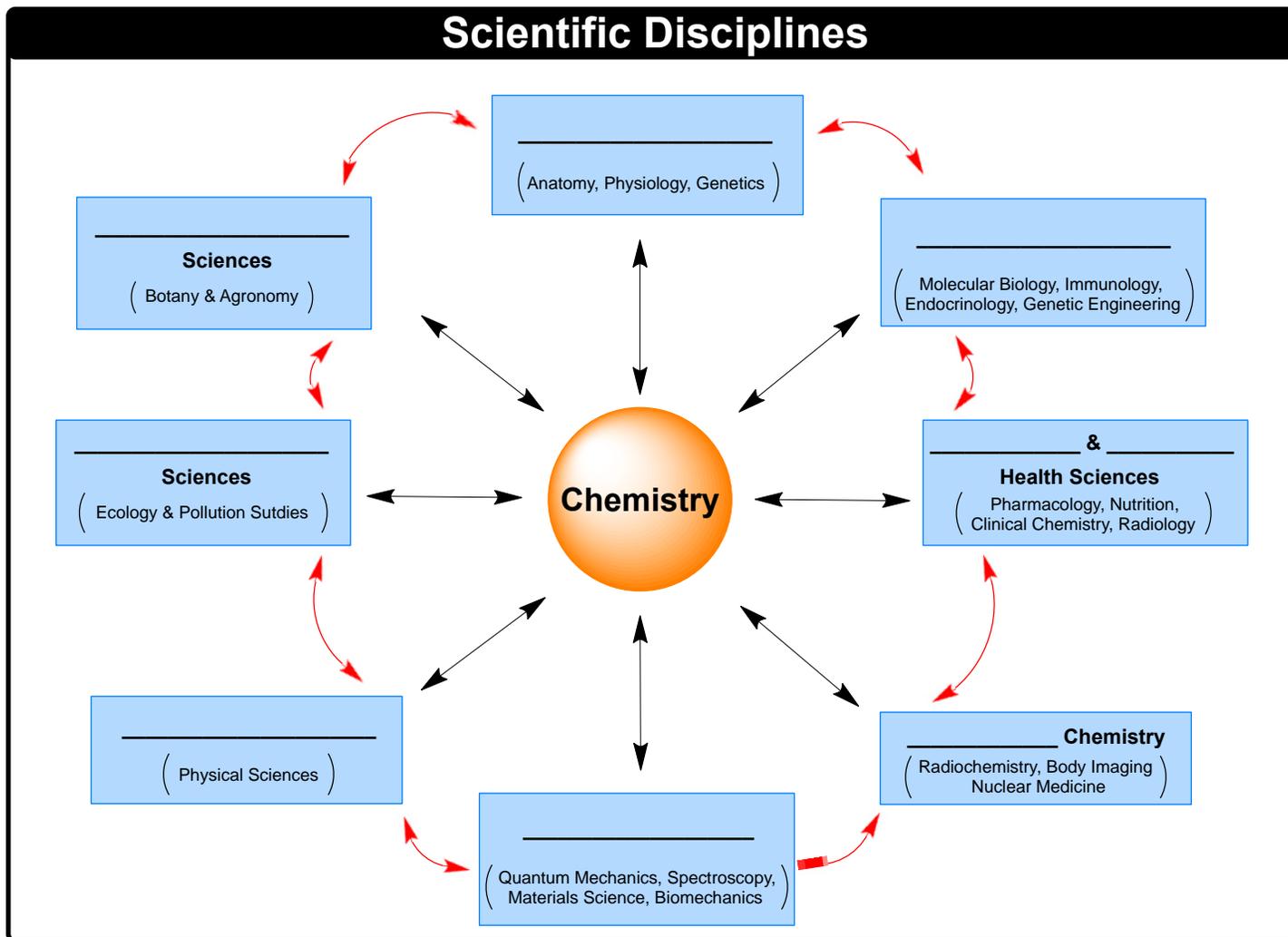


**CLUTCH**

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**CONCEPT: WHAT IS CHEMISTRY?**

- **Chemistry:** the study of matter – its \_\_\_\_\_, \_\_\_\_\_, and the \_\_\_\_\_ it undergoes.
  - **Matter:** anything that occupies \_\_\_\_\_ because of its volume and has \_\_\_\_\_.
  - Chemistry serves as “the central science” and foundation that links together other scientific disciplines.



