KEY

Molarity Problems

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

$\frac{28.0\ g\ NaCl}{1\ L} \times \frac{1\ mol\ NaCl}{58\ g\ NaCl} = 0.48\ M$

NOT IN ORDER

2. What is the molarity of 245.0 g of H_2SO_4 dissolved in 1.00 L of solution?

$\frac{245\ g\ H_2SO_4}{1\ L} \times \frac{1\ mol\ H_2SO_4}{98\ g\ H_2SO_4} = 2.5\ M$

3. What is the molarity of 5.30 g of Na_2CO_3 dissolved in 400.0 mL solution?

$\frac{5.30\ g\ Na_2CO_3}{1} \times \frac{1\ mol\ Na_2CO_3}{106\ g\ Na_2CO_3} = \frac{0.05\ mol}{.400\ L} = 0.125\ M$

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

$\frac{5.00\ g\ NaOH}{1} \times \frac{1\ mol\ NaOH}{37\ g\ NaOH} = \frac{.135\ mol}{.750\ L} = 0.18\ M$

5. How many moles of Na_2CO_3 are there in 10.0 L of 2.0 M soluton?

$\frac{2.0\ mol}{L} \times \frac{10.0\ L}{1} = 20\ mol\ Na_2CO_3$

6. How many moles of Na_2CO_3 are in 10.0 mL of a 2.0 M solution?

$\frac{2.0\ mol}{L} \times \frac{.01\ L}{1} = 0.02\ mol\ Na_2CO_3$

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

$\frac{.20\ mol}{L} \times \frac{.100\ L}{1} = 0.02\ mole\ NaCl$

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

$\frac{.02\ mol\ NaCl}{1} \times \frac{58\ g\ NaCl}{1\ mol\ NaCl} = 1.16\ g\ NaCl$

9. What weight (in grams) of H_2SO_4 would be needed to make 750.0 mL of 2.00 M solution?

$\frac{2.00\ mol\ H_2SO_4}{L} \times \frac{.750\ L}{1} \times \frac{98\ g\ H_2SO_4}{1\ mol\ H_2SO_4} = 147\ g\ H_2SO_4$

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

$\frac{2.45\ g\ H_2SO_4}{1} \times \frac{1\ mol\ H_2SO_4}{98\ g\ H_2SO_4} \times \frac{1\ L}{18\ mol\ H_2SO_4} \times \frac{1000\ mL}{1\ L} = 1.39\ mL$

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

$\frac{3.00\ mol\ HCl}{1} \times \frac{1\ L\ HCl}{12\ mol\ HCl} \times \frac{1000\ mL\ HCl}{1\ L\ HCl} = 250\ mL\ HCl$

12. How many grams of $Ca(OH)_2$ are needed to make 100.0 mL of 0.250 M solution?

$\frac{.250\ mol\ Ca(OH)_2}{1\ L} \times \frac{.100\ L}{1} \times \frac{74\ g\ Ca(OH)_2}{1\ mol\ Ca(OH)_2} = 1.85\ g\ Ca(OH)_2$

H = 28
8
1
x12 = 12
3x16 = 48

13. What is the molarity of a solution made by dissolving 20.0 g of H_3PO_4 in 50.0 mL of solution?

$\frac{20.0\ g\ H_3PO_4}{1} \times \frac{1\ mol\ H_3PO_4}{98\ g\ H_3PO_4} = \frac{.204\ mol}{.050\ L} =$ **4.08 M H_3PO_4**

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

$\frac{.50\ mol\ KCl}{L} \times \frac{2.50\ L}{1} \times \frac{74\ g\ KCl}{1\ mol\ KCl} =$ **92.5 g KCl**

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

$\frac{12.0\ g\ NaOH}{1} \times \frac{1\ mol\ NaOH}{31\ g\ NaOH} = \frac{.387\ mol}{.250\ L} =$ **1.55 M NaOH**

16. Determine the molarity of these solutions:

a) 4.67 moles of Li_2SO_3 dissolved to make 2.04 liters of solution.

$\frac{4.67\ mol\ Li_2SO_3}{2.04\ L} =$ **2.29 M**

b) 0.629 moles of Al_2O_3 to make 1.500 liters of solution.

$\frac{.629\ mol\ Al_2O_3}{1.5\ L} =$ **0.419 M**

c) 4.783 grams of Na_2CO_3 to make 10.00 liters of solution.

$\frac{4.783\ g\ Na_2CO_3}{1} \times \frac{1\ mol\ Na_2CO_3}{106\ g\ Na_2CO_3} = \frac{.0451\ mol}{10\ L} =$ **.0045 M Na_2CO_3**

d) 0.897 grams of $(NH_4)_2CO_3$ to make 250 mL of solution.

$\frac{.897\ g\ (NH_4)_2CO_3}{1} \times \frac{1\ mol\ (NH_4)_2CO_3}{96\ g\ (NH_4)_2CO_3} = \frac{.009343\ mol}{.250\ L} =$ **0.037 M $(NH_4)_2CO_3$**

e) 0.0348 grams of $PbCl_2$ to form 45.0 mL of solution.

