1. How many seconds are in 2.5 hours?
2. How many kgs does a 150 lbs. person weigh?
1 lbs. = 0.45 kgs

Units and Conversions

How do we measure time?

- Time can be measured in seconds, minutes, hours, days, months, years, decades and so on.

What are 'units' of measurement?

- Units of measurements are just the way we define an amount of something.
- Here are some examples. In each example the unit is underlined.
- I am 33 years old.
- The movie was 2 hours and 13 minutes long.
- I have a mass of 75 kilograms.
- The chief needs 4 dozen eggs for tomorrow.

So if I were to ask you to measure time you would need to use your judgment when choosing the correct units. You would pick your units based off of how much time you are measuring and who will be looking at your measurement.

Examples: How old are you?

How long will you be at the store?

How long until the final?

What measuring system do we use in America?

In America we still use ‘imperial’ or ‘standard’ system of units.

What measurement system does the rest of the world use?

- In science there are many symbols and abbreviations.

- Example: The standard unit for mass is pounds (lbs). I weight 155 pounds (lbs).

Time (t)

- Si unit for time is the second (s).
- Standards unit for time is also the second (s)
- Conversion rates
  - 60 seconds (s) = 1 minute (min)
  - 24 hours (hrs) = I day

Mass

In America, mass is measured in pounds (lbs).

The SI Unit for mass (m) is the gram (g) or Kilogram (kg)

Conversions rates
1 lb (pound) = 0.45 kg

Problem:

1. 150 lb person = ______ kg
2. How many pounds are in 55 kgs?

Length/Distance

- Meter is the SI Unit for length and distance.
- Feet is the standard unit.

Conversion rates

1 meter = 3.28 feet

1 mile = 1609 meters

1 meter = 1.09 yards

Problem:

1. 1 football field = 120 yards. How many meters are in a football field?

2. If your are 5 ft and 3 inches tall, what is you height in meters?

Base Quantity		Base Unit	
Name	Symbol	Name	Symbol
Length	*l*, *h*, *r*	meter	m
Mass	*m*	kilogram	kg
Time	*t*	second	s

Base Quantity		Base Unit	
Name	Symbol	Name	Symbol
Length	l, h, r	meter	m
Mass	m	kilogram	kg
Time	t	second	s

Notice that both mass and meter have m as there symbol. Be careful. This can become confusing.

