CONCEPT: INTRODUCTION TO UNITS AND THE S.I. SYSTEM

● Physics = study of natural phenomena**,** which includes lots of measurements & equations**!** Physics = Math + Rules

- In nature, we measure **physical quantities** (*mass, length…*)**,** which must have _____ & _____

(*Example: You measure the mass of a box*)

_____ _____

[Number] **[Unit]**

● For physics equations to work, ALL units in it must be _____ with each other**.**

- Groups of compatible units that "work together" form a _____ of units**.**

- In Physics, *always* use S**.**I**.** units **(** *Système International* **)**

Quantity	S.I.	Imperial
MASS	Kilogram **[ ]**	Pound **[lb]**
LENGTH	Meter **[ ]**	Foot **[ft]**
TIME	Second **[ ]**	Second **[s]**
FORCE	Newton **[ ]**	Foot-pound

Force = Mass × Acceleration

$$F = m \times a$$

[ ] = [ ] × [ ] → [COMPATIBLE | INCOMPATIBLE]

[ ] = [ ] × [ ] → [COMPATIBLE | INCOMPATIBLE]

CONCEPT: METRIC PREFIXES

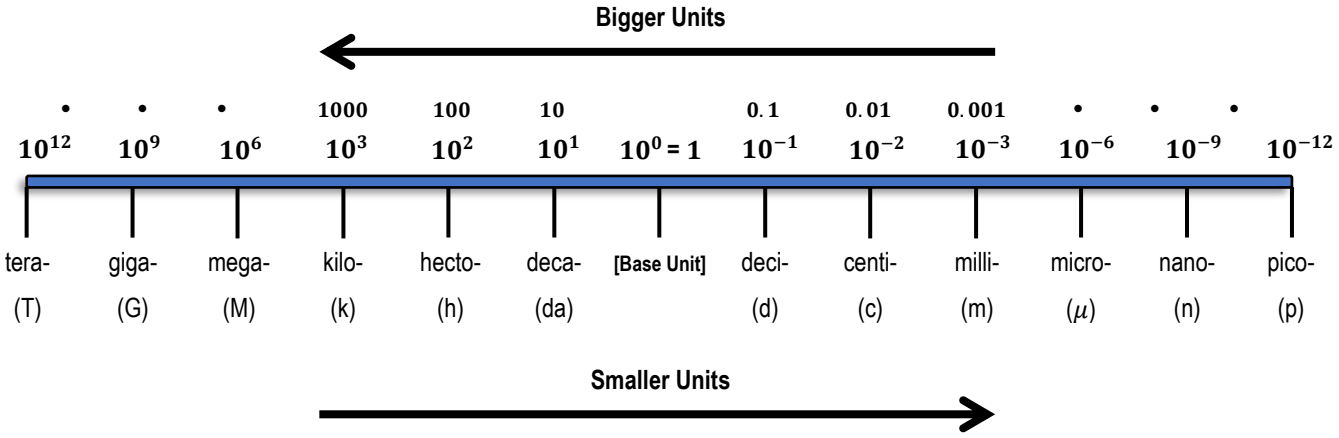
[Base Unit] [Prefixes]

● A metric prefix is a **letter** or **symbol** that goes before a base unit: m, g, s → km, ,mg, μs,

- Each letter / prefix stands for a specific power of 10 multiplied by the base unit.

Example: 5 km = _____ m = _____ m

4.6 ms = _____ s = _____ s



EXAMPLE: Express the following measurements using the desired prefix.

STEPS
1) Identify starting & target prefixes
2) Move from start → target, count # of exponents moved
3) Shift decimal place in the same direction moved in Step 2

