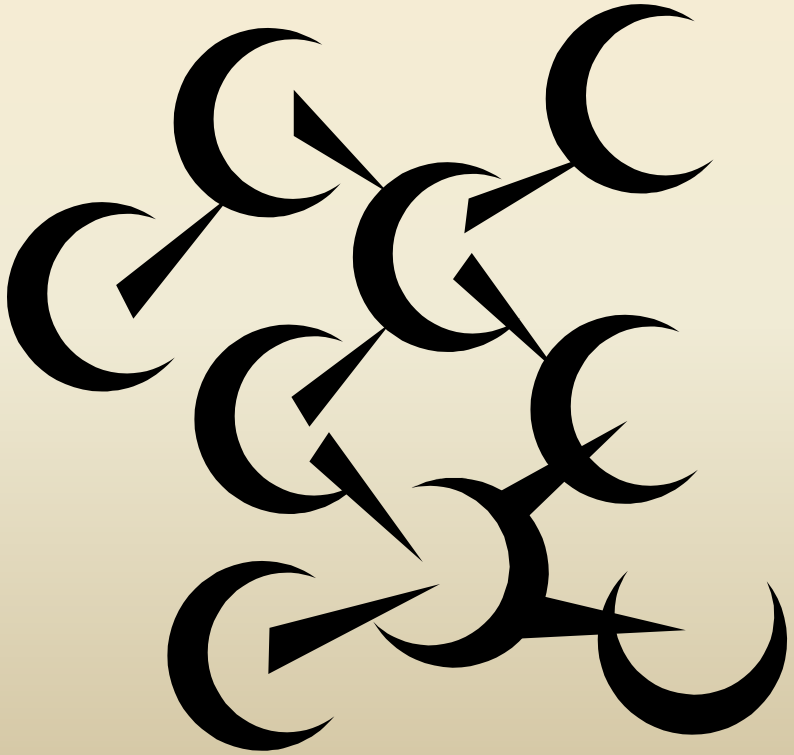
Unit 7 - Matter

Chapter 2 & 3

Chemistry

- Is the study of what things are made of and how things change.



Matter

- Anything that has mass and takes up space.
- Matter is made up of atoms
- Light sound and electricity are NOT matter

Classifying Matter

Pure Substance

- Pure substance is matter that always has exactly the same composition, or simply a substance
- Examples of pure substances: salt, sugar
- **Every sample of a given substance has the same properties because a substance has a fixed, uniform composition**
- Substances can be classified into two categories – elements and compounds

Elements

- Element is a substance that cannot be broken down into simpler substances
- Atom is the smallest particle of an element
- **An element has a fixed composition because it contains only one type of atom**

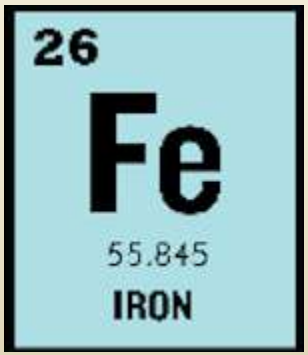
Elements

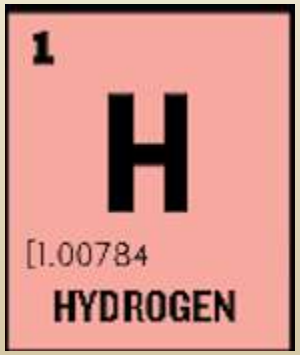
1. Examples of Elements

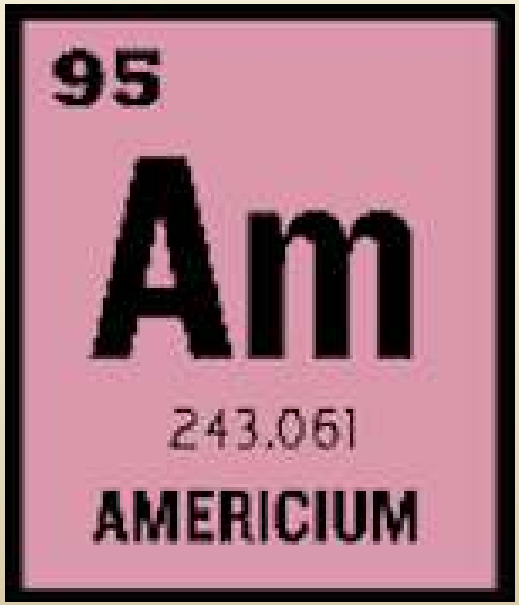
- At room temperature most elements are solids
- Carbon is the main element in the marks you make with a pencil on a piece of paper
- Some elements are gases at room temperature: oxygen, nitrogen
- ONLY two elements are liquids at room temperature: bromine and mercury

Symbols for Elements

- 1813 Jons Berzelius suggested that chemist uses symbols t represent elements
- Each symbol has either one or two letters, with the first letter always being capitalized
- Symbols were bases on the Latin names of elements





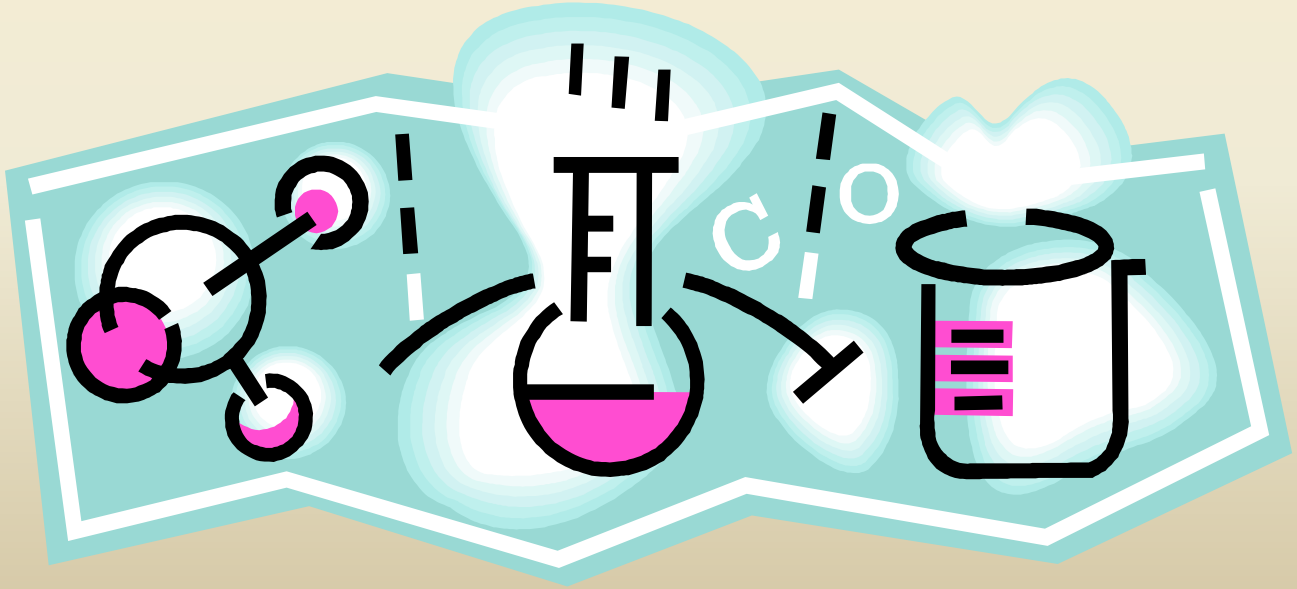


Compounds

- Compound is a substance that is made from two or more simpler substances and can be broken down into those simpler substances.
- the simpler substance are either elements or other compounds
- the properties of a compound differ from those of the substance form which it is made

Compounds

- **a compound always contains two or more elements joined in a fixed proportion**
- example: silicon dioxide has two oxygen for each silicon atom.



