



Dr. Pierce's Physics and Math Videos

PRECALCULUS

[Imaginary & Complex Numbers](#)
[Raising Complex Numbers to a Power \$\(1+\sqrt{3}i\)^4\$](#)
[Plotting a Hyperbola](#) [Plotting an Ellipse](#)
[Plotting Parabolas](#)
[Gaussian Elimination: 3x3 Matrix in Row Echelon Form](#)
[3 Equations for 3 Unknowns with Matrix Calculator](#)
[3 Equations for 3 Unknowns Row Echelon](#)
[Spherical Coordinates](#)
[Cross Products](#)
[Calculating Cross Products \$A_{\text{perp}}B = AB_{\text{perp}} = A \times B\$](#)
[Dot Products](#)
[Inverse Functions](#)
[Using Parent Functions to Sketch Graphs](#)
[Graphs of Polynomial Functions](#)
[Slant Asymptotes](#)
[Long Division & Synthetic Division of Polynomials](#)
[Trigonometry Made Easy \(Shadows for Sine and Cosine\)](#)
[Signs and Graphs of Trig \$x \times \csc c\$ vs \$\csc C \times x\$ vs \$\csc HD\$ vs \$g \times x\$ vs \$g \times x\$](#)
[cdcc vs gv Functions](#)
[Inverse Trig Functions](#)
[What are Logarithms? - Practice with Logarithms](#)
[Logarithm Rules](#)
[Partial Fraction Decomposition](#)
[Finding Inverse Matrices](#)
[Pascal's Triangle for Easy Expansion of Binomials](#)
[Permutations \(nPr\) and Combinations \(nCr\)](#)
[Zeros, Undefined Points, and Holes in Rational Functions](#)
[Add and Subtract Rational Functions:: Common Denominators](#)
[How to Add Vectors](#)

CALCULUS

[Integrals and Double Integrals](#)
[Derivatives and Antiderivatives of Polynomials: Intro to Calculus in Math & Physics](#)
[Differential Equations in Engineering & Physics](#)
[Area of a Circle: Introduction to Double Integrals](#)
[Volume Elements in Cartesian, Spherical, Cylindrical](#)
[Differential Equations in Mechanics and E&M 1](#)
[Total Mass / Center of Mass of Non-Uniform Object](#)
[Center of Mass of an Object with a Changing Mass Density](#)

MECHANICS

Review of Main Ideas

[How to Add Vectors](#) [Tension and Statics](#)
[Tension, Weight, and \$F = ma\$](#) [Tension in Slacklines](#)
[Friction, Normal Force, and \$\Sigma F = ma\$](#) [Static and Kinetic Friction](#)
[Inclined Planes \(Ramps\) and Why We Tilt Our Axes](#)
[Motion Graphs & Simple Calculus](#)
[Motion Graph Basics 1](#) [Motion Graph Basics 2](#)
[Where Do Kinematic Equations Come From?](#)
[Kinematic Equations: for Constant Acceleration](#)
[Projectile Launched at an Angle](#)
[Projectile Motion Lab for Remote Learners](#)
[Centripetal and Tangential Acceleration](#)
[Speed Limit on a Banked Road with Friction](#)
[Falling with Linear Air Drag \(Air Friction\)](#)
[Simple Pendulum](#)
[Physical Pendulum \(Swinging Stick\)](#)
[Simple Pendulum vs. Physical Pendulum](#)
[Mass on a Spring](#)
[Introduction to Newtonian Gravity](#)
[What If You Dig a Tunnel Through the Earth](#)
[Newton's 2nd Law: A Brain Teaser](#)
[Dot Products and Work](#)
[Introduction to Torque](#)
[Signs of Torque: A Few Quick Notes](#)
[Three Ways to Visualize Torque](#)
[Torque Example: Ladder Against Wall Problem](#)
[Torque Example: Ladder Against Rough Wall on Rough Floor](#)
[Moment of Inertia of a Stick about the End](#)
[Moment of Inertia of a Uniform Disc](#)
[Moment of Inertia of a Toilet Paper Roll, Annulus, or Tube](#)
[Introduction to Newtonian Gravity & Circular Orbits](#)
[Gravitational Potential Energy and Escape Velocity](#)
[Moment of Inertia](#)
[Rolling Down a Ramp: Forces & Torques](#)
[Rolling Down an Incline: Sphere vs. Rings vs. Discs](#)
[Rolling Down an Incline - It's a Race!](#)
[Rolling and Skidding Examples](#)
[Angular Momentum - An Example](#)
[Introduction to Angular Momentum](#)
[Gyroscopic Precession of a Bicycle Wheel](#)
[Impulse: Introduction & Example](#)
[Falling Chain Problem: Chain Falls onto Scale](#)



