OPTIKA®

PHYSICS AND SCIENCE EDUCATION

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Optika is already established worldwide as a leading Company in the production and distribution of optical microscopes, with almost 40 years of experience in the field of scientific instrumentation.
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OPTIKA SCIENCE HIGH QUALITY STEP BY STEP

FROM RAW MATERIAL TO INNOVATIVE EDUCATIONAL INSTRUMENTS.

EVOLUTION OF NEW IDEAS

FIRST STEP TO SCIENCE

WORK IN PROGRESS WITH OUR MODERN TECHNOLOGY

ASSEMBLY PROCESS WITH OUR TRAINED STAFF

QUALITY CONTROL DEPARTMENT TO SUPPLY THE BEST

LEARNING WITH HIGH QUALITY

SCIENCE KITS

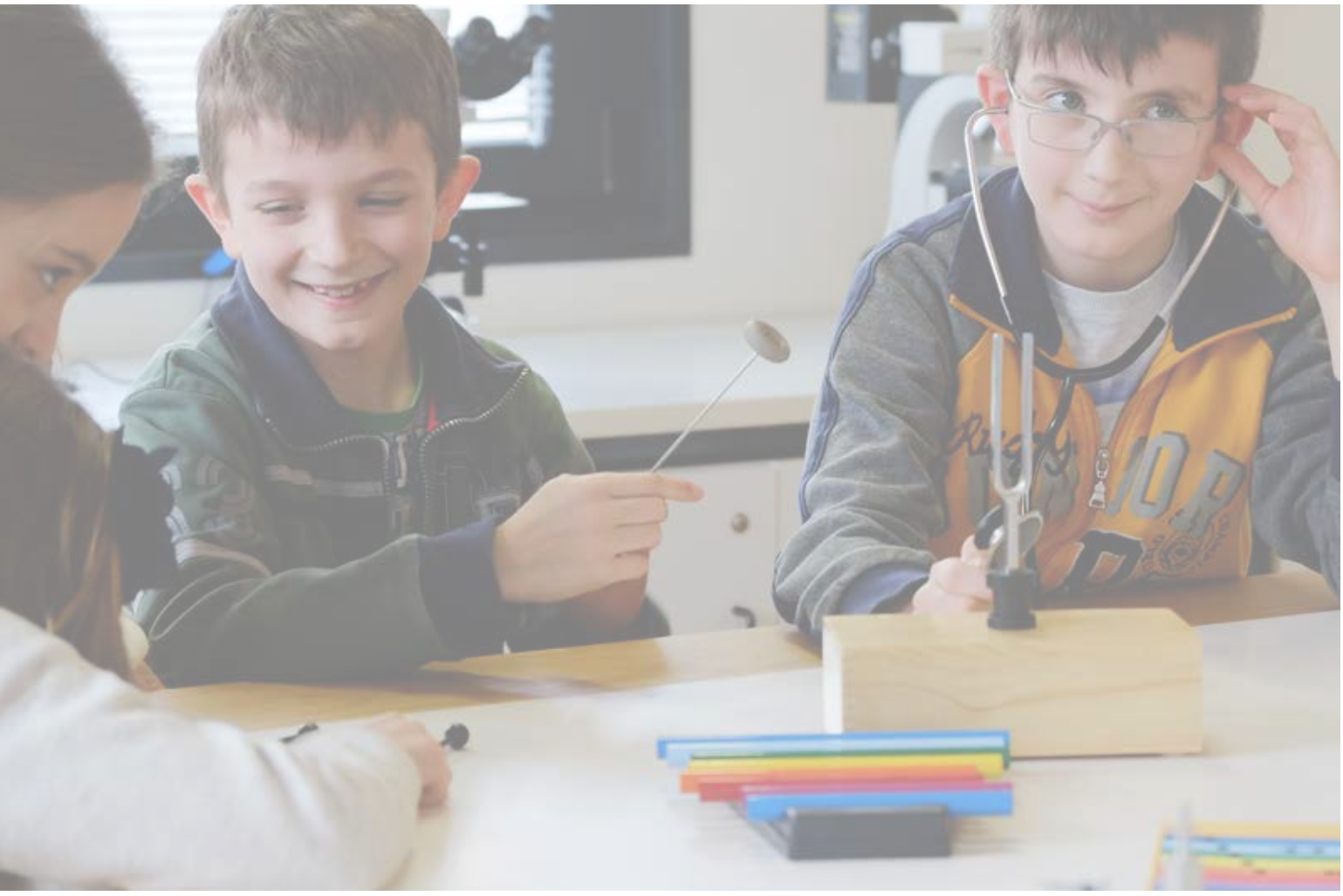
INSTRUMENTS

Primary School

High School

Instruments

SCIENCE KITS



PRIMARY SCHOOL

In a society with a high scientific and technological standard as the one we live in, the students attending primary school, often use terms such as force, mass, work, energy or power, without the right knowledge.
These magnitudes, even though reflecting the fundamental properties of the material systems, are abstract concepts. It is, therefore, extremely difficult for students to understand the scientific meaning without a direct and experimental approach.

In fact, it is extremely important that through practical experiences and using simple measuring tools, they understand that physical magnitudes are only those concepts for which a tool allowing measurement exists.

Index:

P50 Lenght, area, volume and capacity Basic

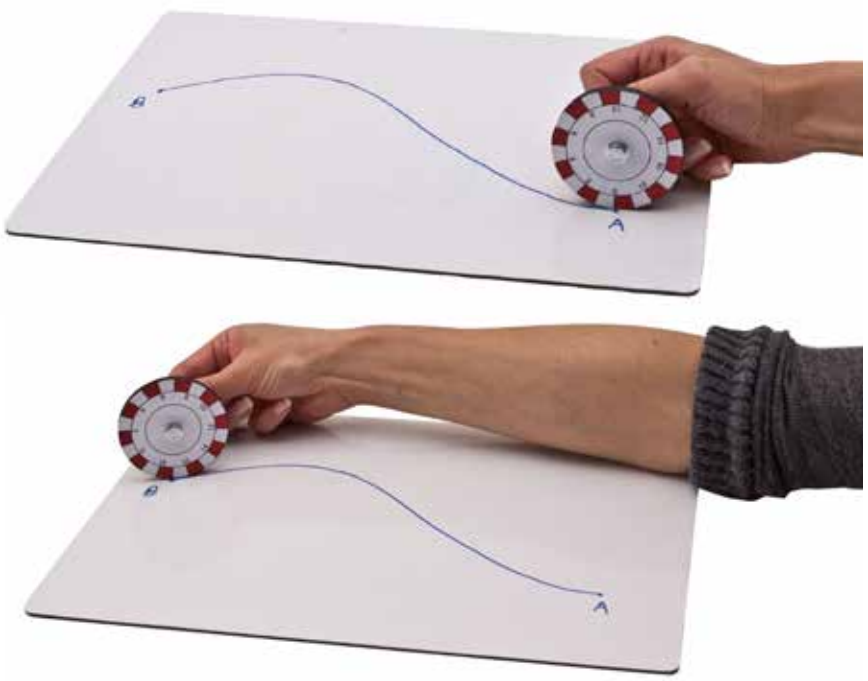
FEASIBLE EXPERIMENTS: 32

Topics

Space
Matter
Bodies
The three layers of matter
Other properties of bodies: impenetrability
Other properties of bodies
What does compare different bodies mean?
Qualitative and quantitative comparisons
Measurable properties - physical quantities
Measuring a physical quantity
Decimal metric system
Length
Linear ruler: calibrated system
Geometry
Basic geometry bodies and the real world
Straight lines and curved lines
Measuring wheel
Curvimeter
Closed lines
Plane figures - boundary lines and area
Perimeter of a plane figure
Area of a plane figure
Simple polygons
Regular simple polygons
Isoperimetrical polygons and equi-extended polygons
How to compare two polygons
Rectangles and squares
How to measure the area of an irregular polygon
Bodies in real life
Volume of solid bodies
Volume of liquid bodies
Graduated cylinder
Volume of an irregular solid body

In this unit are described, in scientific way, the primitive concept of space, known as the framework which we move and where everything exists.
The experiences that are suggested with this unit, allow you to understand abstract concepts as length, area, volume and capacity.

How measuring wheel works



How to measure polygon area

Supplied materials

Items

1	Skein	1	Pair of metal plates
1	Linear ruler	1	1 l bottle
2	Rubber balloons	1	5 ml syringe
1	Dynanometer	1	Pack box of decimal arithmetic blocks
1	Overflow vessel	1	Centimetre grid board
1	Magnifying lens	1	Curvimeter
1	PVC cylinder with hook	1	100 ml graduated cylinder
1	Flexible coated string	2	100 ml beaker
1	Funnel with stopper	2	250 ml beaker
1	Transparent tube	1	250 ml conical flask
1	Arbitrary measurement system	1	Box
1	Washable marker	1	Teaching guide
1	Measuring wheel model		

Box

Teaching guide included

PRIMARY SCHOOL

P51 Weight force and gravity force — Basic

FEASIBLE EXPERIMENTS: 23

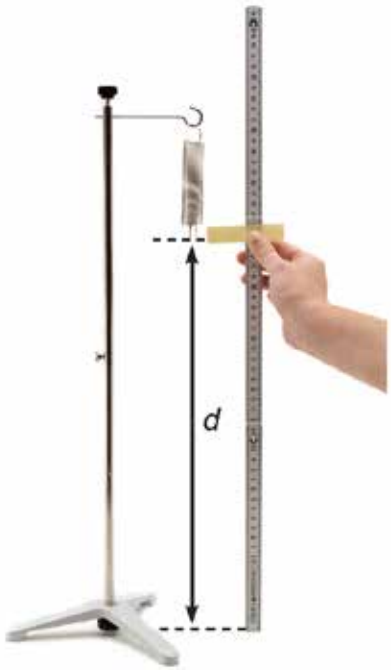
Topics

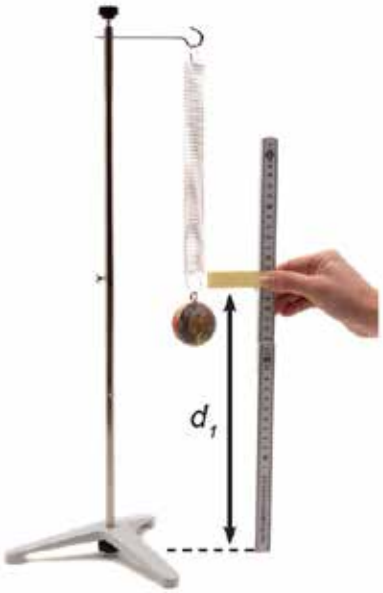
The actual meaning of words
Force, a primitive concept
Some examples of force
Elastic and plastic materials
How to compare forces
How to measure the strenght of a force
Force is a physical quantity
Types of force
Weight force
How to compare two weights
How to measure weight
Weight units of measure in the decimal metric system
Kilogram-force multiples and submultiples
Weight units of measure in the international system
The spring balance
The vectorial representation of forces
Free-falling bodies
The vectorial representation of weight force
The barycentre
The reason why the leaning tower of pisa does not fall
Non contact forces
Weight is a non contact force
Weight is not constant
Which kind of body falls down faster, the light or heavy ones?
The origin of weight: gravity force
Why the moon does not fall down on earth

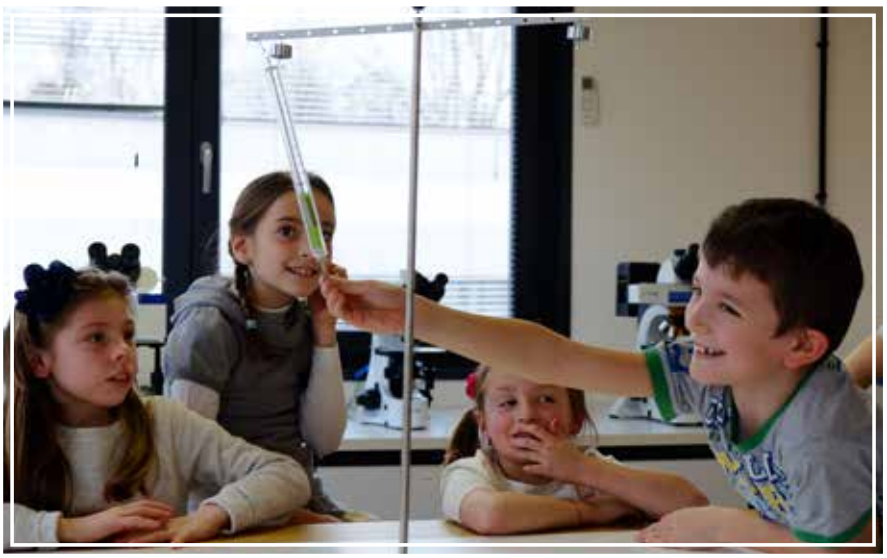
Since we were children, we're known that if we don't hold an object, it falls down.
In a second time, we learn to link this phenomenon to the force concept, that every day speech, is defined as weight.
Understanding that weight isn't an object property is very important: weight is, actually, a consequence of the Earth attraction.

Do you know why Pisa tower doesn't fall down?

How to compare two weights







Supplied materials

Items

1	Skein of string
1	Rod with hook
1	Truck
3	Pins
1	Scale plate
1	Metallic cylinder with hook
1	Folding ruler
1	Rubber balloon
1	Spring balance
1	Modular metallic rod
1	PVC rod
1	Aluminium foil
1	Magnet
2	Cloths
1	Steel coil spring
1	Tripod base
1	Pair of metal plates
1	Plumb line
1	Pair of rubber bands
1	Chest expander
1	Flat washers
20	Device to measure the centrifugal force
1	Latex ball with hook
1	Model of the Tower of Pisa
1	5 ml syringe
1	100 ml beaker
1	Square ruler
1	Didactic guide
1	Box

Box

Teaching guide included

PRIMARY SCHOOL

P52 Specific weight and floating

Basic

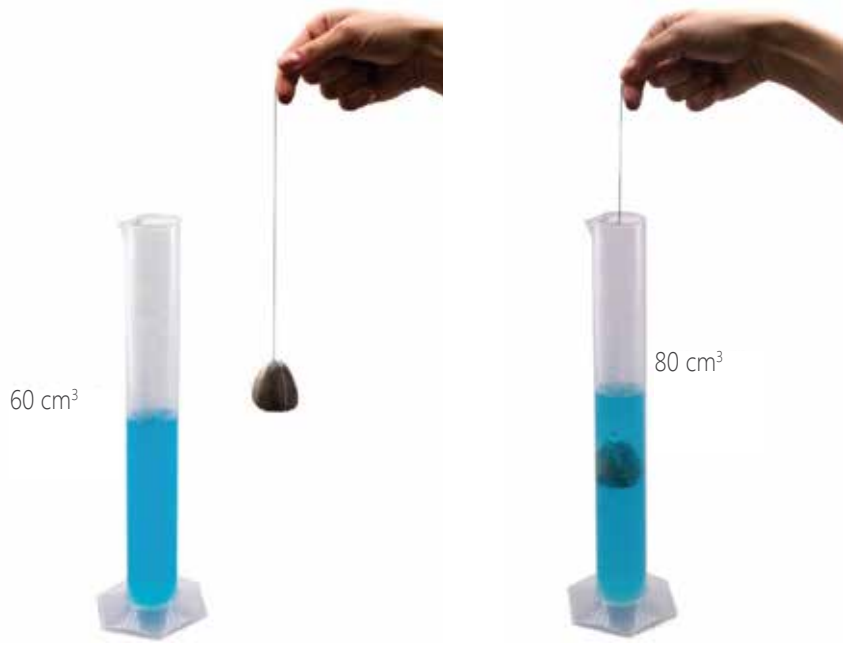
FEASIBLE EXPERIMENTS: 20

Topics

Matter and objects
Materials
A bit of history
Technique
Property of materials
An important physical property of materials: heaviness
Unit of measurement of weight
Unit of measurement of volume
Spring scale: an instrument to measure weight
How to measure the volume of an object
How to compare the heaviness of materials
Specific weight
Reduction to unit
Specific weight of a solid material
Specific weight of a liquid material
Specific weight of a saturated solution
Reverse formulas
How to vary the weight of an object
Weight of an object immersed in a liquid
The archimedes thrust
Floating of solid bodies
Experimental question
Sometimes it floats and sometimes it sinks
Floating of liquid bodies

When you have to build an object, the first thing to do is decide which is the right material that has the demanded properties.
Actually, we could divide materials for its properties, for example: physical, chemical and technological one.
Heaviness is very important for its various applications; specific weight is its measurable magnitude.

How to measure object volume



Archimedes principle

Supplied materials

Items

1	Skein of string	1	Series of 5 samples having equal volume
1	Rod with hook	1	Wax sample
1	Scale plate	1	Test tube support
1	Bottle of denatured alcohol	1	Bottle of glycerin
1	Folding ruler	1	Bottle of castor oil
1	Spring scale	1	100 ml graduated cylinder
1	Modular metallic rod	1	100 ml glass
1	Dropper	1	250 ml glass
1	Bottle of distilled water	1	5 ml syringe
1	Aluminium foil	1	Teaspoon
1	Bottle of colouring	1	Glass test tube - diam. 20
1	Tripod base	1	Box
1	Series of 5 various samples	1	Didactic guide

Box

Teaching guide included

PRIMARY SCHOOL

P53 Force, mass and density — Basic

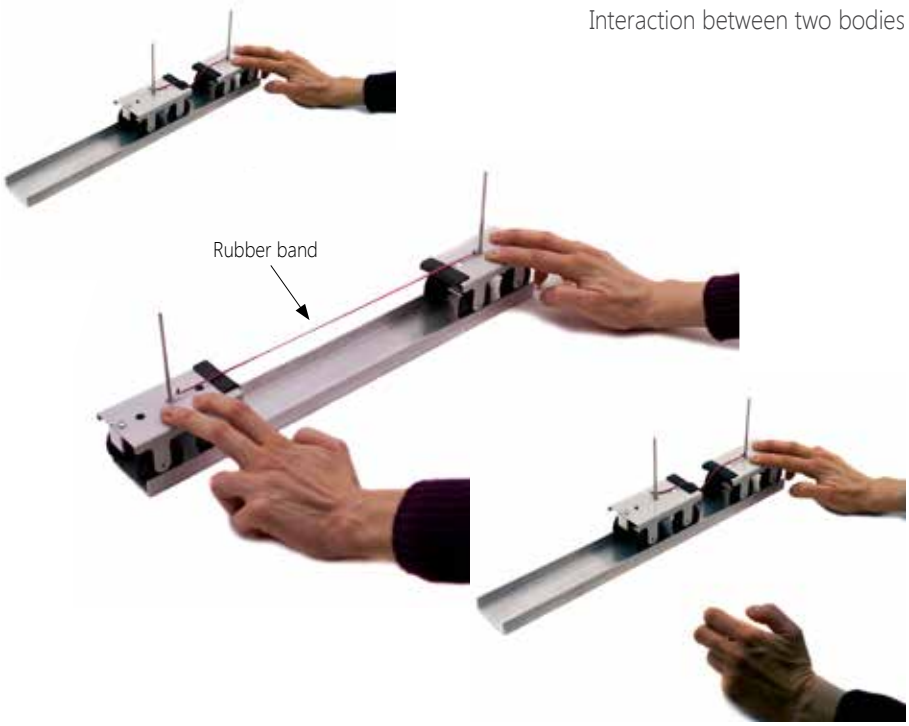
FEASIBLE EXPERIMENTS: 23

Topics

What is a force?
What happens when two bodies are interacting?
Effect due to interaction between two bodies
Another effect due to interaction between two bodies
How to compare different interactions
Take stock of the situation
Physical magnitude
Force is a physical magnitude
How many forces are there?
Gravity force
Weight
Graphical representation of forces
Spring scale
Unit of measure of the force intensity
Characteristics of forces that depend on distance
Weight decreases if the distance from the Earth center increases
Body's volume depends on temperature
Changeable properties and unchangeable properties
Unchangeable property: motion quantity
New physical magnitude: mass
How to measure an object's mass
Mass unit measure in the international system
Scale plates
Relationship between mass and volume of same material
Relationship between mass and volume of different material
Density
Weight on other planets
Matter inertia
Mass and motion
The fundamental law of dynamics

Gravity force, electrical force and magnetic force are all simple examples of forces. What is a force? To understand its meaning is not necessary that you know what Newton's laws are.
Thanks to simple experiments, you can understand that the force applied on a body is nothing else that the result of the interaction with another body.
Weight is not a property of a body; body's mass is the property that characterizes it.
Mass and weight are physical magnitudes and you have to measure them with different instruments.

Interaction between two bodies



How to measure body mass

Supplied materials

Items

1	Skein	1	Rubber band with eyelet
1	Rod with hook	1	Cannon with support
1	Ball	3	50g masses
2	Scale plates	1	Scale beam
1	Linear ruler	1	Masses holder
1	Spring scale	1	Cylinders set
1	Ball and ring apparatus	1	Rail
1	PVC rod	1	Cardboard
2	Linear magnets	1	40cm rod
1	Pair of fabric cloths	1	Rectangular base
1	Spring	4	Steel spheres
1	Ping pong ball with rope	1	Box
1	Chest expander	1	Teaching guide
2	Trucks		

Box

Teaching guide included

PRIMARY SCHOOL

P54 Pressure Basic

FEASIBLE EXPERIMENTS: 23

Topics

How to walk on snow
When a force is applied to a point
When a force is applied to an area
Imprint game
What are the elements on which the imprint depends?
Pressure meaning
Pressure: a new physical magnitude
Confusion into common language
Knives, nails, tacks and so on
Pressure and liquids
How to apply a force to a liquid
How to apply a force to a gas
Pressure in liquids
The Pascal principle
When pressure in liquid is produced by its weight
A pressure property that is generated by a liquid's weight
The Stevin principle
Two effects due to the Stevin principle
Gas pressure
Gases and the Pascal principle
Atmospheric pressure
One proof of atmospheric pressure existence

When a force is not applied to a point, but is spread over an area, to evaluate its effects it is necessary to consider not only the force's intensity but also the area on which it is applied.
The ratio between the force intensity and the area is defined as pressure.

Pressure

Pressure in liquids

Supplied materials

Items

1	Scale plate	1	Pascal apparatus
1	Balloon	1	Stevin apparatus
1	Ruler	1	Scotch-tape
1	Spring scale	1	Stamp pad
1	Dropper	1	Rubber stopper
1	Stain bottle	1	500ml plastic beaker
1	Cardboard	1	Basin
1	Brass rod	1	Rubber pear switch
1	Aluminium rod	1	Test tube
1	Bowl	1	Box
1	Semolina pack box	1	Teaching guide
1	Cork, nails and tacks		

Box

Teaching guide included

PRIMARY SCHOOL

P55 Work, energy and power — Basic

FEASIBLE EXPERIMENTS: 19

Topics

What is a transformation?
Physical and chemical transformations
Balanced and unbalanced forces
Our concept of work in everyday speech
The concept of work in physics
Work: a further physical quantity
When a force is not parallel to the displacement
Our concept of energy in everyday speech
The concept of energy in physics
Work and energy
How to measure energy
The two forms of mechanical energy
Kinetic energy
Gravitational potential energy
Elastic and plastic materials
Elastic potential energy
Further forms of energy
The properties of energy
Mechanical energy transformations
Non usable energy
The atomic constitution of matter
Electric potential energy
The hydraulic circuit
The electric circuit
Energy and human activities
Power

Concepts of work and energy are based on transformation concept that is interpreted as the situation in which an object changes its shape, position and state (rest, motion or aggregation) but it doesn't change its chemical nature.
Physical transformations are the core of this didactic unit; these transformations are produced by an unbalanced force, when it is applied to a body.

A physical transformation due to weight

Potential energy becomes kinetic energy

Supplied materials

Items

1	Rod with hook	1	Metallic cylinder with hook
1	Rod with clip	1	Metallic rod with knurled knob
1	String	1	Fixed pulley
1	Truck	1	String with 2 hooks
2	Boss heads	1	Bucket
1	Rubber ball	1	Rail
1	Folding ruler	1	Turbine model
1	Spring balance	1	Photovoltaic cell
3	30 cm cable	1	Basin
1	Knife switch	1	1,5V bulb
1	Lamp holder	1	Funnel
1	Battery holder	1	50 ml beaker
1	Package of calcium carbonate	1	Petri dish
1	Coil spring	1	Rectangular bases
1	Rubber ball with hook	2	Metallic spheres
1	Spring cannon with support	1	Didactic guide
1	Paper clip	1	Box

Box

Teaching guide included

PRIMARY SCHOOL

P56 Temperature and heat — Basic

FEASIBLE EXPERIMENTS: 23

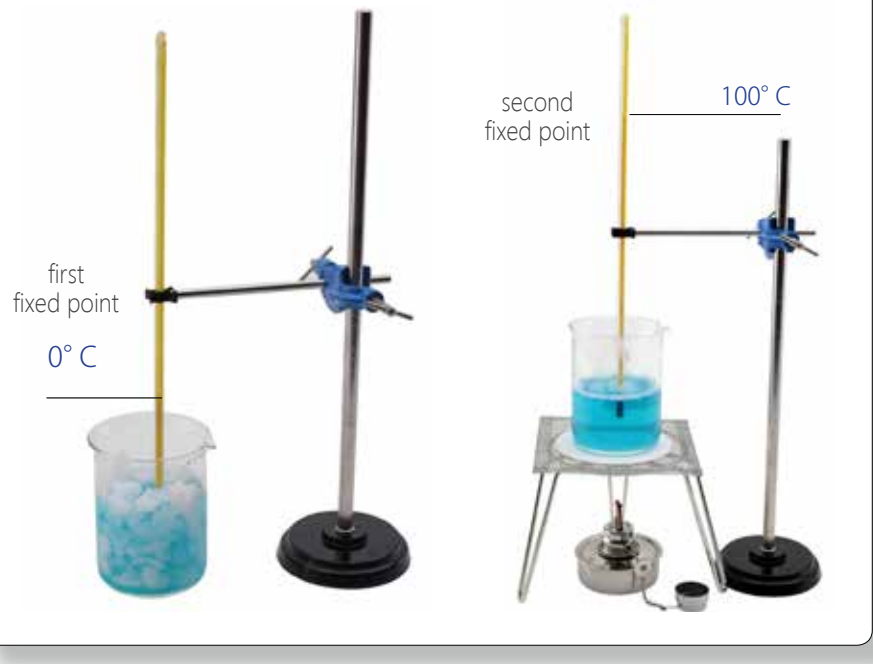
Topics

Thermal sensations
How to compare thermal sensations
A new physical quantity: temperature
Thermal expansion of solid bodies
Thermal expansion of liquid bodies
Thermal expansion of gaseous bodies
How to compare temperatures- the thermoscope
The thermometer
Thermometrical scales
How to use the thermometer
Inside matter
Thermal excitement of molecules
Thermal energy
How to raise the temperature of a body
A further way to raise the temperature of a body
Thermal equilibrium
Heat
Temperature and heat
Heat propagation in solid bodies
Good and poor heat conductors
Heat propagation in liquid bodies
Heat propagation in gaseous bodies
Radiation
The relation between heat and temperature
The relation between heat and mass
Specific heat
How to measure heat

It's easy, in common language, confuse to each other the two concepts of heat and temperature.

The experiences proposed into this unit are made to clarify that temperature and heat are two different physical magnitudes correlated each other.
This two different physical magnitudes must be measured using different instruments.

Thermometer fixed point



Relationship between heat and mass

Supplied materials

Items

1	Rod with clip	10	Candles	1	Wire gauze
1	String	1	Candle holder	1	Full rubber stopper
1	Stopper with glass tube	1	Tongs	1	Thermoscope
1	Double head boss	1	Pack of sawdust	1	20 lead shot pack
1	Bottle of denatured alcohol	1	Base with rod	1	Plastic spoon
1	Rubber balloon	1	Calorimeter	2	Alcohol thermometers
1	Ruler	1	Aluminium rod	2	250 ml beakers
1	Tripod base	1	Perforated aluminium flat bar	1	400 ml beakers
5	Rubber rings	1	Neoprene cylinder	1	100 ml Erlenmeyer flask
1	Dropper	1	Aluminium sample	1	Glass stirrer
1	Alcohol burner	1	Molecule model	1	Box
1	Ball and ring apparatus	1	Pack of methylene blue powder	1	Didactic guide

Box

Teaching guide included

PRIMARY SCHOOL

P60 Air physical properties — Intermediate

FEASIBLE EXPERIMENTS: 32

Topics

What is the atmosphere?
Air exists
Air composition
Absolute humidity and relative humidity
Air is unfathomable
Air is elastic
Air pressure
Pascal pressure
How to apply a force to air
Compressed air and rarefied air
Air temperature
When air is going to be warm
Winds
How to make use of winds
Air weight
Atmospheric pressure
Some application of atmospheric pressure
Barometer
When air is moving
Air to fly
Air to brake free falling
Air to live
Air pollution
The greenhouse effect

The thickness of the atmosphere in respect to the Earth is comparable to the thickness of the peel in respect to an peach.
Moreover, without the atmosphere, there wouldn't be any life forms on the Earth.
Air supplies oxygen that is necessary for breathing, carbon dioxide for photosynthesis and water vapour.
You can't see air, but it exists: it is unfathomable, it has a weight and volume.
Air protects us from cosmic rays and solar rays.

Atmospherical pressure

Air is unfathomable it exists but is invisible

Supplied materials

Items

5	Drinking straws	1	Funnel with stopper	1	400ml beaker
1	Sucker	1	Transparent tube	1	Filtration flask
1	Rod with base	1	Cardboard	1	Test tube
1	Boss-head	1	Stopper with rubber holder	1	Box
4	Small balloon	1	Wind indicator with compass	1	Teaching guide
2	Big balloon	1	Rod with clip		
1	Manual pump	5	Disk of absorbent paper		
1	Wall thermometer	1	Stopper		
1	Tube with stopper	1	Stopper with hole		
6	Candles	1	Plastic pack box		
3	Candle holder	1	Elastic band		
1	Magnifying glass	1	5ml syringe		
1	Aluminium foil	1	Fan		
1	Wind apparatus	1	Rubber pear switch		
1	Bottle of barite water	1	Vaseline bottle		
2	Ping pong ball with rope	1	100ml beaker		
1	Plastic coated iron wire	1	250ml beaker		

Box

Teaching guide included

PRIMARY SCHOOL

P61 Water physical properties — Intermediate

FEASIBLE EXPERIMENTS: 32

Topics

Water is a precious resource
Water is a chemical compound
Water is not elastic
Water molecule's motion
The three states of water
Water in liquid state
How to measure water volume
How to measure water weight
Warming water
Water thermal expansion
Water evaporation
Boiling water
Water vapor condensation
Water in solid state: ice
Ice melting
Water loop
Rain
Rain gauge
Specific weight and water density
Archimede's thrust
Archimede's principle
When does a body float in water?
Ice cycle
Water pressure
The Pascal principle
Water types
Water for life
Water pollution
Acid rain
Acidity indicator
Water, a precious resource to use frugally

Water is essential for all life forms and it represents a fundamental component for civil progress because it stands at the base of human productivity.

Thanks to this didactic unit, you can verify a lot of water physical properties, as its density, capillarity, the pressure applied by its weight and so on.

Water molecule's motion

The Pascal principle

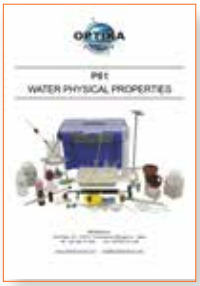
Supplied materials

Items

1	Rod with clip	1	Rain gauge	1	Rubber stopper
1	Nylon string	1	Bottle of distilled water	1	Basin
1	Glass tube with stopper	1	Aluminium foil	1	Rubber band
1	Curved glass tube with stopper	2	Earthenware jar	1	Plastic spoon
1	Rod with hook	1	Plastic pack box	1	Bottle of sand
1	Boss head	1	4 sample set	1	Universal paper PH-1-10
1	Scale plate	1	Rod with disk	1	Alcohol thermometer
1	Archimede's double cylinder	1	Plastic stinning rod	2	100ml beaker
1	Bottle of denatured alcohol	1	Tripod base	1	250ml beaker
2	50g masses with hook	1	Pliers	1	400ml beaker
1	Manual pump	1	Sawdust bottle	1	Glass flask
1	Spring scale 2N	1	Methylene blue dust	3	Test tube
1	Tripod base	1	Stopper with rubber holder	2	Watch glass
6	Rubber bands	1	5ml syringe	1	Capillary tube
1	Dropper	1	Decomposable metallic rod	1	Box
1	Alcohol burner	1	Wire gauze with ceramic disk	1	Teaching guide

Box

Teaching guide included



PRIMARY SCHOOL

P62 Equilibrium — Intermediate

FEASIBLE EXPERIMENTS: 31

Topics

Knowing forces
Forces in action
Weight is a force
Elasticity
Spring scale
Other types of forces
How to summate forces
Parallelogram law
Sum of parallel forces
Friction forces
Barycenter
How to use our forces smartly
Rod equilibrium
Simple machines
First class lever
Second class lever
Third class lever
Some examples of levers
Pulleys
Fixed pulleys
Mobile pulley
Simple hoist
Inclined plane
Pressure
Forces in equilibrium in fluids
Pressure of a liquid
Liquid equilibrium in communicating vessels
Pressure gauge: how to measure pressure
Air exists
Atmospheric pressure

Inclined plane

Parallelogram rule

Children, have to learn how to stay in equilibrium just using their perceptions of the world.
Statics is a part of physics that studies equilibrium laws and teaches how you can realize it in a lot of situations.

This study had allowed us to build beautiful pyramid art works.

Thanks to the instruments that you can find into this kit, you can verify a lot of phenomena about statics of solids and liquids.

Supplied materials

Items

1	Nylon string
1	Rod with hook
1	Boss head for rod
1	Metal sheet
10	Cylinder with hook (50g each)
1	Linear ruler
1	Inclined plane with pulley
1	Truck
2	Simple pulleys
1	Spring scale
1	Paper goniometer
1	PVC rod
1	Linear magnet
1	Spring
1	Rod for lever
1	Cardboard
1	Decomposable metal rod
1	Boss-head for lever rod
2	Pulleys with pivot
1	Pressure apparatus
1	Pressure gauge
1	Red rubber tube
1	Funnel
1	Graduated cylinder
3	Slotted metallic cylinder (50g)
1	250ml beaker
1	Tripod base
1	Rubber ball
1	100ml syringe
1	Test tube
1	Box
1	Teaching guide

Box

Teaching guide included

PRIMARY SCHOOL

P63 Motion — Intermediate

FEASIBLE EXPERIMENTS: 18

Topics

Motion
Relative motion
Reference system
Trajectory
Change of position
Time table
Tools for experimental study of motion
Manual time count
Automatic time count
Average speed
How to measure average speed
Instant speed
How to measure instant speed
Average acceleration
How to measure average acceleration
Instant acceleration
Types of motion
Uniform rectilinear motion
How to achieve uniform rectilinear motion
Uniformly accelerated motion
How to achieve uniformly accelerated motion
Causes of motion
There aren't forces applied to the body
What happens when we apply a constant force to a body
To review the situation
Mass
Fundamental law of dynamics
Free fall motion

Motion is a phenomenon that concerns all matter: from smaller parts, such as atoms and molecules, to bigger ones, such as stars and galaxies.
To study motion, you need some air truck instruments, you need to decrease friction force until you can consider it equal to zero.
Thanks to this kit you can study all concerning motion using a rail that guarantees you low friction; you can measure time using a simple timer and two photogates

How to measure average acceleration

How to measure instant speed

Supplied materials

Items

1 Cord	1 Screwdriver
1 Linear ruler	1 Box
2 Metallic cylinder with hook (10g each)	1 Teaching guide
1 Slotted metal disk (20g each)	
1 Aluminium foil	
1 Kit to measure time	
1 Rail	
1 Truck	
1 Wedge	
1 Pulley with pivot	

Box

Teaching guide included

PRIMARY SCHOOL

P64 Thermal phenomena

Intermediate

FEASIBLE EXPERIMENTS: 25

Topics

Thermal sensations
Thermoscope
Thermometer
Thermometric scales
Types of thermometer
Linear thermal expansion
Coefficient of linear thermal expansion
Bimetallic strip
Volumetric thermal expansion
Thermal expansion in liquids
Thermal expansion in gases
Thermal excitation of the molecules
Thermal energy
How to increase the temperature of a body
Another way to increase the temperature of a body
Thermal equilibrium
Combustion
Flame
Heat
Relation between heat and temperature
Heat propagation in solids
Good and bad conductors of heat
Heat propagation in liquids
Heat propagation in gases
Radiation
Change in state
Fusion and solidification
Evaporation
Boiling
Condensation

Using this kit you can verify and study all thermal phenomena that you could experiment with in everyday life.
This is a useful kit for understanding thermal phenomena as expansion in different states of matter. You can not only study heat propagation, but also learn how thermoscopes and thermometers work.

Thermal equilibrium

Boiling

Supplied materials

Items

1	Rod with clip	1	Rod with base	1	Test tube
1	Glass tube with stopper	1	Calorimeter with thermometer	1	Watch glass
1	Curved glass tube with stopper	1	Aluminium rod	1	Box
1	Boss head	1	Aluminium plate with hole	1	Teaching guide
1	Bottle of denatured alcohol	1	Aluminium sample		
1	Ruler	1	Methylene blue dust		
1	Tripod base	1	Glycerine bottle		
5	Rubber bands	1	Wire gauze with ceramic disk		
1	Dropper	1	Rubber stopper		
1	Bimetallic strip	1	Thermoscope		
1	Alcohol burner	1	Lead pellet		
1	Ball and ring apparatus	2	Thermometers		
6	Candles	2	250ml beaker		
1	Candle holder	1	400ml beaker		
1	Magnifying glass	1	100ml beaker		
1	Pliers	1	Glass stirring rod		

Box

Teaching guide included

PRIMARY SCHOOL

P65 Light phenomena — Intermediate

FEASIBLE EXPERIMENTS: 24

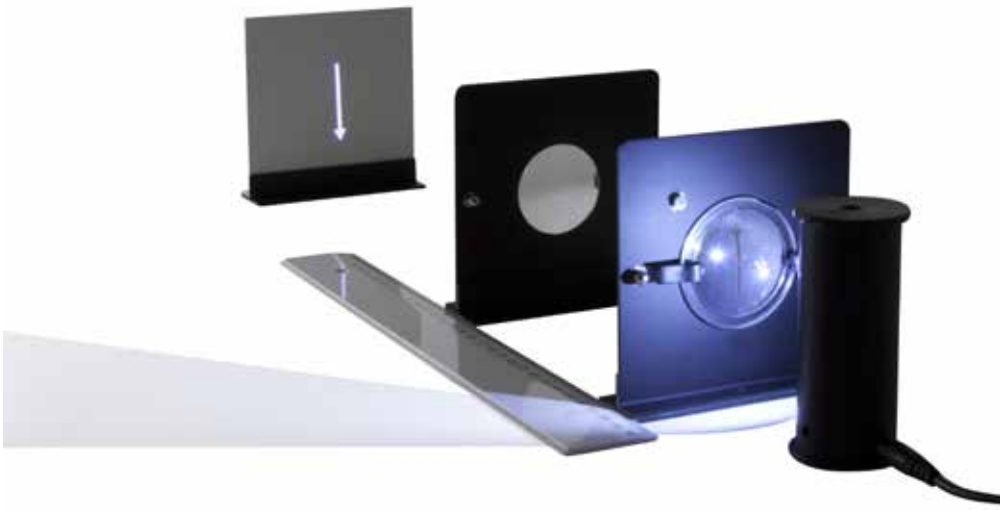
Topics

Optics projector
Why do we see objects?
Rectilinear propagation of light
Illumination laws
Shadow and twilight
Eclipses
Light diffusion
Light reflection
Light reflection in spherical mirrors
Light refraction
Refraction laws
Total reflection
Lenses
The refraction through the lens
Images formed by reflection in plane mirrors
Images created by lenses
Eye
Vision defects
The compound microscope
The slide projector
White light - dispersion
Color filters

Explanations and comprehension of light phenomena request a long inter-disciplinary path using ways and phases that follow the cognitive processes typical of each ages.

Phenomena debated in this didactic unit concern only a physics part called geometrical optics because it is nearer to experience in everyday life.

Images created by converged lenses



Rectilinear light propagation

Supplied materials

Items

1	Ruler	1	Lens +10 and lens holder
1	Diaphragm with one slit	1	Lens -10 and lens holder
1	Diaphragm with four slit	1	Goniometer with support
1	Diaphragm with arrow slit	1	Optical projector
1	Semi-transparent glass	2	Projector support
1	Slide	1	Rubber band
1	Plexiglass semi-cylinder	1	Filter holder
1	Diaphragm with square slit	1	White screen
1	Plane mirror	1	Slide
1	Plane reflective object	1	Wooden sphere
1	Specular double arch	1	Wooden sphere with rope
1	Rectangular prism	1	Transformer
1	Coloured filters set	1	250ml beaker
1	Diffraction grating 500 l/mm	1	Box
1	Lens holder, diaphragm holder and lens +6	1	Teaching guide

Box

Teaching guide included

PRIMARY SCHOOL

P66 Sound — Intermediate

FEASIBLE EXPERIMENTS: 27

Topics

Hearing
When do we hear sound?
Oscillations
Oscillations period
Oscillations frequency
Oscillations graphic representation
Why do we hear sound?
Acoustic waves
How acoustic waves become sounds
Ear: a receiver of acoustic waves
Ear-brain system
The limits of audibility
Sensitivity of auditory system
How to strengthen auditory sensitivity
Sound characteristics
Stereophonics
Acoustic wave's reflection
Interference between acoustic waves
Beats
Sonometer
Resonance
Stringed musical instruments
Wind musical instruments
Take care of your ears

When do we hear sounds? Why do we hear sounds? Using this kit you can answer all these questions. Thanks to this kit you can learn in depth, difficult topics such as swinging, its period, frequency and how to make its graphic.
This kit addresses not only the "classical physics" as the reflection and the interference about acoustic waves, but addresses also how stringed and wind musical instruments work.

When we hear a sound

Resonance

Supplied materials

Items

1	Metal rod	1	Stethoscope
1	Rod with hook	1	Flute with slider
1	Cord	1	Whistle for ultrasounds
1	Cork stopper	1	Tubofono
1	Clip pliers	1	Steel sheet
1	Boss head	1	Ball with hook
1	Linear ruler	2	Acoustic insulating panel
1	Resonance tube	1	Wooden sphere with rope
1	Rod base	1	400ml beaker
1	Sonometer (one rope)	1	Box
1	Pair tuning fork	1	Teaching guide

Box

Teaching guide included

PRIMARY SCHOOL

P67 Electrostatics Intermediate

FEASIBLE EXPERIMENTS: 15

Topics

Let's start
Protons and electrons
Electrification by rubbing
Electrical actions
Electrostatic induction
The double pith-ball electroscope
Electrification by contact
Conductors and insulators
The gold leaf electroscope
Volta's electrophorus
The electrical state of a body
How to discover the sign of a charge
Air can be electrified too
Biological effects of air ionisation
Lightning and flashes
Faraday cage

Electrical forces

Thanks to these simple experiences you can discover the electrical nature of matter that is around us.
Starting from an explanation of what electrons and protons are, and thanks to some simple experience, you reach a full comprehension of the electrical phenomena happening in everyday life.

