Laboratory #10
Heat

Part A: Revenge of the Levitating Ping-Pong Ball

Concepts
Bernoulli's Principle; Pressure; Velocity; Convection; Expansion; Buoyancy

Introduction
Air has mass right? Wicker baskets have mass right? Nylon? Humans? There is nothing in a hot air balloon that is massless, how can a hot air balloon float in the air?

In this experiment you will witness first hand how hot air balloons work. Since hot air balloons are too big and bulky for us to play with we will instead float a ping-pong ball.

Procedure
- Repeat the first 3 steps of "The Amazing Levitating Ping-Pong Ball".
- Holding the hair dryer straight up and down, turn on the heat.
- Watch what happens to the ping-pong ball.
- Allow the remains of the ball to cool before you touch it (it is hot).

Part B. Hot Time in the City

Concepts
Expansion, Heat Transfer, Automatic Switches

Introduction
Ever noticed those big metal teeth looking things going across the road on a bridge? How about going down the highway and hearing "thudump, thudump, thudump, thudump, thudump…". Why would anyone build such an annoying highway?

This experiment will show how things expand and contract based on the temperature. It should be noted that you will be using things that are very hot so please be careful not to burn yourself or anyone else.

Procedure

Part 1: The Strip
- Notice that the strip is actually made of two strips, glued together.
- Light and adjust the Bunsen burner (ask your instructor for guidance).
- Hold the bi-metallic strip above the flame and observe what happens.
- Put the strip in a bath of liquid nitrogen and observe what happens.
- Answer the first 3 questions.

Part 2: The Ball and Ring
- Notice that the ring does fit around the ball.
- Hold the ball above the flame for a short time and see if it still fits through the ring.
- Answer the rest of the questions.

Part C: Hot Potato

Concepts
Conduction; Heat Transfer; Change in Temperature

Introduction
The flame of burning gas is pretty hot. The rapid thermal expansion would probably break a thermometer if you put it directly into a Bunsen burner flame. In this experiment you will measure the temperature of a flame without direct contact. Instead you will measure the temperature change of water.

Procedure
- Measure the mass of the brass ball.
- Put the brass ball in the flame until it is glowing red-hot.
- Meanwhile, put 200 ml of water in a styrofoam cup.
- Measure the temperature of the water.
- Dunk the glowing hot ball in the water and monitor the temperature of the water, stirring constantly.
- When the temperature stabilizes, record the information in the lab report.

Lab Reporting Sheet
Laboratory #10

Name:_____

Date:_____

Part A: Revenge of the Levitating Ping-Pong Ball

- **What happens to the volume of the ball as its temperature changes?**

- **What can be said about the density of the air inside the ball as its temperature increases?**

- **Air has mass, and thus weight. What happens to the weight of the fluid displaced by the ping-pong ball?**

- **What happens to the weight of the ping-pong ball?**

- **Why does the ping-pong ball float higher than before it was heated?**

Part B: Hot Time in the City

- **What does the strip look like at room temperature?**

- **What happens to the strip as its temperature is increased? Why?**

- **What happens to the strip as its temperature is decreased in the liquid nitrogen? Why?**

- **Why does the ball not fit through the ring after it is heated up?**

- **Why do bridges roads and sidewalks have those annoying gaps in them?**

Part C: Hot Potato

Object	Initial Temperature	Final Temperature	Mass	Specific Heat	Gaining or Losing Heat
Water					
Ball					

- **<u>Algebraically</u> solve for the initial temperature of the ball, which is the same as the temperature of the flame.**

- **How does heat transfer from the flame to the ball?**

- **How does heat transfer from the ball to the water?**

- **If you put a coffee cup filled with 95^{o}C coffee on top of an iceberg at 0^{o}C, which way will the energy flow? It should be noted that because of the massive size of the iceberg, it has significantly more internal energy.**