**EXAMPLE:** Suggest a name for the science that studies the motor functions and responses of the Venus Fly Trap.

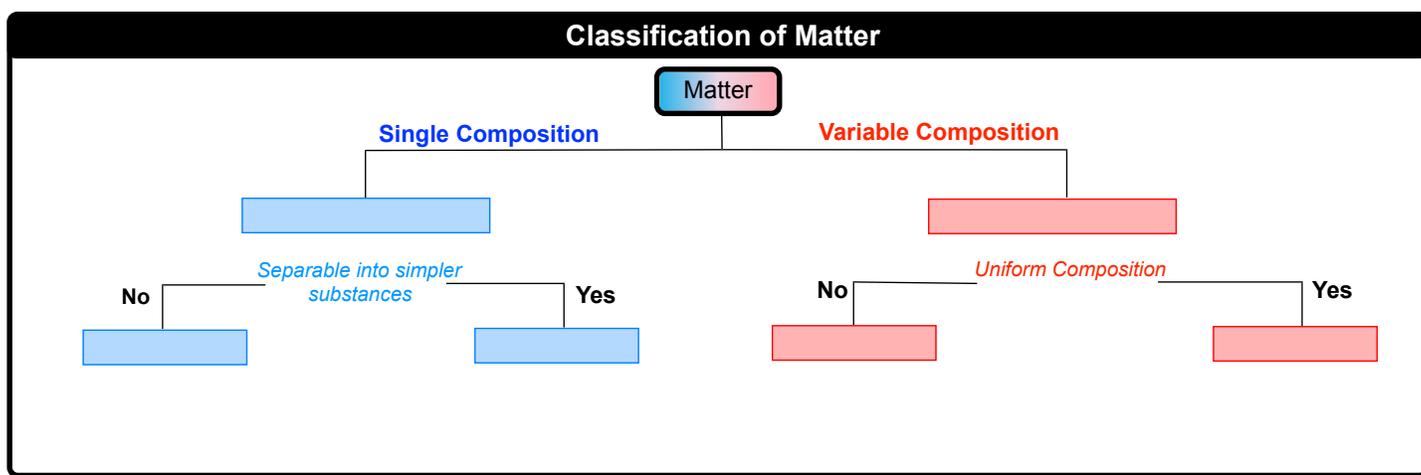
- a) Biochemistry                      b) Physics                      c) Plant Sciences                      d) Health Sciences

**PRACTICE:** Suggest a name for the science that studies the physics of rocks and the earth.

- a) Geology                      b) Biology                      c) Environmental Science                      d) Nuclear Chemistry

**CONCEPT: CLASSIFICATION OF MATTER**

- **Chemistry:** the study of matter and the changes it undergoes, with the \_\_\_\_\_ being its basic functional unit.
  - **Matter:** anything that occupies \_\_\_\_\_ and has \_\_\_\_\_.
  - Classified into 3 types:
    - \_\_\_\_\_: The simplest type of matter that is composed of 1 kind of atom.
    - \_\_\_\_\_: Matter composed of 2 or more different elements that are chemically bonded together.
    - \_\_\_\_\_: Matter composed of elements and/or compounds that are physically mixed together.



**EXAMPLE:** Consider the following substances:

- I. Gatorade                  II. Crystalline sugar                  III. Lead wire                  IV. Salsa

- a) I and II are pure substances, IV is a homogeneous mixture.
- b) I and II are homogeneous mixtures.
- c) II and III are pure substances, I is a homogeneous mixture.
- d) None of the above is true.

