UNIT 2 SUMMARY

MAKE A SUMMARY

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Student flow charts should contain the following information.

Calculations Related to Individual Compounds

$$\text{Molar mass } (M) = \frac{\text{mass } (m)}{\text{amount } (n)}$$

Factor-Label Method

Step 1: Identify Key Value and Conversion Factor Equation
Step 2: Identify Required Value
Step 3: List Possible Conversion Factors
Step 4: Substitute Values into Solution Equation, and Solve
required value = key value × conversion factor × conversion factor …
Note: Use as many conversion factors as required.

Determining Empirical Formulas

Step 1: List Given Values
Step 2: Calculate Mass (m) of Each Element in 100-g Sample
Step 3: Convert Mass (m) into Amount (n)
Step 4: State Amount Ratio
Step 5: Calculate Lowest Whole-Number Amount Ratio

Determining Molecular Formulas

Step 1: Determine Molar Mass of Empirical Formula
Step 2: Determine Ratio of Molar Mass of Compound to Molar Mass of Empirical Formula
Step 3: Calculate Molecular Formula

Percent Concentration

% V/V $\quad c = \frac{v_{\text{solute}}}{v_{\text{solution}}} \times 100\%$

% W/V $\quad c = \frac{m_{\text{solute}}}{v_{\text{solution}}} \times 100\%$

Molar Concentration

$$c = \frac{n}{v}$$

Dilution Equation

$c_i v_i = c_f v_f$

Calculations Based on a Balanced Chemical Equation

Solving Stoichiometric Problems
Step 1: Write Unbalanced Equation
Step 2: Balance Equation, List Given Values and Molar Masses
Step 3: Convert Mass of Given Substance to Amount of Given Substance
Step 4: Convert Amount of Given Substance to Amount of Required Substance
Step 5: Convert Amount of Required Substance to Required Value

Calculating Mass of Product Formed With a Limiting Reagent

Step 1: List Given Values
Step 2: Complete Reaction Chart
Step 3: Identify Limiting and Excess Reagents
Step 4: Calculate Amount of Limiting Reagent
Step 5: Calculate Amount of Product
Step 6: Calculate Mass of Product

Percentage Yield

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

UNIT 2 PERFORMANCE TASK: PRODUCTION CONTROL TECHNICIAN

Question

Do reactions using reagent-grade chemicals produce a higher percentage yield than reactions using store-bought (household quality) reagents?

Prediction

Reactions carried out with reagent-grade chemicals will produce a higher percentage yield than reactions carried out using store-bought reagents.

Experimental Design

A preliminary percentage yield test (Trial 1) was performed according to the procedure outlined in the student text. In this test, store-bought baking soda and store-bought vinegar were used as the sources of sodium hydrogen carbonate and acetic acid, respectively. A second experiment (Trial 2) was conducted in an effort to increase the percentage yield of sodium acetate. In Trial 2, a 5% V/V solution of aqueous (reagent-grade) acetic acid, and an aqueous solution of (reagent-grade) sodium hydrogen acetate (prepared according to the student text procedure) were used as the reagents. In both cases (Trial 1 and Trial 2), the reagents were mixed in a clean, dry 500-mL beaker (according to the instructions in the student text procedure), and allowed to react until all bubbling stopped.

Materials

balance
scoopulas
stirring rods
hot plate
100-mL graduated cylinder
500-mL beaker
watch glass large enough to fit over the mouth of a 500-mL beaker
store-bought baking soda
reagent-grade sodium hydrogen carbonate, $NaHCO_{3(s)}$
store-bought vinegar
5% V/V solution of reagent-grade acetic acid, $HC_2H_3O_{2(aq)}$
distilled water

Procedure

The procedures employed in Trial 1 and Trial 2 were the same as the procedures outlined in the student text, except that in Trial 1, store-bought vinegar and store-bought baking soda were used as the reagents, and in Trial 2, reagent-grade acetic acid, reagent-grade sodium hydrogen acetate, and distilled water (as a solvent) were used as reagents. All reactions were carried out at ambient room temperature (22°C). See the student text procedure for details.

Observations

Trial 1

Mass of baking soda used	4.23 g
Mass of empty beaker	193.03 g
Mass of empty beaker + $NaC_2H_3O_{2(s)}$	196.07 g
Mass of $NaC_2H_3O_{2(s)}$ collected	3.04 g

Trial 2

Mass of $NaHCO_3$ used	4.23 g
Mass of empty beaker	193.03 g
Mass of beaker + $NaC_2H_3O_{2(s)}$	196.90 g
Mass of $NaC_2H_3O_{2(s)}$ collected	3.87 g