

Significant Digits and Measurements

What digits are significant when recording a measurement?

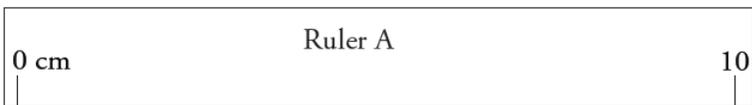
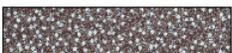
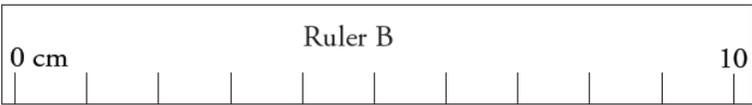
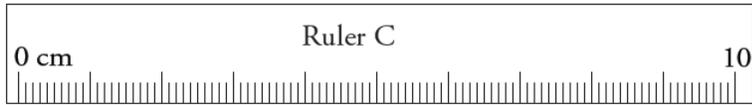
Why?

Scientists do a lot of measuring. When scientists use an instrument (such as a ruler, graduated cylinder, spectrophotometer or balance) to measure something, it is important to take full advantage of the instrument. However, they can't cheat and record a better measurement than the instrument is capable of. There is an understanding among scientists of the proper way to record valid measurements from any instrument. When you are the scientist, you must record data in this way. When you are reading other scientists' work, you must assume they recorded their data in this way.

Read This!

When humans use measuring instruments, variation is expected. Everyone will estimate differently between marks on the instrument. On the other hand, digits that are certain (based on marks on the instrument) should not vary from person to person.

Model 1 – Valid Measurements

| | Valid Measurements | Invalid Measurements |
|--|-------------------------------|---------------------------------------|
|   | 3 cm 2 cm | 2.5 cm 3.00 cm 3¼ cm 3.33 cm |
|   | 3.2 cm 3.1 cm 3.3 cm | 3 cm 3.25 cm 3.20 cm |
|   | 3.21 cm 3.22 cm 3.20 cm | 3.2 cm 3.215 cm 3.205 cm |

1. Six students used each ruler to measure the length of a metal strip. Their measurements are shown to the right of each ruler. The measurements that follow the rules of measurement agreed upon by scientists are in the “Valid Measurements” column. Those that do not follow the rules are in the “Invalid Measurements” column. For each valid measurement shown in Model 1, draw a square around the certain digits (if any) and circle the digits that were estimated (if any).
2. Based on the examples in Model 1, circle the best phrase to complete each sentence below.
 - a. In a valid measurement, you record (zero, one, two) estimated digit(s).
 - b. In a valid measurement, the estimated digit is the (first digit, second to last digit, last digit) in the measurement.
 - c. In a valid measurement, the estimated digit corresponds to (the largest marks, the smallest marks, one tenth of the smallest marks) on the instrument.

3. Using Ruler B from Model 1, Tony recorded a measurement of 3 cm. Explain why this was an invalid measurement.

4. Using Ruler B from Model 1, Dionne recorded a measurement of 3.20 cm, which was invalid. But when Maya made the same measurement using Ruler C, it was considered valid. Explain why the zero was acceptable when using Ruler C, but not when using Ruler B.

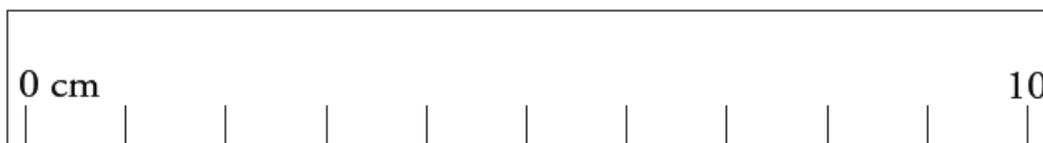
5. A student recorded the length of a test tube as 5.0 cm. Which ruler in Model 1 was the student using? Explain.

6. In Model 1, Ricky recorded his measurement 3.19 cm using ruler C. His classmates thought he was wrong because his second digit was not “2.” However, Ricky’s recorded measurement is perfectly valid. Explain.

Read This!

When a measurement is recorded properly, all of the digits that are read directly (certain) and one estimated (uncertain) digit are called **significant digits**. The number of allowable significant digits is determined by the marks or gradations of the instrument. Sometimes a “0” is the estimated digit and must be recorded.

7. Record the length of the wooden splint to the proper number of significant digits.



8. Record the length of the wooden splint to the proper number of significant digits.

