PHYSICS WEBSITE 2

Topic : Significant Figures (Part I)

Link | https://barisciencelab.tech/Physics2.html

2.1 FLIPPED CLASSROOM

Tutorial : TBA

Any measurement will have a certain number of significant figures associated with it that displays how precise it is. Sig Figs are important because they tell us how to round. So let's refresh our memory with rounding. Let's invite a student to assist us.

Question: How many students do you have in your school?
Answer: 2000

Question: How are you so sure? Did you estimate it?
Answer: It's actually 1950

Question: I think you estimate it.
Answer: 1860

Question: Really?
Answer : 1863

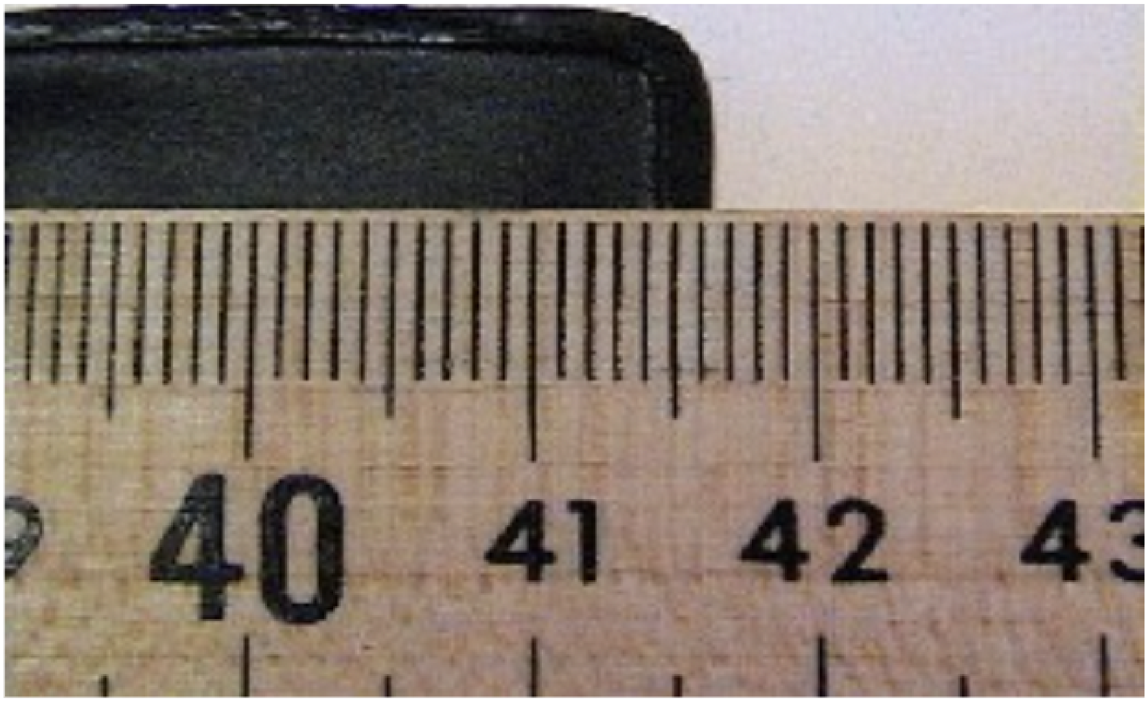
So we see that 1863 is most precise (whole truth) whereas 2000 (little closer to the truth) is least precise. All three, 2000, 1950 and 1860 are rounded versions. So rounding a number means making it less precise. Round 1863 to nearest 10, 100 and 1000 using the number line. Be sure to make the decision based on which round number is close to the original exact number i.e., 1863?

Question: Why would we be making a number less precise?

2.2 Do Now: Measurement

Tutorial: https://youtu.be/apvnImg9kno

Significant figures are reliable digits of a measurement. For example, if a length measurement gives 114.8 mm while the smallest interval between marks on the ruler used in the measurement is 1 mm, then the first three digits (1, 1, and 4, and these show 114 mm) are only reliable so can be significant figures. So what's wrong with the last digit (i.e.0.8 mm) but it is also considered as a significant figure with a big but: It is uncertain.



