

Percentage Error

In making any measurement, the chances are that our results will not be absolutely accurate. We can often compare our results with some standard or accepted value to see how closely they agree. But how much error can be allowed before the result becomes meaningless?

As you may guess, the amount of error that is acceptable varies with the situation. Suppose you measure the distance on a map between your Scarsdale and Mamaroneck and you get a result of 5 miles. If the actual distance is 5 1/2 miles, the chances are this error will have no effect on the trip between the two towns. But if the same degree of error existed in the calculations used to send astronauts to the moon, those people would be in big trouble!

$$\text{Percentage Error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100\%$$

Suppose, you measured the length of a table and obtained a measurement of 202 cm. A friend also measures the table and obtains a result of 198 cm. To calculate the percentage error in each of the measurements, you need to know the "correct" or "accepted value" of the length of the table. After consulting the manufacturer's catalog, you find that the table's length is listed as 200 cm in length. This will be used as the accepted value in our calculation.

The calculations of percentage error for the two measurements are shown below. Both measurements show an error of 1%. Your friend has made a measurement which is on the low side of the accepted value and is therefore, negative. You, on the other hand, have made an error on the high side of the accepted value and it is positive.

$$\text{Percentage Error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100\%$$

$$\text{Percentage Error} = \frac{202 \text{ cm} - 200 \text{ cm}}{200 \text{ cm}} \times 100\%$$

$$\text{Percentage Error} = \frac{2 \text{ cm}}{200 \text{ cm}} \times 100\%$$

$$\text{Percentage Error} = + 1\%$$

$$\text{Percentage Error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100\%$$

$$\text{Percentage Error} = \frac{198 \text{ cm} - 200 \text{ cm}}{200 \text{ cm}} \times 100\%$$

$$\text{Percentage Error} = \frac{-2 \text{ cm}}{200 \text{ cm}} \times 100\%$$

$$\text{Percentage Error} = -1\%$$

DIRECTIONS: For each of the examples below, calculate the percentage error in each measurement. **Show your work and include units of measurement!**

1. A student measures the length of a sheet of paper and finds that it is 27 cm long. The label on the package indicates that the paper length is 28 cm. Calculate the percentage error in the measurement.
2. A student measures the width a sheet of paper and finds that the width is 22 cm. The label on the package indicates than the paper width is 21 cm. Calculate the percentage error in the measurement.
3. The mass or a rubber stopper is found to be 6 g. The science teacher tells the class to use 7.5 g as the standard value for the rubber stopper. What is the percentage error in the measurement?
4. A student measures the volume of a rubber stopper and finds that it is 36mL. The teacher also measures the stopper and obtains a value of 40 ml. Other students measure the stopper and it is decided to use 38 ml as the standard value for the volume of the stopper. What was the student's percentage error? The teachers error?
5. A student measures the mass of an U.S. nickel and determines that the value is 48.0 mg. The U.S. Mint indicates that all U.S. nickels should mass 50.0 mg. What is the percentage error of the student's measurement?
6. A student pours the contents of a 2.0 liter bottle of soda into a large graduate cylinder. She finds that there was 2007.0 ml in the bottle. What was the percentage error made when the bottle was filled at the bottling plant?
7. Mr. Rambone has asked a student to help cut some wood into 12.5-cm pieces for a project. The student cuts each piece to a length of 14.7 cm. What is the percentage error in the student's measurement?
8. Mrs. Rivilini is trying out a new recipe for Home and Careers class. This recipe calls for 2 teaspoons of vanilla extract. Mrs. Rivilini's student assistant puts in 2 teaspoons and so does Mrs. Rivilini. What is the percentage error in the measurement of vanilla extract for this recipe?
9. The area of Mr. Gandelmans classroom was measured by students and found to be 74.27 square meters. According to measurements made from the architect's plans, the room's actual area is 78.5 square meters. What is the error in the students' measurement?
10. The power output of a Cadillac automobile engine is listed as 285.1 kW (kilowatts). When this value was check by an auto mechanic, the output was only 278.6 kW. What was the percentage difference in the output compared to the standard value?

