Unit 13 Acids & Bases
Molar Solubility & Dilutions

Name ______________________
Block _____

Molar Solubility & Molarity

$$\textbf{Moles} = \frac{\textbf{given mass of compound}}{\textbf{molar mass of compound}} \qquad \textbf{Liters} = \frac{\textbf{milliliters}}{\textbf{1000}} \qquad \textbf{Molarity} = \frac{\textbf{moles}}{\textbf{lliters}}$$

1. What is the molarity of a solution in which 58 g of NaCl is dissolved in 500 ml of solution?

$$moles = \frac{58\ g}{58.5\ g} = 0.99\ moles \qquad Liters = \frac{500\ ml}{1000\ ml} = 0.500\ L \qquad \textbf{Molarity} = \frac{0.99\ moles}{0.500\ L} = \textbf{1.98 M NaOH}$$

2. Calculate the number of moles of sodium hydroxide in 2.50 L of 0.100 M NaOH.

$$\frac{0.100\ Molarity}{1} = \frac{\textbf{X moles}}{2.50\ Liters}$$

Cross multiply and divide. **X = 0.25 moles NaOH**

3. How many grams of KNO_3 should be used to prepare 2.00 L of 0.500 M solution?

$$\frac{0.500\ Molarity}{1} = \frac{\textbf{X moles}}{2.00\ Liters}$$

X = 1 mole

$$\frac{1\ \text{mole}}{1} = \frac{\textbf{Y grams}}{101\ g/mole}$$

molar mass of KNO_3 is
K 1 x 39 = 39
N 1 x 14 = 14
O 3 x 16 = 48
Molar Mass = 101 g/mol

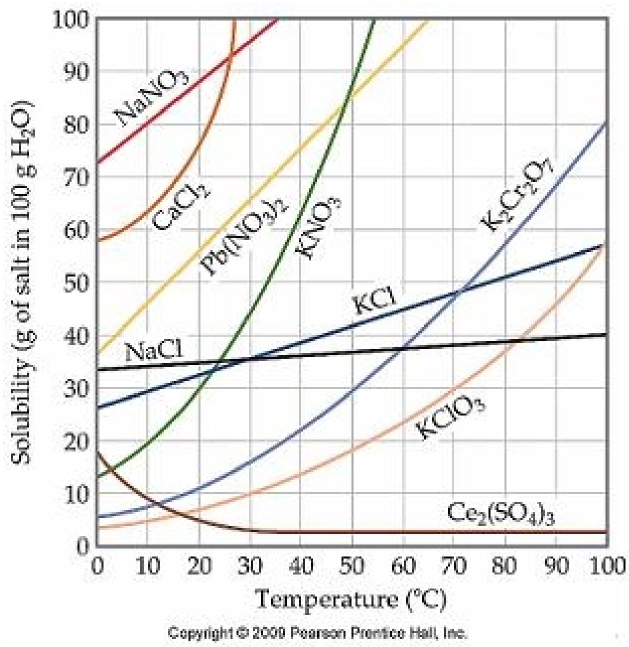
Y = **101 grams KNO_3**

4. How many liters of water should be added to 0.50 moles $MgSO_4$ to prepare a 0.500 M solution?

$$\frac{0.500\ Molarity}{1} = \frac{\textbf{0.50 moles}}{X\ Liters}$$

X = 1 Liter

5. Which is the more soluble at 50 ^{o}C, KNO_3 or $KClO_3$? KNO_3 because it can dissolve more than 80 g at 50 ^{o}C, while $KClO_3$ can only dissolve less than 20 grams.



6. Which substance's solubility is the least affected by temperature? NaCl because the line stays flat all the way across. Also, note that the line for $Ce_2(SO_4)_3$ starts out curved, so it is affected by low temperature.

7. At what temperature will 75 g of $Pb(NO_3)_2$ dissolve in 100 g H_2O? Imagine a line going from 75 grams on the y-axis across until it touches the yellow $Pb(NO_3)_2$ line. When you find the point of intersection, follow it down to the x-axis. This is the corresponding temperature of 40 ^{o}C.

8. If 90 g $NaNO_3$ dissolved in 100 g H_2O at 30 ^{o}C, would the solution be classified as unsaturated, saturated, or super-saturated. Because the point of intersection, where 90 grams meets 30 ^{o}C, is below the line for $NaNO_3$, this solution would be *unsaturated*.