Mixtures

- mixtures tend to retain some of the properties of their individual substances
- **the properties of a mixture can vary because the composition of a mixture is not fixed**
- mixtures can be classified by how well the parts of the mixture are distributed throughout the mixture.

- Mixtures - A combination of substances that are not fixed;

they can change

OJ – is a mixture of water, citric acid and sugar among other things. Any drop of Orange Juice can have different amounts of the

Types of Mixtures

1. Heterogeneous Mixture
   - look as a hand full of sand forma beach and it all looks the same, but under magnification it is not.
   - Heterogeneous mixture the parts of the mixture are noticeably different from one another.

Types of Mixtures

2. Homogeneous Mixture
   - Homogeneous mixture the substance are so evenly distributed that it is difficult to distinguish one substance in the mixture from another
   - Example: stainless steel which is a mixture of iron, chromium, and nickel

- E. Solutions, Suspensions, and Colloids
  - The size of the particles in a mixture has an effect on the properties of the mixture
  - **Bases on the size of its largest particles, a mixture can be classified as a solution, a suspension, or a colloid.**

1. Solutions

- Placing a spoonful of sugar in a glass of hot water and stirring with dissolve the water and make a homogeneous mixture
- Solution forms when a substance dissolves and from a homogeneous mixture
- Example: Kool-Aid, or tea

2. Suspensions

- Suspension is a heterogeneous mixture that separates into layers over time
- Examples: salad dressing, sand and water.
- Because larger particles can scatter light in all direction suspensions are cloudy

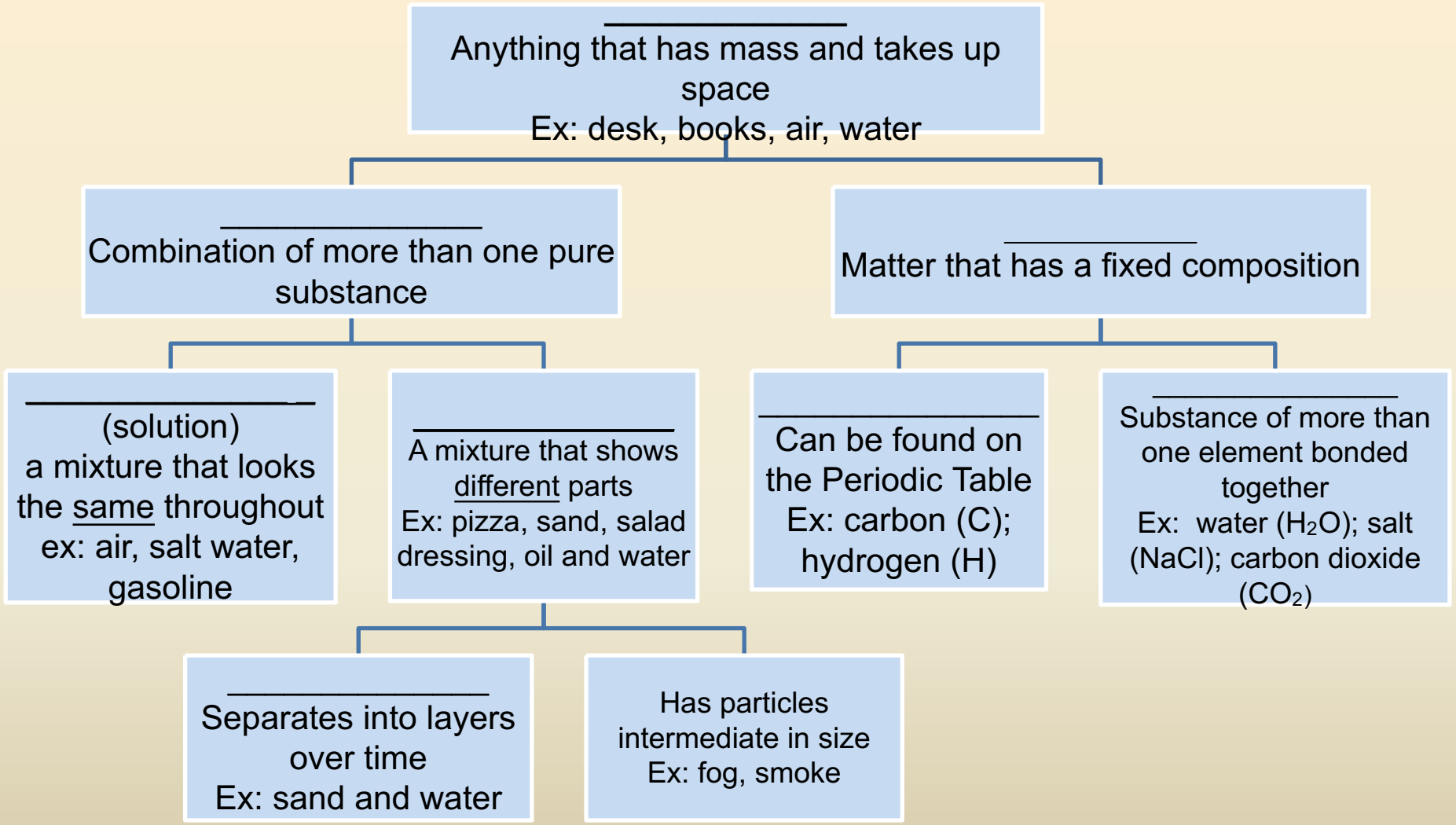
3. Colloids

- Milk is a mixture of substances including water, sugar, proteins and fats
- Colloid contains some particles that are intermediate in size between the small particles in a solution and the larger particles in a suspension
- Colloids do NOT separate into layers
- Fog is a colloid of water droplets in air

