High School Physics

Motion and Forces

Newton's laws predict the motion of most objects

When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest.

The law $F = ma$ is used to solve motion problems that involve constant forces.

When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction.

Applying a force to an object perpendicular to the direction of its motion causes the object to change direction.

Circular motion requires the application of a constant force directed toward the center of the circle.

Newton's laws are not exact but provide very good approximations unless an object is small enough that quantum effects become important.

Conservation of Energy and Momentum

The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects

Kinetic energy can be calculated by using the formula $E = (1/2)mv2$.

Changes in gravitational potential energy near Earth can be calculated by using the formula (change in potential energy) = mgh.

Momentum is calculated as the product mv.

Momentum is a separately conserved quantity different from energy.

An unbalanced force on an object produces a change in its momentum.

The principles of conservation of momentum and energy can be used to solve problems involving elastic and inelastic collisions.

Heat and Thermodynamics

Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat

Heat flow and work are two forms of energy transfer between systems.

The work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature.

The internal energy of an object includes the energy of random motion of the object's atoms and molecules. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.

Most processes tend to decrease the order of a system over time, so that energy levels are eventually distributed more uniformly.

Waves

Waves have characteristic properties that do not depend on the type of wave

Waves carry energy from one place to another.

Transverse and longitudinal waves exist in mechanical media, such as springs and ropes, and in the earth as seismic waves.

Wavelength, frequency, and wave speed are related.

Sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.

Radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3×10^8m/s, and less when passing through other media.

Waves have characteristic behaviors such as interference, diffraction, refraction and polarization.

Beats and the Doppler Effect result from the characteristic behavior of waves.

Electric and Magnetic Phenomena

Electric and magnetic phenomena are related and have many practical applications.

The voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors can be predicted using Ohm's law.

Any resistive element in a DC circuit dissipates energy, which heats the resistor.

The power in any resistive circuit element can be calculated by using the formula Power $= 1^2R$.

Charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.

Magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.

Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.

Plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity.