

Physics

The Underlying Science

Linear Motion

- Motion is relative to the observer
- Speed is the distance traveled over time
- Velocity is speed with a direction
- Acceleration is the change in velocity over time

Projectile Motion

- Vector and scalar quantities
- Forward motion is constant
- Up and down motions are subject to gravitational influences

Newton's Laws of Motion

- 1st Law-The Law of inertia. A force must be applied to change the inertia of an object. A body at rest will remain at rest, and a body in motion will remain in motion unless acted upon by an outside force

Newton's Laws of Motion

- $F=MA$
- The force acting on an object is a product of the mass and the acceleration of the object

Newton's Laws of Motion

- For every action there is an equal and opposite reaction

Momentum

- Momentum of an object is the product of its mass and its velocity.
- Momentum is conserved

Energy

- Work is force times distance
- Power is work over time
- There are kinds of energy and they can be transformed into one another
- There is potential energy and kinetic energy
- Energy is conserved

Circular Motion

- Rotation is around an axis
- Revolution is movement around an external axis
- Rotational speed varies by distance from the axis
- Tangential speed is the speed of the object if it was allowed to move in a straight line

Circular Motion

- Centripetal force is the “center seeking” force that holds an object in orbit around another
- Centrifugal force is a feeling you get from being spun but not allowed to move away in a tangent.

Center of Gravity

- All objects have a center of gravity and a center of mass. If the object is small these are approximately the same
- If the center of mass is beyond the base the object will topple

Rotational Mechanics

- Torque is force applied in a circular motion
- Torque is equal to the force times the length of the lever arm

Rotational Mechanics

- Spinning objects have rotational inertia
- Spinning objects have angular momentum
- Angular momentum is conserved

Universal Gravitation

- All objects have attraction to each other that is determined by the objects mass and the distance they are from each other
- Gravity drops off by the square of the distance between them

Special Relativity

- Space and time are linked
- Motion is relative
- The speed of light is constant for any observer

Special Relativity

- The first postulate is that the laws of physics are the same in all uniformly moving frames of motion
- The second postulate states that the speed of light is constant regardless of the motion of the source or the motion of the observer
- Time moves slower for an object in motion compared to the time for an outside observer

Special Relativity

- The length of an object moving at near light speeds contracts
- Momentum increases with speed to the point that at close to light speeds it is impossible to have the energy to continue to accelerate it. It takes infinite energy to accelerate an object to the speed of light

Special Relativity

- $E=MC^2$
- Energy and mass are equivalent

Properties of Matter

- All matter is made of atoms
- Elements are made of atoms with a specific number of protons, each new proton added makes a new element
- Neutrons are required for the stability of the atom
- Atoms are surrounded by electrons that travel in specific orbitals

Properties of Matter

- Molecules are made from atoms that have electrically combined in specific ratios due to their valence shell electrons and the octet rule.
- Density is the mass per unit of volume

Properties of Matter

- Solids-Definite shape and definite volume
- Attractive forces hold the molecules in place
- Some solids have unique crystalline structure
- Both atoms and solids have elastic properties

Properties of Matter

- Liquids have a definite volume but not a definite shape
- Liquids exert pressure in all directions that can result in buoyancy of a submerged object
- Archimedes principle states that a submerged object displaces a volume of water equal to its own volume
- Pascals Principle states that changes of pressure in an enclosed container are transmitted undiminished throughout the fluid

Properties of Matter

- Gases have no definite shape or volume
- Atmospheric pressure is the weight of the column of air above you
- Bernoulli's Principle states that a moving fluid exerts less pressure as it speeds up

Temperature, Heat, and Expansion

- Temperature is a measure of the average kinetic energy of the molecules
- Heat is a measure of the transfer of energy from one object to another
- Specific heat is the amount of energy it takes to raise the temperature of an object
- All objects expand or contract when heated or cooled
- Water will contract until just before it freezes then it will expand as it solidifies

