List of Demonstrations

Newton's First Law

- **Car on Level Track**
  A car maintains constant motion on a level air track.
- **Car on Inclined Track**
  Air track simulation of Galileo's rolling ball experiment.
- **Ball Dropped**
  A ball is dropped while walking or running.

Newton's Second Law

- **Cars Being Pulled (F = ma)**

Cars on a level air track are pulled with several different forces.

- **Cars Released and Collide**

Two cars of different masses are allowed to "explode" apart, or allowed to collide.

Newton's Third Law

- **Colliding Cars and "Rocket" Balloon**

Cars of various masses and bumpers are allowed to collide on a level air track, and a "rocket" car and a "rocket" balloon are demonstrated.

- **Roller Board**

A person standing on a roller board pushes against the wall or pushes or pulls against another person.

- **Car on Road**

A car accelerates on a surface which is capable of moving.

Free Fall and Projectile Motion

- **Feather and Coin**

A feather and a small weight are dropped in a glass tube, with and without air resistance.

- **Drop Ball and Throw Ball**

A ball is dropped while another ball at the same time is thrown horizontally.

- **Drop Objects**

Different objects are released by the demonstrator as he stands on the top of the classroom table.

- **Throw Ball Upward**

A ball is thrown straight up and then allowed to fall straight down to the original level.

- **Monkey Shoot**

A hanging toy monkey is dropped and then hit by a small steel ball.

- **Projectile Motion**

A ball is thrown through the air as a projectile.

Gravity, Circular Motion, and Satellites

- **Circular Motion**

Different objects are set into circular motion.

- **Gravity and Weight**

A weight hanging from a hanging scale is accelerated upward and then downward.

- **Satellite Motion**

Objects are set into motions similar to orbiting satellites.

- **Ball in Orbit**

A ball is thrown horizontally several times at successively higher speeds.

Linear Momentum

- **Collision of Cars**

Cars of different masses and bumpers collide on an air track.

- **Car and Pendulum**

A car with an attached pendulum glides on an air track.

- **Collision of Balls**

Six pendulum balls on a "swinging-balls" apparatus collide elastically.

- **Car and Balloon**

A car with an attached "rocket" balloon is propelled along a level air track.

Work and Energy

- **Objects Pulled and Lifted**

Work is demonstrated by pulling and lifting various objects.

- **Bowling Ball**

A bowling ball suspended as a pendulum is set to swing.

- **Falling Balls**

Balls are dropped and the respective rebound distances are measured.

- **Lift Weights**

Heavy weights are lifted using simple machines.

- **Loop-the-loop**

A ball is allowed to move on a loop-the-loop track.

- **WF Pendulum**

A weight attached to a Wilberforce pendulum oscillates in different modes.

- **Swinging Toy Lion**

A toy lion suspended as a pendulum is raised and lowered.

Torque, Center of Mass, and Rotational Inertia

- **Torque and Equilibrium**

A torque is applied to various objects.

- **Center of Mass and Equilibrium**

Objects of various sizes and shapes are tested for their location of center of mass and equilibrium condition.

- **Rotational Inertia: Weights**

Rotational inertia is demonstrated using a barbell with weights at various distances from the center.

- **Rotational Inertia: Hoop and Disk**

A hoop and a disk and various solid cylinders and spheres are rolled down an inclined plane.

Angular Momentum

- **Rotating Weights**

A demonstrator holds weights and rotates on a platform.

- **Bicycle Wheel**

A demonstrator holds a bicycle wheel and rotates on a platform.

- **Spinning Phonograph Disk**

A disk with string at its center spins while it swings.

- **Cat-Twist**

A mechanical model of a cat is used to demonstrate how an inverted cat dropped with zero angular momentum can still land on its feet.

Pressure and Density

- **Pressure Definition (P = F/A)**

The pressure of a heavy block of lead is measured.

- **Pressure in Liquids**

The pressure of water is demonstrated at various depths.

- **Atmospheric Pressure Experiments - Part 1**

Various experiments are performed to demonstrate atmospheric pressure.

- **Atmospheric Pressure Experiments - Part 2**

Some additional effects of atmospheric pressure are demonstrated.

- **Density**

The density of some solids and liquids is measured and demonstrated.

- **Buoyancy: Archimedes' Principle**

Archimedes' Principle and the buoyant force are demonstrated.

- **Buoyancy: Styrofoam Block**

The buoyant force is demonstrated and measured by floating a large Styrofoam block in water.

