I I S "Curie-Sraffa" Milano PROGRAMMAZIONE DI "FISICA"
BIENNIO LICEO SCIENTIFICO
OPZIONE CAMBRIDGE

FINALITA'

Lo studio della fisica secondo la modalità prevista dal percorso Cambridge IGCSE consente agli studenti di:

- comprendere meglio il mondo tecnologico, con un interesse informato in materia scientifica
- riconoscere l'utilità (e le limitazioni) del metodo scientifico e come applicarlo ad altre discipline
- e nella vita di tutti i giorni
- sviluppare atteggiamenti pertinenti, come l'interesse per l'accuratezza e la precisione, l'obiettività, l'integrità, l'indagine, iniziativa e inventiva
- sviluppare l'interesse e la cura per l'ambiente
- comprendere meglio l'influenza e le limitazioni poste sullo studio scientifico dalla società, dall'economia,
- tecnologia, etica, comunità e ambiente
- sviluppare una comprensione delle competenze scientifiche essenziali sia per ulteriori studi che per la vita quotidiana.

OBIETTIVI

AO1: conoscenza e comprensione

Gli studenti dovrebbero essere in grado di dimostrare conoscenza e comprensione di:

1. fenomeni scientifici, fatti, leggi, definizioni, concetti e teorie
2. vocabolario scientifico, terminologia e convenzioni (compresi simboli, quantità e unità)
3. strumenti e apparecchi scientifici, comprese le tecniche di funzionamento e gli aspetti di sicurezza
4. applicazioni scientifiche e tecnologiche con le loro implicazioni sociali, economiche e ambientali.

AO2: gestione delle informazioni e risoluzione dei problemi

Gli studenti dovrebbero essere in grado, a parole o usando altre forme di presentazione scritte (cioè simboliche, grafiche e numeriche), di:

1. individuare, selezionare, organizzare e presentare informazioni da una varietà di fonti
2. tradurre le informazioni da un modulo all'altro
3. manipolare dati numerici e di altro tipo
4. utilizzare le informazioni per identificare modelli, segnalare tendenze e trarre inferenze
5. presentare spiegazioni motivate per fenomeni, modelli e relazioni
6. fare previsioni e ipotesi
7. risolvere i problemi, inclusi alcuni di natura quantitativa.

AO3: abilità sperimentali e di indagine

Gli studenti dovrebbero essere in grado di:

1. dimostrare la conoscenza di come utilizzare in sicurezza tecniche, apparati e materiali (anche in seguito a sequenze di istruzioni)
2. pianificare esperimenti e indagini
3. fare e registrare osservazioni, misurazioni e stime
4. interpretare e valutare osservazioni e dati sperimentali
5. valutare i metodi e suggerire possibili miglioramenti.

METODOLOGIA

IN CLASSE

- Lezioni frontali e partecipate.
- Esercitazioni individuali scritte.

- Attività di gruppo.

IN LABORATORIO

- Esercitazioni cattedratiche guidate dall'insegnante - Esercitazioni di gruppo.
- Uso di risorse informatiche (foglio di calcolo, simulazioni) e audiovisive (DVD didattici).
- Elaborazione di tabelle e costruzione di grafici.

TESTO IN ADOZIONE: D. Sang, M. Follows, S. Tarpey, "PHYSICS for Cambridge IGCSE" Coursebook, ed. Cambridge University Press

VERIFICA E VALUTAZIONE

Per quanto riguarda il numero e la tipologia di verifiche da svolgere si veda il verbale n.1 dell'anno in corso. Si prevedono in particolare:

1. Verifiche strutturate con test a risposta chiusa
2. Quesiti con risposte brevi
3. Semplici elaborazioni calcolative
4. Relazioni scritte delle esercitazioni di laboratorio
5. Verifiche di recupero in classe, in laboratorio o con rientri pomeridiani, nel caso in cui i risultati parziali del lavoro risultino insoddisfacenti.

Criteri di valutazione

	CONOSCENZE	COMPETENZE	CAPACITÀ'
1 - 2 3 - 4	Incompleta rispetto ai livelli minimi definiti dal programma, per mancanza di impegno nello studio personale e per gravi difficoltà di comprensione anche negli aspetti più semplici	Labili reminiscenze basate sul lavoro in classe. Espressione inglese inadeguata	Lettura del libro di testo Partecipazione passiva all'attività di laboratorio
5	Incompleta rispetto ai livelli minimi definiti dal programma, per difficoltà di comprensione degli aspetti più complessi	Memorizzazione incompleta o temporanea delle definizioni e delle formule fondamentali. Espressione inglese insufficiente, utilizzo impreciso della terminologia specifica in lingua inglese.	Comprensione del libro di testo Esposizione orale limitata agli enunciati e alle formule Partecipazione passiva al gruppo di lavoro in laboratorio, esposizione schematica scritta delle esperienze Soluzione guidata di problemi applicativi
6 *	Corrispondenti ai livelli minimi definiti dal programma	Memorizzazione stabile delle definizioni e delle formule fondamentali. Espressione inglese sufficiente, utilizzo base della terminologia specifica in lingua inglese.	Comprensione del libro di testo Esposizione orale dei temi più significativi Soluzione guidata di problemi applicativi Integrazione nel gruppo di

