UNIT 1 - WAVES & LIGHT

PHYSICS 2

Content

- Wave properties
- Wave effects
- Reflection of light
- Refraction of light
- Refractive index
- Total internal reflection
- Optical fibres
- Dispersion
- Converging lenses
- Electromagnetic spectrum
- Sound waves
- Pitch and loudness
- Echoes

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- Meaning of wave motion and the vocabulary used to describe a wave
- Relevant formulae; wave equation, refractive index, speed-distance-time
- Law of reflection and rules for refraction
- Names and order of the regions of the electromagnetic spectrum

Students to Understand

- The difference between a transverse and a longitudinal wave
- The nature of reflection, refraction and diffraction
- The relationship between speed, frequency and wavelength
- The principle of total internal reflection and its use in optical fibres

Students to be able to Do

- Recognise different wave effects; reflection, refraction and diffraction
- Draw ray diagrams to represent reflection, refraction and the action of a converging lens
- Perform calculations involving the wave equation, refractive index of a medium, speed of sound and echo time

Cross curricular links

- Mathematics; speed, distance and time, basic algebra, indices, sine function and geometry
- Geography; erosion

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

Watching sunset on Salar de Uyuni, Bolivia

Luca Galuzzi / CC BY-SA 2.5

Global citizenship, internationalism, local environment

- Images in the presentations depict local or international environment (wave diffraction at the port of Alexandria, Egypt; wave refraction in Alaska)
- Optical fibre communications, in Lausanne and globally
- Connection with frequently encountered optical and sound effects (rainbow, thunderstorm over Lake Geneva)

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September-October - 4 weeks

UNIT 2 - MECHANICS

PHYSICS 2

Content

- Speed and velocity
- Uniform and non-uniform acceleration
- Distance-time graphs
- Speed-time graphs
- Freefall
- Nature of forces
- Resultant forces
- Newton's laws of motion
- Mass and inertia
- Weight and gravity
- Density
- Hooke's law
- Centripetal force
- Turning effect
- Principle of moments
- Conditions for equilibrium
- Centre of mass
- Stability
- States of equilibrium
- Work done
- Power
- Air and liquid pressure

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- The difference between vector and scalar quantities
- Relevant laws and formulae
- Conditions needed for an object to be in equilibrium

Students to Understand

- The difference between speed and velocity
- How a falling object accelerates due to the force of gravity and why it moves at its terminal velocity
- The difference between balanced and unbalanced forces
- The difference between mass and weight
- How the position of the center of mass affects stability

Students to be able to Do

- Interpret distance-time graphs and use them to calculate speed
- Interpret speed-time graphs and use them to calculate acceleration and distance travelled
- Explain how a force can change the size, shape or motion of an object
- Identify a centripetal force
- Perform a variety of calculations

Cross curricular links

- Mathematics; speed, distance and time, speed-time graphs, gradients, basic algebra, ratio and proportion

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

Airplane

Pieter van Marion / CC BY-SA 2.0

Global citizenship, internationalism, local environment

- Isaac Newton's contribution to the understanding of the physical universe
- Images in the presentations depict local or international environment (international motor race circuit, Orlando roller coaster)
- Connection with daily encountered mechanical physics
- Internationally used units of distance (kilometers, miles etc.)

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October-November - 4 weeks

UNIT 3 - ENERGY

PHYSICS 2

Content

- Types of energy
- Forms of potential energy
- Energy transfer
- Conservation of energy
- Kinetic energy calculations
- Gravitational potential energy calculations
- Efficiency
- Renewable energy resources
- Non-renewable energy resources
- Production of electricity

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- The law of conservation of energy
- The formulae for kinetic energy and gravitational potential energy
- The meaning of renewable and non-renewable energy resources

Students to Understand

- How objects gain gravitational potential energy
- How energy is conserved in energy transformations
- How electricity is generated in power stations in terms of energy transfers
- How the sun's energy and energy stored in water can be harnessed

Students to be able to Do

- Identify different forms of energy
- Calculate the kinetic energy and/or gravitational potential energy of an object
- Calculate the efficiency of an energy transfer
- Describe the advantages and disadvantages of different energy sources and their impact on the environment

Cross curricular links

- Mathematics; basic algebra, percentages
- Geography; energy resources
- Chemistry; organic chemistry, greenhouse gases, carbon cycle
- Biology; carbon cycle

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

Havvindparken Sheringham Shoal offshore wind farm, England

Global citizenship, internationalism, local environment

- Global impact of a nuclear power disaster
- Different countries uses of energy resources and their environmental impact
- Images in the presentations depict local or international environment
- Connection with daily encountered energy transformations