- **Buoyancy: Floating Bubbles**

The buoyant force is demonstrated by floating soap bubbles on a fog of carbon dioxide.

- **Buoyancy: Density Effects**

The cartesian diver and the Galileo thermometer are demonstrated.

- **Bernoulli Tube**

A Bernoulli tube is used to demonstrate the pressure change in a moving fluid.

- **Bernoulli's Principle: Air Foil and Pieces of Paper**

By blowing air over and between various surfaces, Bernoulli's principle is demonstrated.

- **Bernoulli's Principle: Ping-Pong Ball**

A ping-ball is suspended in a stream of moving air to demonstrate the lower pressure within the stream.

- **Bernoulli's Principle: Drawing Liquid**

By blowing air over the top of a glass tube, water is pushed up the tube, demonstrating the lower pressure within the moving air.

- **Bernoulli's Principle: Hose Attached to a Faucet**

Bernoulli's effect is demonstrated in fast moving water inside a transparent hose.

Waves and Sound Waves

- **Waves on a Rope**

Waves and resonance are demonstrated using a long rope attached to the wall.

- **Waves on a Slinky**

A slinky is used to demonstrate longitudinal and transverse waves.

- **Waves on a Beam**

A 2-m long stick and tuning forks are used to demonstrate standing waves on a beam.

- **Resonance and Vibrating Strings**

Sound produced by different vibrating strings is demonstrated.

- **Resonance and Tuning Forks**

Sound produced by different tuning forks is demonstrated.

- **Resonance and Sound Pipes**

Sound wave resonance produced in open pipes and closed pipes is demonstrated.

- **Resonance and Rod**

By stroking an aluminum rod, sound waves are produced.

- **Resonance and Saw Blade**

Standing waves which produce sound are demonstrated by stroking a circular saw blade with a violin bow.

- **Sound Waves: Frequency and Amplitude**

Using a tuning fork and an oscilloscope, the frequency and amplitude of sound waves are demonstrated.

- **Sound Waves: Quality**

Using an oscilloscope, the quality of sound is demonstrated.

- **Sound Waves: Beats**

The phenomenon of beats is demonstrated with the aid of a signal generator and an oscilloscope.

- **Sound Waves: Whirly Tubes and Alp Horn**

Whirly tubes and an alp horn are used to demonstrate resonance and sound waves.

Thermal Physics

- **Temperature and Internal Energy**

Temperature is demonstrated by simulating molecular motion. Internal energy is demonstrated by heating water and by grinding a nail.

- **Thermal Expansion**

Thermal expansion is demonstrated by heating various solids.

- **Change of Phase**

Change of phase is demonstrated for melting ice, boiling water, and evaporation of water.

- **Radiation**

Heat transfer by radiation is demonstrated by reflection of infrared rays to a radiometer.

- **Convection**

Heat transfer by convection currents is demonstrated by heating air inside a vertical, hollow metal tube.

- **Conduction**

Heat transfer by conduction is demonstrated for various materials.

- **Gas Law**

The ideal gas law is demonstrated by varying the pressure, volume, temperature, and number of molecules of a gas (container of air).

- **Expansion Cooling**

Expansion cooling is demonstrated by allowing compressed air to suddenly expand.

Electrostatics

- **Forces Between Charged Objects**

The electric force between two charged ping-pong balls is demonstrated.

- **Charged Electroscope**

An electroscope is charged and demonstrated.

- **Electric Forces on Neutral Objects**

Neutral objects are shown to be attracted to charged objects.

- **Inducing Electric Charge on an Electroscope**

With a charged rubber rod nearby, the uncharged electroscope is touched by hand, allowing negative charges to leave.

- **Inducing Electric Charge Using Two Metal Spheres**

A charge is induced on a metal sphere as it touches another metal sphere in the electric field of a Van de Graaff generator.

- **Surface Charge**

A metal sphere is charged and it is shown that all charges reside on its surface.

- **Charging a Person**

A person is electrically charged while touching the dome of a Van de Graaff generator.

- **Electric Field: General**

The electric field of a Van de Graaff generator is demonstrated.

- **Electric Field: Examples**

A Van de Graaff generator is charged and shown to apply electric forces to charged objects. The electric field is shown to be stronger near sharp points.

- **Electric Field Breakdown**

Two charged metal spheres are brought close to each other to demonstrate the electric discharge through the air.

- **Electric Field Shielding**

A Van de Graaff generator, a wire cage, and an electroscope are used to demonstrate electric field shielding.

