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# PROGRAMMAZIONE DEL GRUPPO DISCIPLINARE A.S. 2022/2023

| **INDIRIZZO SCOLASTICO: LICEO SCIENTIFICO** | | |
|---|---|---|
| **DISCIPLINA: FISICA** | **ORE SETTIMANALI 2:**<br>**1 (Fisica) + 1 (Physics) in compresenza** | **CLASSI SECONDE** |

## Libri di testo

- David Sang, Cambridge IGCSE Physics, Coursebook – Third Edition, Cambridge University Press
- David Sang, Cambridge IGCSE Physics, Workbook – Third Edition, Cambridge University Press
- Heather Kennet, Cambridge IGCSE Physics, Laboratory Practical Book, Hodder Education
- (Consigliato) James S. Walker, Fisica Presente e Futuro 2, Pearson Scienze

***Syllabus IGCSE***

**Thermal properties and temperature**

*Thermal expansion of solids, liquids and gases*

• Describe qualitatively the thermal expansion of solids, liquids, and gases at constant pressure
• Identify and explain some of the everyday applications and consequences of thermal expansion
• Explain, in terms of the motion and arrangement of molecules, the relative order of the magnitude of the expansion of solids, liquids and gases

*Measurement of temperature*

• Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties
• Recognise the need for and identify fixed points
• Describe and explain the structure and action of liquid-in-glass thermometers
• Demonstrate understanding of sensitivity, range and linearity
• Describe the structure of a thermocouple and show understanding of its use as a thermometer for measuring high temperatures and those that vary rapidly
• Describe and explain how the structure of a liquid-in-glass thermometer relates to its sensitivity, range and linearity

*Thermal capacity (heat capacity)*

• Relate a rise in the temperature of a body to an increase in its internal energy
• Show an understanding of what is meant by the thermal capacity of a body
• Give a simple molecular account of an increase in internal energy
• Recall and use the equation thermal capacity = mc
• Define specific heat capacity
• Describe an experiment to measure the specific heat capacity of a substance
• Recall and use the equation change in energy = $mc\Delta T$

*Melting and boiling*

• Describe melting and boiling in terms of energy input without a change in temperature
• State the meaning of melting point and boiling point

• Describe condensation and solidification in terms of molecules
• Distinguish between boiling and evaporation
• Use the terms latent heat of vaporisation and latent heat of fusion and give a molecular interpretation of latent heat
• Define specific latent heat
• Describe an experiment to measure specific latent heats for steam and for ice
• Recall and use the equation energy = ml

**Thermal processes**

*Conduction*

• Describe experiments to demonstrate the properties of good and bad thermal conductors
• Give a simple molecular account of conduction in solids including lattice vibration and transfer by electrons

*Convection*

• Recognise convection as an important method of thermal transfer in fluids
• Relate convection in fluids to density changes and describe experiments to illustrate convection

*Radiation*

• Identify infra-red radiation as part of the electromagnetic spectrum
• Recognise that thermal energy transfer by radiation does not require a medium
• Describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of radiation
• Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation
• Show understanding that the amount of radiation emitted also depends on the surface temperature and surface area of a body

*Consequences of energy transfer*

• Identify and explain some of the everyday applications and consequences of conduction, convection and radiation

***Textbook***

**6. Energy transformation and energy transfers**
6.1 Form of energy
6.2 Energy conversions
6.3 Conservation of energy
6.4 Energy calculations
**7. Energy resources**
7.1 The energy we use
7.2 Energy from Sun
**8. Work and power**

8.1 Doing work
8.2 Calculating work done
8.3 Power
8.4 Calculating power

***Workbook***

Ex. 6.1 Recognising forms of energy
Ex. 6.2 Energy efficiency
Ex. 6.3 Energy calculations
Ex. 7.1 Renewables and non-renewables
Ex. 7.2 Wind energy
Ex. 7.3 Energy from the Sun
Ex. 8.1 Forces doing work, transferring energy
Ex. 8.2 Calculating work done
Ex. 8.3 Measuring work done
Ex. 8.4 Work done

