Topic 24: Oscillations in water

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International Young Naturalists' Tournament

Problem

Take a vial, a tall glass, or a bottle and load it with heavy objects. Make it float vertically on the water surface. If displaced up or down, the vial will oscillate. **Calculate theoretically** and **measure experimentally** the **period of its oscillations**.

Introduction

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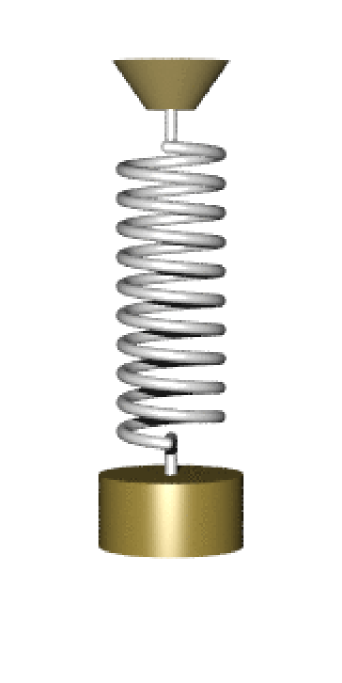
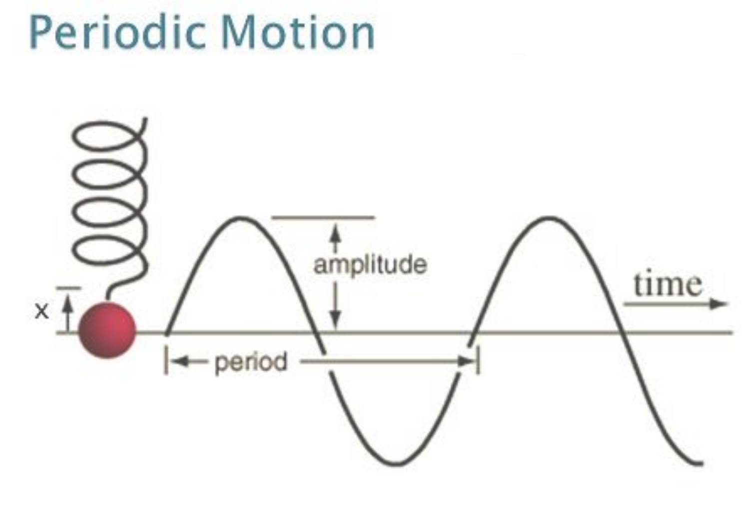
Oscillation and periodic objects

- A regular variation in magnitude or position about a central point called the equilibrium
- In the experiment, the vial is an example of periodic motion.
- A period is the time taken for an object to make one oscillation



Introduction



Graph of the periodic motion of an object

Calculating the Period

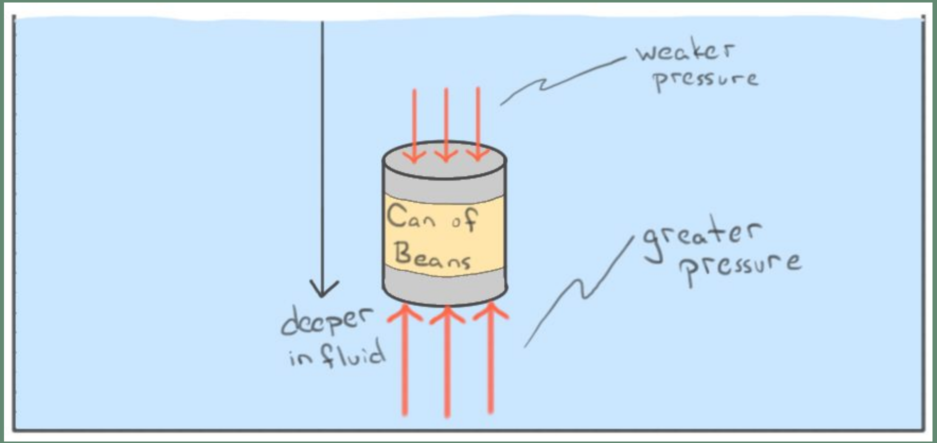
$$T = 2\pi\sqrt{\frac{l}{g}}$$

Where:

T: Period of the oscillation
l: length of the water inside the vail
g: gravitational force

Buoyant

When an object is submerged in a fluid an upward force is applied on the object: the Buoyant force



- Pressure increases as the object goes deeper
- The force from pressure exerted downward on the top of the object will be less than the force from pressure exerted upward on the bottom of the object