Faraday cage

Supplied materials

Items

1	String	1	Faraday cage
1	Circular base	1	Aluminium roll
1	Isolated support with hook	1	Electroscope rod
2	Balloons	1	Scotch-tape
5	Candles	1	Metallic rod
1	Plexiglas rod	1	250 ml Erlenmeyer flask
2	PVC rods	1	Didactic guide
1	Extended U-hook with thread	1	Box
1	Volta's electrophorus		
1	Couple of balls		

Box

Teaching guide included

PRIMARY SCHOOL

P68 Electric current and magnetism — Intermediate

FEASIBLE EXPERIMENTS: 24

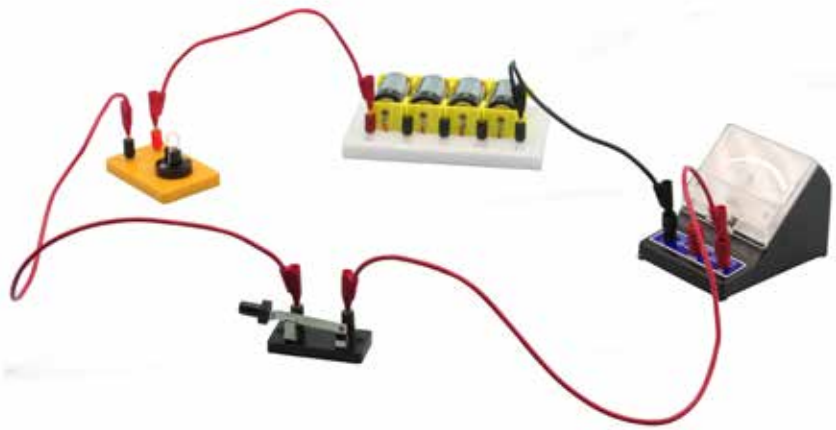
Topics

Knowing electricity
Electricity into matter
Electricity in motion
Battery
Volta battery
Potential difference
Voltmeter
Circuit
Conductor and insulating
Current
Ammeter
Electrical resistance
Electricity
Lamps in series
Lamps in parallel
Transformation of electricity into thermal energy
Domestic electrical systems
Magnets
Magnetic poles
Magnetic materials
Magnetic needle
Earth's magnetism
Compass
Magnetic forces
Magnetic levitation
Magnetic induction
Current's magnetic effect
Electromagnet
Electric bell

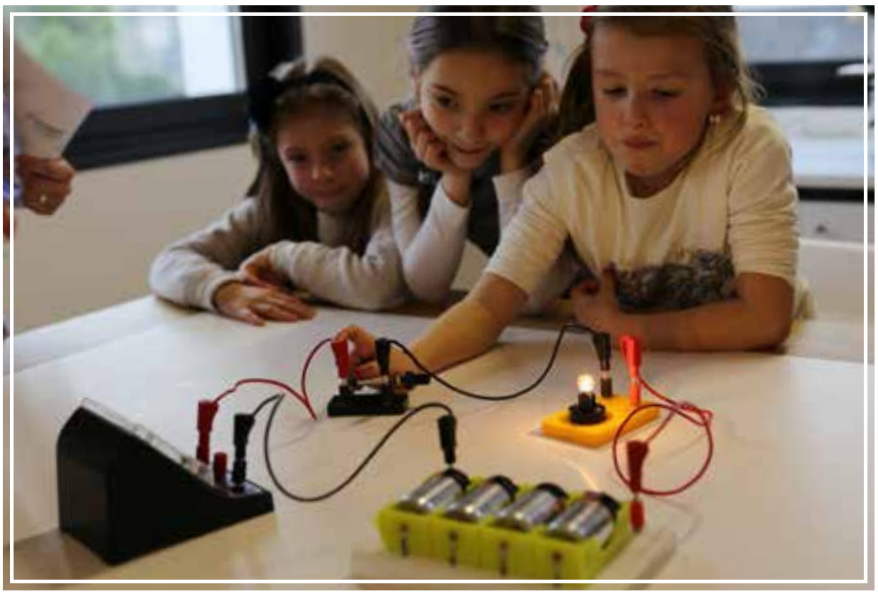
In this didactic unit, phenomena that concern charges in motion in conductors are considered.

In particular, experiences about electric current effects and electricity transformations into other energy forms are proposed.
This kit addresses the definition of electricity, and through the practical section on the use of the voltmeter and ammeter, allows you to understand all of the basic electrical laws.

Electrical circuit



Electric bell



Supplied materials

Items

5	30cm lead	1	Electric calorimeter
2	60cm lead	1	Battery holder (4 places)
1	Black alligator clip	1	Pair of electrodes for battery
1	Red alligator clip	1	Magnetic levitation apparatus
1	Knife switch	10	Nails
2	Lamp with holder	1	Coil with support
1	Electric bell model	1	Electromagnet core
1	Magnetic needle	1	Compass
1	Ammeter	1	Goniometer
1	Voltmeter	1	Box
1	Linear magnet	1	Teaching guide

Box

Teaching guide included

PRIMARY SCHOOL

P70 Introduction to chemistry — Basic / Intermediate

FEASIBLE EXPERIMENTS: 23

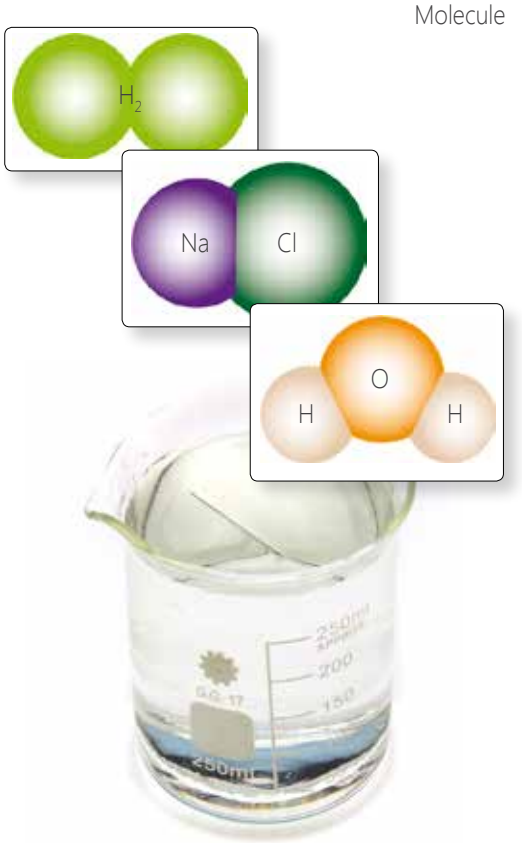
Topics

Alcohol burner
Matter
Atoms
Molecules
Cohesion force
Molecules in motion
Physical phenomena and chemical phenomena
Elements and compounds
Three states of matter
Change in state
Melting and condensation
Mixture: solid and solid
Mixture: solid and liquid
Mixture: liquid and liquid
Solutions
Crystals
Chemical reactions
Oxidation
Combustion

In this didactic unit simple experiences, not dangerous are proposed.
Thanks to these experiments, students can clarify concepts of mixture, element, compound and chemical reaction.

Mixture: liquid and liquid

Molecule



Changes of state

Supplied materials

Items

1	Rod with clip	1	Iron skein
1	Curved glass tube with stopper	1	Pliers
1	Rod base	1	Sawdust
1	Clamp	20	Paper filter disks
2	Rubber balloon	1	Wooden pliers
1	Tripod base for burner	1	Mohr pliers
1	Dropper	1	Wire gauze with ceramic disk
1	Alcohol burner	1	Funnel
1	Ball and ring apparatus	1	Spoon
5	Candle	1	Thermometer
1	Candle holder	1	250ml beaker
1	Magnifying glass	1	100ml flask
1	Linear magnet	2	Test tubes
1	Sieve	2	Watch glass
1	Rod with ring	1	Capsule
1	Rod to shake	5	Test tubes with stoppers
1	Pack of 30 cubes	1	Box
1	Latex bottle	1	Teaching guide
1	Iron cube		

Box

Teaching guide included

Chimical products

1	Denatured alcohol (bottle)	1	Calcium sulfate (bottle)
1	Sulfur dust (bottle)	1	Iron dust (bottle)
1	Iron dust (bottle)	1	Potassium sulfate (bottle)
1	Sodium chloride (bottle)	1	Sawdust (bottle)
1	Sodium carbonate (bottle)	1	Stain (bottle)
1	Copper sulfate (bottle)	1	Sand (bottle)

PRIMARY SCHOOL

P71 Plants — Basic / Intermediate

FEASIBLE EXPERIMENTS: 23

Topics

Introduction
Seed morphology
Seed germination
Osmosis
Roots
Roots hair
Roots can orientate
Trunk
Trunk's interior structure
Underground trunks
Sap absorption
Capillarity
Do you know why leaves are green during summer?
Do you know why leaves are yellow during autumn?
Photosynthesis
Transpiration
Starch
Flower morphology
Fruit
Carbon dioxide development in plants
How to build a herbarium

Using this kit you can learn in which environmental conditions plants can grow.
You can also study their capabilities, for example how they can collect solar energy.

Do you know why leaves are green during summer?

Supplied materials

Items

1 Dropper	1 Rubber stopper with hook
1 Magnifying glass x7	2 Cardboard A4
1 Aluminium foil	1 Test tube holder
1 Pliers	1 Peat disk set
2 Filter paper	1 250ml beaker
1 Scalpel	1 400ml beaker
1 Scissors for microscopy	1 Mortar with pestle
1 Plastic funnel	1 Capillary glass tube
2 100ml graduated cylinder	1 Metallic pivots
2 Plastic sack	1 Trunk sample
2 Rubber bands	5 Petri capsules
5 Plastic binder	10 Test tubes with stoppers
1 Spoon	5 Cylindrical container with stopper
1 Glass tube	1 Box
1 Flower seeds pack box	1 Teaching guide
1 Stopper driller	
1 Plastic spatula	
2 Jars	

Box

Teaching guide included

Chimical products

1 Distilled water (bottle)	1 Sand (bottle)
1 Stain (bottle)	1 Mold (bottle)
1 Ethyl alcohol (bottle)	1 Chromatography mixture (bottle)
1 Fertilizer (bottle)	1 Vaseline (bottle)
1 Lugol solution (bottle)	

PRIMARY SCHOOL

P72 Basic biology — Basic / Intermediate

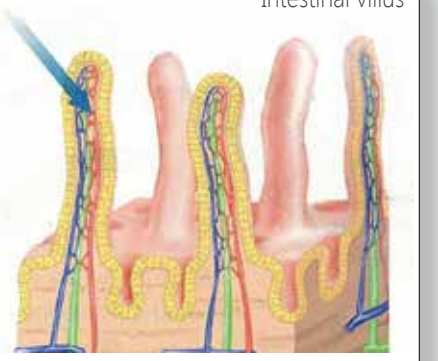
FEASIBLE EXPERIMENTS: 20

Topics

What is biology?
Cell
Water
Watery solutions
Osmosis
Mineral salts
Roots
Mineral salts absorption by soil
Trunk
Capillarity
Life forms and their feeding
Photosynthesis
Plants cellular breathing
Starch: plants' stocks
Food chain
Feed to live
Starch in food
Starch digestion
Grease identification
Grease digestion
Protein's identification
Protein's digestion
Energy and animals life
Combustion
Animal breathing

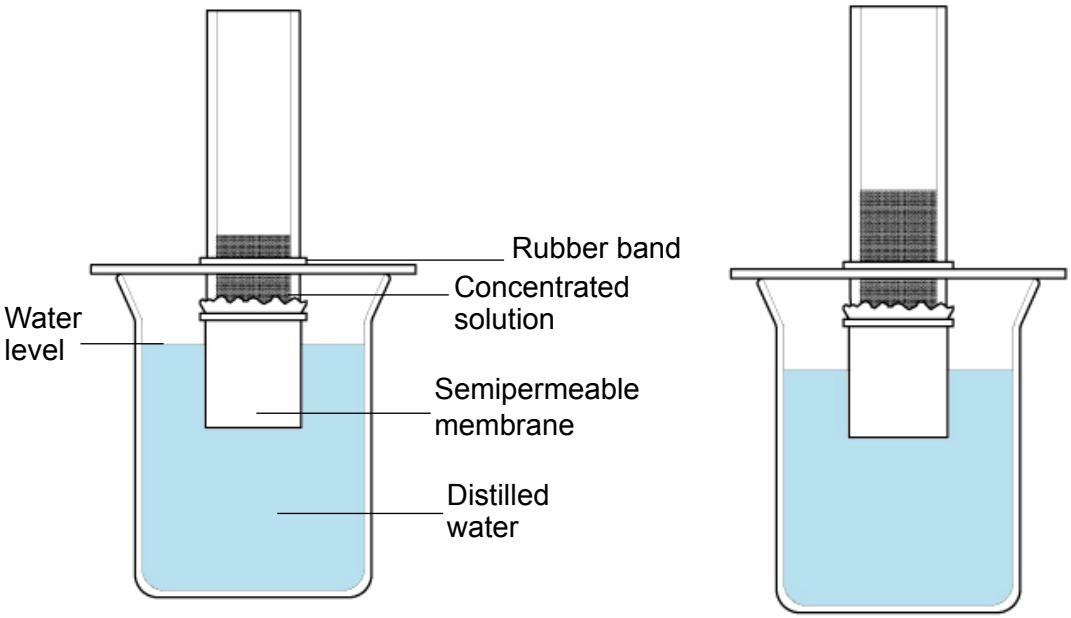
Each life form to be able to grow, needs some environmental conditions, such as nourishment source and breathing.
Thanks to simple experiences, students can learn the importance of these vital functions.

Intestinal villus



Trunk

Osmosis



Supplied materials

Items

1 Dropper	1 Glass tube
5 Candles	1 Flower seeds pack box
1 Candle holder	2 Jar
1 Magnifying glass	1 Test tube holder
1 Aluminium foil	1 100ml beaker
1 Osmometer	1 400ml beaker
1 Pliers	1 Capillary tube
1 Plant cell model	1 Vertical trunk sample
10 Filtration paper disks	1 Horizontal trunk sample
1 Scalpel	2 Petri capsule
1 Spatula with spoon	7 Test tube with stopper
1 Insufflator	1 Box
1 Funnel	1 Teaching guide
1 100ml graduated cylinder	

Box

Teaching guide included

Chimical products

1 Hydrochloric acid solution (bottle)	1 Rice starch (bottle)
1 Distilled water (bottle)	1 Lime water (bottle)
1 Stain (bottle)	1 Mold (bottle)
1 Ethyl alcohol (bottle)	1 Sudan II (bottle)
1 Lugol solution (bottle)	1 Bi-ureter (bottle)

PRIMARY SCHOOL

P73 Environment for life — Basic / Intermediate

FEASIBLE EXPERIMENTS: 23

Topics

Soil as habitat
Soil mineral fraction
Soil organic fraction
Soil contains air
Soil contains water
Training for using acidity indicator
Soil acidity
Types of carbonates in soil
Soil permeability
Soil fecundity
Biodegradable objects and soil
Water for life
Water loop
Water vaporization and condensation
Rain
Sea water
Drinking water and its distribution
Water pollution
Ammonia research
Nitrate research
Sulfate research
Surfactant's research
What is atmosphere?
Air composition
Absolute humidity and relative humidity
Atmospheric pollution
Acid rain
Greenhouse effect

The environment is composed by three fundamental elements: soil, air and water.

The experiences proposed in this didactic unit are designed to teach which are the most important properties that allowed life forms development.

Soil permeability

Acidity indicator

Supplied materials

Items

1 Curved tube with stopper	1 Flower seeds pack box
1 Ruler	3 Jar
1 Tripod base	1 Pear switch
1 Dropper	1 Syringe
1 Alcohol burner	1 Universal paper pH 1-10
5 Candles	1 Alcohol thermometer
1 Candle holder	1 250ml beaker
1 Stirring rod	1 400ml beaker
1 Plexiglass sheet with stem	1 100ml flask
2 Rubber band	3 Test tube
1 Basin	3 Petri capsule
20 Filtration paper disk	3 Container with stopper
1 Wire gauze with ceramic disk	1 Box
3 Rubber stopper	1 Teaching guide
1 Funnel	
1 250ml graduated cylinder	
2 Plastic pack box	
1 Spoon	

Box

Teaching guide included

Chimical products

1 Denatured alcohol (bottle)	1 Water lime (bottle)
1 Hydrochloric acid 10% (bottle)	1 Sand (bottle)
1 Sodium chloride (bottle)	1 Mold (bottle)
1 Sodium hydrate (bottle)	3 Samples of pH known
1 Nessler reactive (bottle)	1 Gravel (bottle)
1 Griess reactive (bottle)	1 Chloroform (bottle)
1 Clay (bottle)	1 Barium chloride 10% (bottle)

PRIMARY SCHOOL

P74 View

Basic / Intermediate

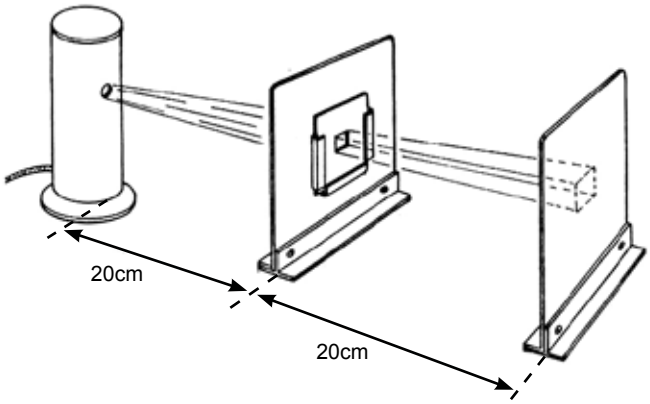
FEASIBLE EXPERIMENTS: 32

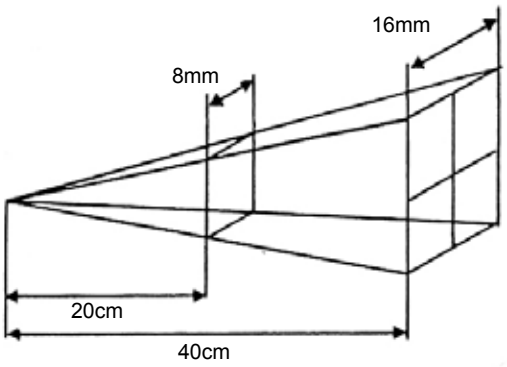
Topics

Optics projector
Light
Light source and illuminated objects
If there is no air
Linear propagation of light
Light carries energy
Illuminance
Illuminance law
Light nature
Electromagnetic waves spectrum
Sight
Eye: light receiver
Lenses
Eye as an optical system
Visual deficiency and its correction
Eye power resolution and visual sharpness
Eye-brain system
Persistence of vision
White light
Newton disk
Colour's spatial synthesis
Binocular vision
Depth of field
Stereoscopic vision
Field of view
Optical illusions

Eyes for us, are like windows through which we can observe the world around us.
Vision is the results of two processes; the first one completely based on physics: it concerns optical waves that stimulate sight; the second one based on psychology, that supplies interpretations of these stirrings.
Simple experiences make you aware of the importance of these two processes.

Lighting law





Newton disk

Supplied materials

Items

1	Linear ruler	1	Newton disk
1	Diaphragm with square slit	1	Vision tube
5	Candles	1	Tables set
1	Candle holder	1	Diaphragm holder
1	Diaphragm with circular slit	1	White screen
1	Stereoscopic glasses	1	Wooden sphere
1	Didactic focuser	1	Transformer
1	Solar cell	1	Stereoscopic figure
1	Lens +6 and lens holder	1	Box
1	Optics projector	1	Teaching guide
1	Flip-book		
1	Diffraction grating		

Box

Teaching guide included

PRIMARY SCHOOL

P75 Touch, olfaction and taste — Basic / Intermediate

FEASIBLE EXPERIMENTS: 25

Topics

TOUCH
Skin
Skin sensitivity
Contact stimulus
Pressure stimulus
Pain stimulus
Temperature and heat
Body temperature
Thermal sensations
See using touch
Fingerprint
Skin cleanliness

Feasible experiments: 11

OLFACTION
How is matter made?
Matter aggregation states
Change in state
Nose: smell organ
How do you smell odour?
How can you identify odours?
Odour inurement
Nose cleanliness

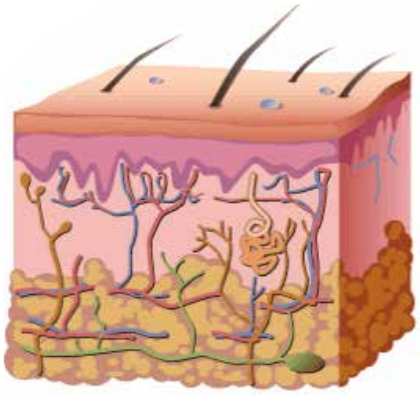
Feasible experiments: 8

TASTE
Tongue: taste organ
How do we taste flavour?
Four fundamental tastes
Taste and smell
Taste and sight
Good tastes and bad tastes

Feasible experiments: 6

Simple experiences are proposed in this didactic unit: thanks to this kit, students can better understand the importance of our senses in everyday life.

Skin sensitivity



Nose

Fingerprint

Supplied materials

Items

4	Dropper
1	Stamp pad
1	Odours set
1	Flavours set
1	Various objects set
1	Tables set
1	Digital thermometer
1	Noise model
3	250ml beaker
1	Plastic spoon
4	Petri capsule
1	Box
1	Teaching guide

Box

Teaching guide included

PRIMARY SCHOOL

HIGH SCHOOL

High school students often have the wrong attitude towards physics and science in general. The most evident aspect of this attitude is a clear disregard for natural phenomena, especially physical ones, and for their practical applications. Their attention is mostly aimed at mathematical formulation of laws ruling the various phenomena which, consequently, becomes an end in itself, instead of being an instrument of representation and survey of reality. To discover the physical fact hidden in the formulas and connect physics to the world of nature, of science and of technology, it is mandatory that all students are personally involved in the realisation of experiences and in the search for explanations of the observed phenomena, by using an appropriate language.

Index:

S80 Statics of liquids and solids — Advanced

FEASIBLE EXPERIMENTS: 33

Topics

Forces and their effects
Elastic elongation: Hook law
Spring scale
Concurrent forces composition
Composition of parallel and concordant forces
Moments equilibrium
Barycenter
Rested bodies equilibrium
Levers
Test sheet
Pulleys
Inclined plane
Specific weight
Density
Pressure
The Pascal principle
The Stevin principle
Communicating essets
Atmospheric pressure
Pressure gauge: how to measure pressure
The Archimede's principle and its applications
Floating

Thanks to this kit you can better understand what equilibrium is.
You can also make a careful study of Pascale and Stevin principe.

Inclined plane

Inclined plane

Supplied materials

Items

1	Skein	10	50g metallic cylinder with hook	1	Pulley with threaded pivot
1	Cork stopper	1	Linear ruler	1	Pressure gauge
1	Pivot with handwheel	1	Rod for lever	1	Red rubber tube
1	Rod with hook	1	Inclined plane with pulley	1	Basin
1	Boss head	1	Truck	1	Rubber stopper
1	Steel sample	1	Spring scale	1	Funnel
1	Aluminium sample	1	Dropper	1	250ml graduated cylinder
1	50g slotted cylinder	1	Bottle of distilled water	1	Tripod base
1	Goniometer with pivot	1	Colourant bottle	1	Wooden thing
1	Metal sheet to determinate barycenter	1	Spring	1	100ml beaker
1	Scale plate	1	Cardboard	1	400ml beaker
1	Archimede's double cylinder	1	Pascal apparatus	1	Test tube
1	Denatured alcohol (bottle)	1	Stevin apparatus	1	Box
1	Multiple pulley with pivot	1	Tower of Pisa model	1	Teaching guide
1	Metallic pulleys	1	Decomposable metal rod		

Box

Teaching guide included

HIGH SCHOOL

S81 Dynamics Advanced

FEASIBLE EXPERIMENTS: 22

Topics

Motion
Relative motion
Reference system
Physical magnitudes that define motion type
Trajectory
Change of position
Instruments to study motion
Average speed
Instant speed
Average acceleration
Instant acceleration
Types of motion
Uniform rectilinear motion
Uniformly accelerated motion
Inertia principle
Fundamental law of dynamics
Friction force
How to verify second law of dynamics
Energy conservation
Free fall motion
Periodic motion
Simple pendulum
Gravity acceleration
Spring properties
Elastic pendulum

Uniform rectilinear motion

Thanks to this kit you can study all concerning motion using a rail that guarantees you low friction; you can measure time using a simple times and two photogates.

Simple pendulum

Supplied materials

Items

1	Rod with hook	1	Truck
1	Rope	1	Pair of balls for pendulum
1	Linear ruler	1	Cylinder with hook (5g)
2	Boss head	1	Cylinder with hook (8g)
9	Slotted metal disk (10g each)	1	Slotted masses holder (20g)
1	Metal rod 75cm	1	Wooden block
1	Rectangular base for rod	1	Rod with pulley
1	Goniometer	1	Screwdriver
1	Spring	1	Box
1	Kit to measure time	1	Teaching guide
1	Rail		

Box

Teaching guide included

HIGH SCHOOL

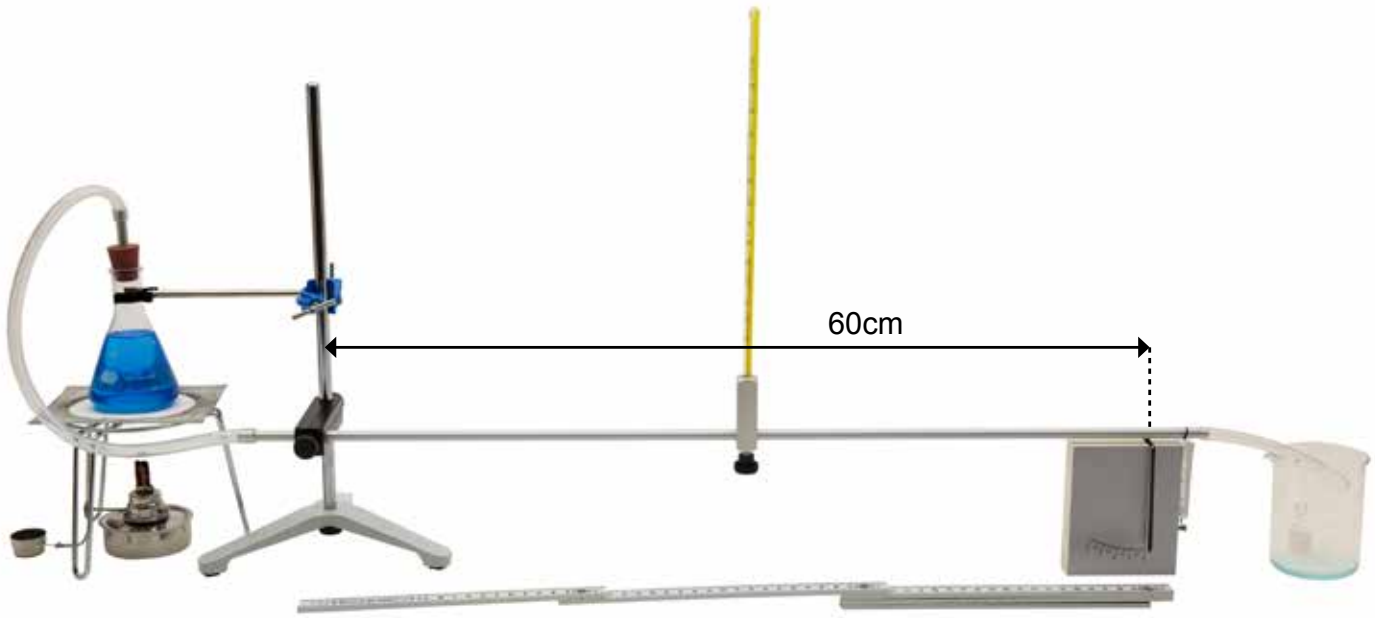
S82 Thermodynamics Advanced

FEASIBLE EXPERIMENTS: 27

Topics

Thermal sensations
The thermoscope
The thermometer
Thermal scales
Molecules thermal excitement
Linear thermal expansion
The coefficient of thermal expansion
Bimetallic strips
Volumetric thermal expansion
Thermal expansion in liquids
Thermal expansion in gaseous bodies
Thermal energy
How to raise the temperature of a body
A further way to raise temperature
Heat
The relation between heat and temperature
Thermal equilibrium
The equivalent in water of the calorimeter
How to measure the specific heat of a solid
Heat propagation by conduction
Heat propagation by convection
Radiation
Changes of state
Melting
Vaporisation
Vapour condensation

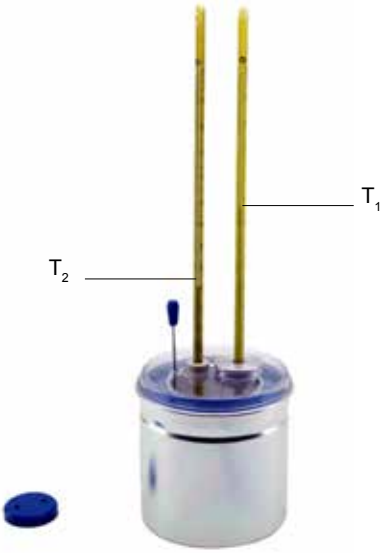
How to measure linear thermal coefficient



Of fundamental importance is the study of thermal phenomena. The experiences proposed in this unit provide explanation of phenomena which students often take for granted in everyday life.

In particular, to help them overcome learning difficulties deriving from conflict between the spontaneous representations of the phenomena and their scientific interpretation.

How to measure a solid's specific heat



Supplied materials

Items

1	Rod with small clip	1	Methylene blue powder
1	String	1	Linear dilatometer
1	Stopper with glass tube	1	Stopper with tube
1	Stopper with curved glass tube	1	Thermal conduction apparatus
1	Double boss head	1	Tripod tripod base with rod
1	Bottle of denaturated alcohol	1	Rod with medium size clip
1	Folding ruler	1	Sheet of filter paper
1	Rubber stopper with hole	1	Wooden peg
1	Tripod support for burner	1	Mohr clamp
5	Rubber rings	1	Wire gauze
1	Dropper	1	100 ml graduated cylinder
1	Bimetallic strip	1	Thermoscope
1	Alcohol burner	1	Thermometer
1	Ball and ring apparatus	2	250 ml beaker
1	Magnifying glass	1	400 ml beaker
2	30 cm cables	1	100 ml Erlenmeyer flask
1	Electric calorimeter with thermometer	1	Watch glass
1	Stirrer	1	Test tube
1	Tongs	1	Box
1	Aluminium sample	1	Didactic guide

Box

Teaching guide included

HIGH SCHOOL

S83 Geometrical optics — Advanced

FEASIBLE EXPERIMENTS: 27

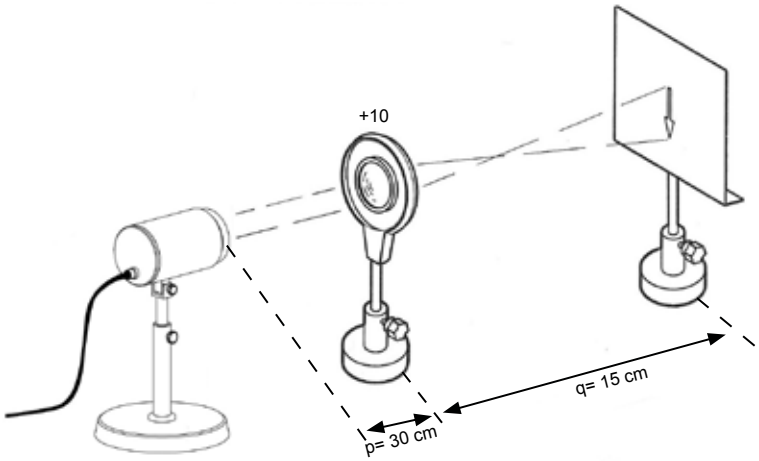
Topics

Optical projector
Rectilinear propagation of light
Eclipses
Moon phases
Illumination laws
Light scattering
Light reflection
Reflection of light in spherical mirrors
Refraction of light
Total internal reflection
Decomposition of white light
Lenses
Images formed by reflection in plane mirrors
Images formed by spherical mirrors
Conjugate points in spherical mirrors
Images created by converging lenses
Images created by diverging lenses
Conjugate points in converging lenses
Eye and defects of vision
Correction of defects of vision
Compound microscope
Slide projector

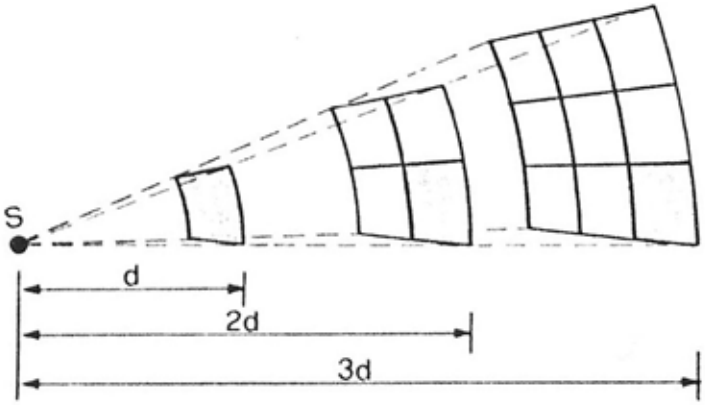
The comprehension of phenomena concerning light requires a long, complex and interdisciplinary journey that needs an in-depth experimental study.

The experiences proposed in this unit provide an explanation to these phenomena which, in particular, relate to that part of physics commonly defined as geometrical optics, because it is closer to everyday life.

Images created by lenses



Illumination law



Supplied materials

Items

1	Linear ruler	1	Lens +10 and lens holder
1	Red filter	1	Lens +20 and lens holder
1	Green filter	1	Lens -10 and lens holder
1	Violet filter	1	Support stand for projector
1	Semitransparent Glass	1	Filter holder
1	Slide	3	Conical small bases
1	Half-circle made of methacrylate	1	White screen
1	Diaphragm with square slit	1	18 mm diam. sphere with stem
1	Plane mirror	1	Goniometer
1	Small plane mirror	1	10 mm diam. sphere with stem
1	Double specular arc	1	Double spheric mirror +10 and -10
1	Equilateral prism	1	Microscope slide with support
1	Isosceles rectangular prism	1	250 ml beaker
1	Dioptric projector 6V with power supply and 3 diaphragms	1	Box
1	6V lamp with stem	1	Teaching guide

Box

Teaching guide included

HIGH SCHOOL

S84 Wave optics — Advanced

FEASIBLE EXPERIMENTS: 16

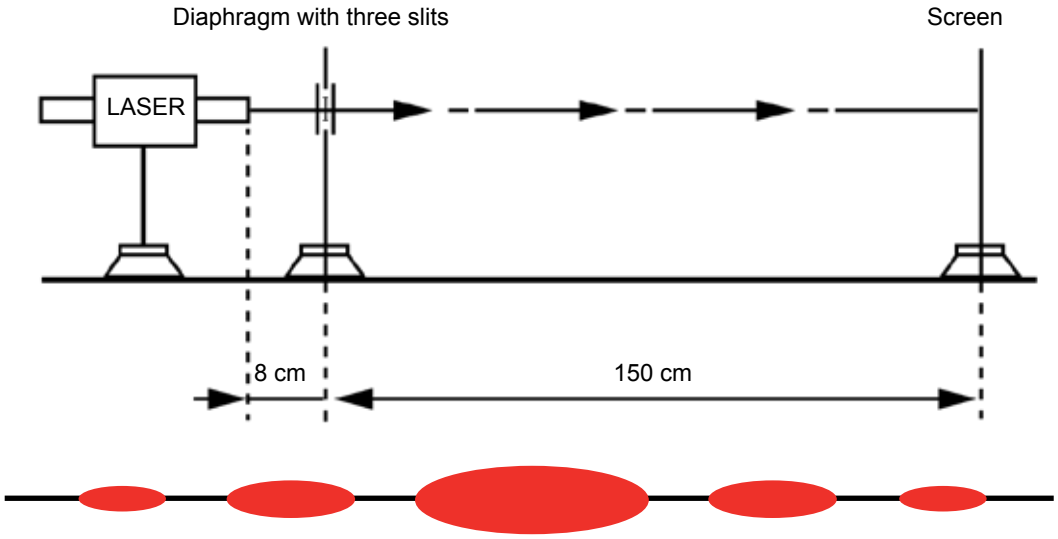
Topics

Double nature of light
Electromagnetic waves spectrum
Optical projector
Semiconductor laser
Optical waves speed
Optical source spectrum
Emission spectrum
Wave interference
Young light interference
How to measure wave length using light interference
One proof of wave nature of light
Diffraction through a slit
How to measure wave length using diffraction
Diffraction grating
How to measure wave length using diffraction grating
How to measure wave length of white light
Linear polarization
Polarizer and analyzer
Malus law

Throughout history, many scientists have tried to find a model able to describe all phenomena related to the nature of light.

The experiences proposed in this teaching unit want to bring the students' attention to the phenomena related to the dual nature of light.

How to measure laser wavelength using diffraction through a slit



How to measure wavelength of white light using diffraction grating

Supplied materials

Items

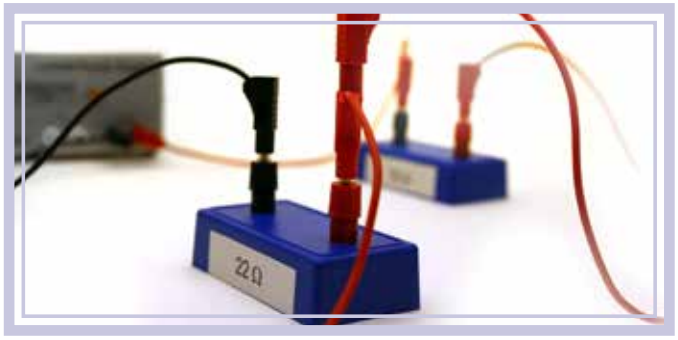
1	Linear ruler	1	Goniometer
1	Cylindric lenses	1	Optical projector
1	Optical prism	1	Pair of polarizer filters
1	Red filter	1	White screen
1	Green filter	1	Diaphragm with 9 slits
1	Violet filter	1	Diaphragm with slit
1	Semiconductor laser	1	Diffraction grating
1	Stand for projector	1	Kit for spectroscopy
2	Filter holder	1	Box
4	Supports	1	Teaching guide

Box

Teaching guide included

HIGH SCHOOL

S85 Electrodynamics Advanced



FEASIBLE EXPERIMENTS: 24

Topics

Electricity
The electrical charge
Electrical charges in matter
Conductors and insulators
The electric field
The electric field energy: electric potential
The battery
The voltmeter
The electric circuit
Electric current intensity: the ammeter
Ohm's first law
Ohm's second law
Resistivity
How to measure electric resistance
Resistors in series
The rheostat
Resistors in parallel
Electric networks
The potentiometer
Battery internal resistance
The thermal effect of electric current
Electric conduction in liquids
Electrolysis

Experiences of some phenomena concerning the movement of electric charges in conductors are proposed in this teaching unit.

In particular, experiences on the nature and on the effects produced by electric currents are proposed.

Ohm's first law

Electric conduction in liquids

Supplied materials

Items

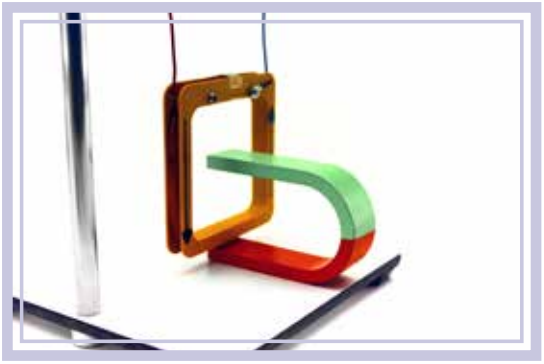
1	Rope	2	Nickel-chrome wire
1	Circular base	1	Disk with copper and brass electrodes
1	Rod with hook	1	Pair of insulators with support
1	Folding ruler	1	Two pieces of cloth
1	Plexiglas rod	1	Electric calorimeter with thermometer
2	PVC rod	1	Set of three resistors
1	Easel	1	Linear rheostat (10 ohm) with base
1	Switch	1	Battery holder
1	Lamp holder	1	Voltmeter
1	Light bulb (6V)	1	Voltmeter
4	Cable (30 cm)	1	Pair of electrodes for each battery
4	Cable (60 cm)	1	Metal rod
1	Copper sulfate (bottle)	1	Beaker (250 ml);
1	Bottle of distilled water	1	Teaching Guide
1	Black alligator clip	1	Box
1	Red alligator clip		

Box

Teaching guide included

HIGH SCHOOL

S86 Electromagnetism Advanced



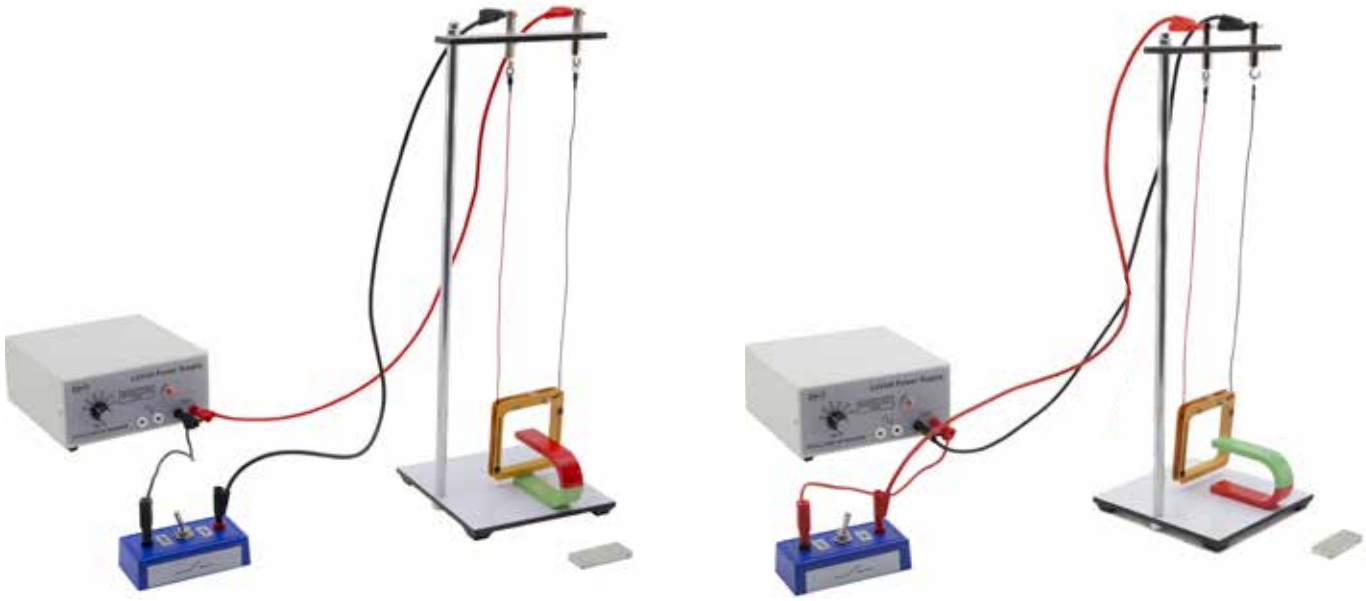
FEASIBLE EXPERIMENTS: 23

Topics

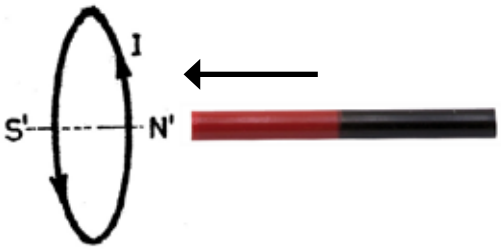
Magnets
Magnetic materials
Magnetic poles
Magnetic levitation
Magnetic induction
The magnetic field
The flux lines of the magnetic field
The magnetic field vector
Lorentz force
The earth's magnetic field
The magnetic effect of electric current
When the conductor is a bar
When the conductor is a loop
Electromagnets
Electric bells
Direct current electric motors
Ampère's theory on magnetism
Electromagnetic induction
The magnetic flux
Neumann's law
Lenz's law
The law of electromagnetic induction

Experiences concerning magnetic phenomena and the relationship between an electric current and a magnetic field are proposed in this teaching unit. In particular, experiences on the effects produced by an electric current and on the transformation of electric energy in other forms of energy, are proposed.

