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|  |  | **Measurements** |  |

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| **Your Tasks (Mark these off as you go)** |
| * Review significant figures in measurements * Review how to count significant figures * Complete the measurement challenges * Receive credit for the group portion of this lab |

**▢ Review significant figures in measurements**

All measuring devices are subject to error, making it impossible to obtain exact measurements.

When recording a measurement, you should record all the digits of the measurement using the markings that you know exactly, plus one further digit that is estimated or uncertain.

The *uncertain digit* is our best estimate using the smallest unit of measurement given and estimating between two of these values. These digits are collectively referred to as *significant figures*.

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| --- | --- |
|  | Here the “ruler” markings are every 0.1-centimeter. The correct reading is 1.67 cm.  The first 2 digits **1.6** are known exactly. The last digit **7** is uncertain. You may have instead estimated this measurement as 1.68 cm.  The recorded measurement has 3 significant figures. 2 certain plus one estimated. |

The *volume* of a liquid can be directly measured with specialized glassware, typically in units of milliliters (mL) or liters (L). Note that when measuring liquid volumes, it is important to read the graduated scale from the lowest point of the curved surface of the liquid, known as the liquid *meniscus*.

|  |  |
| --- | --- |
|  | Here, the graduated cylinder markings are every 1-milliliter. When read from the lowest point of the meniscus, the correct volume reading is 30.0 mL.  The first 2 digits **30** are known exactly. The last digit **0** is uncertain. Even though it is a zero, it is significant and must be recorded.  The recorded measurement has 3 significant figures. 2 certain plus one estimated. |

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| Have each person in your group record each of the measurements below. Don't forget to measure to one place of uncertainty AND include units. For each measurement, indicate the number of significant figures. It is OK if you and your partner estimate the last digit differently. | | | | | |
|  | **Partner 1** | | **Partner 2** | | |
| **Measurement** | **Significant Figures** | | **Measurement** | **Significant Figures** |
|  |  |  | |  |  |
|  |  |  | |  |  |
|  |  |  | |  |  |
| Be careful! Measure from the top down! |  |  | |  |  |
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**▢ Review how to count significant figures**

As you saw above, in any measurement, the number of significant figures in a measurement is the number of digits believed to be correct by the person doing the measuring. It includes all the known digits plus one estimated digit.

If you are the person recording the measurement, the number of significant figures is easy to identify. But, what if you are looking at someone else’s measurement? The rules for determining the number of significant figures in a measurement are as follows,

|  |  |
| --- | --- |
| **Rule** | **Example** |
| Leading zeros are never significant | 000512 has 3 significant figures  0.000512 has 3 significant figures |
| Trapped zeros are always significant | 1001 has 4 significant figures  1.00201 has 6 significant figures |
| Trailing zeros are significant only if the decimal point is specified | 500 has 1 significant figure  10100 has 3 significant figures  100.00 has 5 significant figures |

|  |  |
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| Discuss with your partner the number of significant figures in each of the measurements below. Record the value you both agreed upon. | |
| **Measurement** | **Number of significant figures** |
| 124501 |  |
| 0.00100 |  |
| 500.00 |  |
| 300.0100 |  |
| 500 |  |

**▢ Complete the measurement challenges**

For the remainder of this lab you will practice taking measurements from common laboratory equipment. For each set of measurement challenges

* Navigate to the link provided
* Indicate your first and last name of each lab member
* Take a screen shot of the certificate and paste it in the appropriate box (Both group members need to do this)
* Resize the screen shot as necessary

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| **Challenge** | **Link** | **Screen shot of certificate** |
| Ruler Challenge Part 1 | <http://www.thephysicsaviary.com/Physics/Programs/Games/SimpleRulerUseMS/> |  |
| Ruler Challenge Part 2 | <http://www.thephysicsaviary.com/Physics/Programs/Games/EstimatingRulerUseMS/> |  |
| Ruler Challenge Part 3 | <http://www.thephysicsaviary.com/Physics/Programs/Games/RulerUse/> |  |
| Triple Beam Balance Challenge Part 1 | http://www.thephysicsaviary.com/Physics/Programs/Games/ReadtheTripleBeam/ |  |
| Triple Beam Balance Challenge Part 2 | <http://www.thephysicsaviary.com/Physics/Programs/Games/ReadtheTripleBeamHard/> |  |
| Thermometer Challenge | <http://www.thephysicsaviary.com/Physics/Programs/Games/ReadTheThermometerChallenge/> |  |
| Graduated Cylinder Challenge Part 1 | <http://www.thephysicsaviary.com/Physics/Programs/Games/GraduatedCylinder/> |  |
| Graduated Cylinder Challenge Part 2 | <http://www.thephysicsaviary.com/Physics/Programs/Games/SimpleGraduatedCylinderMS/> |  |
| Graduated Cylinder Challenge Part 3 | <http://www.thephysicsaviary.com/Physics/Programs/Games/EstimatingGraduatedCylinderMS/> |  |

**▢ Receive Credit for this lab**

Make sure indicate the names of all group members on this lab, the Project Manager is charge of submitting this lab