UNIT 1 - GENERAL PHYSICS

ADV. PHYSICS I

Content

- Physical quantities and equations
- Prefixes
- SI base units
- Derived units
- Dimensional homogeneity
- Measuring techniques and instruments
- Precision & accuracy
- Random & systematic errors
- Uncertainty
- Graphs and tables, A-Level paper 3 practical skills
- Scalar quantities and vector quantities
- Vector addition and subtraction
- Vector components

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- A quantity must be stated with its magnitude and its unit
- The units and unit symbols associated with quantities of the AS syllabus
- The prefixes used with unit
- Which measuring instrument is required to record a particular quantity
- The difference between scalar and vector quantity
- Addition and subtraction of vectors

Students to Understand

- How to write a derived unit using only base units
- How to check the homogeneity of an equation
- The difference between precision and accuracy, the ways to reduce each type of systematic or random error

Students to be able to Do

- Calculate uncertainties
- Decompose a vector into its components, example of boat hauling
- Use vector components in more elaborate problems
- Draw tables and plot graphs out of self-measured quantities

Cross curricular links

- Mathematics; graph skills: points plotting, best fit line, gradient and y-intercept calculation, algebra

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production

Barge Haulers on the Volga, 1873

Ilya Efimovich Repin / Public domain

Global citizenship, internationalism, local environment

- Highlight on the collaboration between scientists from different countries in order to establish theories and concepts
- Precision in the industry: field trip to the Peugeot car factory in Sochaux, France

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September-October - 3 weeks

UNIT 2 - MECHANICS

ADV. PHYSICS I

Content

- Kinematics
- Displacement, velocity, acceleration
- Velocity-time graphs
- Equations of motion
- Determination of g
- Free fall, effect of air resistance
- Downwards & sideways
- Dynamics
- Newton's law of motion
- Momentum & second law
- Impulse
- Conservation of momentum
- Collision problems
- Work, energy, power
- Types of energy & calculations
- Efficiency
- Moments & balance
- Couples & torque
- Density & pressure
- Upthrust

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- Definitions of and equations for: displacement, velocity, acceleration, momentum, impulse, work, energy, power, efficiency, moments, couple, torque, density, pressure, upthrust
- The equations of motion

Students to Understand

- The link between Newton's second law of motion and momentum
- How to determine g from a free fall experiment
- How to deal with problems combining downwards and sideways motion
- The principle of conservation of momentum and its use in collision problems (including explosion problems)

Students to be able to Do

- Recall Newton's laws of motion, the principle of conservation of momentum, the conditions for equilibrium
- Determine acceleration and distance form a velocity-time graph

Cross curricular links

- Physical education: bungee jumping, long jump
- Mathematics: gradient and area under a curve, derivation and integration; mechanics

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production


US Navy attack submarine in the Arctic Ocean

Global citizenship, internationalism, local environment

- Shock absorbers in cars: field trip to the Peugeot car factory in Sochaux, France
- How Newton's theory of mechanics was superseded by Einstein's theory of relativity, TOK

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October-November - 5 weeks

UNIT 3 - ELECTRICITY

ADV. PHYSICS I

Content

- Electric circuits
- Resistance and the ohm
- I-V characteristics
- Resistivity
- E.M.F. and 'lost volts'
- Current in series and parallel circuits
- Kirchhoff's first law
- Kirchhoff's second law
- Resistors in series and in parallel circuits
- The potential divider
- Electric fields
- Electric field strength & potential
- Forces on charges

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- Definitions of and equations for: current, charge, potential difference, electrical energy, resistance, electrical power, resistivity, electromotive force, potential divider, electric field, electric field strength, electrical force
- The differences between series and parallel circuits

Students to Understand

- I-V and V-I characteristics for a ohmic conductor, a filament lamp, a diode and a thermistor
- The difference between e.m.f and p.d.
- How 'lost volts' are caused by the internal resistance of batteries
- How potential dividers work

Students to be able to Do

- Calculate equivalent resistances in series and parallel circuits
- Recall Kirchhoff's laws and connect each of them to conservation of charge and conservation of energy
- Use Kirchhoff's laws to solve problems
- Perform calculations using potential difference, distance and electric field strength in order to determine the magnitude and the direction of electrical forces created by an electrical field

Cross curricular links

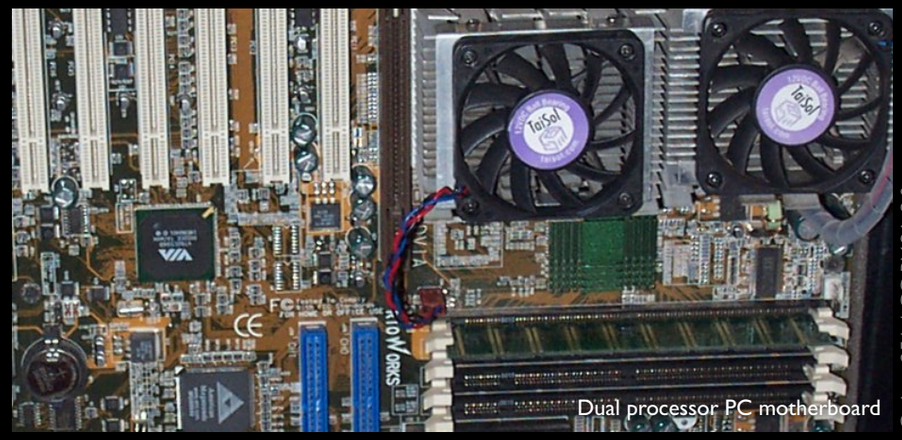
- Chemistry: chemical effects of an electric current
- Biology: potential difference in the body

