Name _____ Date _____ Period _____

Errors, Accuracy and Precision

Introduction:

When driving a vehicle, you often mentally measure distances and times. When investigating vehicle collisions, police officers take actual measurements at the scene. You will measure a given distance using several methods. You will have to determine which method is best. You will also use estimation to decide if several measurements are reasonable.

Part A, Method One: Pacing off the distance

1. Your teacher will select an appropriate location to measure the length of in the classroom or the hallway.
2. Each group member will count the number of steps they take to move the selected distance.
3. Have a group member measure the distance between two steps.

Group Member Name	Number of steps	Distance between steps	Number of steps multiplied by distance between steps

4. Do all the measurements agree? By how much are they different?

5. List as many reasons for differences as you can think of.

6. How could you improve you measurements?

Part B, Method two: Using a single meter stick

1. Measure the distance using a single meter stick. You will have to move the stick many times. Have one of your lab members mark the end of the stick each time you have to move it.

Meter Stick Length	Number of times you moved the stick	Total Distance
1 m		

2. Write your distances on the board in the front of the class. Do all the measurements agree?

3. By how much do the results vary?

4. Why do you think there are differences between the lab groups? List as many reasons as you can.

5. How could you improve you measurements? Would that improvement make all the measurement vary less?

6. What do you think would happen if every group were given a long tape measure? Would the measurements vary more or less? Would it be possible for all groups to get the exact same measurement with this new method?

Part C: Types of Error

A difference in measurement close to a certain accepted value is called an error. Physicist identify two types of errors in measurement. A systematic error can be corrected by calculation. For example, you measure the length of an object starting at the 1 cm mark instead of the end of the ruler (0 cm). You could correct that error by subtracting 1 cm from all your measurements, making it a systematic error.

Random error cannot be corrected by calculation. No measurement is perfect. You make an approximation close to a certain accepted value when you measure. Random errors exist in any measurement, but you can estimate the amount of uncertainty in measurements that random error introduce. Scientists give an estimate of the random error in their data when they present their work or talk about their results.

1. When measuring the distance decided by your teacher did you have any systematic errors?
2. Estimate the size of your random error for each measurement method.

Part D, Estimation:

Sometimes a precise measurement is not needed and a good estimate will do. For example, if one of your friends estimates that a single-serving drink container holds 5 kg (weighing about 11 lbs) of liquid, you can know that that isn't a good estimate. It's unreasonable. A mass of 5 kg is about the weight of a bowling ball. A single-serving drink weighs much less.

Use your common sense and prior knowledge to judge if the following measurements are reasonable. Explain your answers:

1. A college football player has a mass of 100 kg (220 lbs).

2. A high-school basketball player is 4 m (13 ft) tall.

3. Your teacher works 1440 minutes per day.

4. A poodle has a mass of 60 kg (132 lbs)

5. Your classroom has a volume of 150 square meters (5300 square feet).

6. The distance across the school grounds is 1 km (0.62 miles)