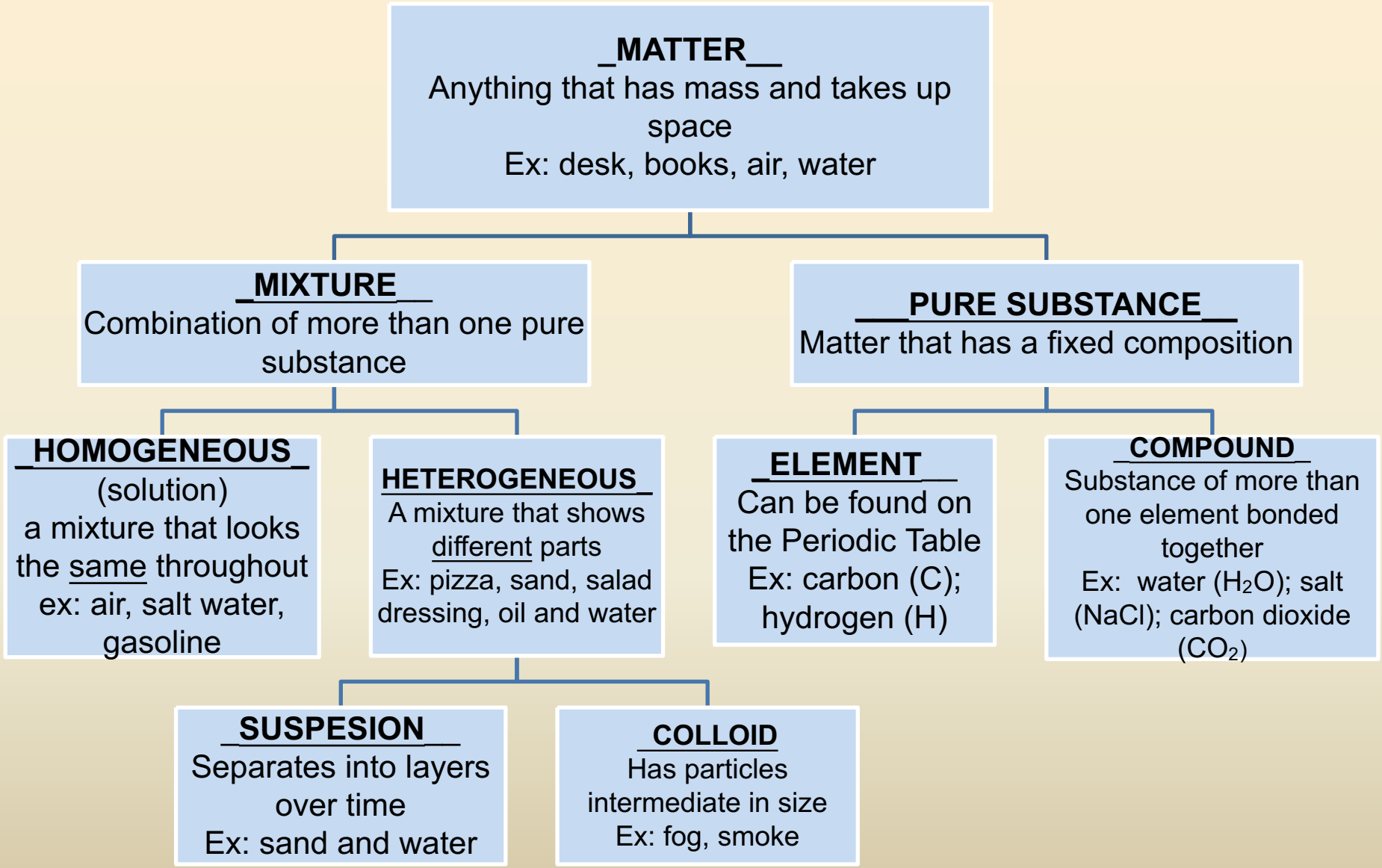
Colloids

- Colloids do NOT separate into layers
- Fog is a colloid of water droplets in air

_____ is the study of matter and how it changes.



__CHEMISTRY_ is the study of matter and how it changes.



Examples of Physical Properties

- Physical property is any characteristic of a material that can be observed or measures without changing the composition of the substances in the material
- **Viscosity, conductivity, malleability, hardness, melting point, boiling point, and density are examples of physical properties**

1. Viscosity

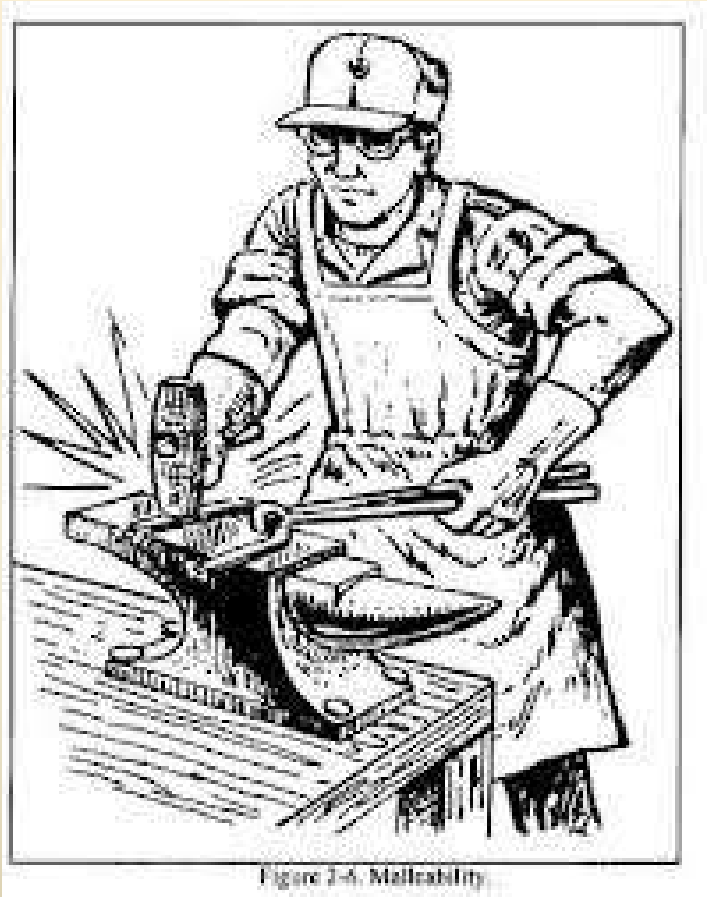
- Viscosity is the tendency of a liquid to keep from flowing (its resistance to flowing)
- the greater the viscosity the slower the liquid moves
- honey and corn syrup have high viscosity and vinegar have low viscosity
- Viscosity will decrease when it is heated

2. Conductivity

- Conductivity is a material's ability to allow heat to flow
- Metals have high conductivity and are conductors
- Wood will not conduct heat and make a great spoon

3. Malleability

- Malleability is the ability of a solid to be hammered in to sheets (or shapes) without shattering
- Most metals are malleable
- Solids that shatter when struck are brittle



4. Hardness

- One way to compare the hardness of two materials is to see which of the materials can scratch the other
- Diamond is the hardest known material

5. Melting and Boiling Points

- Melting point is the temperature at which a substance changes from solid to liquid.
- Melting point for water is 0°C
- Boiling point is the temperature at which a substance boils
- Boiling point of water is 100°C

6. Density

- Recall that density is the ratio of the mass of a substance to its volume
- Density can be used to test the purity of a substance

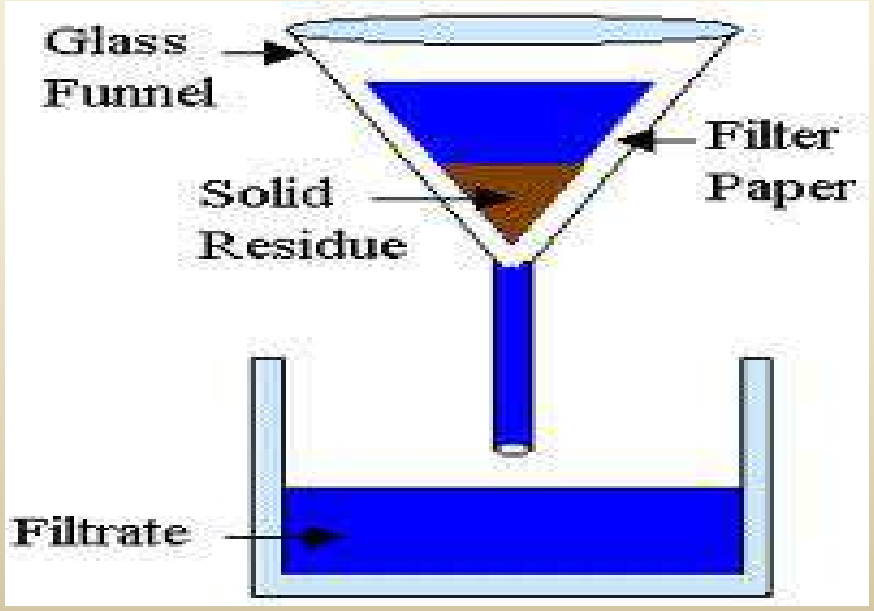
B. Using Physical Properties

- **Physicals properties are used to identify a material, to choose a material for a specific purpose or to separate the substances in a mixture.**