***Syllabus IGCSE***

**General wave properties**

- Demonstrate understanding that waves transfer energy without transferring matter
- Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves
- Use the term wavefront
- Give the meaning of speed, frequency, wavelength and amplitude
- Distinguish between transverse and longitudinal waves and give suitable examples
- Describe how waves can undergo:
  – reflection at a plane surface
  – refraction due to a change of speed
  – diffraction through a narrow gap
- Describe the use of water waves to demonstrate reflection, refraction and diffraction
- Recall and use the equation $v = f \lambda$
- Describe how wavelength and gap size affects diffraction through a gap
- Describe how wavelength affects diffraction at an edge

**Sound**

- Describe the production of sound by vibrating sources

• Describe the longitudinal nature of sound waves
• State that the approximate range of audible frequencies for a healthy human ear is 20Hz to 20000 Hz
• Show an understanding of the term ultrasound
• Show an understanding that a medium is needed to transmit sound waves
• Describe an experiment to determine the speed of sound in air
• Relate the loudness and pitch of sound waves to amplitude and frequency
• Describe how the reflection of sound may produce an echo
• Describe compression and rarefaction
• State typical values of the speed of sound in gases, liquids and solids

**Light**

*Reflection of light*

• Describe the formation of an optical image by a plane mirror, and give its characteristics
• Recall and use the law angle of incidence = angle of reflection
• Recall that the image in a plane mirror is virtual
• Perform simple constructions, measurements and calculations for reflection by plane mirrors

*Refraction of light*

• Describe an experimental demonstration of the refraction of light
• Use the terminology for the angle of incidence i and angle of refraction r and describe the passage of light through parallel-sided transparent material
• Give the meaning of critical angle
• Describe internal and total internal reflection
• Recall and use the definition of refractive index n in terms of speed
• Recall and use the equation $sin(i)/sin(r)=n$
• Recall and use $n=1/sin(c)$
• Describe and explain the action of optical fibres particularly, in medicine and communications technology

Thin converging lens

• Describe the action of a thin converging lens on a beam of light
• Use the terms principal focus and focal length
• Draw ray diagrams for the formation of a real image by a single lens
• Describe the nature of an image using the terms enlarged/same size/diminished and upright/inverted
• Draw and use ray diagrams for the formation of a virtual image by a single lens
• Use and describe the use of a single lens as a magnifying glass
• Show understanding of the terms real image and virtual image

*Dispersion of light*

• Give a qualitative account of the dispersion of light as shown by the action on light of a glass prism including the seven colours of the spectrum in their correct order
• Recall that light of a single frequency is described as monochromatic

*Electromagnetic spectrum*

• Describe the main features of the electromagnetic spectrum in order of wavelength
• State that all electromagnetic waves travel with the same high speed in a vacuum
• Describe typical properties and uses of radiations in all the different regions of the electromagnetic spectrum including:
– radio and television communications (radio waves)
– satellite television and telephones (microwaves)
– electrical appliances, remote controllers for televisions and intruder alarms (infra-red)
– medicine and security (X-rays)
• Demonstrate an awareness of safety issues regarding the use of microwaves and X-rays
• State that the speed of electromagnetic waves in a vacuum is 3.0 × 108 m/s and is approximately the same in air

***Textbook***

**12. Sound**
12.1 Making sound
12.2 At the speed of sound
12.3 Seeing sounds
12.4 How sound travels
**13. Light**
13.1 Reflecting light
13.2 Refraction of light
13.3 Total internal reflection
13.4 Lenses
**14. Properties of waves**
14.1 Describing waves
14.2 Speed, frequency and wavelength
14.3 Explaining wave phenomena
**15. Spectra**
15.1 Dispersion of light
15.2 The electromagnetic spectrum

***Workbook***

Ex. 12.1 Sound on the move

Ex. 12.2 Sound as a wave
Ex. 13.1 On reflection
Ex. 13.2 Reflection if light
Ex. 13.3 The changing speed of light
Ex. 13.4 A perfect mirror
Ex. 13.5 Image in a lens
Ex. 14.1 Describing waves
Ex. 14.2 The speed of waves
Ex. 14.3 Wave phenomena
Ex. 15.1 Electromagnetic waves
Ex. 15.2 Using electromagnetic radiation