Dr. Pierce's Physics & Math Videos

[Related Rates: Growth of a Circle and a Cone](#)

ALGEBRA 2

[Equation of a Line: 3 Forms](#)

[How to Complete the Square](#)

[How to Factor Quadratic Expressions](#)

[Solving Inequalities: Flip the Sign when Multiplying by a Negative Number](#)

[Solving 3 Equations for 3 Unknowns with Elimination](#)

[Three Forms of Quadratic Equations: Standard, Vertex, Factored](#)

[Finding Roots of Polynomial Functions Using \(\$\pm p/q\$ \)](#)

[Introduction to Functions \$f\(x\)\$](#)

[Composition of Functions \$f\(g\(x\)\)\$](#)

[Logarithm Change of Base Formula](#)

[Long Division & Synthetic Division of Polynomials](#)

[Trigonometry Made Easy \(Shadows for Sine and Cosine\)](#)

[Signs and Graphs of Trig Functions](#)

[Inverse Trig Functions](#)

[What are Logarithms? - Practice with Logarithms](#)

[Logarithm Rules](#)

[Zeros, Undefined Points, and Holes in Rational Functions](#)

[Add and Subtract Rational Functions; Common Denominators](#)

[Intersection of Functions via Substitution and TI-84 Calculator](#)

[Review of Algebra 2](#)

MECHANICS

[Why Do Paintballs Hurt When They Bounce? \$F=\Delta p/\Delta t\$](#)

[Total Mass / Center of Mass of Non-Uniform Object](#)

[Oscillations in Physics: \$A \sin\(2\pi f t\)\$ or \$A \cos\(2\pi f t\)\$](#)

[Center of Mass in 2D: Point Masses](#)

[Center of Mass of a 2D Plate](#)

[Center of Mass of a Half Disc / Semicircular Plate](#)

[Center of Mass, Momentum & Energy in Collisions](#)

[Motion of a Stick Dropped from One End \(Demo\)](#)

[Falling Faster than \$g\$: Motion of a Dropped Stick](#)

[Motion with Linear Drag: Falling with Air Friction](#)

[Centripetal & Tangential Acceleration](#)

[Newton's 2nd Law \(\$F=ma\$ \) Example: Block on a Moving Ramp](#)

[Back Flip Physics](#)

[Collisions with Rotation: Center of Mass and Angular Momentum](#)

[Entire 1984 AP Physics Multiple Choice Solutions](#)

[Coffee Filter Experiment: Linear vs. Quadratic Drag](#)

[Flying Pig: Uniform Circular Motion & Centripetal Force](#)

[Review of Energy: \$E_{\text{before}} = E_{\text{after}} + E_{\text{wasted}}\$](#)

[Common Pitfalls in Introductory Mechanics](#)

[-saying "isn't \$g\$ supposed to be \$-9.8\$?"](#)

[-saying \$v_f = 0\$ if an object hits the ground](#)

[-saying "force of the acceleration"](#)

[-saying "THE centripetal force"](#)

THERMODYNAMICS

[How do Engines Work?](#)

[\$PV=nRT\$ and Gas Cycles](#)

[Gas Cycles and the First Law of Thermodynamics](#)

[Entropy](#)

NUCLEAR, ATOMIC & MEDICAL

[Chemical Reactions vs. Nuclear Reactions](#)

[Introduction to the Photoelectric Effect](#)

[Radioactivity in Smoke Detectors](#)

