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

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

Subtopic	Subtopic Number	IB Points to Understand
Motion	2.1	• Distance and displacement • Speed and velocity • Acceleration • 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

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 • 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

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

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

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

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

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

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

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

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

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

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

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

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

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

Option C: Imaging—15 Hours for SL and HL

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

Additional HL Imaging Topics—10 More Hours for HL

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

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

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