$$\text{Molarity} = \frac{\text{moles}}{L}$$

Key

Molarity & Titration

Calculate the molarity of a solution made by dissolving **15.0 g of KNO_3** in **200. mL of water**.

mL → L: $200.0\ \text{mL} \cdot \frac{1\ L}{1000\ \text{mL}} = .200\ L$

molar mass: $39.098\ g/mol + 14.007\ g/mol + 3\cdot(15.999) = 101.1\ g/mol$

$15.0\ g\ KNO_3 \cdot \frac{1\ mol}{101.1\ g} = 0.148\ mol\ KNO_3$

$M = \frac{0.148\ mol\ KNO_3}{.200\ L} = 0.74$

0.740 M

What is the molarity of a KOH solution if 28.0 mL neutralizes 15.0 mL of 0.195 M H_2SO_4?

$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2HOH$

$15.0\ mL \rightarrow 0.015\ L \qquad 0.195\ M \cdot 0.015\ L = 0.002925\ mol\ H_2SO_4$

$0.002925\ mol\ H_2SO_4 \cdot \frac{2\ mol\ KOH}{1\ mol\ H_2SO_4} = 0.00585\ mol\ KOH$

$28.0\ mL \rightarrow 0.0280\ L \qquad M = \frac{0.00585\ mol\ KOH}{0.0280\ L} = 0.208928571 \rightarrow$ **0.209 M KOH**

What is the molarity of a $Ca(OH)_2$ solution if 50.0 mL of $Ca(OH)_2$ neutralizes 40.0 mL of 0.250 M HNO_3?

Steps

① Write balanced equation: $Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$

② Calculate moles for HNO_3 + mL → L: $0.250\ M\ HNO_3 \cdot 0.0400\ L = 0.0100\ mol\ HNO_3$

③ Calculate moles for $Ca(OH)_2$: $0.0100\ mol\ HNO_3 \cdot \frac{1\ mol\ Ca(OH)_2}{2\ mol\ HNO_3} = 0.00500\ mol\ Ca(OH)_2$

④ Calculate Molarity + mL → L: $50.0\ mL \rightarrow 0.0500\ L \qquad M = \frac{0.00500\ mol\ Ca(OH)_2}{0.0500\ L} =$ **0.100 M $Ca(OH)_2$**

Calculate the molarity of the following solution and its ions: 15.6 g of potassium hydroxide (KOH) is dissolved in water to make 300 mL of solution.

① Find molar mass KOH: $39.1 + 16 + 1.0 = 56.1\ g/mol\ KOH$

② Calculate mole KOH: $15.6\ g \cdot \frac{1\ mol}{56.1\ g} = 0.278\ mol\ KOH$

③ convert mL → L: $300\ mL \cdot \frac{1\ L}{1000\ mL} = 0.300\ L$

④ Calculate Molarity: $M = \frac{0.278\ mol\ KOH}{0.300\ L} = 0.927\ M$

⑤ Determine concentration of ions: *For every 1 mol of KOH, it dissolves into 1 mol K^+ and 1 mol OH^-.

$[K^+] = 0.927\ M$

$[OH^-] = 0.927\ M$

What is the equation for dilution? $M_1V_1 = M_2V_2$

How many milliliters of 12.0 M HCl are needed to make 1.5 L of 0.50 M HCl?

$$(12.0\ M)\ V_1 = (0.50\ M)(1.5\ L)$$

$$V_1 = \frac{(0.50\ M)(1.5\ L)}{(12.0\ M)}$$

$$= 0.0625\ L \cdot \frac{1000\ mL}{1\ L} = \boxed{62.5\ mL\ HCl}$$

200 mL of a 6.0 M HCl solution is diluted by adding water to make the total volume 1.0 L.
What is the new concentration of the HCl solution?

1.0 L → 1000 mL

$$M_1V_1 = M_2V_2$$

$$(6.0\ M)(200\ mL) = M_2\ (1000\ mL)$$

$$M_2 = \frac{(6.0\ M)(200\ mL)}{1000\ mL}$$

$$M_2 = \boxed{1.2\ M\ HCl}$$

A 40.0 mL sample of a sulfuric acid (H_2SO_4) solution is titrated with 0.250 M sodium hydroxide (NaOH). It takes 50.0 mL of NaOH to reach the endpoint. What is the molarity of the sulfuric acid solution?

$$\_\ H_2SO_4 + 2\ NaOH \longrightarrow \_\ Na_2SO_4 + 2\ H_2O\ (l)$$

Acid · base · salt · water

$$0.250\ M\ NaOH \cdot 0.0500\ L = 0.125\ mol\ NaOH$$

$$0.125\ mol\ NaOH \cdot \frac{1\ mol\ H_2SO_4}{2\ mol\ NaOH} = 0.0625\ mol\ H_2SO_4$$

$$40.0\ mL \cdot \frac{1\ L}{1000\ mL}$$

$$M = \frac{0.0625\ mol\ H_2SO_4}{0.0400\ L} = \boxed{1.56\ M\ H_2SO_4}$$