**PRACTICE:** Which of the following statements is true?

- a) Compounds can only be broken down by chemical means.
- b) Gasoline is a pure substance.
- c) Only elements are pure substances.
- d) Milk is an example of a homogeneous mixture.
- e) Concrete is an example of a homogeneous mixture.

**CONCEPT: CLASSIFICATION OF MATTER**

**PRACTICE:** Choose the homogeneous mixture from the list below.

- a) Soda
- b) Smog
- c) Trail mix
- d) Blood
- e) Air

**PRACTICE:** Choose the homogeneous mixture from the list below.

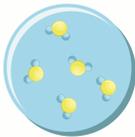
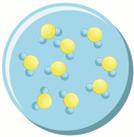
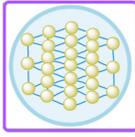
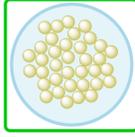
- a) Chicken noodle soup
- b) Coffee
- c) Sand
- d) Fruit salad
- e) Seawater

**PRACTICE:** Classify each of the following as an element, compound or mixture.

- a) Ammonia,  $\text{NH}_3$
- b) Gold bar
- c) Orange juice
- d) Wine
- e) Saline solution

**CONCEPT: STATES OF MATTER**

- Under varying conditions of pressure and temperature, most substances can exist in 3 states of matter.
  - These forms of matter have an effect on *physical properties*, which deal with physical appearance or state.
    - **Compressibility**: The capacity to \_\_\_\_\_ or \_\_\_\_\_ in size by increasing pressure.
    - **Viscosity**: The resistance to \_\_\_\_\_ or to change in \_\_\_\_\_.

<b>States of Matter</b>		
<div style="text-align: center; border: 1px solid black; padding: 2px; color: white; background-color: #f08080; margin-bottom: 10px;"><b>Gas</b></div>  <p>□ Assumes _____ &amp; _____ of container.</p> <p>□ _____ Compressibility.</p> <p>□ _____ Viscosity.</p>	<div style="text-align: center; border: 1px solid black; padding: 2px; color: white; background-color: #add8e6; margin-bottom: 10px;"><b>Liquid</b></div>  <p>□ Assumes _____ but not _____ of container.</p> <p>□ _____ Compressibility.</p> <p>□ _____ Viscosity.</p>	<div style="text-align: center; border: 1px solid black; padding: 2px; color: white; background-color: #a9a9a9; margin-bottom: 10px;"><b>Solid</b></div> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid purple; padding: 5px;">  </div> <div style="border: 1px solid green; padding: 5px;">  </div> </div> <p>□ Maintains a fixed _____ &amp; _____.</p> <p>□ _____ Compressibility.</p> <p>□ _____ Viscosity.</p>

□ Solid matter can be *crystalline* or *amorphous solid*.

- **Crystalline**: well-organized 3D structure

- **Amorphous**: lacks organized pattern or shapes

**EXAMPLE:** An unknown substance has a volume of 12.1 L and upon quadrupling the pressure has an unchanged volume. Which is the likely physical state of the unknown?

a) Solid

b) Liquid

c) Gas

d) Neutron

**CONCEPT:** STATES OF MATTER**PRACTICE:** Which of the following choices will have the lowest observed viscosity?

a) Water

b) Helium gas

c) Molasses

d) Tar

**PRACTICE:** Nitric acid, which is used in the production of fertilizers, plastics and dyes, has a melting point of  $-42^{\circ}\text{C}$  and a boiling point of  $83^{\circ}\text{C}$ . Determine its physical state at a temperature of  $110^{\circ}\text{C}$ .

a) Solid

b) Liquid

c) Gas

d) Plasma

**CONCEPT: PHYSICAL & CHEMICAL CHANGES**

**Physical Changes**

- Changes in the physical state of a substance without a change in composition.

**Physical Changes**

- \_\_\_\_\_ of solute
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ Material
- \_\_\_\_\_ substances
- \_\_\_\_\_ a substance

**EXAMPLE:** Which change is a physical change?

- a) Wood burning      b) Iron rusting      c) Dynamite exploding      d) Dissolving sugar in water

**Chemical Changes**

- Changes in chemical composition that creates a new chemical bonds and product(s).

