ScienceCube

Modern Galileo Experiment

Measure and explain whether Galileo's assumption of uniformly accelerated motion is valid through experimentation.

Fundamental Concept

1. **Galileo Galilei**

An Italian astronomer, physicist, and mathematician known for his discoveries of the law of the pendulum and the principle of inertia, among other contributions. He supported Copernicus' heliocentric theory and faced opposition from the Catholic Church.

2. **Tower of Pisa**

It is said that Galileo dropped two spheres of different masses from the Leaning Tower of Pisa to demonstrate that their time of descent was independent of their mass, contradicting Aristotle's theory. This experiment is a famous example showing that scientific conclusions should be based on experimental results rather than theoretical speculation.

3. **Law of Uniform Acceleration**

Galileo introduced the law of uniform acceleration, which he defined as the increase in velocity of an object by equal amounts in equal time intervals. He further explained that objects of different sizes and masses experience the same acceleration. Galileo illustrated this with examples of both free fall and inclined planes. This theory opposed the then-common belief that heavier objects fall faster than lighter ones. While Galileo measured time using a water clock, we will use a motion sensor in this experiment to determine whether Galileo's hypothesis holds true.

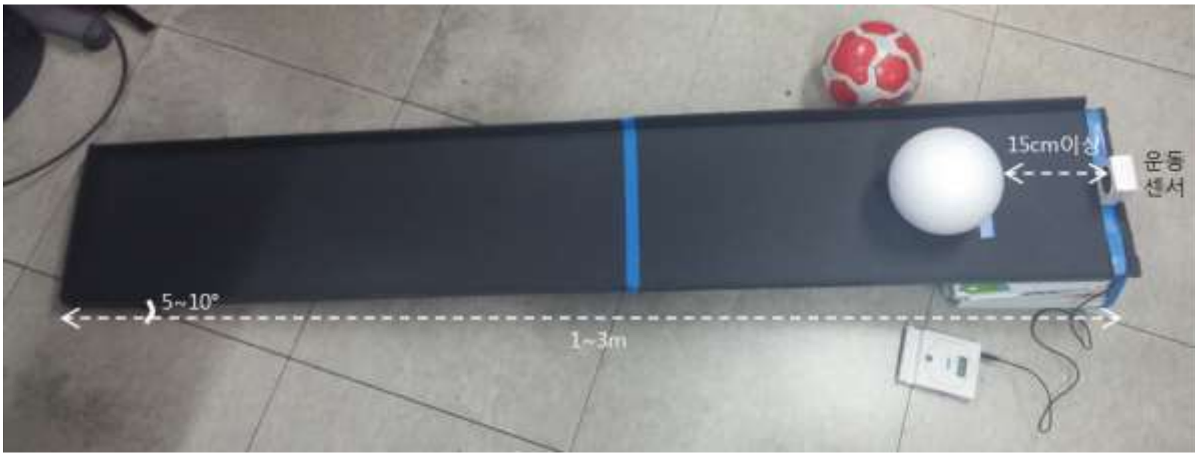
Experiment

Materials Needed

Interface, Science# program, Smart device, Motion sensor, Inclined plane (1-3m), Two balls of different masses (15-20cm in diameter), Digital scale