Introduction

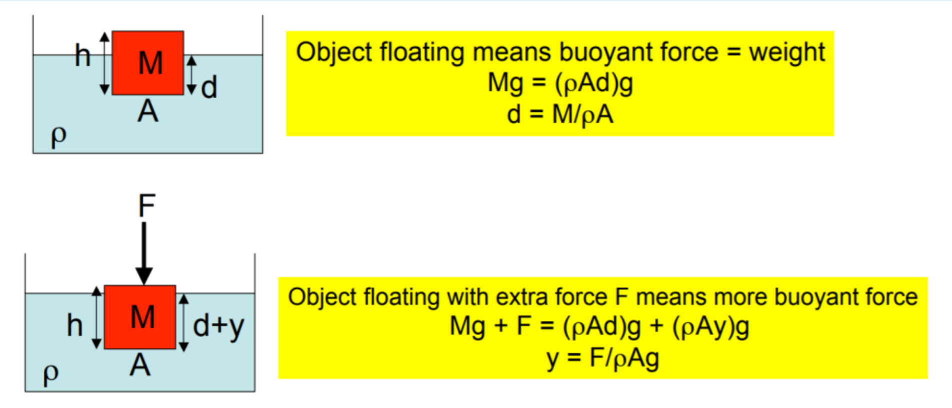
Buoyancy Formula

Buoyant Force: F_b=-pgV

Object floating means buoyant force = weight

$Mg = (\rho Ad)g$

$d = M/\rho A$



M = Mass
g = Acceleration of gravity
ρ = Fluid density
A = Surface area

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Research Question:

Does an increase in the height from the base affect in the period of oscillation of the test tube?

Introduction

Hypothesis:

Based on research, The oscillating object goes through and damped simple harmonic motion.

That means that at the best approximation, the number of the oscillations will will be more when the height is greater.

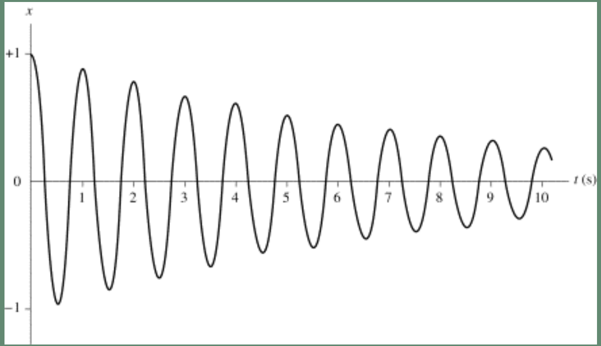

Figure 2: Graph of a Damped SHM

Variables-Exp 1

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Independent	Dependent	Control
• Height from the base of the jar	• Number of oscillations	• Size of test tube • Temperature of water • Amount of water in container (ml)

All Materials

1. Containers
    a. Erlenmeyer Flasks Conical Glass Beaker (500ml)
    b. Test tube (ml
2. Mass blocks (1.17g)
3. Water
4. Motion Sensor (NeuLog)
5. Sticker (target for sensor)
6. Clamp
7. Ruler stick
8. Test tube (22.42g)
9. Small blocks of mass 1.17g

Figure 3: Erlenmeyer Flasks 500ml Conical Glass Beaker

Figure 5: NeuLog Motion Sensor

Figure 4: Test Tube

Method

1. An jar was filled till 1000ml.
2. Five blocks of mass was added inside the test tube and the top of the test tube was covered with a sticker.
3. A ruler was also fixed in place, so that the top of the test tube was located at 20 cm.
4. The test tube was released at 4 different heights (-2cm, 1cm, 3cm, 5cm).
5. A video was taken and the number of times the object oscillated was recorded.