			lavoro in laboratorio ed esposizione sintetica scritta delle esperienze
7-8	Corrispondenti ai livelli minimi definiti dal programma, arricchite da conoscenze di interesse culturale o tecnologico	Memorizzazione stabile delle definizioni e delle formule fondamentali e della loro deduzione. Espressione inglese discreta, utilizzo adeguato della terminologia specifica in lingua inglese.	Padronanza consapevole dei temi più significativi associata a capacità di esposizione Soluzione autonoma di problemi applicativi Organizzazione del gruppo di lavoro in laboratorio ed esposizione esauriente scritta delle esperienze
9 – 10	Completa e personalmente e criticamente approfondita conoscenza	Memorizzazione stabile delle definizioni e delle formule fondamentali, della loro deduzione e dei loro legami logici. Ottima espressione inglese, utilizzo completo e preciso della terminologia specifica in lingua inglese.	Lo studente definisce e discute l'argomento proposto con competenza, proprietà e ricchezza di mezzi espressivi; sviluppa sintesi concettuali organiche e personali; produce elaborati completi, ordinati, rigorosi e approfonditi

* corrisponde agli obiettivi minimi

PROGRAMMAZIONE ANNUALE
CLASSE 1 LICEO DELLE SCIENZE APPLICATE – OPZIONE CAMBRIDGE

1 General Physics

1.1 Length and time

- The International System
- Use and describe the use of rules and measuring cylinders to find a length or a volume
- Use and describe the use of clocks and devices, both analogue and digital, for measuring an interval of time
- Obtain an average value for a small distance and for a short interval of time by measuring multiples (including the period of a pendulum)
- Understand that a Vernier Caliper is used to measure very small distances

1.2 Motion

- Define speed and calculate average speed from total distance/total time
- Distinguish between speed and velocity
- Plot and interpret a speed-time graph or a distance-time graph
- Recognise from the shape of a speed-time graph when a body is:
  - at rest
  - moving with constant speed
  - moving with changing speed
- Calculate speed from the gradient of a distance-time graph
- Calculate the area under a speed-time graph to work out the distance travelled for motion with constant acceleration
- Demonstrate understanding that acceleration and deceleration are related to changing speed including qualitative analysis of the gradient of a speed-time graph
- Define and calculate acceleration using change of velocity/time taken
- Calculate acceleration from the gradient of a speed-time graph
- Recognise linear motion for which the acceleration is constant
- Recognise motion for which the acceleration is not constant
- Understand deceleration as a negative acceleration
- State that the acceleration of free fall for a body near to the Earth is constant
- Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)

1.3 Mass and weight

- Show familiarity with the idea of the mass of a body
- State that weight is a gravitational force
- Distinguish between mass and weight
- Recall and use the equation $W = mg$
- Demonstrate understanding that weights (and hence masses) may be compared using a balance
- Demonstrate an understanding that mass is a property that 'resists' change in motion
- Describe, and use the concept of, weight as the effect of a gravitational field on a mass

1.4 Density

- Recall and use the equation $\rho = m/V$
- Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation
- Describe the determination of the density of an irregularly shaped solid by the method of displacement

1.5 Forces

1.5.1 Effects of forces

- Recognise that a force may produce a change in size and shape of a body
- Plot and interpret extension-load graphs and describe the associated experimental procedure
- Describe the ways in which a force may change the motion of a body
- Find the resultant of two or more forces acting along the same line
- State I, II and III Newton's laws
- Understand friction as the force between two surfaces which impedes motion and results in heating
- Recognise air resistance as a form of friction
- State Hooke's Law and recall and use the expression $F = k\,x$, where k is the spring constant
- Recognise the significance of the 'limit of proportionality' for an extension-load graph
- Describe qualitatively motion in a circular path due to a perpendicular force

1.5.2 Turning effect

- Describe the moment of a force as a measure of its turning effect and give everyday examples
- Understand that increasing force or distance from the pivot increases the moment of a force
- Calculate moment using the product force × perpendicular distance from the pivot
- Apply the principle of moments to the balancing of a beam about a pivot
- Apply the principle of moments to different situations

1.5.3 Conditions for equilibrium

- Recognise that, when there is no resultant force and no resultant turning effect, a system is in equilibrium
- Perform and describe an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium

