

PhET Interactive Physics Simulations for IB DP Physics (SL & HL)

Sub-Topics	PhET Simulations
1.2 Uncertainties and Errors	<p>Curve Fitting Polynomials, Error Analysis</p> <p>Extra: Least-Squares Regression Linear Regression, Correlation, Residuals, Outlier, Data</p> <p>Graphing Lines Graphing Linear Equations, Lines, Slope</p> <p>Graphing Quadratics Graphing, Parabola, Quadratic Function</p> <p>Calculus Grapher Derivative, Integral</p> <p>Trig tour Trigonometry, Unit Circle, Sines</p>
1.3 Vectors and Scalars	<p>Vector Addition Vectors, Vector Addition</p>
2.1 Motion	<p>The Moving Man Position, Velocity, Acceleration</p> <p>Motion in 2D Motion, Velocity, Acceleration</p> <p>Projectile motion Range, height, time, initial speed, mass, air resistance, diameter.</p> <p>Maze Game Displacement, velocity, acceleration, vectors.</p>

<p>2.2 Forces</p>	<p>Forces and Motion: Basics Net force (sum of forces), mass, speed, applied force, friction force, acceleration (1st and 2nd laws).</p> <p>Forces in 1 Dimension 1D motion; graphs: applied force, acceleration, velocity, position; free body diagram, total force, horizontal force, vectors, friction, mass, friction coefficients.</p> <p>Forces and Motion 1D motion, FBDs, vectors, friction, gravity, normal, spring, and applied forces, sum of forces, position, friction coefficients, force/time graphs, game "Robot Moving Company".</p> <p>Ramp: Forces and Motion Same as Forces and motion above, but includes ramp with adjustable angle.</p> <p>Friction Friction, Thermodynamics, Heat</p> <p>Extra: Buoyancy Buoyancy, density</p>
<p>2.3 Work, Energy, and Power</p>	<p>The Ramp Quantitative energy and work graphs and qualitative bar charts. Might be able to use to show work done equals change in gravitational potential energy</p> <p>Energy Skate Park Basics Similar to Energy Skate Park, but includes speed indicator. Limitations: no quantitative graphs (bar and pie only), friction coefficient adjustable only on student build screen, no adjustable PE reference line.</p> <p>Energy Skate Park Quantitative energy and time graph, energy and position graph; qualitative energy bar graphs, pie chart; variable friction and gravity, moveable PE reference line, mass, slow motion option, student builds ramp shapes.</p> <p>Energy Forms and Changes Qualitative introduction to conservation of energy principles.</p>
<p>2.4 Momentum and Impulse</p>	<p>Collision Lab Elastic and inelastic collisions in 1D and 2D; center of mass; velocity and momentum vectors; momentum, mass, velocity, time and kinetic energy values; path tracing in 2D; 2 or more balls.</p>
<p>3.2 Modelling a gas</p>	<p>Gas properties</p>

	Gas, Heat, Thermodynamics
4.1 Oscillations	<p>Pendulum Lab Periodic Motion, Simple Harmonic Motion, Conservation of Energy</p> <p>Masses and Springs Vary masses, spring constants, friction, gravity force; use ruler, stopwatch, for quantitative measurements. Qualitative energy bar charts.</p>
4.2 Travelling waves	<p>Wave on a String Waves, Frequency, Amplitude</p> <p>Sound Sound, Waves</p>
4.4 - Wave behaviour	<p>Bending light Snell's Law, Refraction, Reflection, Optics, Prisms, Lenses, Light</p> <p>Wave interference Interference, Double Slit, Diffraction</p> <p>Fourier: Making Waves Waves, Sines, Cosines</p>
5.1 Electric Fields	<p>Balloons and Static Electricity Static electricity, charges, forces, polarization, charging by friction, insulators, net charge. Conceptual.</p> <p>John Travoltage Charging by friction, discharge by contact, grounding, conductors. Conceptual.</p> <p>Charges and Fields Electric field, field plots, voltage, equipotential lines, charge units, tape measure. Quantitative.</p> <p>Electric Field Hockey Game with electric field plots and charges. Students love this one. Qualitative.</p> <p>Coulomb's law Electrostatics, Electric Force, Force, Pairs, Coulomb's Law</p> <p>Electric field of dreams Electricity, Electric Charges, Electric Field</p>