- **TWO BEAKER DEMO**

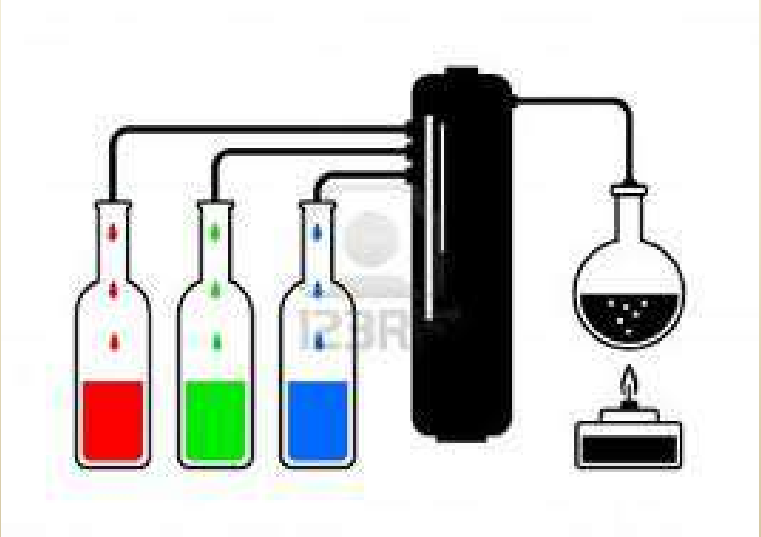
Using Properties to Separate Mixtures

1. Filtration
   - Filtration is a process that separates materials bases on the size of their particles
   - Example: tea leaves caught in a strainer when making tea



Using Properties to Separate Mixtures

2. Distillation
   - Distillation is a process that separates the substances in a solution bases on their boiling points
   - A practical use of distillation is to provide freshwater for submarines



Recognizing Physical Changes

- Physical change occurs when some of the properties of a material change, but the substances in the material remain the same
  - Heating butter until it melts, crumpling a piece of paper, slicing a tomato
  - Some physical changes can be reversed: freezing and melting
  - Some physical changes can NOT be reversed: reforming a whole tomato from its slices

Chemical Properties

- Chemical property is any ability to produce a change in the composition of matter
- **Chemical properties can be observed only when the substances is a sample of matter are changing into different substances**

1. Flammability
   - Flammability is a material's ability to burn in the presence of oxygen
   - Example: burning newspapers to start a fire
2. Reactivity
   - Reactivity describes how readily a substance combines chemically with other substances
   - Oxygen is highly reactive element and reacts easily with most other elements
   - Oxygen reacts with iron and water to form rust
   - Nitrogen has low reactivity and can be used inside tanks to limit rust formation

Recognizing Chemical Changes

- Chemical change occurs when a substance reacts and forms one or more new substances
- **three common types of evidence for a chemical change are a change in color, the production of a gas, and the formation of a precipitate.**

1. A change in Color
   - a change in color is a clue that a chemical change has produced at least one new substance
   - silver that tarnishes over time, copper roof changing from red to green when exposed to water

2. Production of a Gas

– bubbles of gas forming when u mix vinegar and baking soda is a sign that a chemical change occurred

3. Formation of a Precipitate

- precipitate is a solid that forms and separates from a liquid mixture
- adding lemon juice to milk will form some white solid

C. Is a Change Chemical or Physical?

- Ask yourself: are different substances present after the changes takes place
- NO=physical change, yes= chemical change
- **When matter undergoes a chemical change the composition of the matter changes**
- **When mater undergoes a physical change the composition of the matter remains the same.**

Chapter 3

States of Matter

3.1 Solids, Liquids, and Gases

A. Describing the States of Matter

- **Materials can be classified as solids, liquids, or gases based on whether their shapes and volumes are definite or variable**
- **Frequently referred to as the phases of matter or states of matter**

3.1 Solids, Liquids, and Gases

1. Solids

- Solids is the state of matter in which materials have a definite shape and definite volume
- The shape and volume of a solid will NOT change
- Almost all solids have some type of orderly arrangement of particles at the atomic level

States of Matter

2. Liquids

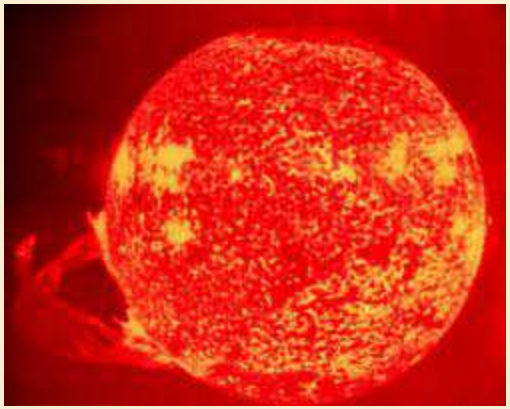
- Liquid is the stage of matter in which a material has a definite volume but not a definite shape
- A liquid always has the same shape as its container and can be poured from one container to another
- The arrangement is more random then in a solid.

States of Matter

3. Gases

- Gas is the state of matter in which a material has indefinite shape and indefinite volume
- A gas takes the shape and volume of its container
- The atoms are not arranged in a regular pattern, and they are at random locations throughout the container

States of Matter



4. Other Stats of Matter

- 99% of all matter in the universe exists in a state that is not as common on Earth
- Plasma is gas-like substance of charged particles; traveling very fast
- Plasmas exist at extremely high temperatures ,such as on the sun or on stars
- plasma is found on earth during lighting.

B. Kinetic Theory

- Kinetic energy is the energy an object has due to its motion
- the faster the object moves the greater its kinetic energy is
- **the kinetic theory of matter says that all particles of matter are in constant motion**
- These tiny particles are always in motion. The higher the temperature, the faster the particles move.
- At the same temperature, more massive (heavier) particles move slower than less massive (lighter) particles.

C. Explaining the Behavior of Gases

- The particles in a gas are never at rest
- Particles in a gas are in constant, random motion
- **The constant motion of particles in a gas allows a gas to fill a container of any shape or size**
- The motion of one particle is unaffected by the motion of other particles unless the particles collide
- Forces of attraction among particles in a gas can be ignored under ordinary conditions