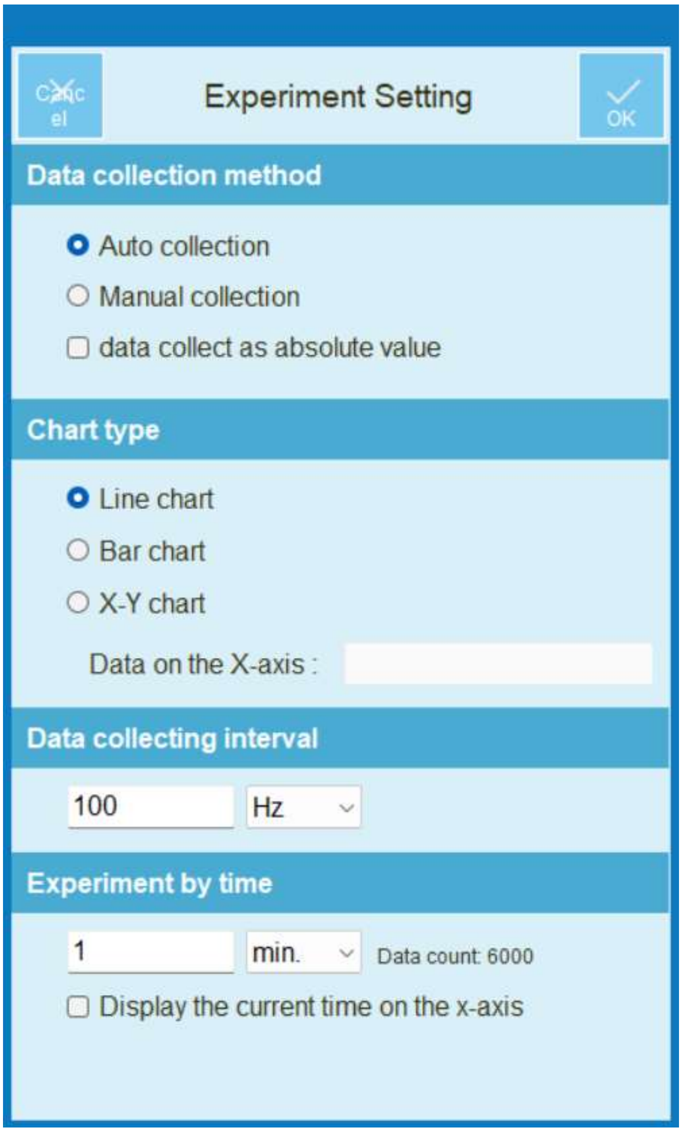
Experimental Setup

1. Fix the inclined plane at an angle of 5-10° relative to the horizontal.
2. Place the motion sensor at the top of the inclined plane.
3. Mark a starting line 15cm away from the motion sensor.



Interface Setup

1.  Run the Science# program.
2. Connect the motion sensor to the interface.
3. Click  to set up the experimental environment or click  for automatic setup.



Data Collection

1. Place the lighter ball at the starting line, ensuring it is at least 15cm away from the motion sensor.
2. Click to start data collection.
3. Release the ball and allow it to roll down the inclined plane, recording the time-distance graph.
4. Once the measurement is complete, click to stop data collection.
5. Convert the time-distance graph to a time-velocity graph using [Analyze] -> [Basic

Analysis] -> [Differentiate].

6. Calculate the slope (A) of the time-velocity graph using [Analyze] -> [Basic Analysis] -> [Linear f(x) - Ax + B].
7. Repeat the same procedure with the heavier ball.

Data Analysis

Recording Data

1. Measure and record the masses of the two balls..

구분	질량이 작은 공	질량이 큰 공
질량(g)		

2. We rolled two balls of different masses down an inclined plane and plotted the time-distance graph of the moving balls..

< Time-Distance Graph_Small Mass Ball>

< Time-Distance Graph_Large Mass Ball>

데이터 적용

3. Convert the time-distance graph of the two balls rolling down the inclined plane into a time-velocity graph using [Analyze]-[Basic Analysis]-[Differentiate]. Then, using [Analyze]-[Basic Analysis]-[Linear f(x) = Ax + B], determine the slope (A value)..

< Time-Velocity Graph_Small Mass Ball>

< Time-Velocity Graph_Large Mass Ball>

4. Record the acceleration (A value from f(x) = Ax + B) of the two balls of different masses.

Category	Small Mass Ball	Large Mass Ball
Acceleration (m/s^2)		

5. Do the movements of the two balls with different masses follow Galileo's hypothesis? Explain based on the measured data.


Report
(For Teachers)


Report
(For Students)