How do we define a ‘good’ measurement

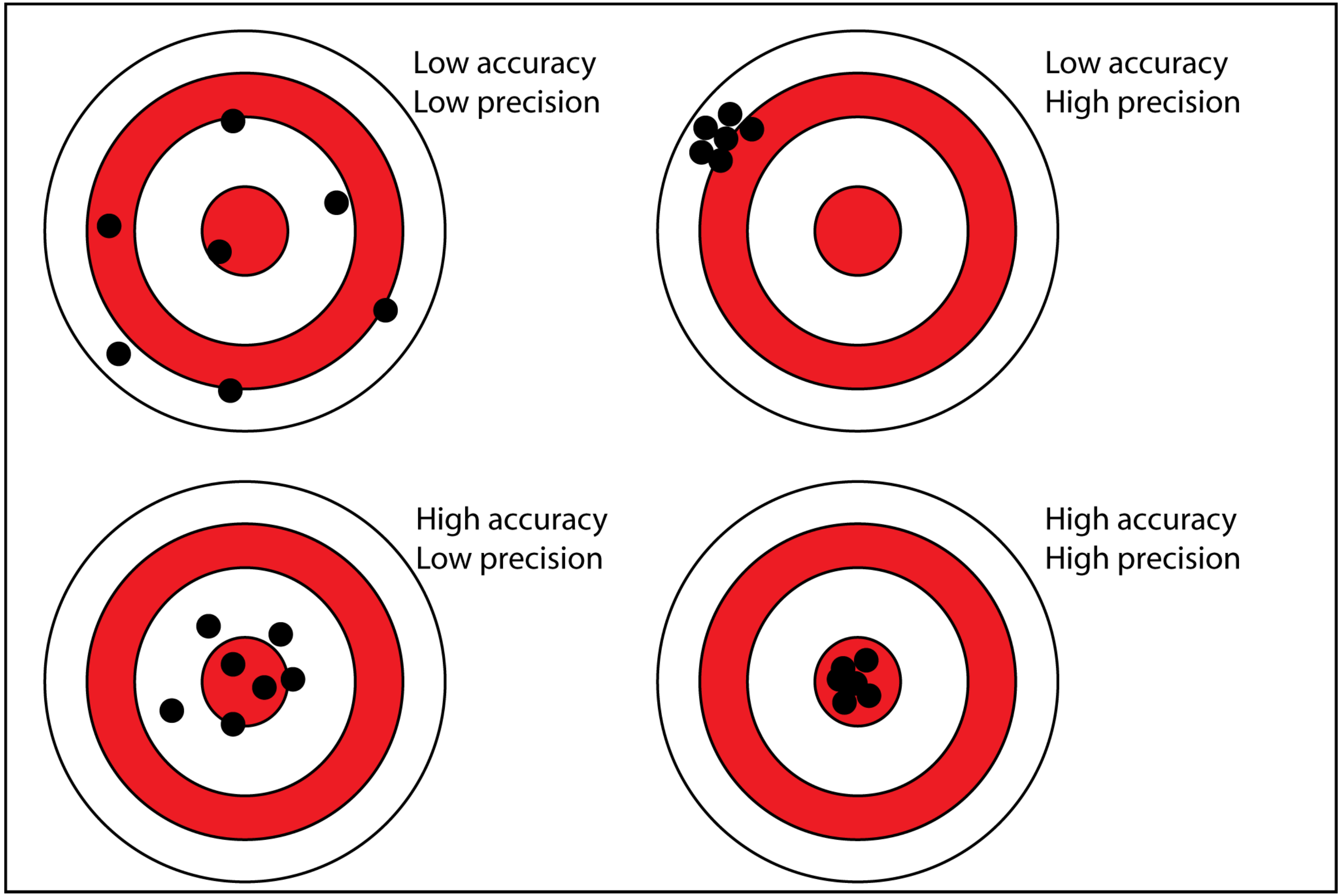
- When taking measurement there are bound to be mistakes.
- When is a mistake ok? When do we need to remeasure?

Precision vs. accuracy

- <u>Accuracy</u> refers to the closeness of a measured value to a standard or known value. For example, if in lab you obtain a weight measurement of 3.2 kg for a given substance, but the actual or known weight is 10 kg, then your measurement is not accurate. In this case, your measurement is not close to the known value.

- Precision refers to the closeness of two or more measurements to each other. Using the previous example, if you weigh a given substance five times, and get 3.2 kg each time, then your measurement is very precise.

- Precision is independent of accuracy. You can be very precise but inaccurate, as described above. You can also be accurate but imprecise.
    - For example, if on average, your measurements for a given substance are close to the known value, but the measurements are far from each other, then you have accuracy without precision.


Low accuracy
Low precision
Low accuracy
High precision
High accuracy
Low precision
High accuracy
High precision

- *Error is not a mistake*
- Error is the unavoidable difference between a measurement and the true value.
- Example: If I were going to just my hand and a stop watch to measure how long you are airborne when you jump off the ground my measurement would have unavoidable error because there is a delay in my reaction time. I can minimize this error by focusing and trying to be quick but I can not eliminate the error completely.

How do we define a ‘good’ measurement

- These questions do not have simple answers.
- Scientist must make this determination on a case by case basis.
- Example: if your measurement is 2 inches off is that ‘ok?’
  - If you are measuring the length of North Carolina and you are only 2 inches off than that is an acceptable difference.
  - If you are measuring a table then 2 inches is a significant difference and the table should be remeasured.