Solenoid magnetic field



How to verify Lenz law



Supplied materials

Items

1	Switch	1	Galvanometer
4	60 cm cables	1	Cylindrical rare earth magnet
1	Bar magnet	1	Pack of waste filings of iron
1	Electric bell	1	Stand with 2 floating magnetic rings
1	Compass	1	Set of nails
1	Apparatus for electromagnetic actions	1	Coil support
1	Primary and secondary coils with core	1	Compass support
1	Electric motor	1	Plastic teaspoon
1	Lentz's law demonstrator	1	Test tube
1	Magnetic needle on stand	1	Didactic guide
1	Horseshoe magnet	1	Box
1	Magnetic field demonstration plate		

Box

Teaching guide included

HIGH SCHOOL

S87 Electrostatics — Advanced

FEASIBLE EXPERIMENTS: 18

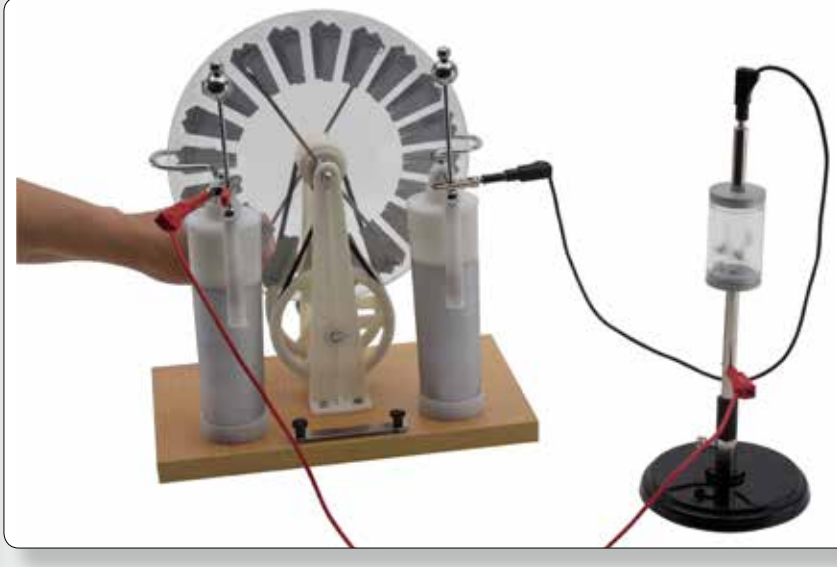
Topics

Electrification
Protons ed electrons
Electric forces
Electrostatic induction
The pith-ball electroscope
Conductors and insulators
The gold leaf electroscope
How to determine the sign of an electric charge
The sign of an electric charge
The wimshurst machine
Flashes and lightnings
The electric field
How to reveal the existence of electric fields
The power of points
The electric whirl
The dancing beads
The electrostatic plume
Franklin's electrostatic engine

The environment in which each form of life evolves is a huge magnetic field.
The simple phenomena that can be realised with the materials provided in this teaching unit, highlight that static electricity is always around us.

Electric field

Balls dance



Supplied materials

Items

1	Rope	1	Universal support
1	Circular base	2	Tip conductor
1	Isolated support with hook	1	Electric twist
2	Balloons	1	Balls dance apparatus
5	Candles	1	Pair of balls
1	Candle holder	1	Electroscope
1	Plexiglass rod	1	Two pieces of fabric
2	PVC rod	1	Electrostatic motor
1	Support	1	Rod with hook and polystyrene ball
2	60cm lead	1	Metal rod
1	Aluminum foil	1	Box
2	Alligator clip	1	Teaching guide
1	Wimshurst machine		

Box

Teaching guide included

HIGH SCHOOL

S88 Electromagnetic induction and alternating current — Advanced

FEASIBLE EXPERIMENTS: 18

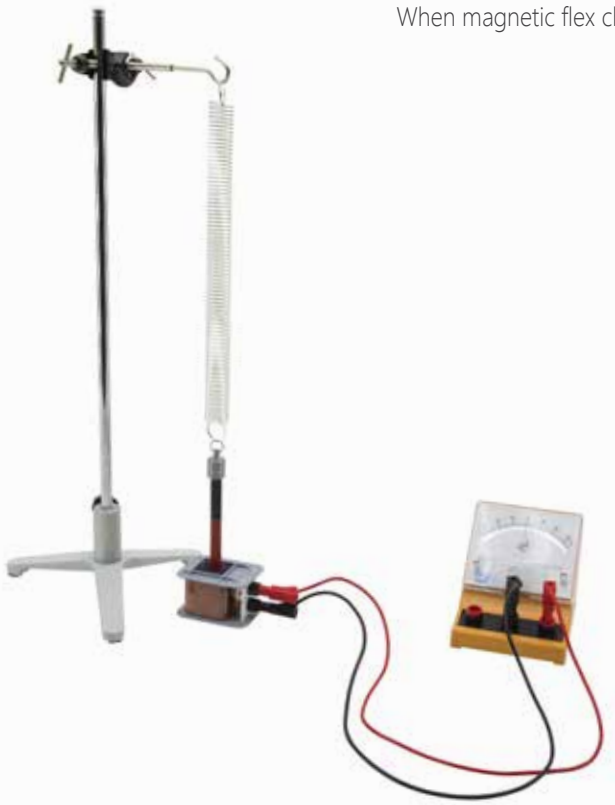
Topics

Faraday's experiments with permanent magnets
Faraday's experiments with electromagnets
The magnetic flux
Neumann's law
Lenz's law
The law of electromagnetic induction
When a magnetic flux varies according to the sinusoidal law
Alternating currents
The properties of alternating currents and the rms value
Devices to measure alternating current
The transformer
The efficiency of a transformer
Self-induction
Self-induction and alternating current
Impedance
Inductive reactance

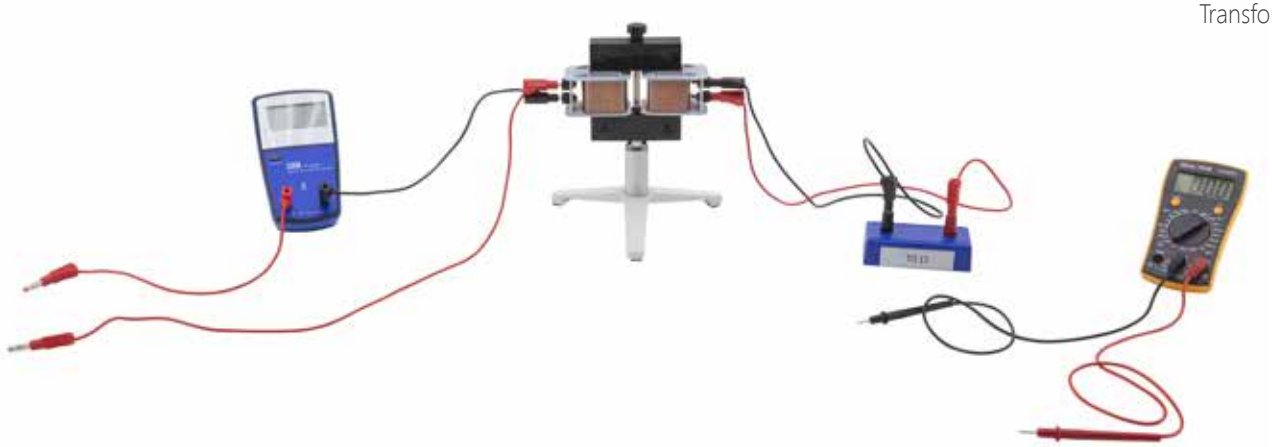
The most important technic application of electromagnetic induction is the production of alternating currents.

Using the materials into this kit you can make a careful study of this phenomenon and verify its laws.

When magnetic flex changes



Transformer efficiency



Supplied materials

Items

1	Metallic rode	1	Digital multimeter
1	Rode with hook	1	Lenz's law apparatus
1	Tripod base	1	Coil 400 turn
1	Boss-head	1	Coil 1600 turn
1	Switch on base	1	AC Digital ammeter
1	Lamp holder	1	Galvanometer
1	Lamp 6V	1	Magnet support
2	Leads 30 cm	1	Alternator model
4	Leads 60 cm	1	10 Ω resistor
1	Linear magnet	1	Spring
1	Support for transformer	1	Teaching guide
1	Rode for transformer	1	Box

Box

Teaching guide included

HIGH SCHOOL

INSTRUMENTS

1354 Rod for levers with stand

Supplied with tripod stand, metal rod, pivot and boss-head, a series of mass discs 1309 (9x10g), and a series of mass discs 1310 (9, 20g).

1032 Equilibrium forces composition device

The equilibrium forces composition device allows the examination of the physics laws of concurrent forces composition - the parallelogram's law and the parallel forces law.
The equilibrium forces composition device is supplied with a protractor, 8 masses of 10 g and 8 masses of 25 g.
Dimensions 45x17x60 cm.

1341 Levers and pulleys experiment kit

12 experiments

CONTENTS
The spring scale
How to measure a weight or a force
Let's learn how to use forces in a wise way
Equilibrium of a rod pivoted on its centre
Simple machines
Levers
The fixed pulley
The mobile pulley
The simple block and tackle
Couple pulleys in paralel
Couple pulleys in series

SUPPLIED EQUIPMENT

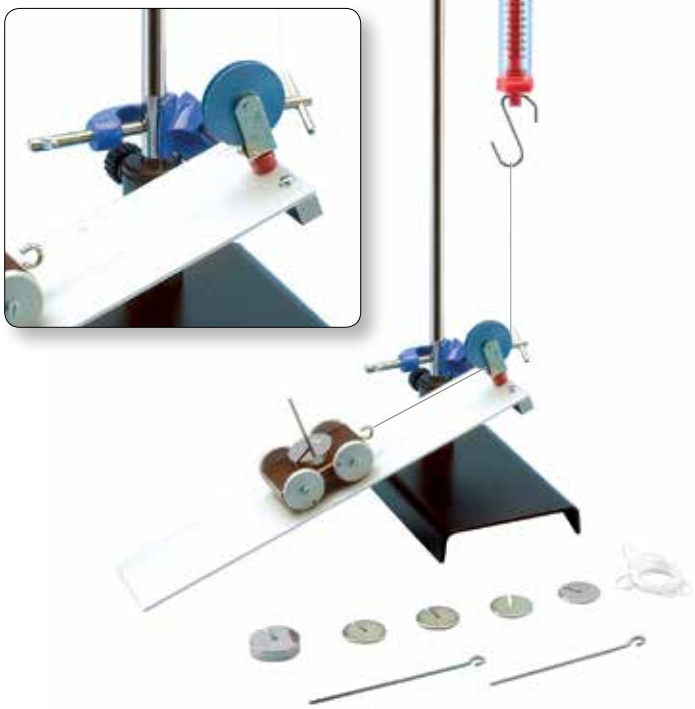
1 Base with rod
1 Rod with hook
1 Boss-head
1 Perforated rod with pivot
1 Spring scale
10 50 g Weights with 2 hooks
2 Simple pulleys
2 Couple pulleys in parallel
2 Couple pulleys in series
1 String
3 Lens holders
1 Experiment Guide
1 Case

1171 Inclined plane

The Inclined plane apparatus shows the physics laws of equilibrium forces in an easy and clear way.

SUPPLIED EQUIPMENT

1 Metal inclined plane
1 Low friction trolley
1 Spring scale
2 50 g Masses
4 10 g Masses
1 Linear ruler
1 Stand



1169 Momenta apparatus

The Momenta apparatus demonstrates the equilibrium of forces in rotational movements. The Momenta apparatus is composed of an aluminium disk rotating around a central pivot.
Different weights can be attached to the disk in different positions.
Since the arm of every weight can be measured directly on the ruler, it is possible to check that the sum of the clockwise moments is equal to the sum of the counterclockwise moments.

SUPPLIED EQUIPMENT

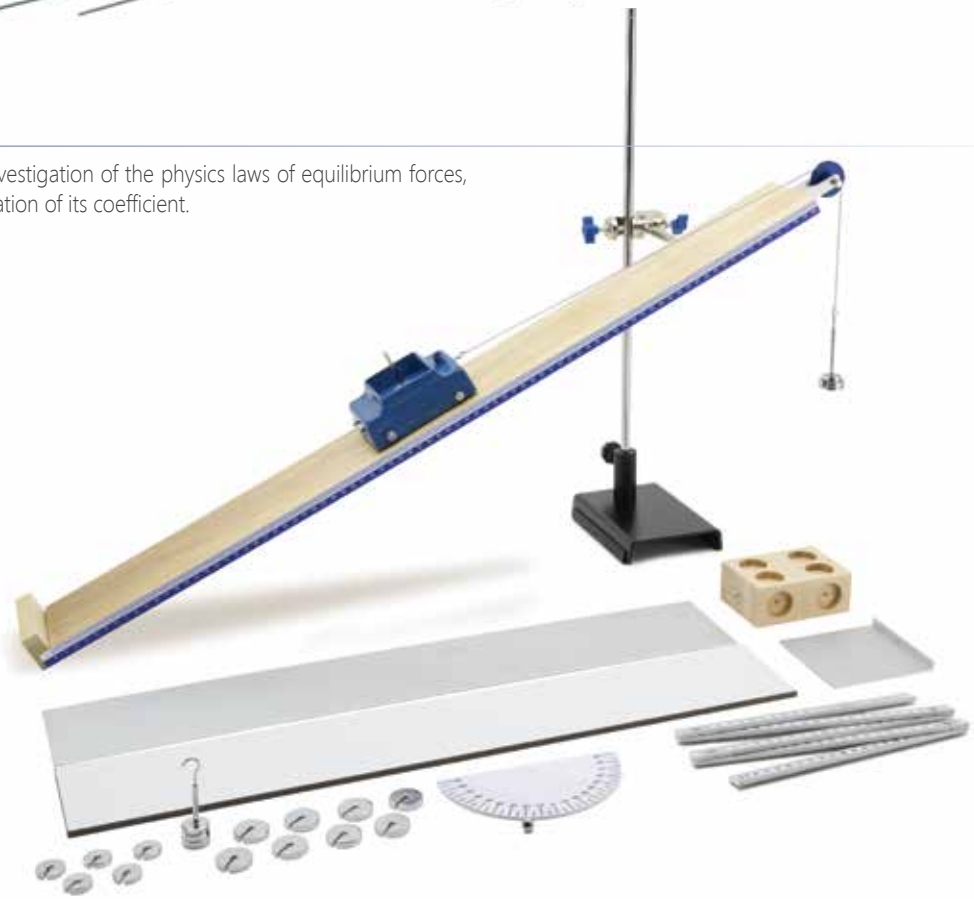
10 g weights (10 pcs);
25 g weights (10 pcs);
4 strings.
Disk's diameter: D 25 cm.

1291 Friction inclined plane

The Friction inclined plane apparatus enables investigation of the physics laws of equilibrium forces, the laws of sliding friction and also the determination of its coefficient.

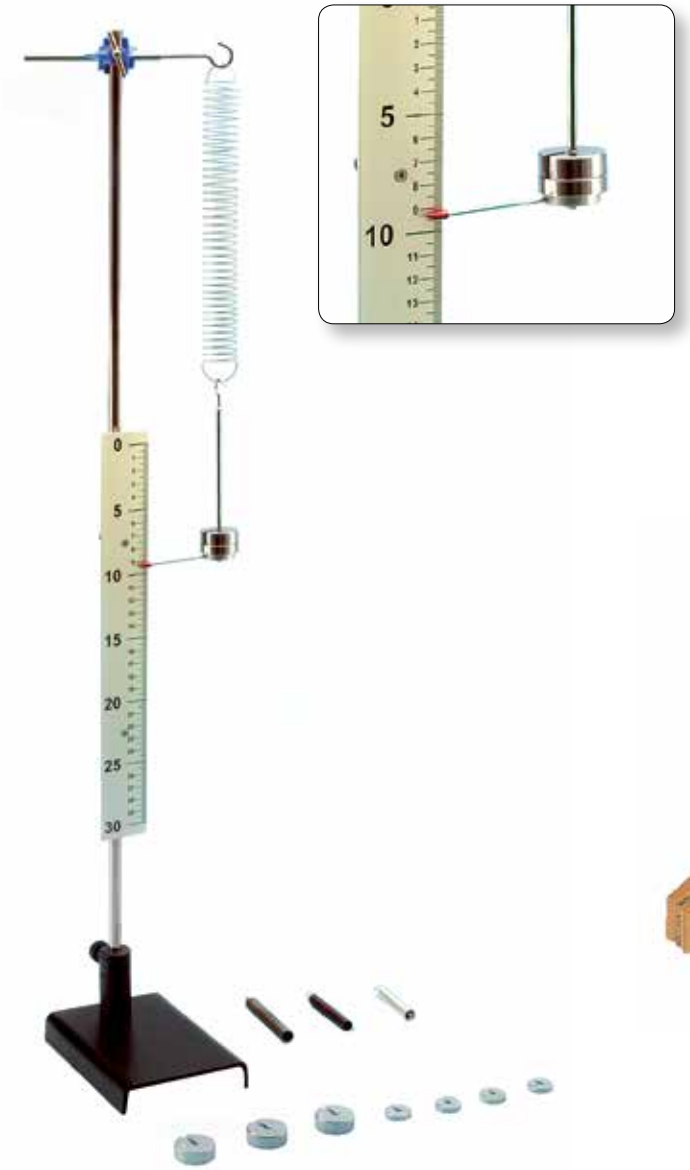
SUPPLIED EQUIPMENT

1 Wooden plane
1 Masonite plate
1 Aluminium block
1 Tin foil
1 Low friction trolley
1 Series of 9 20g masses + 20g hanger
4 50g Slotted masses
1 Inclination protractor
Plane dimensions: 800 x 100mm.



1111 Hooke's law apparatus

The Hooke's law apparatus can demonstrate the laws of equilibrium.
The apparatus allows you to verify that, within specific limits, the lengthening of a spring is proportional to the intensity of the applied force.
The graduated scale has 1 mm divisions and the perfectly balanced weight-holder has an index which can rotate to esnure perfect allignment with the graduated scale. The Hooke's law apparatus is supplied with four 50 g masses, four 10g masses and four different springs.
Height: 82 cm.



1078 Device for the demonstration of equilibrium

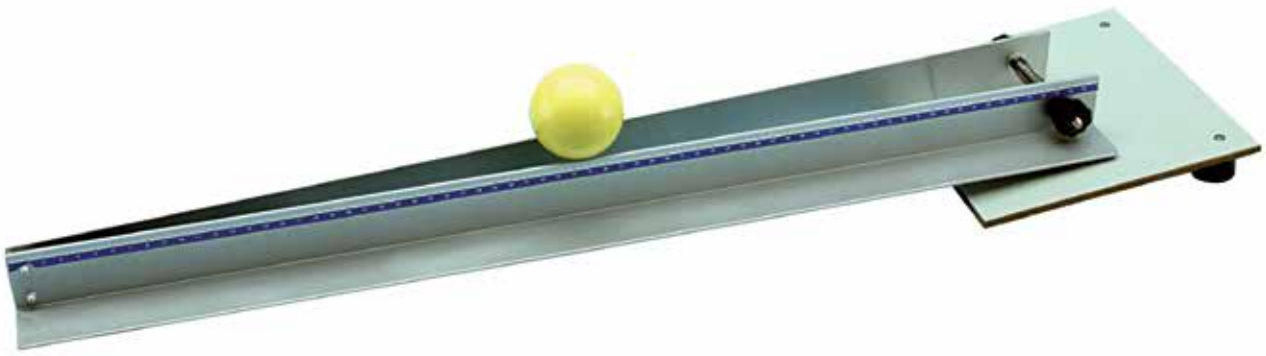
The equilibrium forces of physics can be demonstrated by moving the two lateral masses in this device. The center of gravity of the system can be moved to different positions, demonstrating how the equilibrium depends on the position of the center of gravity in respect to the basement point.
Dimensions: 20x28 cm.

1079 Mechanical paradox

As the cylinder goes down the inclined plane, the double cone goes up, apparently contravening the laws of mechanics.
In reality the center of gravity of both moving bodies goes down.
Made entirely of wood.
Length of the inclined plane: 50 cm.
Dimensions of the double cone: 35 cm.
Dimensions of the cylinder: 35 cm.

1401 Does it go up or down?

A sphere moves spontaneously along a horizontal variable-gauge rail, and it always moves in the same direction. Which direction? And why? If the rail is inclined, the sphere doesn't always roll in the same direction. Why?
The explanation of these phenomena lies in the study of the position of the sphere's centre of gravity; a good amount of physics with such a simple device.



1123 Equilibrium forces, momenta and machines

Set for experiments of solid statics:

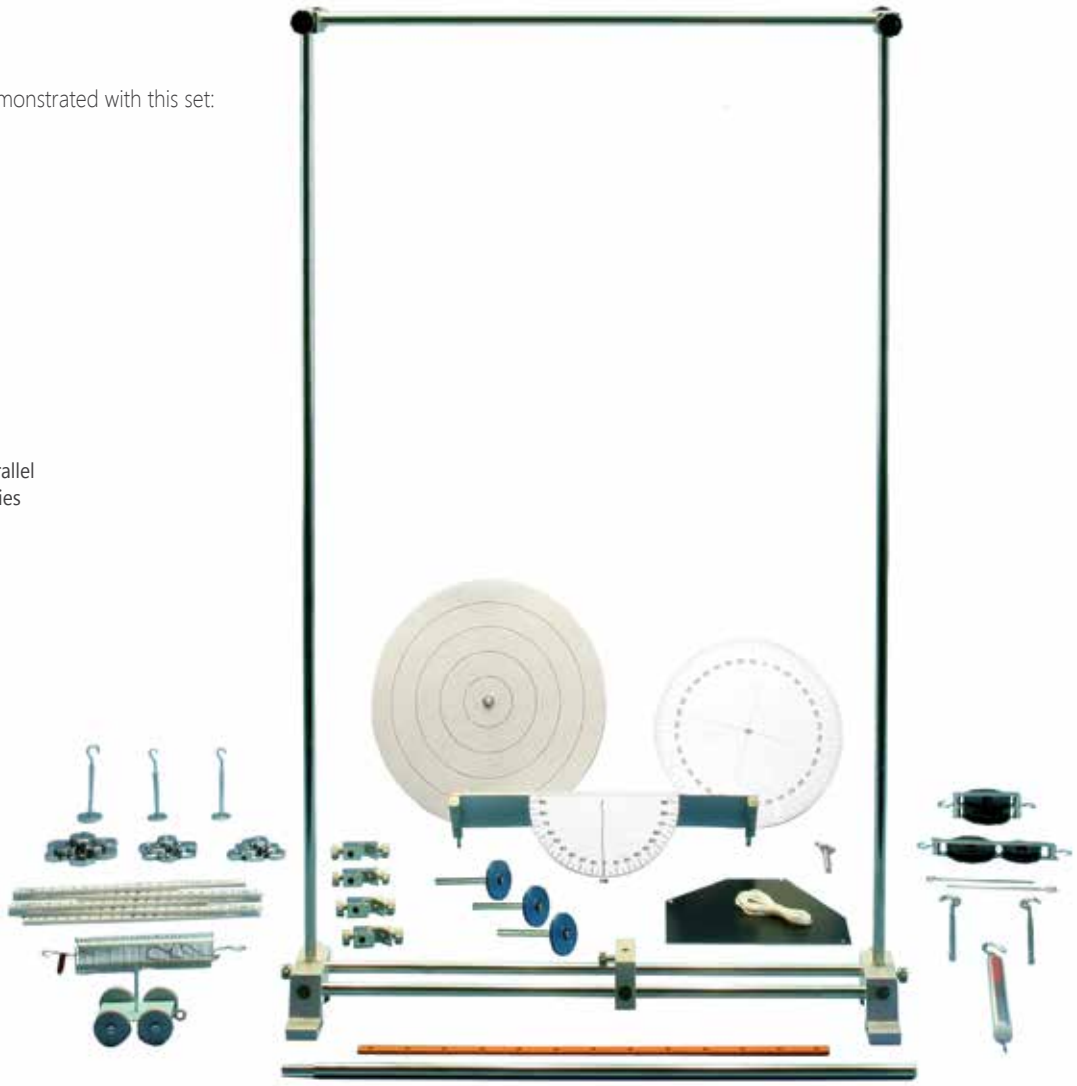
15 EXPERIMENTS

Equilibrium forces experiments that can be demonstrated with this set:

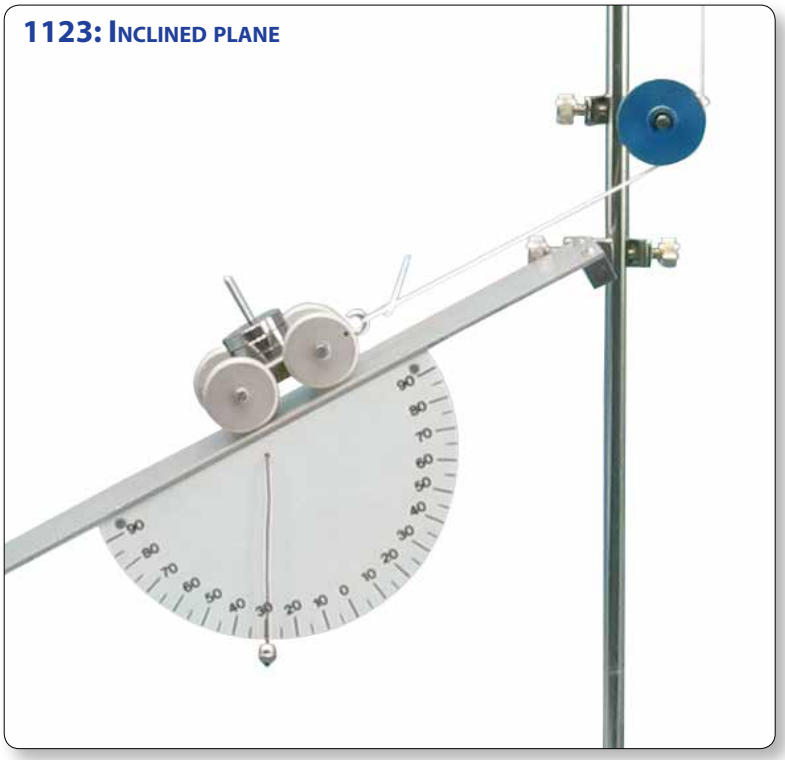
Composition of concurrent forces
Decomposition of a force
Composition of paralel concording forces
Composition of paralel discording forces
The center of gravity
Hooke's law
Equilibrium of a bar
Equilibrium of moments
Levers
Fixed pulley
Mobile pulley
Simple block and tackle
Block and tackle with two couple of pulleys in parallel
Block and tackle with two couple of pulleys in series
Inclined plane

SUPPLIED EQUIPMENT

1 Frame
4 Bossheads D6mm
3 Fixed pulleys
1 Spring scale
1 Rod for levers with pivot
2 Rods with hook
2 Series of masses10 g
1 Series of masses 20 g
1 Protractor
1 Metal sheet for center of gravity
3 Boss-heads D10mm
1 Mobile pulley
2 'S' shaped hooks
1 Coil with index
1 Moments' disk
1 Linear ruler
1 Square
1 Inclined plane with protractor
1 Friction trolley
2 Couple of pulleys in series
2 Couple of pulley in paralel
2 Skeins of cord
1 Case



1123: INCLINED PLANE



1328 Experiments set for magnetic board

For the performance of statics experiments visible at distance, easy and quick to perform on a magnetic board (sold separately).

CONTENTS

Composition of concurrent forces
Composition of parallel forces
Decomposition of a force
Elastic forces
Hooke's law
The centre of gravity
Equilibrium of a pivoted rod
Equilibrium of moments
Levers
The inclined plane
The grazing friction
Pulleys
Pulleys in parallel
Pulleys in series
Combinations of simple machines

20 EXPERIMENTS

SUPPLIED EQUIPMENT

4 Magnetic anchors
3 Rods with hook
2 Mobile pulleys
2 Series of weights 10 g with hanger
2 Cylindrical masses 50 g
1 Rod for levers with pivot
1 Spring with index
1 Moments' disk
2 Couples of pulleys in series
1 Wooden block
2 Strings
1 'S' shaped hook
1 200 g Spring scale
2 Fixed pulleys
1 Protractor 360 degrees
1 Series of weights 20 g with hanger
1 Metal sheet for center of gravity
2 Triple pulleys in series
1 Linear ruler
1 Spring scale boss-head
1 Inclined plane with protractor
1 Friction trolley
2 Couples of pulleys in parallel
1 Experiment Guide
1 Case

1329 MAGNETIC BOARD WITH STAND

1329 Magnetic board with stand

Optika precision spring scales

Tractive working.
Transparent plastic made with engraved graduated scale.
Protection against overload and possibility to set to zero.

- **1193.1** Linear, capacity 1N, division 0.01N.
- **1256.1** Linear, capacity 2N, division 0.02N.
- **1257.1** Linear, capacity 5N, division 0.05N.
- **1258.1** Linear, capacity 10N, division 0.1N.
- **1259.1** Linear, capacity 20N, division 0.2N.

1434 Low friction track

Every movement is influenced by the phases of friction that you have the ability to reduce but not cancel. With low friction track you can experiment on the kinematics and on the dynamics of traslational motion in reality.

SUPPLIED EQUIPMENT

1 Cord
1 Folding ruler
1 Set of 9 discs (10 g each) with plate
1 Time measuring kit
1 Track
1 Truck
1 5 g cylinder with hook
1 8 g cylinder with hook
1 Wooden block
1 Pulley with rod
1 Screwdriver
1 Didactic guide
1 Box

CONTENTS

Motion
Motion is relative
Reference systems
Physical quantities defining motion
Trajectory
Displacement
The instruments for the experimental study of motion
Average velocity
Instantaneous velocity
Average acceleration
Instantaneous acceleration
Different types of motion
Uniform rectilinear motion
Uniformly accelerated rectilinear motion
The principle of inertia
The fundamental law of dynamics
Frictional force

Set for experiments on solid statics.
15 EXPERIMENTS

5586 Air-track 150cm

5587 Air-track 200cm

This set has been designed to allow teachers to perform, on demonstrative purpose, a series of experiments on linear motion kinematics and dynamics, and on isolated systems.
The track has triangular section and it is very sturdy in order to avoid every possible deformation caused by temperature variation.

CONTENTS

Set up and balancing the apparatus
The timer
The releasing device
The photogates
Linear uniform motion
Uniformly accelerated motion
The dynamic fundamental law
Isolated systems
The conservation principle of motion quantity
The principle of energy conservation
Elastic bumps
Elastic oscillations
Falling bodies

SUPPLIED EQUIPMENT

1 150/200 cm track with supports
2 Nylon string
3 Bossheads
1 Metallic rod 12x1200 mm
1 Folding ruler
1 Table clamp
1 Air compressor
1 Folder for sand
2 Photogates for the air track and cables
1 Hook for recovery of the string from the pulley
1 Timer with photogates for falling bodies and cables
1 Electromagnet for falling bodies
2 Support disks for track
4 Drop disks
3 Spring buffer
6 Fixing thumbscrew
1 Couple of springs
4 U-shaped spring holder
1 Iron core for release system
2 Steel wires for cleaning holes
2 Steel balls
1 Plumb line
2 Gliders
1 Elastic buffer
1 Weight holder of 5g
1 Series of 4 weights of 5g
2 5 mm darkening foil
2 40 mm darkening foil
2 60 mm darkening foil
1 Couple of velcro shock absorbers
Weights 12,5 g: 2 pcs. for 5586 / 4 pcs. for 5587
Weights 25 g: 2 pcs. for 5586 / 4 pcs. for 5587
1 Screwdriver
1 Cotton string
1 Electromagnet for rail
1 Didactic guide
1 Box

1109 Small manual rotating machine

This manual rotating machine is made of a metal sheet plane with dimensions 40x30 cm.
The rotating machine is equipped with a metallic spindle for shafts with 6mm diameter.

1093 Watt's regulator

It represents the model of a centrifugal regulator. During the rotation , two masses move away and, therefore, press the spring. To be used with a rotary machine (1109).

BASE NOT INCLUDED

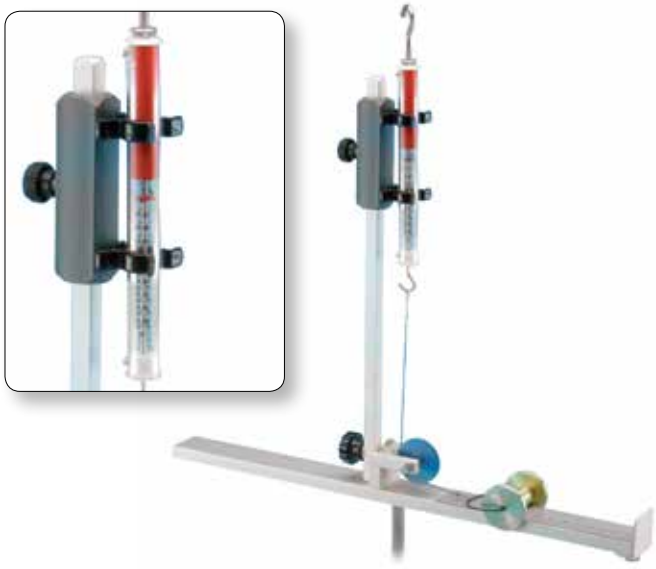
1081 Centrifugal force device

This Centrifugal Force device shows how when the device rotates, the centrifugal force presses the screw.
The compression is directly proportionate to the angular speed of the system and to the mass of the rotating cylinder.
The device must be used with a rotation machine.

BASE NOT INCLUDED

1135 Device for measuring the centrifugal force

The Centrifugal force measuring device is composed of a track where a low friction cart can run.
By rotating the device with the rotary machine, it is possible to read the value of the centrifugal force on the spring scale placed on the rotation axis.
Moreover, it is possible to verify the centrifugal force formula too, knowing the radius.
The device must be used with a rotary machine capable of measuring the frequency



1092 Coaxial cylinders

This Coaxial cylinders device allows to verify some important aspects related to the centrifugal force in a simple way. Since the mass of one cylinder is twice the other cylinder's mass, during the rotation the equilibrium is reached when the distances between each center of gravity and the center of rotation are inversely proportional to the masses.
To be used with rotary machine.

BASE NOT INCLUDED

1094 Elastic rings

They show that the centrifugal force increases as the distance from the rotation centre increases. During the use their shape becomes elliptical.
The device must be used with a rotation machine.

BASE NOT INCLUDED

1429 Rotational dynamics

Our apparatus consists of a variable binary gauge: the distance between the two sides of the binary gauge can be varied at its centre by means of a screw activated by an external knob.
The binary gauge is made of iron to prevent the ball's weight (a billiard ball) from deforming the system's geometry and affecting the results. A base to be positioned on the binary gauge and a level ensure the perfect horizontal position of the binary gauge. During the motion, the kinetic energy continuously transforms into rotational kinetic energy, creating curious effects, which can be explained with a detailed analysis of the centre of gravity position.

CONTENTS
Dynamics of roto-translational motion
Relationship between gauge and speed of translation
Transformation of translational mechanical energy into rotational mechanical energy and vice-versa
Research of the point of maximum translational speed
Centrifuge model
Newton's disk
Savart's siren

SUPPLIED EQUIPMENT

1 Iron variable gauge guide with supporting pins
2 PVC supporting bases
1 Billiard ball
1 board
1 Level

5617 Rotational motion kit

This apparatus allows experiments that show the effect of the centrifugal force and angular velocity.

7 EXPERIMENTS

CONTENTS
Two masses device
Two elastic rings device
Centrifuge with inclined test-tubes
Centrifuge model
Newton's disk
Savart's siren

SUPPLIED EQUIPMENT

1 Elastic rings apparatus
1 Inclined test-tube apparatus
1 Centrifuge model
1 Coaxial cylinder
1 Newton's disk
1 Hand rotary machine
1 Savart's siren
1 Experiment Guide
1 Case

8109 Apparatus for the analysis of rotational motion

With this device it is possible to perform experiments on the dynamics of rotational motion and on the moment of inertia of rotating bodies, by using a stopwatch (not included in this kit).

CONTENTS

Uniform circular motion and harmonic motion
Kinematics of rotational motion
Similarities between translatory and rotational motion
The dynamics of rotational motion
The fundamental law of rotational motion
The moment of inertia
The kinetic energy of rotational motion
Conservation of mechanical energy
How to use the distance sensor

SUPPLIED EQUIPMENT

1 Tripod base
1 Rod with chuck
1 Clamping device
1 Rod with sphere
1 Rod for balancer
1 Red mass with locking screw
1 Green mass with locking screw
1 Aluminium disc (diameter 320 mm)
1 20 g weight holder
5 10 g disc weights
5 20 g disc weights
1 Table clamp
1 Boss head
1 Rod with pulley
1 Metal rod (10x470 mm)
2 Skeins of string
2 Pins
1 Folding ruler
1 Didactic guide
1 Box

8109 : ENERGETIC BALANCE IN ROTARY MOTION

1177 Rotating platform

The rotating platform is characterised by a sturdy metal structure and a couple of conical bearings which allow it to rotate ensuring great resistance to stresses and low friction. Thanks to the didactic guide and the several accessories supplied with this collection, students will be able to carry out experiments on non inertial reference frames which otherwise would be impossible to perform. Our rotating platform is a particular and interactive instrument particularly suited to study angular momentum, moment of inertia and centrifugal force.

Platform diameter: 50 cm

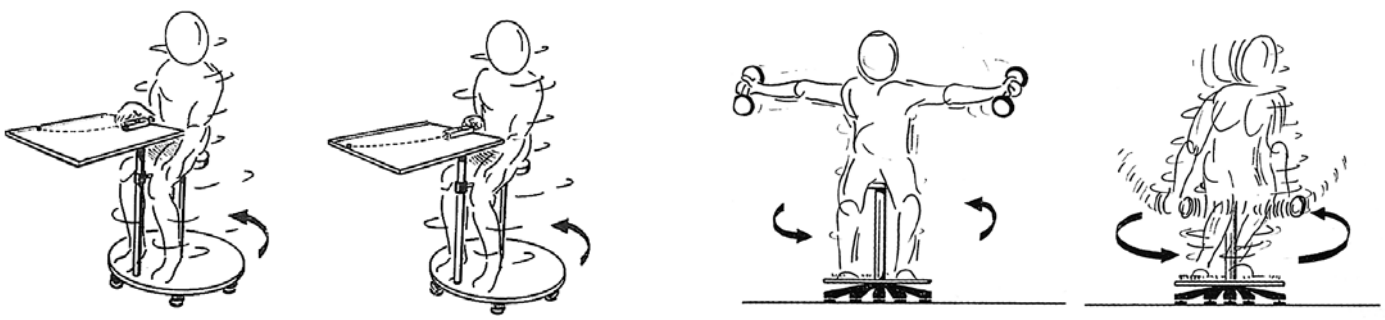
CONTENTS

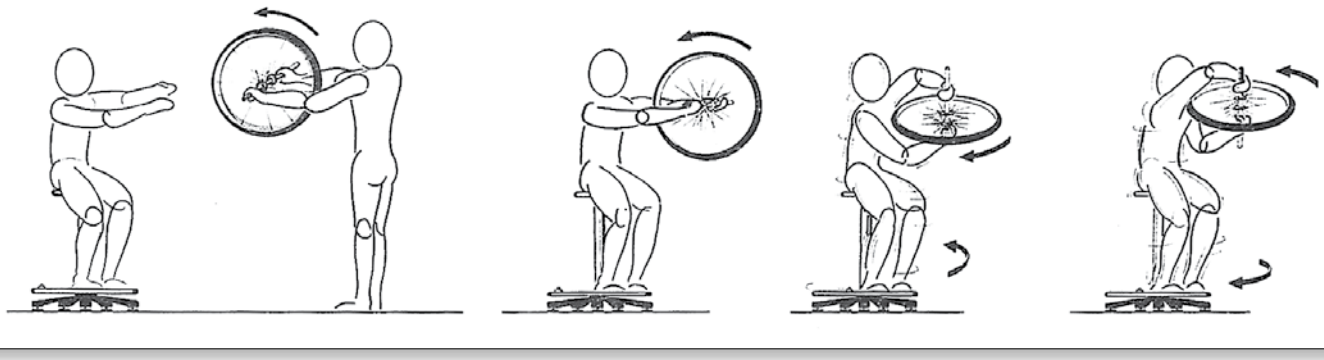
Action and reaction' principle
Preservation of the angular momentum
Non-inertial systems of uniform rotatory motion
A falling body in non-inertial systems
Centrifugal force and its effects
Measurement of the centrifugal force
Centrifugal force depending on the rotation radius.
Centrifugal force depending on the angular velocity
Corioli's force
Inertia moment

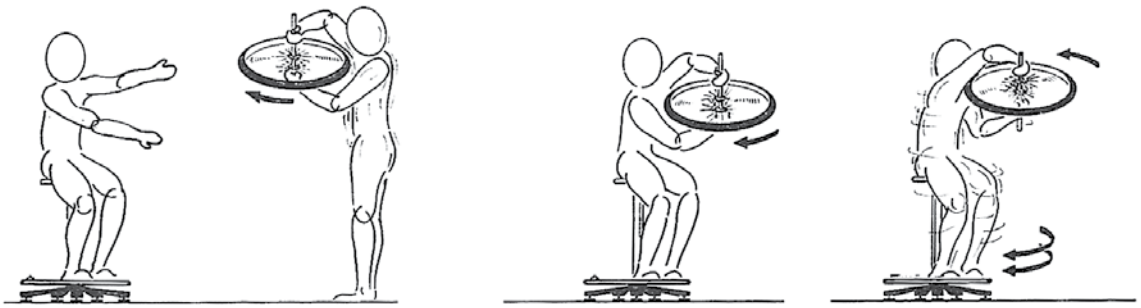
SUPPLIED EQUIPMENT

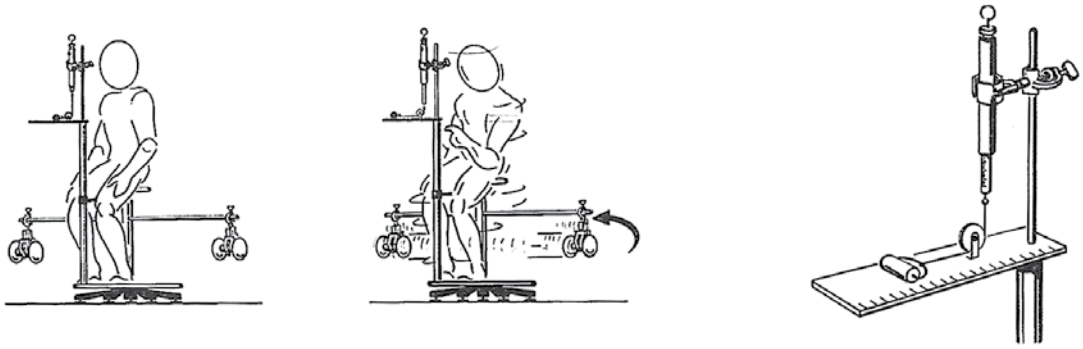
1 String
2 Spring tweezers
1 Rotating platform
1 Aluminum rod 800x35 mm
1 Ring stand for vertical tube
1 Ring stand for falling plane
1 Complete bicycle wheel
1 Plane with cannon
1 Falling plane
1 Device for measuring the centrifugal force with spring scale, pulley, roller and rod.
2 Dumbbells 4 Kg
1 Inclination protractor
1 AVP rod 1200x18 mm
1 Set of 3 steel sphere
1 Support for launch
2 Clamp for round flasks with bosshead

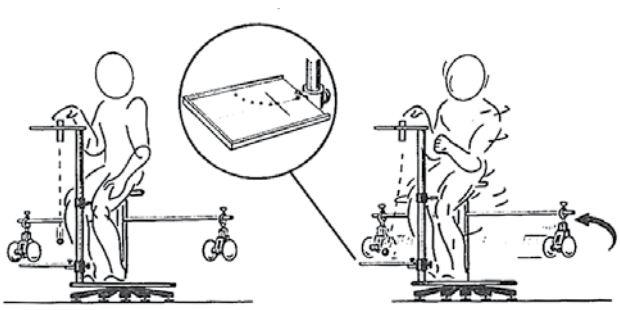
Some examples:







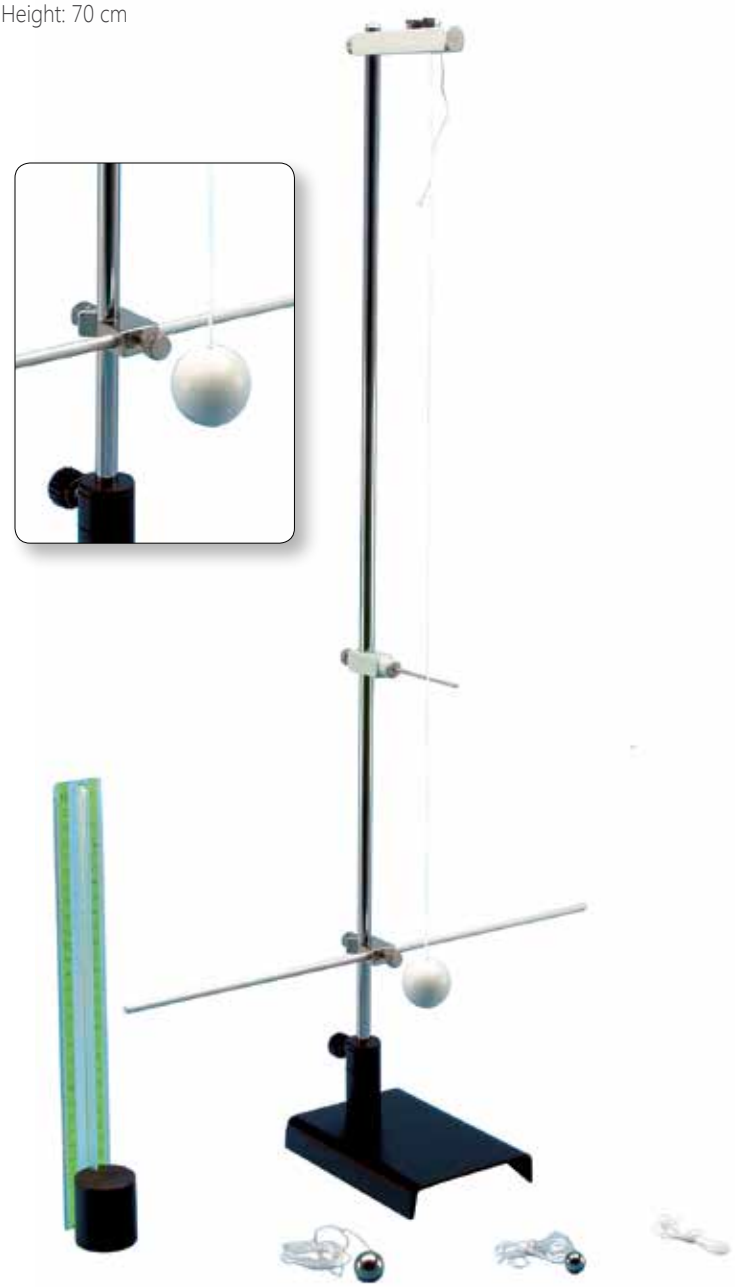




1272 Simple pendulum

This Simple Pendulum device can be used to verify the laws of simple oscillations. More specifically, it can be used to verify that initial potential energy is preserved regardeless of the trajectory (Galileo's pendulum).
The pendulum is supplied with 3 different spheres with strings.