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



Dual processor PC motherboard

Global citizenship, internationalism, local environment

- Examples taken from daily life: electric cables, kettle, computers...
- Field trip to the Plasma Physics Research Center, EPFL, Lausanne: uses of high voltages to create large electromagnetic fields

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December - 3 weeks

UNIT 4 - MATTER

ADV. PHYSICS I

Content

- States of matter
- Kinetic model for solids, liquids and gases
- Brownian motion
- Pressure & kinetic theory
- Melting, boiling, evaporation
- Crystalline & non-crystalline solids
- Deformation of solids
- Elasticity
- Hooke's law
- Stress & strain
- Young's modulus
- Typical force-extension graphs
- Model of the nuclear atom
- The α-particle scattering experiment
- Simple nuclear reactions
- Radioactive decay

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The representation of solids, liquids and gases using the kinetic theory of matter; the characteristics of each state
- The differences between boiling and evaporation
- The structure of metals, polymers and amorphous materials
- The nuclear structure of the atom
- Define the terms: nuclide, nucleon and isotope

Students to Understand

- How gas pressure can be explained using the kinetic model
- The principle of the α-particle scattering experiment
- How α and β particles are obtained through radioactive decay; the nature of γ rays
- Why radioactivity is spontaneous and random

Students to be able to Do

- Calculate the strain energy when given a force-extension graph
- Determine experimentally the Young's modulus of a metal
- Recall typical force-extension graphs for ductile, brittle and polymeric materials

Cross curricular links

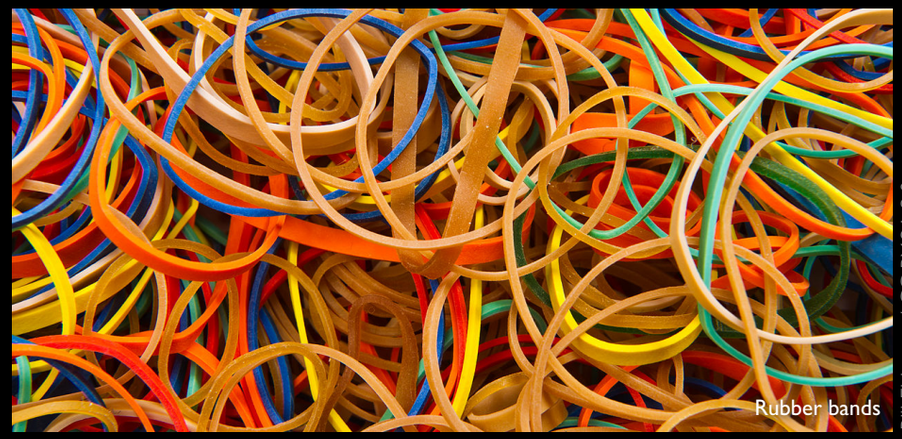
- Chemistry: atomic structure
- PSHE: effects of radioactivity on human health
- History: atomic weapons

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production



Global citizenship, internationalism, local environment

- Examples taken from daily life: expanding ballon, bungee jumping
- Discussion of the advantages and dangers of nuclear power plants
- Field trip to the Plasma Physics Research Center, EPFL, Lausanne: principle of nuclear fusion
- Field trip to Mont Terri: visit to the underground Swiss laboratory performing research about confinement of radioactive wastes, discussion about uses of nuclear sources
- Field trip to the CERN: particle accelerator, research center

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January - 3 weeks

UNIT 5 - WAVES

ADV. PHYSICS I

Content

- Transverse & longitudinal waves
- Vocabulary: amplitude, wavelength, frequency, period, wavefront, phase difference
- The wave equation
- The electromagnetic spectrum
- Sound as a longitudinal wave
- Intensity of a wave
- Interferences between waves
- Interference patterns
- Young's slit experiment
- Diffraction
- Standing waves
- Modes of vibration
- Determination of the speed of sound

Resources & ICT

- Textbook
- Study guide
- Keynote
- Online resources available from BM website
- Internet research

Types of assessment

- Exercises from study guides and online textbooks
- Multiple choice questions from past papers
- Structured questions from past papers
- Practical work
- Judgements on effort and attitude towards learning

Students to Know

- The difference des between longitudinal and transverse waves; representations, examples
- The vocabulary connected to waves and the equations linking them: amplitude, wavelength, frequency, period, wavefront, phase difference
- The order and the names of the waves belonging to the electromagnetic spectrum
- The relationship giving the fringe separation
- The relationship giving the first (or second) order maximum angle

Students to Understand

- The relationships between intensity and distance, and between intensity and amplitude
- Why waves may interfere, what are the required conditions, what are the consequences of interferences

Students to be able to Do

- Draw the fundamental first and second modes of vibration for a standing wave on a string, in a closed pipe and in an open pipe

Cross curricular links

- Music; music instruments, sound decomposition

Differentiation incl. EAL

- Extension tasks for students who previously studied material or have a good grasp of it
- Group work considerations; mixed ability

Learning styles activities

- Lectures
- Individual and group exercises
- Quizzes
- Test
- Presentation production
- Poster production

Surface waves of water

Global citizenship, internationalism, local environment

- Examples taken from the students daily life: waves on the lake, resonance phenomena, interferences

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February - 3 weeks