**Chemical Changes**

- \_\_\_\_\_ of Metals
- \_\_\_\_\_ of food
- \_\_\_\_\_ Change
- \_\_\_\_\_ of material
- \_\_\_\_\_ Reactions
- \_\_\_\_\_ Change

**EXAMPLE:** Which of the following is a chemical change?

- a) Melting wax      b) Cooking an egg      c) Condensing water vapor      d) Carving a piece of wood

**PRACTICE:** Which of the following is a physical change?

- a) Milk sours when left out of the refrigerator.
- b) Tums (containing  $\text{CaCO}_3$ ) neutralizes stomach acid.
- c) Sugar caramelizing when heated on a skillet.
- d) Tearing a piece of paper.

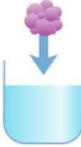


**CONCEPT: CHEMICAL PROPERTIES**

● **Chemical Property:** a property of matter that is observed during a chemical reaction.

□ The matter will be changed into a new substance after the reaction.



Chemical Properties		
Chemical Property	Chemical Property	Chemical Property
 _____	 _____	 _____
 _____	 _____	 _____

**EXAMPLE:** Which of the following is not a chemical property for an unknown element?

- a) It has a yellow-orange color.
- b) It is very soluble in an acid solution.
- c) It is radioactive.
- d) It experiences rusting when exposed to pure oxygen gas.
- e) It has a high reactivity with acids.

**PRACTICE:** Which of the following represents a chemical property of hydrogen gas?

- a) It exists as a gas at room temperature.
- b) It is less dense than air.
- c) It reacts explosively with oxygen gas.
- d) It is a colorless gas.
- e) It is a tasteless molecule.

**CONCEPT: PHYSICAL PROPERTIES**

- **Physical Property:** a measurable property that describes the state of a chemical compound.
  - Can be observed through your senses without changing the chemical structure of a substance.

<b>Physical Properties</b>		
Physical Property	Physical Property	Physical Property
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**EXAMPLE:** Which of the following represents a physical property?

- a) Potassium metal is extremely reactive when placed in water.
- b) Rusting is a common issue with aluminum.
- c) Neon has an unreactive nature.
- d) The butane in a lighter is highly flammable
- e) Mercury is a silvery liquid at 25°C.

**PRACTICE:** Which of the following is **not** a physical property?

- a) The brittleness of solid sulfur.
- b) The density of iron is 7.87 g/cm<sup>3</sup>.
- c) A platinum wire glows red when heated.
- d) Osmium is a silver-colored metal.
- e) An iron bar rusts.

CONCEPT: SCIENTIFIC NOTATION

Format for Scientific Notation

- **Scientific Notation:** used to turn small or large, inconvenient numbers into manageable ones.

$$6.88 \times 10^{-12}$$

- **Coefficient:** The beginning part of value that is  $\geq$  \_\_\_\_, but less than \_\_\_\_.
- **Base:** The portion of the scientific notation value that is always 10.
- **Exponent:** The number of places the decimal was moved to create the scientific notation value.
  - Must be expressed as a whole number integer.

**EXAMPLE:** Which of the following scientific notation values is written correctly?

- a)  $1.25 \times 10^{-1/4}$       b)  $0.00320 \times 10^{-9}$       c)  $5.220 \times 10^3$       d)  $7.3000 \times 2^7$

Scientific Notation to Standard Notation

- **Standard Notation:** The normal way of writing numbers.
  - A \_\_\_\_\_ exponent tells you to make the coefficient value larger.
 

$7.17 \times 10^5$       \_\_\_\_\_
  - A \_\_\_\_\_ exponent tells you to make the coefficient value smaller.
 

$3.25 \times 10^{-7}$       \_\_\_\_\_

**PRACTICE:** Convert the following scientific notation values into standard notation.

- a)  $1.25 \times 10^{-4}$       b)  $3.20 \times 10^{-9}$       c)  $1.6100 \times 10^4$

Standard Notation to Scientific Notation

- To convert a number into a scientific notation value, make sure the coefficient is  $\geq$  \_\_\_\_, but less than \_\_\_\_ .
  - Increasing the coefficient value makes the exponent value decrease.
 

