Answer key

$M = \frac{mol}{L}$

Molarity Practice Problems:

1) How many grams of NaCl must you add to 500 mL of water to make a 2.0 M solution?

$M = \frac{mol}{L}$

$mol = M \cdot L = (2\ M)(.5\ L) = 1\ mol$

$\frac{1\ mol\ NaCl}{1} \left| \frac{58.44\ g\ NaCl}{1\ mol\ NaCl} \right. = \boxed{58.44\ g\ NaCl}$

2) How many moles of HCl are in 250 mL of 5.0 M HCl?

$mol = M \cdot L = (5.0\ M)(.250\ L) = \boxed{1.25\ mol\ HCl}$

3) You need 2 moles of $CuSO_4$ for a reaction. You have a solution that is 0.1 M. How many liters must you add?

$L(M) = \left(\frac{mol}{L}\right)L$

$\frac{mol}{M} = \frac{L \cdot M}{M}$

$L = \frac{mol}{M} = \frac{2\ mol}{0.1\ M} = \boxed{20\ L}$

4) You have a 6.0M solution of HCl, but for an experiment you need to make 2.0L of a 0.5M solution. How many ml of the 6M solution will you use?

$V_2 = \frac{M_1 V_1}{M_2} = \frac{(.5\ M)(2.0\ L)}{6.0\ M} = 0.167\ L \rightarrow \boxed{167\ mL}$

5) If you add 15.0 g of NaBr to make a 1.5 L solution, what is the molarity?

$\frac{15\ g\ NaBr}{1} \left| \frac{1\ mol\ NaBr}{102.89\ g\ NaBr} \right. = 0.146\ mol\ NaBr$

$M = \frac{0.146\ mol}{1.5\ L} = \boxed{0.097\ M}$

6) 450 mL of a solution contains 1.5 moles of solute. What is the molarity?

0.45 L

$M = \frac{mol}{L} = \frac{1.5\ mol}{0.45\ L} = \boxed{3.3\ M}$

7) How many grams of $AgNO_3$ do you need to make 500 mL of a 0.100 M solution?

.5 L

$mol = M \cdot L = (0.1\ M)(.5\ L) = .05\ mol$

$AgNO_3 = 169.88\ g/mol$

$\frac{.05\ mol\ AgNO_3}{1} \left| \frac{169.88\ g\ AgNO_3}{1\ mol\ AgNO_3} \right. = \boxed{8.49\ g\ AgNO_3}$

8) You made 500ml of a 2.5M solution of NaCl for an experiment and left it in the fume hood overnight. In the morning due to evaporation there is only 450ml left. What is the new concentration?

$M_2 = \frac{M_1 V_1}{V_2} = \frac{(2.5\ M)(500\ mL)}{450\ mL} = \boxed{2.78\ M}$

9) How many grams of lithium phosphate (Li_3PO_4) are needed to make 3.0 L of a 0.25 M solution?

$M = \frac{mol}{L}$

$mol = M \cdot L = (0.25\ M)(3.0\ L) = 0.75\ mol\ Li_3PO_4$

$\frac{0.75\ mol\ Li_3PO_4}{1} \left| \frac{115.79\ g\ Li_3PO_4}{1\ mol\ Li_3PO_4} \right. = \boxed{86.84\ g\ Li_3PO_4}$

10) If 45.0 g of barium chloride($BaCl_2$) is added to 450 mL of solution, what is the molarity?

→ .45 L

$$\frac{45\text{ g } BaCl_2}{1}\left|\frac{1\text{ mol } BaCl_2}{208.23\text{ g } BaCl_2}\right. = 0.216\text{ mol } BaCl_2$$

$$M = \frac{\text{mol}}{L} = \frac{0.216\text{ mol}}{0.45\text{ L}} = \boxed{0.48\text{ M}}$$

11) How many liters of solution will contain 35.0 g of calcium sulfate ($CaSO_4$) if the molarity is 1.5 M?

? → 35 g → mol

$$\frac{35\text{ g } CaSO_4}{1}\left|\frac{1\text{ mol } CaSO_4}{136.15\text{ g } CaSO_4}\right. = 0.257\text{ mol } CaSO_4$$

$$L = \frac{\text{mol}}{M} = \frac{0.257\text{ mol}}{1.5\text{ M}} = \boxed{0.171\text{ L}}$$

12) A 4.0M solution must be diluted to make a 1.0M solution with a volume of 0.8L. How many ml should you start with?

$$V_2 = \frac{M_1 V_1}{M_2} = \frac{(1.0\text{ M})(0.8\text{ L})}{4\text{ M}} = 0.2\text{ L} = \boxed{200\text{ mL}}$$

13) If you need make 1.5 L of a 2.5 M solution of sodium hydroxide (NaOH), how many grams must you weigh out?

$$\text{mol} = M \cdot L = (2.5\text{ M})(1.5\text{ L}) = 3.75\text{ mol}\left|\frac{40\text{ g NaOH}}{1\text{ mol NaOH}}\right. = \boxed{150\text{ g NaOH}}$$

14) How many moles of nitrogen disulfide (NS_2) are found in 300 mL of a 2.0 M solution?

.3 L

$$\text{mol} = M \cdot L = (2\text{ M})(.3\text{ L}) = \boxed{0.6\text{ mol } NS_2}$$

15) What is the molarity of a solution made with 15.5 g of beryllium fluoride (BeF_2) and 250 mL of water?

.25 L

$$\frac{15.5\text{ g } BeF_2}{1}\left|\frac{1\text{ mol } BeF_2}{47.01\text{ g } BeF_2}\right. = 0.33\text{ mol } BeF_2$$

$$M = \frac{0.33\text{ mol}}{0.25\text{ L}} = \boxed{1.32\text{ M}}$$

Bonus – You (the teacher) must make several solutions of different concentrations for a lab. You open a new bottle of a solid $CaCl_2$. You need to make 2.0L of a 1M stock solution that you will use to make serial dilutions of 1.0M, 0.8M, 0.6M, 0.4M and 0.2M. You need 200ml of each dilution.

a- How many grams of $CaCl_2$ will you measure out for the stock solution

b- How many ml of the stock solution will you need for each dilution (5 different answers for the 5 dilutions)?