Molarity Calculations

Essential Question

How do we measure concentration?

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Concentrated vs. Dilute

- Dilute: a little solute
- Concentrated: a lot of solute
- Words are not precise enough

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Molarity

- M = mol of solute ÷ L of solution
- Read 2.0 M as "2.0 molar"
- 2.0 M means 2.0 mol in every liter

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Rearranging the Formula

- Find M: $M = mol \div L$
- Find mol: $mol = M \times L$
- Find L: $L = mol \div M$

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Liters, Not Milliliters

- Molarity always uses liters
- mL ÷ 1000 = L
- 250. mL = 0.250 L (same sig figs)

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Molarity Calculations

Starting From Grams

- Grams ÷ molar mass = moles
- Moles ÷ liters = molarity
- NaCl: 22.99 + 35.45 = 58.44 g/mol

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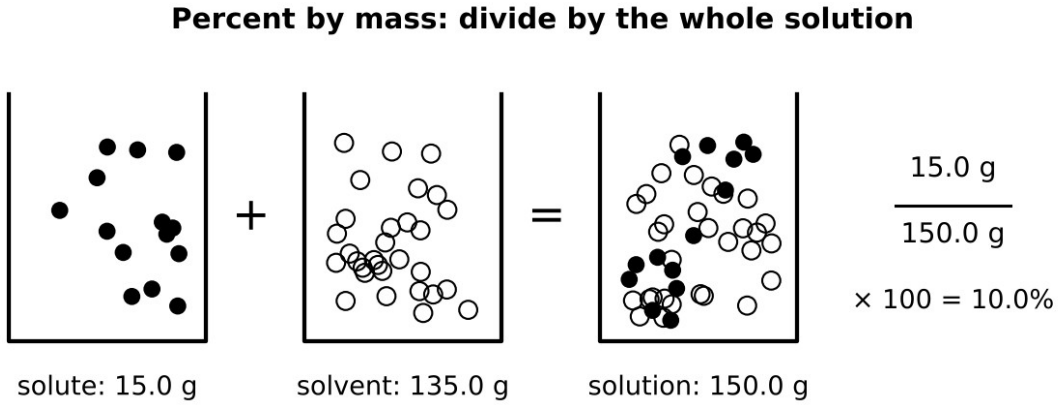
Making a Solution in Lab

- Weigh the solute
- Dissolve it in some water in a volumetric flask
- Fill to the line, stopper, invert
- Known exact concentration: a standard solution

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Percent by Mass, Percent by Volume, and ppm

- % by mass = g solute ÷ g solution × 100
- % by volume = mL solute ÷ mL solution × 100
- ppm = g solute ÷ g solution × 10^6
- Solution = solute + solvent



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Which Unit When?

- Molarity: lab work and reactions

Unit	Used for	Example
percent by mass	labels on products	3% hydrogen peroxide
percent by volume	liquid in a liquid	70% isopropyl alcohol
ppm	tiny amounts in water	1 ppm ≈ 1 mg per L

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Example: Molarity From Moles

What is the molarity of a solution made by dissolving 0.50 mol NaCl in enough water to make 2.0 L of solution?

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Example: Molarity From Grams

A student dissolves 11.7 g of NaCl in water to make 250. mL of solution. What is the molarity?

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Example: Finding Moles

How many moles of HCl are in 350. mL of 0.200 M HCl?

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Example: Grams Needed

How many grams of KCl are needed to make 500. mL of 0.150 M KCl?

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Example: Finding Volume

What volume of 2.00 M NaOH contains 0.500 mol of NaOH? Give your answer in mL.

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Example: Percent by Mass

A student dissolves 15.0 g of sugar in 135.0 g of water. (a) What is the percent by mass of sugar? (b) How many grams of sugar are in 40.0 g of this solution?

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Example: Parts per Million

A 250.0 g sample of drinking water contains 0.00030 g of fluoride ions. What is the fluoride concentration in ppm?

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Molarity Calculations

Big Ideas

- Molarity (M) = mol of solute ÷ L of solution
- Always convert mL to L first
- Molar mass links grams and moles
- Rearrange: mol = M × L and L = mol ÷ M
- Percent and ppm: solute ÷ the whole solution

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