Prefixes

- Prefixes are put onto base units to increase or decrease the unit be a power of 10.
- Example: centi- is put onto meter to make centimeter (cm)
- Conversion rate: 100 centimeters (cm) = 1 meter (m)

Prefixes go up and down by a factor of 10.

name	symbol	meaning	ratio to base unit
deci	d	1 tenth (0.1) 10^{-1}	$\frac{\text{10 deci units}}{\text{1 base unit}}$
centi	c	1 hundredth (0.01) 10^{-2}	$\frac{\text{100 centi units}}{\text{1 base unit}}$
milli	m	1 thousandth {0.001) 10^{-3}	$\frac{\text{1000 milli units}}{\text{1 base unit}}$

Prefix	Meaning
Kilo -	1,000
Hecto-	100
Deca-	10
Liter/Gram/Meter	1
Deci-	0.1
Centi-	0.01
Milli-	0.001

Metric Prefix Conversions

PREFIX	tera	giga	mega	kilo	m (meter)	deci	centi	milli	micro	nano	pico
SYMBOL	T	G	M	k		d	c	m	μ	n	p
NUMBER	10^{12}	10^{9}	10^{6}	10^{3}	10^{0}	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}

Problems:

1. What is bigger, one kilometer or one millimeter?
2. How many kgs are in 115,000 grams?
3. How many milliliters are in 13 liters?

Scientific notation

- In science we deal with very large and very small numbers.
- Writing them out can be time consuming and can lead to error.
- Scientific notation is a way of writing very large and very small numbers in a way that is easier to understand.

