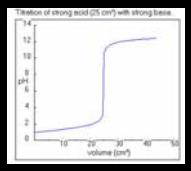
Titration Calculations



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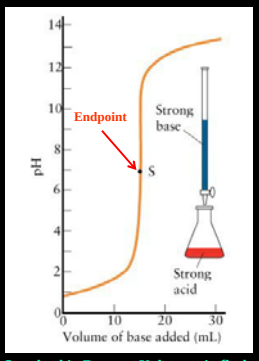
The Titration Experiment



At Endpoint:

1. Moles Standard (Given) Added:

$$\left(\frac{\text{Moles}}{1000\ \text{ml}}\ \text{x ml added}\right)$$

2. Moles in Unknown:

$$1\ \text{x}\ \left(\frac{\text{Reaction Coefficient Wanted}}{\text{Reaction Coefficient Given}}\right)$$

3. Unknown Molarity (mole/Liter):

$$\frac{\text{(Moles Unknown)}}{\text{Volume Unknown}}$$

Standard in Burette; Unknown in flask

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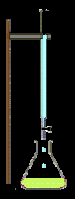
Generalized Titration Pathway

"Per" Expression" (Molar Ratio)

Grams → Moles → Moles → Grams

Given (Standard) **Wanted**

moles / 1000 mL x mL | **moles / L = Molarity**



Entry & Exit Points Depend On:

Given

Wanted

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A student finds that 15.80 mL of 0.2840 M H_2SO_4 are required to neutralize a 20.00 mL sample of a certain NaOH solution. What is the molarity of the NaOH solution? $H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2\ H_2O$

Given: 15.80 mL of 0.2840 M sulfuric acid
Wanted: molarity (M/L) of 20.00 mL solution of sodium hydroxide

1. Start with given and get moles H_2SO_4

$$\frac{0.2840\ \text{moles } H_2SO_4}{1000\ \text{mL}} \times 15.80\ \text{mL}$$

2. Use "per expression" to convert to moles sodium hydroxide

$$\frac{0.2840\ \text{moles } H_2SO_4}{1000\ \text{mL}} \times 15.80\ \text{mL} \times \frac{2\ \text{mole NaOH}}{1\ \text{moles } H_2SO_4}$$

3. Convert moles NaOH to molarity (moles per Liter) of the solution:

$$\frac{0.2840\ \text{moles } H_2SO_4}{1000\ \text{mL}} \times 15.80\ \text{mL} \times \frac{2\ \text{mole NaOH}}{1\ \text{moles } H_2SO_4} \times \frac{1}{0.02000\ \text{L}} = 0.4487\ \text{M}$$

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A student finds that 34.80 mL of 0.4830 M KOH are required to neutralize a 10.00 mL sample of a certain H_3PO_4 solution. What is the molarity of the H_3PO_4 solution? $H_3PO_4 + 3\ KOH \rightarrow K_3PO_4 + 3\ H_2O$

Given: 34.80 mL of 0.4830 M potassium hydroxide
Wanted: Molarity (M/L) of 10.00 mL phosphoric Acid

1. Start with standard molarity 2. 3.

$$\frac{0.4830\ \text{moles KOH}}{1000\ \text{mL}} \times 34.80\ \text{mL} \times \frac{1\ \text{mole } H_3PO_4}{3\ \text{moles KOH}} \times \frac{1}{0.01000\ \text{L}} = 0.5603\ \text{M}$$

1. Start with standard added 2. 3.

$$34.80\ \text{mL} \times \frac{0.4830\ \text{moles KOH}}{1000\ \text{mL}} \times \frac{1\ \text{mole } H_3PO_4}{3\ \text{moles KOH}} \times \frac{1}{0.01000\ \text{L}} = 0.5603\ \text{M}$$

Let the Units Drive the Solution

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A student finds that 20.00 mL of 0.3950 M HNO_3 are required to neutralize a 29.70 mL sample of a certain KOH solution. What is the molarity of the KOH solution? $HNO_3 + KOH \rightarrow KNO_3 + H_2O$

Given: 20.00 mL of 0.3950 M nitric acid
Wanted: Molarity (M/L) of 29.70 mL potassium hydroxide

1. Start with standard molarity 2. 3.

$$\frac{0.3950\ \text{moles } HNO_3}{1000\ \text{mL}} \times 20.00\ \text{mL} \times \frac{1\ \text{mole KOH}}{1\ \text{mole } HNO_3} \times \frac{1}{0.02970\ \text{L}} = 0.2660\ \text{M}$$

1. Start with standard added 2. 3.

$$20.00\ \text{mL} \times \frac{0.3950\ \text{moles } HNO_3}{1000\ \text{mL}} \times \frac{1\ \text{mole KOH}}{1\ \text{mole } HNO_3} \times \frac{1}{0.02970\ \text{L}} = 0.2660\ \text{M}$$

Let the Units Drive the Solution

LPT

A student finds that 15.00 mL of 0.1860 M H_2SO_4 are required to neutralize a 26.30 mL sample of a certain NaOH solution. What is the molarity of the NaOH solution? $H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2\ H_2O$

Given: 15.00 mL of 0.1860 M sulfuric acid
Wanted: Molarity (M/L) of 26.30 mL sodium hydroxide

1. Start with standard molarity 2. 3.

$$\frac{0.1860 \text{ moles } H_2SO_4}{1000 \text{ mL}} \times 15.00 \text{ mL} \times \frac{2 \text{ mole NaOH}}{1 \text{ mole } H_2SO_4} \times \frac{1}{0.02630 \text{ L}} = 0.2122 \text{ M}$$

1. Start with standard added 2. 3.

$$15.00 \text{ mL} \times \frac{0.1860 \text{ moles}}{1000 \text{ mL}} \times \frac{2 \text{ mole NaOH}}{1 \text{ mole } H_2SO_4} \times \frac{1}{0.02630 \text{ L}} = 0.2122 \text{ M}$$

Let the Units Drive the Solution

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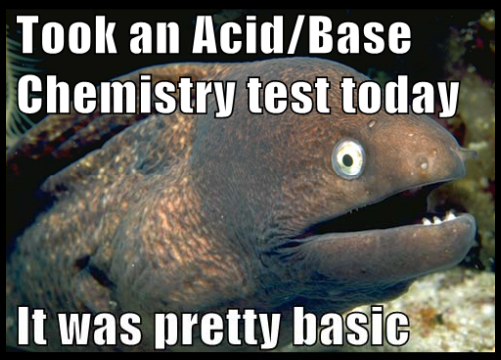

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