0.0000145      \_\_\_\_\_
  - Decreasing the coefficient value makes the exponent value increase.
 

101,325,000      \_\_\_\_\_

**PRACTICE:** Convert the following standard notation values into scientific notation.

- a) 377,000      b) 0.000101      c) 707.82

CONCEPT: SI UNITS (SIMPLIFIED)

SI Base Units

- The International System of Units (SI) is related to the metric system and is based on six base units.

SI Base Units					
Physical Quantity	Name	Symbol	Physical Quantity	Name	Symbol
 Mass	_____	_____	 Temperature	_____	_____
 Length	_____	_____	 Amount of substance	_____	_____
 Time	_____	_____	 Volume	_____	_____

**EXAMPLE:** Which of the following values is given with SI units?

- a)  $1.25 \times 10^4$  min                      b)  $6.82 \times 10^{-3}$  mg                      c)  $25.6^\circ\text{C}$                       d) 101.3 s

**PRACTICE:** Which of the following represents volume in SI units?

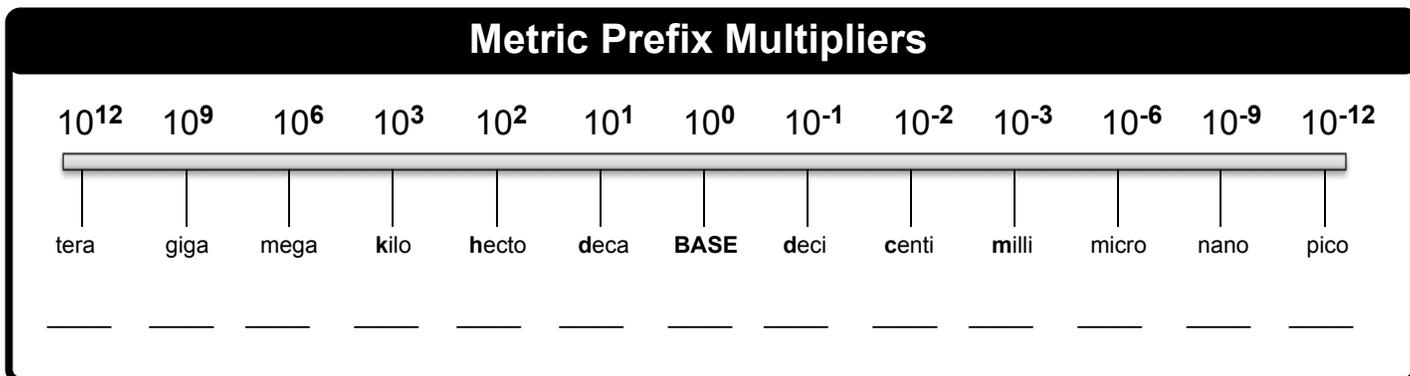
- a)  $2.71 \times 10^{-1}$  cm<sup>3</sup>                      b) 207.2 km<sup>2</sup>                      c)  $5.18 \times 10^5$  m<sup>3</sup>                      d) 582.28 mm

**PRACTICE:** Convert 12 minutes into acceptable SI units.

- a) 720 s                      b) 0.20 s                      c)  $3.33 \times 10^{-3}$  s                      d)  $4.32 \times 10^4$  s

CONCEPT: METRIC PREFIXES

- **Metric Prefixes** are modifiers that are multiples of \_\_\_\_\_.



**MEMORY TOOL**

The **G**reat **M**onarch **K**ing **H**enry's **D**aughter **B**arbara **d**rinks **c**hocolate **m**ilk **μ**ntil **n**ine **p**m



- The metric prefixes act as "labels" that can be placed in front of various base units.