Scientific Notation

exponent

coefficient

$$6.022 \times 10^{23}$$

base

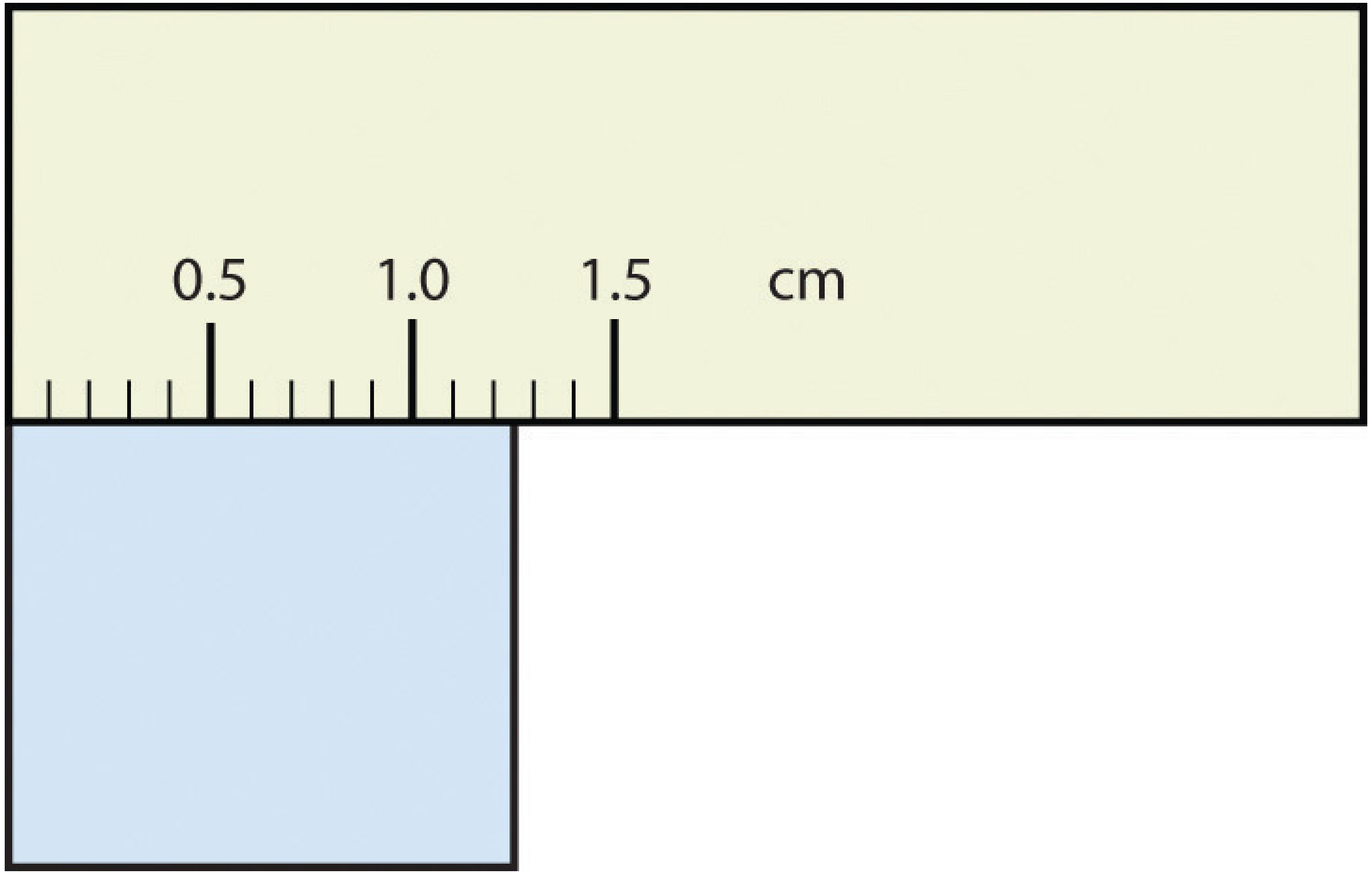
Scientific Notation

- For example the speed of light is 2.99 x 10^8 m/s.
- If I were to write this out it would be 29,900,000,000 m/s (meter per second).
- In this example
  - The coefficient is 2.99
  - The base is 10 (it will always be 10)
  - The exponent was 8

