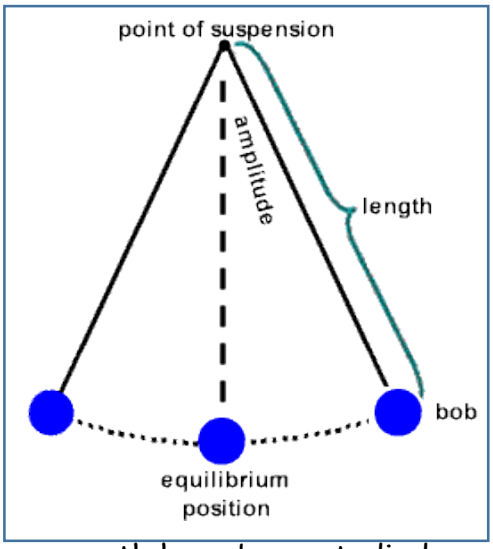
Name _____ date_____ period___ mailbox_____

SCIENCE 8 **SCIENCE 8**

Kinetic and Potential Energy Lab – Pendulum Study **VIDEO** https://youtu.be/YhMiuzyU1ag

Background Information: If you've ever ridden on a swing at a playground then you are familiar with a pendulum. A swing is similar to a pendulum, except that a weight (called a pendulum bob) is placed at the end of one string that hangs from a fixed position, rather than *you* seated at the end of a pair of chains affixed to a seat or old tire. The physics of the movement of a pendulum is so precise that pendulums are often used in clocks and metronomes. A *metronome* is an instrument used to keep time for musicians. A pendulum swings back and forth at a steady pace under the influence of gravity. The distance between the bob and the anchor point at the top of pendulum is called the *amplitude*. The amount of time it takes a pendulum to complete one swing, (out and back), is called the *period* of the pendulum. The physics of pendulums on earth have been studied intimately for ages. The period is a very precise, consistent and predictable variable. Because of this, pendulums were once critical to people around the world, in that they kept the mechanics and timing of clocks precise before the digital age. You are likely familiar with or have seen a grandfather clock. It is in fact a pendulum, which ticks back and forth inside. Pendulums represent the essence of both potential and kinetic energy in constant transformation, as they swing back and forth. Once the initial gravitational potential energy of a pendulum is set in motion, there is a constant exchange between potential and kinetic for as long as the pendulum's bob continues to swing. Many variables can impact the timing of a pendulum's swing. In this study, we will consider two, **mass** and **(amplitude) "string length"**.



Directions: To help our experimental data we will have multiple pendulums swinging at several lab stations around the room. Be sure to observe your assigned pendulum and be diligent in recording your data precisely and accurately using proper scientific techniques. (see Burn's demo)

Experiment: For experimental purposes we will consider two different variables that may influence ***period*** of the pendulum.

- Team 1 will investigate the **mass** of a pendulum bobs' effect on the pendulum's **period time**.
- Team 2 will consider the pendulum's **string length** on the length of the **period time**.

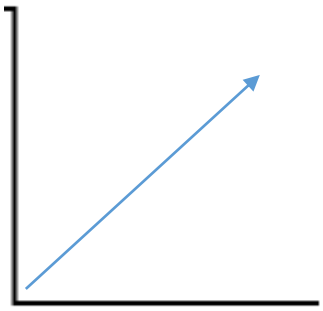
Procedure for Team 1 & Team 2:

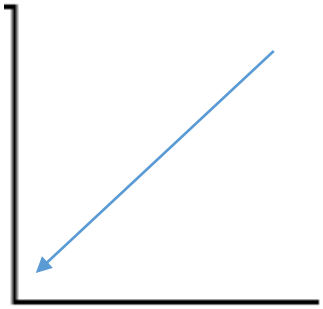
1. Pull the pendulum out so that the string makes a 45° angle with the metal stand. Start the pendulum's swing from this point every time. (Be consistent)
2. Release the pendulum and count the number of swings (to and fro) for 30 seconds. Repeat three times. If your team messing up in anyway, don't count it and run the trial again.
3. Record the # of swings in the data table. Find class data table on board and record on your personal data sheet.