Metric Prefixes			
Base Units	Metric Prefixes	Base Units	Metric Prefixes
L	___ L	mol	___ mol
s	___ s	A	___ A

**EXAMPLE:** Convert the following value to the desired units: 694 kg to  $\mu\text{g}$

**STEP 1:** If the given value has a **metric prefix** then convert it to the \_\_\_\_\_ unit.

- In order to cancel out units always make sure they are on opposite levels.
- Always place the coefficient \_\_\_\_\_ on the side with the **metric prefix**.

**STEP 2:** If necessary, convert the \_\_\_\_\_ unit to a new **metric prefix**.

**CONCEPT: METRIC PREFIXES****PRACTICE:** Which quantity in the following pair is smaller?155 pm or  $7.8 \times 10^{-9}$  cm**PRACTICE:** Use the prefix multipliers to express each measurement without any exponents.a)  $32 \times 10^{-13}$  Lb)  $7.3 \times 10^6$  gc)  $18.5 \times 10^{11}$  s**PRACTICE:** Use scientific notation to express each quantity with only the base unit.a) 83  $\mu\text{m}$ 

b) 193 kg

c) 2.7 mmol

**PRACTICE:** If a room has a volume of  $1.15 \times 10^8$   $\text{cm}^3$ , what is the volume in  $\text{km}^3$ ?



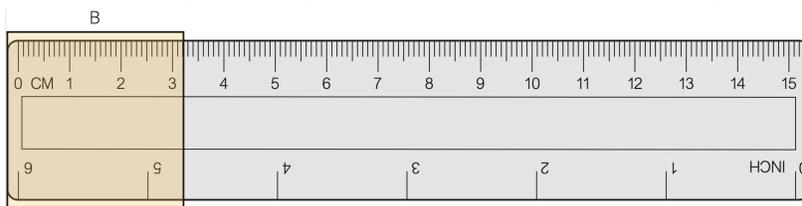
**CONCEPT: SIGNIFICANT FIGURES: PRECISION IN MEASUREMENTS**

- The more significant figures in a measurement then the more precise it is.
  - A reading of 25.00 mL is more precise than just 25 mL.

**Recording Measurements**

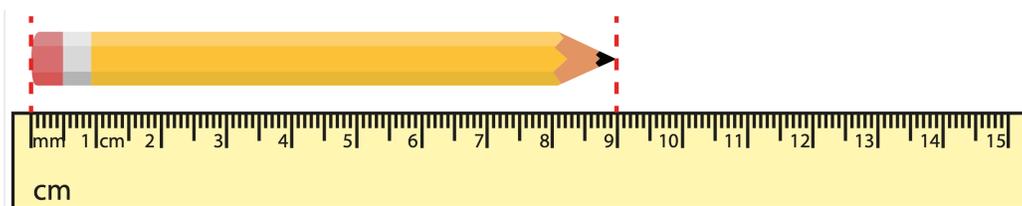
- When taking a measurement, you must include all of the known numbers plus an additional \_\_\_\_\_ place.
  - EYEBALL TEST: Based on an estimate or best guess from looking.

**EXAMPLE:** Determine the number of significant figures involved in measuring the length of the square.



- a) 3 cm                                      b) 3.2 cm                                      c) 3.20 cm                                      d) 3.200 cm

**PRACTICE:** Read the length of the pencil to the correct number of significant figures.



- a) 8.0 cm                                      b) 8.000 cm                                      c) 9 cm                                      d) 9.0 cm                                      e) 9.00 cm

**PRACTICE:** What is the correct reading for the liquid in the burette provided below?

- a) 7 mL
- b) 7.0 mL
- c) 7.20 mL
- d) 7.00 mL
- e) 6.80 mL



CONCEPT: SIGNIFICANT FIGURES: IN CALCULATIONSMultiplication and Division

- When either multiplying or dividing different numbers the final answer will contain the least \_\_\_\_\_.

**EXAMPLE:** Perform the following calculation to the right number of sig figs:

$$(3.16) \times (0.003027) \times (5.7 \times 10^{-3})$$

Addition and Subtraction

- When either adding or subtracting different numbers the final answer will contain the least \_\_\_\_\_.