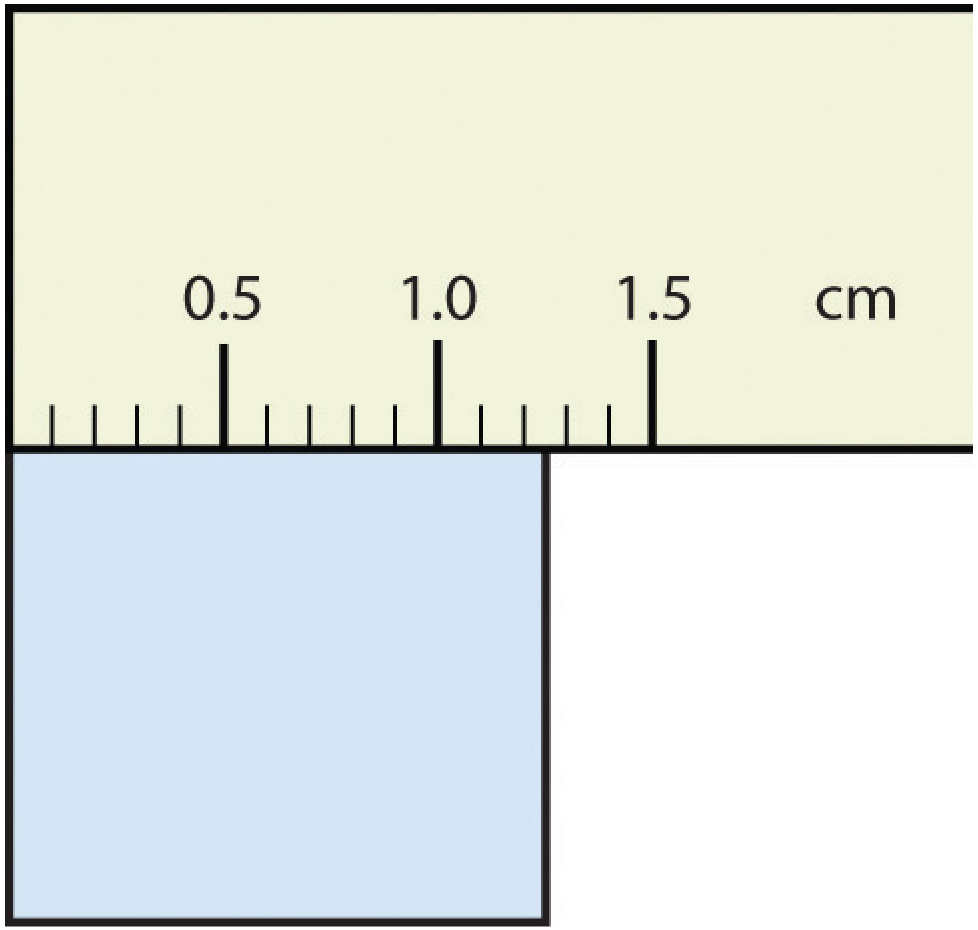
Scientific Notation

- When converting a number to scientific notation you keep only the significant figures.
- Significant figures of a number are digits that carry meaning contributing to its measurement resolution.

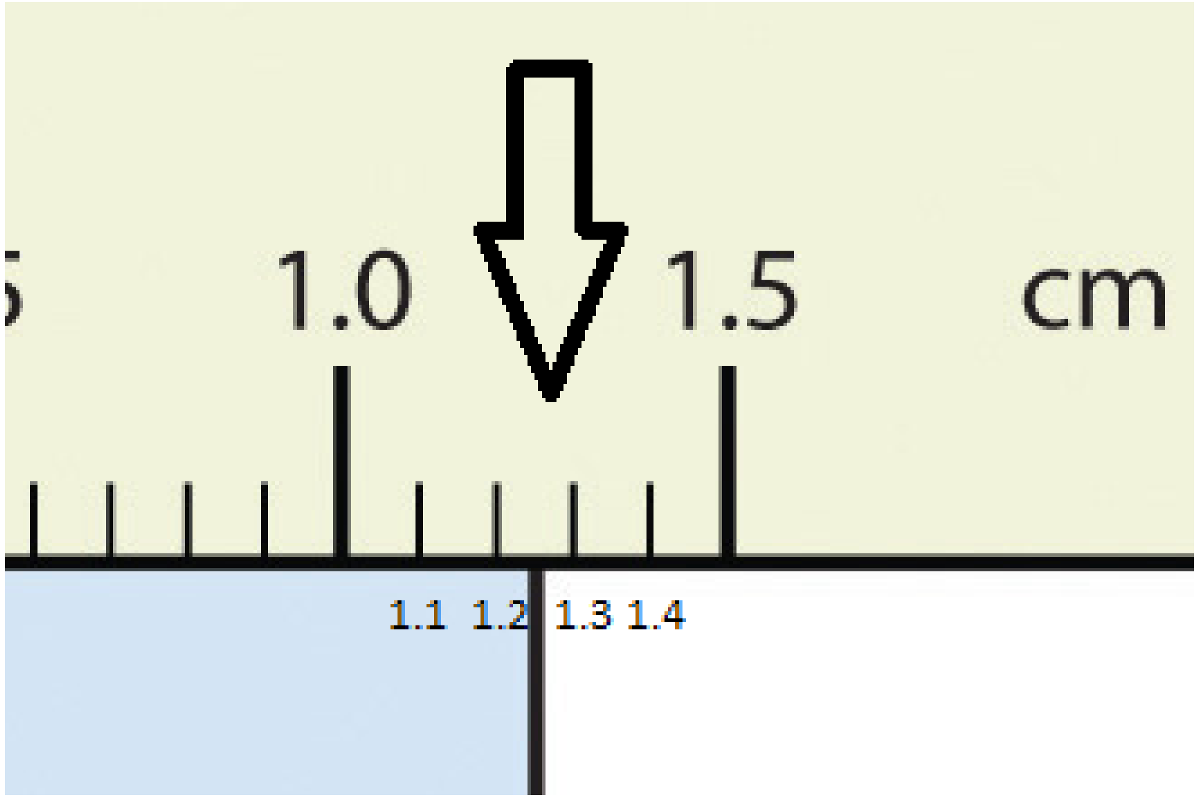
For example, use this picture to tell me how long the blue piece of paper is.



