PHYSICS – MINIMUM REQUIREMENTS
for pre-IB and IB classes

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Caution! Text in gray NOT REQUIRED for pre-IB class candidates

MATHEMATICAL REQUIREMENTS:
1. addition, subtraction, multiplication, division
2. 10-powers prefixes
3. calculating exponentials, reciprocals, roots, logarithms, powers, arithmetic means, degrees, radians, sin, cos, tan and inverse asin, acos, atan functions, and their approximations
4. solving equations, roots, fractions, algebraic equations, simultaneous linear equations with two variables
5. understanding the meaning and use of symbols: /, >, <, «, », =, ≈, α, ∆, ≤, ≥, ≠, ∆x, lxl,...
6. geometry and trigonometry: calculating areas, surface areas and volumes of known 2D and 3D objects, solving triangle problems, similarity of triangles, angles problems: radians, degrees, Pythagorean theorem, small angles approximations, links between sine, cosine, tangent and their inverse functions, approximations of the functions
7. graphs: gradients/slopes and intercepts finding (interpretation in physics graphs)
8. understanding meaning of the integrals and differential equations
9. use of popular scientific calculators

PHYSICAL REQUIREMENTS:

WORLD OF PHYSICS; MECHANICS: Kinematics, Dynamics, Waves
1. general physical constants i.e.: speed of light, Planck constant, etc...
2. physical units
3. everyday quantities knowledge i.e. car’s battery voltage, average step length, etc...
4. orders of magnitude of times, masses and distances, estimations, approximations and calculations, significant figures
5. vectors and scalars - solving problems in 1D and 2D graphically and in vector notation
6. resolving 2D vectors into 2 orthogonal components
7. measurements and uncertainties
8. equation of motion for
   • uniform motion
   • uniformly accelerated motion and projectile motion at an arbitrary angle
   • simple harmonic motion (SHM)
9. graphical representation of motion; finding gradients, intercept, area under the curve and slope of the curve – interpretation
10. performing graphs on the basis of other graphs
11. forces and dynamics – Newton’s laws, inertial and non-inertial systems of reference
12. work, energy, power
13. circular motion, centripetal acceleration and force
14. oscillations and waves; SHM, wave’s characteristics, properties and phenomena (standing waves, Doppler effect, diffraction, interference, reflection, refraction, polarization, resonance) problems of resolution, energy, power and intensity of waves; Huygen’s principle, wavelets, dB scale

ELECTROMAGNETIC WAVES
1. range, nature, properties

FIELDS AND FORCES
1. gravitational, electrical and magnetic fields
2. potential, force, energy, strength of the fields
4. motion of particles in the fields – solving problems, description
5. right/left-hand rules for magnetic fields and forces

ELECTRICITY
1. potential difference, current, resistance, internal resistance
2. Ohm’s law
3. electrical circuits and symbols, voltmeters, ammeters, ohmmeters – in theory and practice, solving problems
4. Kirchoff’s rules and solving problems – currents and the junction
5. DC and AC currents; maximum, average and RMS-values of current and voltage

ELECTROMAGNETIC INDUCTION
1. qualitative description and understanding of variable Electric and Magnetic fields, induced EMF
2. right/left-hand rules for variable fields
3. coils, inductors, bar magnets, N-S poles finding, current direction finding, …
4. Maxwell equations – only interpretation !!! (no equations)
5. flux, magnetic field, induced EMF (electromotive force) - quantitatively
6. AC currents
7. transmission of power – transformers
8. Faraday’s law – interpretation and calculations
9. Lenz law - interpretation and solving problems

THERMAL PHYSICS
1. thermal properties of matter; specific heat capacities, heat capacities etc..., molar mass, number of moles, Avogadro constant...
2. energy flow; conduction, convection, radiation
3. states of matter, phase changes, boiling and evaporation...
4. temperature scales
5. ideal gas assumptions
6. equation of state for ideal gas – Clapeyron equation of state
7. processes; isothermal, isovolumetric (isochoric), isobaric – changes of state
8. laws of thermodynamics

**ATOMIC AND NUCLEAR PHYSICS**
1. the atom – Thomson model, Bohr’s model, Schrodinger model
2. atomic spectra, atomic level decay
3. photoelectric effect
4. wave nature of matter
5. energy units: J, eV
6. Einstein’s equation and interpretation $E=mc^2$
7. nucleus, nucleons, binding energy, radioactive decay; α,β,γ -decays, α,β,γ - particles, radioactive decay law, decay constant, half-life, activity
8. nuclear reactions, fission, fusion, scattering,...
9. C-14 dating and others
10. Radiation and safety