Height: 70 cm



1350 Variable inclination pendulum

It allows you to demonstrate that the period of a simple pendulum depends only on its length and on the gravitational acceleration. The latter can be varied from 0 to g, varying the inclination of the oscillation plane. The oscillating disk is placed on a plank with air-bearing which needs to be fed by an air compressor (code 1331) purchased separately.

The measurement of the period can be done with the help of a hand timer or by the photogate (both items must be purchased separately).

1393 Wilberforce's pendulum

The Wilberforce's Pendulum demonstrates the surprising phenomenum of the pairing of torsional and longitudinal oscillation in a mass-spring system. The surprising effect is that , to a faraway observer(who doesn't notice the torsional oscillation) it looks like the vertical oscillation first slows down and eventually stops; then, without external interference, it starts growing up again as if it was under the influence of an invisible force.
It is supplied without a table boss-head, a metal rod and a boss-head.

1331 Air blower

To use with the variable inclination pendulum. it is particularly silent and, therefore, suitable for desk experiments.

5718 Low-frequency signals generator

It is a generator of precision signals, amplified in power.
It can generate sine , square and triangular waves.
The frequency of the main generator varies from 0.1 Hz to 100 KHz.
The maximum output power is 4.5 W.
Equipped with LED display mentioning the frequency and the output amplitude level.
This instrument is particularly suitable for teaching and for scientific research.

TECHNICAL FEATURES

- 4 ohm output and at 6 ohm.
- Auxiliary input for the amplifier stage.
- Frequency range: 0.001 Hz - 100 kHz with 0.01% accuracy.
- Wave shape: sine, square and triangular.
- Output power: 4W on the whole range of frequencies.
- Output width: 17V peak to peak (600ohm output),
- 8.8 V peak to peak (4ohm output)
- Output attenuator 1x / 0,1X / 0,01X (on the 600ohm output)

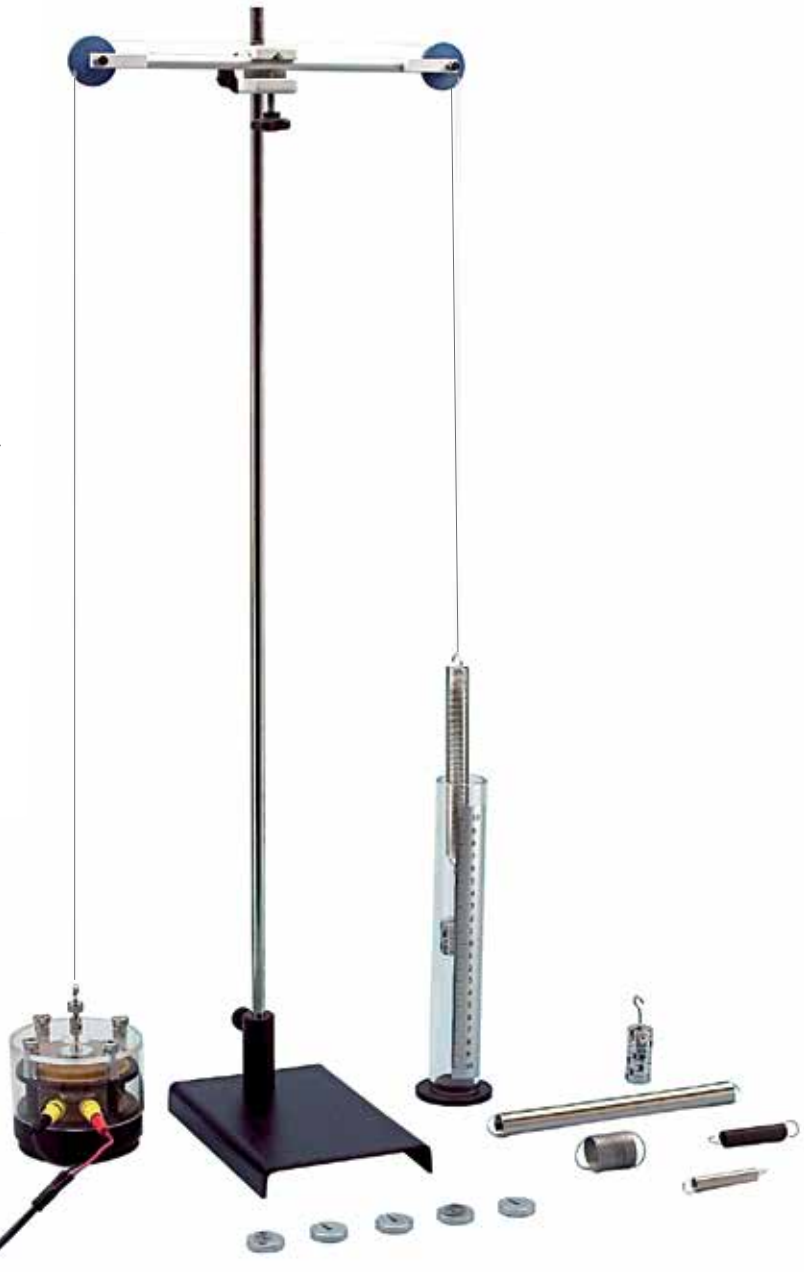
1302 Forced oscillation apparatus

This device allows the study of the phenomenon of a system's forced oscillations and lets you observe what happens under resonance conditions.

SUPPLIED EQUIPMENT

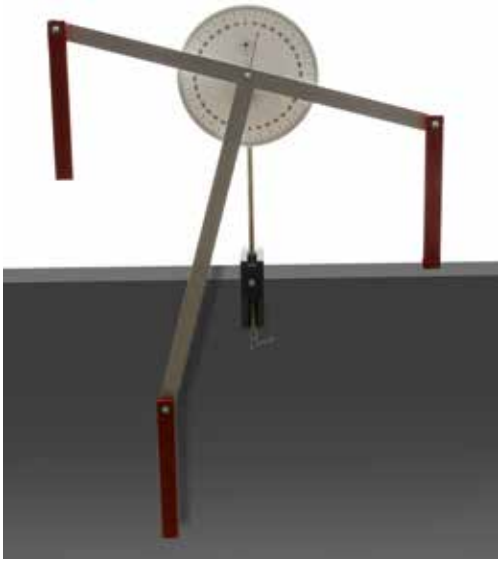
1 base for rod;
1 metal rod;
1 system of 2 low friction pulleys;
5 springs;
1 20 g series of weights;
1 boss-head;
1 graduated cylinder;
1 electromagnetic vibrator.

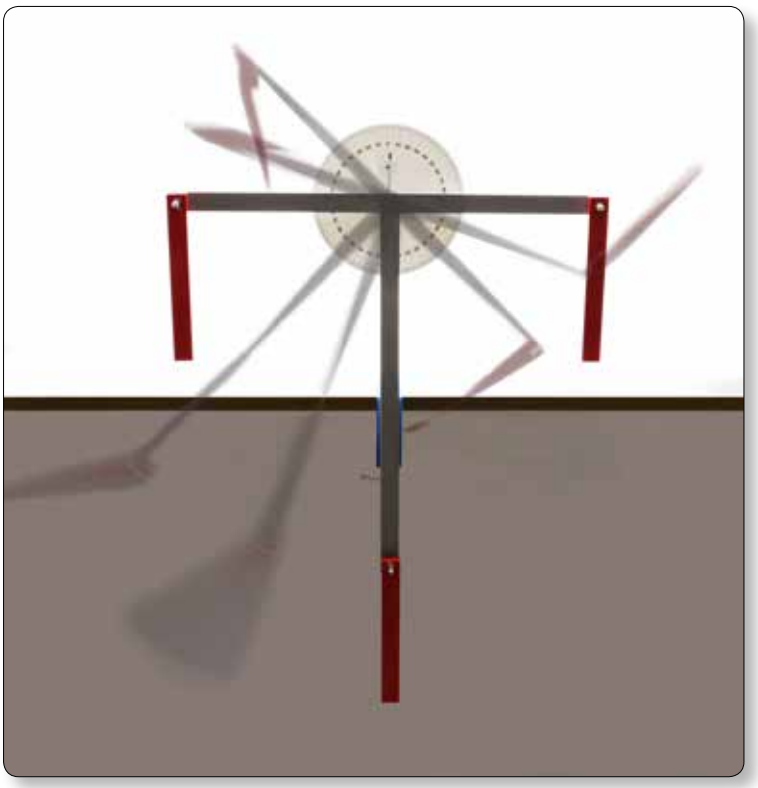
For the functioning of the vibrator we suggest using the function generator code 5718 (sold separately).



▶ 1425 Todd's Pendulum

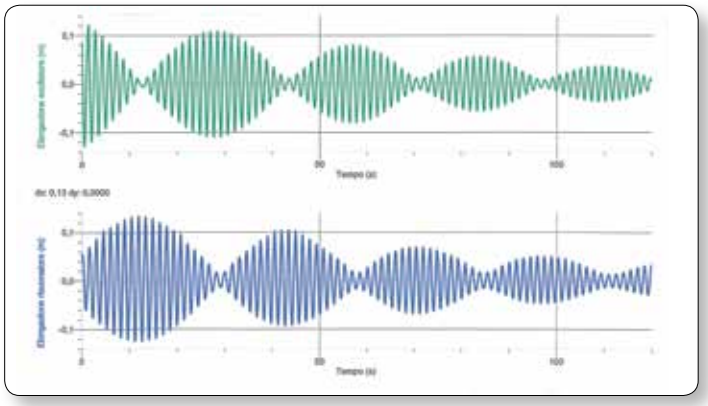
The Todd's Pendulum is composed of an aluminum T-shape frame which can rotate with minimal friction around a support. At the center of the pendulum there is a protractor for measuring the initial angle of rotation and at the three extremities of the frame are fixed three rods, able to rotate. It is easy to note that the evolution of the movement of the pendulum is very sensitive to initial conditions, as a result, once removed from the equilibrium position, begins to oscillate in a chaotic and unpredictable motion. It is useful to understand the importance of initial conditions in the so-called 'deterministic chaos'.

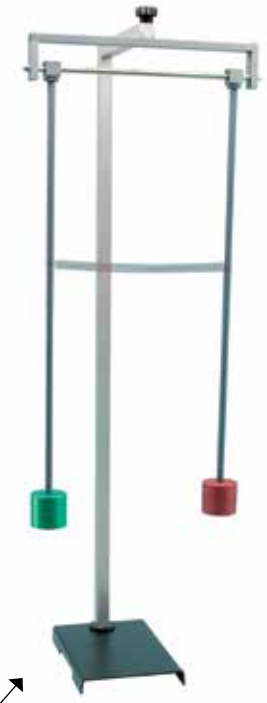




▶ 8113 Apparatus of the paired pendulums

The Apparatus of Paired Pendulums consists of two pendulums paired through a coil spring slightly stretched out. The spring allows the energy transfer between the two pendulums so it is possible to study the phenomena of resonance and beats.
The study becomes quantitative if we use two distance sensors (as shown in the diagrammes).
The Apparatus of Paired Pendulums can be used as optional equipment to the Apparatus for the study of harmonic oscillations (code 8111), or with the stand (code 0209) sold separately.





▶ 0209 Stand for apparatus of the paired pendulums

8111 Apparatus for the study of harmonic oscillations

The study of oscillatory motion of a mass hanging from a spring allows students to be introduced to the motion features of an harmonic oscillator and to be acquainted with one of the most powerful models for the physical interpretation of a wide range of phenomena.

CONTENTS

Hooke's law
Mechanics of the harmonic motion
Mass-spring oscillator
The simple pendulum
The physical pendulum
The torsion pendulum

SUPPLIED EQUIPMENT

1 Metal support with rod and upper cross-bar for pendulums
1 Kit with 4 springs and 1 elastic
1 Wooden sphere for simple pendulum, diameter 50
1 Polystyrene sphere, diameter 50
1 Polystyrene sphere, diameter 160
1 Skein of string
1 Composed pendulum
2 Metal cylinders
1 Lower cross-bar with protractor for torsion pendulum
1 Brass rod 2x600mm
1 Steel rod 2x600mm
1 Steel rod 2x300mm
1 Steel rod 2,5x600mm
1 Equalizer for torsion pendulum
1 Weight holder (Pan)
1 Reflector disk
4 10g weights
4 20g weights
1 Clamp
1 Base with rod
1 Hex key

EQUIPMENT REQUIRED NOT SUPPLIED

1 Distance sensor cod. 9041+ interface
1 Force sensor cod. 9032
1 Support for sensors cod. 4014

8111: SIMPLE PENDULUM

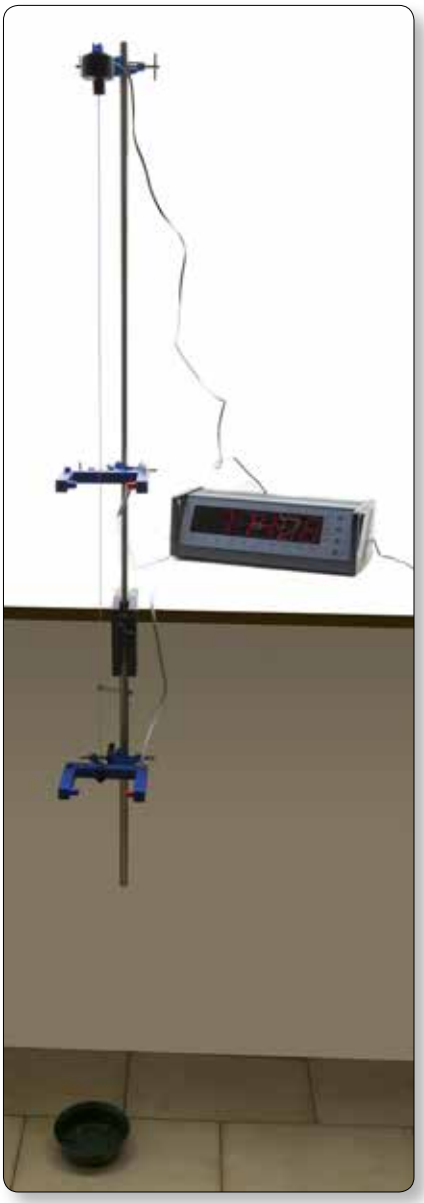
8111: VERTICAL ELASTIC PENDULUM

8111: TORSION PENDULUM

8111: COMPOUND PENDULUM

1318 Free falling bodies apparatus

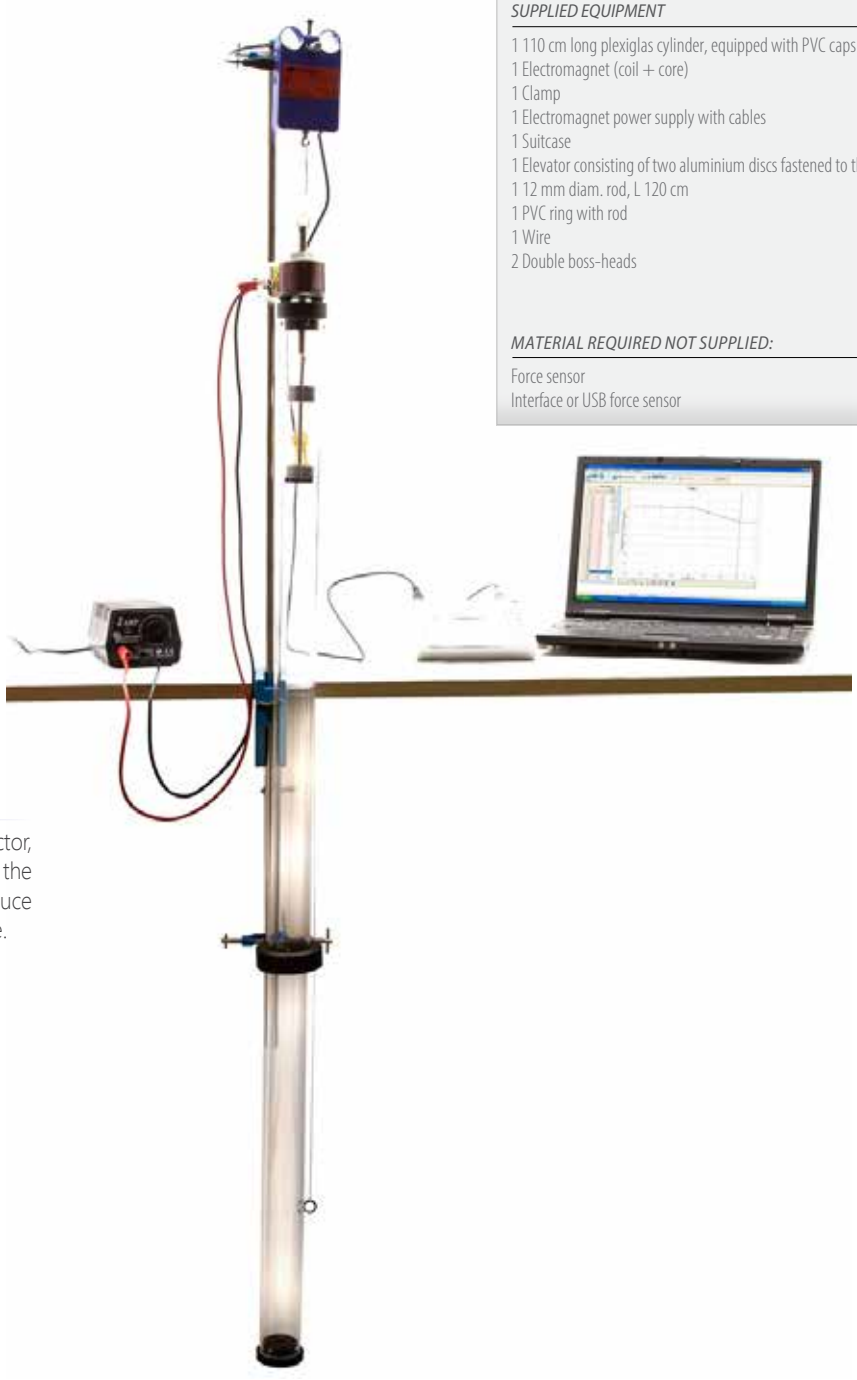
It is composed of a digital timer with a division of 1/1000 of a second which can guide an electromagnet in order to start the fall of a metal ball. A switch records the impact instant in order to measure the fall time of the ball. Once you know the fall's distance and average time, it is possible to deduce the gravity acceleration value g.



1428 Einstein's elevator

The reasons that led Einstein to develop the Theory of General Relativity can be basically explained by using ideal experiments. The most important one is known as Einstein's elevator.
With this apparatus it's possible to show and measure the absence of gravity in addition to a standard experiment that is possible to do with the apparatus for free fall.

EXPERIMENTS
Verification of Einstein's equivalence principle



SUPPLIED EQUIPMENT

1 110 cm long plexiglas cylinder, equipped with PVC caps
1 Electromagnet (coil + core)
1 Clamp
1 Electromagnet power supply with cables
1 Suitcase
1 Elevator consisting of two aluminium discs fastened to the same pin
1 12 mm diam. rod, L 120 cm
1 PVC ring with rod
1 Wire
2 Double boss-heads

MATERIAL REQUIRED NOT SUPPLIED:

Force sensor
Interface or USB force sensor

1397 Horizontal accelerometer

A mass, hanging from the centre of a protractor, creates through its vertical an angle which depends on the acceleration along the protractor. It is possible to deduce the acceleration value by measuring the deviation angle.

1365 Rolling marbles and cylinders, strange accelerations

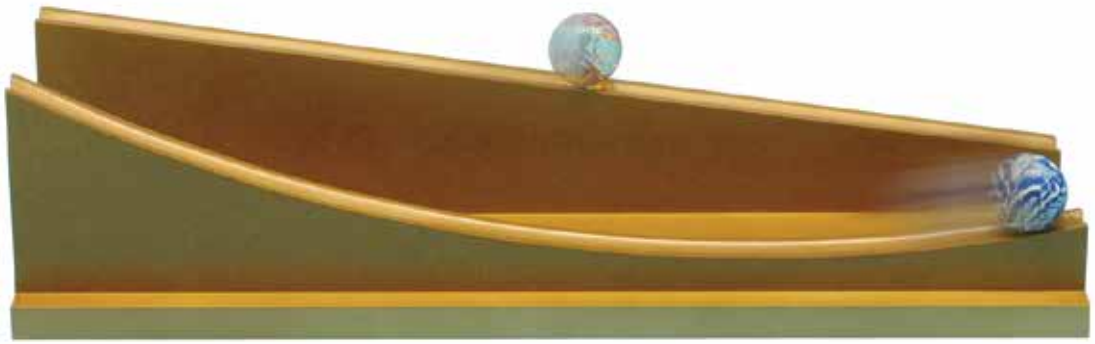
In order to study dynamics in the high school physics courses, teachers use different models, such as particle material and other abstract notions that have little to do with the experimental reality.
But when we want to turn the theoretical analysis (that is carried out with reference to mathematical models) into a real laboratory experiment, as for example using a cart, we obtain unsatisfactory results.
With this device we will study the dynamics of rolling.

SUPPLIED EQUIPMENT

1 Wooden plane, dimensions 65x15 cm
1 "U" shaped aluminium bar, dimensions 65x6x3 cm
1 Rubber covered plane, dimensions 40x15 cm
2 Marbles Ø65 mm
1 Marble Ø 58 mm
6 Cylinders of different materials and with different diameters
1 PVC spool
1 Adjustable height stand for inclined plane
1 Case
1 Experiment guide

1364 Downward speed

Two balls with the same diameter roll down at the same time, from the same height difference, but following different trajectories.
Departing from the same height, which will be the fist ball to reach the finish point?

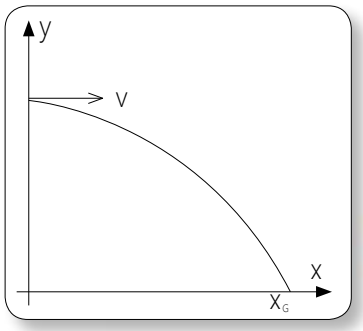


1431 Parabolic motion apparatus

This simple apparatus enables you to study in a quantitative way the parabolic motion.
This cannon has 5 launch positions, and the projectile is a plastic sphere. The regulation system allows you to vary inclination from 0° to 90°.
If cannon is h metres from ground, and it is horizontal, the rifle range depends on launch velocity:

$$X_G = V\sqrt{\frac{2h}{g}}$$

Knowing V, you can determine X_G and knowing X_G, you can appreciate V.



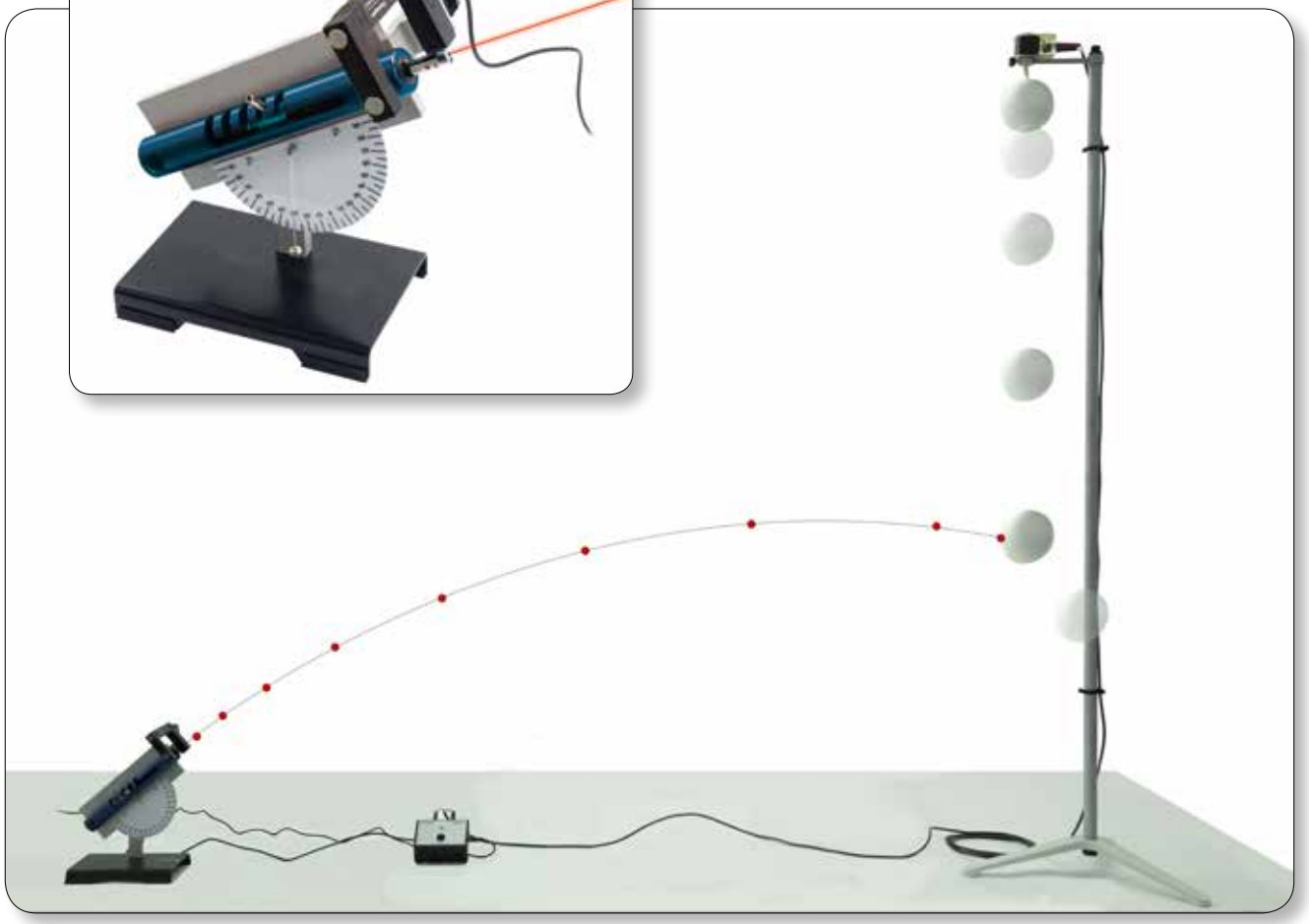
9095 Apparatus to measure launch velocity

To measure launch velocity of apparatus (code 1431),
the purchase of apparatus 9095 is recommended.
It is composed of a photogate connected to a timer that is able to observe interruption time due to transit of the projectile.

1431 + 9095

1422 The monkey and the hunter: an historical quest

A hunter wants to shoot a monkey hanging from a tree branch, hence he aims his blowpipe at the animal. As soon as the monkey sees the arrow coming out of it, it loosens the grip to avoid being shot. The hunter, as the monkey jumps, thinks he missed the target; shortly thereafter, however, he can see with great surprise the arrow hit the free falling animal. It is possible to demonstrate that the monkey would be hit in all cases, whatever the velocity v_0 at which the arrow moves, provided that its value is such as to allow the arrow to hit the animal before it reaches the ground. In apparatus 1422, at the very instant in which the projectile exits the cannon, the photocell positioned on the muzzle sends a signal, deactivating the electromagnet which holds the polystyrene ball used to simulate the monkey.
If the condition mentioned above is satisfied, while falling, the polystyrene ball will be hit by the projectile in any case. The apparatus we offer you is particularly sturdy. Moreover, the anodised aluminum cannon can be rotated and is characterised by a thick high pressure bilaminates base.
This apparatus was entirely realised in our factory, from the production of its components to mounting.



1432 Precession motion

This equipment allows students to learn the motion of precession with the laws of classical mechanics applied to the rigid bodies, using simple devices like the spinning top and the gyroscope.

SUPPLIED EQUIPMENT

1 Gyroscope
1 Giant Gyroscope
1 Spinning top
1 Rule
1 Launching motor

By the giant gyroscope, you can also perform a quantitative test of the report that provides the value of the angular momentum precession as a function of mechanical momentum and angular momentum of rotation.
The teaching guide as well as a theoretical explanation of the phenomenon, provides instructions for a correct execution of the experiences.

1001 Apparatus for the study of viscosity

The liquid's laws of physics can be demonstrated with this apparatus for studying the viscosity coefficient by a sphere falling through a liquid.

SUPPLIED EQUIPMENT

1 Base for rod
1 Metal rod 75 cm
1 Plexiglass tube 75 cm
2 Double boss-heads
2 Rods with clip
1 Funnel
1 Glycerine bottle
3 Steel balls
1 Plexiglass ball
3 Elastic rings
2 Rubber stoppers
1 Magnet with handle
1 Experiment Guide
1 Case

1182 Pascal's apparatus with communicating vessels, modular model

It enables you to perform experiments on communicating vessels, on capillary vessels, on Stevin's principle and on Pascal's principle.

1042 Stevin's principle apparatus

This apparatus is used to check Stevin's principle.
It is supplied with base, manometer, tube, manometric sensor and jar.
Jar height :38 cm.

1219 Hare's apparatus

With this apparatus, it is possible to determine the specific density of a liquid. A small depression done with a syringe leads the two liquids to reach different levels if they have different density.

If the first liquid is water, it is possible to find the other liquid's density in relationship to the water's.
The item is supplied with stand, pincers, syringe and glasses.

Glass part height 35 cm.

1132 Specific weight kit

To measure the specific weight of solids and liquids.
Possible experiments:
Determination of the specific weight of a solid
Bodies with the same weight but different volume.
Bodies with the same volume but different weight
Determination of a specific weight of a liquid

SUPPLIED EQUIPMENT

1 Tripod base
1 Metal rod 70 cm
1 Boss-head
1 Rod with hook
1 Spring scale
1 Scale pan
1 100 ml Beaker
1 Dipper
1 Series of 5 samples with the same mass
1 Series of 3 samples with the same volume
1 String
1 Graduated cylinder
1 Experiment Guide
1 Case

1409 Two-stage vacuum pump

The rotary vane vacuum pump is designed to create vacuum in a sealed container.
Technical features: Two-stage; recycled lubrication, tank, fan, silencer.
It is supplied with oil and vacuum tube (1m).
Pressure limit: 0.067 Pa. Engine power: 250 W.
Pumped volume: 3,5 m^3/h. Power supply 230 V.

1426 Torricelli's apparatus

After filling the cylinder with water up to a certain level, at which height should a hole be made to obtain the maximum flow?
By letting the water flow out through the taps, it can be verified that the maximum flow is obtained when the hole is located at half the level of the liquid in the cylinder.

1415 One-stage vacuum pump

The rotary vane vacuum pump is designed to create vacuum in a sealed container.
Technical features: single-stage; recycled lubrication, tank, fan, silencer.
Capacity: 1 m^3/h. Minimum pressure: 10-30 Pa. Engine power: 90W.
Power supply: 230 V. It is supplied with oil and vacuum tube (1m).

1068 Plate for bell jar

The Pneumatic plate is made of perfect sealing ground metal and is provided with a disk of para rubber in order to increase its resistance. It has two stopcocks: one of them is used to connect the vacuum pump while the other one is used to restore the atmospheric pressure.

1069 Bell jar

It is made of very thick cast glass.
Dimensions: ø external 235mm / internal 185mm; h = 315mm
The lower rim is frosted to have a perfect seal.
To use with silicone grease code 1068.

0090 Rubber tube for vacuum pumps

Dimensions: 7x17x1000 mm.

6147 High vacuum silicone grease

Tube pack: 50 g.

1373 Round flask for the measurement of the air density

The air density can be measured using a round flask with an electronic scale with a division of at least 0.01 g.
Flask capacity: 500 ml

1374 Pressure surprises

To demonstrate how air flows due to air pressure, use two balloons with different amounts of air in them. When you open the linking stopcock between the balloons, you would expect to see the air flowing from the most inflated balloons into the less inflated one.But..

1107 Empty Newton's tube

Inside this tube there is a sufficient vacuum, It contains a ball and a feather. Making them fall together from one end, it is observed that they reach the bottom of the tube at the same time, indeed the acceleration of gravity is independent of the mass of the body. It is made of glass; It doesn't have air inside, but a feather and a wooden ball.
Length: 1 mt.
Made of glass.

1070 Newton's tube (to be emptied)

It has stoppers and stopcock to link it to a vacuum pump, after having placed small item inside it. In this way it's possible to realize a sufficient vacuum. Making the items fall from one end, it is possible to observe that they reach the bottom of the tube at the same time, indeed the acceleration of gravity is independent of the mass of the body.
Length: 1 mt.
It is made of plexiglass.

1043 Torricelli's experiment apparatus

It enables you to perform the classic Torricelli's experiment, thanks to the tube (length 85 cm, D 6 mm) with chemically carved millimetric division on the glass all along the interested part. It is supplied with base, basin, stands and funnel.
Mercury is sold separately.

RA1047 Mercury

Pack of 1KG MERCURY

1071 Baroscope

The baroscope demonstrates the Archimedes push.
In the air, the beam reaches the equilibrium, while in the vacuum it tilts on the balloon side, because the Archimedes push stops working.

1242 Magdeburg's hemispheres

The Magdeburg Hemispheres demonstrate that a lot of force is needed to separate the hemispheres if there is a partial vacuum inside them.
The Magdeburg Hemispheres show that the atmospheric pressure pushes the two spheres one against the other. They are made of metal, with grinding rims, supplied with rubber-holder so that they can be fitted to a vacuum pump through a rubber tube.
Diameter: 80 mm.

1075 Magdeburg's hemispheres

The Magdeburg Hemispheres are two hemispheres which confine the atmospheric pressure inside them that is equal to the atmospheric pressure outside. This balance means that they can be separated without any effort. However, if the air from inside is pumped out, the pressure balance is destabilised. This means that a considerable amount of force is necessary to separate them. The Magdeburg Hemispheres are made of metal, with ground rims and plane in order to be placed on a plate for bell jar (code 1068)
Diameter: 100 mm.

1072 Pressure tear device

In accordance with the priciple of Pascal, atmospheric pressure is manifested in all directions, and the forces that act on the surfaces of the same body are in equilibrium. With the Pressure Tear Device it is possible to show the effect of the difference of the pressure on two faces of one membrane. The Pressure Tear Device is made of ground and rimmed PVC, with perfect seal. It is supplied with its paper.

1074 Electric bell

The Electric Bell can be used to show the propagation of sound waves in vacuum. The bell can show the change of the waves with the air density and in a vacuum. It is powered by batteries.
To be used with bell jar code 1069.

Free air manometers

- **1047** Height 20 cm, without stopcock.
- **1048** Height 30 cm, without stopcock.
- **1049** Height 40 cm, without stopcock.
- **1050** Height 20 cm, with stopcock.
- **1051** Height 30 cm, with stopcock.
- **1052** Height 40 cm, with stopcock.

1088 Aneroid vacuum-meter

The Aneroid Vacuum Meter measures the depression in vacuum pumps.
It measures the pressure on Mercury from 0 to 76 cm.

1089 Bennert's vacuum-meter

Bennert's Vacuum Meter is used to measure the residual pressure in a series of pumps. It measures the pressure for up to 100 mm of Mercury.

1217 Kit for the verification of the laws of gases

The kit for the verification of the laws of gases contains two devices - Charles' Law apparatus (code 1137) and Gay-Lussac's Law apparatus (code 1122). Saving on the items which are common to both devices, the price is more attractive than the sum of the two prices.

1137 Charles'Law apparatus

The Charles Law Apparatus allows us to verify the physics law that rules the volume variations of a gas (at constant pressure) as its temperature varies.
Therefore we can measure the dilatation coefficient (at constant pressure). The burner, the tripod and the fire-spreading net are sold separately.

1122 Gay-Lussac's Law apparatus

The Gay-Lussac's Law Apparatus allows us to verify the physics law that rules the pressure variation of a gas (at constant volume), as its temperature varies.
The burner, the tripod and the fire-spreading net are sold separately.

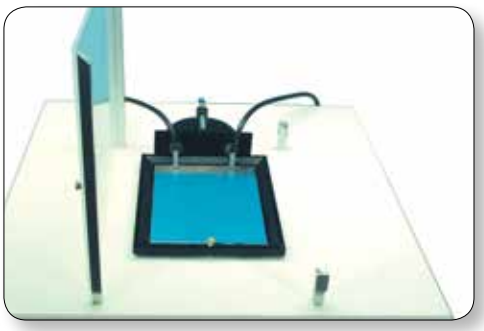
3030 Kit for experiments on surface waves in liquids (ripple tank)

This kit is a fundamental instrument for the study of wave phenomena because it visualizes them. The teacher can project the surface waves on a translucent screen, on a wall or on the ceiling.
Water surface waves are created through air jets; they create regular, steady waves.
The kit is composed of:
- 1 Double wave generator, supplied with two independent air blowers.
- Variable frequency guide from 5 to 35 Hz.
- The phase angle between the generators can vary at intervals of 45°.

Moreover, it has a digital display screen with wave generation frequency indicator 1
Built-in Stroboscope, obtained by switching on a lamp with
electronic control, in order to see images of still or decelerated waves.

SUPPLIED EQUIPMENT

1 Magnetic fixation beater for plane waves
2 Magnetic fixation beaters for circular waves
1 Concave-convex mirror
1 Converging lens and 1 diverging lens.
1 Plate with plane parallel faces.
1 Trapezoidal plate.
3 Obstacles for diffraction and interference phenomena
1 Wash bottle
Dim.: 60x60x90 cm.



3014 Stationary wave apparatus

The Stationary Waves Apparatus allows observation of the phenomenon of longitudinal and transversal stationary waves.

SUPPLIED EQUIPMENT

1 Vibrator
2 Elastic cords
1 Coil spring
1 Rod 75 cm
1 Rod 4.8 cm with hand wheel
1 Double boss-head
1 Base for rod
1 Clamp with pulley
1 Series of masses 10 g
1 Rod with hook

The vibrator can be powered through the low frequence signal generator (code 5718 page 190), which is not supplied with this apparatus.

3014.1 Kit to study stationary waves

As for code 3014, but without base, rods and boss-head.

3032 Ripple tank

The Ripple Tank has the following advantages:
-simple to mount
-ease of carrying out the experiment
-results reliable and repeatable
-excellent visual resolution of the wave front

The stroboscopic lamp is made with a highly-luminous 3W LED, which is synchronised with the surface-wave generator.

The control unit is equipped with a digital display and allows setting or inhibiting of the synchronism of the vibrator with the lamp, the wave amplitude modulation and its frequency.

The vibrator is of electro-dynamic type.
Dimensions of the tray: 30 x 30 cm.

Experiments that can be carried out with the standard supply:

- Single point source to create circular wave fronts
- Double point for studying the wave interference
- Linear hitting unit for linear front waves
- Bi-convex refracting body
- Bi-concave refracting body
- Parallel flat plate

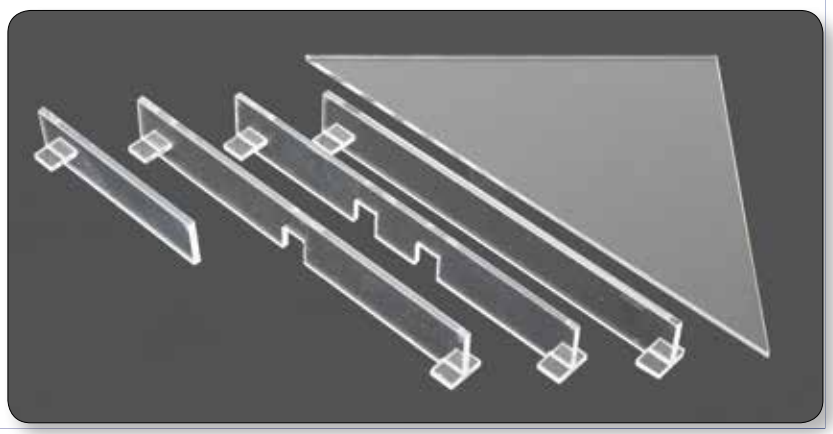
Main characteristics of the wave:
- Frequency, wavelength, amplitude, wave front, surface-wave with circular front and surface-wave with flat front
- Interference of two circular waves' refraction on a flat surface
- Refraction on a bi-convex lens
- Refraction of a bi-concave lens

3033 Ripple tank accessories

This Plexiglas kit of accessories allows execution of tests for the propagation study, diffraction and interference of surface waves.

SUPPLIED EQUIPMENT

- Barrier with a slit for the waves' diffraction
- Barrier for reflection on the plane surface
- Barrier for diffraction from a corner
- Refractive prism
- Interference from two slits



3004 One-string sonometer

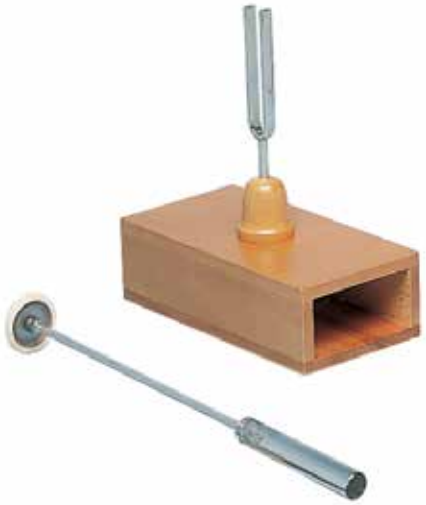
On the harmonic box there are scales of notes composing the temperated scale, in correspondence to the vibrations frequency.

3002 Vibrant bell

The pendulums oscillate when the bell is hit with the hammer, thus demonstrating that the sound is generated by the bell's vibrations. Height 40 cm.

3003 Tuning fork

Oscillation frequency: 440 Hz. It is supplied with resonance box and hammer.



3010 Acoustic resonance apparatus

By acting on the discharge tap of a tube full of water, it is possible to let the air column above the liquid enter in resonance with the tuning fork.

3029 Couple of tuning forks

Oscillation frequency: 440 Hz. With resonance box, hammer and spare masses for beats

3020 Set of 8 tuning forks

The items are made of chrome steel, with different length and section of 5.5x8.5 mm.
Hz frequencies : 261.6 - 293.6 - 329.6 - 349.6 - 392 - 440 - 493.9 - 523.2.
Error ±0,2% at a temperature of 20°C.
With case and hammer. Suitable for demonstrating the tones-frequencies relationship, and for tuning music instruments.