Results

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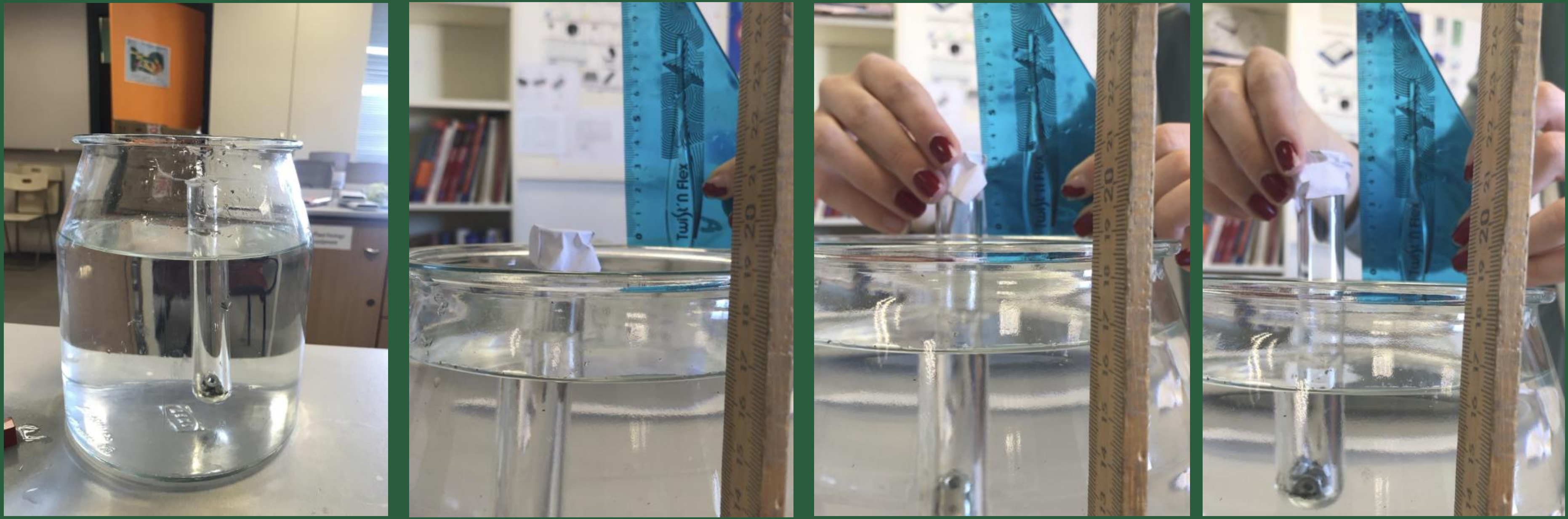

Figure 6 The set up of experiment

Results

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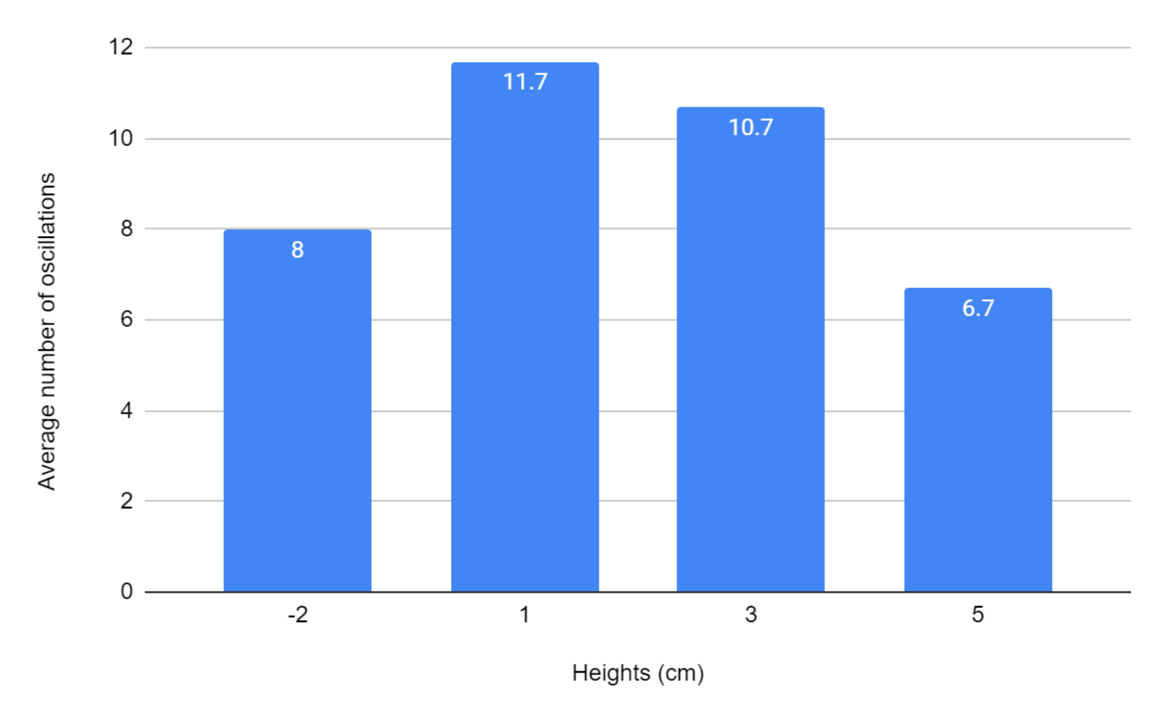
Raw Data

Insert graph

	-2 cm	1 cm	3 cm	5 cm
Trial 1	8	12	11	5
Trial 2	9	11	6	5
Trial 3	7	12	5	10
Mean	**8**	**11.7**	**10.7**	**6.7**

Results



Graph 1: Number of oscillations per height

Variables-Exp 2

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Independent	Dependent	Control
• Positions of	• Time in Seconds	• Size of test tube • Temperature of water • Amount of water in container (ml)

