Gravity

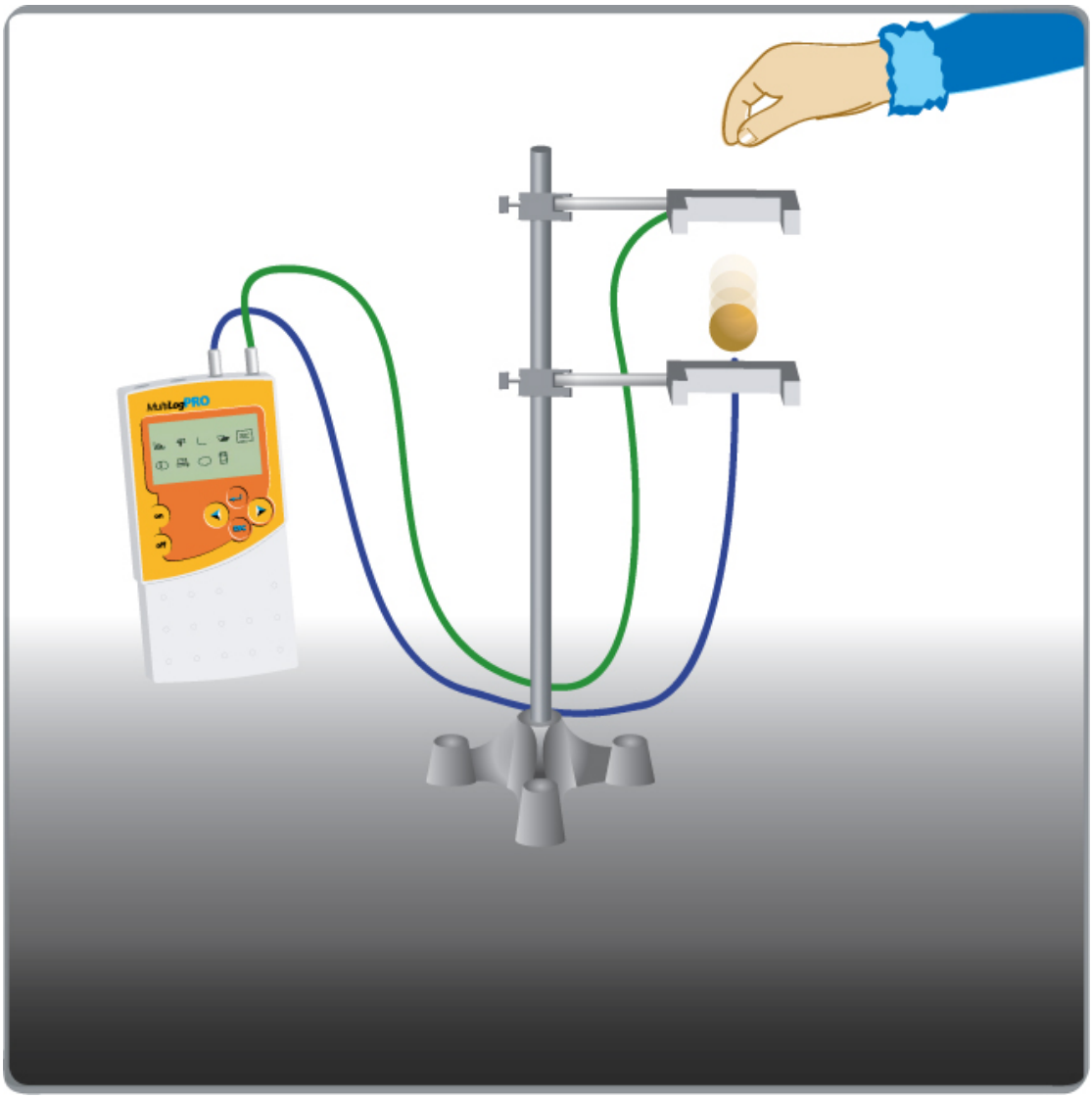
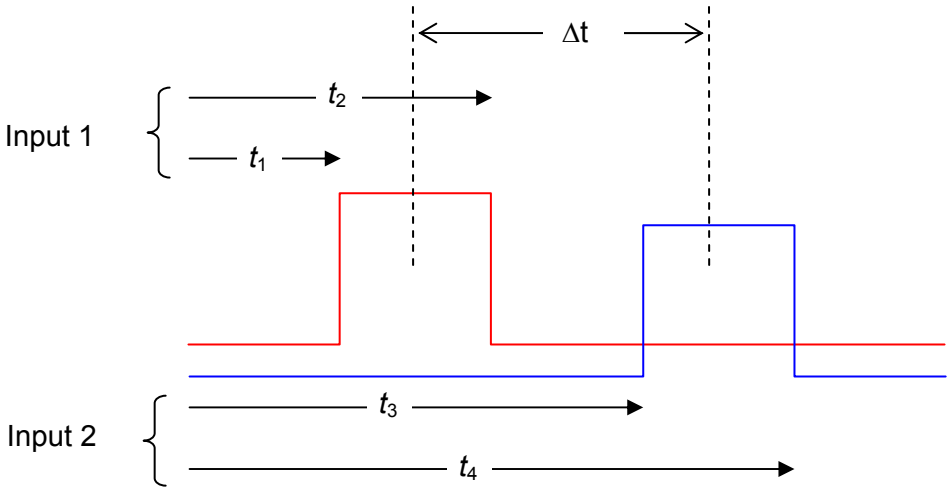