3016 Signal generator

Frequency field:20 Hz - 20000 Hz on 3 ranges.
Built-in amplificator.
Undistorted output power: 2 W.
It is supplied with two 60cm long cables.

5718 Low frequency signal generator & amplifier

It is a generator of precision signals, amplified in power. It can generate sine, square and triangular waves. The frequency of the main generator varies from 0.1 Hz to 100 KHz. The maximum output power is 4.5 W. Equipped with LED display showing the frequency and the output amplitude level.
This instrument is particularly suitable for teaching and for scientific research.

3017 2,5W, Loudspeaker

Supplied with two journal boxes for the linking to the oscillation generator code 3016.
Impendance: 8 Ω.

3021 0,5W, Loudspeaker

With stand (10 mm) in order to be housed on a base (code 0010).
With two journal boxes at the back to link it to the oscillation generator code 3016.
Impedance: 8 Ω.

3114 5W, Amplifier

Power: 5W. You can use it also with loudspeakers code 3017 and code 3021.

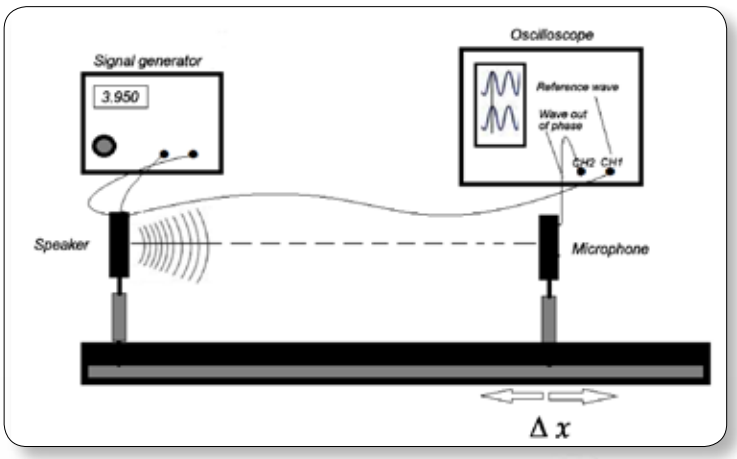
3008 Kundt's tube

The incident acoustic wave interferes with the reflected one, creating the stationary waves. The cork powder visualizes nodes and bellies, so making wavelength measurement possible. Now, knowing the frequency, you can measure the acoustic waves' speed in the air. The item is supplied with tube, stands and bases, piston and cork powder spreader. It must be used with a loudspeaker code 3017 and an oscillation generator code 3016 sold separately.

3034 Apparatus to measure acoustic waves' velocity in air

SUPPLIED EQUIPMENT
1 bench 50cm
2 supports
1 loudspeaker
1 microphone with amplifier
2 leads
2 BNC leads

Necessary equipment not supplied
Acoustic signals generator
Double traces oscilloscope



Using the bench you can measure the distance l (wave length) at which the delay is a period T.

So:

$$v = \frac{l}{T}$$

2112 Device for the study of the Brownian motion

The irregular motion of the tea particles, due to the collisions with the liquid's molecules, can be highlighted with this equipment. The trace of the Brownian motion can be seen on the screen thanks to laser diffusion by increasing the liquid temperature (e.g. with a hair dryer or by holding the cuvette in your hand for a few minutes), we can observe the increase of the thermal energy.
-code 5011- is recommended.

2046 Linear expansion apparatus

To prove the thermal expansion of a bar. It works with cotton wads soaked in denatured alcohol and it is supplied with three rods made of iron, brass and aluminium.
Dimensions: 30x13 cm.

2076 Ball and ring apparatus

With the following experiment we can verify the thermal expansion of a metal

2137 Expansion apparatus for liquids and gases

With this simple apparatus it is possible to determine the thermal expansion coefficient of liquids and of air.

6149 Heating plate

To use with steam generator. Power 800W, power supply 230V/50Hz.

2059 Ingenhousz's case

The item highlights the different thermal conductivity in different materials. Bars must be covered in paraffin and the metal case must be filled in with hot water. Supplied with two candles.

2079 Linear expansion apparatus

It is particularly suitable for student group exercises; it allows a quite reliable measurement of the linear expansion coefficient. It is supplied with thermometer and beaker.
Steam generator is required to heat the rod. Dimensions: 70x10 cm.

2056 Water calorimeter 1000 ml

Supplied with thermometer and stirrer and has double aluminium walls insulation from heat.
Dimensions: Ø 150 mm. Height: 150 mm.

8201 Electric calorimeter 350 ml

Suitable for the verification of Joule's law; capacity 350 ml.
It is supplied with two resistors you can use alone or in series.
Maximum working voltage: 6V.
Supplied with stirrer and thermometer.

2036 Set of 4 samples with equal volume

For the measurement of specific heat through water calorimeter up to 350 ml.
They are made of iron, brass, aluminium and PVC.

2087 Set of 4 samples with equal mass

For the measurement of specific heat through 1000 ml water calorimeter.
They are made of iron, brass, aluminium and PVC.

2055 Apparatus for the measurement of the mechanical equivalent of heat

This solid apparatus is composed of a 7 cm long brass calorimetric cylinder width 5 cm and supported by ball bearings.
A copper ribbon is rolled around the cylinder and retained by a spring; a 5 kg weight hangs from it.

Because of the friction between the ribbon and the cylinder during the rotation, the water inside the cylinder warms up.
If you measure the work done and the heat produced, it is possible to determine the mechanical equivalent of heat.

The apparatus is supplied with boss-heads and 1/10 degree digital thermometer.

2058 Convection tube

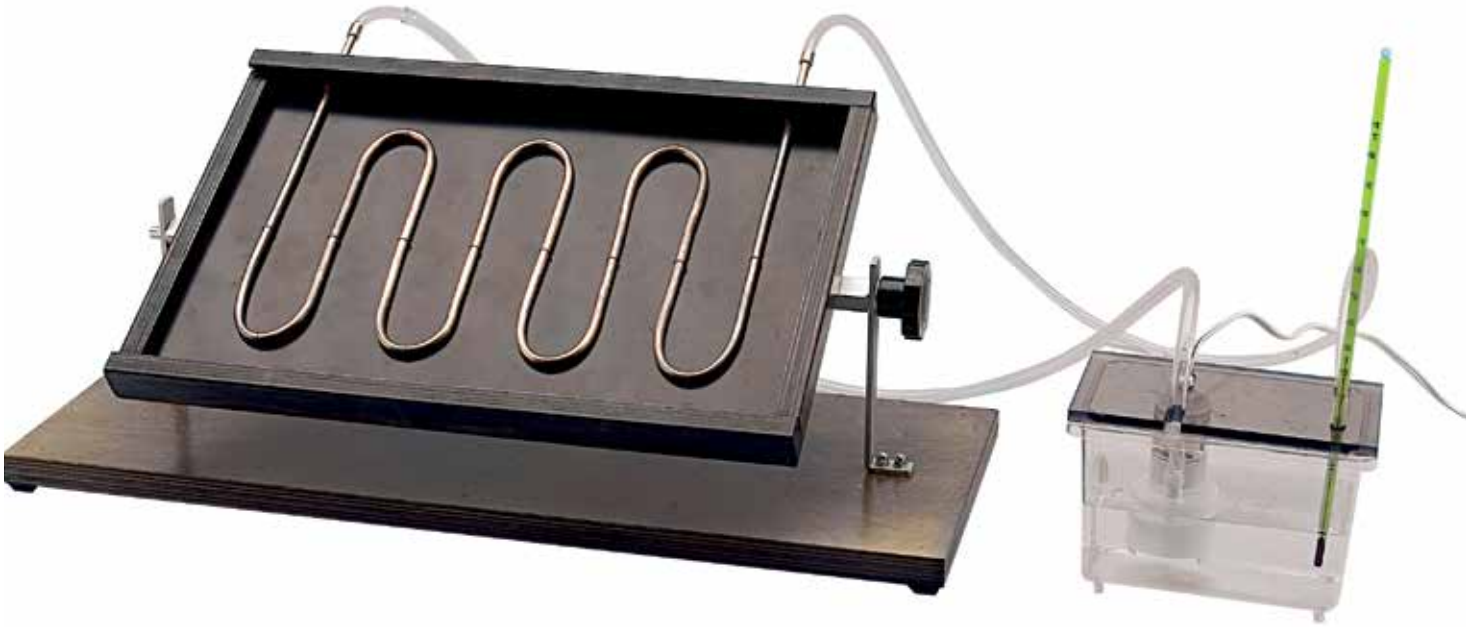
Insert water first and then potassium permanganate crystals into the tube through the upper opening.
If you heat up the lower part, the salt depositated at the bottom moves upward, colouring the whole water. The burner is sold separately.

2058.1 Convection tube

The previous model but with glass part only.

2000 Solar water heater

It is a model of the devices used in domestic applications. Thanks to this item you can heat water by means of sun radiant power. An immersion pump, working at 12 Vdc, makes the water circulate in the heating coil of the solar panel.
After a few minutes it is possible to notice an increase in temperature.
It is supplied with a transformer.



2052 Radiation apparatus

It is composed of two parabolic reflectors.
In the first one there is a 30W light bulb (6V-5A) with its transformer; in the second one there is a thermometer.
Both light bulb and thermometer are placed in the focus point of the reflectors.

2031 Absorbent and emitting powers apparatus

It is supplied with 3 aluminium bodies.
One body is black-black, another is black-white and the last one is white-white.
If you expose them to the energetic flux of the light bulb, you can verify how the absorbent power and the emitting power depend on the colour of the surface.

2136 Ruchardt's apparatus

With this apparatus it is possible to study an adiabatic transformation of a gas. It is composed of a 2000 cm3 conical flask linked hermetically to a glass cylinder with a sealed external piston above it; it can be burdened by adding calibrated metal cylinders.
Deaden oscillations are generated displacing the piston from its equilibrium position.
The T period of these oscillations is linked to the adiabatic constant of the γ gases according to the following ratio:

$$T = 2\pi \sqrt{\frac{mV}{\gamma p s^2}}$$

4157 Tortelli's thermometer

This kit lets you measure the thermosulphuric index of olive oil, establishing the level of purity or any oil adulteration.

SUPPLIED EQUIPMENT

1 25 ml graduated cylinder tall form
1 5ml glass graduated pipette
1 Digital electronic thermometer -50° + 150° resolution 0,1
1 Vacuum pipette with 3 valves
1 350ml Thermos
1 50ml sulphuric acid 96%
1 Plastic box

4361 LED light source

This projector has a white LED as a light source.
It is supplied with a power supply but without
the base shown in picture.

4030 Mirror-like dihedral

The item proves that the number n of images is determined by the formula:

$$n = \frac{360}{\alpha} - 1$$

e α is the angle created by the mirrors.

4059 Lens-holder

The item supports lenses and circular mirrors.

4017 Filter-holder

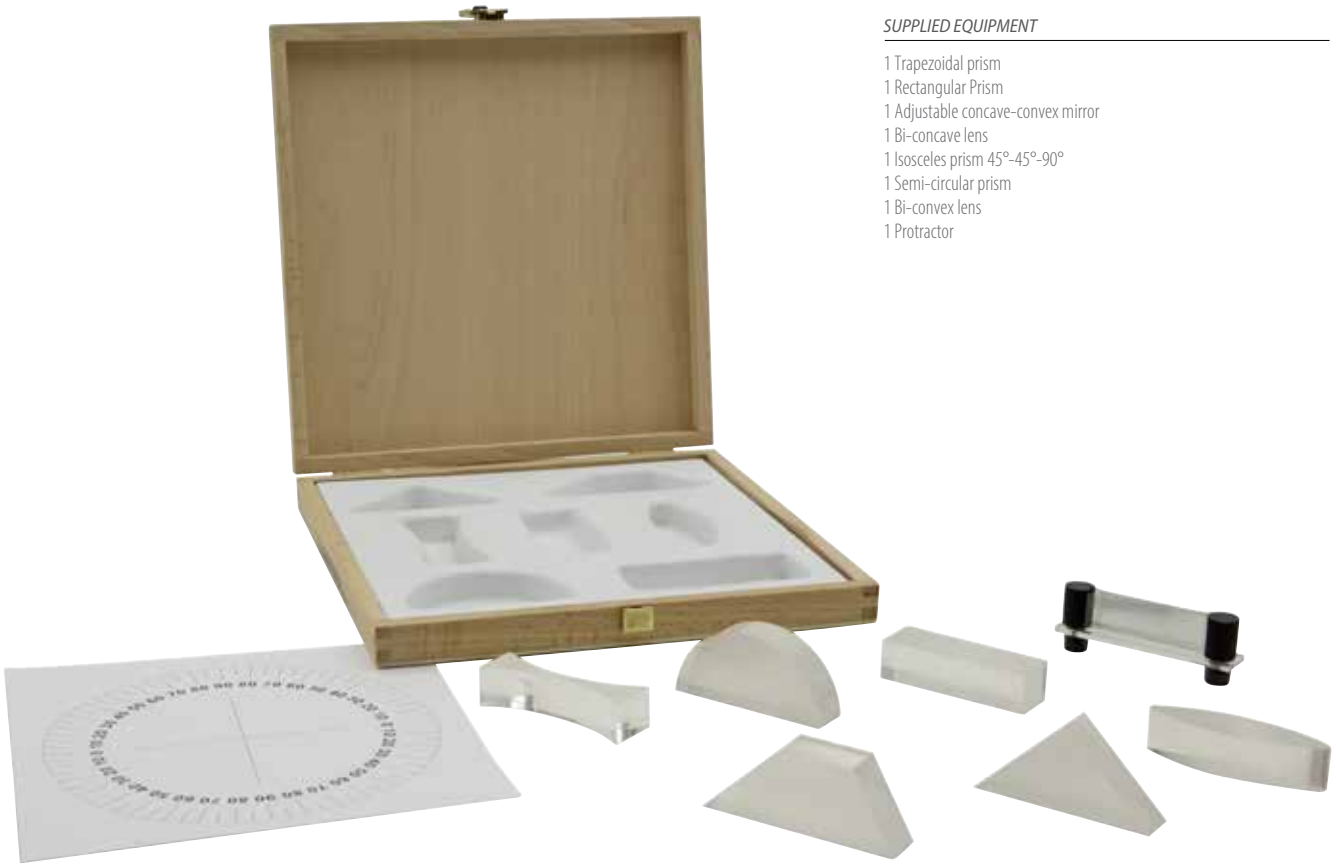
The item supports diaphragms , filters, slides, etc.

4158 Set of 7 optical bodies

The set includes:

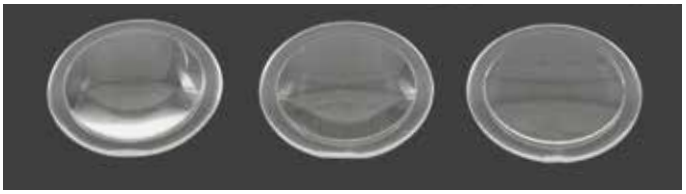
SUPPLIED EQUIPMENT

1 Trapezoidal prism
1 Rectangular Prism
1 Adjustable concave-convex mirror
1 Bi-concave lens
1 Isosceles prism 45°-45°-90°
1 Semi-circular prism
1 Bi-convex lens
1 Protractor



4060 Set of 3 plexiglass lenses

Focus +6, +10, -10 cm.
Diameter 5 cm; to be mounted on lens-holder code 4059.



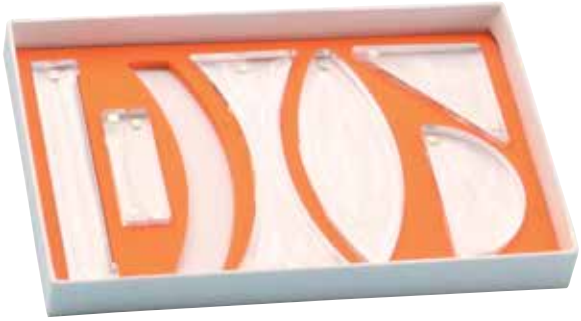
4214 Hartl's disk with laser ray box

This projector has a white LED as a light source.
It comes with a power supply.

Contents:
The Laser ray box
Reflection's Law
Reflection in spherical mirrors
Refraction's Law
Absolute refractive index
Refraction through a plate
Refraction through an optic prism
Total reflection
Prisms and total reflection
Converging lenses
Diverging lenses

SUPPLIED EQUIPMENT

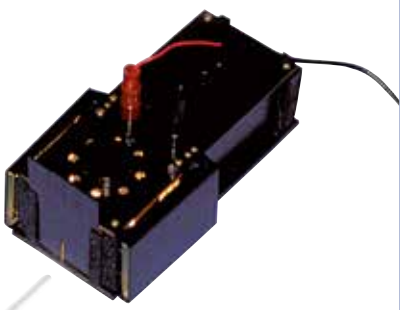
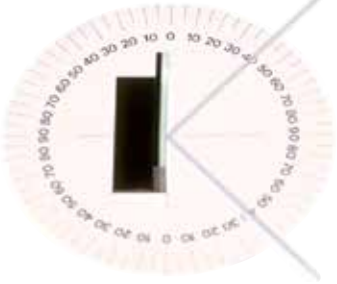
1 Laser ray box with power-unit
1 Set of magnetic optic bodies
1 Optic disk with stand
1 Basement
1 Case
1 Didactic Guide



▶ 4129 Optical ray projector and colour mixer

This fundamental item for the study of light phenomena, is composed of a rectangular case (175x90x55 mm) containing a lamp with vertical filament (12V - 36W) placed in the upper part.
A system of cylindrical converging lenses enables you to obtain converging , diverging or parallel light beams.
On the front of the case there are three windows with clasps, whose internal part are mirror-like and endowed with guides for inserting diaphragms and other colour filters.
All equipment is contained in a wooden case.
Power-unit included.

CONTENTS
Law of reflection
Refraction in diverging lenses
Reflection in mirrors
Refraction in prisms
Laws of refraction
Dispersion of white light
Total reflection
Filters
Refraction in a plate
Primary and secondary colours
Refraction in converging lenses
Colour composition


▶ 5607 Geometrical optics kit with laser ray box

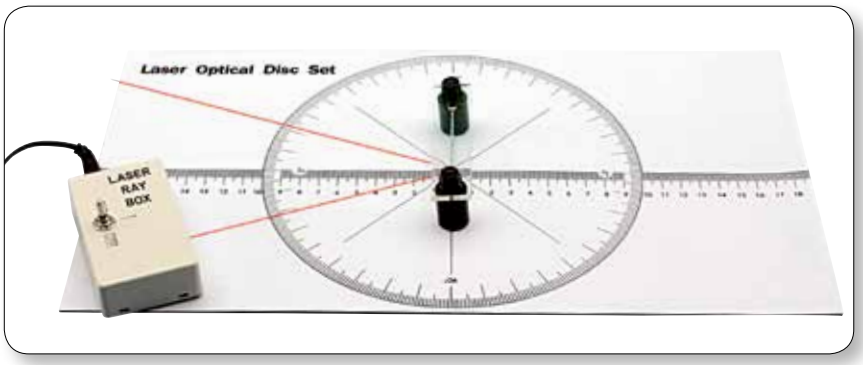
With this kit you can easily and quickly perform all basic geometrical optics experiments.
The laser ray box is endowed with a switch which allows three different beam configurations (1-3-5).
The high-quality optic bodies allow you to observe the trajectory of reflected and refracted beams.
Because of its good quality/price ratio and because of the number and quality of possible experiments, this kit represents the best solution for geometrical optics experimentation for primary and secondary school.

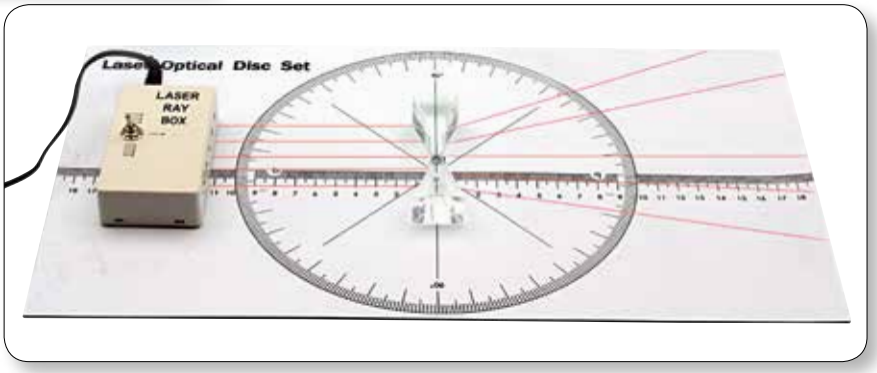
CONTENTS

Reflection in a flat mirror.
Reflection in a concave mirror.
Reflection in a convex mirror.
Refraction Law.
Measure of the refraction index of a transparent solid.
Measure of the refraction index of a transparent liquid.
The prism and the total reflection.
Converging lenses.
Diverging lenses.
System of two lenses.

SUPPLIED EQUIPMENT

1 Laser ray box with power unit
1 Changeable geometry mirror
1 Optic foil
1 Diverging lens
1 Converging lens
1 Half-circular optic body
1 Half-circular tray
1 Amici's prism
1 Isosceles right-angle prism
1 Chart for geometrical optics studies
1 Experiment Guide
1 Case





5609 Magnetic version of geometrical optics kit with laser ray box and magnetic board

4321 Geometrical optics kit

This item enables you to perform, on a horizontal stand, all phenomena regarding the geometrical aspect of light propagation. The components have been designed to simplify and to speed up performance.

CONTENTS

Light reflection on a plane mirror
Optical lever
Reflection on a concave spherical mirror
The properties of the focus and of the centre of a mirror
Convex spherical mirror
Refraction on a plane surface
Refraction on a plane surface with parallel plane faces
How to measure an inaccessible thickness (optical pachymetry)
Refraction through prisms: how to measure total deflection angles
How to measure the index of refraction by means of the minimum deflection angle
The index of refraction of liquids
Total reflection and critical angle
Total reflection on a rectangular prism
Focal distance of converging lenses
Focal distance of diverging lenses
Galileian telescope systems
Spherical aberration

SUPPLIED EQUIPMENT

1 Equilateral glass optical prism 25x25 mm
1 Equilateral plexiglas optical prism
1 Plane mirror
1 Spherical mirror
1 Set of seven optical bodies
1 Hollow prism
1 Penta laser with spot selection switch
1 150x150 mm screen with 10 mm stem
1 Support for screen
1 Small size optical bench
1 Protractor (diameter 200 mm) with stem (diameter 10 mm)
1 Support for optical bodies (rectangular base)
1 T square
1 Penta laser support
1 250 ml beaker
1 Box

4329 Optical fibre kit

This educational model allows the observation of a wave guide's behaviour and the measurement of the numeric opening of an optical fibre as the refractive index of the mantle varies (air, water, alcohol).

SUPPLIED EQUIPMENT

1 Base with protractor and screen
1 Laser diode with turnable stand
1 Plexiglas basin
1 Plexiglas panel
1 Plexiglas curved silhouette
1 Experiment Guide

4200 Electric Newton's disk

The item is linked to an electric engine which is powered by voltage of 4-6 Vdc. It is supplied with 5 disks to show the additive colour synthesis.

4510 Benham's disk

This simple and original machine shows the effects of different reply times and image persistence times of the retina's photoreceptors.
If you light up the disk and make it turn, it is possible to see rings whose colour changes according to the rotary speed and from person to person.
The item is supplied with stand, battery holder and cables, but without battery.

1097 Newton's disk

Divided into coloured parts, it allows you to verify the additive colour synthesis by rotating it on a rotary machine.

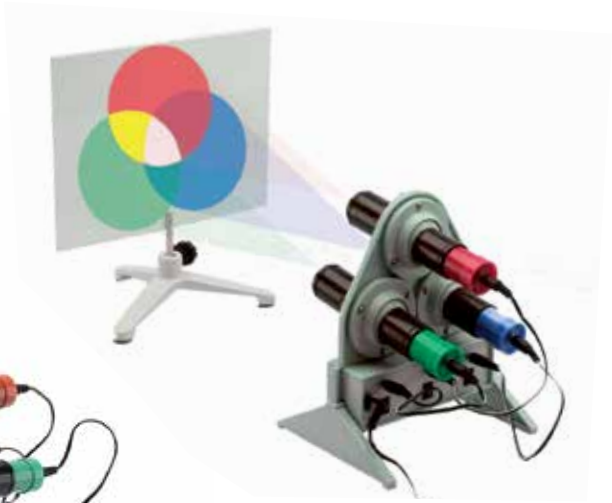
4352 Additive colour synthesis apparatus

With this apparatus it is possible to perform the additive colour synthesis of the primary colours : red, green and blue.
The apparatus is composed of 3 led projector, whose intensity can be changed with continuity. In this way it is possible to obtain the white colour and all the other colours of the colour triangle.

CONTENTS
Binary colour synthesis; example: red + green = yellow
Complementary colours
The trichromatic coordinates
Colour triangle
Colour reproduction

SUPPLIED EQUIPMENT

3 led projector: red, green, blue
1 Stand
1 Power-unit
1 Tripod base
1 White screen
1 Colour triangle chart
1 Case



4126 Simple spectroscope

The item can test the emission and the absorption of spectral radiations.
Model for direct vision.

4353 Subtractive colour synthesis apparatus

The subtractive colour synthesis is the base for colour printing and exploits the method of the chromatic filters in series. This kit enables you to experiment so that, subtracting different chromatic components from white light, you can obtain primary colours or their additive synthesis on a white screen. In the printing method, paints and inks play the role of the filters.

CONTENTS
According to the additive colour synthesis:

- Red + Green = Yellow R + G = Y
- Red + Blue= Magenta R + B = M
- Green + Blue= Cyan G + B = C
- Red + Green + Blue = White R + G+ B =W

Consequently, if you place before a white light source:

- A yellow filter, you subtract the blue colour: W - B = G
- A magenta filter, you subtract the green colour W - G = M
- A cyan filter, you subtract the red colour W - R = C
- A yellow filter + a magenta filter + a cyan filter, you subtract blue, green and red colours. W - B - G- R = N.

SUPPLIED EQUIPMENT

1 White light projector
1 Projector power-unit
3 Filter holders
1 White screen
1 Series of 3 secondary colour filters
5 Bases
1 Case

4117 Polarimetric tube

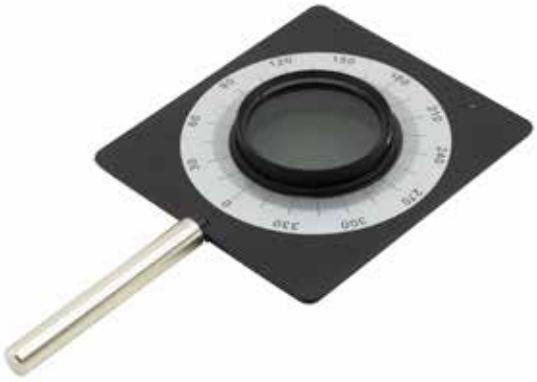
The item is made of plexiglas, it is closed at its ends and it has an upper opening where you can pour the liquid under examination.
It is possible to show the rotary power of the solutions' polarizing plane in function of its concentration by using two polarizing filters.

4207 Red diode laser device with stand

Continuous emission device with power-unit. Visible up to 35 m; power: < 1 mW; wavelength : 635 nm. It is supplied with a removable lens which is able to turn the circular section of the ray into a linear one. Jointed stand diameter: 10 mm. Base not included.

4370 Couple of polarizing filters

Screen dimensions: 100 x100 mm; stem diameter: 6 mm. They are supplied with graduated scale.



4354 Red diode laser device with magnetic base and lens

This continuous emission laser device is supplied with a lens to obtain a linear ray of light.
Moreover base and battery-holder are supplied with magnets in order to be applied to a magnetic blackboard.
Wavelength : approx. 635 nm. Power: 1mW.

4151 Green diode laser device with stand

It has a continuous emission; power-unit included.
Power: 3mW; wavelength : 532 mm.
It is supplied with a lens to obtain a linear trace.
Adjustable stand diameter: 10mm.
Base not included.

4335 Set of 4 interferential filters

The passing wavelengths are: Red: 636nm; Orange: 589nm, green: 532nm, Blue: 436nm.

4104 Diaphragm with 1 slit

On a frame 50x50 mm, to be mounted on filter-holder code 4017.
Slit width: 0.1mm.

4105 Diaphragm with 2 slits

On a frame 50x50 mm, to be mounted on filter-holder code 4017.
Slit width: 0.1 mm.
Pass 0.1 mm.

DIFFRACTION GRATINGS

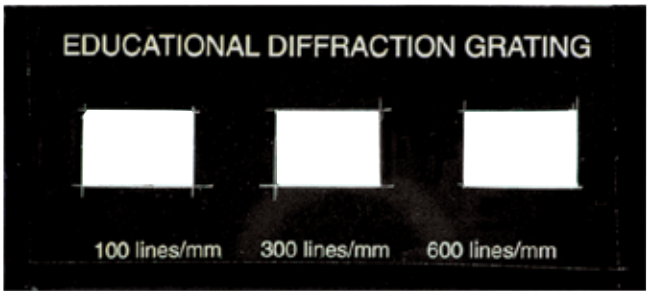
On a frame50x50 mm, to be mounted on filter-holder 4017.

4106 80 lines/mm

4212 500 lines/mm

4213 1000 lines/mm

4143 Set of 3 diffraction gratings



4325 Kit for observation of emission and absorption spectral lines

It consists of a small burner in to which to place cotton wool soaked in a saturated solution of alcohol and sodium chloride (included). Observing the flame with a spectroscope it is possible to identify the emission line of the sodium at 589 nm.
If a projector (not included) is switched on behind the flame, it is possible to see a continuous spectrum with the absorption line of sodium.

4028 Kirchoff-Bunsen's spectroscope

The item is mounted on a circular metal platform, it is composed of: 1 collector with adjustable slit, 1 collector with graduated scale and 1 collimator with 2 inter-changeable eyepieces. The slit of the collector is supplied with a small prism which allows you to compare the spectrum of two different sources. While the collector, equipped with achromatic objective, is fixed to the platform, the collimator can rotate on an alidade, keeping the directional axis in the centre of the apparatus. The collector with graduated scale requires a small white light source to project the image of the scale in the eyepiece of the collimator by means of the reflection on a face of the prism. The equilateral prism made of highly dispersive material. With this device you can study the spectrum of a source of monochromatic or polychromatic light. We recommend the use of interferential filters to the check of the wavelength. Complete with teaching guide.

4209 Spectrometer

This instrument has very good optic and mechanical features which allow the exact measurement of the optical ray deviation angles; therefore it can determine the refractive index of solids and liquids and the wavelength of monochromatic sources.
Base: made of fire-varnished cast-iron. Goniometer: Ø 17.5 cm and divided in 360° with a precision of 1°. It is equipped with a vernier, which allows to measure with an accuracy of 1/10°. Telescope: it has achromatic objectives with an 178 mm focal length and an eyepiece 15x. Focusing allows fine regulation.
Collimator: endowed with achromatic objective with 178mm focal length and with a steady adjustable slit up to 6 mm.
Plane of the prism: it can be adjusted both vertically and horizontally and it is supplied with boss-heads for the fixing of the diffraction grating. Diameter: 80 mm.
Equipment: 1 Crown glass equilateral prism 32x32 mm; 1 diffraction grating 500 lines/mm; 1 magnifying lens.
Dimensions: 48x33x33h cm. Weight: 12 Kg. The purchase of the diffraction gratings 80 lines/mm and 1000 lines/mm is suggested to verify the variation of the spectral resolution.

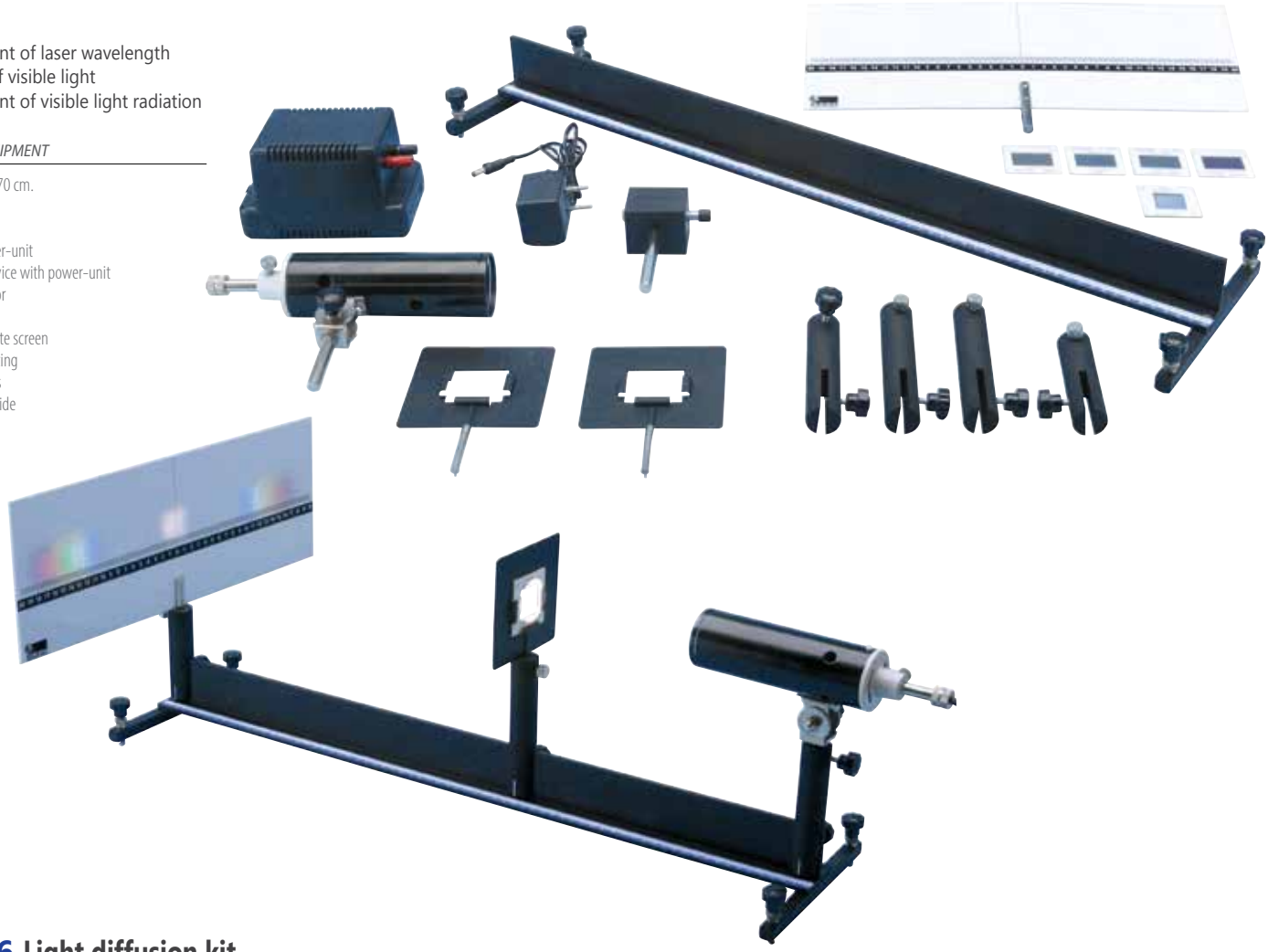
4322 White light wavelenght measuring apparatus

This apparatus determines the white light wavelength through the diffraction grating formula.
It is possible to measure the wavelength of both laser radiation and visible radiation.

CONTENTS
Measurement of laser wavelength
Spectrum of visible light
Measurement of visible light radiation

SUPPLIED EQUIPMENT

1 Optical bench 70 cm.
4 Riders
1 Optic projector
1 Projector power-unit
1 Diode laser device with power-unit
1 Slit for projector
2 Filter holders
1 Graduated white screen
1 Diffraction grating
3 Coloured filters
1 Experiment Guide
1 Case



4336 Light diffusion kit

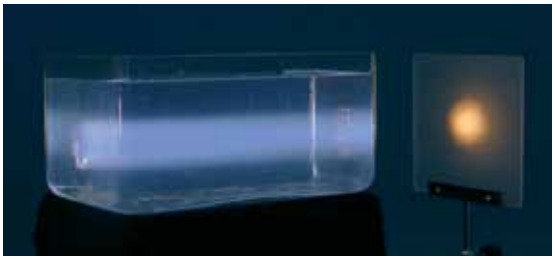
If you pour into acid, a solution containing a sulphur salt, within 10 minutes the sulphur crystals increase progressively. When their dimension becomes comparable to the light's wavelength, light diffusion takes place. According to Rayleigh's explanation, the blue component is deflected much more effectively than the red one, which goes on undisturbed. Thus it is possible to simulate the phenomenon which causes the blue colour of the sky and the reddish colour of the Sun and the Moon when they are on the horizon. With the polarizing filter it is also possible to study the polarization of the diffused light.
The optic projector must be bought separately.

SUPPLIED EQUIPMENT

1 Basin
1 Dropper
1 Polarizing filter
1 Glass stirrer
1 Half-transparent screen

NOT SUPPLIED EQUIPMENT

1 Whole milk



4202 90 cm Small optical bench

CONTENTS

Dioptric projector
Rectilinear propagation of light
Eclipses
Moon phases
Lighting law
Diffusion of light
Reflection of light
Reflection of light into spherical mirrors
Refraction of light
Refractive index and the colours of light
Total reflection
Refraction of light through a prism
Dispersion of the white light
Lenses
Images in flat mirrors
Images in spherical mirrors
Conjugate points of spherical mirrors
Images in converging lenses
Conjugate points of converging lenses
The eye and its defects
Correcting eye defects
The compound microscope
The slide projector

SUPPLIED EQUIPMENT

1 Linear ruler
1 Equilateral prism
1 Red filter
1 Green filter
1 Blue filter
1 Semi transparent screen
1 Slide 50x50
1 Plexiglas semi cylinder
1 Screen with squared hole
1 Flat mirror
1 Small flat mirror
1 Isosceles prism
3 Riders
1 Holder for the projector
1 Concave and biconvex mirror
1 Optical bench 90 cm
1 Optical projector LED 6V
1 Lamp
1 Earth-Moon system
1 Lens +6 cm with lens holder rod
1 Lens +10 cm with lens holder rod
1 Lens -10 cm with lens holder rod
1 Protractor
1 Filter holder
1 White screen
1 Microscope slide with holder
1 Square ruler
1 Glass
1 Box
1 Experiment's guide

OPTICAL BENCHES, MODULAR SYSTEM

In this modular system it is possible to choose between two benches of different lengths (100cm or 150cm). It's possible to connect a joint extension of 50cm to each bench; this is very useful for doing optical experiments where the optical beam, due to the effect of reflections or refractions comes out from the main axis of the bench. With this optical bench, the teacher can run a large number of experiments on optical waves
It also recommends the use of a green laser cod. 4151, sold separately.
According to their teaching needs, the teachers can choose various accessories (sold separately) that make up the complex

4401 Optical bench, 100cm
4402 Optical bench, 150cm

4361 LED light source
4362 Optical bench extension 50cm
4363 Lens holder with rod
4365 Plexiglas white screen 250x190x4mm
4366 White screen with scale
4367 Screen support
4368 Optical bench laser
4370 Couple of polarizing filters
4372 Set of optically active substances
4373 Prism support
4374 Optical bench lux meter
4375 Iris diaphragm
4376 Punctiform lamp
4377 Earth-Moon system
4380 Adjustable slit
4381 Set of 4 plexiglas lens and two mirrors
4382 Set of 4 glass lens + 2 mirrors and container
4383 Horizontal goniometer
4371 Polarimetric tube
4212 Diffraction grating 500 lines/mm
4301 Support straddle

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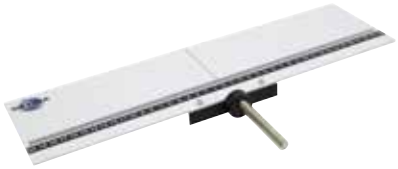

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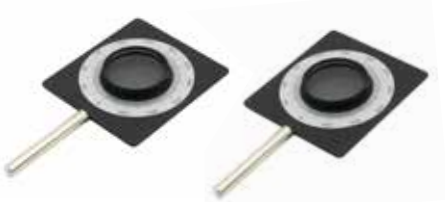

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4301

5680 Undulatory optics bench

CONTENTS

1. Optic waves
2. Dioptric projector
3. Diode laser
4. Optic waves speed
5. Polychromatic and monochromatic sources
6. Emission spectrum
7. Light diffraction
8. Diffraction through a hole
9. Diffraction through a slit
10. Measurement of λ
11. Interference of light
12. Interference according to Young
13. Diffraction grating
14. Linear polarization
15. Polarized light
16. Polarization by reflection
17. Brewster's angle

SUPPLIED EQUIPMENT

1 Off-axis arm
1 Linear ruler
1 Dioptric projector
1 Cylindical lens
1 Trasformer
2 Filter-holders
3 Coloured filters
1 Optical bench
1 Dark mirror
1 Stand for lenses
1 Set of 3 lenses
1 White screen
1 Kit for spectrum analysis
1 Laser with half-conductor
1 Adjustable slit
1 Diaphragm with hole 2 mm
1 Diaphragm with hole 0.4 mm
1 Diaphragm with hole 0.2 mm
1 Diaphragm with slit
1 Diaphragm with double slit
1 Diffraction grating
500 lines/mm
2 Polarizing filters
4 Straddlers
1 Optic prism
1 Horizontal protractor
1 Experiment Guide
1 Case

▶ 4080 120 cm, wave and geometrical optics bench

With this optical bench, the teacher can perform a great number of quantitative and qualitative experiments on both geometrical and undulating aspects of optic waves. This bench is a necessary educational instrument in order to make a lesson a real moment of union between theory and experimental reality, and this is because of the quickness of its assembly and the ease in performing the experiments.

CONTENTS

Rectilinear propagation of optical waves
Lunar and solar eclipse
Light scattering
Radiation law
Reflection laws
Reflection in spherical mirrors
Images in spherical mirrors
Refraction laws
Total internal reflection
Refraction through a prism
Refraction through lenses
Images in lenses
The eye and its imperfections
Optical instruments
The diode laser
Diffraction through a hole
Diffraction through a slit
Measuring the wavelength of a laser
Interference of light
Interference according to Young
Measurement of a wavelength with Young's method
Diffraction grating
Measurement of a wavelength with a grating
Measuring the wavelength of white light
Linear polarization
Polarized light
Natural rotatory power

SUPPLIED EQUIPMENT

1 Linear ruler
1 Red filter
1 Green filter
1 Blue filter
1 Semitransparent glass
1 Slide
1 Plexiglas semicylinder
1 Diaphragm with square hole
1 Plane mirror
1 Double symmetrical arc
1 Rectangular isosceles prism
1 Diaphragm with hole 2mm
1 Diaphragm with hole 0,4 mm
1 Diaphragm with hole 0,2 mm
1 Diaphragm with 1 slit
1 Diaphragm with 2 slits
1 Crown glass optical prism
1 Red diode laser with 3V power supply
4 Holder
1 Projector holder
1 Sphere with stem
1 Double spherical mirror +10 -10
1 Optical bench 120 cm
1 Movable LED projector with 6V power supply
1 White screen with graduated scale
1 Pair of polarizers
1 Polarimetric tube
1 Punctiform bulb
1 Earth – Moon system
1 Adjustable slit
1 Horizontal goniometer
1 Lens +6 cm with lens holder rod
1 Lens +10 with lens holder rod
1 Lens -10 with lens holder rod
1 Filter holder
1 Microscope slide with holder
1 Grating 500 lines/mm
1 Square ruler
1 Glass beaker
1 Large box
1 Experiments guide

▶ 4362 Optical bench extension 50cm (to be used with 4080).

5348 Set of 5 friction rods

The set is composed of 5 electrifiable rods: plexiglas, nylon, hard rubber, glass, hard rubber-brass.
With wool cloth, silk cloth and rod stand.
Diameter 12 mm length 25 mm.

FRICTION rods

5139 Hard rubber rod. Diameter 12mm length 25mm

5002 Plexiglas rod. Diameter 12mm length 25mm

5003 PVC rod. Diameter 12mm length 25mm

5058 Glass rod. Diameter 12mm length 25mm

5090 Double electric pendulum

If you bring an electrified body near the instrument, its two balls diverge because they acquire an electric charge of the same sign, due to the electric induction.

6440 Franklin Motor

It shows how electrostatic forces can be used to obtain motion.