**EXAMPLE:** Perform the following calculation to the right number of sig figs:

$$402.09 - 212.2 + 2.671$$

Mixed Operations

- When dealing with a mixture multiplication, division, addition and subtraction we must follow the order of operations.
  - **PEMDAS** stands for \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_.

**EXAMPLE:** Perform the following calculation to the right number of sig figs:

$$\frac{[(1.89 \times 10^6) \cdot (3.005)] \cdot (5.21^3)}{(8.829 - 6.5) + (2.920)}$$

CONCEPT: SIGNIFICANT FIGURES: IN CALCULATIONS

**PRACTICE:** Perform the following calculation to the right number of sig figs:

$$[(1.7 \times 10^6) \div (2.63 \times 10^5)] + 6.96$$

**PRACTICE:** Perform the following mathematical operations and express the result to the correct number of significant figures.

$$\frac{(6.404 \times 2.91)}{(18.7 - 17.1)}$$

**PRACTICE:** What answer should be reported, with the correct number of significant figures, for the following calculation?

$$\frac{(42.00 - 40.914) \cdot (25.739 - 25.729)}{(11.50 \cdot 1.001) + (0.00710 \cdot 700.)}$$

**CONCEPT: CONVERSION FACTORS (SIMPLIFIED)**

● **Conversion Factor:** a ratio or fraction that ties together \_\_\_\_\_ different units.

□ For example, a day is composed of 24 hours:

\_\_\_\_\_ or \_\_\_\_\_

● **Given Amount:** a value containing only \_\_\_\_\_ unit.

□ For example, we spent **3 hours** studying chemistry today.

**EXAMPLE:** Clutch’s “Ugly but Good” chocolate chip cookie recipe is always a hit at our office parties. My budget is \$80. The recipe makes 18 servings for the party. Each serving requires 8 chocolate truffle chips at a cost of \$0.50 per 5 chocolate truffle chips. From the information provided, determine the given amount and all conversion factors.

**Common Conversion Factors**

● The most common conversion factors deal with units involved with length, volume or mass.

Conversion Factors					
Length		Volume		Mass	
1 inch = _____ cm	1 meter = _____ yds	1 mL = _____ cm <sup>3</sup>	1 L = _____ dm <sup>3</sup>	1 tablet = _____ mg	1 oz = _____ g
1 yard = _____ feet	1 mile = _____ feet	1 mL = _____ cc	1 fl oz = _____ mL	1 lb = _____ g	1 kg = _____ lbs
1 km = _____ miles		1 L = _____ quarts	1 gallon = _____ L		

**EXAMPLE:** While packing for a trip to Spain a traveler wishes to weigh their luggage to make sure it doesn’t exceed 23 kilograms. Unfortunately their bathroom scale for some reason can only weigh in ounces. What conversion factors could they use to determine the mass of their luggage?

**CONCEPT: CONVERSION FACTORS (SIMPLIFIED)**

**PRACTICE:** A patient has approximately 83 mL of blood pumping by their heart at each beat. By assuming they have a pulse of 75 beats per minute it is calculated that the patient pumps  $8.964 \times 10^6$  mL in one day. Identify the given amount and all conversion factors.

**PRACTICE:** For 7 hours, an intravenous bag delivers medication to a patient at a rate of 2.75 drops a second with a mass of 42 mg per drop. Identify the given amount and all conversion factors.

**PRACTICE:** The dispensing of prescription drugs are usually prescribed in units of mg per kg of body weight. A new prescription drug has a recommended dosage of 11 mg/kg. A 75 lb child requires three tablets each weighing 125 mg for their recommended dosage. Identify the given amount and all conversion factors.

**CONCEPT: DIMENSIONAL ANALYSIS**

● **Dimensional Analysis** is a fail proof process that allows you to convert from one unit to another.

- Design the problems to \_\_\_\_\_ with your **given amount**, and to \_\_\_\_\_ with the **end amount** of your unknown.
- Just follow the units to ensure the unwanted units are canceled out.