***Syllabus IGCSE***

**Electric charge**

**Core**

• State that there are positive and negative charges
• State that unlike charges attract and that like charges repel
• Describe simple experiments to show the production and detection of electrostatic charges
• State that charging a body involves the addition or removal of electrons
• Distinguish between electrical conductors and insulators and give typical examples

**Supplement**

• State that charge is measured in coulombs
• State that the direction of an electric field at a point is the direction of the force on a positive charge at that point
• Describe an electric field as a region in which an electric charge experiences a force
• Describe simple field patterns, including the field around a point charge, the field around a charged conducting sphere and the field between two parallel plates (not including end effects)
• Give an account of charging by induction
• Recall and use a simple electron model to distinguish between conductors and insulators

***Textbook***

**Static electricity**

- Charging and discharging
- Explaining static electricity
- Electric field and electric charge

***Workbook***

**Static electricity**

- Attraction and repulsion
- Moving charges
- Static at home

***Syllabus IGCSE***

**Supplement**

• State that charge is measured in coulombs
• State that the direction of an electric field at a point is the direction of the force on a positive charge at that point
• Describe an electric field as a region in which an electric charge experiences a force
• Describe simple field patterns, including the field around a point charge, the field around a charged conducting sphere and the field between two parallel plates (not including end effects)
• Give an account of charging by induction
• Recall and use a simple electron model to distinguish between conductors and insulators

**Electromotive force**

**Core**

• State that the electromotive force (e.m.f.) of an electrical source of energy is measured in volts

**Supplement**

• Show understanding that e.m.f. is defined in terms of energy supplied by a source in driving charge round a complete circuit

**Potential difference**

**Core**

• State that the potential difference (p.d.) across a circuit component is measured in volts
• Use and describe the use of a voltmeter, both analogue and digital

**Supplement**

• Recall that 1 V is equivalent to 1 J/C

***Textbook***

**Electrical quantity**

- Current in electric circuits
- Electrical resistance
- More about electrical resistance
- Electricity and energy

***Workbook***

**Electrical quantity**

- Current in a circuitCurrent and charge
- Electrical resistance
- Current - voltage characteristics
- Electrical energy and power

***Syllabus IGCSE***

**Resistance**

**Core**

• State that resistance = p.d. / current and understand qualitatively how changes in p.d. or resistance affect current

• Recall and use the equation R = V / I

• Describe an experiment to determine resistance using a voltmeter and an ammeter

• Relate (without calculation) the resistance of a wire to its length and to its diameter

**Supplement**

• Sketch and explain the current-voltage characteristic of an ohmic resistor and a filament lamp

• Recall and use quantitatively the proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area of a wire

**Electrical working**

**Core**

• Understand that electric circuits transfer energy from the battery or power source to the circuit components then into the surroundings

**Supplement**

• Recall and use the equations P = IV and E = IVt

**Circuit diagrams**

**Core**

• Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), heaters, thermistors, light-dependent resistors, lamps, ammeters, voltmeters, galvanometers, magnetising coils, transformers, bells, fuses and relays

**Supplement**

• Draw and interpret circuit diagrams containing diodes

**Series and parallel circuits**

**Core**

• Understand that the current at every point in a series circuit is the same

• Give the combined resistance of two or more resistors in series

• State that, for a parallel circuit, the current from the source is larger than the current in each branch
• State that the combined resistance of two resistors in parallel is less than that of either resistor by itself
• State the advantages of connecting lamps in parallel in a lighting circuit

**Supplement**

• Calculate the combined e.m.f. of several sources in series
• Recall and use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply
• Recall and use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit
• Calculate the effective resistance of two resistors in parallel

**Action and use of circuit components**

**Core**

• Describe the action of a variable potential divider (potentiometer)
• Describe the action of thermistors and light dependent resistors and show understanding of their use as input transducers
• Describe the action of a relay and show understanding of its use in switching circuits