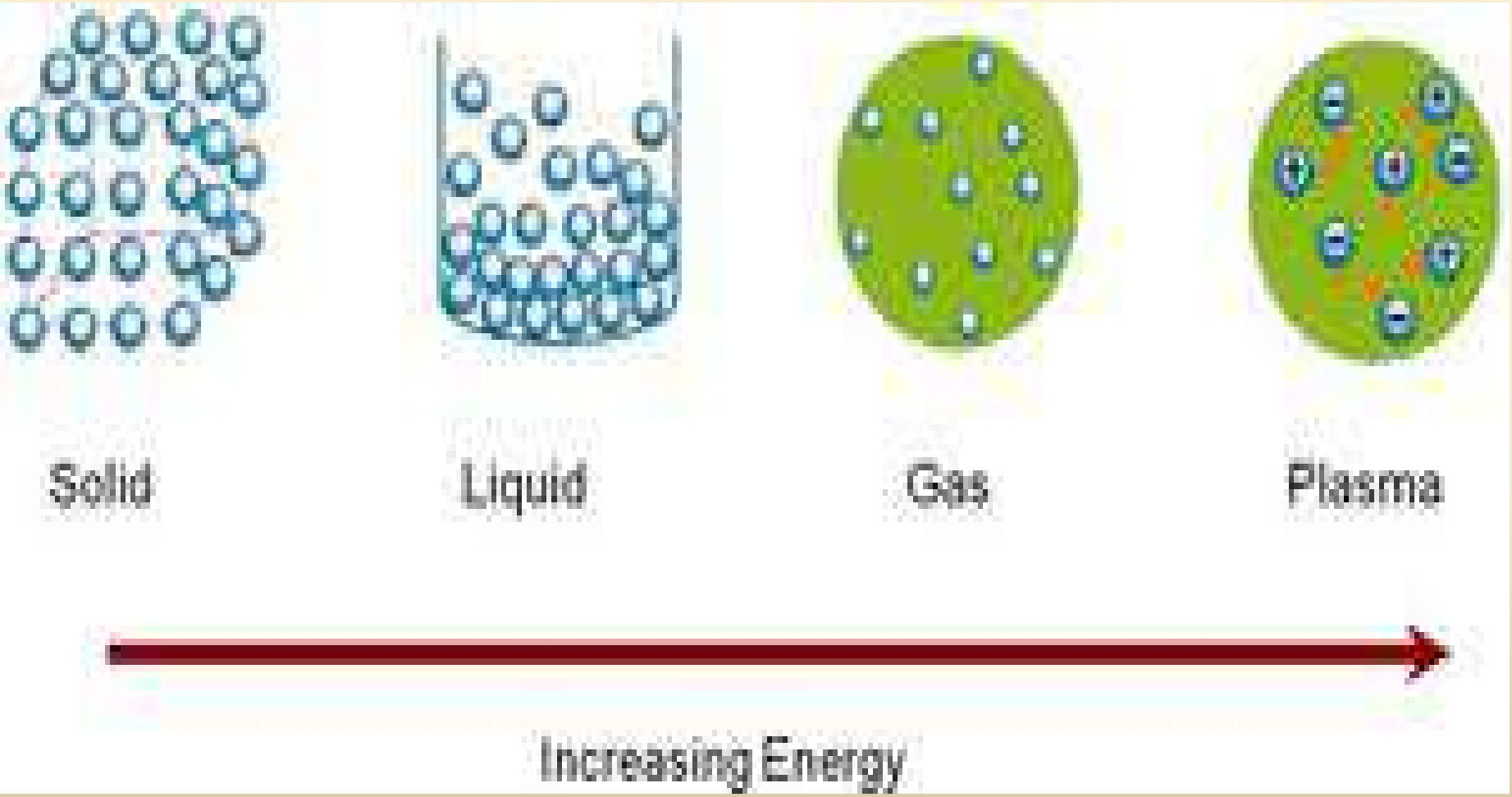
D. Explaining the Behavior of Liquids

- The particles in a liquid are more closely packed than the particles in a gas
- The attractions between the particles in a liquid DO affect the movement of the particles
- **A liquid takes the shape of its container because the particles in a liquid can flow to new locations.**
- **The volume of a liquid is constant because forces of attraction keep the particles close together.**

E. Explaining the Behavior of Solids

- **Solids have a definite volume and shape because particles in a solid vibrate around fixed locations**
- Vibration is a repetitive back and forth motion
- Each atom vibrates around its location but it does not exchange places with a neighboring atom

4 States of Matter



4 States of Matter

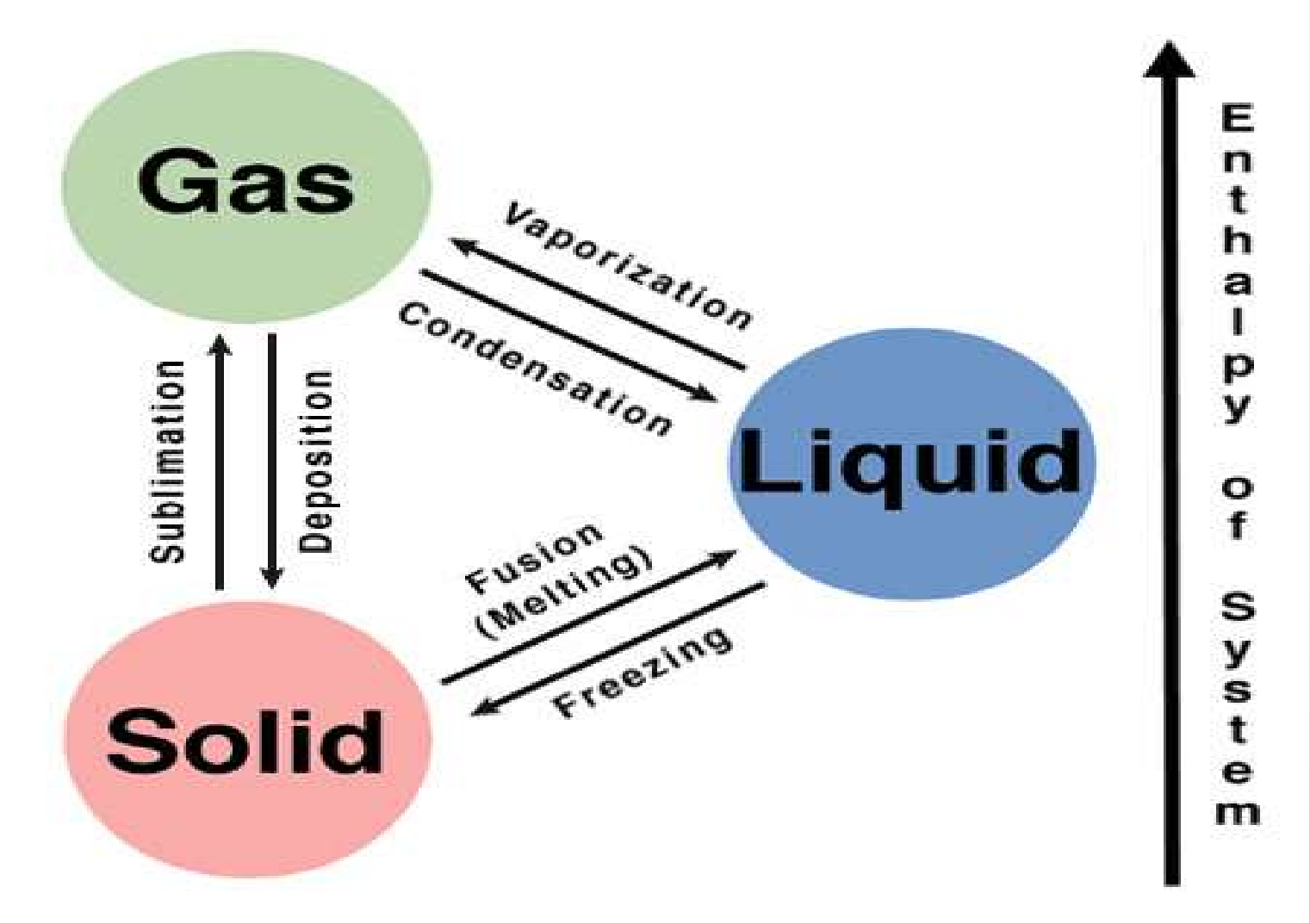
States of matter	**Shape**	**Volume**
Solid	Definite	Definite
Liquid	Indefinite	Definite
Gas	Indefinite	Indefinite

Reading Data Table

Substance	Melting Point	Boiling Point
Rubbing Alcohol	- 89 °C	82.5 °C
Salt	801 °C	1413 °C
Water	0 °C	100 °C
Baking soda	50 °C	851 °C

1. What phase of matter is alcohol in at 0 °C?
2. What phase of matter is Salt in at 900 °C?
3. What substances are a gas at 110 °C?
4. What is the freezing point of baking soda?
5. At what temperature is salt a gas?
6. At what temperature range is baking soda a liquid?

