Molarity Problems

Molarity = mol/L

Molarity = moles of solute / Liters of solution

Equation

- $[A] = \frac{n}{V}$
- [A] = square brackets mean concentration in molarity of A
- n = number of particles, moles
- V = volume, liters

Molarity problems

- How many moles of HCl are in 125 mL of 2.5 M HCl?

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- How many moles of HCl are in 125 mL of 2.5 M HCl?
- $[HCl] = \frac{n}{V}$
- $2.5\ M = \frac{n}{0.125\ L}$
- n = .31 mol HCl
- ----Or---

$$\frac{2.5 \text{ mol HCl}}{1 \cancel{\text{L of soln.}}} \left| \frac{.125 \cancel{\text{L of soln}}}{} \right. = .31 \text{ mol HCl}$$

Here we go

- What concentration solution would be prepared if 39 g of $Ba(OH)_2$ were mixed in a 450 mL solution?

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$$39 \text{ g } Ba(OH)_2 \left| \frac{1 \text{ mol } Ba(OH)_2}{171.316 \text{ g } Ba(OH)_2} \right. = .2276 \text{ mol } Ba(OH)_2$$

$$M = \text{mol/L} \quad \frac{.2276 \text{ mol } Ba(OH)_2}{.45 \text{ L of solution}} = .51 \text{ M } Ba(OH)_2$$

More

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- For a lab in this chapter, I need to make .60 L of 3.0 M NaOH, what mass of NaOH did I need?
- .6 L x 3.0 M NaOH = 1.8 mol NaOH
- 1.8 mol NaOH x 39.998 g/mol
- = 72 g NaOH

Molarity Problems

- A 0.24 *M* solution of Na_2SO_4 contains 0.36 moles of Na_2SO_4. How many liters were required to make this solution?

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$$\frac{0.36 \text{ mol } Na_2SO_4}{0.24 \text{ mol}} \left| \frac{1 \text{ L soln}}{} \right.$$

= 1.5 L Na_2SO_4

Getting tougher

- $AgNO_3 + BaCl_2 \rightarrow AgCl + Ba(NO_3)_2$
- Balance the equation. If 1.2 L of .50 M $AgNO_3$ is reacted completely, what molarity solution of $Ba(NO_3)_2$ will be created if the volume increased to 1.5 L?

Getting tougher

- $2AgNO_3 + BaCl_2 \rightarrow 2AgCl + Ba(NO_3)_2$
- Balance the equation. If 1.2 L of .50 M $AgNO_3$ is reacted completely, what molarity solution of $Ba(NO_3)_2$ will be created if the volume increased to 1.5 L?

1.2 L x .5 M $AgNO_3$ = .6 mol $AgNO_3$

$$\frac{.6 \text{ mol } AgNO_3}{2 \text{ mol Ag NO}_3} \left| \frac{1 \text{ mol } Ba(NO_3)_2}{} \right. = \frac{.3 \text{ mol } Ba(NO_3)_2}{1.5 \text{ L}}$$

= .20 M $Ba(NO_3)_2$

- $HNO_3 + Zn \rightarrow H_2 + Zn(NO_3)_2$
- If you have .65 L of 1.2 M HNO_3 and you react it completely what volume of H_2 gas will you produce at STP?

- $2\,HNO_3 + Zn \rightarrow H_2 + Zn(NO_3)_2$
- If you have .65 L of 1.2 M HNO_3 and you react it completely what volume of H_2 gas will you produce at STP?

1.2 M HNO_3 x .65 L = .78 mol HNO_3

$$\frac{.78 \text{ mol } HNO_3}{2 \text{ mol } HNO_3} \left| \frac{1 \text{ mol } H_2}{} \right. = .39 \text{ mol } H_2$$

$$\frac{.39 \text{ mol } H_2}{1 \text{ mol } H_2} \left| \frac{22.4 \text{ L at STP}}{} \right. = \textbf{8.7 L at STP}$$

- $HNO_3 + Zn \rightarrow H_2 + Zn(NO_2)_2$
- If you have .65 L of 1.2 M HNO_3 and you react it completely, what conc. of $Zn(NO_3)_2$ will be left if the volume increases to .75 L?

- $2HNO_3 + Zn \rightarrow H_2 + Zn(NO_3)_2$
- If you have .65 L of 1.2 M HNO_3 and you react it completely, what conc. of $Zn(NO_3)_2$ will be left if the volume increases to .75 L?

1.2 M HNO_3 x .65 L = .78 mol HNO_3

$$\frac{.78 \text{mol } HNO_3}{2 \text{ mol } HNO_3} \left| \frac{1 \text{ mol } Zn(NO_3)_2}{} \right. = \frac{.39 \text{ mol } Zn(NO_3)_2}{.75 \text{ L}}$$

= **.52 M $Zn(NO_3)_2$**

- $Fe + H_2SO_4 \rightarrow Fe_2(SO_4)_3 + H_2$
- If 350 mL of 2.3 M H_2SO_4 is completely reacted, what is the volume of hydrogen gas produced at 24° C and 114 kPa?

- $2\,Fe + 3\,H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3\,H_2$
- If 350 mL of 2.3 M H_2SO_4 is completely reacted, what is the volume of hydrogen gas produced at 24° C and 114 kPa?

.35 L x 2.3 M = .805 mol H_2SO_4

$$\frac{.805 \text{ mol } H_2SO_4}{1 \text{ mol } H_2SO_4} \left| \frac{1 \text{ mol } H_2}{} \right. = .805 \text{ mol } H_2$$

PV = nRT

114 kPa V = .805 mol (8.31) 297 K **=17 L H_2**