UNIT 4 - THERMAL PHYSICS

PHYSICS 2

Content

- Kinetic theory
- Gases liquids and solids
- Brownian motion
- Heat and temperature
- Gas laws
- Thermal expansion in solids, liquids and gases
- Temperature scales
- Thermometers
- Heat capacity
- Evaporation and boiling
- Changes of state
- Latent heat
- Conductors and insulators
- Conduction, convection and radiation
- Absorbers and emitters
- Practical applications

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- The principles of the kinetic theory
- The relationship between pressure, volume and temperature
- The definitions of heat capacity, specific heat capacity, latent heat and specific latent heat
- The properties associated with thermometers
- The meaning of conduction, convection and radiation

Students to Understand

- How kinetic theory explains how gases, liquids and solids behave
- The difference between, temperature and heat, evaporation and boiling, conductors and insulators
- Melting and boiling in terms of energy input

Students to be able to Do

- Calibrate a thermometer
- Identify and explain everyday applications of conduction, convection and radiation
- Perform calculations related to energy transfer and changes of state
- Interpret graphs linked to the gas laws

Cross curricular links

- Chemistry; particulate nature of matter, atomic structure
- Geography; onshore and offshore breezes, trade winds
- Biology; regulation of body temperature

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

Firefighters

United States Armed Forces / Public domain

Global citizenship, internationalism, local environment

- Combining of Charles', Boyle's and Gay-Lussac's individual laws to become the ideal gas law
- Images in the presentations depict local or international environment
- Local and international building industry's use of specific materials
- Internationally used temperature scales

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September-October - 4 weeks

UNIT 5 - ELECTRICITY

PHYSICS 2

Content

- Static electricity
- Conductors and insulators
- Induced charges
- Charging by induction
- Electric fields
- Current
- Potential difference
- Electromotive force
- Resistance
- Resistivity
- Electrical power and energy
- Circuits in series
- Circuits in parallel
- Dangers of electricity

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- The meaning of the terms current, voltage, resistance and e.m.f.
- Formulae for resistance, resistivity, electrical energy and power

Students to Understand

- The difference between an insulator and a conductor
- How some insulators become electrically charged
- How different factors affect resistance
- The dangers of mains electricity and various safety devices used

Students to be able to Do

- Explain how to measure current and voltage
- Calculate resistance from a V-I graph or using Ohm's law
- Draw and interpret circuit diagrams and name individual components
- Calculate resistance, current and voltage for series and parallel circuits

Cross curricular links

- Chemistry; atomic structure and metallic bonding
- Mathematics; basic algebra, graph plotting, gradients

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions


Lightning

Global citizenship, internationalism, local environment

- Differences between countries in electrical safety methods employed
- Connection with daily encountered circuits
- Impact of conventional theory on international standards for circuit diagrams

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December-January - 2-3 weeks

UNIT 6 - ELECTROMAGNETISM

PHYSICS 2

Content

- Hard and soft magnetic materials
- Magnetic fields
- Induced magnetism
- Methods of magnetizing
- Methods of demagnetizing
- Magnetic field around a current carrying wire
- Electromagnets
- Magnetic relay
- Circuit breakers
- Magnetic force on a current
- D.C. motor
- Induced e.m.f.
- A.C. generator
- Mutual induction
- Transformers (step-up and step-down)

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- The differences between hard and soft magnetic materials
- Fleming's left hand rule
- Relationship between input and output voltage in a transformer

Students to Understand

- How electricity and magnetism are linked
- How a current carrying wire can induce magnetism
- The motor effect
- How a changing magnetic field induces an e.m.f. and the factors affecting the magnitude
- How generators produce alternating current

Students to be able to Do

- Explain how materials can be magnetised and demagnetised
- Explain the function and structure of various practical applications of electromagnets
- Conversion calculations in transformers

Cross curricular links

- Geography; electrical power production and transfer
- Mathematics; ratios

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

Loading machine using electromagnet

Hans-Peter Scholz / CC BY-SA 3.0

Global citizenship, internationalism, local environment

- International use of electromagnets (for example – maglev train, Shanghai)
- Use of circuit breakers in local housing
- Country differences in transfer of electrical power

