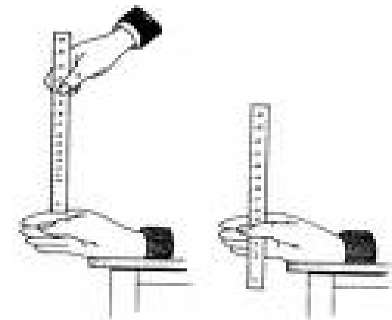
| Physics | name_______________ |
|---|---|
| Activity: Measuring Reaction Time and Error Analysis | hour_______ date___________ |

Did you know you can use a ruler to measure your reaction time? Have a partner hold the ruler vertically with the "0 cm" mark just above your fingers and release it with no warning. Try to close your fingers as quickly as possible to catch the falling ruler. We can use the distance the ruler falls before you catch it to calculate how long it takes you to react to the motion and close your fingers to stop the falling ruler. We'll find several sources of uncertainty and we'll practice using our new understanding of uncertainty during these calculations.



**Collect Data**

1. You'll work in pairs. One person holds the ruler vertically as shown above. The other person places their hand at the bottom of the rule, at the "0 cm" mark.

2. The person holding the ruler will drop it without warning and the other person will try to catch it as quickly as possible.

3. Record the location on the ruler where your fingers caught the ruler. Do at least 15 trials and record the results.

4. Switch places and have record 15 trials for the other lab partner.

| trial | Drop distance (cm) | Deviation (cm) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| average | | ± |

**Determine uncertainty**

There are at least two sources of uncertainty in your distance measurement: uncertainty caused by your inability to see exactly where on the ruler your fingers catch the ruler, and uncertainty caused by random variation in each trial. Let's find each one and compare them.

Estimate the uncertainty of your distance measurements based on the uncertainty of the position of your fingers on the ruler. That is, what is the maximum amount do you think your distance measurements could be off due to your inability to see exactly where your fingers stopped the ruler? ± ___________ cm

Complete the table to find your average deviation. ± _________ cm

Which of these is the greater contributor to uncertainty?

Express your final average distance measurement including uncertainty using the larger contributor to measurement uncertainty.

$x \pm \Delta x$: ____________ ± _______cm

As we'll see in an upcoming chapter, we can calculate the amount of time for an object to fall if we know the distance it falls, and its initial velocity (zero in this case). Soon we will learn ***why*** this formula works, but for now, just accept it as a gift and use it:

$$time = \sqrt{\frac{2 \times drop\ distance\ (in\ meters)}{9.8}}$$

Calculate your reaction time: ________________

Use the methods we've learned in the ***Error and Uncertainty Packet*** to find the uncertainty of the time. Show your calculations here:

Uncertainty: ± _______s

The average reaction time for a young adult to respond to a visual stimulus is 0.20±0.025 seconds. Draw a number line and error bars to show your reaction time and associated uncertainty, and the average human reaction time including uncertainty:

Based on this test, is your reaction time faster, slower, or the same as the average reaction time?

**Questions**

1. Identify three plausible sources of systematic error that might affect your results.
   a.

   b.

   c.

2. What are the two greatest contributors to measurement uncertainty in this test? For each one, can you suggest a method to reduce the uncertainty?

3. Suggest two ways you could determine whether your results are affected by systematic error?

4. Humans respond faster to auditory stimulus than visual stimulus. Suggest a test to find your reaction time of an auditory stimulus.