Electric Circuits

- **Ohm's Law: Basic**

The relationship between current and resistance is demonstrated for a fixed voltage.

- **Ohm's Law and Power**

The relationship between current and voltage is demonstrated for a fixed resistance. Electric power is also demonstrated.

- **Resistors in Series**

A circuit with two resistors in series is demonstrated.

- **Resistors in Parallel**

A circuit with two resistors in parallel is demonstrated.

Capacitance

- **Capacitance: Wimshurst Machine**

A Wimshurst machine is used to demonstrate the concept of capacitance and charge storage.

- **Parallel Plate Capacitor**

The dependence of the capacitance on different variables is demonstrated.

- **Charge and Discharge**

A capacitor is charged and then slowly discharged through a light bulb.

Magnetism

- **Permanent Magnets**

The magnetic forces and the iron fillings patterns of magnetic fields are demonstrated for permanent magnets.

- **Oersted's Experiment**

Oersted's original discovery is demonstrated.

- **Field Lines of a Coil**

The magnetic filed lines of a current-carrying coil are demonstrated.

- **Field Lines of a Wire**

The magnetic field lines of different wire geometries are demonstrated.

- **Magnetic Forces on a Beam of Electrons**

A magnet is brought near a beam of electrons in a cathode ray tube and the magnetic force is demonstrated.

- **Force Between Two Wires**

The magnetic force between two current-carrying wires is demonstrated.

- **Jumping Wire Experiment**

The magnetic force on a current-carrying wire in a magnetic field is demonstrated.

- **Ferromagnetic Pole Reversal**

A strong magnet is used to change the polarity of a small bar magnet.

- **Induced Ferromagnetism**

An iron rod is shown to become magnetized when placed in the core of a current-carrying coil.

- **Electric Motor**

The magnetic forces on the coils in a simple electric motor are demonstrated.

Faraday's Law of Induction

- **Faraday's Discovery**

Faraday's original discovery is demonstrated by observing the induced current in the secondary of overlapping coils.

- **Magnet in Coil**

Faraday's law is demonstrated by moving a magnet in and out of a coil.

- **Hand Generator**

A small hand cranked generator is used to produce a current in a light bulb.

- **Transformer**

A small light bulb is lit by placing it in the changing magnetic field of an AC coil.

- **Jumping Ring**

A conducting ring is observed to be propelled upward by the changing magnetic field of a coil.

- **Eddy Current Brake**

Magnetic forces are observed on conducting and nonconducting plates as they move between the poles of a magnet.

- **Dropping Magnet**

A magnet is observed to move slowly while falling through a copper tube.

Inductance

- **General Demonstration**

An inductor is used to create a large emf across a switch and arcing is observed.

- **Dependence on Permeability (mu)**

Different materials are placed in the core of an inductor and the inductance is measured.

- **Dependence on Number of Turns (N)**

The inductance of a coil is measured as the number of turns is doubled while other variables remain constant.

- **Dependence on Length (l)**

The inductance of a coil is measured as the length is changed while other variables remain constant.

- **Dependence on Cross Sectional Area (A)**

The inductance of two coils of different cross sectional areas is measured and compared.

Reflection of Light

- **Law of Reflection**

A laser beam, illuminated by chalk dust, is reflected from a plane mirror.

- **Blackboard Optics**

Blackboard optics is used to demonstrate reflection from different surfaces and to show focal points.

- **Object-Image Diagrams**

Object-image diagrams are shown for various mirrors.

- **Plane Mirror**

The image formation for a plane mirror is demonstrated.

- **Multiple Mirrors**

The image formation for a two-mirror system is demonstrated.

- **Convex Mirror**

The image formation for a convex mirror is demonstrated.

- **Concave Mirror - Object at Large Distance**

The image formation for a concave mirror with the object at a relatively large distance is demonstrated.

- **Concave Mirror - Object at Short Distance**

The image formation for a concave mirror with the object at a relatively short distance is demonstrated.

- **Concave Mirror - Magnifier**

The image formation for a concave mirror with the object at a distance less than the focal length is demonstrated.

Refraction of Light

- **Law of Refraction**

Blackboard optics is used to demonstrate refraction as light passes through a block of plastic.

- **Total Internal Reflection**

Total internal reflection is demonstrated for different refracting media.

- **Dispersion**

White light is passed through a prism to produce the spectrum of colors and demonstrate dispersion.

