The Chemistry of Life – Laboratory Investigation
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Station 1

PROBLEM: What are the masses and relative abundances of isotopes of "pennium" and what is the atomic mass of the element?

MATERIALS

- 20 pennies in a resealable bag
- Lab balance

INTRODUCTION

Unless you're a coin collector, you probably think all US pennies are pretty much the same. To the casual observer, all the pennies in circulation do seem to be identical in size, thickness, and composition. But just as elements have one or more isotopes with different masses, the pennies in circulation have different masses. In this investigation, you are going to use ***pennies with different masses to represent different "isotopes"*** of an imaginary element called ***pennium***, or ***Pe***. Remember that chemical isotopes are atoms that have the same number of protons, but different numbers of neutrons. Thus, chemical isotopes have nearly identical chemical properties, but some different physical properties. In this investigation, you will determine the relative abundance of the isotopes of ***pennium*** and the masses of each isotope. You will then use this information to determine the atomic mass of ***pennium***. Recall that the atomic mass of an element is the weighted average of the masses of the isotopes of the element. This average is based on both the mass and the relative abundance of each isotope as it occurs in nature.

PRE-LAB DISCUSSION

1. *What do the 20 pennies in this investigation represent?*
2. *What do the different masses of the pennies represent?*
3. *What information do you need to calculate the average atomic mass for an element?*

PROCEDURE

1. *Put on your goggles! Remove the pennies from the re-sealable bag and count them to make sure that there are 20. Determine and record the combined mass of your 20 pennies.*
2. *Find the mass of each penny separately. Create a data table, record the year the penny was minted and its mass to the nearest 0.01 g.*
3. *Place the 20 pennies in the re-sealable bag and return the pennies back to where you got them.*
4. *Clean up your work area and wash your hands before leaving the laboratory.*

OBSERVATIONS:

Combined mass (to nearest 0.01 g) of 20 pennies _____ g

CALCULATIONS

1. Inspect your data carefully. Determine the number of isotopes of ***Pe*** that are present.

   _____

2. Calculate the ***fractional abundance*** of each isotope in your sample.

   Fractional Abundance = # of pennies for each isotope/total # of pennies

3. Calculate the average atomic mass of each isotope.

   Ave. Atomic Mass = total mass of pennies of each isotope/# of pennies of that isotope.

4. Using the ***fractional abundance*** and the ***average atomic mass*** of each isotope, calculate the atomic mass of ***Pe***. _____

   Atomic mass of Pe = mass iso_a x $frac_a$ + mass iso_b x $frac_b$...

	Date of Penny	Weight of Penny
1		
2		
3		
4		

5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
	Total Mass	

DATA ANALYSIS

1. *Was the mass of 20 pennies equal to 20 times the mass of one penny? Explain.*
2. *In what year(s) did the mass of Pe change? How could you tell?*
3. *How can you explain the fact that there are different "isotopes" of **pennium**?*
4. *Why are the atomic masses for most elements not whole numbers?*
5. *How are the three isotopes of hydrogen (hydrogen-1, hydrogen-2, and hydrogen-3) alike? How are they different?*
6. *Copper (Cu) has two isotopes, copper-63 and copper-65. The relative abundance of copper-63 is 69.1% and copper-65, 30.9%. Calculate the average atomic mass of copper. Show all work.*

CONCLUSION: On a separate Sheet of Paper

Station 2

Introduction

A liquid may be an acid, base, or neutral. The degree of acidity or basicity can be measured by using the pH scale. The scale is divided into three areas: Acid (readings below 7) and basic (readings above 7). Each division either increases or decreases the pH of a substance 10 times. The pH of 5 is ten times more acidic than a pH of 6. Water has a pH of 7 but when it mixes with air the suspended materials will either raise or lower its pH. Acid Rain is an example of this type of reaction.

Objective

The student will determine the pH of various substances and will also determine how some of these substances can affect the environment.

Materials

- pH paper and chart
- well plate
- pipettes
- various household solutions

Procedure

1. Put a drop of each substance, one per well on the well plate. Remember, do NOT come in contact with any of the materials and do not mix-n-match pipettes.
2. Using your knowledge of the pH scale, hypothesize whether the liquid would be an acid or base. Record this number on your data table.
3. Pick up a piece of pH paper with dry hands.
4. Touch the pH paper to the liquid in well "A" and remove it. Compare the color of the paper with that on the pH chart. Record your observations on the chart below.
5. Repeat the procedure with the rest of the slides.
6. Clean-up
    a. Place used pH paper in the trash can.
    b. Rinse out well plate
    c. Dry work station
    d. Complete data sheet and answer questions.

Acid and Base Lab Data and Questions

ID	Item	Hypothesis	pH	Acid H^+	Base OH^-	Neutral
A						
B						
C						
D						
E						

F						
G						
H						
I						
J						
K						
L						
M						

Data Analysis

1. Which of the liquids had the lowest pH?
2. Which of the liquids had the highest pH?
3. Which of the liquid(s) were closest to being neutral?
4. If the pH of a sample was 3, how many times more acidic is it than a solution with a pH of 6?
5. How might one correct the pH of a lake with a reading of 3? Explain your reasoning.

Biological Applications of pH:

6. What is the pH of human blood?
7. What would happen to our bodies if blood pH was changed or altered?
8. The pH of stomach acid is 2, why is this both good, but possibly destructive to our bodies?

9. What could happen to our local environment if a company pumped materials into the atmosphere which created a drastic pH change in the rain water?

10. When we eat too many tomato products (ex. Salsa) our stomachs can become upset. Using your understanding of pH and the pH chart in your text, why does an antacid make you feel better?

Real World Applications:

A. Fort Castillo De San Marco is located in St. Augustine, Florida. The fort was originally built using coquina rock. The mortar used to hold the coquina together was made with ground limestone (lime) and sand. Over the years, environmental factors have caused the structure of the Fort to deteriorate. Many say it is due to acid rain. Why would acid rain affect the coquina and lime?

B. When carbon dioxide dissolves in this ocean, carbonic acid is formed. This leads to higher acidity, mainly near the surface, which has been proven to inhibit shell growth in marine animals and is suspected as a cause of reproductive disorders in some fish. List some causes for this phenomenon.