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January-February - 3 weeks

UNIT 7 - ELECTRONICS

PHYSICS 2

Content

- Variable potential dividers
- Diodes
- Rectifiers
- Transistors
- Capacitors
- Time-delay circuits
- Reed switch and relay
- Thermistors
- Switching circuits
- Digital and analogue
- Logic gates
- Thermionic emission
- Deflection tube
- Cathode ray oscilloscope

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Quality and accuracy of practical work
- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- Symbols used to represent each circuit component
- The difference between digital and analogue
- Electrons are produced in thermionic emission

Students to Understand

- How the different components are used in circuits and for what purpose
- How cathode rays are produced

Students to be able to Do

- Describe the action of different circuit components and gates
- Design simple digital circuits
- Describe the structure and action of a cathode ray oscilloscope

Cross curricular links

- Chemistry; semiconductors

Differentiation incl. EAL

- Extension work for gifted students
- Mixed ability practical groups
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- Individual and group practicals
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions

A hard disk inner view

Global citizenship, internationalism, local environment

- Connection with the school fire alarm system
- Connection with daily encountered circuits e.g. dimmer switches, night lights
- International electronic industry's use of integrated circuits
- International standards for graphical symbols in circuit diagrams

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February - 1-2 weeks

UNIT 8 - ATOMIC PHYSICS

PHYSICS 2

Content

- Atomic model
- Nucleus
- Isotopes
- Ionising radiation
- Nuclear radiation
- Effects on electric fields
- Effects on magnetic fields
- Geiger-Muller tube
- Radioactive decay
- Half-life
- Safety precautions
- Uses of radioisotopes
- Geiger Marsden experiment
- Rutherford's nuclear model

Resources & ICT

- Textbooks
- Worksheets
- PowerPoint presentations
- Past exam papers
- Practical equipment
- YouTube clips
- Online resources from the BM website

Types of assessment

- Past exam questions
- Exercises from textbooks
- End of unit topic test

Students to Know

- Random nature of radioactive emissions
- The meaning of isotopes, radioactive decay and half-life
- Existence of background radiation

Students to Understand

- The difference between alpha, beta and gamma radiation
- Why isotopes decay
- How radioisotopes can be beneficial
- How the scattering of alpha particles by thin gold foil led to the current nuclear model

Students to be able to Do

- Describe the structure of an atom and the composition of the nucleus
- Use nuclide notation
- Write decay equations
- Plot the activity of a radioactive isotope with time and calculate the half-life
- Describe how radioactive materials should be handled, used and stored

Cross curricular links

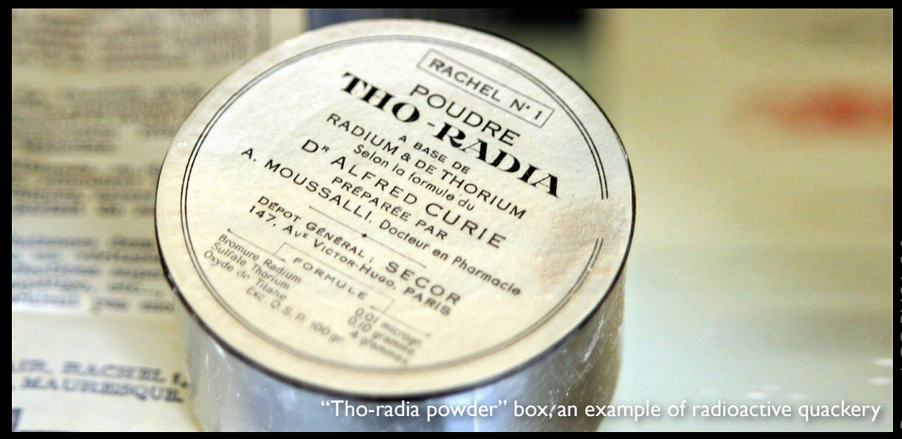
- Chemistry; atomic structure
- Geography; agricultural and oil industry's use of tracers
- Biology; use of radioisotopes to check the function of the body's organs

Differentiation incl. EAL

- Extension work for gifted students
- Group work, individual and with teacher support

Learning styles activities

- Lectures
- YouTube clips
- Quizzes and tests
- Individual exercises
- Group discussions



"Tho-radia powder" box, an example of radioactive quackery

Rama / CC BY-SA 2.0

Global citizenship, internationalism, local environment

- Connection with nuclear disasters in Russia and Japan
- Ernest Rutherford's contribution to our understanding of the atom
- Impact on local and global industries e.g. manufacturing (paper, aluminium foil), medical, oil,
- Impact on the global detection of illegal contraband and people trafficking
- Carbon dating of international artifacts

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March - 1-2 weeks