Temperature, Heat, and Expansion

- Heat can transfer by three means
- Heat always moves from hot to cold

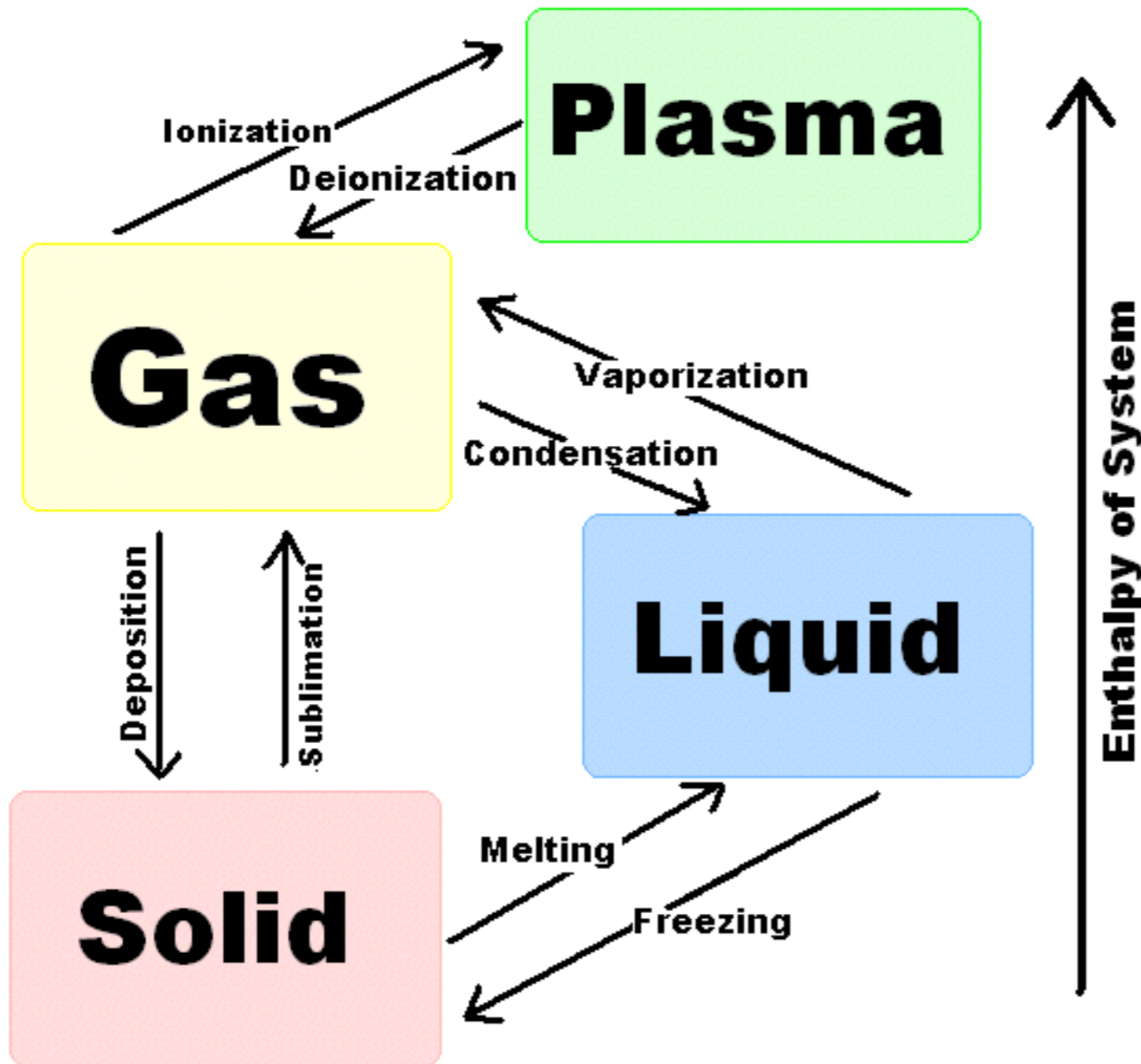
Temperature, Heat, and Expansion

- Conduction is the movement of heat in a solid from the increase in movement of one atom causing increased movement in the next atom
- Convection is the movement of heat in currents caused by a lower density hot areas in the medium being replaced by higher density cold areas in a fluid
- Radiation is the transfer of heat by electromagnetic radiation, no medium is required

Temperature, Heat, and Expansion

- Matter can exist in four phases, solids, liquids, gases and plasma
- Moving from one state of matter to another is a change in phase
- Each phase of matter is a result of the kinetic energy of the molecules

Temperature, Heat, and Expansion



Thermodynamics

- Absolute zero is the absence of energy
- Absolute zero is 0° on the Kelvin scale or -273 on the Celsius scale

Thermodynamics

- First Law of Thermodynamics states that whenever heat is added to a system, it transforms to an equal amount of some other form of energy
- The Second Law states that heat will always flow from a hot object to a cooler object
- The Third Law states that the entropy of a system always increases, disorder always grows larger

Sound and Light

- Waves are disturbances created in a medium that transfers energy
- Waves are defined by wavelength, frequency, period, amplitude and wave speed
- The two major types of waves are transversal where the medium moves at right angles to the wave motion and longitudinal where the medium moves back and forth in the direction of wave motion.

Sound and Light

- Waves can interfere constructively or destructively when they meet.
- Standing waves occur when a wave interferes with itself and creates nodes, zero energy, and antinodes, maximum energy.

Sound and Light

- The Doppler effect is the apparent shift in frequency when the source or the observer is in motion.
- The frequency is higher if the source or the observer are moving towards each other
- The frequency is lower if the source or the observer are moving away from each other

Sound and Light

- When the speed of the source is equal to the speed of the wave is equal the medium piles up in a bow wave
- When the speed of the source is greater than the speed of sound a conical shock wave is formed

Sound and Light

- Sound is a longitudinal wave in a fluid that is detected and interpreted by our ears.
- Loudness is measure in decibels. For every ten decibels the sound is ten times louder
- Objects vibrate at their own natural frequency.
- Resonance occurs when one object vibrates and another object starts vibrating at the same frequency

Light

- Light travels at 300,000 kilometer per second in a vacuum.
- Light is an electromagnetic wave that our eyes can detect
- Light can be absorbed and remitted in transparent substances
- Light is absorbed in opaque objects