[Anti-Matter and PET Scans](#)



Dr. Pierce's Physics & Math Videos

MAGNETISM How Motors Work - A Practical Explanation A Simple Motor that Anyone Can Make Cross Products How Do Music Speakers Work? How does a Loudspeaker Work? Magnetic Fields Magnetic Force Mapping Magnetic Fields Magnetic Fields are created by Current Motion with Magnetic Drag Biot-Savart Law Introduction Biot-Savart Example: Field at the Center of Circular Loop Biot-Savart Law Example: Very Long Wire Biot-Savart Law Example: Field along Axis of Current Loop Drag Forces in Mechanics and E&M Ampere's Law - Example with Current Density that Varies with Radius Ampere's Law - Example with Uniform Current Density Mass Spectrometry What is the Most Useful Discovery in Physics? (Faraday's Law) Magnetic Flux and Lenz's Law Examples Motional EMF & Faraday's Law EMF of a Bar Rotating in a Magnetic Field Motional EMF of a Bar Pulled into a Magnetic Field Eddy Current Demonstrations 1 Eddy Current Demonstrations 2 Levitating a Superconductor Magnets, Motion, and Motors Interim Highlights	ELECTROSTATICS & CIRCUITS Introduction to Flux Electric Fields Created by Point Charges Gauss' Law in Cylindrical Symmetry Gauss' Law in Spherical Symmetry Gauss' Law in Rectangular (Cartesian) Coordinates Electric Field Due to a Long, Uniformly Charged Wire Electric Field Due to a long, Charged Wire with Coulomb's Law Voltage and Potential Energy Isolines: Equipotentials, Isotherms, and Contours Finding Currents in a Combination Circuit with Ohm's Law Kirchoff Loops - Simple Example Kirchoff Loops and Junctions Example Introduction to Capacitors Capacitors in Series: Example Problem Capacitors in Parallel: Example Problem Time Dependence of Current in a Resistor Capacitor (RC) Circuit Time Dependence of Current in a Resistor Inductor (RL) Circuit Introduction to LC Circuits or Tank Circuits Introduction to Inductors and RL Circuits RL and RC Circuits Summary Transmitting Music with Visible Light (Optoisolator) RESISTIVITY, DRIFT VELOCITY, & HALL EFFECT Introduction to the Hall Effect Resistivity, Drift Velocity, & Hall Effect



Dr. Pierce's Physics & Math Videos

LIGHT RAYS & GEOMETRICAL OPTICS Ray Diagrams for Lenses and Mirrors Double Lens System Ray Diagram Double Lens System and the Thin Lens Equation Introduction to Ray Diagrams for Lenses Ray Diagrams for Convex (Converging) Lenses and Concave (Diverging) Lenses Refraction of Light by a Fish Tank Refraction/Marching Band Theory of Light	SPREADSHEETS Data Linearization Spreadsheet Basics Scatter Plots and Linear Regression Numerical Solutions: Euler's Method SPECIAL RELATIVITY Special Relativity: Velocity Addition and Time Dilation
LIGHT WAVES & WAVE INTERFERENCE Path Difference and Conditions for Constructive and Destructive Interference Two Source Interference, Path Difference, and Interpreting Interference Patterns Interference from Two Loudspeakers Double Slit Pattern Geometry Single Slit Pattern Geometry Introduction to the Double Slit Experiment Thin Film Interference Example Problem Polarized Light Oscillations in Physics: $A \sin(2\pi f t)$ or $A \cos(2\pi f t)$ Transmitting Music with Visible Light (Optoisolator)	FLUIDS How do Hydraulics Work? Bernoulli Effect Demonstrations Bernoulli Equation Example Why Do Curveballs Curve? Fluid Flow Rate: $\text{Volume/Time} = \text{Area} \times \text{Velocity}$ Fluid Flow in Nozzles and Pipes
GRAVITY Butter Guns! Inverse Square Laws Introduction to Newtonian Gravity What If You Dig a Tunnel Through the Earth	
	YouTube CHANNEL LINK © 2021, J.P. Pierce