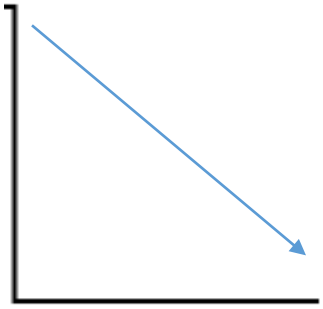
DO NOW: Copy down the following **(CLASS NOTES)**

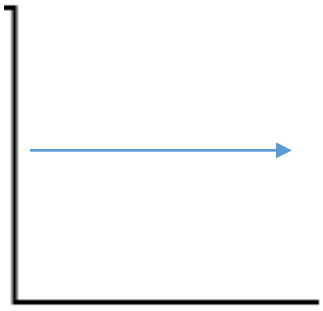
Label each axis **DV** or **IV**

Label which type of **relationship** each graph depicts.









Data Table Team 1	Trial 1	Trial 2	Trial 3	Trial 4	Avg. # of swings
Mass 1 (lightest) _____ grams					
Mass 2 (light) _____ grams					
Mass 3 (medium) _____ grams					
Mass 4 (heavy) _____ grams					

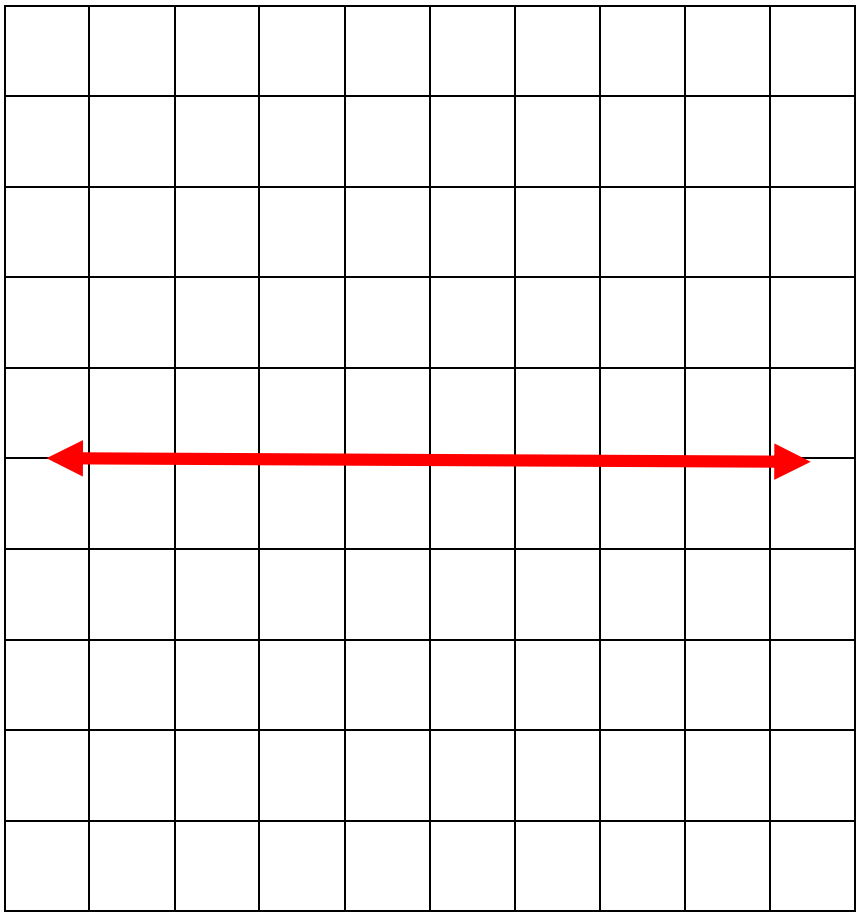
Graphing Directions: Label both the x & y axes. Determine the DV and IV. Label appropriate numbers along both axes utilizing the majority of the graphing space. Then plot the data from the appropriate table above.

