**Topic #1: Measurements and Uncertainties—5 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Measurements in physics | 1.1 | * Fundamental and derived SI units * Scientific notation and metric multipliers * Significant figures * Orders of magnitude * Estimation |
| Uncertainties and errors | 1.2 | * Random and systematic errors * Absolute, fractional and percentage uncertainties * Error bars * Uncertainty of gradient and intercepts |
| Vectors and scalars | 1.3 | * Vector and scalar quantities * Combination and resolution of vectors |

**Topic #2: Mechanics—22 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Motion | 2.1 | * Distance and displacement * Speed and velocity * [Acceleration](https://blog.prepscholar.com/acceleration-formula-equation) * Graphs describing motion * Equations of motion for uniform acceleration * Projectile motion * Fluid resistance and terminal speed |
| Forces | 2.2 | * Objects as point particles * Free-body diagrams * Translational equilibrium * Newton's laws of motion * Solid friction |
| Work, energy and power | 2.3 | * Kinetic energy * Gravitational potential energy * Elastic potential energy * Work done as energy transfer * Power as rate of energy transfer * Principle of conservation of energy * Efficiency |
| Momentum and impulse | 2.4 | * Newton's second law expressed in terms of rate of change of momentum * Impulse and force–time graphs * Conservation of linear momentum * Elastic collisions, inelastic collisions and explosions |

**Topic #3: Thermal Physics—11 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Thermal concepts | 3.1 | * Molecular theory of solids, liquids and gases * Temperature and absolute temperature * Internal energy * [Specific heat capacity](https://blog.prepscholar.com/specific-heat-capacity-of-water) * Phase change * Specific latent heat |
| Modelling a gas | 3.2 | * Pressure * Equation of state for an ideal gas * Kinetic model of an ideal gas * Mole, molar mass and the Avogadro constant * Differences between real and ideal gases |

**Topic #4: Waves—15 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Oscillations | 4.1 | * Simple harmonic oscillations * Time period, frequency, amplitude, displacement and phase difference * Conditions for simple harmonic motion |
| Travelling waves | 4.2 | * Travelling waves * Wavelength, frequency, period and wave speed * Transverse and longitudinal waves * The nature of electromagnetic waves * The nature of sound waves |
| Wave characteristics | 4.3 | * Wavefronts and rays * Amplitude and intensity * Superposition * Polarization |
| Wave behaviour | 4.4 | * Reflection and refraction * Snell's law, critical angle and total internal reflection * Diffraction through a single-slit and around objects * Interference patterns * Double-slit interference * Path difference |
| Standing waves | 4.5 | * The nature of standing waves * Boundary conditions * Nodes and antinodes |

**Topic #5: Electricity and Magnetism—15 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Electric fields | 5.1 | * Charge * Electric field * Coulomb's law * Electric current * Direct current (dc) * Potential difference |
| Heating effect of electric currents | 5.2 | * Circuit diagrams * Kirchhoff's circuit laws * Heating effect of current and its consequences * Resistance expressed as R = V/I * Ohm's law * Resistivity * Power dissipation |
| Electric cells | 5.3 | * Cells * Internal resistance * Secondary cells * Terminal potential difference * Electromotive force (emf) |
| Magnetic effects of electric currents | 5.4 | * Magnetic fields * Magnetic force |

**Topic #6: Circular Motion and Gravitation—5 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Circular motion | 6.1 | * Period, frequency, angular displacement and angular velocity * Centripetal force * Centripetal acceleration |
| Newton's law of gravitation | 6.2 | * Newton's law of gravitation * Gravitational field strength |

**Topic #7: Atomic, Nuclear and Particle Physics—14 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Discrete energy and radioactivity | 7.1 | * Discrete energy and discrete energy levels * Transitions between energy levels * Radioactive decay * Fundamental forces and their properties * Alpha particles, beta particles and gamma rays * Half-life * Absorption characteristics of decay particles * Isotopes * Background radiation |
| Nuclear reactions | 7.2 | * The unified atomic mass unit * Mass defect and nuclear binding energy * Nuclear fission and nuclear fusion |
| The structure of matter | 7.3 | * Quarks, leptons and their antiparticles * Hadrons, baryons and mesons * The conservation laws of charge, baryon number, lepton number and strangeness * The nature and range of the strong nuclear force, weak nuclear force and electromagnetic force * Exchange particles * Feynman diagrams * Confinement * The Higgs boson |

