

### Inertia & Torque

**Inertia** - is defined as the tendency of an object at rest to remain at rest.

**Moment of Inertia** - it is also known as rotational inertia, it is defined as the property of a rotating body to resist change in its state of rotation

**Radius of gyration (k)** - it is the distance from an axis of rotation

**Torque** - it is the effectiveness of a force in rotating a body

----- *Torque is a vector quantity, Torque is positive if it produce counterclockwise rotation. It is negative if it produce clockwise rotation* -----

The SI unit for the moment of inertia is  $kg \times m^2$

*Formula For Inertia* -  $I = mr^2$

*Formula For Radius of Gyration* -  $\sqrt{I/m}$

*Formula For Torque* -  $\tau = Fr$

### Newton's Law of Gravitation

**Law of Gravitation** - *that any particle of matter in the universe attracts any other with a force varying directly as the product of the masses and inversely as the square of the distance between them.*

**Gravitational Field** - defined as equal to the universal gravitational constant (G) times the objects mass, divided by the square of the distance.

**Gravitational Potential Energy** - has been defined in a system consisting of the Earth and an object of mass.

### Intensity of Waves

**Wave Intensity** - power delivered per unit area.

**Superposition** - the disturbance of waves are superimposed when they come together.

**Wave Interference** - is a phenomenon that occurs when two waves meet while traveling along the same medium.

#### Types of Superposition of waves

1.) **Constructive Interference** - type of interference that occurs at any location along the medium where the two interfering waves have a displacement in the same direction.

2.) **Destructive Interference** - if two waves superimpose with each other in opposite phase.

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**Standing Waves** - when the incident wave interferes with the reflected wave

**Nodes** - point in a wave where the particles are relatively at rest.

**Antinodes** - positions of maximum transverse displacement.

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**Formula for Intensity of Waves** -  $I = P/2\pi r$

### Pascal's Principle

**Pascal's Principle (Pascal's Law)** - "statement that, in a fluid at rest in a closed container, a pressure change in one part is transmitted without loss to every portion of the fluid and to the walls of the container."

### Zeroth Law of Thermodynamics

**Thermodynamics** -refers to the study of energy that deals with heat, work and temperature.

#### Laws of Thermodynamics

**Zeroth Law of Thermodynamics** - "states that if two thermodynamic systems are in thermal equilibrium with each other, and also separately in thermal equilibrium with a third system, then the three systems are in thermal equilibrium with each other."

#### Temperature

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*-It is the degree of hotness or coldness of an object-*

#### Temperature Scales

**Celsius** - Introduced by Swedish astronomer Andres Celsius in 1742

**Fahrenheit** - Introduced by the 18th Century German physicist Daniel Gabriel Fahrenheit

**Kelvin** - Named after the British psychiatrist William Thompson

**Rankine** - Introduced by William Rankine

**Reaumur** - Established by the French naturalist Rene-Antoine Ferchault Reaumur

### Second Law of Thermodynamics and Entropy

**Second Law of Thermodynamics** - "states that the state of entropy of the entire universe, as an isolated system, will always increase over time. The second law also states that the changes in the entropy in the universe can never be negative."



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[cheatography.com/syntaa/](https://cheatography.com/syntaa/)

Not published yet.  
Last updated 9th February, 2023.  
Page 1 of 3.

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### Second Law of Thermodynamics and Entropy (cont)

**Entropy** - the measure of a system's thermal energy per unit temperature that is unavailable for doing useful work.

**The second law of thermodynamics shows that it is impossible to convert heat energy to mechanical energy with 100% consistency.**

### Rotational Quantities & Static Equilibrium

**Rotation** - refers to the motion of a body turning about an axis where each particle of the body moves along a circular path.

**Angular Velocity** - is defined as the rate at which angular displacement changes with time.

**Statics** - it is concerned with the calculation of forces acting on and within structures that are in equilibrium.

**Static Equilibrium** - defined as a body at rest having zero acceleration and zero net forces.

**Center of gravity of a body** - it is the point where its entire weight may be assumed to be concentrated.

**Equilibrant** - resultant of the forces acting on a body is not zero.

*Angular Velocity may be expressed in deg/s, rad/s, or rev/s.*

*Angular Acceleration may be expressed in deg/s<sup>2</sup>, rad/s<sup>2</sup>, or rev/s.<sup>2</sup>*

### Oscillations and Waves

**Oscillatory Motion** - is defined as a motion that is repeating itself.

**Frequency** - it is Defined as the number of cycle in oscillation.

**Period** - classified as the time it takes for an object to return to its position after undergoing Oscillation.

**Cycle** - one complete oscillation.

**Simple Harmonic Motion** - Refers to the back and forth movement through an equilibrium, or central, position.

#### Spring Mass Oscillator

**Simple Pendulum** - The simple pendulum is another mechanical system that moves in an oscillatory motion. It consists of a point mass 'm'.

