Name

Date

THE VAULT
www.rawsonvault.com

Pendulum Dampening Lab

INTRODUCTION
In a frictionless world, a pendulum oscillation would continue on forever. However, we do not live in such a world. If you start a pendulum swinging, eventually this pendulum will slow down, the amplitude (height of swing) will decrease, and eventually it will stop swinging altogether, resting at the equilibrium position. The amount that a pendulum amplitude decreases each time is called *dampening*.

In this lab you will determine how the dampening of a pendulums oscillation depends upon its mass.

EQUIPMENT:

- String
- Ruler
- Timer
- Set of Weights

IN THE LABORATORY:
Hypothesis: How do you think the amount of dampening depends upon the mass?

Dampening can be broadly defined as the loss of energy in the oscillations. The outward energy losses arise from any possible frictional forces which are unavoidable in a realistic system. Note that the angle of the oscillations can cause anomalies in the dampening if they are large, so you should try to keep the oscillations small and to about the same angle; keep the pendulums total swing under 30°.

The pendulum length has already been set for you, and you have a range of masses to choose from. Set graph paper upon the wall, and make a point where the equilibrium position is. Then pull the pendulum to a specific height, and measure the initial amplitude. When releasing the pendulum, measure the amount of time it takes the maximum amplitude to drop 1 cm, 2 cm, 3 cm, etc. After you have recorded the dampening measurements for 1 mass, change the amount of mass, ranging from 50 - 500g. You should take data with at least 4 different masses, measuring dampening each time. Overall you should have at least 4 sets of data.

IN THE COMPUTER LAB:
Does the dampening change as the mass changes? Graph the dampening as a function of time for each mass, and write a full lab report explaining your findings.

Name

Date

THE VAULT
www.rawsonvault.com

Spring Mass Dampening Lab

INTRODUCTION
In a frictionless world, a spring-mass oscillation would continue on forever. However, we do not live in such a world. If you start a spring-mass oscillation in motion, eventually the spring will slow down, the amplitude (height of bounce) will decrease, and eventually it will stop bouncing altogether, resting at the equilibrium position. The amount that a spring-mass amplitude decreases each time is called *dampening*.

In this lab you will determine how the dampening of a spring-mass oscillation depends upon mass.

EQUIPMENT:

- Spring
- Ruler
- Timer
- Set of Weights

IN THE LABORATORY:
Hypothesis: How do you think the amount of dampening depends upon the mass?

Dampening can be broadly defined as the loss of energy in the oscillations. The outward energy losses arise from any possible frictional forces which are unavoidable in a realistic system. Note that springs can denature if they are pulled too far, so you should try to keep the oscillations at a reasonable amount. The mass given to you should be the greatest amount of mass used.

Set graph paper upon the wall, and hang the mass upon the spring, recording where the equilibrium position is. Then raise the spring upwards a specific length, and measure the initial amplitude. When releasing the spring, measure the amount of time it takes the maximum amplitude to drop 1 cm, 2 cm, 3 cm, etc. After you have recorded the dampening measurements for 1 mass, change the amount of mass, ranging from 20 - 60g. You should take data with at least 4 different masses, measuring dampening each time. Overall you should have at least 4 sets of data.

IN THE COMPUTER LAB:
Does the dampening change as the mass changes? Graph the dampening as a function of time for each mass, and write a full lab report explaining your findings.

Name

Date

Absolute Zero Temperature Lab

INTRODUCTION

In 1802, Joseph-Louis Gay-Lussac was studying the effects of how changing temperature may affect the pressure upon gasses. He found that the pressure upon gases increase in direct proportion with the change of temperature, provided the volume remains constant. His law was tested and proven to be true, but it was later shown that Gay-Lussac's law applied exactly only to a hypothetical ideal gas; real gases don't follow the law perfectly.

In this lab you will determine the relationship between the pressure and the temperature of a gas when its volume is held constant. You will also determine the value of absolute zero on the celsius scale.

EQUIPMENT:

- Hot Plate
- Ice
- Thermometer
- Closed, Metal ball with Pressure Gauge

IN THE LABORATORY:

Hypothesis: What relationship do you expect to see between pressure and temperature? What value do you expect for absolute zero?

The water temperature has already been raised to nearly boiling for you. You are going to measure the pressure in the tank as the temperature decreases. First record the air temperature, and measure the pressure gauge on the pressure device in regular air temperature. Then place the thermometer and the pressure gauge in the boiling water and record again. Next place ice and cool water into the tank to lower the temperature of the water, measuring the pressure numerous times.

IN THE COMPUTER LAB:

Graph the pressure of the gas as a function of its temperature. What relationship between pressure and temperature do you see? Use the equation your graph generates to extrapolate backward to determine absolute zero, the temperature at which pressure reaches zero. Based on these graphs and values, and write a full lab report explaining your findings.