**Topic #8: Energy Production—8 Hours for Both SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Energy sources | 8.1 | * Specific energy and energy density of fuel sources * Sankey diagrams * Primary energy sources * Electricity as a secondary and versatile form of energy * Renewable and non-renewable energy sources |
| Thermal energy transfer | 8.2 | * Conduction, convection and thermal radiation * Black-body radiation * Albedo and emissivity * The solar constant * The greenhouse effect * Energy balance in the Earth surface–atmosphere system |

**Topic #9: Wave Phenomena—17 Hours for HL Only**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Simple harmonic motion (HL ONLY) | 9.1 | * The defining equation of SHM * Energy changes |
| Single-slit diffraction (HL ONLY) | 9.2 | * The nature of single-slit diffraction |
| Interference (HL ONLY) | 9.3 | * Young's double-slit experiment * Modulation of two-slit interference pattern by one-slit diffraction effect * Multiple slit and diffraction grating interference patterns * Thin film interference |
| Resolution (HL ONLY) | 9.4 | * The size of a diffracting aperture * The resolution of simple monochromatic two-source systems |
| Doppler effect (HL ONLY) | 9.5 | * The Doppler effect for sound waves and light waves |

**Topic #10: Fields—11 Hours for HL only**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Describing fields (HL ONLY) | 10.1 | * Gravitational fields * Electrostatic fields * Electric potential and gravitational potential * Field lines * Equipotential surfaces |
| Fields at work (HL ONLY) | 10.2 | * Potential and potential energy * Potential gradient * Potential difference * Escape speed * Orbital motion, orbital speed and orbital energy * Forces and inverse-square law behaviour |

**Topic #11: Electromagnetic Induction—16 Hours for HL Only**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Electromagnetic induction (HL ONLY) | 11.1 | * Electromotive force (emf) * Magnetic flux and magnetic flux linkage * Faraday's law of induction * Lenz's law |
| Power generation and transmission (HL ONLY) | 11.2 | * Alternating current (ac) generators * Average power and root mean square (rms) values of current and voltage * Transformers * Diode bridges * Half-wave and full-wave rectification |
| Capacitance (HL ONLY) | 11.3 | * Capacitance * Dielectric materials * Capacitors in series and parallel * Resistor-capacitor (RC) series circuits * Time constant |

**Topic #12: Quantum and Nuclear Physics—16 Hours for HL Only**

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| Subtopic | Subtopic Number | IB Points to Understand |
| The interaction of matter with radiation (HL ONLY) | 12.1 | * Photons * The photoelectric effect * Matter waves * Pair production and pair annihilation * Quantization of angular momentum in the Bohr model for hydrogen * The wave function * The uncertainty principle for energy and time and position and momentum * Tunnelling, potential barrier and factors affecting tunnelling probability |
| Nuclear physics (HL ONLY) | 12.2 | * Rutherford scattering and nuclear radius * Nuclear energy levels * The neutrino * The law of radioactive decay and the decay constant |

**Option A: Relativity—15 Hours for SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| The beginnings of relativity | A.1 | * Reference frames * Galilean relativity and Newton's postulates concerning time and space * Maxwell and the constancy of the speed of light * Forces on a charge or current |
| Lorentz transformations | A.2 | * The two postulates of special relativity * Clock synchronization * The Lorentz transformations * Velocity addition * Invariant quantities (spacetime interval, proper time, proper length and rest mass) * Time dilation * Length contraction * The muon decay experiment |
| Spacetime diagrams | A.3 | * Spacetime diagrams * Worldlines * The twin paradox |