a) 6.5 hm to m

b) 3.89 mm to m

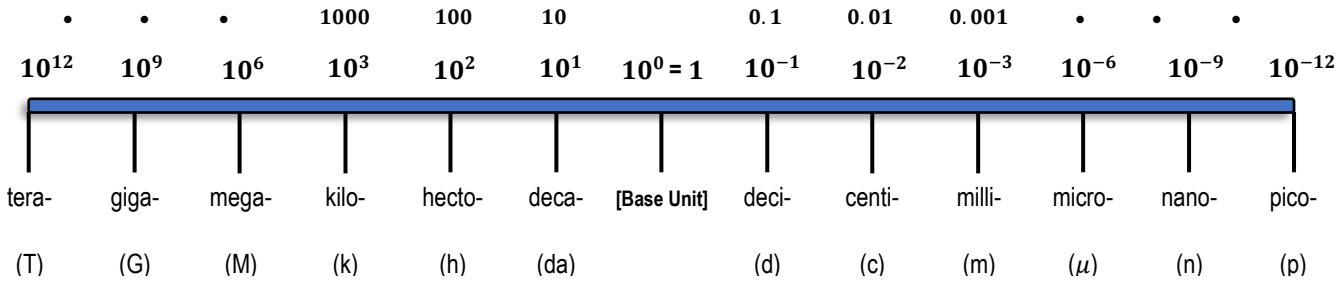
c) 7.62 kg to μg

● When re-writing numbers with metric prefixes,

- Shifting from a ***bigger*** to ***smaller*** unit, number becomes **[LARGER | SMALLER]**
- Shifting from a ***smaller*** to ***bigger*** unit, number becomes **[LARGER | SMALLER]**

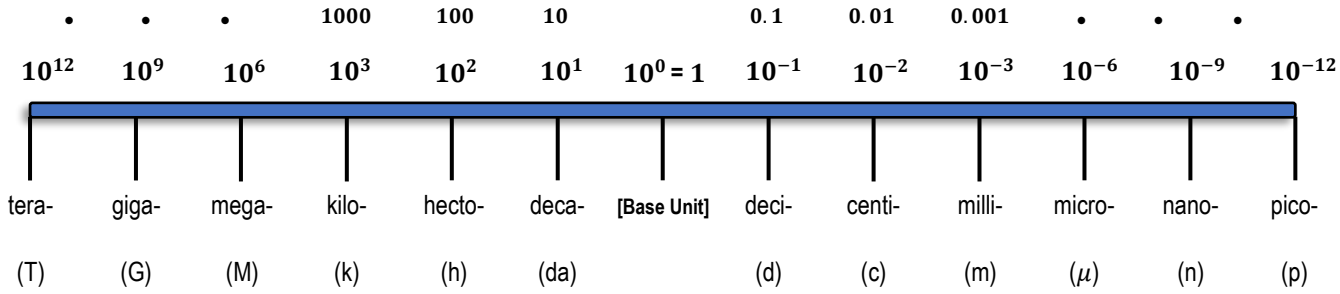
PRACTICE: The earth's circumference is approximately 40.1 Mm (megameters). What is this circumference in kilometers?

A) 0.0401 km
B) 40,100,000 km
C) 40,100 km
D) 0.00401 km



PRACTICE: Astronomers often detect radio waves with wavelengths of 3,000,000,000 nm. What is this wavelength expressed in decameters (dam)?

A) 3 dam
B) 0.3 dam
C) 30 dam
D) 0.03 dam



CONCEPT: SCIENTIFIC NOTATION

● We use **Scientific Notation** to _____ very LONG, inconvenient numbers into SHORTER ones.

Mass of Earth = 5,972,000,000,000,000,000,000,000 kg

= _____

General Format for Scientific Notation

$$\underbrace{A.BC}_{[\,\#\geq \_\_\_ \text{ but } < \_\_\_\,]} \times 10^{\overbrace{D}^{[\,\_\_\_\_\_\,]}}$$

STANDARD FORM → SCIENTIFIC NOTATION

a) 304,605.27 kg

b) 0.000102 m

c) 7 s

Standard Form → Scientific Notation

1) Move decimal to get # ≥ 1 but < 10

2) Round long numbers with many non-zero numbers to 2 decimal places

3) # of decimal places moved = Exponent
- If original number > 10, exponent is **+**
- If original number < 1, exponent is **–**

SCIENTIFIC NOTATION → STANDARD FORM

a) 5.45×10^{8} kg

b) 9.62×10^{-5} s

Scientific Notation → Standard Form

1) Exponent = # of decimal places moved
- If exponent is **+**, number becomes ***larger***
- If exponent is **–**, number becomes ***smaller***

PRACTICE: Rewrite 0.00016 kg in scientific notation.

A) 1.6×10^{-4} kg
B) 16×10^{-3} kg
C) 1.6×10^{4} kg
D) 1.6×10^{-3} kg

PRACTICE: Rewrite 299,800,000 m/s in scientific notation.

A) 2.998×10^{5} m/s
B) 3.00×10^{8} m/s
C) 3.00×10^{5} m/s
D) 2.998×10^{-8} m/s

EXAMPLE: Express 0.0000529×10^{-6} m in scientific notation.

PRACTICE**:** Rewrite 3.41×10^{-4} in standard form**:**

A) 0.000341
B) 34,100
C) 0.0000341
D) 3,410

PRACTICE**:** Rewrite 9.98×10^{7} in standard form**.**

A) 0.000000998
B) 0.0000000998
C) 9,980,000,000
D) 99,800,000