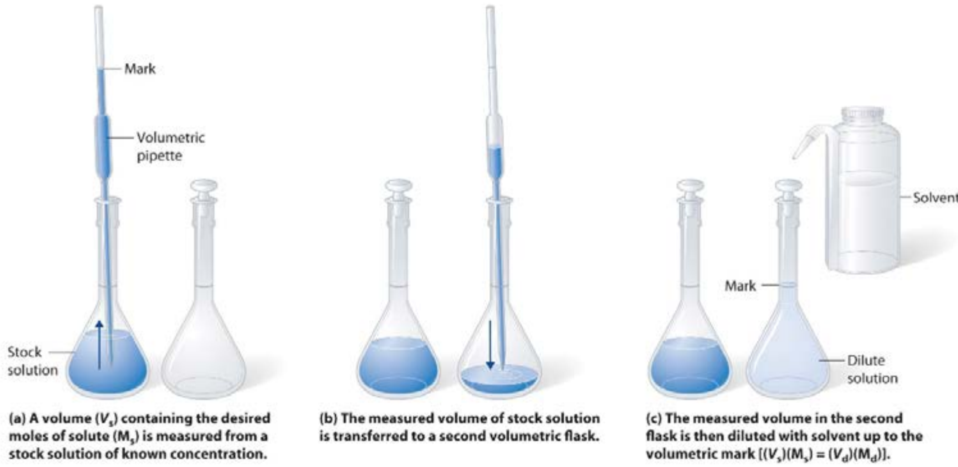
   UNsaturated means the point will be **UNDER** the line. This occurs when you haven't reached the maximum about of salt that can dissolve at that temperature.

   SATurated means the point **SAT** on the line because you **SAT**ISFIED the requirements and dissolved as much as possible for the given temperature.

   SUPERsaturated means the point is flying above the line like **SUPER**man. This means that you have super powers and you were able to get more to dissolve than is usually possible for the given temperature.

Scroll down for Volumetric Dilution answers…

Preparing Volumetric Dilutions



$$\textit{Molarity of Stock} \times \textit{Volume of Stock} = \textit{Molarity of Dilution} \times \textit{Volume of Dilution}$$

$$\textit{Strong side} \rightarrow \quad M_1V_1 = M_2V_2 \quad \leftarrow \textit{Weak side}$$

1. What volume of concentrated **12 M H_2SO_4** is needed to prepare **250 mL of a 6.0 M solution**?

$$(12\ M)\ (X\ )\ =\ (250\ ml)\ (6.0\ M)$$

$$X = \frac{(250\ ml)\ (6.0\ M)}{12\ M} = \mathbf{125\ ml}$$

This means you would measure out 125 ml of the strong concentration and add it to the 250 ml flask, then dilute it with water to the mark. Put on lid and shake to get 6.0 Molar solution.

2. What is the concentration of acid, if 17 ml HCl is required to prepare 100 mL of a 2.0 M solution?

$$(X)\ (17\ ml\ )\ =\ (100\ ml)\ (2.0\ M)$$

$$X = \frac{(100\ ml)\ (2.0\ M)}{17\ ml} = \mathbf{11.76470588\ M} \quad \textbf{(approx. 12 M)}$$

This means you would measure out 17 ml of the strong concentration, which is approx. 12 M and add it to the 100 ml flask, then dilute it with water to the mark. Put on lid and shake to get 2.0 Molar solution.

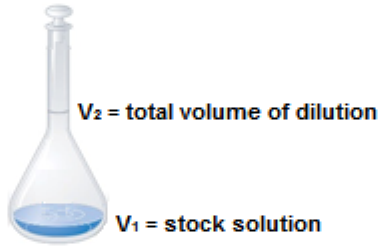
3. To what volume should 25 mL of 1.5 M nitric acid be diluted to prepare a 0.30 M solution?

$$(25ml)\ (1.5\ M\ )\ =\ (X\ )\ (0.30\ M)$$

$$X = \frac{(25ml)\ (1.5\ M\ )}{0.30\ M} = \mathbf{125\ ml}$$

This means you would measure out 25 ml of the 1.5 M strong concentration and add it to the 125 ml flask, then dilute it with water to the mark. Put on lid and shake to get 0.30 Molar solution.

4. How many ***milliliters of water*** must be added to a volumetric flask in order to prepare a **2.4 M** solution, if **100.0 mL of 12.0 M** hydrochloric acid is transferred to the flask?

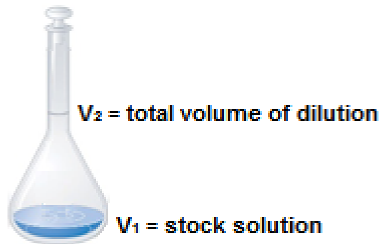


$$(\mathbf{100\ ml})(12.0\ M) = (2.4\ M)(\mathbf{V_2})$$

$$\mathbf{V_2 = 500\ ml}$$

$$V_2 - V_1 = 500\ ml - 100\ ml = \mathbf{400\ ml\ of\ water\ needed}$$

5. What ***volume of water*** should be added to **50.0 mL of 6 M** sulfuric acid in order to prepare a **1.5 M** solution?



$$(\mathbf{50.0\ ml})(6.0\ M) = (1.5\ M)(\mathbf{V_2})$$

$$\mathbf{V_2 = 200\ ml}$$

$$V_2 - V_1 = 200\ ml - 50\ ml = \mathbf{150\ ml\ of\ water\ needed}$$