**Conversion Strategies**

- Many conversion problems utilize the **given amount** and **conversion factors** in order to isolate an **end amount**.
- Their general format can be shown as:

Given Amount	Conversion Factor 1	End Amount
32 inches	2.54 cm 1 inch	= _____ cm

Given Amount		End Amount
115 min		= _____ year

**EXAMPLE:** A TA can grade 4 assignments per hour. If each assignment has 12 questions, how many questions can the TA grade in 130 minutes?

**STEP 0:** If present, start with the **given amount** that is not a **conversion factor**.

**STEP 1:** Identify the **end amount** you want to isolate for your unknown.

**STEP 2:** Write down all the **conversion factors**.

**STEP 3:** Find the connection between the **given amount** and the **conversion factors** in order to isolate the **end amount**.

**CONCEPT: DIMENSIONAL ANALYSIS**

**PRACTICE:** If the distance between Washington, D.C. and New York City is 224.9 miles, determine the distance in centimeters.

**PRACTICE:** The average human body is composed of approximately 160 fluid ounces of blood. How many quarts of blood does the average human body possess? (1 gallon = 4 quarts , 1 pint = 2 cups , 1 cup = 8 fluid ounces , 1 quart = 2 pints).

**PRACTICE:** Lipitor, a pharmaceutical drug that has been shown to lower “bad” cholesterol levels, while boosting “good” cholesterol levels had over \$12 billion in sales last year. Each pill weighs 2.5 g, which contains 4.0% of the active ingredient by mass. What mass in kg of the active ingredient is present in one bottle of 120 pills?

**CONCEPT: DENSITY**

- **Density** represents the amount of \_\_\_\_\_ per unit of \_\_\_\_\_.

**Density Formula**

Density = \_\_\_\_\_

- For solids and liquids, the units are in \_\_\_\_\_ or \_\_\_\_\_.
- Since gases are less dense, the units are in \_\_\_\_\_ or \_\_\_\_\_.

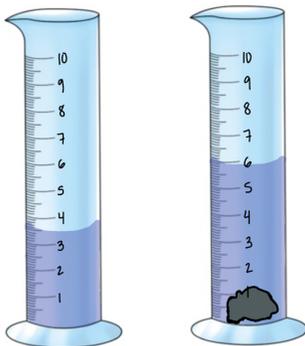
**EXAMPLE:** If the density of an unknown metal is  $21.4 \text{ g/cm}^3$ , express its density in  $\text{lb/ft}^3$ .

**PRACTICE:** When lead levels in blood exceed 0.80 ppm (parts per million) the level is considered dangerous. 0.80 ppm means that 1 million g of blood would contain 0.80 g of Pb. Given that the density of blood is  $1.060 \text{ kg/cm}^3$ , how many grams of Pb would be found in 400.00 mL of blood at 0.620 ppm?

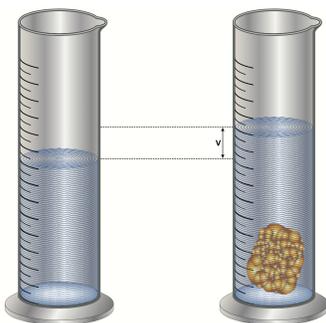
**CONCEPT: DENSITY OF NON-GEOMETRIC OBJECTS: WATER DISPLACEMENT**

- **Water Displacement:** The amount of water moved out of the way when an object is totally submerged.
  - Water displacement can be used to determine the volume of *non-geometric objects*.

**EXAMPLE:** Calculate the volume of the water displaced by the submerging of the object. (The volume of the given cylinders are in mL).



**PRACTICE:** A piece of unknown solid weighs approximately 0.045 lbs. When a scientist places it in a glass beaker the water level increases from 200 mL to 260 mL. What is the density of the unknown solid in g/mL?



**PRACTICE:** If an irregularly shaped apple possesses a density of  $0.96 \text{ g/cm}^3$ , what is its mass in milligrams? (The volume of the given cylinders are in mL).

