Reaction Time

Authored by *Paul Robinson*, laserpablo.com

Topic: Accelerated Motion

Purpose

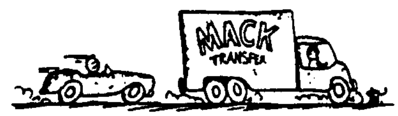
To measure reaction time and the role it plays in a variety of situations.

Equipment and Supplies

dollar bill
centimeter ruler

Discussion

Reaction time is the time interval between receiving a signal and acting on it—for example, the time between when a frog sees a fly land on an adjacent leaf and the flick of the frog's tongue to capture the tasty morsel.

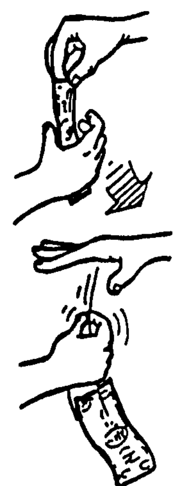


Reaction time often affects the making of measurements, such as when using a stopwatch to measure the time for a 100-m dash. The watch is started after the gun sounds and is stopped after the tape is broken. Both actions involve the reaction time.

Procedure

Part A: What's My Time?

Step 1: Hold a dollar bill so that the mid-point hangs between your partner's fingers. Challenge your partner to catch it by snapping his or her fingers shut, without moving the rest of the hand, when you release it. Also, have your partner hold the bill in the same way and see if you can catch it when you it is released. What do you discover?



Now try it using a ruler as shown to the right. The distance the ruler will fall is found using

$$d = \frac{1}{2}gt^2$$

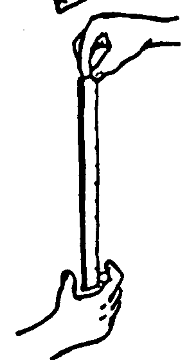
Simple rearrangement gives the time of fall in seconds

$$t^2 = \frac{2d}{g}$$

$$t = \sqrt{\frac{2}{980}}\sqrt{d}$$

$$t = 0.045\sqrt{d}$$

(for d in cm, t in s, we use g = 980 cm/s^2)



Step 2: You and your partner will now take turns dropping a centimeter ruler between each other's fingers. Catch it and record the number of centimeters that passed during the reaction time it took each of you to catch the ruler each time. Each of you should drop the ruler three times. Then calculate your reaction time using the formula:

$t = 0.045\sqrt{d}$ where d is the average distance in centimeters.

Reaction Time Measured in Ruler Catching Distance

Trial #	Starting Point (cm)	Ending Point (cm)	Distance Traveled (cm)
1			
2			
3			
Average			

Calculate your reaction time using the average for your three trials. Show your calculations.

your reaction time = __________

Summing Up

1. Do you think your reaction time is always the same? Is your reaction time different for different stimuli?

2. Suggest possible explanations why reaction times are different for different people.

3. Do you think reaction time significantly affects measurements you might make when using timers for this course? How could you minimize its role?

4. What role does reaction time play in applying the brakes to your car in an emergency situation? Estimate the distance a car travels at 100 km/h due to your reaction time in braking.

5. Give examples where reaction time is important in sports.

Procedure

Part B: Heavier vs. Lighter Meterstick

Select the lab partner with the most consistent reaction time for this portion of the lab. Each meterstick has a mass of about 150 grams. Use string or masking tape to attach an additional 150 grams to the end of your meterstick double its mass and weight. Answer the following questions *before* repeating the reaction time experiment using this modified meterstick.

6. Predict how much the heavier meterstick will fall compared to the lighter one. Justify your answer.

7. Predict what the reaction time of the heavier meterstick compared to the light one. Justify your answer.

Now perform the experiment with the heavier meterstick and record your results below. Remove the string and mass after you are finished.

Trial #	1	2	3	4	5	6	7	8	9	10	Average
Distance (cm)											
Time (s)											

8. Compare the average distance fallen and average reaction time for both sets of trials below. The data must be for the same person for the heavier meterstick. Were your predictions correct? Considering that the meter stick was twice as heavy in the second set of trials, explain your results below the data table.

	lighter meterstick	heavier meterstick
Average Distance (cm)		
Average Reaction Time (s)		

Part C: Lunar Reaction Time

Suppose twenty years from now you have checked into the *Lunar Hilton* for a second honeymoon. You discover a meterstick in your room and remember the cool physics experiment you did back in your high school days. You and your spouse decide to repeat the experiment. What do suppose will happen to your reaction time compared to when you did it on Earth? Ignore the affects of 20 years of aging. Justify your answer and use the fact that g on the moon is 1.67 m/s^2 instead of 9.8 m/s^2)

Instead of going to the moon, your teacher has set up a mass and a meterstick connected with a string over a pulley. This arrangement is often referred to as an *Atwood's Machine*. This particular arrangement will cause the meterstick to fall as if it were on the moon. Based on the data from Parts A and B, predict how far it will the meterstick fall now? Show your work below. Have your lab partner release the moon meterstick for you to catch as in Parts A and B.

9. How do your results compare to your prediction?

Analysis

Explain how doubling the mass of the meterstick affects how far it falls and your corresponding reaction time.