#### Types of Damped Oscillation

**Underdamped** - An underdamped system moves fast and overshoot toward equilibrium.

**Overdamped** - Overdamped system moves more slowly toward equilibrium.

**Critically Damped** - Critically Damped system moves more fast toward equilibrium without over shooting

### Sound & Doppler Effect

**Sound Wave** - a pattern of disturbance caused by the movement of energy traveling through a medium (such as air, water or any other liquid or solid matter) as it propagates away from the source of the sound.

**Doppler Effects** - is the apparent change in the frequency of the sound.

### Archimedes Principle

**Archimedes Principle** - "states that a body immersed in a fluid experiences an upthrust equal to the weight of the fluid displaced, and this is fundamental to the equilibrium of a body floating in still water."

**Buoyancy** - is the tendency of an object to float in a fluid. All liquids and gases in the presence of gravity exert an upward force.

**Buoyant Force** - the net upward force on any object in any fluid.

**Specific Gravity** - the ration of the density of an object to a fluid.

#### NOTE

The object will rise to the surface and float if the **buoyant force is greater than the object's weight**

The object will sink if the **buoyant force is less than the object's weight**

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[cheatography.com/syntaa/](https://cheatography.com/syntaa/)

Not published yet.  
Last updated 9th February, 2023.  
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### Thermal Expansion

**Thermal Expansion** - is the tendency of matter to change its shape, area, volume, and density in response to a change in temperature.

**Linear Expansion** - is the change in the length of a body when the temperature changes.

**Volume Expansion** - is the change in the volume of a body when the temperature changes.

### Kinematics

**Kinematics** - description of motion.

**Rotation Angle** When object rotate about its axis.

**Angular Speed** - it is the rate of change of an angle.

**Angular velocity** - it is a derivative of the change of angular displacement over a change of time.

**Angular acceleration** - change of angular velocity per unit time and measure in radians per second squared.

### Oscillations and Waves (Types of Waves)

**Mechanical Waves** - Waves can occur whenever a system is disturbed from an equilibrium and when the disturbance can travel, or propagate, from one region of the system to another.

#### Types of Mechanical waves

1.) **Transverse Waves** - The vibration of the wave is at a right angle or perpendicular to the direction of the wave.

2.) **Longitudinal Waves** - When the vibration of the medium is parallel to the direction of the waves.

### Oscillations and Waves (Types of Waves) (cont)

#### Types of waves

**Periodic Wave** - Periodic Wave is a wave with a repeating continuous pattern that determine its wave length and frequency

**Sinusoidal Wave** - Sine wave or Sinusoidal Wave is a periodic waveforms whose shape can be plotted using the sine or cosine function from trigonometry

#### Parts of Waves

**Crests** - Highest point of a wave

**Troughs** - Lowest point of a wave

#### Direction of Waves

**Compression** - Refers to the area where the coils are squeezed together

**Rarefaction** - Refers to the area where the coils are spread out

### Pressure

**Pressure** - is the push on the surface created by one or more forces.

*The SI Unit of pressure is the **pascal (Pa)** named after the French mathematician and physicist Blaise Pascal.*

#### Factors in Pressure

1.) **The magnitude of force applied**

2.) **The area over which force is applied**

$$1 \text{ Pa} = 1 \text{ N/m}^2$$

### Bernoulli's Principle

**Bernoulli's Principle** - states that an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or a decrease in the fluid's potential energy.

### First Law of Thermodynamics

**First Law of Thermodynamic** - state that energy cannot be created nor destroyed, but it can be transferred.

**Thermodynamic System** - Body of matter and/or radiation, confined in space by walls, with defined permeabilities, which separate it from its surroundings. The surroundings may include other thermodynamic systems.

#### PV Diagrams

*-pressure-volume diagrams that illustrates the thermodynamic processes. This are graphs in which pressure is the y-axis and volume is the x-axis.-*

#### 4 Process in PV Diagrams

1.) **Isobaric** - An isobaric process is a process in which a gas is held by a constant pressure

2.) **Isochoric** - Isochoric process is derived from the Greek words "iso" means "constant" and "Choric" means "space" or "volume".

3.) **Isothermal** - In the isothermal process that temperature remains at constant. In this process the transfer of heat in the system happens so slowly

4.) **Adiabatic** - The adiabatic process is the vice versa of the isothermal process. In which, there is no transfer of heat through the system.