5431 Volta's Electrophore

The item is composed of a polystyrene base that you can electrify by rubbing it; on this base there is an alluminum disk with insulating handle.
If you bring the disk near the electrified base several times, and each time you connect its upper face to the ground, it is possible to store big quantities of electricity on it, to the point that you can obtain electric discharges up to 1 cm long.

5085 Wimshurst's electrostatic machine

The item has two special disks which don't deform over the course of time. Two Leyda decomposable bottles.
Adjustable distributor. Spark: 50-60 mm. Disk diameter: 400 mm with disk supported by bearings for greater stability.

100% Plexiglas MADE

THE BIGGEST ON THE MARKET

5253 Wimshurst's machine

This is an economic, light and practical version.
Disc diameter: 30 cm
Sparks 25-30 cm long can be obtained.
This generator also lets you carry out the most significant electrostatic experiments.

5051 Set of accessories for electrostatic machines

The set includes: dance of the balls, double electric pendulum, 2 cables, paper plume, blowing point, electric whirl, candle with candle-holder , 2 crocodile clips with stand.

5408 Electric or hand driven Van de Graaff's generator

The item is powered by a low-voltage engine or by hand. It is able to produce a potential difference up to 300000 V with 10 cm long sparks.
Sphere diameter: 27 cm.

SUPPLIED EQUIPMENT

1 Power-unit 3-12V
1 Electric whirl
1 Sphere with stand
1 Electric feather
2 Cables100 cm
1 Pair of protective goggles

5404 Van de Graaff generator's equipment kit

It is composed of: universal stand; metal sphere with insulating handle; electric whirl; dance of the balls; Faraday's cage; Faraday's well; electrostatic engine; articulated discharger; spark panel; electric pendulum; blowing point; electric feather; two crocodile clips; two cables.

5714 Electrostatic cell

An hermetically sealed acrylic case, containing polystyrene tiny balls.
When the upper part is rubbed for a long time with a cloth, the electrostaic charge generated makes the balls move, demonstrating the action among charges.

5099 Electric whirl

The item can show the dispersive power of the points thanks to the mechanical effect.

5046 Electrostatic blower

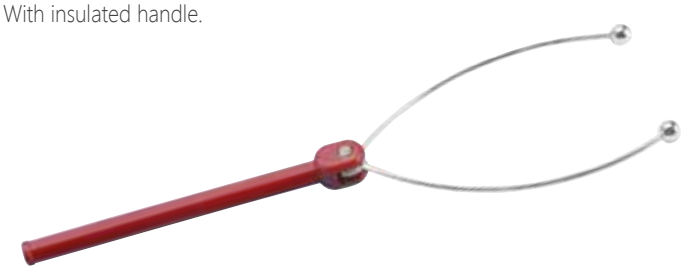
The item can show the dispersive power of the points.

5204 Point-shaped conductor

Made of nickel-plated brass, it enables you to experiment on charge distribution in insulated conductors.
Length: 220 mm.
Height: 300 mm.

5092 Articulated discharger

With insulated handle.



5091 Spherical conductor

For experiments on electrisation (through contact and through induction), on the potential and charge density in conductors.
Sphere diameter: 100 mm. Height: 370 mm.

5073 Electrostatic bell ring

If you connect the apparatus to an electrostatic machine, the pendulum hits the two bells alternatively because of the electric actions.
Height: 380 mm.

5087 Coulomb's sphere

For experiments on electrostatic induction (Faraday's well, for example)
It is supplied with electric spoon.
Sphere diameter: 100 mm.
Height: 370 mm.

5070 Cylindrical conductor

For experiments on electrisation (through contact and through induction), on the potential and charge density of conductors.
Cylinder length: 220 mm. Height: 320 mm.

5072 Cavendish's hemispheres and spherical conductor

The item can verify that the electric charges in metal conductors are distributed on their surface. If you put the sphere in contact with the hemispheres , the sphere discharges completely.
Sphere diameter 100 mm. Height: 370 mm

5071 Couple of cylindrical conductors

Being a kind of divisible conductor, this apparatus verifies the electric poles through the phenomenon of the electrostatic induction.

5140 Faraday's cage

The item is supplied with double electric pendulum, thus allowing the performance of experiments on the electrostatic screen.
Diameter: 120 mm.
Height : 260 cm.

5351 Device for showing the flux lines of the electric field

The item is composed of a tray made of transparent material, to be placed on an overhead projector, and of electrodes to be fixed along the rim of the tray. The latter is filled with castor oil; semolina grains float on the oil's surface. If you connect two electrodes to the poles of the high-voltage generator (code 5324) or to an electrostatic machine, the behaviour of the flux lines of the electric field becomes visible.
The item is supplied with 250 ml of castor oil and a bottle of semolina grains.

5089 Couple of conductors with electroscope

They have the same function as the previous couple of conductors code 5071, with the advantage of being connected to a two leaf electroscope.

5324 High voltage generator, 5KVdc

This generator is a necessary instrument to perform quantitative experiments on electrostatics.
Its use isn't dangerous for the operator because, even in the event of a short circuit, the maximum current reaches only 2 mA because of a great output resistance.
It is supplied with two highly insulating safety cables.
The output voltage is adjustable with continuity up to 5 kVdc.
Built-in digital voltmeter with 3 digits Fixed output 6.3Vac/3A.
Dimensions: 285x220x140 mm.

5093 Plate capacitor

It is a capacitor which allows you to prove that the electric capacity depends on the distance from the framework and on the dielectric material. It can be used to show the flux lines of a uniform electric field too.

5703 Electrostatic smoke precipitator

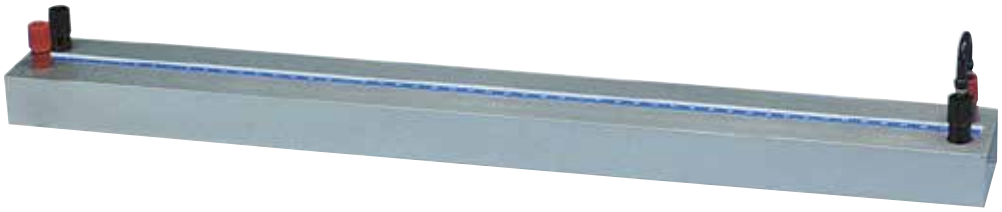
The smokes and powders coming out of the chimneys of those mills where toxic substances are used, contribute greatly to air pollution.
With this apparatus you can show how to obtain their elimination.
Using a rubber tube, a lit sigarette is put in communication with the inside of the flask.
If you suck out the air using the pump, the flask fills up with smoke.
The internal electrode, which is pointed, and the external plate must be connected to an electrostatic machine (we suggest the code 5085).
Switching on the machine, you will notice that , at first, the smoke spins around and then it disappears. If you repeat this operation several times, the walls become black. Cleaning the flask with a bit of white spirit, the tar contained in the cigarette's smoke melts down, allowing the teacher to show the damage caused to the airways.
Instruction guide included.

SUPPLIED EQUIPMENT

1 Büchner flask (or vacuum flask), 500 ml
1 Electrode tip with a rubber stopper
1 Suction pump with Rubber tube
1 Metal disk
1 Mohr's Clip (Clamp)
1 White spirit bottle
2 Wires
2 Crocodile clips

8504 Ohm laws' table

To be used with the set of wires code 8503 (see above) in order to test Ohm's laws.
Dimensions: 500x60 mm. It is supplied with a short-circuit bridge.



8503 Set of 4 metal wires, 10 m, Ø 0,3 mm

Components:
Nickel 0.88 Ohm/m
Costantan 6.98 Ohm/m
Nickel-Chrome 15.14 Ohm/m
Kantal 18.00 Ohm/m

5098 Series of conductors

For the verification of Ohm's laws.

Composed of:

1 Kanthal wire, Ø 0,35mm;
1 Constantan string wire, Ø 0,4mm;
1 Base
2 Nichel-chromium wire, Ø 0,3mm;
1 Jumper;

Dimensions: 1000 x 100 mm.

5130 Set for experiments on the electric circuits

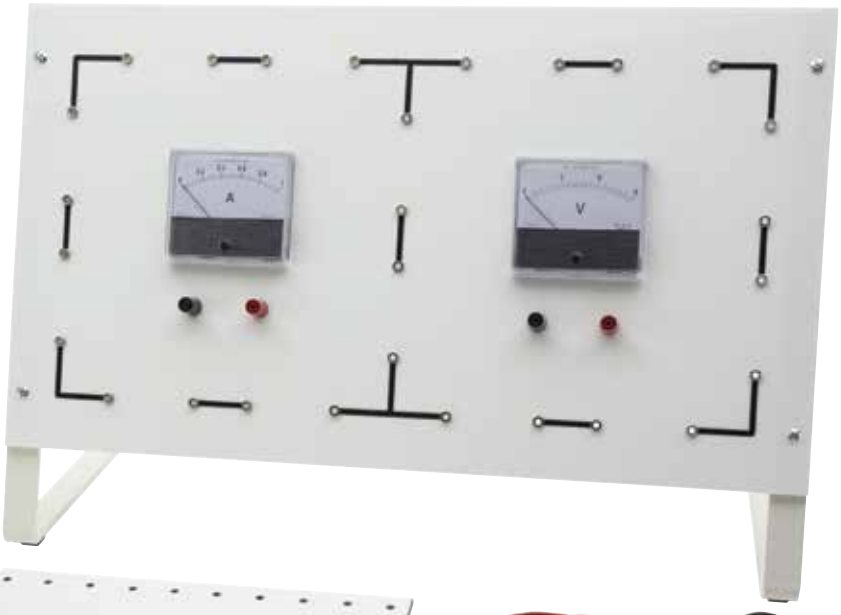
To be used with an electric, low-voltage power unit ,which can be adjusted from 0 to 12V.
Supplied with experiment guide. Structure made of painted metal.
Panel dimensions: 57x33 cm.

Contents

The electric circuit
The insertion of the switch
Current measurement with the ammeter
Voltage measurement with the Voltmeter
Verification of Ohm's first law
Charges in series
Charges in parallel
Electrical nets

SUPPLIED EQUIPMENT

1 Panel with two instruments
10 Bridges with short-circuit
2 Bridges with switch
2 Bridges with lamp
5 Bridges with resistor
4 Cables 30 cm
2 Cables 60 cm
1 Experiment Guide



5332 Modular set to study electric circuits

This modular set enables the performance of many experiments on electrical conduction, reducing to a minimum, the use of connecting cables. In this way, besides simplifying the operating production of circuits, their layouts are highlighted.
Assembly table dimensions: 45x33 cm.

15 EXPERIMENTS

CONTENTS
Lamp with a sole control.
The protective fuse
Lamps in series with a sole control
Lamps in parallel with a sole control
Lamps in parallel with deflector
Lamps with double control by means of deflector
Lamp with double control with power relay
Use of the voltmeter
Use of the ammeter
Ohm's first law
Ohm's second law
The rheostat
The potentiometer
Circuits in series
Circuits in parallel

SUPPLIED EQUIPMENT

1 Battery holder
1 Panel
6 flexible cables
10 Bridges
4 linear conductors
1 "T" shaped conductor
2 "L" shaped conductor
4 Insulators
2 lamp holder with lamps
2 Deflectors
2 Resistors
1 Fuse-holder
10 Fuses
4 Universal connector
1 Rheostat
1 Power relay
1 Spool of kantal wire
1 Spool of Nickel-chrome wire
1 Voltmeter
1 Ammeter
1 Didactic Guide
1 Case

5333 Support for mounting boards

For a better view of the circuits assembled on the table.
The above described modular set is not supplied; it must be bought separately.

5146 Silica diode on base

The item is mounted on plastic base 103x54x27 mm.
It can straighten up a half-wave.

5144 Thermistor NTC on base

The item is mounted on plastic base 103x54x27 mm.
Its resistance varies with a negative temperature.

5389 Thermistor PTC on base

The item is mounted on plastic base 103x54x27 mm.
It's resistance with a positive temperature.

5133 Photoresistor on base

The item is mounted on plastic base 103x54x27 mm.
It varies its resistance as a function of the light received.

5009 Lamp holder E12 on base

Dimensions: 103x54x27 mm.

5008 Switch on base

Dimensions: 103x54x27 mm.

5136 Deflector on base

Dimensions: 103x54x27 mm.

5132 Rheostat 22 ohm on base

Dimensions: 103x54x27 mm.

5137 Inverter on base

Dimensions: 103x54x27 mm.

5056 Resistor-holder and Capacitor-holder base

Dimensions: 103x54x27 mm.

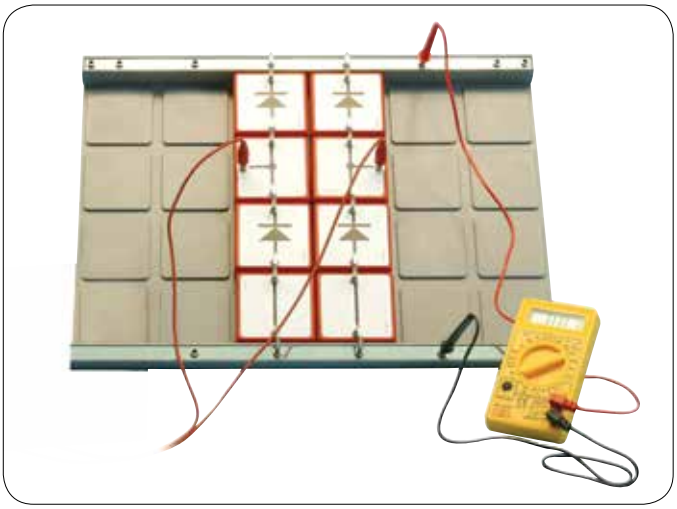
5433 Modular set for the study of basic electronics

This modular set allows you to perform several experiments on electronic principles: from reactive components to semiconductors.
The main advantage lies in the minimum use of connecting cables. In this way, besides simplifying the operative production of circuits, their layouts are highlighted.
The function generator (code 5718) required to perform the experiments with alternating current must be purchased separately.
For the direct current experiments, it is necessary the use of the generator code 5011, to be purchased separately.

18 EXPERIMENTS

CONTENTS

The condenser with direct current
Effective voltage and current
The condenser with alternating current
The capacitive reactance
The inductive reactance
The rlc circuit
Low-pass filter
High-pass filter
Conductivity in metals and semiconductors
P-n junction: the diode
The half-wave rectifier
The double half-wave rectifier
The filtered rectifier
The transistor
The transistor as interrupter
The transistor as amplifier
The photoresistor
The thermistor



SUPPLIED EQUIPMENT

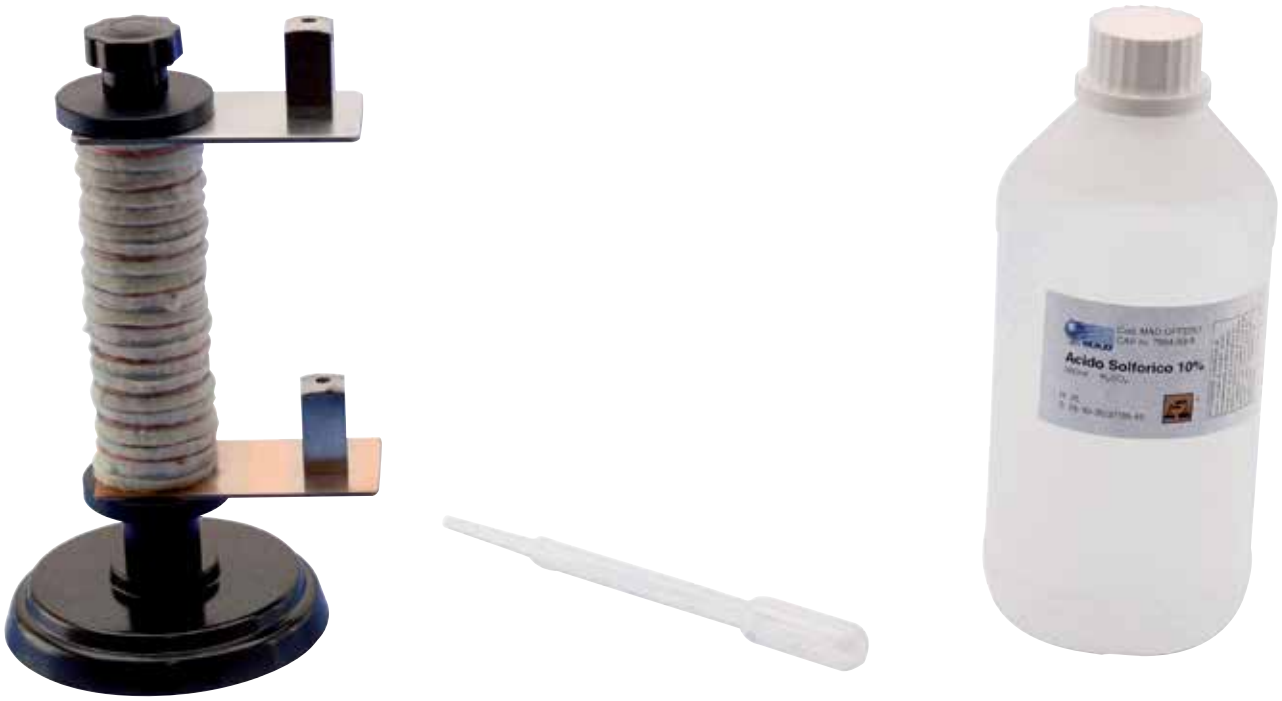
1 Module with lamp holder
1 Lamp 6V 2W
6 Tie cables 60cm
1 Mounting boards
5 Linear conductors
1 L-shaped conductor
2 T-shaped conductors
1 Module with deflector
6 Universal connectors
1 Set of 5 different condensers
1 Set of 5 different resistors
1 Module with potentiometer 2K 2A
4 Modules with silicon diodes
1 Module with transistor
2 Universal digital Multimeter
1 Cross conductor
16 U bolts
1 Module with inductor
1 Photoresistor
1 NTC 47 ohm – 50 ohm
1 Big box
1 Didactic guide

5333 Support for mounting boards

For a better view of the circuits assembled on the table.
The above described modular set is not supplied; it must be bought separately.

5124 Volta's battery, column type

It is made of copper and zinc parts, separated by felt disks soaked in an acid solution.
It is supplied with a bottle of acid solution.



5167 Volta's battery, cups type

The item varies its resistance with a positive temperature. It is composed of 4 voltmeters in series. It is supplied with copper and zinc electrodes, acid solution, cables and an LED assembled on a panel.

5350 Thermoelectric generator

The sensitive part of this item consists of a Peltier cell. It is in contact on one side with a small aluminium wing to be immersed in hot water, on the other side with a small basin to be filled with ice and cold water.
Due to the Seebeck effect, the difference in temperature produces a difference in potential that is noticeable at the terminals, this difference can make a small electric motor work: applying a difference in potential to the terminals (max 12V), due to Peltier effect, a great difference in temperature is set between the two faces of the ceramic block.

5287 Human battery

Placing your hand on two of the four metal plates (zinc, lead, aluminium and copper), you create a potential difference between the plates because of the electrical conduction properties of the human body.
This potential difference can be measured through the use of a millimetric voltmeter (not included)
Trying all possible combinations between metals, it is possible to guess the existence of the electrochemical series.

Plates dimensions: 15x23 cm.
Board dimensions: 23x65 cm.

5113 Apparatus for the electrical conductivity of liquids

Comprised of 4 bulbs in parallel. The electrolytic liquids must be poured into the four glasses, in which the electrodes are immersed.
With this simple device, the electrolyte solutions can be recognised and the variation of conductivity as a function of the concentration can be studied.

Hofmann's voltmeter

To verify Faraday's law.
With graduated tubes and their metal stands. Height: 70 cm.

- **5102** With carbon electrodes 100 ml total capacity.
- **5103** With platinum electrodes.

Replacements for Hofmann's voltmeter

- **5102.1** Glass part only.
- **5165** Carbon electrodes(couple).
- **5166** Platinum electrodes (couple).

- **5251** Demonstrative voltmeter

Non-graduated tubes, closed with latex small tubes and Mohr's pincers.
Supplied with stand and carbon electrodes.
Glass part height: 35 cm.
Total capacity: 60 ml

Steel magnets

5279 Linear rectangular magnet

Dimensions: 170x20x10 mm.

5281 U-shaped magnet

Dimensions: 55x10x14 mm.

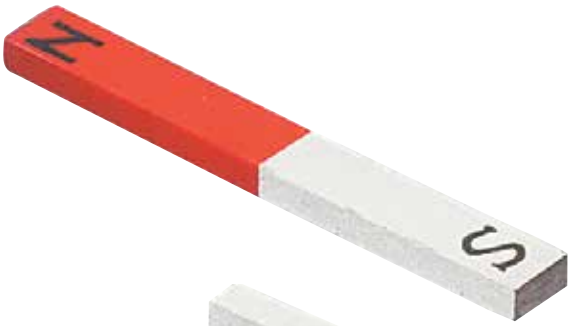
5286 U-shaped magnet

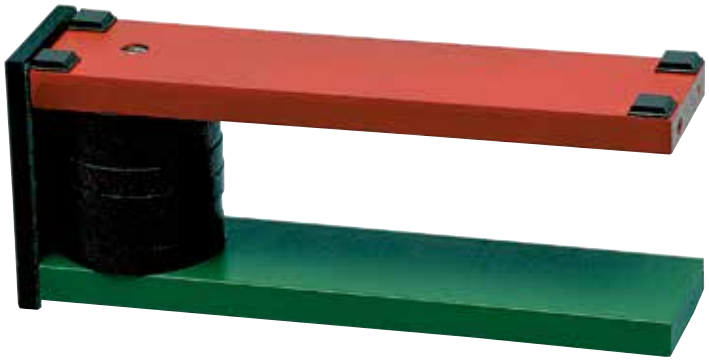
Dimensions: 75x16x40 mm.

5173 U-shaped magnet

Dimensions: 200x75x45 mm.

5206 Horseshoe magnet





Al-Ni-Co ALLOY MAGNETS

Made of cobalt and nickel alloy, these magnets are able to create magnetic fields much more intense than those created by steel magnets.
Moreover, their magnetisation lasts for decades.

Linear magnets with round section

5238 Dimensions: 60x6 mm circular, single.

5024 Dimensions: 100x10 mm circular, single.

5169 Dimensions: 150x12 mm circular, single.

5170 Dimensions: 150x12 mm circular, couple.

U-SHAPED MAGNETS WITH STAND

Dimension in mm

5077 U-shaped magnets

A=19; B=14; C=8; D=19; stand Ø 6mm.

5141 U-shaped magnets

A=29; B=22; C=11; D=29; stand Ø 6mm.

5182 Disk magnet

Made of SINTEROX/F. alloy
Diameter: 18 mm.
Thickness: 5 mm.

5183 Ring magnet

Made of SINTEROX/D alloy
External diameter: 51 mm.
Internal diameter: 24 mm.
Thickness: 9 mm.

U-SHAPED MAGNETS WITHOUT STAND

5382 U-Shaped magnet

80x52,7x21mm.

5383 U-Shaped magnet

130x80,5x30mm.

NEODYMIUM MAGNETS

Made of Neodymium- Iron-Boron alloy, these magnets produce an exceptionally intense magnetic field (about 1 Tesla).

8517 Ring magnet

External diameter: 25mm.
Internal diameter:10mm Height: 10 mm.

8516 Disk magnet

Diameter 25mm, height 10 mm.

MAGNETIC NEEDLES

5105 Magnetic needle

Mounted on a rod 120 mm and base.
Needle length: 75 mm.

5174 Magnetic needle with protractor

Mounted on rod 100 mm and base.
Needle length: 60 mm.

5135 Big didactic compass

Thanks to its dimensions it can be seen from far away.
Diameter: 200 mm.

5359 Set of 12 compasses

Diameter 25 mm height 6 mm.

5125 Magnetic forces apparatus

This item lets you visualise the remote action of magnetic forces.
With two ring magnets.

6154 Iron filings bottle 25 cc

5027 Apparatus to show the magnetic spectrum

Components:
1 "U"shaped magnet
1 Circular base
1 Plexiglas plate
1 Iron filings bottle

5322 Set of accessories for experiments on magnetism

POSSIBLE EXPERIMENTS
The magnet
Two magnetic poles
The compass
Magnetic forces
Magnetic induction
The magnetic spectrum

SUPPLIED EQUIPMENT

2 Magnetic needles
2 Linear alloy-made magnets
1 "U"-shaped steel magnet with stand
1 Plexiglas plate
1 Rotating stand
1 Iron filings bottle
1 Compass
1 Experiment guide
1 Case

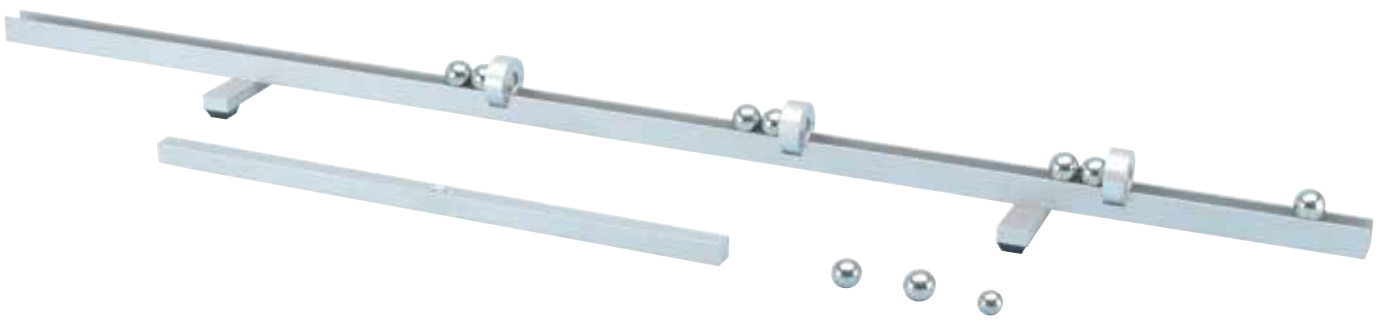
5369 1 Stage magnetic cannon (Gauss cannon)

The magnetic field of a permanent magnet decreases quickly as distance increases. The sphere in the charger, is located in the field of a powerful neodymium magnet; therefore it is abstracted by a force which increases quickly as the sphere's distance from the magnet decreases.
Once delivered, its potential energy turns into kinetic energy.
Two 1 stage cannons may be connected in series to create a 2 stage cannon.
Cannon length: 40 cm.

TWO MAGNETIC CANNONS IN SERIES

5370 3 Stage magnetic cannon

With 3 magnets and 10 spheres. Track length: 100 cm.



5026 Coil 400 turns, 1A

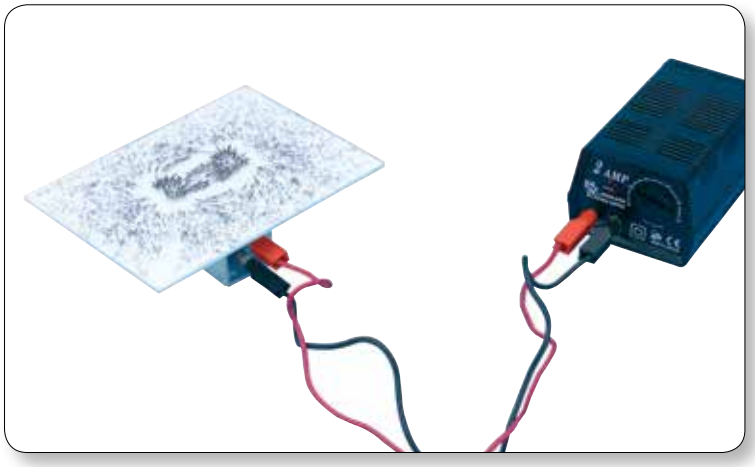
For experiments with electromagnetism.

5078 Coil 1600 turns, 1A

For experiments with electromagnetism.

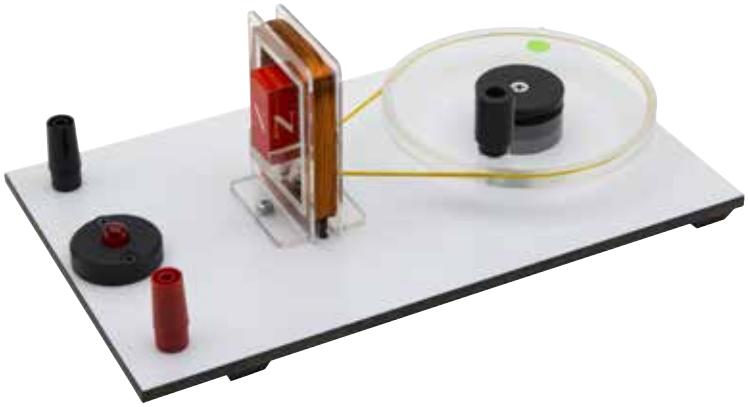
5356 Apparatus to show the field of an electromagnet

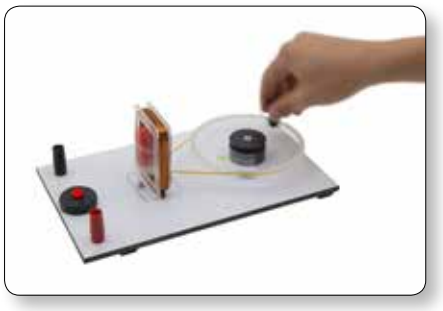
It consists of a plastic material plate and an electromagnet (composed of an inductor and a metal nucleus) which must be placed under the plate.
The item is supplied with a bottle of iron filings and an allen screw to assemble the electromagnet. Maximum voltage: 6V.
To be used with DC POWER supply unit.



5434 Generator model

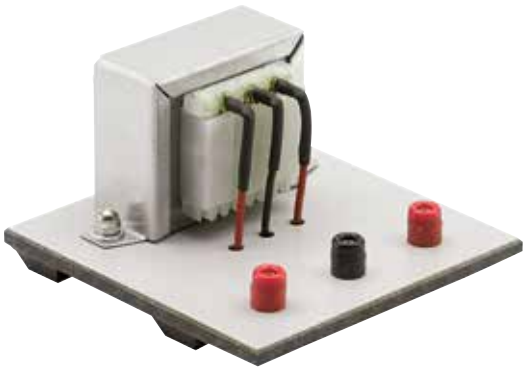
Turning the crank, the magnet rotates inside the coil inducing an electrical current that turn on the LED.





8510 Inductor

Features in alternating current 1 kHz:
L=0.22 H, R= 56 Ohm between two extreme poles;
L= 58 mH, R= 24 Ohm between an extremity and the intermediate pole
Features in direct current:
R= 0.6 Ohm between two extreme poles , R= 0.3 Ohm between an extremity and the intermediate pole.



5110 Linear Oersted apparatus

The item can show the magnetic effect of electric current flowing in a linear conductor. With magnetic needle.

5109 Circular Oersted apparatus

The item can show the magnetic effect of the electric current flowing in a circular conductor. With magnetic needle

5122 Oersted apparatus with two needles

The item can show the magnetic effect of the electric current flowing in a circular conductor through the use of 2 magnetic needles.

5110

5109

5122

5274 Horseshoe-shaped electromagnet

With anchor and stand.
Voltage: 6 - 12 Vdc o ca. Height: 30 cm.

5178 Extensible solenoid

This item allows the study of the magnetic field generated by a solenoid, because it is possible to vary the coil number per length measurement unit.
Once the magnetic needle has been positioned toward the earth field and the solenoid has been positioned in a perpendicular direction, the tangent of the needle's deviation angle is proportional to the intensity of the magnetic field and, therefore, to the intensity of the electric current and to the number of coils per length measurement unit.
To be used with generator code 5230 pag.190 or to be powered through a battery in series with resistance.
Dimensions: 63x15x20h cm.

5184 Electromagnetic actions kit

With this apparatus it is possible to experiment on currents-magnets and currents-currents interactions.

Components:
1 Frame 2 Cables 60 cm
1 Rectangular reel
1 "U" conductor
1 Linear magnet
1 Magnetic needle
1 "U" shaped magnet

5177 Apparatus for the verification of Lorentz force

It consists of two metal tracks where a cylindrical aluminium bar can roll while positioned in order to be immersed in the field of a permanent magnet.
Allowing the current to flow in the aluminium bar through the use of generator (code 5230) or of a battery in series to the resistance, the bar is given a force whose direction is determined through the "the left hand" rule.
Track length: 50 cm.

5179 Electromagnetic scale

The electromagnetic scale has a solid and elegant plexiglass structure.
One of the two arms ends with a rectangular aluminium coil immersed in the field of a powerful permanent magnet. The other arm has two sliding masses, which allow the item to obtain equilibrium at rest. Allowing the current to flow through the use of apparatus code 5361, a force ***F*** appears between the magnetic field ***B*** and the electric current ***i***, whose value is given by the Ampere law:

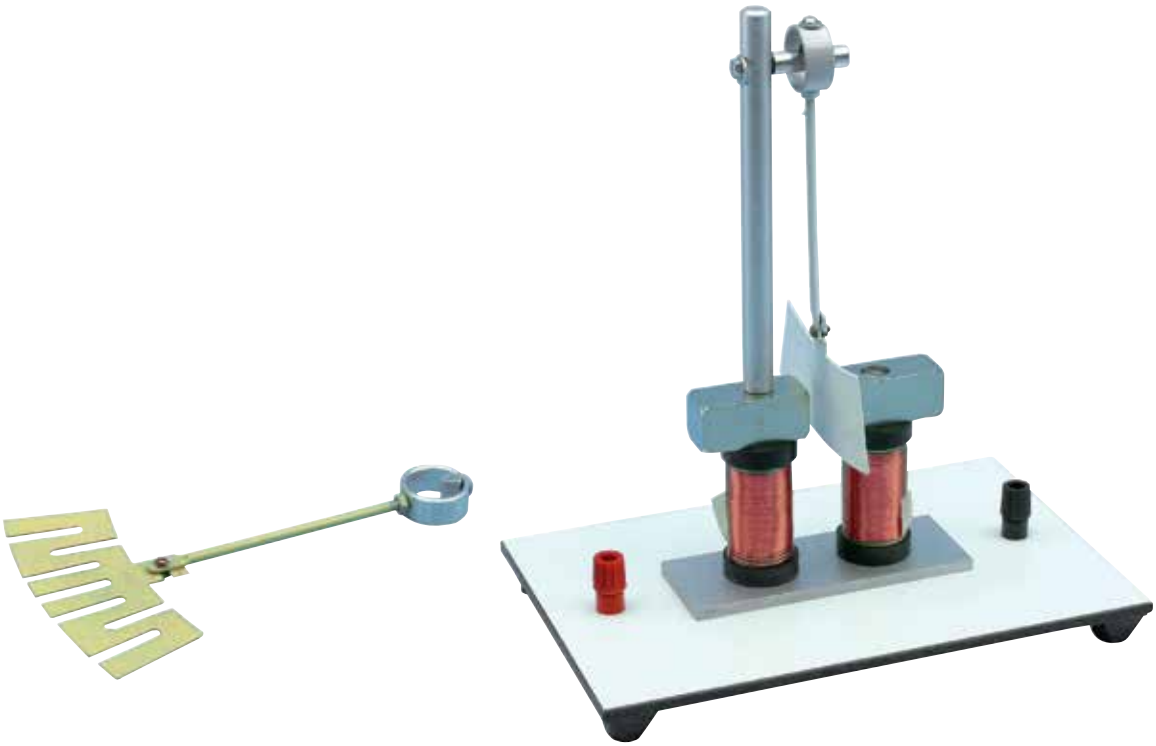
$F = B \cdot l \cdot i \cdot \sin \alpha$

where ***l*** is the length of the conductor and α is the angle created between the conductor and the magnetic field. It is possible therefore to verify that the intensity of the force reaches its maximum when α=90° and it is zero when α=0°. Using the power supply, the value ***i*** of the electric current can be read with an ammeter and, therefore, it is possible to deduce the permanent magnet's induction value ***B***. The experiment can be repeated replacing the permanent magnet with the solenoid. In this way it is possible to verify the ratio which gives the value of the magnetic field inside a solenoid.
Scale sensibility: 10 mg.
Dimensions: 58x18x17cm.

Components:
1 Scale
1 Solenoid
1 Permanent magnet
1 Weight box 200 g with gram fractions

5120 Waltenhofen pendulum

If you allow two aluminium sectors, one whole and the other cut, to oscillate with the excited magnet, you can see that the oscillation slows down more quickly in the first instance, because of the parasitic currents.



5114 Modular transformer

It consists of a nucleus made of laminated ferromagnetic material which can be divided into two parts (one is "U" shaped, the other straight) in order to replace the coils. Max. applied voltage: 6Vac.

CONTENTS

The electromagnetic induction
Verification of Neumann's law
Verification of Lenz's law
Transformation of alternating voltages
Transformation of alternating currents
The auto - transformer
Thomson's ring
The induction oven

SUPPLIED EQUIPMENT

1 Tripod base
1 "U"shaped nucleus made of laminated iron
1 Closure yoke
1 Support rod
1 Coil 1600 turns
1 Coil 400 turns
1 Coil 50 turns
1 Aluminium ring
1 Melting pot with handle

1342 Apparatus to verify the electromagnetic induction law and the principle of action-reaction

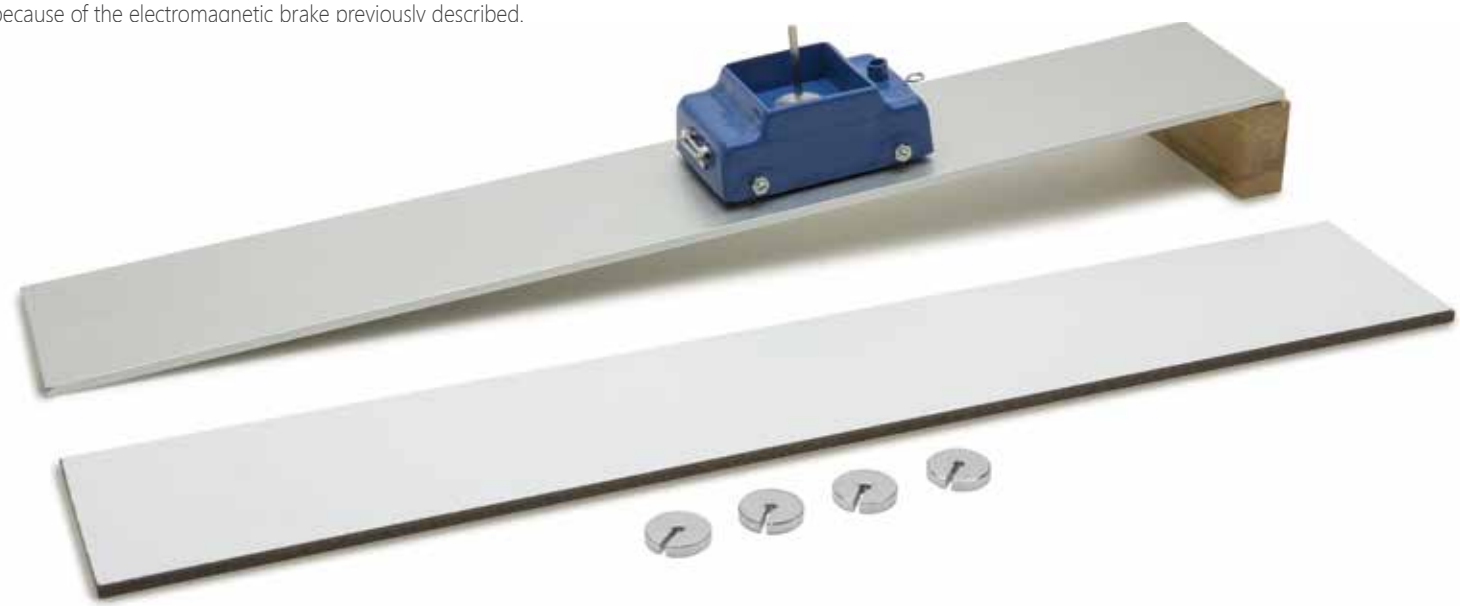
Inside the aluminium tube, a magnet falls with uniform motion.
The explanation is the following: during the fall of the magnet, the aluminium tube is linked to a variable magnetic flux and therefore it has induced currents whose directions, according to Lenz's law, are opposite to what has generated them, i.e. the magnet's motion, in this case. The consequence is that the latter , in the beginning phase, falls with uniformly accelerated motion because it's moved by a vertical force whose intensity is equal to the difference between its weight P and the electromagnetic force F. This force is proportional and opposed to the speed of the fall, i.e. it is a viscous force: $F = - kv$. The moment the magnet reaches the speed v_0 so that $P - kv_0 = 0$, its motion becomes uniform.
Thanks to the principle of action and reaction, the magnet reacts on the tube with an equal and opposite force and, therefore, during the fall with uniform motion of the magnet, the spring scale measures a force with an intensity equal to the sum of the tube's and the magnet's weights.

SUPPLIED EQUIPMENT

1 Table clamp
2 Dobble bossheads
1 750 x 10 mm rod
1 Spring scale 1000 g
1 Kit of magnets
4 10 g masses, diameter 4 mm
1 Aluminium tube with ring-shape support
1 Container to collect the magnets
1 Ring-shape PVC support for tube
1 Support for spring scale
1 Didactic guide

5327 Uniform motion trolley

Along the inclined plane made of plastic laminate, the motion of the trolley is uniformly accelerated; along the aluminium inclined plane, the motion is uniform because of the electromagnetic brake previously described.



5263 Set for the study of electromagnetic waves

BEST SELLER

By performing these experiments within the microwave spectrum, whose wavelength is 2.7 cm, it becomes easier for students to understand the analogy with light wave theory.

CONTENTS

Reflection
Refraction
Prism deviation
Diffraction
Stationary waves
Polarization
Absorption and the refractive index

CHARACTERISTICS OF THE MICROWAVE TRANSMITTER

Frequency range: 11±1.1GHz
Output power: ≥10mW
Modulation input signal: 1KHz off-on music
Modulation output signal: ≥ 1Vpp
Power: 220 ± 22V 50Hz

CHARACTERISTICS OF THE RECEIVER WITH AMPLIFIER

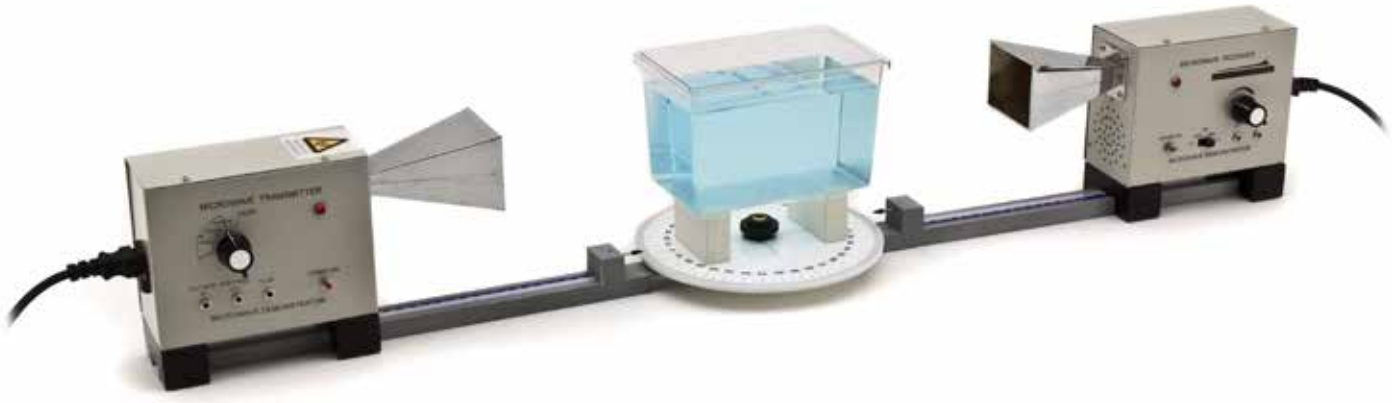
Amplifier Gain: ≥ 60dB
Power: 220 ± 22V 50Hz
Power consumption: ≤ 5W

MATERIAL PROVIDED

1 Microwave transmitter with power cable
1 Microwave receiver with amplifier and power cable
1 Dipole areal with knight and conjunction cable to the receiver
1 Link cable receiver – measure tool (tester-oscilloscope–tension sensor)
1 Thin metallic layer 150mm x 150mm
1 Thin metallic layer with one slit: slit width 22mm
1 Thin metallic layer with two slits: width of each slit 22mm
1 Grid with 5 slits: slit width 22mm step 26.4 mm
1 Grid with 11 slits: slit width 3mm
1 Paraffin prism
1 Alignment system junction provided with goniometer
1 Plexiglas basin
1 Polystyrene panel
1 Linear ruler
1 Goniometer with hub
1 Knight holder for thin layers

5263 - Reflection

5263 - Absorption



5292 DC Power supply

Suitable for powering electronic tubes.
Powering voltage: 300VDC.
Output voltage: 0 - 250 VDC
adjustable 0 - 30 VDC
6.3 VAC fixed.

