

How Do Your Errors Grow?

6982

INTRODUCTION

Significant figures, or sig-figs, play an important role in scientific calculations. Sig-figs change depending on whether a calculation involves addition, multiplication, or both. Unfortunately, this essential part of the scientific process can be a difficult concept to understand.

Activity Overview

In this activity we will

- learn how to use the Sig-Fig Calculator
- determine the sig-figs of some measurements and check this work using the Sig-Fig Calculator

Approximate Total Time: 15 minutes

Science Objective

A simple measuring activity allows students to explore the sometimes difficult concept of significant figures, both manually and with the help of the Sig-Fig Calculator App.

MATERIALS

- metric ruler marked in 1mm increments
- textbook, small box, or other rectangular prism-shaped object

PROCEDURE

1

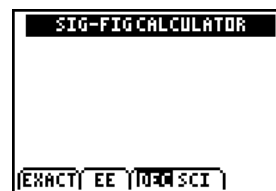
Use the ruler to measure the length, width, and height of your textbook or other object in centimeters. Record your measurements in the data table. Remember that you cannot measure more accurately than 0.05 cm with a ruler that has 1 mm increments. In other words, if the height of your textbook is about half way between 10.3 and 10.4 cm, you should *not* record a measurement of 10.3467 cm. Instead, you should record a measurement of 10.35 cm. If your textbook is exactly 10.3 cm high, you should record 10.30, not just 10.3.

2

Turn your calculator on and press [APPS]. Use the arrow keys to scroll down to highlight SCI TOOLS and press [ENTER]. Press [ENTER] again to get to the main menu. The SIG-FIG CALCULATOR should be highlighted. Press [ENTER] to select SIG-FIG CALCULATOR.

3

On the SIG-FIG CALCULATOR screen, you can enter numbers and calculations, and the Sig-Fig Calculator will determine the number of significant figures in each number you enter.

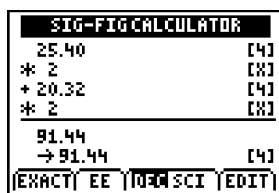


4

Determine the perimeter of the cover of your textbook or other object. To do this, multiply both the length and the width by 2 and then add the results together. In the Sig-Fig Calculator screen, enter the length of the cover. Make sure to enter the correct number of significant figures. Then press [x], and enter [2]. Press [Y=] to select EXACT for the number 2. This tells the calculator that the number 2 is an exact number, so its significant figures will not be used.

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to determine the final answer. Press $\boxed{+}$ and enter the width of the cover with the correct number of significant figures. Then press $\boxed{\times}$ and enter $\boxed{2}$. Press $\boxed{=}$ again to make this 2 an exact number. Press $\boxed{\text{ENTER}}$ to calculate the perimeter of your textbook cover.



5

The number in brackets on the right tells you how many significant figures are in your answer. Record the perimeter of your textbook cover, with the correct number of significant figures, in the data table.

DATA TABLE

Length	Width	Height	Perimeter	Volume

DATA ANALYSIS

- Determine the number of significant figures in the measurements in the table below *without* using your calculator. When you have finished, use the calculator to check your answers. (Hint: To find the number of significant figures in a single number, enter the number on the Sig-Fig Calculator screen and press $\boxed{\text{ENTER}}$.)

Measurement	Your prediction	Sig-Fig Calculator results
3.245 g		
0.0004 L		
$1.20 \times 10^4 \text{ cm}^3$		
20000.0 μg		
0.4 mL		

- A student measures a chunk of metal and finds that it has a mass of 23.55 g and a volume of 4.5 cm^3 . What is the density of the metal? Show your work. Make sure to include the correct number of significant figures in your answer.
- When 100.0 g of water beginning at 10.0°C is cooled to 2.4°C, how much energy does the water lose? (Hint: Use the equation $Q = m \times \Delta T \times C_p$ to calculate energy in joules. The specific heat (C_p) for water is 4.18 J/g °C.) Show your work. Make sure to include the correct number of significant figures in your answer.
- How many molecules of sodium bicarbonate (NaHCO_3) are in 168.02 g? (Hint: Avogadro's number, 6.023×10^{23} , is an exact number.) Show your work. Make sure to include the correct number of significant figures in your answer.

6

Now, find the volume of your textbook. Press $\boxed{\text{ENTER}}$ to return to the blank Sig-Fig Calculator screen. Enter the height of your textbook and press $\boxed{\times}$. Enter the length of your textbook and press $\boxed{\times}$. Enter the width of your textbook and press $\boxed{\text{ENTER}}$. The volume of your textbook is displayed in the last row. Record the volume with the correct number of significant figures in your data table.

7

Exit the Sig-Fig Calculator by pressing $\boxed{2\text{nd}}$, $\boxed{\text{MODE}}$ and then $\boxed{=}$.