3.3 Phase Change



A. Characteristics of Phase changes

- Phase change is the reversible physical change that occurs when a substance changes form one state of matter to another
- **Melting, freezing, vaporization, condensation, sublimation, and deposition are six common phase changes**
- All phase changes share certain characteristics related to energy and temperature

B. Temperature and Phases Changes

- One way to recognize a phase change is by measuring the temperature of the substances as it is heated or cooled
- **The temperature of a substance does not change during a phase change**
- **TEMPERATURE remains constant during a phase change**

1. Energy and Phase Changes

- During a phase change, energy is transferred between a substance and its surroundings
- **Energy is either absorbed or released during a phase change**
- Endothermic change the system absorbs energy from its surroundings
- Exothermic change the system releases energy to its surroundings

1. Melting

- Melting is when energy is added to a solid object and it turns into a liquid.
- The average kinetic energy of the molecules increase and the temperature rises
- This is ENDOTHERMIC

2. Freezing

- Freezing is when energy is removed form an object and it goes form a liquid to a solid.
- As the average kinetic energy decreases, the molecule move more slowly
- This is EXOTHERMIC

1. Vaporization (Boiling)

- Vaporization (Boiling) is when a substance changes form a liquid into a gas
- Vaporization is an endothermic process, the substance has to absorb energy to change from a liquid to a gas
- As the temperature increases the molecules move faster and faster
- This is ENDOTHERMIC

2. Condensation

- Condensation is the phase change in which a substance changes from a gas or vapor to a liquid
- Condensation is an EXEOTHERMIC process

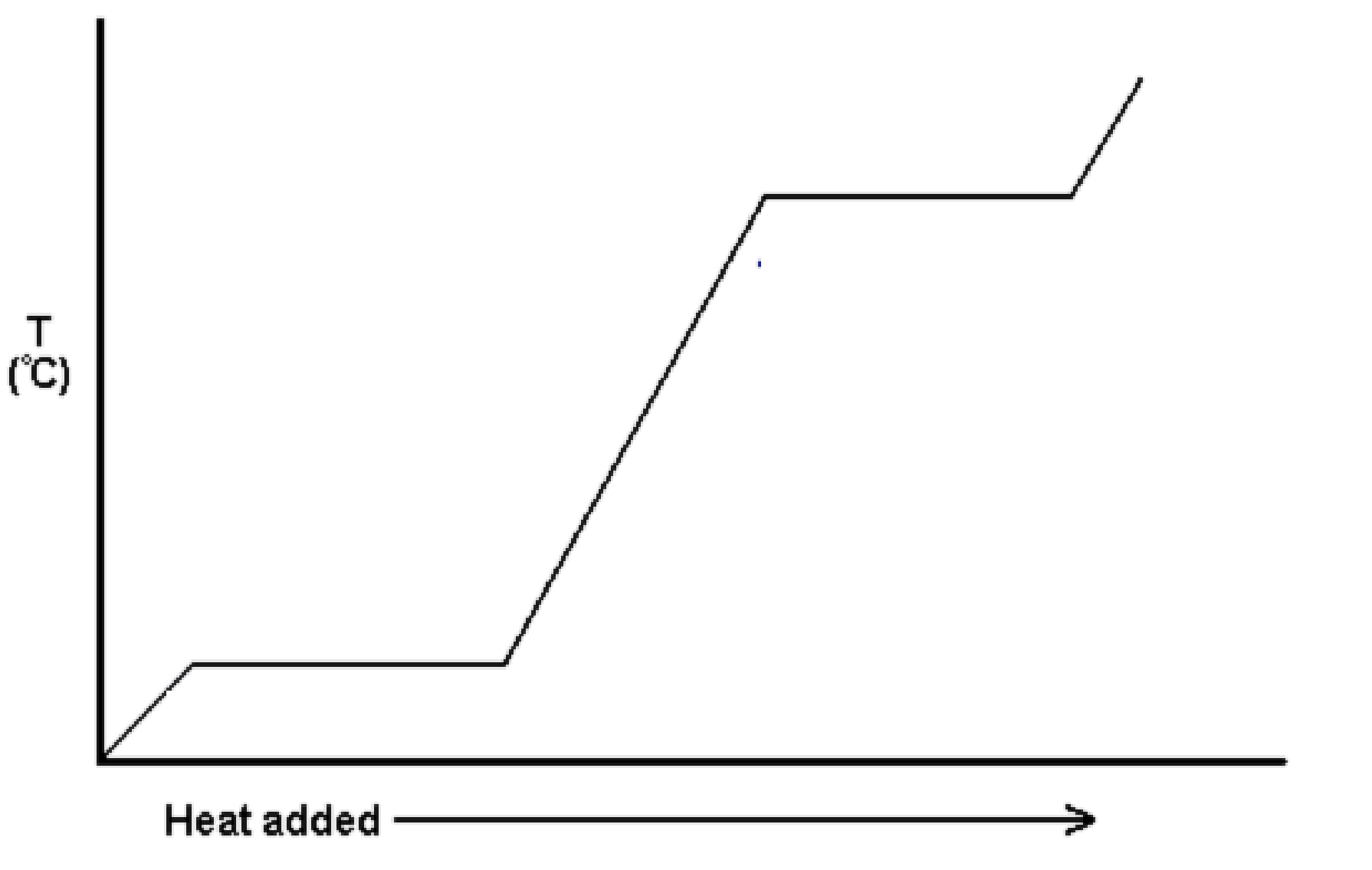
Sublimation

- Sublimation is the phase change in which a substance changes form a solid to a gas or vapor without changing to a liquid first
- Dry Ice (solid carbon dioxide) at room temperature goes from solid to gas and forms a "fog"
- Sublimation is ENDOTHERMIC