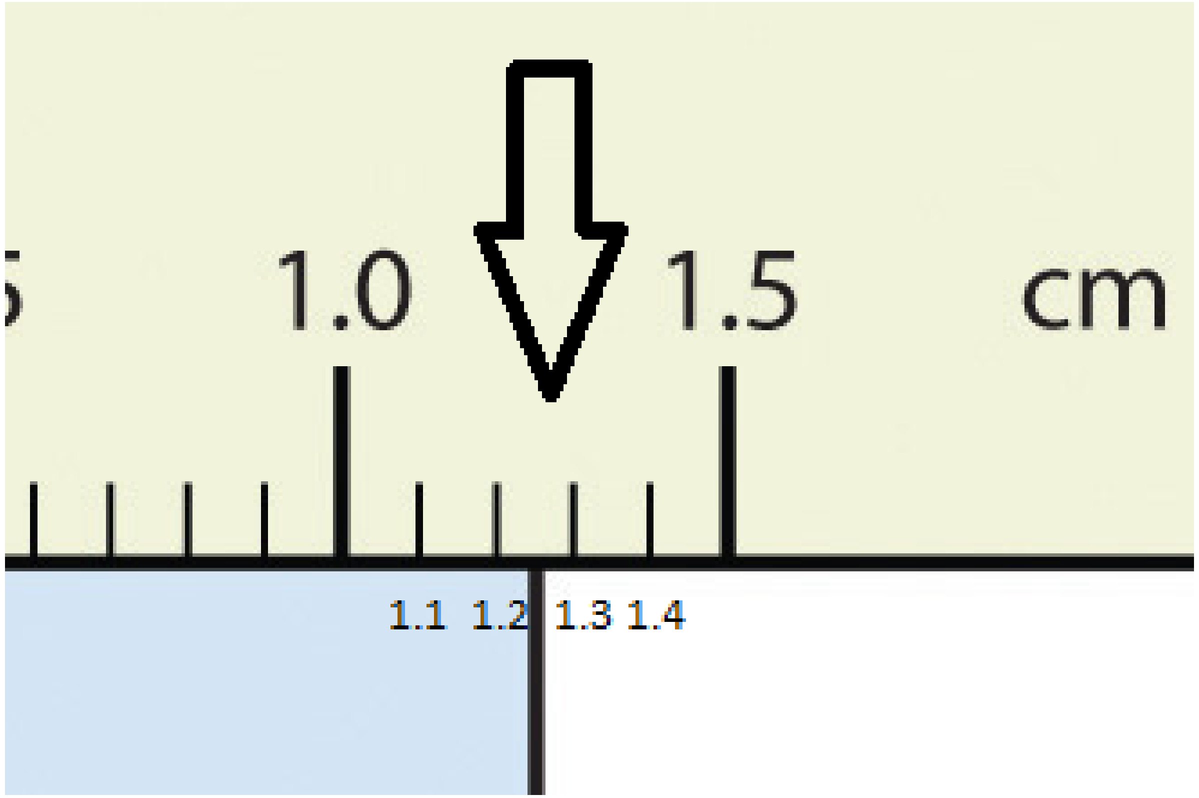
You could say it is 1 cm long but we can be more accurate than that.



I would be more accurate to say it is 1.25 cm long. This measurement has 3 significant figures.



If I said the paper was 1.25<u>55555</u> cm long the underlined digits are inaccurate and can not be considered significant.



Problems:

1. $2x10^4$ = ________________
2. $3.\ 08x10^6$ = ________________
3. $4.5x10^{-4}$ = ________________
4. 3,800 = ________________
5. 9,800,000 = ________________
6. 0.0000089 = ________________