

Pre-university Science Olympiad

Syllabus

PHYSICS

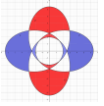
Mechanics

- Kinematics (Concepts of: Position, Trajectory, Displacement, Distance travelled, Velocity, Acceleration, Time, Linear motion, 2D and 3D motion, Circular motion)
- Dynamics
 - Basic concepts (weight, mass, force, free body diagram, etc.)
 - Momentum
 - Kinetic, potential, and mechanical energy
 - Work, power, and conservation of energy
- Statics
 - Basic concepts (torque, center of mass, and pair of forces)
 - Equilibrium conditions
- Fluid Mechanics
 - Pressure, Buoyancy, and Pascal's Principle
 - Core theorems (Archimedes theorem, continuity law and Bernoulli's theorem)
- Celestial mechanics
 - Law of gravitation, Gravitational potential, and Kepler's Laws

Miscellaneous

- Electrostatics (Electric charge, conservation of electric charge, Coulombs Law, etc.)
- Electric currents (Current intensity. Resistors. Ohm's law, DC circuits, etc.)
- Geometrical optics (Rays and optical images. Mirrors. Construction of images created by ideal thin lenses)

"We are all connected; To each other, biologically. To the earth, chemically. To the rest of the universe atomically." - Neil DeGrasse Tyson



BIOLOGY

Basic Biomolecules

- Carbohydrates
- Amino acids (to proteins)
 - Primary Structure
 - Secondary Structure
 - Tertiary and Quaternary Structure
 - Protein folding and denaturalization
- Lipids
 - Fats, Steroids and Phospholipids
- Nucleic Acids
 - DNA and RNA

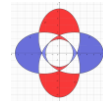
Bioenergetics

- Thermodynamics
 - Free Energy (ΔG)
- ATP and other energetic molecules (such as Creatine Phosphate)
- Enzyme functions
 - Enzyme properties
 - Active site
 - Enzyme inhibitors
- Cellular Metabolism
 - Photosynthesis
 - Respiration
 - Fermentation

Genetics

- DNA denaturalization and renaturation
 - Highly repeated fraction
 - Moderately repeated fraction
 - Non-repeated fraction
- “Jumping Genes” → Transposons
- Cell Cycle and Telomeres

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Miscellaneous

- Free Radicals
- Electrochemical gradients (Photosynthesis and Respiration)
- CRISPR (Clustered regularly interspaced short palindromic repeats)
- Tools for experiments (X-ray crystallography, in situ-hybridization, electrophoresis, protein extraction techniques, Green Fluorescent Protein, etc.)

CHEMISTRY

Organic Chemistry

- Training and nomenclature
- Solving equations
- Stoichiometric calculations
- Acid-base reactions
- Oxide-Reduction Reactions
- Isomerism
 - Structural isomerism
 - Chain isomerism
 - Cis – trans isomerism
 - Position isomerism
- Main reactions (Alkanes, cycloalkanes, alkenes, alkyls, alkyl halides, aromatics, etc.)

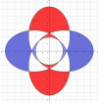
Physical Chemistry

- Thermodynamics (work, laws of thermodynamics, ΔG , etc.)
- Chemical Balance

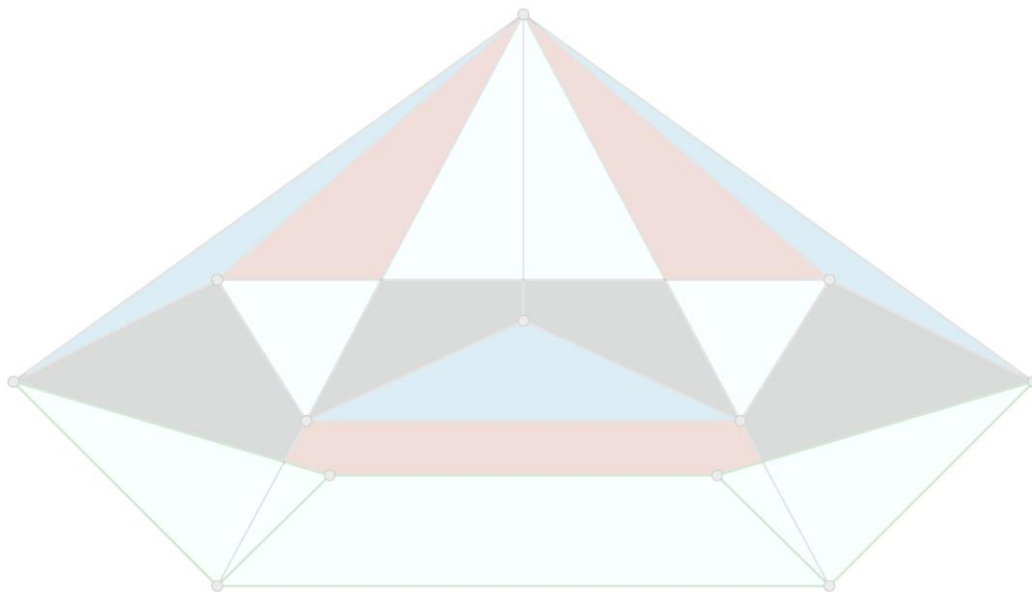
Analytical Chemistry

- Solutions and concentration units (such as molality, molarity, molar fraction, and percentages)

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- Chemical Balance
 - Types of Chemical Balance
 - Balance Constant
 - Le Chatelier principle and balance-altering factors
- Acid – Base
 - Acid Base theories
 - Conjugated Acids and Bases
 - pH and pOH calculations



Disclaimer: To solve problems you do not need pre-knowledge in differential calculus or integrals. The problems will be centred in the comprehension and use of scientific concepts rather than the application of complex math (although that's pretty cool as well!)