Name

Date

THE VAULT
www.rawsonvault.com

Speed of Sound

INTRODUCTION

Sound is a common type of mechanical wave that can be heard but not seen. In todays lab, you will investigate the nature of sound waves by exploring the phenomena of resonance and the propagation of sound waves in a tube. When a tuning fork vibrates above a tube, there are certain lengths at which the tube will amplify the sound from the tuning fork. This happens because the sound wave travels down the tube and is reflected back and forth from each end in the tube. As the tube changes length, it will encounter the wave that has been reflected from the end of the tube, and a loud buzzing sound can be heard. When this happens, you observe the sum of the two waves and you have created a standing wave; this is known as a harmonic. As you remember from our standing waves diagrams, only $\frac{1}{4}$ of a wavelength is created for the first harmonic of a pipe open at one end.

In this lab you will determine the speed of sound in room temperature air.

EQUIPMENT:

- Tuning Forks
- 1000 mL graduated cylinder
- Water
- Graduated PVC pipe

IN THE LABORATORY:

Hypothesis: At what speed do you think sound travels through the air?

First record the temperature of the air in the room using a thermometer. The speed of sound varies with temperature, so you are really determining the speed of sound in air of a certain temperature. Fill the combined cylinders with water nearly to their tops. Set a tuning fork vibrating and hold it over the top of the tubes. Raise the inner tube until resonance occurs. Record the frequency of the tuning fork and the length of the column of air in which resonance occurs. Repeat this process with each tuning fork.

IN THE COMPUTER LAB:

Remember that the formula for a standing wave of a pipe open at one end is:

$$f_n = n\frac{v}{4L}$$

And that velocity = frequency * wavelength:

$$v = f \cdot \lambda$$

Determine the wavelength of each sound wave from the length of the air columns used. Then use the wavelengths and the frequencies of the tuning forks to determine the speed of sound in the air. Calculate an average value, and write a full lab report explaining your findings.

Name

Date

THE VAULT
www.rawsonvault.com

Resistor Combinations

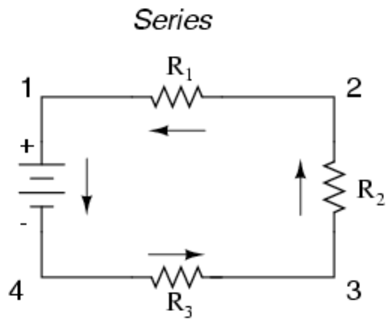
INTRODUCTION
In this lab you will try to determine how the total resistance of a collection of nearly identical resistors in series or parallel depends upon the individual resistors.

In this lab you will determine the speed of sound in room temperature air.

EQUIPMENT:

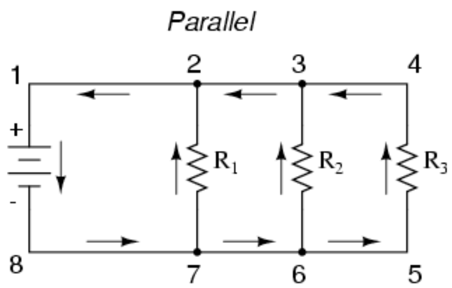
- Resistors
- Breadboard
- Multimeter

IN THE LABORATORY:



The *breadboard* in front of you is simply a network of wires, which help electricians map out a circuitry platform. Notice that the rows are numbered from 0 - 65, and the columns are given letters from A - J. Most of the breadboard has already been set up for you. First you will work with identical resistors in "series," which means that the electricity has only 1 direction to flow. It is often shown in an image similar to the one shown at right.

PART A: Identical Resistors Set the multimeter to measure resistance, looking for the Omega symbol, which looks like this: Ω. Measure the resistance across one of the resistors. Then start placing more resistors *in series* with the rst; give the electricity only one direction to flow. Measure resistance across all resistors in series.



Repeat this process with the same resistors, but place them *in parallel* with one another. When they are placed in parallel, it means that the electricity can choose more than one path to follow. If you look at the image on the left, you can see that the electricity has more than 1 direction to flow at all times. Record the resistance when there is 4 resistors in parallel, then 3 resistors in parallel, etc.

PART B: Different Resistors Hopefully by this point you have found a pattern between resistors in series and resistors in parallel. However, now we are going to add a new factor – using multiple resistors of *different* values. Now if you consider the first resistance of strength A, and the next resistor of strength B, add in some A's and some B's. FOr instance, add ABAB in series. Try ABAB in parallel. What do you get?

IN THE COMPUTER LAB:

Write a full lab report which incorporates the following:

- PART A: Identical Resistors – Graph the overall resistance as a function of the number of resistors. Create 2 separate graphs, one for series and one for parallel circuits. Based upon the two trendlines, write a general equation representing the overall resistance when resistors are placed in a series circuit and a parallel circuit.
- PART B: Different Resistors – Graph your overall resistances as a function of number of resistors, and types of resistors. Could you find a pattern that related to part A?