1.5.4 Centre of mass

- Perform and describe an experiment to determine the position of the centre of mass of a plane lamina
- Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects

1.5.5 Scalars and vectors

- Understand that vectors have a magnitude and direction
- Demonstrate an understanding of the difference between scalars and vectors and give common examples
- Determine graphically the resultant of two vectors

1.6 Momentum

- Understand the concepts of momentum and impulse
- Recall and use the equation momentum = mass × velocity, $p=mv$
- Recall and use the equation for impulse $Ft = mv - mu$
- Apply the principle of the conservation of momentum to solve simple problems in one dimension

1.7 Energy, work and power

1.7.1 Energy

- Identify changes in kinetic, gravitational potential, chemical, elastic (strain), nuclear and internal energy that have occurred as a result of an event or process
- Recognise that energy is transferred during events and processes, including examples of transfer by forces (mechanical working), by electrical currents (electrical working), by heating and by waves
- Apply the principle of conservation of energy to simple examples
- Recall and use the expressions kinetic energy = $\frac{1}{2}mv^2$ and change in gravitational potential energy = $mg\Delta h$
- Apply the principle of conservation of energy to examples involving multiple stages
- Explain that in any event or process the energy tends to become more spread out among the objects and surroundings (dissipated)

1.7.2 Energy resources

- Describe how electricity or other useful forms of energy may be obtained from:
    - chemical energy stored in fuel
    - water, including the energy stored in waves, in tides, and in water behind hydroelectric dams
    - geothermal resources
    - nuclear fission
    - heat and light from the Sun (solar cells and panels)
    - wind
- Give advantages and disadvantages of each method in terms of renewability, cost, reliability, scale and environmental impact
- Show a qualitative understanding of efficiency
- Understand that the Sun is the source of energy for all our energy resources except geothermal, nuclear and tidal
- Show an understanding that energy is released by nuclear fusion in the Sun
- Recall and use the equation: efficiency = (useful energy output/energy input) × 100%

1.7.3 Work

- Demonstrate understanding that work done = energy transferred
- Relate (without calculation) work done to the magnitude of a force and the distance moved in the direction of the force
- Recall and use W = Fd= ΔE

1.7.4 Power

- Relate (without calculation) power to work done and time taken, using appropriate examples
- Recall and use the equation $P = \Delta E / t$ in simple systems

1.8 Pressure

- Recall and use the equation $p = F / A$
- Relate pressure to force and area, using appropriate examples
- Describe the simple mercury barometer and its use in measuring atmospheric pressure
- Relate (without calculation) the pressure beneath a liquid surface to depth and to density, using appropriate examples.
- State Stevin's law and Pascal's law. Recall and use the equation $p = hpg$
- Use and describe the use of a manometer
- State Archimedes' law. Predict whether an object will float based on density data

2. Thermal physics

2.1 Simple kinetic molecular model of matter

2.1.1 States of matter

- State the distinguishing properties of solids, liquids and gases

2.1.2 Molecular model

- Describe qualitatively the molecular structure of solids, liquids and gases in terms of the arrangement, separation and motion of the molecules
- Interpret the temperature of a gas in terms of the motion of its molecules
- Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules
- Describe qualitatively the pressure of a gas in terms of the motion of its molecules
- Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter
- Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment
- Explain pressure in terms of the change of momentum of the particles striking the walls creating a force.
- Show an appreciation that massive particles may be moved by light, fastmoving molecules

2.1.3 Evaporation

- Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid

- Relate evaporation to the consequent cooling of the liquid
- Demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation
- Explain the cooling of a body in contact with an evaporating liquid

2.1.4 Pressure changes

- Describe qualitatively, in terms of molecules, the effect on the pressure of a gas of:
  - a change of temperature at constant volume
  - a change of volume at constant temperature
- Recall and use the equation pV= constant for a fixed mass of gas at constant temperature

2.2 Thermal properties and temperature

2.2.1 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

2.2.2 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
- Describe and explain how the structure of a liquid-in-glass thermometer relates to its sensitivity, range and linearity
- Understand Celsius, Fahrenheit and Kelvin scales of temperature
- Demonstrate understanding of sensitivity, range and linearity

2.2.3 Thermal capacity (heat capacity)

- Understand the meaning of heat and the difference between heat and temperature
- Describe Joule's experiment
- 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 = $mc\Delta T$

2.2.4 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*

2.3 Thermal processes

2.3.1 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

2.3.2 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

2.3.3 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
- Identify and explain some of the everyday applications and consequences of conduction, convection and radiation

(*) Gli obiettivi minimi sono indicati con sottolineatura; il raggiungimento degli obiettivi minimi comporta la sufficienza. Libro di testo: D. Sang, M. Follows, S. Tarpey, “PHYSICS for Cambridge IGCSE” Coursebook, ed. Cambridge University Press