DO NOW: Imagine this as a ruler. How would you report this length?

Answers from various students: 7.2, 7.3, 7.4, 7.25, 7.2576 cm

So, which is correct? Well, obviously, 7.3576 is wrong, but so is 7.25.

WHY? It's not following the rule for measuring precisely.

Aim: How do we measure precisely?

Precisely - to measure in such a way that anyone else can repeat your measurement. In other words, consistently, reproducibly…

1a) The Rule: You are allowed to <u>estimate</u> only <u>ONE</u> decimal place past the markings on your instrument.

To estimate, imagine **10 spaces between the 2 marks** and tell which division the arrow is closest to.

dashed lines, imagined divisions
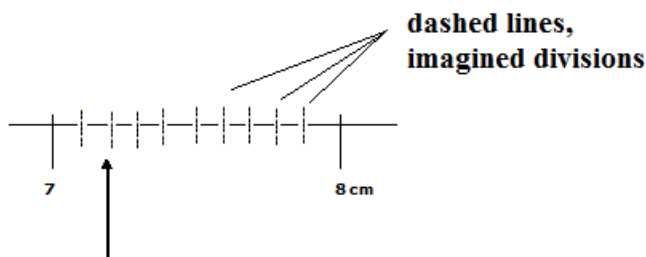
7	2
7	3
7	4

The "**estimated**" part of the measurement can differ from person to person because some people estimate better than others.

The **"certain"** part of the measurement is marked on the instrument. Everyone should agree on this part of the measurement.

b) Scientists call all the digits that are measured the **significant figures**. They include all certain digits + one <u>estimated</u> digit.

So, all of these measurements (7.2, 7.3 & 7.4 cm) have 2 significant figures ("sigfigs").

To get 7.25 cm, you need a **more precise** ruler (has **more marks**).

estimated (Remember: The **last place** is always estimated.)

7.25 , you would need this ruler:

Marked

7.1 7.2 | 7.3

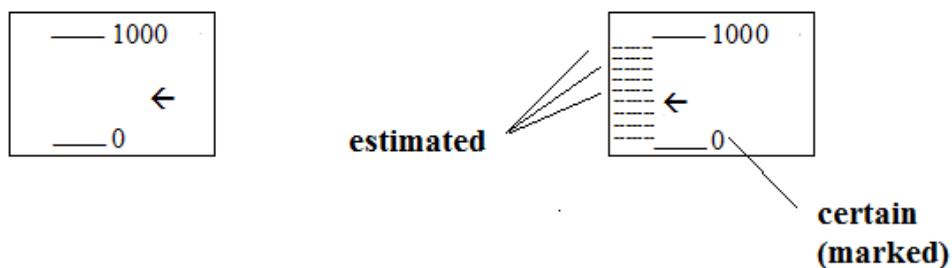7

8 cm
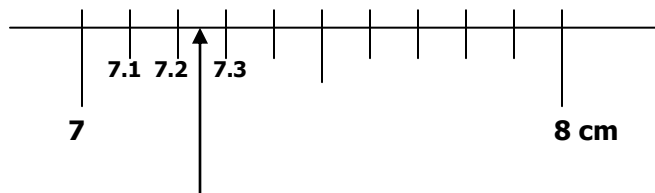
7.25 has 3 sigfigs

How many sigfigs in 7.2576? Answer: 5 sigfigs

2) All **non-zero** digits are significant, but **zeros** may or may not be significant depending upon their position and function.

For example, 400 = 400. True or False?   Answer: False.

To be precise, never assume decimal points!

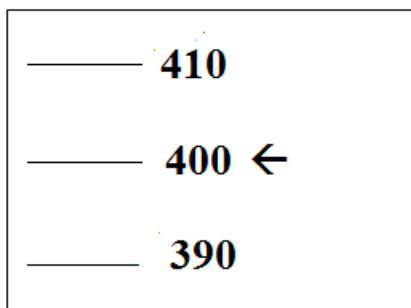For 400 you are using a scale measuring to the nearest 100.

In this case, the **0** marked on the scale is certain and you are estimating where the arrow lies.

Since it's about 4/10^{ths} of the way between 0 and 1000 this leads to 400 lbs (4/10 x 1000 = 400).

That is, the zeros in 400 are **not actually measured (significant)**. We say they are **"place holders"**; they hold the power of 10.

So, 400 has only 1 sigfigs

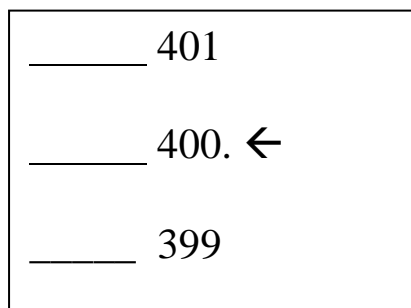For 400. you are using a scale measuring to the nearest 1.

```
——— 410

——— 400 ←

——— 390
```

So, 400. has 3 sigfigs

Another example, 400. = 400.0 True or False? Answer: False

To be precise, you can't assume zeros!

For 400.0 you are using a scale measuring to the nearest 0.1

```
——— 401

——— 400. ←

——— 399
```

So, 400.0 has 4 sigfigs

Confused?

3) Here are some simple rules to follow.

$$0.\ 0010070$$

| Zeros	Zeros	Zeros
to the **left**	in the **middle**,	to the **right** of non-zeros, are sig' only
of non-zeros	of non-zero are	if a **decimal point** appears **anywhere.**
are never	always significant.	
significant.		
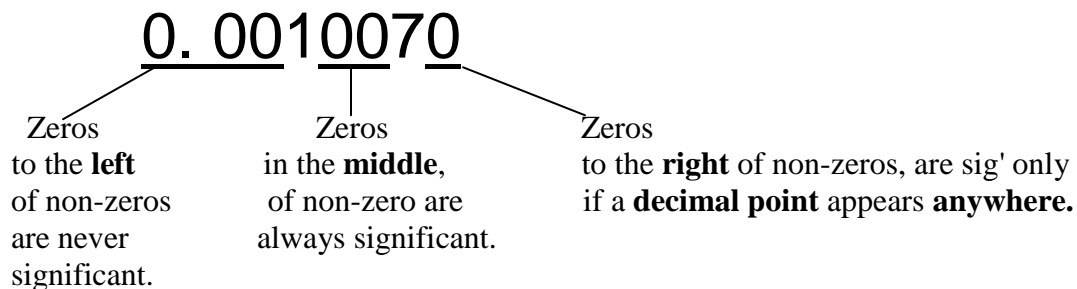
Refer to the bottom of today's handout:

Class work:

How many "sig figs" are in each of the following numbers?

a) 50   **1**   c) 50.0   **3**   e) 0.05   **1**   g) 0.0505   **3**

b) 50.   **2**   d) 0.5   **1**   f) 0.050   **2**   h) 5.0 x 10³   **2** Anything in coefficient is sig

Draw the markings on a ruler that would enable you to measure a length of 4.77 cm?

```
        |
  +-----------+---------
  |           |
 4.7         4.8
```
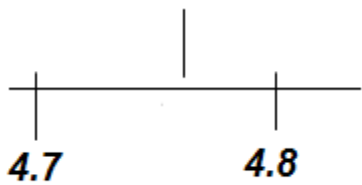
Draw the markings on a scale that would enable you weigh
a mass of 202 grams.

```
       |
  +----------+------
  |          |
 200        210
```