

## Physical vs Chemical

- Physical Property – a characteristic that can be observed without changing the substance

Examples: color, size, shape, density, melting point, boiling point,

- Chemical Property - a characteristic that is observed when the composition of the substance changes

Examples: flammability, toxicity, acidity, corrosiveness, combustibility

- Physical Change – a process that involves changing how a substance looks without changing what it is

Examples: freezing, melting, boiling, subliming, ductility, solubility

- Chemical Change – a process that involves changing the composition of a substance (or substances) so it has new physical and chemical properties.

Examples – rust, tarnish, oxidation, fermentation, electrolysis, pH indicator changing colors, burning, decomposing, formation of a gas or a precipitate

## Classifying Matter

- Element – the simplest form of pure matter made of only 1 kind of atom.

Examples: hydrogen, sodium, magnesium, iron, copper, carbon, oxygen, chlorine

- Compound – two or more elements chemical bonded together as one pure substance

Examples: water, carbon dioxide, sodium chloride, salt, sugar

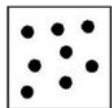
- Homogeneous Mixture – a solution that all looks uniform (the same)

Examples: alloys- brass, bronze, air, salt water, sugar water

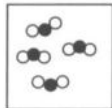
- Heterogeneous Mixture – an immiscible mixture that DOES NOT all look the same

Examples – concrete, muddy water, chocolate milk, oil & water

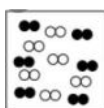
## Particle Diagrams



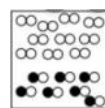
Element



Compound



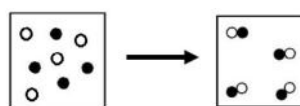
Homogenous



Heterogeneous



physical change

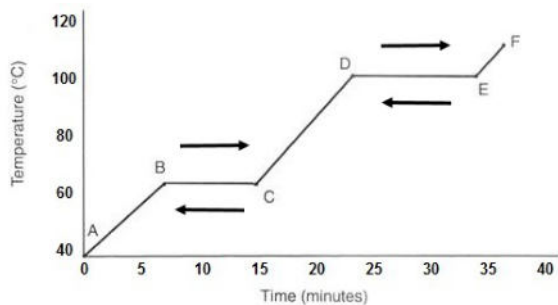
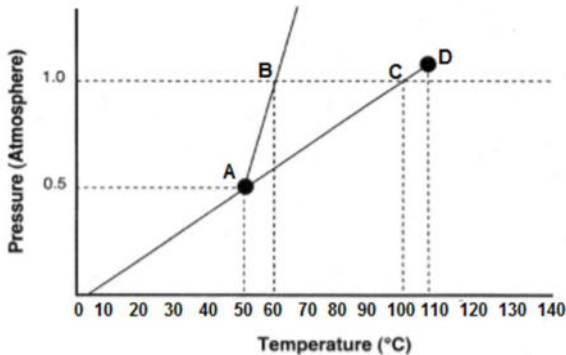


chemical change

## Classifying Matter

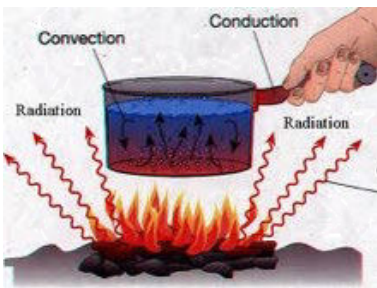
- Solid – definite shape, fixed volume, low kinetic energy – particles vibrate in place; strong intermolecular forces hold particles close together
- Liquid – no definite shape, fixed volume, medium kinetic energy – particles flow past each other but remain touching, medium intermolecular forces hold particles near each other
- Gas – no definite shape, no definite volume, high kinetic energy – particles move freely in straight paths, weak intermolecular forces have no attraction to other nearby particles

## Phase Changes



## Energy

- Law of Energy Conservation – says energy is neither created nor destroyed.
- Heat energy travels through matter. When energy is absorbed, it is recorded as positive number (+Q); and when energy is released, it is recorded as a negative number (-Q)
- Heat can be transferred three different ways:



- Conduction – a process of transferring heat through direct contact
- Convection – a process where hot current rises and cooler currents sink
- Radiation – a process involving absorption of electromagnetic waves