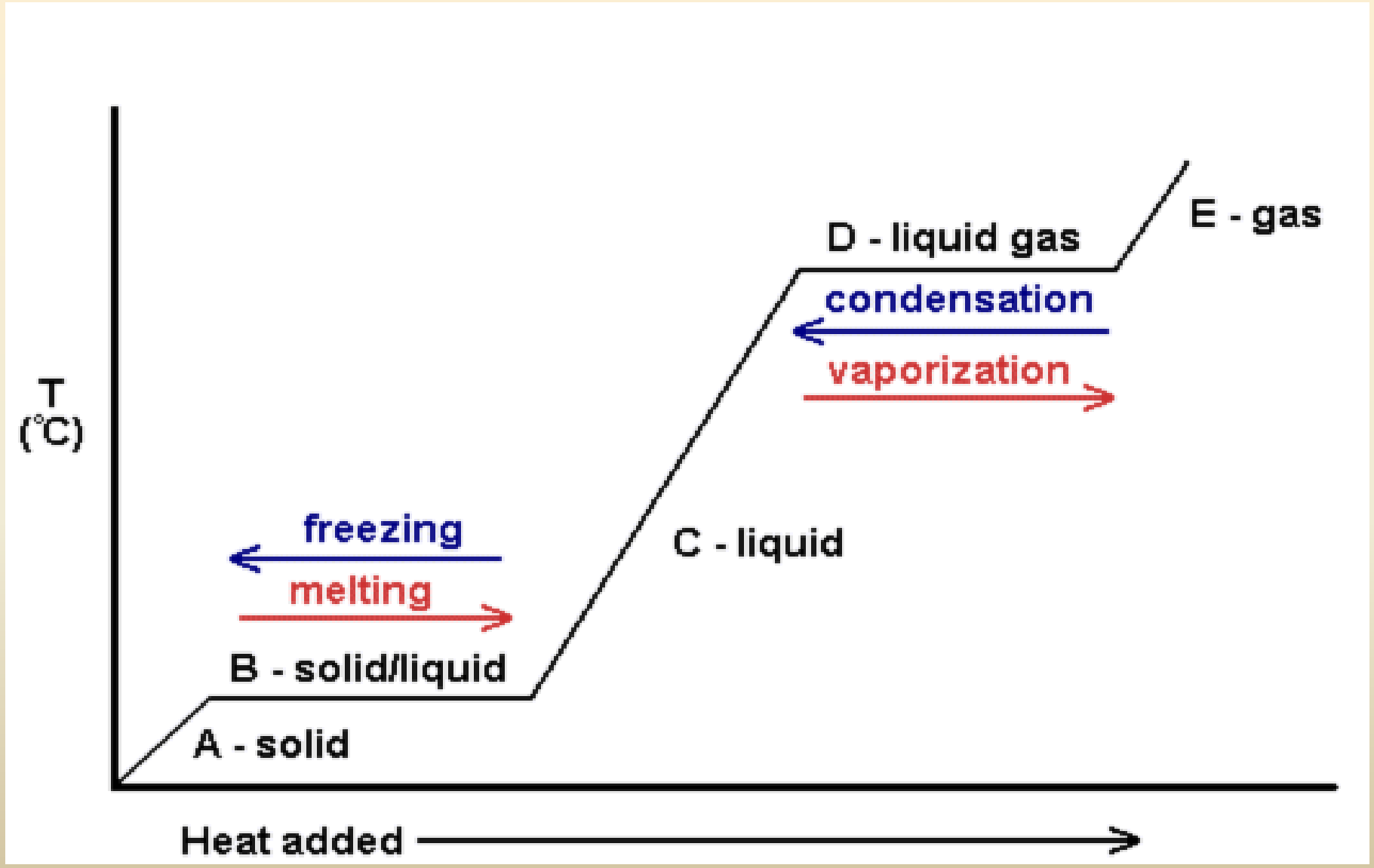
Deposition

- Deposition is when a gas or vapor changes directly into a solid without first changing to a liquid
- Deposition causes frost to form on windows
- This is EXOTHERMIC

Phase Change Diagram Combined



Phase Change Diagram Combined



Phase Change Diagram Practice

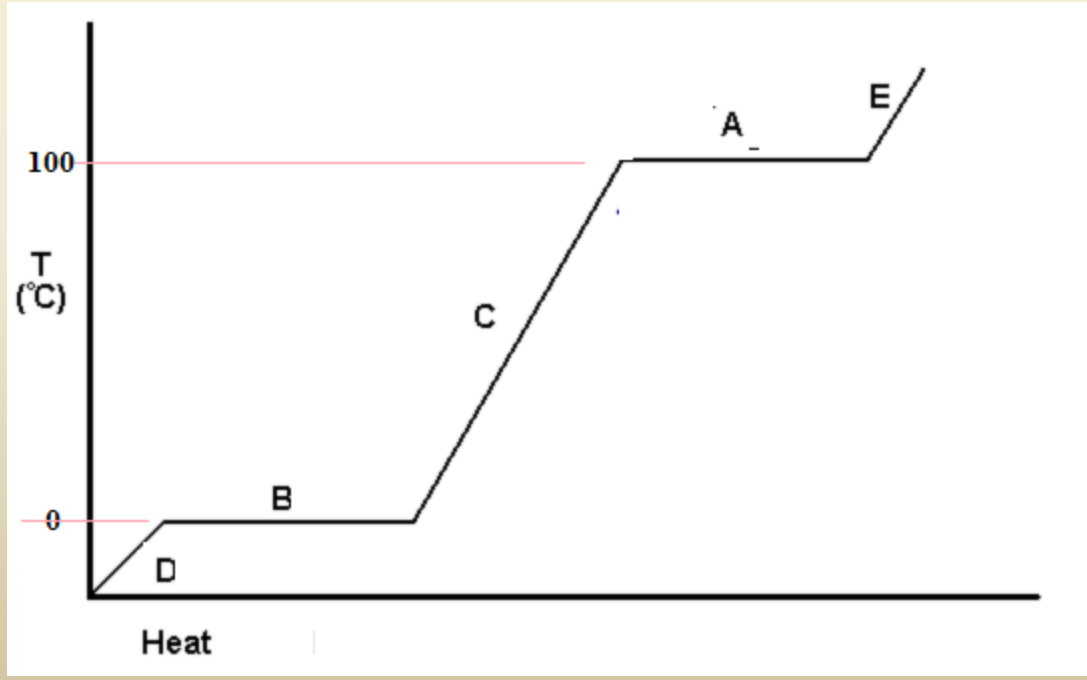
- What is occurring at the following points

A Object is vaporizing or condensing

B Object is melting or freezing

- What phase is present at the following points

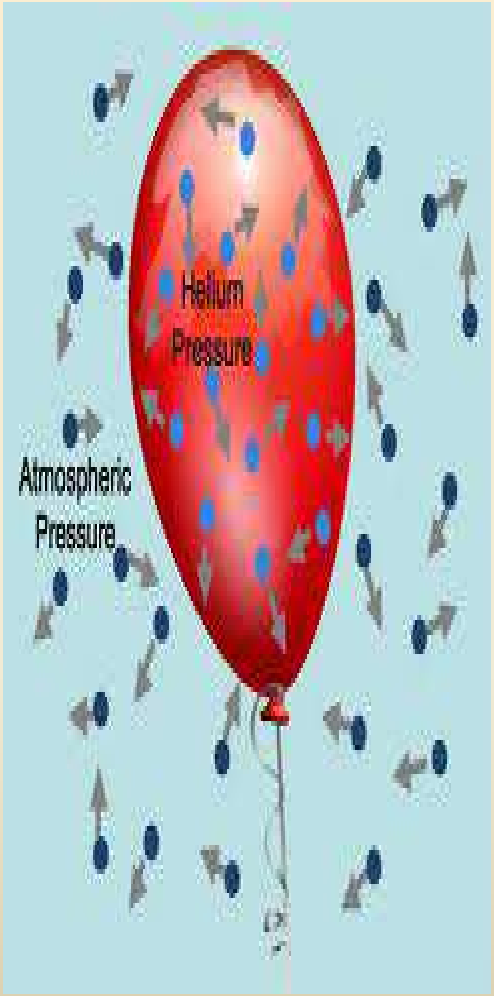
A. Liquid & Gas
B. Solid & Liquid
C. Liquid ONLY
D. Solid ONLY
E. Gas ONLY



3.2 The Gas Laws

A. Pressure

- Pressure is the result of a force distributed over an area
- Pressure is a gas is produced by the gas atoms colliding with a wall
- **Collisions between particles of a gas and the walls of the container cause the pressure in a closed container of gas**
- The more frequent the collisions the greater the pressure of the gas



B. Factors that Affect Gas Pressure

- **Factors that affect the pressure of an enclosed gas are its temperature, its volume, and the number of its particles.**

1. Temperature

- As the temperature rises, the average kinetic energy of the particles in the air increases
- The particles move faster and collide more often.
- **Raising the temperature of a gas will increase its pressure if the volume of the gas and the number of particles are constant**

B. Factors that Affect Gas Pressure

2. Volume

- **Reducing the volume of a gas increases its pressure if the temperature of the gas and the number of particles are constant**

3. Number of Particles

- The more particles there are in the same volume, the greater the number of collisions and the greater the pressure
- **Increasing the number of particles will increase the pressure of a gas if the temperature and the volume are constant**