Set up 2

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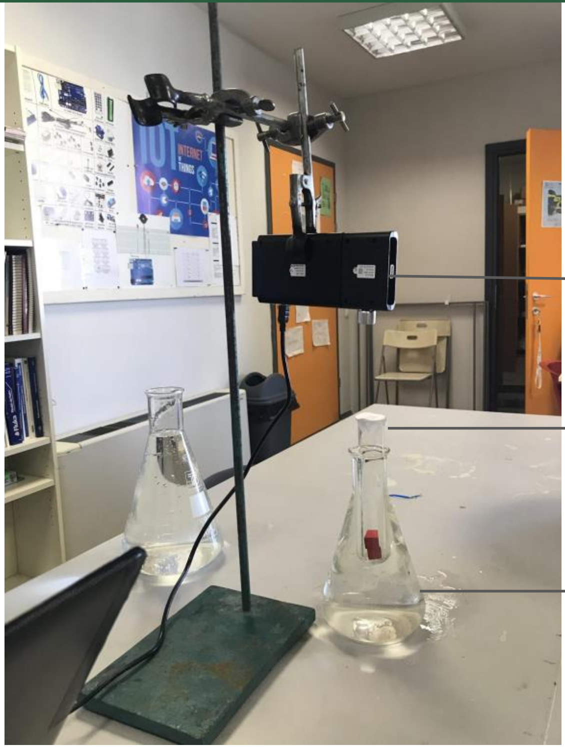


NeuLog Motion Sensor

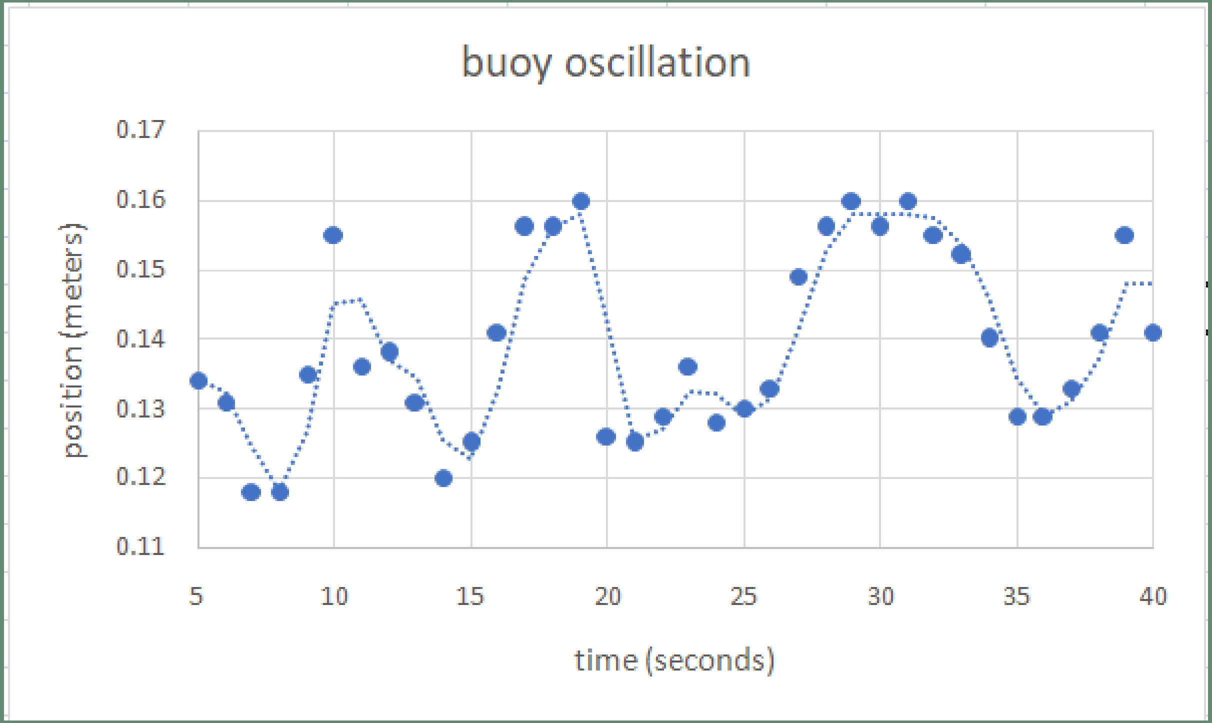
Test tube with the blocks of masses inside

Erlenmeyer Flask - 500ml water

Figure 5.

Figure 4. Setup of Erlenmeyer Flasks Conical beaker and test tube

Graph-Experiment 2



Thank you