5222 Cathode ray tube for magnetic deflection

In this tube a white, fluorescent screen, appropriately inclined, allows you to visualise the deflection of a beam of electrons produced by a magnet. We suggest the use of the "U" shaped magnet code 5173.
To be used with 5cm Spark induction coil.

5223 Cathode ray tube with whirl

This tube enables you to show the mechanical effects of cathode rays. In fact a small, fluorescent whirl , which can rotate with little friction, starts spinning the moment the cathode ray beam hits it. To be used with 5cm Spark induction coil.

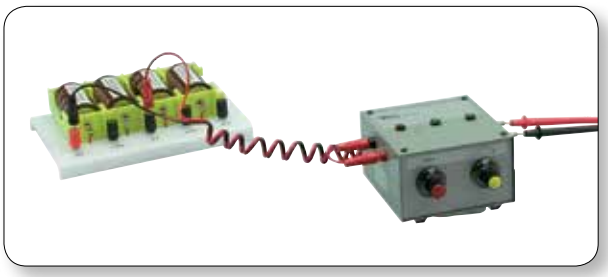
5324 High voltage generator, 5kvdc

This generator is indispensable for the performance of quantitative electrostatic experiments.
Its use doesn't present any danger to the user as, in the event of a short circuit, the maximum current output is limited to 2 mA by the presence of a high resistance output. Supplied with two safety cables for high- insulation.
Output voltage continuously adjustable up to 5 KVDC. 3 digit digital voltmeter integrated.
Fixed output 6.3 VAC/3A.
Dimensions: 300x180x100h mm.

5224 Malta cross tube

With this tube it is possible to prove that cathode rays spread in a straight line. A Malta cross- like metal screen can be placed to intercept the cathode ray beam, producing a shadow zone on the screen which satisfies the laws of rectilinear propagation. To be used with 5cm Spark induction coil.

5410 Planck's constant measurement kit



The measurement of Plack's constant can be obtained also exploiting the quantum properties of the LED diodes.
If a LED diode is directly polarized, it starts emitting light the moment the potential energy eVs, produced by the electrons, is enough to make them pass from the conduction band to the valence band (Energy gap).
As consequence of this energy gap , every electron emits one photon of energy.

$$hf = eVs$$

If you know the potential Vs in correspondence of which the LED starts emitting a weak light , it is possible to go back to the value of h.
3 LED are supplied, red green and blue, in order to verify that the higher the energy gap is, the more intense the emitted light frequency becomes.

5392 Led light wavelength measurement kit

The light emitted by a LED, is not monochromatic; it covers a small frequency band.
If you want to measure Planck's constant with a LED , it is necessary to know this band medium frequency, which is easy to measure with this kit that exploits the diffraction grating.

SUPPLIED EQUIPMENT

1 Linear ruler
1 LED projector with power unit
1 Lens +10 with lens holder
1 Filter holder
1 Diffraction grating 500l/mm
1 Base for LED
3 Bases
1 White screen
1 Case
1 Didactic guide

5413 Set for the study of solid state physics

In 1948 when American physicists H. Brattain, W. and J.Bardeen Shockley discovered the transistor effect, the electronic technique has implemented an extraordinary evolution.

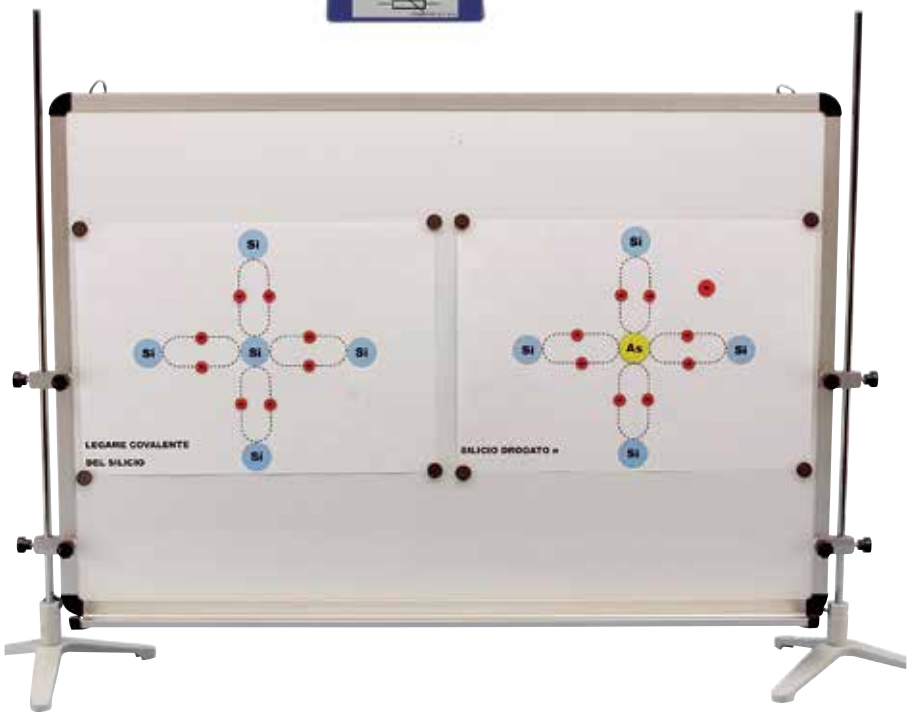
Since when, in 1948, the American physicists H. Brattain, J.Bardeen and W. Shockley discovered the transistor effect, the electronic technology has seen an amazing development. The technology world is everyday more and more dominated by semiconductors, and the energetic future of mankind is tightly linked to them.
But the functioning of the devices which employ the semiconductors is based on the principles of quantum physics, whose fundamental notions are normally included in the educational curriculum of high schools.
This set has been designed to make it easier for students to grasp concepts which are not that intuitive.
It consists of a series of explanation charts to be applied on a magnetic blackboard and of magnetic tokens representing ions, electrons and gaps.
The interactive feature of the set allows the teacher to simulate some processes of interaction between photons and matter, showing the passages from a situation to the following one.

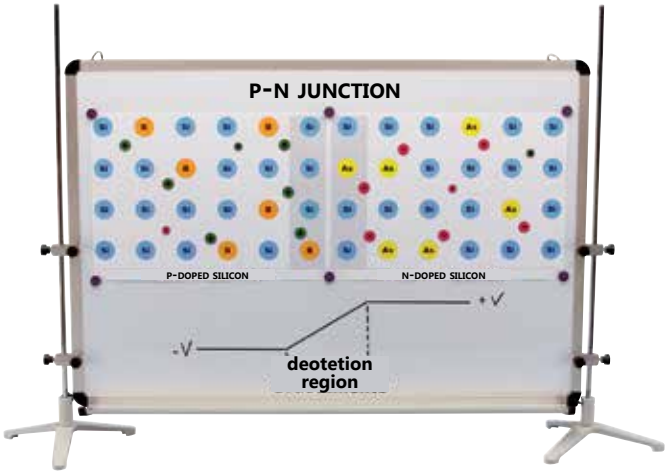
CONTENTS

Atomic energy levels
The metals crystal lattice
Energy bands
Allowed bands and forbidden bands
Insulators, conductors and semiconductors
The Ohmic conductor
The PTC thermistor
The NTC thermistor
The photoresistor
Semiconductors doping
The junction diode
The Led
How to measure the Planck's constant
The reversibility of the Led
The photovoltaic cell
The solar panels

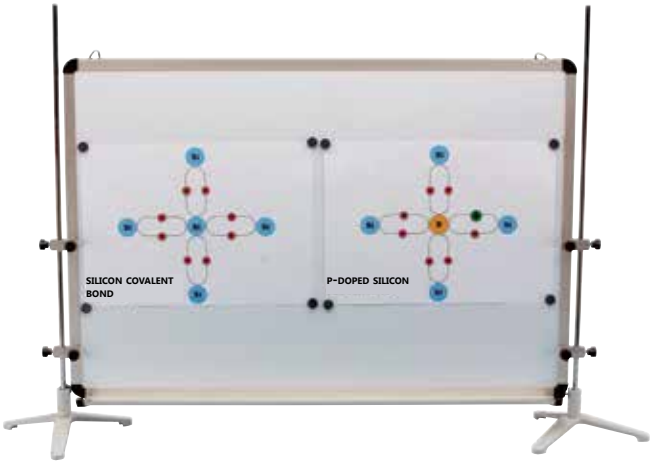
SUPPLIED EQUIPMENT

1 Red filter
1 Green filter
1 Purple/blue filter
1 Resistor holder base
1 Photoresistor on base
1 Thermoresistor NCT
1 Silicon Diode on base
2 Portable digital multimeters
1 Photovoltaic panel
1 PTC thermistor
1 Red led on base
1 Green led on base
1 Resistor 10 Ω 7W
1 Resistor 1 KΩ 2W
1 Resistor 100 Ω 2W
1 Set of 11 Tables
1 Small case for tables
1 Set of magnetic tokens
1 Didactic guide
1 Box





5413 - p-n junction



5413 - p-doped silicon

J265 Franck-Hertz apparatus

This device allows you to perform the famous experiment – which dates back to 1914 – by Franck and Hertz, who confirmed Bohr's theory on the quantification of energy in an atom.
This device includes a power supply unit equipped with analogue instrumentation and, inside it, a neon electronic tube.

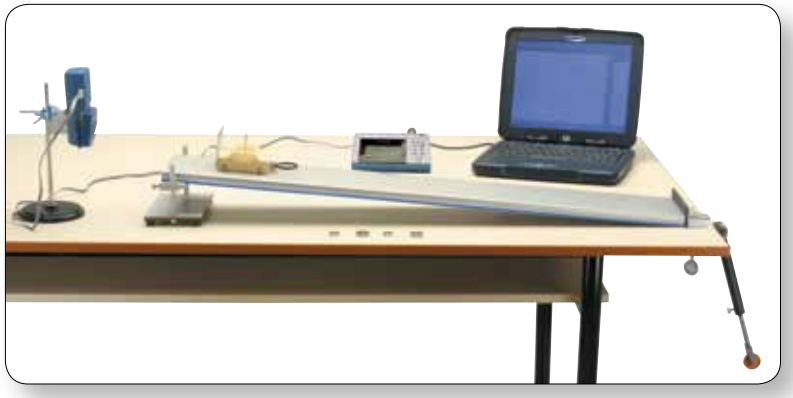
8101 Motion plane

The motion plane together with the two "punctiform" friction-trolleys and with the "non-punctiform" trolley allows you to perform several experiments on motion using RTL (Real Time Laboratory) techniques.
The didactic interest of the executable experiments with this item is multiple. In fact the student can:
- familiarise himself with the magnitudes characterizing the motion;
- learn how to correlate the distance-time graph with the speed-time and acceleration-time graphs;
- measure the intensity of frictional forces and gravity acceleration;
- study how potential and kinetic energies vary according to time and distance

EXPERIMENTS
Rectilinear uniform motion;
Uniformly accelerated motion;
Basic Law of dynamics F = m a;
The inclined plane;
Rolling (with the kit code 8105);
The principle of energy conservation;
Friction forces;
Elastic collision against a wall.

SUPPLIED EQUIPMENT

1 Plane, length:100 cm and width:25 cm, graduated in mm, sturdy and perfectly linear, one of the surfaces made of plastic laminate and the other made of anodized aluminium;
1 Device to tilt the plane;
1 Rigid shore for elastic collision;
1 Soft shore to absorb the collision;
1 Screen for the distance sensor;
1 Linear ruler;
1 Table boss-head with telescopic bar and low-friction pulley with brief inertia inactivity moment;
1 Weight -holder plate which reflects ultrasounds emitted by the distance sensor;
1 Reel made of fine and resistant wire;
5 10 g Weights
1 Punctiform friction-trolley
1 Magnetic punctiform friction-trolley
1 Support for sensors
4 40 g Weights
1 Experiments guide.



8101 - INCLINED PLANE

REQUIRED MATERIAL NOT SUPPLIED

1 Distance sensor + interface, or 1 usb distance sensor.

8119 Low friction track

Anodized aluminium track, length: 120cm, on which two friction-trolleys, fitted with two wheels mounted on low-friction bearing can scroll.

EXPERIMENTS:
Uniform motion;
Accelerated motion;
Motion on an inclined plane;
Pulse theorem;
Elastic collisions in isolated systems;
Inelastic collisions;
Harmonic oscillations of a mass - spring system;
Conservation of mechanical energy.

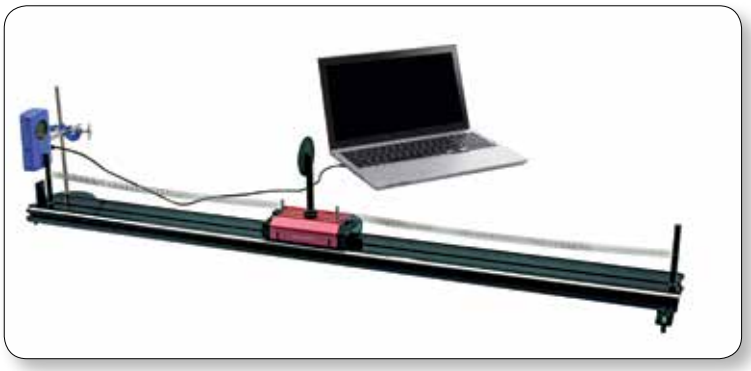
SUPPLIED EQUIPMENT

1 Track, length: 120 cm
1 Stand with one support
1 Stand with double support
1 End run shore
1 End run with pulley
2 Photocell supports
2 stands with bar
1 Additional mass, 500g
1 Series of 9, 10 g weights with weight holder
2 Pivots for springs
1 Linear ruler
2 Coil springs
1 Central pivot
2 Side pivots
1 Cord
1 Elevator for inclined plane
1 Friction-trolley with buffer
1 Friction trolley without buffer
2 Reflectors
8 Magnets
1 Allen key
1 USB cable extension
1 Small case
1 Experiment guide

REQUIRED MATERIAL NOT SUPPLIED

2 Distance sensor
1 Force sensor + interface
or
2 USB Distance sensor
1 USB Force sensor

8119 - MOTION ON AN INCLINED PLANE



8119 - OSCILLATIONS OF A MASS-SPRING SYSTEM

▶ 8116 200cm, air track

It is essential to minimize friction in order to study some phenomena related to motion.
Otherwise, it wouldn't be possible to study the uniform rectilinear motion and the conservation of motion quantity in the collisions.
The track is the only item which can minimize the friction to low levels. This model has a triangular section and is very sturdy in order to prevent deformations due to temperature changes.
The analysis of data is performed through RTL techniques which are an innovation compared to older techniques, due to the photocell terminals.
The use of RTL lets you:
- perform the experiments in a small space, even directly in the classroom, and quickly.
The graphs are made in real time;
- analyse immediately the data measured according to the time;
- adapt a model to experimental data, finding the curves that better fit the graphs up;
- see the evolution of quantities not directly measurable, such as the potential energy, the kinetic energy and the quantity's variation of motion and pulse forces.

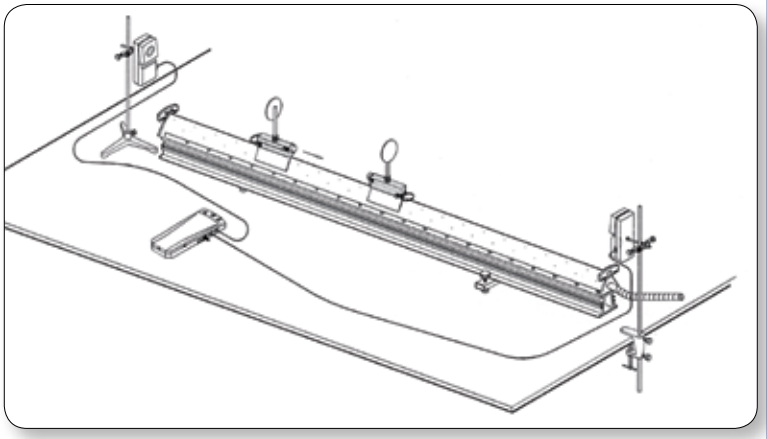
EXPERIMENTS:
Set up and balancing the apparatus
Uniform linear motion
Glider motion along an inclined plane
The fundamental law of dynamics
The conservation of energy principle
Impulse and quantity of motion
Elastic collision against a fixed wall
The conservation of momentum
Elastic collision between two gliders with the same mass
Elastic collision between two gliders with a different mass
Inelastic collision between two gliders
scillation of a mass-spring system

SUPPLIED EQUIPMENT

1 Metallic bar 500 x 10 mm
1 Table clamp
2 Strings
1 Tripod base
5 S-hooks 0.8g
2 Bossheads
1 Folding ruler
1 Vernier caliper
1 Air compressor
1 Metallic bar 750 x 10 mm
2 Neodymium magnets
1 Hook for recovery of the string from the pulley
2 Support disks for track
4 Drop disks
3 Spring buffer
6 Fixing thumbscrew
4 Masses of 12,5 g
4 Masses of 12,5 g
1 Cotton string
1 Pair of coil springs
4 U-shaped spring holder
2 Steel wires for cleaning holes
2 Gliders
1 Elastic buffer
1 Weight holder of 5g
1 Series of 4 weights of 5g
1 5 mm darkening foil
1 40 mm darkening foil
1 60 mm darkening foil
1 Couple of velcro shock absorbers
1 Screwdriver
1 200 cm track with supports
2 Reflectors for sonar
2 U-shape fixing device for magnets
1 Stopping plate
1 Square pivot
1 Box
1 Didactic guide

REQUIRED MATERIAL NOT SUPPLIED

2 USB Distance sensor
1 USB Force sensor
1 Precision scale



8106 Atwood machine

Thanks to this item it is possible to perform experiments on kinematics and body dynamics in translational motion and to measure gravity acceleration carefully. Using the item code 8107 it's also possible to study uniform motion.

EXPERIMENTS:
Uniform rectilinear motion;
Uniformly accelerated rectilinear motion;
The second Law of dynamics;
Measurement of the acceleration due to gravity;
Principle of energy conservation.

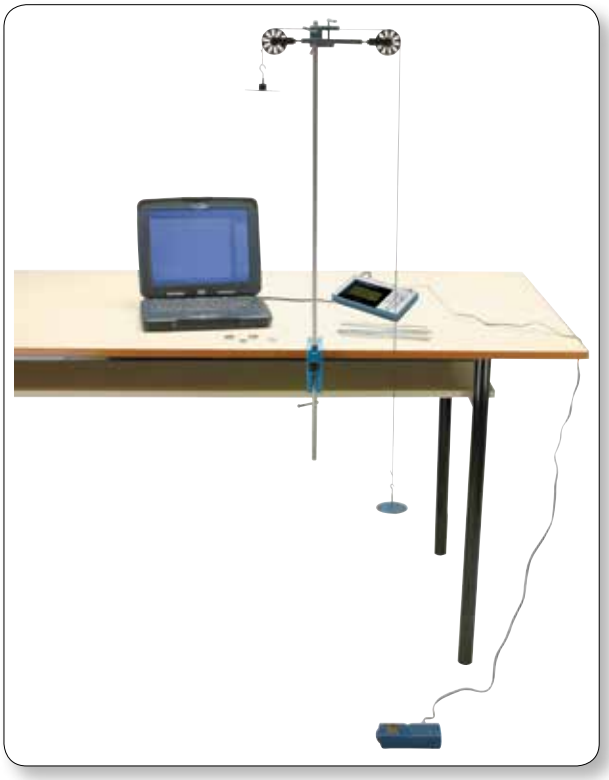
The uniform motion is feasible through the Atwood machine using two opposite equal masses. It is easier and more visible to perform it through the item code 8107.

SUPPLIED EQUIPMENT

1 System composed of two pulleys at low friction and with negligible inertia moment
2 Weight-holder plates
4 10 g Mass
1 Thin resistant skein of cord
1 Set of small, lead balls, 0.25g
1 Experiments guide

REQUIRED MATERIAL NOT SUPPLIED

1 Table clamp
1 Metallic rod 12x1200
1 Boss-head
1 Distance sensor + interface or USB distance sensor



EXPERIMENT WITH THE ATWOOD MACHINE

8107 Uniform linear motion apparatus

This item is composed of a couple of neodymium magnets which are dropped into an aluminium tube. During their fall, the tube is the centre of induced forces which, due to Lenz's Law, oppose the magnets motion. The kit of magnets is submitted to a force F = - k v, which is proportional and opposite to the speed. Therefore, after a brief transitional phase, the motion of the two magnets becomes uniform thanks to this force.Connecting trolleys or other objects to the magnets through a cord, it is possible to obtain the uniform motion of these objects.

EXPERIMENTS:
Falling of a magnet in an aluminium tube;
Verification of the action-reaction law;
Uniform motion with Atwood machine (cod. 8106).

UNIFORM MOTION WITH THE ATWOOD MACHINE

In order to realize the third experience of the uniform motion is necessary to have the appliance code 8106.

SUPPLIED EQUIPMENT

1 Base for rod
2 Dobble bossheads
1 1000 x 10 mm rod
1 Spring scale 1000 g
1 Kit of magnets
1 Perforated stopper
4 10 g masses, diameter 4 mm
2 Clamps with bosshead
1 Aluminium tube with ring-shape support
1 Container to collect the magnets
1 Ring-shape PVC guide for tube
1 Support for spring scale
1 Didactic guide

REQUIRED MATERIAL NOT SUPPLIED

1 Balance
1 Atwood machine cod. 8106
1 USB Distance sensor

8109 Apparatus for the analysis of rotational motion

It's rare to find in a physics laboratory, the equipment for a complete study of the rotational motion laws. This argument, in fact, is usually overshadowed by the study of linear motion. This item allows the study of both rotational and linear uniformly accelerated motion, by using a stopwatch (not included in this kit). If you have a data acquisition system with a distance sensor, you can refer to the last chapter of the didactic guide which explains how to use this tool for the study of the rotational motion. We recommend our model code 9066. The application fields of the experiments available with this device are various, such as:

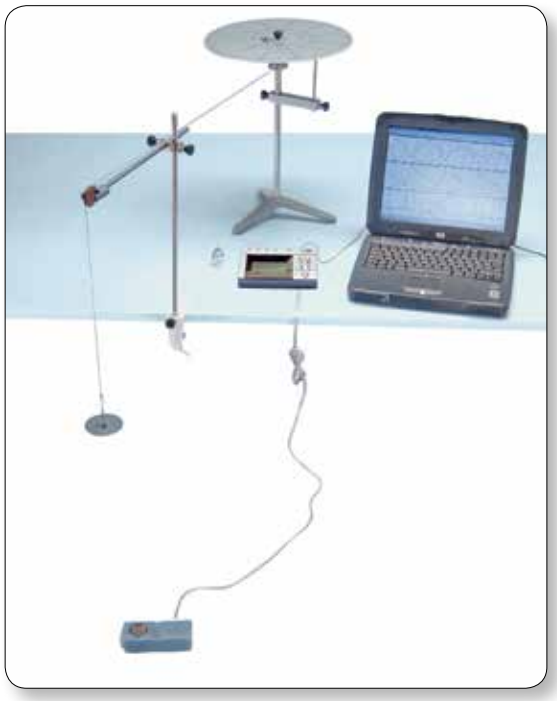
- to become acquainted with the angular sizes characterizing the rotary motion;
- to learn how to recognize the formal similarities between the Laws of rectilinear and rotary motion;
- to learn how to measure the inertia moment of the bodies or of a masse' distribution;
- to verify the conservation principle of energy.

TOPICS:
- Uniform circular motion and harmonic motion
- Kinematics of rotational motion
- Similarities between translatory and rotational motion
- The dynamics of rotational motion
- The fundamental law of rotational motion
- The moment of inertia
- The kinetic energy of rotational motion
- Conservation of mechanical energy
- How to use the distance sensor

In absence of losses, the variation of the plate's potential energy has to be equal, in each moment, to the sum of the plate's translational kinetic energy plus the rotational kinetic energy of the disc or of the handle:

$$mpg\ h = mp\ v^2 + I_0\ \omega^2$$

I_0 is the mass-centred inertia moment and ω is the angular speed.
The graph below shows the potential energy variation in green, the rotational kinetic energy in blue, the translational kinetic energy in magenta and the total energy in red. The translation energy is insignificant due to the small mass and the low speed. In addition, the total energy is not constant but it is subject to a slow decay caused by inevitable friction.



SUPPLIED EQUIPMENT

1 Tripod base
1 Rod with chuck
1 Clamping device
1 Rod with sphere
1 Rod for balancer
1 Red mass with locking screw
1 Green mass with locking screw
1 Aluminium disc (diameter 320 mm)
1 20 g weight holder
5 10 g disc weights
5 20 g disc weights
1 Table clamp
1 Boss head
1 Rod with pulley
1 Metal rod (10x470 mm)
2 Skeins of string
2 Pins
1 Folding ruler
1 Didactic guide
1 Box

8120 Kit to study translational rotational and oscillatory motion

This kit has been designed to allow students to perform experiments on translational, rotary and oscillatory motion in real time, using a distance sensor.

EXPERIMENTS:

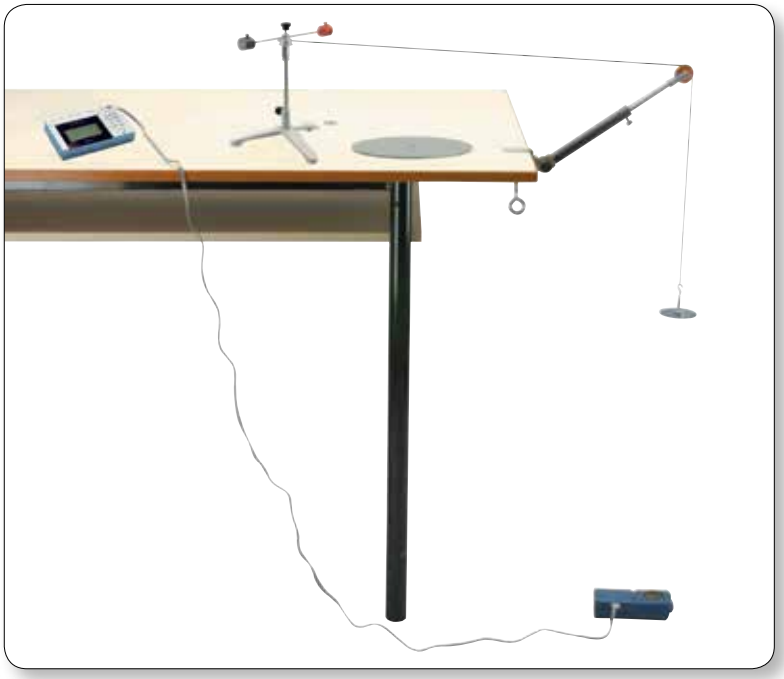
Uniform rectilinear motion
Uniformly accelerated rectilinear motion
Newton's Laws
Kinetic energy
Potential energy
Conservation of energy
Kinematics of rotary motion
Dynamics of rotary motion
Inertia moment
Harmonic oscillations
Simple pendulum
Compound pendulum

SUPPLIED EQUIPMENT

1 Tripod support
1 Metallic rod, 75 cm
1 Boss-head
1 Table boss-head with pulley
1 Support for chuck
1 Chuck for balancer
1 Balancer with two masses
1 Metallic disc
1 Simple pendulum
1 Compound pendulum
1 Support for Atwood disc
1 Atwood disc
1 weights-holder
1 Masses-holder plate
2 10 g Masses
1 Linear ruler
Lead balls
Cord

REQUIRED MATERIAL NOT SUPPLIED

1 Distance sensor + interface or USB distance sensor



8120 - STUDY OF OSCILLATORY MOTION

8120 - STUDY OF OSCILLATORY MOTION

8123 Galileo's cart

Thanks to this cart it is possible to perform experiments on reference systems in translational motion. It is fitted with an electromagnet which holds a steel sphere at a level of 25 cm over the cart's plane.
The release of the sphere is controlled by a photocell which can be activated through a simple torch.
The falling point of the sphere is imprinted on a strip of carbon paper, letting students check Galileo's relativity principle for the systems in uniform and accelerated motion both on an horizontal and on an inclined plane.

SUPPLIED EQUIPMENT

1 Low friction cart
2 Steel spheres
5 Carbon paper rolls
1 Torch
1 Support for torch
2 Neodymium magnets
1 9V battery

REQUIRED MATERIAL NOT SUPPLIED

1 Motion plane
1 Distance sensor
1 Callipers
1 Data acquisition system

8123 - HOW TO USE GALILEO'S CART WITH THE MOTION PLANE

8105 Kit to study rolling motion

The motion of bodies which roll on a plane is roto-translational because they translate while they roll. Their rolling motion doesn't occur around the axis which goes through the centre of gravity but around the axis that goes through the point of contact with the rolling plane.
A rolling body generates two types of energy: translational kinetic energy Et and rotational kinetic energy Er expressed in the following way:

$Et = m\ v\ 2\ Er = I_0\ \omega^2$

I_0 is the inertia moment as regards the axis of the centre of gravity, which has a great importance in the energy balance because the way the total kinetic energy distributes into the two forms depends on its value.
It is easy and instructive to perform experiments on rolling body dynamics, particularly using RTL techniques and this kit.

The energy balance, not considering the losses due to friction is expressed as following:

$m\ g\ h = m\ v^2 + I_0\ \omega^2$

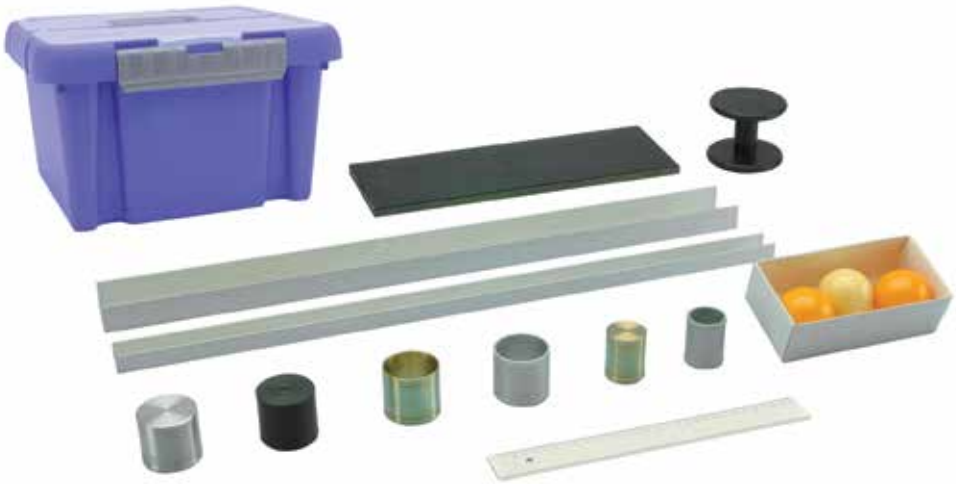
and being

$I_0 = m\ r^2\ e\ \omega^2 = v^2 / r^2$

you obtain $g\ h = v^2$

and so $v = \sqrt{10/7\ g\ h}$

i.e. the final speed is independent of the mass and radius.



POSSIBLE EXPERIMENTS:
Rolling motion of a sphere on a plane;
Rolling motion of a cylinder on a plane;
Rolling motion of a cylindrical shell on a plane;
Rolling motion of a sphere on a wide-gauge rail;
Rolling motion of a sphere on a thin gauge rail;
Friction that accelerates;
Rolling motion of a reel;
Energetic balances;
Speed races.

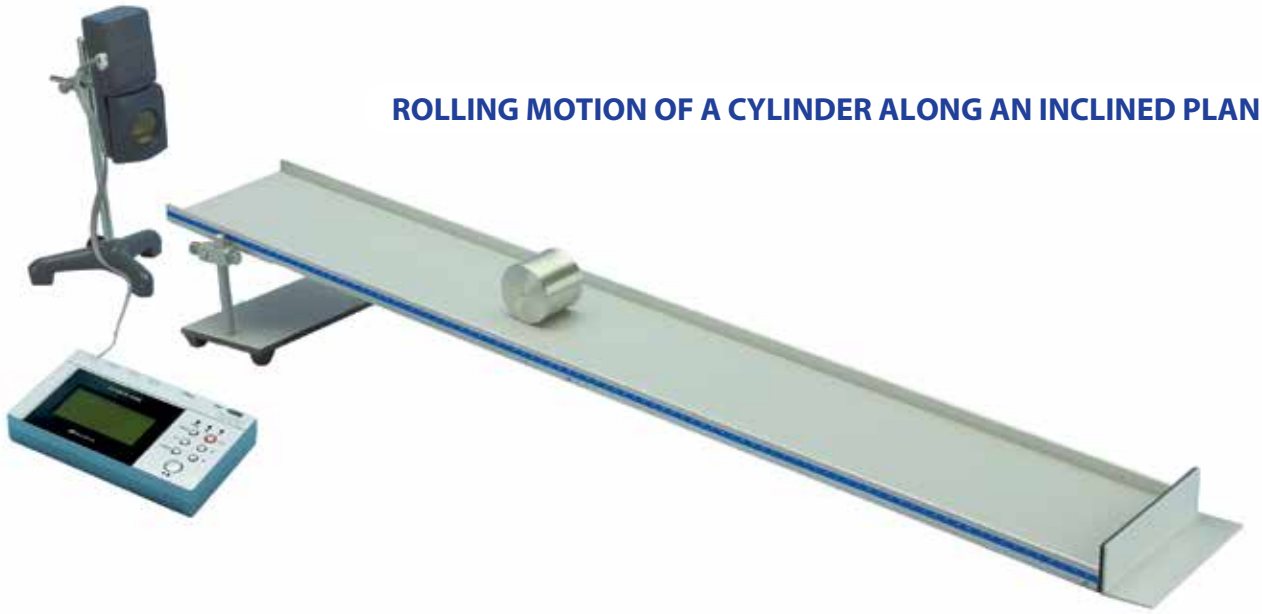
SUPPLIED EQUIPMENT

3 Solid cylinders with different diameters and masses
3 Cylindrical shells with different diameters and masses
3 Spheres with different diameters and masses
2 Rails with different gauges
1 Rubber plane
1 Spool
1 Ruler
1 Experiment

REQUIRED MATERIAL NOT SUPPLIED

1 Motion plane
1 Distance sensor + interface
or
1 USB Distance sensor

ROLLING MOTION OF A CYLINDER ALONG AN INCLINED PLANE



8111 Apparatus for the study of harmonic oscillations

The study of oscillatory motion of a mass hanging from a spring allows students to be introduced to the motion features of an harmonic oscillator and to be acquainted with one of the most powerful models for the physical interpretation of a wide range of phenomena.

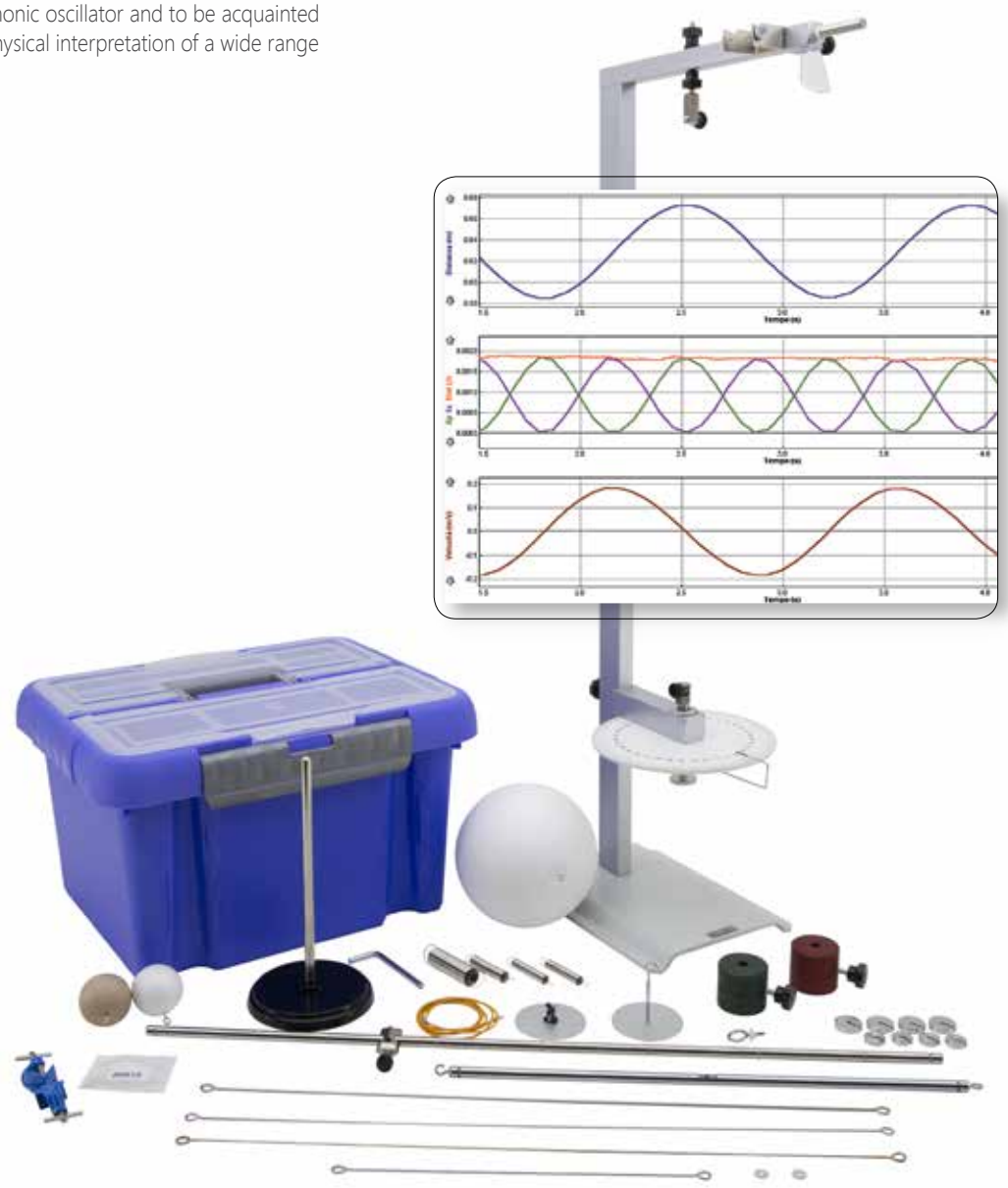
TOPICS:
Hooke's law
Mechanics of the harmonic motion
Mass-spring oscillator
The simple pendulum
The physical pendulum
The torsion pendulum

SUPPLIED EQUIPMENT

1 Metal support with rod and upper cross-bar for pendulums
1 Kit with 4 springs and 1 elastic
1 Wooden sphere for simple pendulum, diameter 50
1 Polystyrene sphere, diameter 50
1 Polystyrene sphere, diameter 160
1 Skein of string
1 Composed pendulum
2 Metal cylinders
1 Lower cross-bar with protractor for torsion pendulum
1 Brass rod 2x600mm
1 Steel rod 2x600mm
1 Steel rod 2x300mm
1 Steel rod 2,5x600mm
1 Equalizer for torsion pendulum
1 Weight holder (Pan)
1 Reflector disk
4 10g weights
4 20g weights
1 Clamp
1 Base with rod
1 Hex key

REQUIRED MATERIAL NOT SUPPLIED

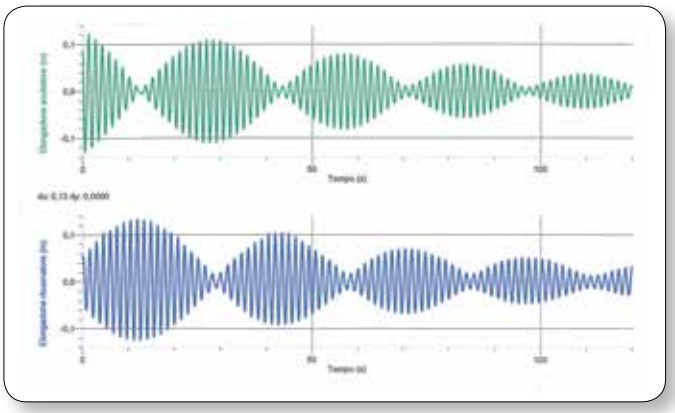
1 Distance sensor cod. 9041+ interface
1 Force sensor cod. 9032
1 Support for sensors cod. 4014



8113 Apparatus of the paired pendulums

The Apparatus of Paired Pendulums consists of two pendulums paired through a coil spring slightly stretched out. The spring allows the energy transfer between the two pendulums so it is possible to study the phenomena of resonance and beats.
The study becomes quantitative if we use two distance sensors (as shown in the diagrammes).
The Apparatus of Paired Pendulums can be used as optional equipment to the Apparatus for the study of harmonic oscillations (code 8111), or with the stand (code 0209) sold separately.
With two distance sensors it is possible to study the phenomenon of forced oscillations and beats. It can be used with the item code 8111 or with any other support.

0209 - STAND FOR APPARATUS OF THE PAIRED PENDULUMS



8117 Variable slope pendulum

This is a slightly modified version of the pendulum code 1350 of page 164.
The modification allows the use of the item with a distance sensor for the real time measurement of the oscillation period and allows checking its dependence on the acceleration due to gravity.
The period of oscillation of a simple pendulum depends only on its length and on the gravity acceleration. It is easy to perform experiments varying the length while it is more difficult to vary the slope, that is the acceleration due to gravity acting on a pendulum. The oscillating disc leans on a air cushion table; varying the slope of the oscillating plane the gravity force acting on the pendulum varies.
The use of the sensor allows the study of the simple pendulum in all its aspects, also in quantitative terms.

EXPERIMENTS:
Dependence of the period on the pendulum's length;
Period's independence from the pendulum's mass;
Period's dependence on the pendulum's slope;
Kinematic and dynamic study of pendular motion;
Study of pendular motion in terms of energy.

SUPPLIED EQUIPMENT

1 Tilting surface
1 PVC disc with weight-holder
1 Reflecting ball
5 10g masses
1 Pendulum fulcrum
1 Suspension wire

REQUIRED MATERIAL NOT SUPPLIED

1 Compressor	code 1331
1 USB Distance sensor	code 9066
1 Tripod base	code 0018
1 Rod Ø10x500	code 0004
1 Boss head	code 0159

BLOWER 1331

8117

Starting from the vertical position, the pendulum is made to oscillate and simultaneously its slope is reduced. The period noticeably increases according to the increase of the inclination angle compared to the vertical.

8118 Maxwell's pendulum

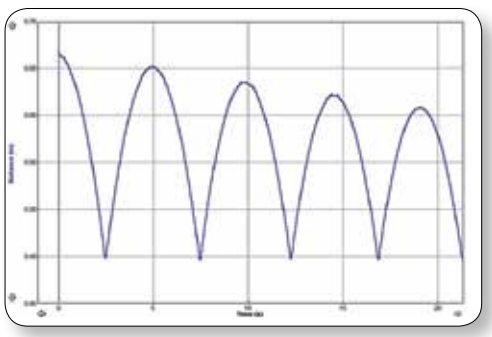
Maxwell's pendulum consists of a wheel hanging by two wires which are wound in the same direction on an axis passing through its centre of gravity. Once released, the wheel comes down under the action of its weight , but it is forced to rotate in order to unwind the two wires. It slowly comes down (low kinetic translation energy) but it rotates rapidly (high kinetic rotary energy).
At the end of the fall the total kinetic energy, not considering the losses, has to be equal to the gravitational energy supplied at the beginning.
After the wires have been unwound, the wheel goes on rotating rewinding the wires on its axis and coming back up. If there were no friction, it would go up to the initial level of its fall. The falling and rising motion is repeated more than once with a period that depends on the initial height difference h, on the acceleration due to gravity g and on the relationship between the radius of the wheel and the radius of its pivot.
Through the position sensor it possible to evaluate at which speed the wheel gets to at the end run point and to perform accurate measurements.

