**Purpose:** To investigate the relationship between a squared quantity and its result. To investigate the distance of free fall during equal time intervals.

**Equipment:**

Long piece of string, meter stick, calculator, hex nuts, metal pan.

**Introduction:**

1. Imagine taking a long piece of string and tying hex nuts at equally spaced distances. If you dropped the string from a great height you would hear the nuts hit the pan below as they fell. Would you hear a steady beat or would the time between clangs change as they fall? Explain your answer.\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The goal of this activity is to tie hex nuts onto the string at the correct distances so that they will hit the pan at equal intervals of time. In other words, you want to hear a steady beat. Galileo determined that there is a relationship between the distance an object falls and the square of the time that it is falling. Objects speed up as they fall because of gravity. This increase in speed is known as acceleration. Acceleration caused by gravity (on Earth) is 9.81 m/s2. We will use 10 m/s2 to make our calculations simpler.

Here is the formula that shows the relationship between distance, gravity, and time:

2. Since gravity causes things to move very quickly, you will need to use small units of time. **Complete the chart** for the distances required by using the given units of time. The distances you will find are measured in *meters.*

|  |  |  |
| --- | --- | --- |
| **Given *t* in seconds**  **(x values)** | **Substitution** | **Distance *d*  in meter**  **(y values)** |
| 1/6 | d=.5 (10) (1/6)2 | .139 |
| 2/6 |  |  |
| 3/6 |  |  |
| 4/6 |  |  |
| 5/6 |  |  |
| 1 |  |  |
| 7/6 |  |  |

3. Measure out a length of string as long as necessary, with a little extra for knot tying. Tie the first nut to the end of the string. This will be the nut that hits the pan first. Then tie each successive nut at the distances you calculated. Each distance is measured from the first nut, not from the previous nut.

4. Take your string to a high place (top of staircase, balcony, etc. . . ) Hold the string so that the first nut is hanging about 10 centimeters above the pan on the floor below. Let go and listen to the clangs as the nuts hit the pan. Did you hear a steady beat?\_\_\_\_\_\_\_\_ Did the clangs occur at *equal* time intervals?\_\_\_\_\_\_\_

5. **Graph** the relationship you found on the graph below. Mark each space on the x-axis in equal intervals of time. Mark each space on the y-axis with equal distances. Choose an appropriate scale for the distances you have calculated.