What is the IV_____? What is the DV_____?

*Relationship between **Mass** and Period duration in Pendulums*

_____

Y axis (DV)



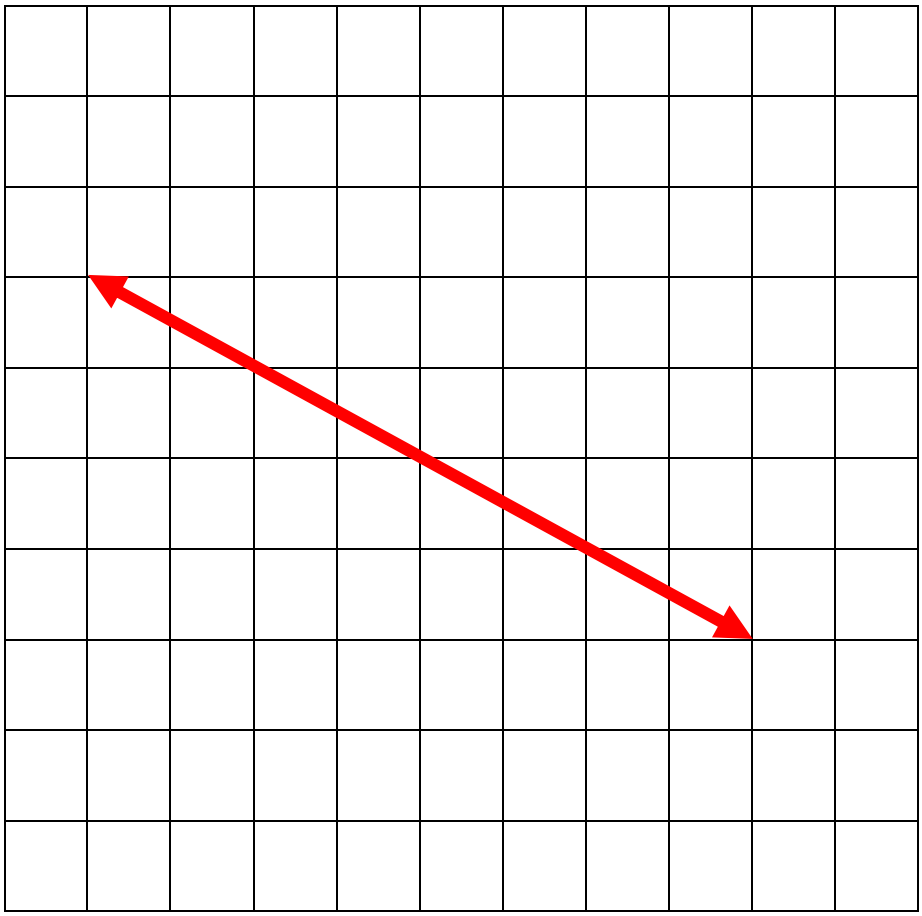
_____ **X** axis (IV)

Data Table Team 2	Trial 1	Trial 2	Trial 3	Trial 4	Avg. # of swings
Length 1 (shortest) _____ (cm)					
Length 2 (medium) _____ (cm)					
Length 3 (longer) _____ (cm)					
Length 4 (longest) _____ (cm)					

Graphing Directions: Label both the x & y axes. Determine the DV and IV. Label appropriate numbers along both axes utilizing the majority of the graphing space. Then plot the data from the appropriate table above.

What is the IV_____? **What is the DV_____?**

*Relationship of Amplitude (**Length of String**) and Period duration in Pendulums*



_____
Y axis (DV)

_____ X axis (IV)

Team-1 How does the **mass** of the pendulum affect the (*period*) number of swings in 30 seconds? After having analyzed the data select the choice that forms a correct hypothesis. In other words select the choice that makes this a true statement.