**Additional HL Relativity Topics—10 More Hours for HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Relativistic mechanics (HL ONLY) | A.4 | * Total energy and rest energy * Relativistic momentum * Particle acceleration * Electric charge as an invariant quantity * Photons * MeV c^–2 as the unit of mass and MeV c^–1 as the unit of momentum |
| General Relativity (HL ONLY) | A.5 | * The equivalence principle * The bending of light * Gravitational redshift and the Pound–Rebka–Snider experiment * Schwarzschild black holes * Event horizons * Time dilation near a black hole * Applications of general relativity to the universe as a whole |

**Option B: Engineering Physics—15 Hours for SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Rigid bodies and rotational dynamics | B.1 | * Torque * Moment of inertia * Rotational and translational equilibrium * Angular acceleration * Equations of rotational motion for uniform angular acceleration * Newton's second law applied to angular motion * Conservation of angular momentum |
| Thermodynamics | B.2 | * The first law of thermodynamics * The second law of thermodynamics * Entropy * Cyclic processes and pV diagrams * Isovolumetric, isobaric, isothermal and adiabatic processes * Carnot cycle * Thermal efficiency |

**Additional HL Engineering Physics Topics—10 More Hours for HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Fluids and fluid dynamics (HL ONLY) | B.3 | * Density and pressure * Buoyancy and Archimedes' principle * Pascal's principle * Hydrostatic equilibrium * The ideal fluid * Streamlines * The continuity equation * The Bernoulli equation and the Bernoulli effect * Stokes' law and viscosity * Laminar and turbulent flow and the Reynolds number |
| Forced vibrations and resonance (HL ONLY) | B.4 | * Natural frequency of vibration * Q factor and damping * Periodic stimulus and the driving frequency * Resonance |

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| Subtopic | Subtopic Number | IB Points to Understand |
| Introduction to imaging | C.1 | * Thin lenses * Converging and diverging lenses * Converging and diverging mirrors * Ray diagrams * Real and virtual images * Linear and angular magnification * Spherical and chromatic aberrations |
| Imaging instrumentation | C.2 | * Optical compound microscopes * Simple optical astronomical refracting telescopes * Simple optical astronomical reflecting telescopes * Single-dish radio telescopes * Radio interferometry telescopes * Satellite-borne telescopes |
| Fibre optics | C.3 | * Structure of optic fibres * Step-index fibres and graded-index fibres * Total internal reflection and critical angle * Waveguide and material dispersion in optic fibres * Attenuation and the decibel (dB) scale |

**Option C: Imaging—15 Hours for SL and HL**

**Additional HL Imaging Topics—10 More Hours for HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Medical imaging (HL ONLY) | C.4 | * Detection and recording of X-ray images in medical contexts * Generation and detection of ultrasound in medical contexts * Medical imaging techniques (magnetic resonance imaging) involving nuclear magnetic resonance (NMR) |

**Option D: Astrophysics—15 Hours for SL and HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Stellar quantities | D.1 | * Objects in the universe * The nature of stars * Astronomical distances * Stellar parallax and its limitations * Luminosity and apparent brightness |
| Stellar characteristics and stellar evolution | D.2 | * Stellar spectra * Hertzsprung–Russell (HR) diagram * Mass–luminosity relation for main sequence stars * Cepheid variables * Stellar evolution on HR diagrams * Red giants, white dwarfs, neutron stars and black holes * Chandrasekhar and Oppenheimer–Volkoff limits |
| Cosmology | D.3 | * The Big Bang model * Cosmic microwave background (CMB) radiation * Hubble's law * The accelerating universe and redshift (z) * The cosmic scale factor (R) |

**Additional HL Astrophysics Topics—10 More Hours for HL**

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| Subtopic | Subtopic Number | IB Points to Understand |
| Stellar processes (HL ONLY) | D.4 | * The Jeans criterion * Nuclear fusion * Nucleosynthesis off the main sequence * Type Ia and II supernovae |
| Further cosmology (HL ONLY) | D.5 | * The cosmological principle * Rotation curves and the mass of galaxies * Dark matter * Fluctuations in the CMB * The cosmological origin of redshift * Critical density * Dark energy |