CHM 110
Sample molarity problems - set 2

Problem

3.47 g of NaBr solid is transferred to a a volumetric flask. After filling to the mark with water, the total volume of the solution is 100.0 mL. Calculate the molar concentration of the solution.

Solution

Find the moles of NaBr used, then divide by the solution volume in liters.

Substance	Formula weight
NaBr	102.89 g/mol

$$3.47\,\text{g NaBr}\,\text{timex}\,\frac{\text{mol NaBr}}{102.89\,\text{g NaBr}} = 3.37\times10^{-2}\,\text{mol NaBr}$$

$$\frac{3.373\times10^{-2}\,\text{mol NaBr}}{0.1000\,\text{L}} = \mathbf{0.337\,M\ NaBr}$$

Problem

You use 47.3 mL of 0.337 M NaBr solution in a chemical reaction. How many moles of NaBr did you use? How many grams?

Solution

Use the definition of molarity. The formula weight below is only necessary to answer the question about mass - it's not required to use the formula weight to calculate moles from volume and molarity.

Substance	Formula weight
NaBr	102.89 g/mol

$$0.0473\,\text{L}\times\frac{0.337\,\text{mol NaBr}}{\text{L}} = \mathbf{0.0159\,mol\ NaBr}$$

$$0.0473\,\text{L}\times\frac{0.337\,\text{mol NaBr}}{\text{L}}\times\frac{102.89\,\text{g NaBr}}{\text{mol NaBr}} = \mathbf{1.64\,g\ NaBr}$$

Problem

How many milliliters of 0.337 M NaBr is needed to react with 1.00 g $AgNO_3$ in the reaction given below?

$$AgNO_3(aq) + NaBr(aq) \rightarrow AgBr(s) + NaNO_3(aq)$$

Solution

Convert grams of $AgNO_3$ to moles, use the chemical equation to relate moles of $AgNO_3$ to moles of NaBr, then convert moles of NaBr to volume using the molarity.

Substance	**Formula weight**
$AgNO_3$	169.91 g/mol

$$1.00\,\text{g AgNO}_3 \times \frac{\text{mol AgNO}_3}{169.91\,\text{g AgNO}_3} \times \frac{1\,\text{mol NaBr}}{1\,\text{mol AgNO}_3} \times \frac{\text{L}}{0.337\,\text{mol NaBr}} = 1.75 \times 10^{-2}\,\text{L}$$

*The volume expressed in milliliters, is **17.5 mL**.*

Problem

It takes 38.5 mL of 0.157 M NaOH to completely react with 10.0 mL of H_3PO_4 solution. Calculate the molar concentration of the H_3PO_4 solution. The reaction is given below.

$$H_3PO_4(aq) + 3NaOH(aq) \rightarrow 3H_2O(l) + Na_3PO_4(aq)$$

Solution

Convert the volume of NaOH to moles using the molarity. Then, convert the moles of NaOH to moles of H_3PO_4 using the chemical equation. Finally, divide by the volume of the H_3PO_4 used to find its concentration. You don't need any formula weights at all to solve this problem!

$$0.0385\,\text{L NaOH} \times \frac{0.157\,\text{mol NaOH}}{\text{L NaOH}} \times \frac{1\,\text{mol H}_3\text{PO}_4}{3\,\text{mol NaOH}} = 2.015 \times 10^{-3}\,\text{mol H}_3\text{PO}_4$$

$$\frac{2.015 \times 10^{-3}\,\text{mol H}_3\text{PO}_4}{0.0100\,\text{L}} = \mathbf{0.202\,M\,H_3PO_4}$$