Lab 1 Motion – Reaction Time

Objectives

In this lab, students will review the concepts they have learned about motion, and find their own reaction time to a visual stimulus by studying the free fall (approximately) motion of a dollar bill and a ruler.

Supplies

- One-dollar bill (the newer, the better)
- Ruler
- Timer

Theory

If we assume the ruler released vertically from rest is doing free fall, the distance it travels before you catch it can be calculated using the following formula:

$$\Delta h = \frac{1}{2} g t^2$$

where g is the gravitational acceleration and its value is $g = 9.8 m/s^2$.
Then we can find the time it takes you to react and catch the ruler by isolating t from the above formula:

$$t = \sqrt{\frac{2\Delta h}{g}}$$

Please think whether or not the assumption that a ruler released vertically from rest is doing free fall is reasonable. Why?

Procedure

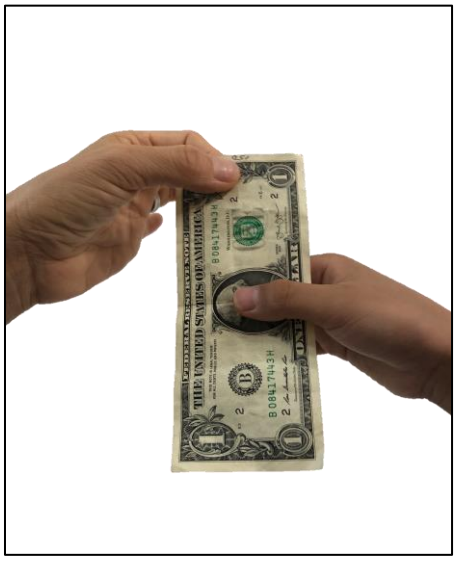
Step 1

a. Find a partner and form a two-student team. Decide who will release (the Releaser) the one-dollar bill and who will catch it (the Catcher)

b. Take out a one-dollar bill. The Releaser holds the bill using two fingers (thumb and index) right above the image of President Washington vertically (see Figure 1) and gets ready to release it any moment. The Catcher puts his/her fingers at the same level around the Releaser's fingers from the other side and gets ready to catch the bill as soon as the Catcher sees that it is released.

(**NOTE: The Releaser should not give any warning** about when the bill will be released. We are studying one's reaction time to a visual stimulus, so the Catcher should try to catch the bill the moment the Catcher "sees" the other student releases it.

Figure 1. How to hold the dollar bill



c. Students exchange role and repeat Step 1(b). The student who caught the bill will now be the Releaser, and the other student will catch the bill.

d. Report whether or not each student caught the bill without cheating.

Step 2

a. Now repeat the experiment with a ruler instead of a one-dollar bill, but hold the ruler vertically at a relatively lower position.

b. Record the reading of the start position on the ruler under column H_1 in Table 1 before it is released.

c. The Catcher tries to catch the ruler as soon as it is released and record the end position where the ruler is caught under column H_2 in Table 1 below.

Step 3

Repeat Step 2 between the two students 6 times. Record the start position (H_1) and the end position (H_2) for each trial.

Step 4

Calculate he change h, which is H_2 minus H_1 ($\Delta h = H_2 - H_1$) for each trial and record them in Table 1 below.

Step 5

Find the reaction time using the formula:

$$t = \sqrt{\frac{2\Delta h}{g}}$$

Data and Calculations

Table 1. Measurement results and reaction time

Trial	H_1	H_2	$\Delta h = H_2 - H_1$ (change in h)	$t = \sqrt{\frac{2\Delta h}{g}}$ (reaction time)
1				
2				
3				
4				
5				
6				

What is the average t for all six trials? Average: _____

Questions

1. Google human's reaction time to a visual stimulus.

   Write down the given value: _____

   Compare your experimental value, which is your average t answer, with the Googled given value using this formula:

$$error\% = \frac{experimental\ value - given\ value}{given\ value}$$

2. Discuss the possible reasons for the difference between the value you measured in class and the value given online. (Hint: Is the fall of the ruler a real free fall? What sources of error can you identify in doing the experiments? Etc.)

First and last name:

_____

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