**Supplement**

• Describe the action of a diode and show understanding of its use as a rectifier
• Recognise and show understanding of circuits operating as light-sensitive switches and temperature-operated alarms (to include the use of a relay)

***Textbook***

**Electric circuits**

- Circuit components
- Combinations of resistors
- Electronic circuits
- Electrical safety

***Workbook***

**Electric circuits**

- Circuit components and their symbols
- Diodes
- Resistor combinations
- More resistor combinations
- Light sensor
- Logic state
- Electrical safety

***Syllabus IGCSE***

**Simple phenomena of magnetism**

**Core**

• Describe the forces between magnets, and between magnets and magnetic materials
• Give an account of induced magnetism
• Distinguish between magnetic and nonmagnetic materials
• Describe methods of magnetisation, to include stroking with a magnet, use of direct current (d.c.) in a coil and hammering in a magnetic field
• Draw the pattern of magnetic field lines around a bar magnet
• Describe an experiment to identify the pattern of magnetic field lines, including the direction
• Distinguish between the magnetic properties of soft iron and steel
• Distinguish between the design and use of permanent magnets and electromagnets

**Supplement**

• Explain that magnetic forces are due to interactions between magnetic fields
• Describe methods of demagnetisation, to include hammering, heating and use of alternating current (a.c.) in a coil

***Textbook***

**Magnetism**

- Permanent magnet
- Magnetic fields

**Electromagnetic forces**

- The magnetic effect of current
- How electric motors are constructed
- Force on a current-carryng conductors

***Workbook***

**Magnetism**

- Attraction and repulsion
- Make a magnet
- Magnetic fields

**Electromagnetic forces**

- Using electromagnetism
- Electron deflection

***Syllabus IGCSE***

**Electromagnetic induction**

**Core**

• Show understanding that a conductor moving across a magnetic field or a changing magnetic field linking with a conductor can induce an e.m.f. in the conductor
• Describe an experiment to demonstrate electromagnetic induction
• State the factors affecting the magnitude of an induced e.m.f.

**A.C. generator**
**Core**
• Distinguish between d.c. and a.c.
**Supplement**
• Describe and explain a rotating-coil generator and the use of slip rings
• Sketch a graph of voltage output against time for a simple a.c. generator
• Relate the position of the generator coil to the peaks and zeros of the voltage output

**Transformer**
**Core**
• Describe the construction of a basic transformer with a soft-iron core, as used for voltage transformations
• Recall and use the equation (Vp / Vs) = (Np / Ns)
• Understand the terms step-up and step-down
• Describe the use of the transformer in high voltage transmission of electricity
• Give the advantages of high-voltage transmission
**Supplement**
• Describe the principle of operation of a transformer
• Recall and use the equation Ip Vp = Is Vs (for 100% efficiency)
• Explain why power losses in cables are lower when the voltage is high

**The magnetic effect of a current**
**Core**
• Describe the pattern of the magnetic field (including direction) due to currents in straight wires and in solenoids
• Describe applications of the magnetic effect of current, including the action of a relay
**Supplement**
• State the qualitative variation of the strength of the magnetic field over salient parts of the pattern
• State that the direction of a magnetic field line at a point is the direction of the force on the N pole of a magnet at that point
• Describe the effect on the magnetic field of changing the magnitude and direction of the current

**Force on a current-carrying conductor**

**Core**

• Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing:

- the current
- the direction of the field

**Supplement**

• State and use the relative directions of force, field and current

• Describe an experiment to show the corresponding force on beams of charged particles

**D.c. motor**

**Core**

• State that a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by:

- increasing the number of turns on the coil
- increasing the current
- increasing the strength of the magnetic field

**Supplement**

• Relate this turning effect to the action of an electric motor including the action of a split-ring commutator

***Textbook***

**Electromagnetic induction**

- Generating electricity
- Power lines and transformers
- How transformers work

***Workbook***

**Electromagnetic induction**

- Electricity generation
- Transformers