5.2 Heating Effects of Electric Currents	<p>Battery Resistor Circuit Resistor, Voltage, Batteries, Electrons</p> <p>Battery Voltage Voltage, Batteries, Electrons</p> <p>Circuit Construction Kit (DC Only) Virtual Lab Quantitative. Circuits, light bulbs, resistors, voltmeter, ammeter, switches, batteries, series and parallel.</p> <p>Ohm's Law Lab Quantitative. Voltage, Current, Resistance, Ohm's Law</p> <p>Resistance in a Wire Resistivity, Resistance, Circuits</p>
5.4 Magnetic effects of electric currents	<p>Magnets and Electromagnets Magnetic Field, Magnets, Electromagnets</p> <p>Magnet and Compass Magnetic Field, Magnets, Compass</p>
6.1 Circular Motion	<p>Ladybug Revolution Quantitative angular and linear position, velocity, acceleration with time graphs and values for circular motion; can vary radius, radians and degrees, vectors are very small, may be hard to see.</p>
6.2 Newton's law of gravitation	<p>Gravity Force Lab Gravitational Force, Inverse Square Law, Force Pair</p>
7.3 The Structure of Matter	<p>Build an Atom Atoms, Atomic Structure, Isotope Symbols, Atomic Nuclei</p> <p>Rutherford Scattering Atomic Nuclei, Atomic Structure, Quantum Mechanics</p>
8.1 Energy Sources	<p>Energy Forms and Changes Conservation of Energy, Energy Systems, Energy Transfer</p>
8.2 Thermal Energy Transfer	<p>Blackbody Spectrum Blackbody, Sun, Light, Quantum Mechanics</p>
9.1 Simple Harmonic Motion	<p>Masses and Springs: Basics Periodic Motion, Hooke's Law, Conservation of Energy, Measurement</p> <p>Hooke's Law Springs, Force, Potential Energy</p>

	<p>Pendulum Lab Periodic Motion, Simple Harmonic Motion, Conservation of Energy</p> <p>Resonance Resonance, Harmonic Motion, Oscillator</p>
10.2 Fields at Work	<p>Gravity and Orbits Conceptual only, gravity force and velocity vectors for orbital motion. Vary initial velocity, mass of satellite, observe changes in orbit.</p> <p>My Solar System Motion, Acceleration, Velocity</p>
11.1 Electromagnetic Induction	<p>Generator Generator, Faraday's law, Magnetic Field</p> <p>Faraday's Electromagnetic Lab Electromagnetic induction, Faraday's law, transformer, generator. Semi-quantitative (field strength, loop area, number of loops)</p>
11.3 Capacitance	<p>Capacitor Lab - Basics Parallel Plate Capacitor, Capacitance, RC Circuit, Circuits</p> <p>Capacitor Lab Capacitor, Capacitance, Circuits</p> <p>Conductivity Conductivity, Energy Levels, Photoconductors</p> <p>Circuit Construction Kit (AC+DC) Virtual Lab Quantitative. Similar to CCK DC only, but includes capacitors, inductors, AC, I and V graphs.</p>
12.1 Interaction of matter with radiation	<p>Photoelectric Effect Light, Quantum Mechanics, Photons</p> <p>Models of the Hydrogen Atom Quantum Mechanics, Hydrogen Atom, Bohr Model</p> <p>Quantum Tunnelling and Wave Packets Quantum Particles, Tunneling</p> <p>Extra</p> <p>Colour Vision Photons, Monochromatic Light, White Light, Rainbows</p> <p>Lasers Laser, Photon Beams, Quantum Mechanics</p>

	<p>Microwaves Microwaves, Heat, Thermodynamics</p> <p>Molecules and Light Molecules, Photons, Absorption</p> <p>Optical Quantum Control Optics, Pulses</p> <p>Atomic Interactions Interaction Potential, Atomic Bonding, Van der Waals Force, Pauli Repulsion</p> <p>Electron Diffraction Electron Diffraction</p>
12.2 Nuclear Physics	<p>Alpha Decay Alpha decay, half life, radiation</p> <p>Beta decay Nuclear Decay, Beta Decay, Nuclear Physics</p> <p>Nuclear Fission Fission, Chain Reaction, Atomic Nuclei</p> <p>Isotopes Isotopes, Atomic Mass</p> <p>Radioactive Dating Game Radiometric Dating, Carbon Dating, Half Life</p>
B.1 Rigid Bodies and rotational dynamics	<p>Torque Torque (positive and negative), force, radius, braking force, mass, moment of inertia, angular acceleration, angular velocity, angular momentum. Velocity and acceleration vectors, degrees and radians, quantitative graphs.</p> <p>Balancing Act Balance masses at various positions on a beam. Pivot at center only. May cause a misconception that beams balance only horizontally.</p>
B.3 Fluids and fluid dynamics	<p>Fluid pressure and flow Pressure, Water, Fluids, Fluid Dynamics, Bernoulli Density</p> <p>Under pressure Pressure, Fluids, Density</p>

