/L} \times 0.2000 \text{ L} = 0.08 \text{ mol}$$

26. Calculate the molarity of a solution by dissolving 100.0 g of KBr in water to make a 2.0 L solution.

$$n = \frac{m}{m_m} = \frac{100.0 \text{ g}}{119.00 \text{ g/mol}} = 0.840336134 \text{ mol} = 0.42 \text{ mol/L}$$

27. What volume of a 2.5 mol/L solution of  $\text{PCl}_3$  contains 7.0 g of solute?

$$n = \frac{m}{m_m} = \frac{7.0 \text{ g}}{137.32 \text{ g/mol}} = 0.050975832 \text{ mol} = \frac{2.5 \text{ mol}}{\text{L}} = 0.020 \text{ L}$$

28. How much potassium iodide is needed to make 250 mL of a 0.25 mol/L solution?

$$m = n \times m_m = 0.0625 \text{ mol} \times 166 \text{ g/mol} = 10.375 \text{ g} \approx 10 \text{ g}$$

$$\frac{0.25 \text{ mol}}{\text{L}} = \frac{x}{0.25 \text{ L}} = 0.0625 \text{ mol}$$

29. There are 10 g / 2 L of salt NaCl in a Gatorade drink. What is the molar concentration of the drink?

$$\frac{10 \text{ g}}{2 \text{ L}} = \frac{x}{1 \text{ L}} = 5 \text{ g}$$

$$n = \frac{m}{m_m} = \frac{5 \text{ g}}{58.44 \text{ g/mol}} = 0.085 \text{ mol/L} \approx 0.09 \text{ mol/L}$$

30. What volume of a 7.0 mol/L solution of H<sub>2</sub>O contains 18 g of solute?

$$n = \frac{m}{mm} \quad \frac{18g}{18.02g/mol} = \frac{998890122 \text{ mol}}{x} = \frac{7 \text{ mol}}{L} = 0.14L$$

31. How many molecules are in 3.0 g of NaCl?

$$n = \frac{m}{mm} \quad \frac{3.0g}{58.44g/mol} = 0.051334702 \text{ mol} \times 6.02 \times 10^{23} \text{ molec} = 3.1 \times 10^{22} \text{ molec}$$

32. Which of the following solutions has the highest g/L concentration?

Solution 1- 3.5 moles of Br in 2.1 litres of solution

Solution 2- 1.0 moles of NaOH in 3 litres of solution

Solution 3- 5.6 moles of HCl in 5 litres of solution

$$m = n \times mm$$

$$3.5 \text{ mol} \times 159.80 \text{ g/mol} = 559.30g$$

$$\frac{559.30g}{2.1L} = 270g/L$$

$$1.0 \text{ mol} \times 40.00 \text{ g/mol} = 40g$$

$$\frac{40g}{3L} = 10g/L$$

$$5.6 \text{ mol} \times 36.46 \text{ g/mol} = 204.176g$$

$$\frac{204.176g}{5L} = 40g/L$$

33. How many molecules are in 36 g of NaCl?

$$n = \frac{m}{mm} \quad \frac{36g}{58.44g/mol} = 0.616016427 \times 6.02 \times 10^{23} \text{ molec} = 3.7 \times 10^{23} \text{ molec}$$

34. Aspartame is an artificial sweetener that is 160 times sweeter than sucrose. Its molecular formula is C<sub>14</sub>H<sub>18</sub>N<sub>2</sub>O<sub>5</sub>.

a- Calculate the molecular weight of aspartame.

$$294.34 \text{ g/mol}$$

b- How many moles of the molecule are in 10 g of aspartame?

$$n = \frac{m}{mm} \quad \frac{10g}{294.34g/mol} = 0.03 \text{ mol}$$

c- What is the mass in grams of 1.56 mol of aspartame?

d- How many molecules are in 5.0 mg of aspartame?

$$m = n \times mm$$

$$1.56 \text{ mol} \times 294.36 \text{ g/mol} = 459g$$

$$n = \frac{m}{mm} \quad \frac{0.0050g}{294.34g/mol} = 0.000016987 \text{ mol} \times 6.02 \times 10^{23} \text{ molec} = 1.0 \times 10^{19} \text{ molec}$$

e- How many atoms of nitrogen are in 1.2 g of aspartame?

$$n = \frac{m}{mm} = \frac{1.2g}{294.34g/mol} = 0.004076918 \text{ mol} \times 6.02 \times 10^{23} \times 2 = 4.9 \times 10^{21} \text{ N atoms}$$

35. The molecular formula of acetylsalicylic acid (aspirin) is  $C_9H_8O_4$ .

a- Calculate the molar mass of aspirin.

$$180.17 \text{ g/mol}$$

b- A typical aspirin contains 500 mg of  $C_9H_8O_4$ . How many moles of  $C_9H_8O_4$  and molecules of aspirin are in a 500 mg tablet?

$$n = \frac{m}{mm} = \frac{0.5g}{180.17g/mol} = 0.002775157 \text{ mol} \times 6.02 \times 10^{23} \text{ molecules} = 2 \times 10^{21} \text{ molecules}$$

36. Calculate the molarity of a solution prepared by bubbling 11.5 g of solid NaOH in enough water to make 1.5 L of solution.

$$n = \frac{m}{mm} = \frac{11.5g}{40.00g/mol} = 0.2875 \text{ mol} \div 1.5L = 0.19 \text{ mol/L}$$

37. Typical blood serum is about 0.14 M NaCl. What volume of blood contains 1.0 mg of NaCl?

$$n = \frac{m}{mm} = \frac{0.0010g}{58.44g/mol} = 0.000017112 \text{ mol} \div 0.14 \frac{\text{mol}}{L} = 0.00012 \text{ L} = 1.2 \times 10^{-4} \text{ L}$$

38. How many molecules are in 2.0 g of  $CCl_4$ ?

$$n = \frac{m}{mm} = \frac{2.0g}{153.81g/mol} = 0.013003056 \text{ mol} \times 6.02 \times 10^{23} \text{ molec} = 7.8 \times 10^{21} \text{ molecules}$$

39. To analyze the alcohol content of a certain wine, a chemist needs 1.0 L of aqueous 0.20 M  $K_2Cr_2O_7$  (potassium dichromate) solution. How much solid  $K_2Cr_2O_7$  must be weighed out to make this solution?

$$m = n \times mm = 0.20 \text{ mol} \times 294.2 \text{ g/mol} = 59 \text{ g}$$

$$n = CV = \frac{0.20 \text{ mol}}{1} \times 1.0 \text{ L} = 0.20 \text{ mol}$$