SUPPLIED EQUIPMENT

1 Support
1 Wheel with pivot
1 Cord

REQUIRED MATERIAL NOT SUPPLIED

1 D istance sensor + interface,
or 1 USB distance sensor



8118

The graph mentioned on the left is related to the distance of the wheel from the pendulum's base.
The inevitable friction makes the quota reached after each cycle inferior to the quota reached during the previous cycle.

8121 Vessel for hydrostatic and hydrodynamics experiments

Thanks to this item and to a pressure sensor it is possible to check that the pressure on each surface element immersed in a liquid is independent from the surface's orientation and its value is equal to the weight of a liquid's column having the considered surface element as a base and as the height difference between the centre of this surface and the free surface of the liquid.
It is also possible to experiment with the outflow speed of a liquid under the effect of gravity and with the thrust that a solid body receives when it is immersed in a liquid (Archimedes principle).

EXPERIMENTS:
Experimental verification of Stevino's Law;
Experimental verification of Toricelli's Law;
Experimental verification of Archimedes principle.

If you want to know more about, we recommend the accessory 8122 for the study of hydrostatic-equilibrium.

SUPPLIED EQUIPMENT

1 Glass cylinder with base and tap
1 sensor holder and probe holder cap
1 PVC tube for drainage
1 cup 1 dm^3
1 PVC cylinder
1 Aluminum cylinder
1 Base

REQUIRED MATERIAL NOT SUPPLIED

1 interface with software
1 Pressure sensor type B
1 Force sensor
1 Metal rod 75cm
1 Boss head
1 Metal rod 25cm
1 Tripod base

8121

8121.1 Spare glass part for code 8121

8122 Vessel for experiments on hydrostatic-equilibrium

This vessel is an accessory of the cod. 8121 for the study of hydrostatic-equilibrium.
With the vessel code 8121 and the accessory code 8122 you can perform two additional experiments about communicating vessels:
- Water balance with two vases having the same capacity;
- Water balance with two vases having different capacity.

In particular, when two vases containing the same liquid at different levels are connected, a flow of liquid occurs from the vase in which the level is higher to the vase in which the level is lower.
The flow goes on until the height difference is cancelled. During the transitory phase the higher level decreases over the time following an exponentially decreasing law.

SUPPLIED EQUIPMENT

1 Glass cylinder with base, tap and rubber holder
1 sensor holder and probe holder cap
1 Transparent PVC tube
1 Base
1 PVC rod
1 PVC rod support

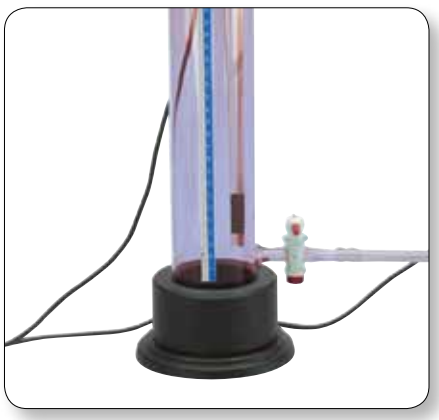
REQUIRED MATERIAL NOT SUPPLIED

1 Pressure sensor type B

8122

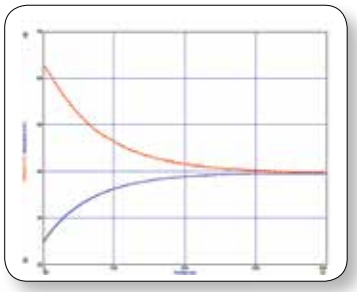
8122.1 Glass spare part for code 8122

8121+8122



8202 Kit to study processes to achieve thermal equilibrium

Through the use of two temperature sensors, this item lets you study how the transfer of heat occurs between two bodies, solids or liquids, with different initial temperature.
As in each balance phenomenon, the warmer body gives heat to the colder body until the cancellation of the thermal difference. The Law, states that the temperature of the warmer body varies over the time is exponentially decreasing, while the Law according to which the temperature of the colder body increases is exponentially increasing. It is possible to establish an analogy with the water balance phenomenon and electric balance.



EXPERIMENTS:
Thermal balance between two bodies with the same thermal capacity;
Thermal balance between two bodies with different thermal capacity.

SUPPLIED EQUIPMENT

1 Thermostatic container, capacity: 350 ml
1 Alcohol thermometer
1 Hollow aluminium cylinder wire, mass 400 g
1 Aluminium cylinder to be inserted into the previous one , mass 400 g
1 Brass cylinder to be inserted into the hollow cylinder, mass 1000 g
1 PVC hose
1 Experiments guide

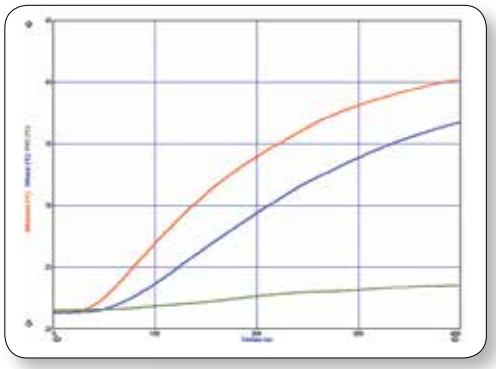
REQUIRED MATERIAL NOT SUPPLIED

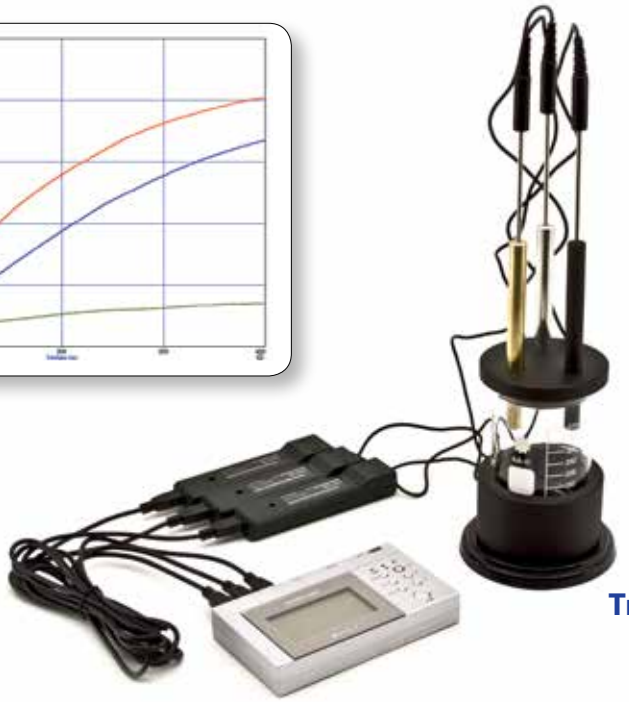
1 Heating plate
2 Temperature sensors + 1 interface

8203 Device to study thermal conductivity in solids

The propagation of heat in solids occurs by conduction. The speed at which the heat spreads varies according to the substance. As regards metal, the speed is high while in other substances such as glass or plastic, it is very low. For this reason metals have been defined good conductors of heat.
Thermal conductivity can be studied thanks to this kit using three temperature sensors.
An aluminium rod, a brass rod and a PVC rod, with a temperature sensor connected to each of them, are immersed simultaneously in a glass containing warm water. It is possible to observe the heat propagation speed difference between each rod.

EXPERIMENTS:
Comparison concerning thermal conductivity of three different materials, both for heating and cooling;
Comparison between thermal sensations and actual measurements of temperature.





THERMAL CONDUCTIVITY OF THREE MATERIALS

8206 Kit to study heat dissipation

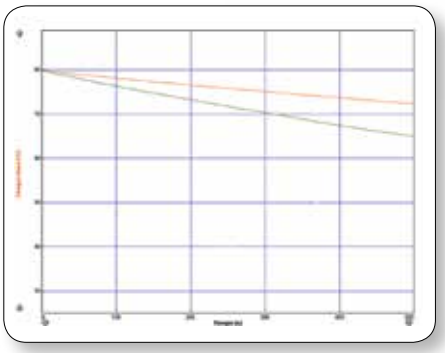
With this kit and two temperature sensors, it is possible to compare the different speeds at which two bodies with the same mass and the same initial temperature dissipate heat. The dissipation is quicker when the exposed surface is bigger and it is decelerated if the body is protected by a heat-insulating material.

SUPPLIED EQUIPMENT

1 Brass cylinder with hook
2 Aluminium cylinders with hook
1 Aluminium thermal radiator
1 Insulating-material tube
1 Handle
1 Hardboard support plate
1 Experiments guide

REQUIRED MATERIAL NOT SUPPLIED

1 Heating plate
2 Temperature sensors
+ 1 Interface



Cooling curve of two cylinders with the same size but made of different material: brass (red) and aluminium (green).

8205 Apparatus to study irradiation

At a constant radiant flux, the heating of a body when it is exposed to electromagnetic radiation depends on its surface, its mass and its absorption power. Exposing two discs with different features to a flux of radiation emitted by the same source, (the sun, or simply a lamp), it is possible to observe the different trends of the temperature.

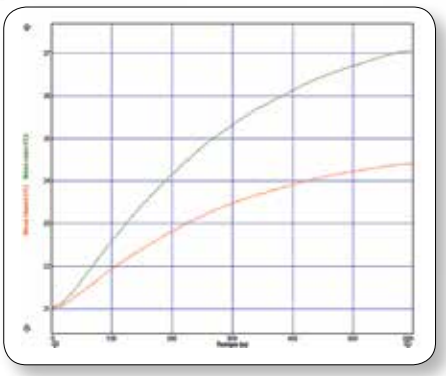
EXPERIMENTS:
Comparison between the absorption power of a disc with two polished faces and that of a disc with a polished face and a blackened face;
Comparison between the absorption power of a disc with two polished faces and that of a disc with two blackened faces;
Comparison between the absorption power of a disc with two blackened faces and that of a disc with a polished face and a blackened face;
Verification of the irradiation Law as a function of distance.

SUPPLIED EQUIPMENT

1 Platform with two adjustable supports;
1 Aluminium disc with two polished faces;
1 Aluminium disc with two blackened faces;
1 Aluminium disc with a polished face and a blackened one
1 Experiments guide 1 Handle
1 Hardboard support plate
1 Experiments guide

REQUIRED MATERIAL NOT SUPPLIED

2 Temperature sensors + 1 interface
1 Lamp



Two identical aluminium discs, a black-painted one and a polished one, are exposed to the light of a 100W lamp. A temperature sensor located on the discs demonstrates that the absorption coefficient of the black disc (green) is higher than the coefficient of the polished disc (red).

How to use apparatus 8205

8212 Thermology kit

Thanks to these items it is possible to perform some experiments related to thermal phenomena.
For data collection and representation, 3 temperature sensors are enough. The real time data-collection system allows you to obtain the temperature graph according to time in several thermal phenomena which are essential to the Physics' program in secondary schools, for example, thermal balance, heat propagation, state changes, etc.

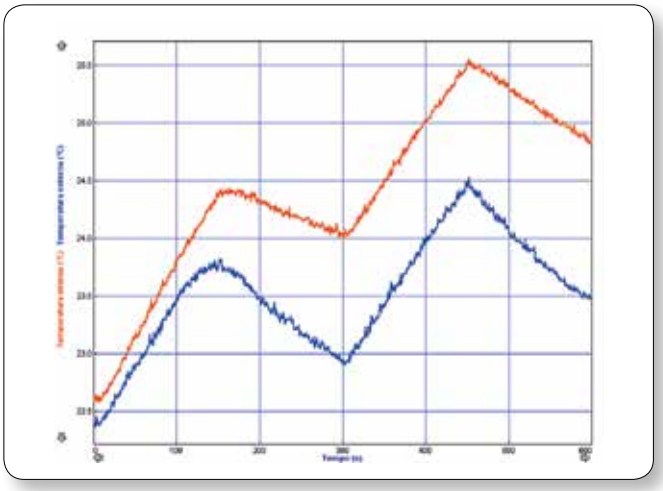
EXPERIMENTS:
Relation between heat and temperature;
Conversion of electric power into heat;
Measurement of specific heat;
Thermal balance among solids;
Heat conduction in solids;
Cooling;
State changes;
Greenhouse effect.

SUPPLIED EQUIPMENT

1 Electrical calorimeter
4 Metal samples
1 Thermal equilibrium kit
1 Conductivity kit
1 Cooling kit
1 Conical flask 250 ml
1 Rubber plug with hole for conical flask
1 Tripod base
1 Metal rod
1 Pincers with boss-head
1 D enatured alcohol bottle
1 Glass test-tube
1 Rubber plug with hole for test-tube
2 Electrical cables
1 Beaker 400 ml
1 Thermometer -10°C + 110°C
1 Experiment guide

REQUIRED MATERIAL NOT SUPPLIED

3 Temperature sensors + 1 Interface
1 Heating plate
1 Scale



Two temperature sensors are submitted to a light-darkness cycle. One of the sensors is immersed in a conical flask which creates a "greenhouse effect". The phenomenon is highlighted in the cooling curve of the two sensors.

8209 Gas thermometer

In a gas thermometer, temperature readings are practically independent from the aeriform contained in the volume in which an isochoric process transformation (the variation in pressure and temperature at a constant volume) is produced if pressure and temperature conditions allow you to consider the aeriform used to be perfect.
The kit consists of an aluminium container, with a capacity of about 330 cc, immersed in a glass container. Pressure and a temperature sensors allow you to characterize the system's evolution when it is heated or cooled. The straight line p = f (T) defined by the experimental data is the calibration curve of the air thermometer. The temperature value which is obtained extracting the graph up to the value p = 0, indicates that there is a temperature minimum value which is physically meaningful. The item is supplied with an experiment guide.

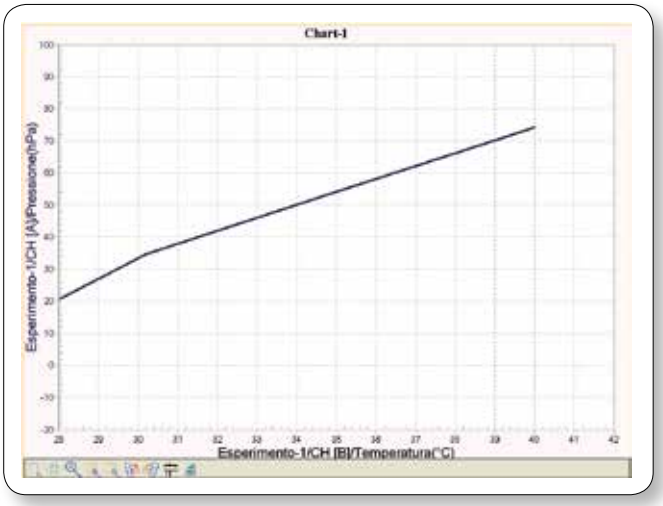
EXPERIMENTS:
Verification of the Gay-Lussac Law.
The gas thermometer.

SUPPLIED EQUIPMENT

1 Rubber tube
1 Beaker, 1000 ml
1 Support stage
1 Aluminium container with plug
1 Cover supporting the sensors
1 Experiments guide

REQUIRED MATERIAL NOT SUPPLIED

1 Temperature sensor + 1 Interface
1 Pressure sensor
1 Heating plate



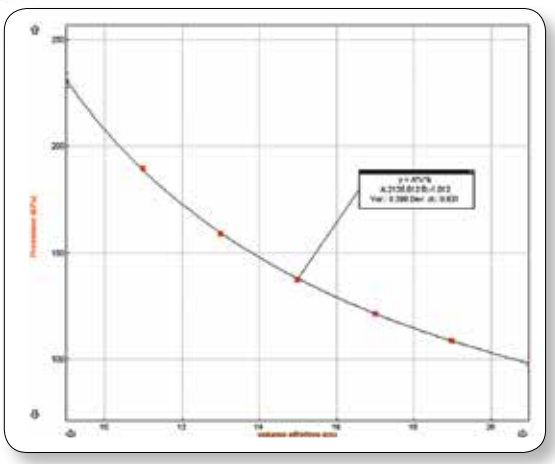
Heating the gas contained in the close container slowly, at a constant volume, the pressure increases. The pressure graph according to the temperature is a straight line (Gay-Lussac law). Extracting the straight line at a void volume, it is possible to find a value for the temperature corresponding to absolute zero.

8216 Device to study Boyle's Law

Thanks to this item it is possible to study quantitatively the isothermal conversions of gases.
A transparent graduated cylinder is linked to a pressure sensor through a dual tap.
Acting on the control knob the piston moves varying the volume of the air contained in the cylinder. Connecting the sensor to a real time data acquisition system it is possible to obtain the pressure Vs volume chart at a constant temperature.
Supplied with teaching guide.

REQUIRED MATERIAL NOT SUPPLIED:

Pressure sensor



Pressure graph according to volume, obtained point by point thanks to data acquisition system based on a PC. The interpolating curve approximates with precision the equation p V = cost.

OPTICTS

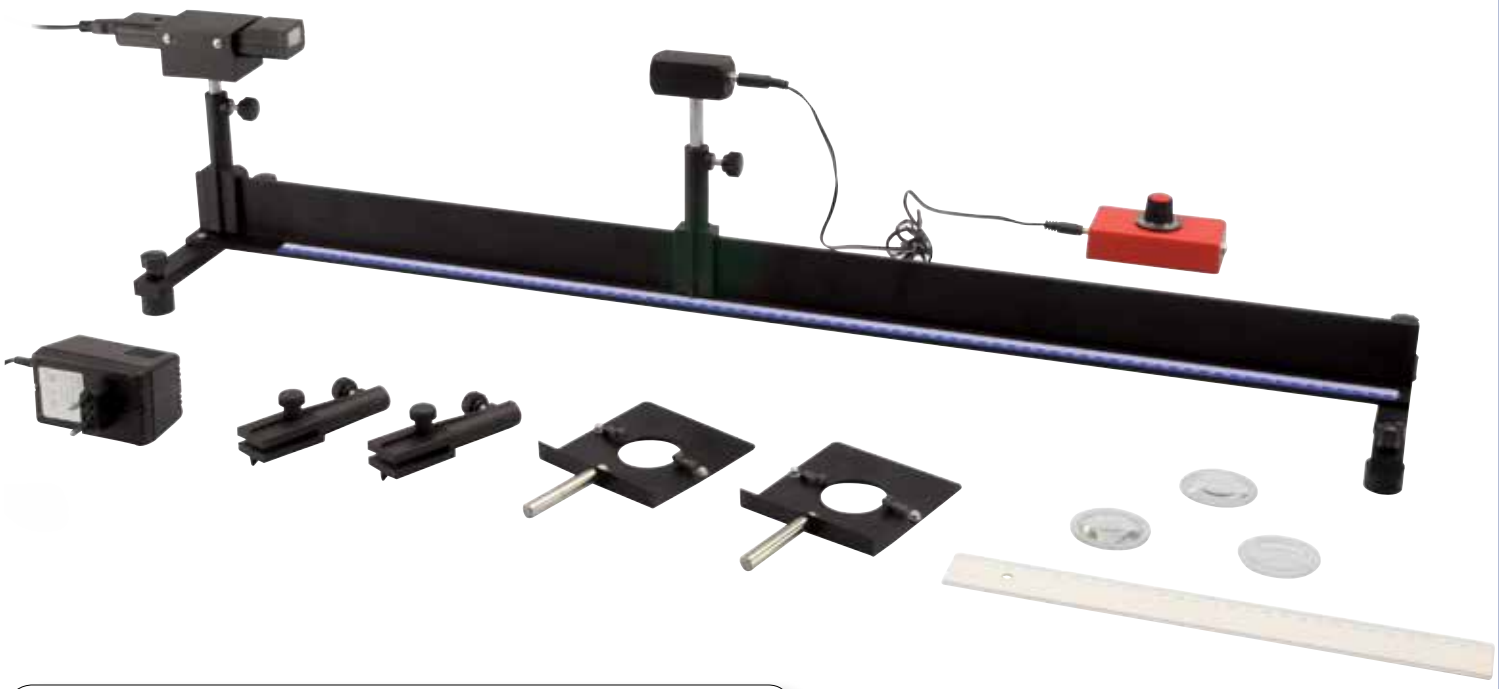
Performing effective laboratory experiments in a classroom is not an easy matter for a physics teacher due to several organizational problems: the main one begin lack of time. For this reason, the teacher usually prefers theoretical lessons over practical ones.
A solution to this problem is to bring the laboratory to the students using a portable data acquisition system.
If we add to these problems the need to observe, for example, a phenomenon of wave optics through an eyepiece, one student at a time, it is easy to realize that a teacher may prefer to give up and limit the classes to a theoretical presentation.
A solution to the problem? If it is difficult to bring students to the lab, let's bring the lab to the students instead, using a portable data acquisition system.

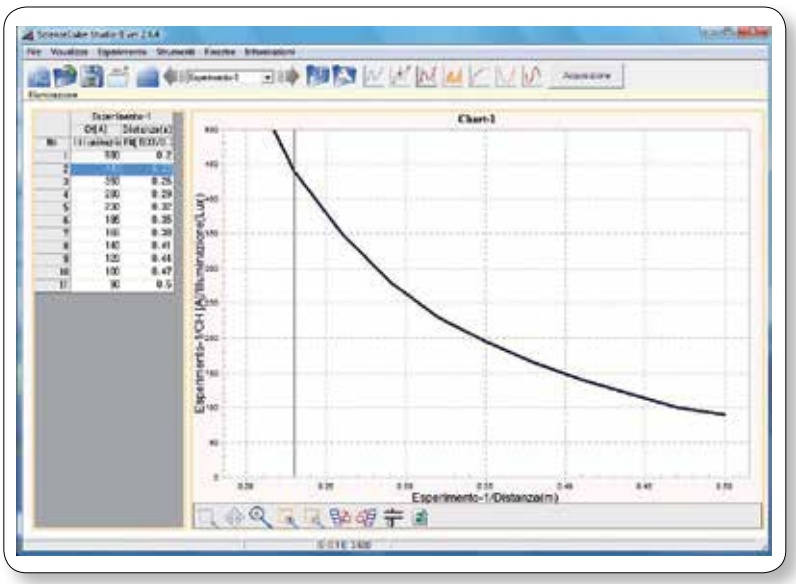
▶ 8405 90 cm, optical bench to study luminance, with sensor

This item allows you to obtain the graph which shows how the luminance on a surface depends on the distance of the source.
With the supplied items it is possible to perform experiments on the distribution of radiant energy using a lens, and determine the focal distance by photometric means.

SUPPLIED EQUIPMENT

1 90 cm Optical bench
1 White LED light source with support
1 Power supply for LED
1 Intensity dimmer
1 Brightness sensor with support
4 Supports
2 Lens-holder
3 Lenses
1 Ruler
1 Small case





The curve obtained with the item 8405 clearly shows that the luminance is inversely proportional to the square of the distance.

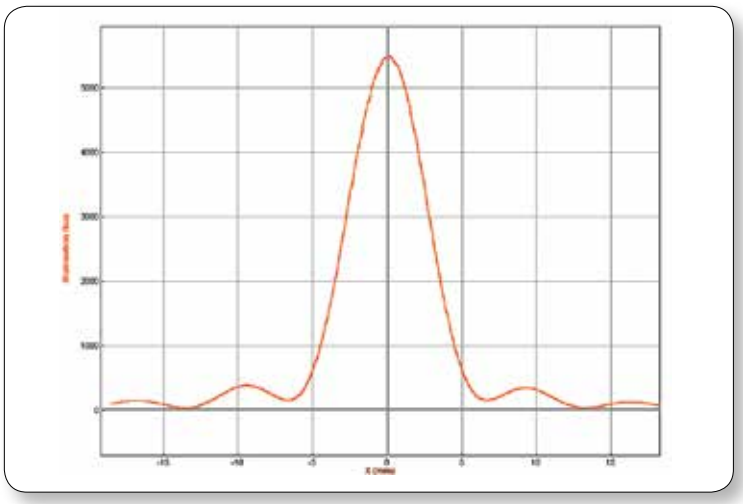
8403 90 cm Optical bench to study diffraction

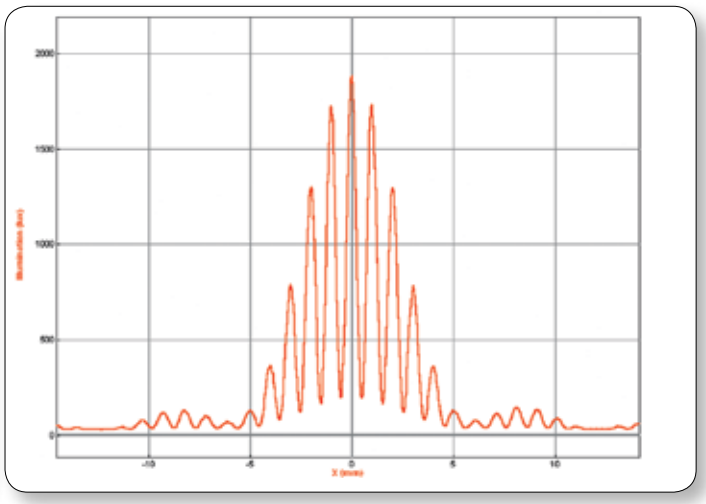
The optical bench allows you to study qualitatively and quantitatively the phenomena of diffraction.
A beam of laser light is directed on a revolving support which has some splits, holes and openings. The diffraction figures which are formed are collected by a light sensor which is in line with the linear position sensor. Moving the sensor horizontally with a handle, you will get a voltage which is proportional to the light intensity related to the position of the light sensor.
Connecting the outputs of the two sensors to a data acquisition system, it is possible to obtain the curves that show how the light intensity varies according to the position. Knowing the geometrical features of the openings and holes and evaluating the distance between the diaphragm and the light sensor, it is possible to quantitatively verify these phenomena.

EXPERIMENTS:
Diffraction phenomena;
Interference phenomena.

SUPPLIED EQUIPMENT

01 Optical bench provided with brightness sensor and potentiometer for linear position
01 High quality diode laser
01 Support with laser holder
01 Power supply for diode laser
01 Support for disk with slots (to place directly on the laser source)
01 Set of revolver diaphragms with slots of different size
01 Support for white screen
02 Cables for brightness and potentiometer sensors





The graph illustrated above was obtained directing the laser ray on a slit, width = 0.04 mm located at a distance L = 700 mm from the sensor. Knowing that the wavelength of the laser is λ = 635 nm, it is possible to verify the relation that provides the minimum distance from the centre point.

$$X_m = L \frac{\lambda}{a} n \qquad \text{for } n = 1,2,3,....$$

It is also possible to check that the relation between the intensity of the first secondary maximum and the intensity of the centre maximum is

$$\frac{I_1}{I_0} = 0{,}045$$

The graph illustrated above was obtained directing the laser ray on a dual slit. It clearly shows the overlap of two wave phenomena: the Young interference produced by the two slits and the diffraction generated by each slit. Also in this case it is possible to check the relation which provides the distance from the center of the secondary maximums and minimums.

OPTICAL BENCHES, MODULAR SYSTEM

In this modular system it is possible to choose between two benches of different lengths (100cm or 150cm). It's possible to connect a joint extension of 50cm to each bench; this is very useful for doing optical experiments where the optical beam, due to the effect of reflections or refractions comes out from the main axis of the bench. With this optical bench, the teacher can run a large number of experiments on optical waves
It also recommends the use of a green laser, sold separately.
According to their teaching needs, the teachers can choose various accessories (sold separately) that make up the complex

4401 Optical bench, 100cm
4402 Optical bench, 150cm

4361 Led projector
4362 Optical bench extension 50cm
4363 Lens holder with rod
4365 Plexiglas white screen 250x190x4mm
4366 White screen with scale
4367 Screen support
4368 Optical bench laser
4370 Couple of polarizing filter
4372 Set of optically active substances
4373 Prism support
4374 Optical bench lux meter
4375 Iris diaphragm
4376 Punctiform lamp
4377 Earth-Moon system
4380 Adjustable slit.
4381 Set of 4 plexiglas lens and two mirrors
4382 Set of 4 glass lens + 2 mirrors and container
4383 Horizontal goniometer
4371 Polarimetric tube
4212 Diffraction grating 500 lines/mm

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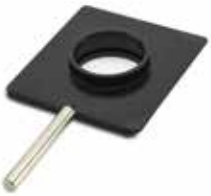

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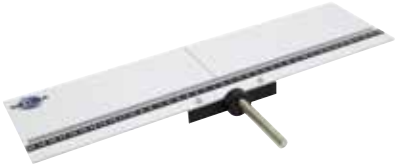

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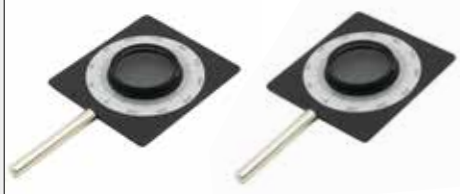

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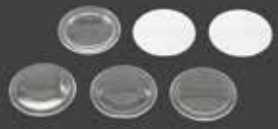

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8519 Extensible solenoid

It allows the study of the magnetic field generated by a solenoid, varying the number of coils for length unit.

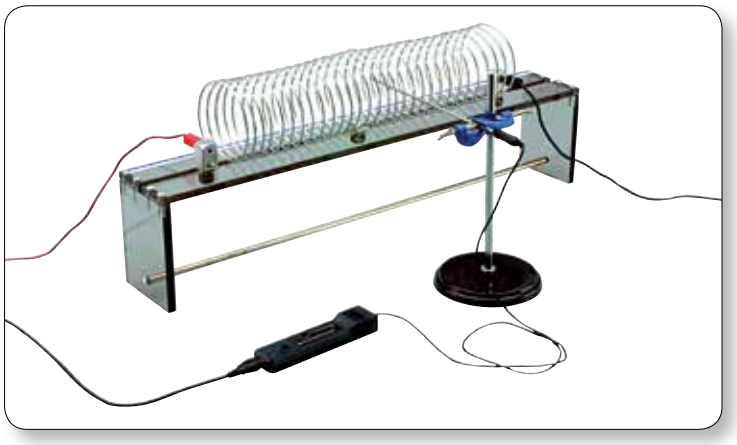
EXPERIMENTS :
- Flow lines of the magnetic field in the solenoid;
- Flow lines of the magnetic field out of the solenoid;
- Dependence of the magnetic field on the current intensity;
- Dependence of the magnetic field on the number of coils per length unit.

SUPPLIED EQUIPMENT

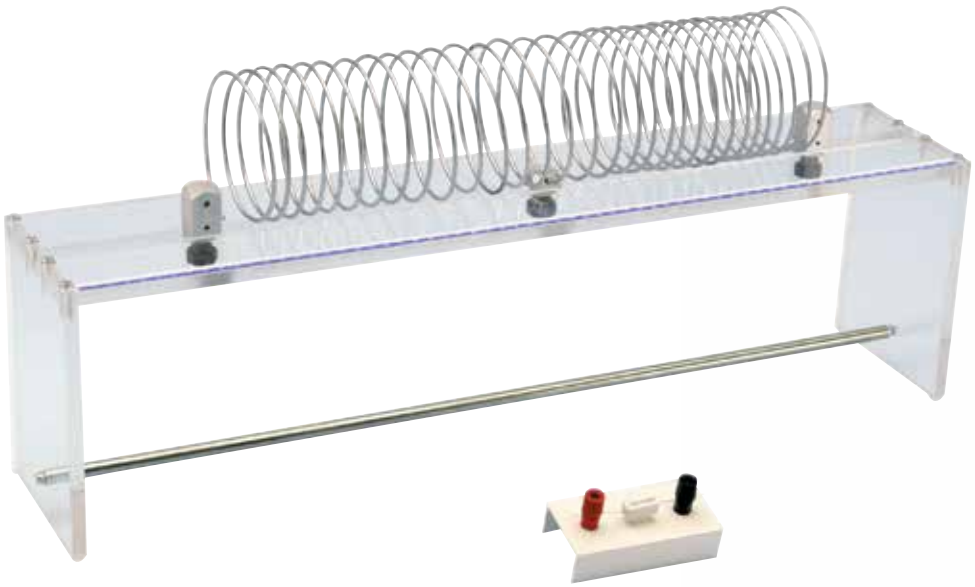
1 Extensible solenoid
1 Base with two binding posts boss-heads
1 Resistor of 47 Ω, 7 w

REQUIRED MATERIAL NOT SUPPLIED

1 Adjustable power unit, 0-5A
1 Sensor support
1 Magnetic field sensor
4 Leads
1 Current sensor

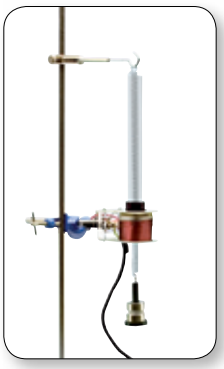


STUDY OF THE MAGNETIC FIELD IN A SOLENOID



8515 Electromagnetic pendulum

Essential item to study electromagnetic interactions. It consists of a linear magnet hanging from a spring and where a spool is located. Starting the magnet's motion, an electromotive force is induced in the spool which is measurable at the resistor's ends.
Similarly, making a/c circulate in the spool, the magnet starts its motion.



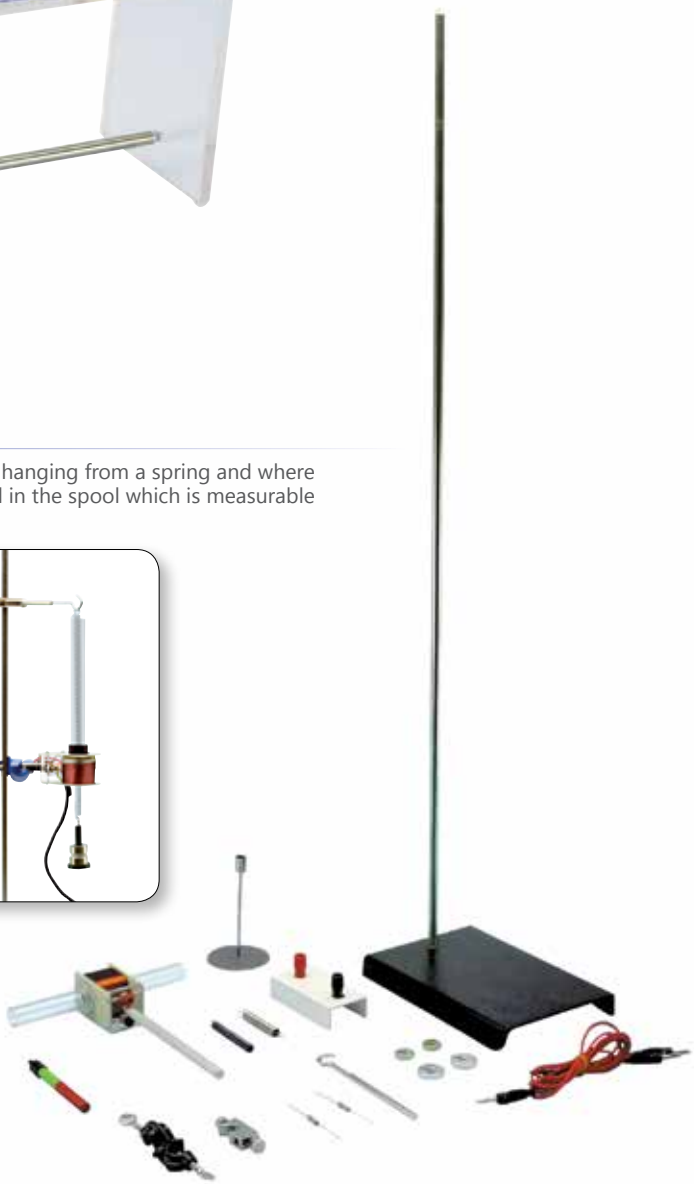
EXPERIMENTS :
1. Electromagnetic induction;
2. A/c production;
3. Electromagnetic resonance.

SUPPLIED EQUIPMENT

1 Spool with 1600 coils fitted with support and plexiglas tube
1 Linear magnet, diam. 10 mm with support
2 Coil spring
1 Magnetic weights-holder
2 Slotted masses, 10g
2 Slotted masses, 20g
2 Leads, 120 cm
1 Rectangular base with bar, 10x800 mm
2 Boss-head
1 Bar with hook
1 Base with two bonding posts boss-heads
2 Resistors

REQUIRED MATERIAL NOT SUPPLIED

1 Tension sensor + 1 Interface
1 Distance sensor
1 Functions generator



8514 Electromagnetism kit

Laboratory experiments on electrical circuits are difficult due to the use of cables to connect the different parts. It becomes difficult to vary the typology of a circuit without risking incorrect or damaging connections. In addition we risk losing sight of the structure of the circuit.
This kit is based on modules which can be quickly assembled on a table. In this way, the type of circuit is immediately recognizable and replacing a part or changing the circuit become simple and quick.

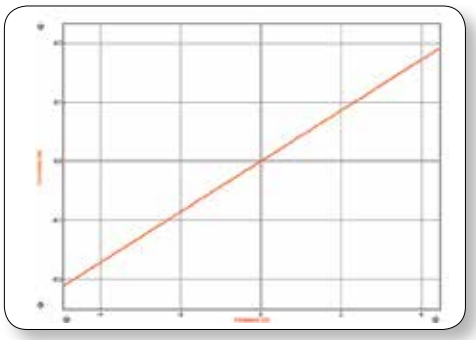
EXPERIMENTS:
Ohm's Laws.
Adjustment in series/parallel.
Charging and discharging the Capacitor.
Auto induction.
The reactive components in ac.
Magnetic field in a solenoid.
Electromagnetic induction.
Transformer.
Oscillator circuits.
Resonance.
Rectifier circuit.

SUPPLIED EQUIPMENT

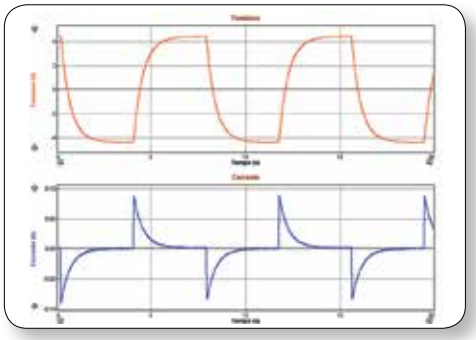
1 Assembling plate
14 U bolts
1 Set of 10 resistors
1 Set of 4 non linear dipoles
1 Set of 10 Capacitors
10 Leads
2 "T" conductors
4 Linear conductors
2 "L" conductors
1 Switch/diverter
4 Universal connectors
4 Insulators
1 Kantal wire
2 Crocodile clips
1 Potentiometer, 22 ohm
1 Lamp holder
1 Bulb
1 Bar magnet
1 Modular transformer
1 Experiments guide

REQUIRED MATERIAL NOT SUPPLIED

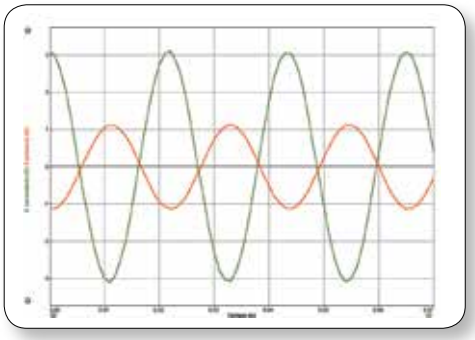
Voltage sensors + 1 Interface
2 Current sensors
1 Generator of low frequency signals
1 Power unit 0-5A
1 Extensible solenoid



OHM'S LAW



CHARGING AND DISCHARGING OF A CAPACITOR



VOLTAGE IN THE PRIMARY (IN RED) AND IN THE SECONDARY (IN GREEN) OF A TRANSFORMER

5228 AC/DC power supply 5A

Suitable for experiments that don't need any balance of the output voltage, this power supply unit is equipped with two independent outputs, both with a 3A maximum current:
- 1st output: from 1 to 12Vac, 1V jerky adjustable;
- 2nd output: from 1 to 12Vdc, 1V jerky adjustable.

5230 Variable L.T. Power supply 8A

Suitable for teachers.
Adjustable output voltage, continuity from 0 to 12Vdc.
Adjustable output voltage, continuity from 0 to 12Adc.
Maximum current: 8A (for short periods); nominal current: 6A.
Dimensions: 255x220x110h mm; weight: 4.75 Kg.

5718 Low frequency signal generator & amplifier

It is a generator of precision signals, amplified in power. It can generate sine, square and triangular waves. The frequency of the main generator varies from 0.1 Hz to 100 KHz. The maximum output power is 4.5 W. Equipped with LED display showing the frequency and the output amplitude level.
This instrument is particularly suitable for teaching and for scientific research.

TECHNICAL FEATURES

- 4 ohm output and at 6 ohm.
- Auxiliary input for the amplifier stage.
- Frequency range: 0.001 Hz - 100 kHz with 0.01% accuracy.
- Wave shape: sine, square and triangular.
- Output power: 4W on the whole range of frequencies.
- Output width: 17V peak to peak (600ohm output),
- 8.8 V peak to peak (4ohm output)
- Output attenuator 1x / 0.1X / 0.01X (on the 600ohm output)

5229 Student power supply – AC/DC 5A

Like the previous model but fitted with locking system which allows the teacher to lock the output voltage on a specific position.

5324 High voltage generator, 5kVdc

This generator is a necessary instrument to perform quantitative experiments on electrostatics. Its use isn't dangerous for the operator because, even in the event of a short circuit, the maximum current reaches only 2 mA because of a great output resistance. It is supplied with two highly insulating safety cables. The output voltage is adjustable with continuity up to 5 kVdc.
Built-in digital voltmeter with 3 digits Fixed output 6.3Vac/3A.
Dimensions: 285x220x140 mm.

5292 DC Power supply

Suitable for powering electronic tubes.
Powering voltage: 300Vdc.
Output voltage: 0 - 250 Vdc
adjustable 0 - 30 Vdc
6.3 Vac fixed.

1427 Digital timer

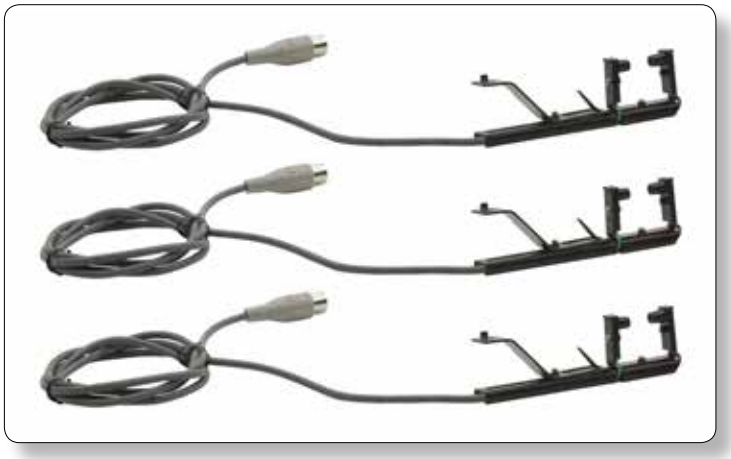
This device is a timer with self-adjusting scale, which provides a millisecond count, with a maximum range of 999s.

1267 Digital Timer

Model with 1/1000 sec accuracy, with the detection of 3 intermediates. Detection 99.999 sec max. Equipped with a large 5-digit LED display with an additional one that shows the corresponding split time measured (1 st, 2 nd or 3 rd split).
Provided with 3 photocells.
Indication of the blanking time of the photocells to detect the average and instantaneous speed. Special function for calculating the half-period of a pendulum's oscillation.
Equipped with a serial communication port for PC and the following analogue inputs:

- START: start, with automatic control device for electro-magnetic release
- S1: first photocell
- S2: second photocell
- STOP: third photocell or end-stroke detection
- START-STOP: semi-period detection of a pendulum

PROVIDED WITH 3 PHOTOCELLS



7014 Air pollution station on tripod

The station been designed for a first quantitative study of air quality.
It can be installed against a wall or on a tripod and it measures the temperature, the humidity and the concentration of carbon monoxide, typical of pollution caused by traffic.
It is possible to set an alarm that sounds when the CO level exceeds a specific threshold. The supplied sensors are powered by lithium batteries (replaceable) that permit the unit to operate continuously for up to three months.
At the end of the measurement, the data can be transferred to a pc and displayed on a graph.
Range: temperature: from -35 to + 80°C.
Relative humidity: from 0% to 100% RH.
CO: from 0 to 200 ppm CO.
(Values greater than 800 ppm can damage the sensor)

COUPLE OF USB SENSORS

COUPLE OF USB SENSORS

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Code index

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