Name ______________________________ Period __________ Date __________

Free Fall — Lab 1.3

Purpose

The purpose of this lab is to understand the relationship between the time and height for an object in free fall.

Required Equipment

- Meter stick or meter tape
- Tennis ball
- Timer

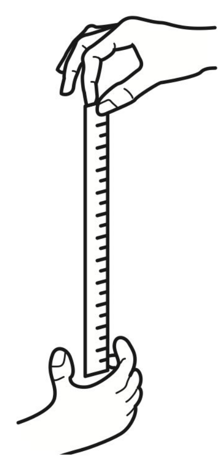
Discussion

In this activity you will find the height of a locations using only a stopwatch and a tennis ball. In a universe with no friction, all objects will accelerate at constant rate we call g. Close to the surface of the Earth g is equal to 9.8 m/s2 and this means a falling object will gain 9.8 m/s of speed each second or a rounded 10 m/s of speed. At the end of one second an object will be traveling close to 10 m/s, at the end of two seconds an object should be traveling close to 20 m/s, at the end of three seconds the object should be traveling at 30 m/s, and so on. At the end of this activity you will compare your calculated value for height with the actual value and see how close you were to each location.

$$\Delta h = v_o t + \frac{1}{2} g(\Delta t)^2$$

Reaction Time

Your reaction time is the time it takes from when you see an event to how long it takes you to react to that event. In this part of the activity each person is going to find their reaction time.



1. Have another student hold a meter stick or ruler, between your open index finger and thumb. Line up your fingers on meter stick and record this point as the starting point. When you are ready, your partner will release the ruler and you will try to catch the ruler between your fingers as fast as possible. Repeat three times and record your results and calculate the average for each column .

Trial #	Starting Point (m)	Ending Point (m)	Fall Distance (m)
1			
2			
3			
Average			

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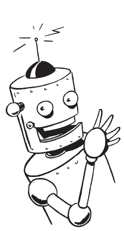

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Chapter 1 Linear Motion

Calculate your Reaction Time

2. Calculate the time of fall (your reaction time). Since the ruler starts from rest we can cancel out the original velocity. Use 9.8 m/s² for g

$$\Delta d = v_o \Delta t + \frac{1}{2}a(\Delta t)^2 \longrightarrow \Delta d = \frac{1}{2}a(\Delta t)^2 \longrightarrow t^2 = \frac{2d}{g} \longrightarrow \boxed{t = \sqrt{\frac{2d_{\text{fall distance}}}{g}}}$$

Show your work:

Your reaction time (s): ______________________

Procedure

3. Report to your instructor. Your instructor will give you several location where you will attempt to calculate the height using only a tennis ball and a stopwatch.

4. Based on who has the best reaction time in your group, select that person to do both the dropping and timing. **Important:** The person dropping the ball must also be the timing.

5. Do several practice runs in order to get a feel before starting the timing.

6. Record the fall time for each location in **Data Table A**.

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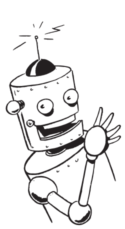
Data Table A

Location	Time (s)				Final Velocity (m/s)	Calculated Fall Height (m)
	trial #1	trial #2	trial #3	Ave Time		



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Chapter 1 Linear Motion

Free Fall **Lab 1.3**

Complete Data Table A

7. Using the equation for final velocity, calculate the final velocity (v_f) of the ball in each location. (The original velocity is 0 and use 9.8 m/s^2 for g)

$$v_f = v_o + g\Delta t \longrightarrow \boxed{v_f = gt}$$

Show your work:

8. Using the equation for distance, calculate the fall height (Δh) for each location. (The original velocity is 0 and use 9.8 m/s^2 for g)

$$\Delta h = v_o t + \frac{1}{2}g(\Delta t)^2 \longrightarrow \boxed{\Delta h = \frac{1}{2}g(t)^2}$$

Show your work:

Finding Percent Error

9. Record the actual height and the calculated height in **Data Table B.**

10. Calculate the percent error for each location and record in **Data Table B**.

$$\% \text{ error} = \left(\frac{\text{calculated height} - \text{actual height}}{\text{actaul height}}\right) \times 100$$

Data Table B

Location	Actual Height (m)	Calculate Height (m)	% Error

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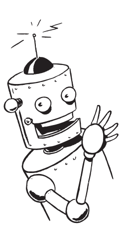

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Free Fall

Lab 1.3

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