A. **If** the mass of the bob increases, **then** the number of swings will remain the same **because** acceleration due to gravity is a constant on earth.

B. **If** the mass of the bob increases, **then** the number of swings will increase **because** acceleration due to gravity on earth speeding up on object with more mass.

C. **If** the mass of the bob increases, **then** the number of swings will decrease **because** acceleration due to gravity slowing the heavier object down.

Team-2 How does the **amplitude** (string length) of the pendulum affect (*period*) the number of swings in 30 seconds? After having analyzed the data select the hypothesis that is correct.

A. **If** the amplitude of the pendulum decreases **then** the (*period*) the number of swings in 30 seconds will decrease **because** it takes longer to swing out and back.

B. **If** the amplitude of the pendulum increases **then** the (*period*) the number of swings in 30 seconds will increase **because** it takes longer to swing out and back.

C. **If** the amplitude of the pendulum increases **then** the (*period*) the number of swings in 30 seconds will decrease **because** it takes longer to swing out and back.

Lab Write-Up cont: *Relationship between **Amplitude** and Period duration in Pendulums*

1. The length of time it takes a pendulum to swing out and back is called the _____
2. The length of string or distance between the pendulum bob and anchor point on the ring stand is referred to as the _____

3. ____ **After** analyzing the data, how does the length of the pendulum have an effect on the number of swings in 30 seconds?

A. The length does not have effect.
B. Increased length increases the number of swings
C. Increased length decreases the number of swings
D. Mass is the dependent variable

4. What are possible sources of error when performing the lab? (What were some factors/actions that may have caused the data to be inaccurate?) Elaborate, explain, etc. If in your opinion it went perfectly, then tell me what could have gone wrong.

_____

_____

_____

Legible complete sentences for full credit.

Lab Write-Up Questions: *Relationship between **Mass** and Period duration in Pendulums*

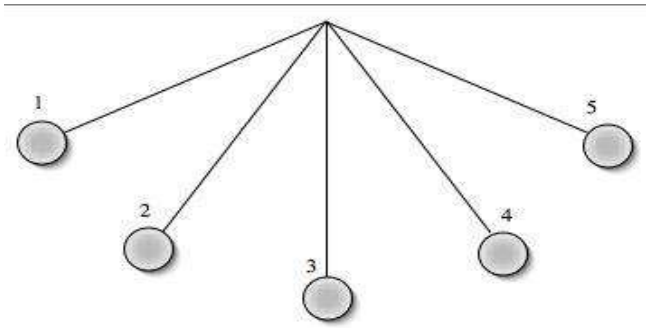
1. The name of the weight that is tied to the bottom of the string is called a _____

2. What instrument were pendulums critical for, before the digital age? _____

3. _____ **After** analyzing the data, answer the following. How does the change in mass have an effect on the number of swings or ***period*** of a pendulum?

A. The mass does not have effect.
B. Increased mass increases the number of swings
C. Increased mass decreases the number of swings
D. Mass is the dependent variable

Physics of Pendulums Questions



1. At the start of each trial, the pendulum bob was raised up at an angle from its resting position 1. What specific *form* of energy did the pendulum bob have at this point? _____

2. Write the number(s) from diagram where the pendulum bob has the greatest kinetic energy: _____

3. Write the number(s) from diagram where the pendulum bob has the greatest potential energy: _____

4. Where does the bob have nearly equal amounts of both KE and PE? _____

5. Where does the bob have the least potential energy? _____

6. Recall &/or look up from your notes, The Law of Conservation of Energy (LoCoE). How does the energy in a swinging pendulum represent the LoCoE? **Explain with details and use the following vocabulary: CREATED, DESTROYED, KINETIC (KE), POTENTIAL (PE)**

_____
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Legible complete sentences for full credit.