C. Charles's Law

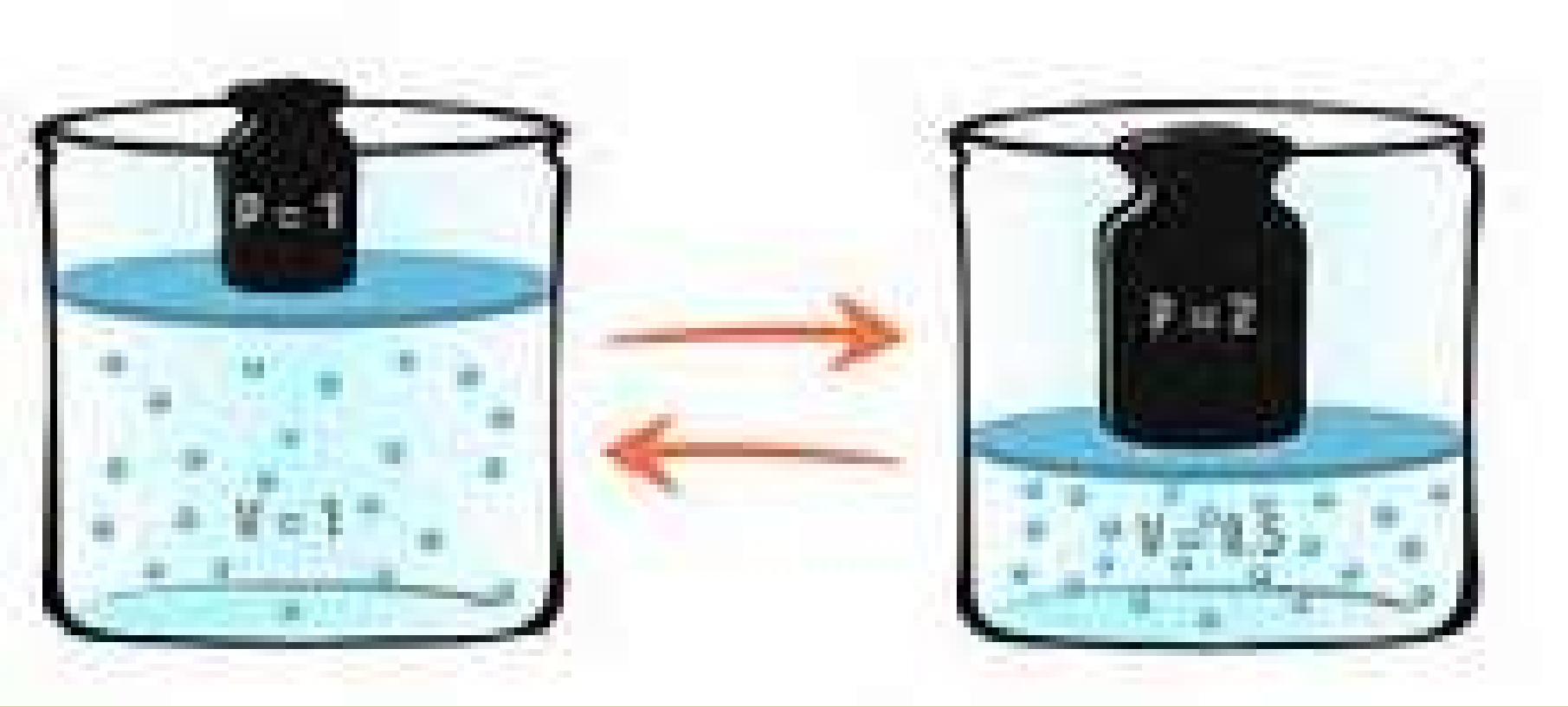
- Jacques Charles showed that as the volume of a gas increases at the same rate as the temperature of the gas
- Charles's Law states that the volume of a gas is directly proportional to its temperature in Kelvins if the **pressure is constant**

- Charles's Law
  - Volume of a gas is directly proportional to the temperature
    - Pressure must not change
    - Number of particles must not change
    - Temperature is in Kelvin
      - Add 273 to Celsius temperature

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

D. Boyle's Law

- Boyle's law states that the volume of a gas is inversely proportional to its pressure if the **temperature is constant**

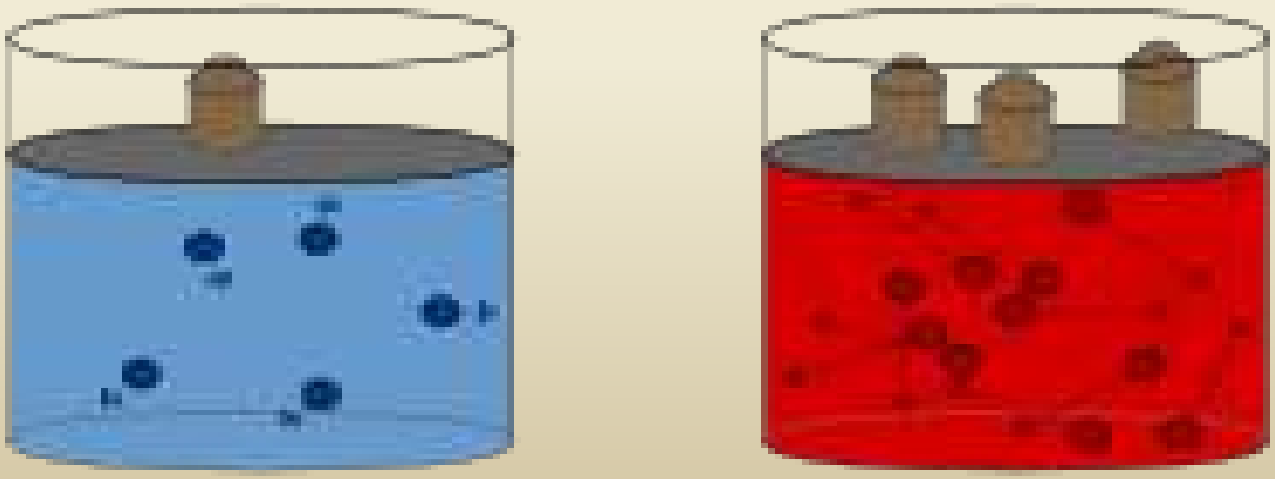


- Boyles Law
  - The volume of a gas is inversely proportional to the pressure
    - If pressure goes up, volume goes down
    - Number of particles must not change
    - If temperature stays constant

$$P_1V_1 = P_2V_2$$

E. Guy-Lussac's Law

- According to **Guy-Lussac's law**, for a given amount of gas held at **constant volume**, the pressure is proportional to the temperature
- If one increases the other will increase



Gas Laws Card

P	T	V
Pressure	temperature	volume
Charles	Boyles	Guy-Lussac

- Combined Gas Law
  - Boyle's and Charles's law can be combined into a single equation

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Gas Law Practice

- Pressure is constant:
  - If temperature increases volume increases
  - If temperature decreased volume decreases
- Temperature is constant:
  - If pressure increases volume decrease
  - If pressure decreases volume increases
- Volume is constant:
  - If the temperature decreases pressure decrease
  - If the temperature increases pressure increases

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A gas starts with a temperature of 415 K and is cooled to 300 K. If the original volume was 25 mL, what is the new volume?
  - Equation?
  - Fill in variables
  - Solve

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad \frac{25\,ml}{415\,K} = \frac{V_2}{300\,K} \qquad V_2 = 18.07\,ml$$

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A cylinder has 118 L of gas in at a pressure of 792 kPa. What is the pressure if the volume is reduced to 41 L?
  - Equation?
  - Fill in variables
  - Solve

$$(792\,kPa)(118\,L) = P_2(41\,L)$$

S-100

How are the temperature, volume, and pressure of a gas related?

- A piston is compressed from 18 L to 7 L. The initial pressure was 218 kPa. What is the new pressure?

3.2 The Gas Laws

How are the temperature, volume, and pressure of a gas related?

- Practice Problem – A cylinder that contains air at 100 kPa has a volume of 0.75 L and a temperature of 298 K. If the pressure is increased to 300 kPa and the temperature drops to 119 K, what is the new volume?
  - Equation?
  - Fill in variables
  - Solve

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \qquad \frac{(100kPa)(0.75L)}{298K} = \frac{(300kPa)V_2}{119K} \qquad V_2 = 0.10L$$