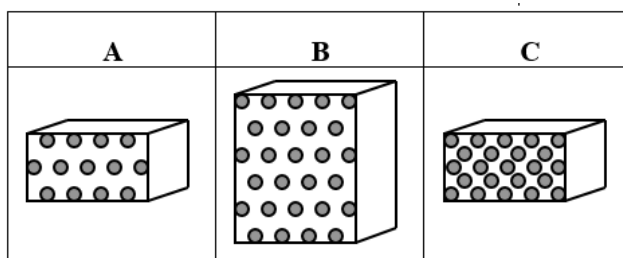
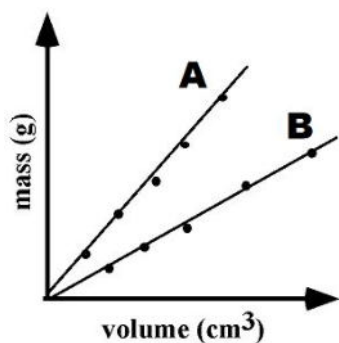
- Potential Energy is stored energy
  - Examples:
    - during phase change when temperature is constant
    - wood that hasn't burned yet
- Kinetic Energy involves energy in motion
  - Examples:
    - when you overcome intermolecular forces to change the state of matter, you must MOVE the particles to separate them (solid → liquid)
    - wood on fire that is burning
- Thermal Energy – involves heat; *thermal has the same root word as thermometer*

## Temperature

- A measure of the **AVERAGE Kinetic Energy** of the particle in matter.
- The **Kinetic Molecular Theory** says that as particles **gain heat** they **move faster** and **spread out**.
- Determines the direction of heat flow
- Heat travels from **HOTTER** toward **COOLER** matter and we measure the heat flow with change in temperature (**°C**)

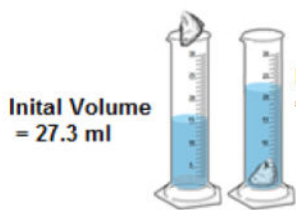
## Density

- The density of pure water is **1.00 g/ml**
- Density is **directly proportional** to MASS and **inversely proportional** to Volume



### Calculation:

The density of a piece of metal is determined by the **water displacement method**. The metal had a mass of 23.47 g. A graduated cylinder was filled with 27.3 mL of water and after the metal was added the volume was 33.7 mL. What is its density?



$$V_{obj} = V_{final} - V_{initial}$$

$$density_{object} = \frac{mass_{object}}{volume_{object}}$$

$$D_{obj} = \frac{23.47 \text{ g}}{(33.7 \text{ ml} - 27.3 \text{ ml})}$$

$$D_{obj} = 3.6671875 \frac{\text{g}}{\text{ml}} \quad \text{sig figs} \rightarrow 3.67 \text{ g/ml}$$

A sample of alcohol has density 0.82 g/mL. What is the mass of 75.0 mL of the liquid?

$$\frac{0.82 \text{ g/ml}}{1} = \frac{\text{mass}}{75.0 \text{ ml}} \quad \text{mass} = 62 \text{ g}$$

A spherical ball has a radius of 0.50 cm and has a mass of 2.0 g. Will this ball float or sink when placed in water?

$$\text{Volume} = \frac{4\pi r^3}{3} = 0.52 \text{ cm}^3$$

$$\text{Density} = \frac{2.0 \text{ g}}{0.52 \text{ cm}^3} = 3.9 \text{ g/cm}^3$$

IT WILL SINK!

**Specific Heat Capacity Problems:  $Q = m \cdot s \cdot \Delta T$  or  $Q = m \cdot s \cdot (T_f - T_i)$**

- 1) Calculate the amount of energy required to raise the temperature of 145 grams of water from 22.3°C to 75°C. (Specific Heat of Water = 4.184 J/g·°C)

$$q = (4.184 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}) (145 \text{ g}) (75^\circ\text{C} - 22.3^\circ\text{C})$$

$$q = 31972 \text{ Joules}$$

- 2) The specific heat capacity of iron is 0.45 J/g·°C. If 47 Joules of energy is required to raise the temperature of a sample of iron from 25°C to 90°C, what is the mass of the sample?

$$m = \frac{q}{C_p \cdot \Delta T}$$

$$\text{mass} = \frac{47 \text{ J}}{(0.45 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}) (90^\circ\text{C} - 25^\circ\text{C})}$$

$$\text{mass} = 1.6 \text{ grams}$$

- 3) A 35.2 gram sample requires 1251 Joules of energy to heat the sample by 25°C. What is the specific heat capacity of the sample?

$$C_p = \frac{q}{m \cdot \Delta T}$$

$$\text{Specific Heat Capacity} = \frac{1251 \text{ J}}{(35.2 \text{ grams})(25^\circ\text{C})}$$

$$\text{Specific Heat Capacity} = 1.42 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}}$$