Teacher Guide: The Chemical Evidence

Time: 4–5 days
Grades: 11 and 12 (2nd-year Chemistry)

Objectives

1. Students will solve a forensics case using their knowledge of chemistry (for performance assessment #2 this includes balancing equations, mole calculations, stoichiometry, limiting reactants, percent yield, and molecular formulas).
2. Students will assemble their evidence and present their case at the end of the year.
3. Students will answer three questions:
    a. Identify the unknown chemicals based on their composition.
    b. Analyze the suspect residues to determine the chemicals found on them.
    c. Identify the limiting reactant, excess reactant, unknowns and percent yield.

Preparation

- Make copies of the student handouts packet including the suspect file B.
- No lab preparation is required for this assessment.

The Lab

Students use the scenario provided to calculate information which will provide evidence for their forensics case. The work that they do will be assembled as part of their evidence file, which will be maintained throughout the year.

Question Guidelines

For calculations, formulas, and work, see the student example at the end of the chapter.

Part I

1. For calculations of each of the following, see the student example.
    a. Chemical A: vanilla
    b. Chemical B: vanilla
    c. Chemical C: cocaine
    d. Chemical D: aspirin
    e. Chemical E: unknown #1 (determined to be caffeine in PA #5)
2. The empirical formula of unknown #1 is $C_4H_5N_2O$.

Part II

1. For calculations of each of the following, see the student example.

    a. Victim: vanilla
    b. Suspect #1—Harold M.: aspirin
    c. Suspect #2—Gladys V.: cocaine
    d. Suspect #3—Elizabeth G.: acetaminophen, unknown #2
    e. Suspect #4—Larry J.: nitroglycerine, unknown #1
2. The empirical formula for unknown #2 is $C_2H_2O_3$.

Part III

1. See student example for calculations

Part IV

1. $2C_7H_8O_2 + C_2H_2O_3 \rightarrow 2C_8H_8O_3 + H_2O$
2. Limiting reactant: guaiacol, $C_7H_8O_2$; excess reactant: glyoxylic acid, $C_2H_2O_3$
3. Theoretical yield: 5.13%
4. Percent yield: 3.19%
5. % composition matches unknown #2: glyoxylic acid

Materials

- Suspect File B
- Student Guide
- Calculator

Teacher Hints

- The Unknown Chemical is found to be caffeine in personal assessment for Chapter 7. Students cannot determine it in this PA because they only have the empirical formula.
- This performance assessment includes a tremendous amount of calculations. I would recommend that the calculations are graded from the performance assessment packet so students don't have to retype all the calculations.
- To figure out the chemicals in Part II of the assessment, students will not have to redo all the calculations if they are observant and notice that most of the percentages are the same as the percentages from Part I.