The least count of our Lab meter sticks is 0.1 cm and therefore a reading can be made to 0.01cm. Picture above shows Mr. Bari using a meter stick to measure the length of a plastic strip. The meter stick is calibrated in centimeters, so we know that the strip is between 41 and 42 cm. The least count of this meter stick is one millimeter, so we know with absolute certainty that the object is between 41.6 cm and 41.7 cm. We then estimate the object's length to the fractional part (doubtful figure) of the least count subdivision. We may estimate that the strip is closer to 41.6 cm than it is to 41.7 cm and report the length to be 41.64 cm or 0.4164 m.

2.3 Big Idea : |Measurement and Significant Figures
Tutorial: https://youtu.be/yb094rhKYXo

Any measurement will have a certain number of significant figures associated with it that displays how precise it is. However, you don't want to be more precise than what you started with. For example, The ball I drop on the glass. What is the mass of this ball? If I give it to my grandma, she will say 1 kilogram. Because for her, everything is 1 kilogram. However, what if I measure it using a lab scale? It reads 82 gram. However, if I measure it by NASA laser scale, it reads 82.327812 grams. Which is more correct?

Let's say we want to calculate the density of the ball. And density is,
$d = \frac{m}{V} = \frac{82}{47} = 1.74468085106383 = 1.7$ g /cm^3

Now let's use data collected by NASA lab instruments:

$d = \frac{m}{V} = \frac{82.327812}{47.430128} = 1.73577039 = 1.7357704$

I called my two sons and asked them their location and here's what they have said:
Ref: I'm in the crowd
Isaac : He is near big buildings.

With this information, would I be able to precisely tell that they are at 42nd street and 8 Ave?
No.

Rules:

1. Non Zero numbers are significant , example 124 has 3 Sig Fig
2. Zero in the middle is significant , example, 203 has also 3 SigFig
3. Trailing zeros are not significant if there is no decimal, 23000, has only 2 SigFig
4. Zeros right to the decimal place significant, .00200 has actually 3 SigFig
5. Leading zeros are not significant, .00003 has only 1 SigFig

The following digits are not significant figures.

- All leading zeros. For example, 013 kg has two significant figures, 1 and 3, and the leading zero is not significant since it is not necessary to indicate the mass; 013 kg = 13 kg so 0 is not necessary. 0.056 m has two insignificant leading zeros since 0.056 m = 56 mm so the leading zeros are not absolutely necessary to indicate the length.

- Trailing zeros when they are merely placeholders. For example, the trailing zeros in 1500 m as a length measurement are not significant if they are just placeholders for ones and tens places as the measurement resolution is 100 m. In this case, 1500 m means the length to measure is close to 1500 m rather than saying that the length is exactly 1500 m.

- Spurious digits, introduced by calculations resulting in a number with a greater precision than the precision of the used data in the calculations, or in a measurement reported to a greater precision than the measurement resolution.

Non-zero digits within the given measurement or reporting resolution are **significant**.

- 91 has two significant figures (9 and 1) if they are measurement-allowed digits.

Zeros between two significant non-zero digits are **significant (*significant trapped zeros)***.

- 101.12003 consists of eight significant figures

Zeros to the left of the first non-zero digit (leading zeros) are not **significant**.

- If a length measurement gives 0.052 km, then 0.052 km = 52 m so 5 and 2 are only significant; the leading zeros appear or disappear, depending on which unit is used, so they are not absolutely necessary to indicate the measurement scale.

Zeros to the right of the last non-zero digit (trailing zeros) in a number with the decimal point are **significant**.

- 1.200 has four significant figures (1, 2, 0, and 0)

2.4 Exit Slip/Escape Room

Question 1: Mr. Bari drops a 1 kg ball from 50 cm above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

Question 2: Mr. Bari drops a 1 kg ball from 100 cm above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

Question 3: Mr. Bari drops a 1 kg ball from 150 cm above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

2.5 Homework

Question 1: Mr. Bari drops a 3 kg ball from 1 feet above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

Question 2: Mr. Bari drops a 4 kg ball from 2 feet above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

Question 3: Mr. Bari drops a 5 kg ball from 3 feet above the glass. Find the velocity of the ball when it hits the glass. Use appropriate significant figures.

Answer: ?

Question 4 : What did you learn and discover from website #2. Be specific?