

# Syllabus for the National Physics Olympiad of Bangladesh

The questions will solely be based on problems. They can involve numerical and/or algebraic operations.

1. **Kinematics:** Vector representation of displacement, velocity and acceleration; Vector form of the equation of motion under uniform acceleration. Projectile motion, circular motion. Centripetal acceleration. Relation between angular and linear velocity (using vectors); Angular acceleration.
2. **Laws of Motion:** Inertia and forces. Newton's laws of motion; Momentum, Impulse; Conservation of linear momentum (using vectors/ components); Motion of a system with varying mass (example: Rocket). Equilibrium of forces; Frictional forces, Coefficients of friction.
3. **Work, Energy and Power:** Open and closed systems. Calculation of work, Kinetic energy and Work-energy theorem; Potential energy; Conservation of energy; Power.
4. **Gravitation:** Newton's Law of gravitation, Gravitational field, Gravitational potential; Escape velocity; Kepler's laws
5. **Mechanics of Rigid Bodies:** Statics, Center of mass, conditions of equilibrium. Angular momentum; Torque; Newton's laws for angular motion; Conservation of Angular momentum. Moment of inertia; Radius of gyration; Parallel axes theorem. Kinetic energy of a rotating body.
6. **Fluids:** Concepts of Pressure, buoyancy and continuity law for fluids.
7. **Simple Harmonic Motion:** Definition; equation and its solution (qualitatively); Variation of potential and kinetic energy (graphical); Oscillation of a spring; Simple pendulum and its period. Attenuation and Resonance (qualitatively).
8. **Elasticity:** Elasticity and Hooke's law; Potential energy related to elastic deformations.
9. **Heat and Gas:** Ideal gas equation; Primary concept about the distribution of velocities of molecules of a gas; Root mean square velocity; Relation of molecular velocity with pressure and temperature; Mean free path. Absolute Temperature. Avogadro's number.
10. **Laws of Thermodynamics:** Thermal equilibrium, Heat and internal energy; Work done in Adiabatic and isothermal expansion and contraction of gases; first law of thermodynamics. In adiabatic processes:  $PV^\gamma = \text{constant}$ . Quantities depending on state and quantities depending on processes. Carnot cycle. Reversible and irreversible processes, the second law of thermodynamics, Entropy, Efficiency of an engine.

11. **Heat Radiation:** Black body radiation, Stefan-Boltzmann law;
12. **Wave and Sound:** General characteristics of waves; Amplitude, wavelength, frequency, phase, intensity; Transverse and longitudinal waves; Superposition and interference; Progressive and standing waves. Doppler's effect. Beats, laws of vibration of stretched string; Resonance Determination of velocity of sound.
13. **Electrostatics:** Static electricity, conservation of charge, Coulomb's law, field intensity, Potential and equipotential surface. Capacitors, capacitance, dielectric constant. Series and parallel constant. Series and parallel combination of capacitors; Energy stored in a capacitor.
14. **Electric current:** Current, Ohm's law; Resistance and specific resistance; Series and parallel combination of resistance; Kirchhoff's laws, internal resistance of an electric cell, I-V characteristics oh non-Ohmic devices. Joule's laws. Work and power of currents.
15. **Magnetic effects of current:** Magnetic field due to current; Magnetic field due to current in a long straight wire, circular loop. Force on a charge moving in a magnetic field; cyclotron. Ampere's law – field due to a long solenoid.
16. **Electromagnetic induction and Alternating Current:** Faraday's laws and Lenz's law; magnetic Flux, Self and Mutual induction. Alternating current; Root mean square value and peak value of voltage and current. Energy density of magnetic fields.
17. **Electromagnetic Waves:** electromagnetic spectrum, Velocity of light (Dependence on medium and wave length): Determination of velocity of light. Dispersion of light;
18. **Wave Optics:** Wave front, Huygens's principle, Interference. Young's double-slits' experiment, diffraction, diffraction due to a single slit, use of grating; Resolving power of a grating. Polarization; Polarizers. Electromagnetic waves as transverse waves.
19. **Quantum Physics:** the concept of Photon. Photoelectric effect and Einstein's equation. De Broglie wavelength and Uncertainty principle. Bohr's model of an atom. Energy levels of atoms and molecules. Emission and absorption spectrum. Radioactive decay, alpha, beta and gamma decays. Decay law and half life; nuclear reactions and mass defect.
20. **Theory of relativity:** Basic postulates of theory of relativity; Mass energy equation. Conservation of Energy.