Figure 1

Introduction

In this activity we are going explore the motion of falling bodies. We will use two photogates. A photogate is made of infrared light source which sends a narrow light beam to a light sensor on the other arm of the photogate. The data logger uses its electronic clock to record the time whenever the light beam is blocked or unblocked. By using two photogates we can measure the velocity of a falling body at each gate and the time it takes the body to move from one gate to the other – thus enabling the data logger to calculate the acceleration:



Result:

(1)

$$v_1 = \frac{w}{t_2 - t_1}; \quad v_2 = \frac{w}{t_4 - t_3}$$

$$\Delta t = \frac{t_4 + t_3 - t_2 - t_1}{2}$$

$$a = \frac{v_2 - v_1}{\Delta t}$$

Where w is the falling body width.

Equipment

- MultiLogPRO or Nova or TriLink data logger
- Photogate (2)
- Various small balls
- Stand
- Right angle clamp (2)
- Caliber or Meter stick

Equipment Setup Procedure

1. Assemble the equipment as shown in Figure 1
2. Mount two photogates one above the other, about 20cm apart, so that a ball can fall freely through the photogates arms

3. Measure the balls' diameters and record the data in your notebook

4. Weigh the balls' and record the data in your notebook

5. Turn on the data logger

6. Connect the upper photogate to input 1 (I/O-1) of the data logger

7. Connect the lower photogate to input 2 (I/O-2) of the data logger

8. Connect the data logger to the computer

9. Run MultiLab

10. Click **Setup Wizard**  on the main toolbar and **program** the data logger according to the setup specified below

Data Logger Setup

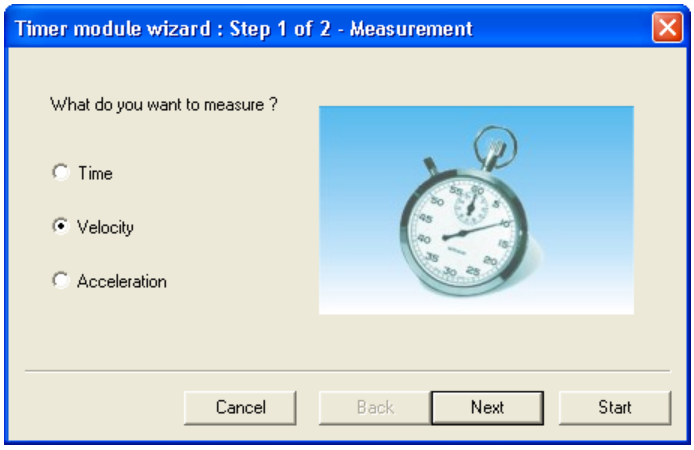
Sensors:

Input 1: Voltage 5V

Input 2: Voltage 5V

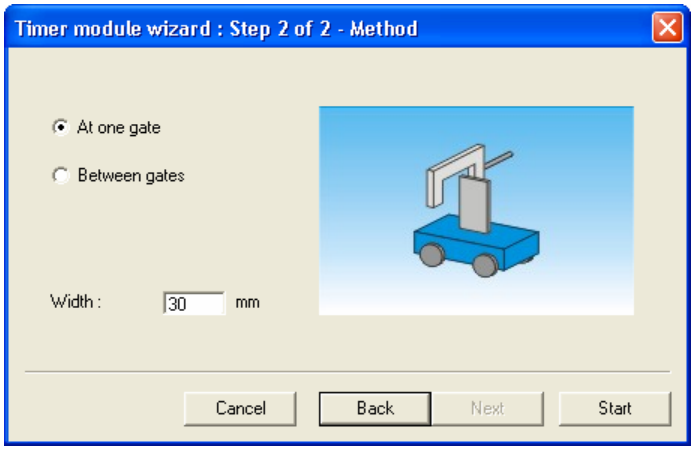
Experimental Procedure

1. Click **Logger** on the menu bar, then click **Timing Wizard** to open the Timer module wizard:



2. Click **Acceleration**

3. Click **Next** to move to step 2:



4. Click **Between gates**

5. Enter the body's width in mm

6. Click **Start** to enter to a timing standby mode

Timing begins each time a body blocks the photogate in input 1 and ends when unblocking the photogate in input 2. MultiLab displays the results in a bar graph and in the table

7. Drop the ball through the two photo gates

Hints:	Take care to drop the ball vertically to limit interference with the fall Center the ball so its core diameter crosses the photo gates' beam

8. Repeat this procedure several times

9. After several trials, click **Stop** 

10. Save your data by clicking **Save**  on the upper toolbar

11. Repeat this procedure with different balls

Data Analysis

1. Calculate the average acceleration for each ball (you can use MultiLab's statistics tool)

2. Do the results agree with the accepted value?

3. Does the free fall acceleration depend on the body's weight?

4. Does the free fall acceleration depend on the body's shape?

5. Explain how is it that all body's fall with the same acceleration