

Introduction

- **Physics & Major Sciences**
 - **Physics – the science of matter and energy**
 - **Chemistry - the science of the composition, properties, and reactions of matter**
 - **Biology - the science of living organisms**

- **Nature has Rules**
 - **You can better play the game when you know the rules.**
 - **Physics is nature's rule book.**
 - **Physics shows how everything in nature is interconnected.**

- **Why Learn Physics**
 - **To see how the natural world works, conceptually.**
 - **To see the mathematics behind the rules.**
 - **To be connected to nature and to your own self.**

Estimation

- **Calculators** Only use calculators to remember arithmetic facts. Please do all math in your head.
- **"SIG FIGS"** How accurate could you be if you were asked ...
 - **The height of a tree measured with a stick known to be a yard long?**
 - **The height of that same tree measured with a micrometer - accurate to a thousandth of an inch?**
 - **The volume of water in a standard beaker with lines each 100 ml?**
 - **The volume of that same water measured with a volumetric cylinder with lines for each ml?**

Rewrite the number ...

- **6.02×10^{23} accurate to 1 digit** →
- **6.02×10^{23} accurate to 2 digits** →
- **6.02×10^{23} accurate to 3 digits** →

- **6.02×10^{23} accurate to 4 digits** →

A student weighed himself at 100 pounds.
The scale could be read accurately to within a pound.
He wanted to know how many kilograms he weighed.
One pound equals 0.45359237 kilograms.
He multiplied. Should he say he weighs 45.359237 pounds?

$$\frac{100 \text{ pounds}}{1 \text{ pound}} \times \frac{0.45359237 \text{ kg}}{1 \text{ pound}} = 45.359237 \text{ kg}$$

Rules for deciding the number of significant figures in a measured quantity:

(1) All nonzero digits are significant:

1.234 g has 4 significant figures, 1.2 g has 2 significant figures.

(2) Zeroes between nonzero digits are significant:

1002 kg has 4 significant figures, 3.07 mL has 3 significant figures.

(3) Leading zeroes to the left are not significant:

0.001 °C has only 1 significant figure, 0.012 g has 2 significant figures.

(4) Trailing zeroes to the right of a decimal point in a number are significant:

0.0230 mL has 3 significant figures, 0.20 g has 2 significant figures.

(5) Trailing zeroes that are not to the right of a decimal point are not necessarily significant:

190 miles may be 2 or 3 significant figures, 50,600 calories may be 3, 4, or 5 significant figures.

Use scientific notation to avoid ambiguity. For example, for 3, 4, or 5 sig figs write 50,600 calories as:

5.06×10^4 calories (3 sig figs) 5.060×10^4 calories (4 sig figs), or 5.0600×10^4 calories (5 sig figs).

- **Scientific Notation**

- **What is easier to write: 600,000,000,000,000,000,000 or 6×10^{23} ?**
(How is it done? Count the 23 places after the 6. Always keep just one main digit.)

- **4,000,000,000 or _____**

- **602,000,000,000,000,000,000 = _____**

- **602,214,199,000,000,000,000 = _____**