- **Apparent Depth**

A plastic block is used to demonstrate apparent depth by using blackboard optics and also by using the overhead projector.

- **Focal Lengths of Lenses**

Blackboard optics is used to demonstrate the focal lengths of various lenses.

- **Diverging Lens**

Image formation for a diverging lens is demonstrated.

- **Converging Lens - Object-Image Diagrams**

Using chalkboard diagrams, image formations are described for a converging lens.

- **Converging Lens - Object at Large Distance**

Image formation for a converging lens with the object at a relatively large distance is demonstrated.

- **Converging Lens - Object at Short Distance**

Image formation for a converging lens with the object at a relatively short distance is demonstrated.

- **Converging Lens - Magnifier**

Image formation for a converging lens with the object distance less than the focal length is demonstrated.

- **Telescope**

Two converging lenses are used to demonstrate a telescope.

Lens Defects

- **Spherical and Chromatic Aberrations**

Blackboard optics is used to demonstrate chromatic aberration and spherical aberration.

- **Farsightedness**

A converging lens is used to demonstrate the correction for farsightedness.

- **Nearsightedness**

A diverging lens is used to demonstrate the correction for nearsightedness.

- **Astigmatism**

A lens of nonuniform curvature is used to demonstrate astigmatism.

Interference and Diffraction

- **Double-Slit Interference**

Two overlapping transparencies on the overhead projector are used to simulate the interference from two coherent sources.

- **Interference Simulation Using Polarized Light**

A rotating polarizing transparency on the overhead projector is used to simulate the double-slit interference pattern.

- **Thin Film Interference: Oil Surfaces**

Oil is dropped onto a water surface and the interference pattern is observed.

- **Thin Film Interference: Soap Bubbles**

The thin film interference of soap bubbles is demonstrated.

- **Interference: Hologram**

A hologram is demonstrated.

- **Single-Slit Diffraction: Laser**

A single-slit together with a laser is used to demonstrate a diffraction pattern.

- **Single-Slit Diffraction: Line Filament**

A single-slit together with a line filament light source is used to demonstrate a diffraction pattern.

- **Diffraction: Various Objects**

Various objects together with a laser are used to form diffraction patterns.

Polarization of Light

- **Polarized Light: General Demonstration**

Polarizing sheets are employed to demonstrate polarized light.

- **Polarized Light: Stacked Polarizing Sheets**

Three polarizing sheets are used to demonstrate the rotation of the polarization plane.

- **Polarized Light: Optical Activity**

Optically active materials are used to demonstrate the rotation of the polarization plane.

- **Polarized Light: LCD**

Light from a liquid crystal display on a hand-held calculator is demonstrated to be polarized.

- **Polarized Light: Laser**

Light from a He-Ne laser is demonstrated to be polarized.

- **Polarized Light: Sky Light**

Light scattered from the sky is demonstrated to be partially polarized.

- **Polarized Light: Car Glare**

A polarizing sheet is used to diminish the glare from cars in a parking lot.

- **Interference Simulation Using Polarized Light**

A rotating polarizing sheet on the overhead projector is used to simulate the double-slit interference pattern.

Electromagnetic Waves

- **Electromagnetic Spectrum**

The entire EM spectrum is discussed and radio waves emitted by a transmitter are detected by a receiving antenna.

- **Visible Spectrum**

A prism is used to demonstrate the visible spectrum.

- **Primary Colors**

A transparency on the overhead projector is used to demonstrate the additive and subtractive primary colors.

- **Shielding of EM Waves**

The shielding of radio waves is demonstrated by covering a radio with a wire cage.

Modern Physics

- **Emission of Light**

Various electric discharge tubes are used to demonstrate the spectrum of emitted light from excited gas atoms.

- **Fluorescence and Phosphorescence**

An ultraviolet light source is used to illuminate various fluorescent materials and a visible light source is used to energize a phosphorescent ball.

- **Photoelectric Effect**

Electrons are demonstrated to be ejected from a metal plate when the plate is illuminated by ultraviolet light, but not ejected when illuminated by visible light.

- **Radioactivity**

A Geiger counter in conjunction with various absorbers is used to demonstrate radiation from radioactive sources.

- **Cloud Chamber**

The tracks of radioactive particles as they pass through a cloud chamber are shown.

- **Michelson-Morley Experiment**

A Michelson interferometer is used to demonstrate the original experiment of Michelson and Morley.

- **Time Dilation**

Time dilation is illustrated using two identical "light clocks" in relative motion.