$\frac{.0348\ g\ PbCl_2}{1} \times \frac{1\ mol\ PbCl_2}{278\ g\ PbCl_2} = \frac{.000134\ mol\ PbCl_2}{0.045\ L} =$ **.00299 M $PbCl_2$**

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.

$\frac{2.35\ L}{1} \times \frac{2.00\ mol}{1\ L} =$ **4.7 mol $Cu(NO_3)_2$**

b) 16.00 mL of a 0.415-molar $Pb(NO_3)_2$ solution.

$\frac{.415\ mol}{L} \times \frac{.016\ L}{1} =$ **.00664 mol $Pb(NO_3)_2$**

c) 3.00 L of a 0.500 M $MgCO_3$ solution.

$\frac{.500\ mol}{1L} \times \frac{3.00\ L}{1} =$ **1.50 mol $MgCO_3$**

d) 6.20 L of a 3.76-molar Na_2O solution.

$\frac{3.76\ mol\ Na_2O}{1L} \times \frac{6.20\ L}{1} =$ **23.312 mol Na_2O**

6 x 16 = 96
2 x 14 = 28
63

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

a) 0.289 liters of a 0.00300 M $Cu(NO_3)_2$ solution.

$$\frac{.00300 \text{ mol } Cu(NO_3)_2}{1\text{ L}} \times \frac{.289\text{ L}}{1} \times \frac{187\text{ g } Cu(NO_3)_2}{1 \text{ mol } Cu(NO_3)_2} = 0.162\text{ g } Cu(NO_3)_2$$

b) 16.00 milliliters of a 5.90-molar $Pb(NO_3)_2$ solution.

$$\frac{5.90 \text{ mol } Pb(NO_3)_2}{1\text{ L}} \times \frac{.016\text{ L}}{1} \times \frac{331\text{ g } Pb(NO_3)_2}{1 \text{ mol } Pb(NO_3)_2} = 31.25\text{ g } Pb(NO_3)_2$$

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

$$\frac{2.75 \text{ mol NaF}}{1\text{ L}} \times \frac{.508\text{ L}}{1} \times \frac{42\text{ g NaF}}{1 \text{ mol NaF}} = 58.7\text{ g NaF}$$

d) 6.20 L of a 3.76-molar Na_2O solution.

$$\frac{3.76 \text{ mol } Na_2O}{1\text{ L}} \times \frac{6.20\text{ L}}{1} \times \frac{62\text{ g } Na_2O}{1 \text{ mol } Na_2O} = 1445\text{ g } Na_2O$$

e) 0.500 L of a 1.00 M KCl solution.

$$\frac{1.00 \text{ mol KCl}}{1\text{ L}} \times \frac{.500\text{ L}}{1} = 0.500 \text{ mol KCl} \times \frac{74\text{ g KCl}}{1 \text{ mol KCl}} = 37\text{ g KCl}$$

f) 4.35 L of a 3.50 M $CaCl_2$ solution.

$$\frac{3.5 \text{ mol } CaCl_2}{1\text{ L}} \times \frac{4.35\text{ L}}{1} \times \frac{111\text{ g } CaCl_2}{1 \text{ mol } CaCl_2} = 1690\text{ g } CaCl_2$$

19. Determine the final volume of these solutions:

a) 4.67 moles of Li_2SO_3 dissolved to make a 3.89 M solution.

$$4.67 \text{ mol } Li_2SO_3 \times \frac{1\text{ L}}{3.89 \text{ mol } Li_2SO_3} = 1.20\text{ L}$$

b) 4.907 moles of Al_2O_3 to make a 0.500 M solution.

$$4.907 \text{ mol } Al_2O_3 \times \frac{1\text{ L}}{.500 \text{ mol}} = 9.814\text{ L}$$

c) 0.783 grams of Na_2CO_3 to make a 0.348 M solution.

$$.783\text{ g } Na_2CO_3 \times \frac{1 \text{ mol } Na_2CO_3}{106\text{ g } Na_2CO_3} \times \frac{1\text{ L}}{.348 \text{ mol}} = 0.0212\text{ L}$$

d) 8.97 grams of $(NH_4)_2CO_3$ to make a 0.250-molar solution.

$$8.97\text{ g } (NH_4)_2CO_3 \times \frac{1 \text{ mol } (NH_4)_2CO_3}{96\text{ g } (NH_4)_2CO_3} \times \frac{1\text{ L}}{.250 \text{ mol}} = 0.374\text{ L}$$

e) 48.00 grams of $PbCl_2$ to form a 5.0-molar solution.

$$48.00\text{ g } PbCl_2 \times \frac{1 \text{ mol } PbCl_2}{278\text{ g } PbCl_2} \times \frac{1\text{ L}}{5.0 \text{ mol}} = 0.0345\text{ L}$$