

Laboratory #6

Atomic Structure

Part A: Styrofoam Rain Drops

Concepts

Scaling; Surface Area; Volume; Air Friction; Terminal Velocity; Force of Gravity

Introduction

Why is it that if you or I were to fall off the 9th floor of Haley Center, we would make a big mess on the ground, but if an ant (or more likely a cockroach) were to fall off, it would land and scurry away? Doesn't gravity affect everything on this planet? The answer to this paradox has to do with terminal velocity.

This experiment deals with the relationship between the force of gravity and volume as well as the force of air friction and surface area. To determine these relationships, you need a couple of formulas and some Styrofoam balls.

Procedure

- Choose a big and a small Styrofoam ball, and drop them simultaneously from as high up as you can get (you might have to get up on a lab table).

Fill in the Table provided.

Part B. Enough Styrofoam to Sink a Battleship!

Concepts

Density; Volume; Mass; Atomic Structure

Introduction

Which weighs more: a 5 lb chunk of styrofoam or a 5 lb chunk of lead? The answer is obvious, but if you were to see the two side by side you might be shocked at the difference in size between the two. This experiment will help to clarify some of the differences between the ideas of volume, mass, and density.

Procedure

- Weigh the three objects that your instructor provides for you.
- Find the volume of the three objects.
- Find the density of each object.
- Record the information in the Table provided.

Part C. Egg Drop Soup

Concepts

Density; Mass; Volume; Relative Density

Introduction

Have you ever been to an ocean harbor and looked at the cargo ships? They are enormous! Some cargo ships can be as big as 900 feet long (three football fields), weigh 67,000 tons when fully loaded, and are made of solid steel! How is it possible that this much steel can possibly float when something like a bowling ball sinks?

This experiment will deal with why things float (we will deal with this question more extensively in the next couple weeks) by considering the concept of density. Our objects will be water, an egg (try not to crack it!), and some salt.

Procedure

- Find the mass of the plastic cup.
- Find the mass of the egg.
- Find the volume of the egg.
- Put enough water in the plastic cup to submerge the egg.
- Find the mass of the water in the cup
- Find the volume of the water in the cup (use milliliters).
- Put the egg in the plastic cup with the water
- Record the information in the Table provided, and answer the first 2 questions.
- Remove the egg.
- Start pouring salt into the water and thoroughly dissolve it into the water.
- Return the egg to the cup.
- If it floats move on, if not add more salt and dissolve it again.
- Find the new mass and volume of the water
- Record the information, and answer the rest of the questions

Lab Reporting Sheet Laboratory #6

Name: _____

Date: _____

Part A: Styrofoam Rain Drops

- Which ball hits the ground first?

Ball	Mass	Radius	Surface Area	Volume	Force of Gravity
Small					
Large					

- Neglecting air friction, what is the acceleration at which the large ball should fall? The small ball?
- How is the force of gravity related to volume? Use the formulas you know to answer this.
- How is volume related to radius?
- How is the force of gravity related to radius?
- What is the formula for force of air friction? (look back at Lab #2)
- How is Force of air friction related to velocity and radius?

- **When does terminal velocity happen?**
- **Assuming density is constant, how is terminal velocity related to radius?**
- **What does this information tell you about terminal velocity as radius increases?**
- **Why do humans splat after falling 9 stories but cockroaches scurry away?**

Part B: Enough Styrofoam to Sink a Battleship!

Object	Mass	Volume	Density
Styrofoam			
Wood			
Iron			

- If it takes 500 kg of Iron to sink a toy battle ship, how many kg of styrofoam does it take?
- What volume would 5 kg of iron occupy?
- What volume would 5 kg of styrofoam occupy?
- Why does styrofoam take up so much more space?
- Why is it's density so much less?

Part C: Egg Drop Soup

Item	Mass	Volume	Density
Fresh Water			
Egg			
Salt Water			

- **Does the egg sink or float in fresh water?**
- **What is true about the density of the egg compared to fresh water? (Show that it is true)**
- **Does the egg sink or float in salt water?**
- **What is true about the density of the egg compared to salt water? (Show that it is true)**
- **What is true about the density of fresh water compared to salt water?**
- **In both cases (egg in water and egg in salt water): the most-dense item is on the _____ (bottom or top).**
- **How is it that a cargo ship made of steel and weighing 134,000,000 pounds can possibly float? Call your mom and explain it to her.**