

Index

A

aberration 16.3 Lenses

absolute zero 11.1 Temperature and Thermal Energy

absorption spectrum 22.1 The Structure of the Atom

Acceleration 2.4 Velocity vs. Time Graphs, Introduction, Introduction, 3.1 Acceleration, 3.2 Representing Acceleration with Equations and Graphs, 4.1 Force, 4.3 Newton's Second Law of Motion, 4.4 Newton's Third Law of Motion, 6.2 Uniform Circular Motion

acceleration due to gravity 3.2 Representing Acceleration with Equations and Graphs

Accuracy 1.3 The Language of Physics: Physical Quantities and Units

acoustics 1.1 Physics: Definitions and Applications

activity 22.3 Half Life and Radiometric Dating

air resistance 5.3 Projectile Motion

alpha (α) decay 22.2 Nuclear Forces and Radioactivity

alpha particle 22.2 Nuclear Forces and Radioactivity

alternating current 19.1 Ohm's law

ampere 19.1 Ohm's law

amplitude 5.5 Simple Harmonic Motion, 13.1 Types of Waves, 14.1 Speed of Sound, Frequency, and Wavelength, 15.1 The Electromagnetic Spectrum

amplitude modulation 15.1 The Electromagnetic Spectrum

analytical method 5.2 Vector Addition and Subtraction: Analytical Methods

Anger camera 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation

angle of incidence 16.1 Reflection

angle of reflection 16.1 Reflection

angle of refraction 16.2 Refraction

angle of rotation 6.1 Angle of Rotation and Angular Velocity

angular acceleration 6.3 Rotational Motion, 8.2 Conservation of Momentum

angular momentum 8.2 Conservation of Momentum

angular velocity 6.1 Angle of Rotation and Angular Velocity, 6.2 Uniform Circular Motion

annihilation 22.4 Nuclear Fission and Fusion, 23.2 Quarks
 Antimatter 23.2 Quarks
 antinode 13.3 Wave Interaction: Superposition and Interference, 14.4 Sound Interference and Resonance
 Antoine Henri Becquerel 22.2 Nuclear Forces and Radioactivity
 aphelion 7.1 Kepler's Laws of Planetary Motion
 arc length 6.1 Angle of Rotation and Angular Velocity
 atomic number 22.2 Nuclear Forces and Radioactivity
 atoms 1.1 Physics: Definitions and Applications
 Average acceleration 3.1 Acceleration
 Average speed 2.2 Speed and Velocity
 Average velocity 2.2 Speed and Velocity
 B
 baryons 23.2 Quarks
 base quantities 1.3 The Language of Physics: Physical Quantities and Units
 base units 1.3 The Language of Physics: Physical Quantities and Units
 beat frequency 14.4 Sound Interference and Resonance
 Beats 14.4 Sound Interference and Resonance
 becquerel 22.3 Half Life and Radiometric Dating
 beta (β) decay 22.2 Nuclear Forces and Radioactivity
 Big Bang 23.3 The Unification of Forces
 binding energy 10.2 Consequences of Special Relativity, 21.2 Einstein and the Photoelectric Effect
 blackbody 21.1 Planck and Quantum Nature of Light
 Boltzmann constant 12.2 First law of Thermodynamics: Thermal Energy and Work
 bottom 23.2 Quarks
 C
 capacitor 18.5 Capacitors and Dielectrics
 carbon-14 dating 22.3 Half Life and Radiometric Dating
 carrier particles 23.1 The Four Fundamental Forces
 Celsius scale 11.1 Temperature and Thermal Energy

central axis 16.1 Reflection

centrifugal force 6.2 Uniform Circular Motion

centripetal acceleration 6.2 Uniform Circular Motion, 6.3 Rotational Motion

centripetal force 6.2 Uniform Circular Motion

cesium atomic clock 1.3 The Language of Physics: Physical Quantities and Units

chain reaction 22.4 Nuclear Fission and Fusion

change in momentum 8.1 Linear Momentum, Force, and Impulse

charmed 23.2 Quarks

chromatic aberration 16.3 Lenses

circuit diagrams 19.2 Series Circuits

Circular motion 6.1 Angle of Rotation and Angular Velocity, 6.2 Uniform Circular Motion

classical physics 1.1 Physics: Definitions and Applications

closed system 9.2 Mechanical Energy and Conservation of Energy

closed-pipe resonator 14.4 Sound Interference and Resonance

coefficient of friction 4.2 Newton's First Law of Motion: Inertia

Colliding beams 23.1 The Four Fundamental Forces

collision 8.1 Linear Momentum, Force, and Impulse

collisions 8.3 Elastic and Inelastic Collisions

color 23.2 Quarks

complex machine 9.3 Simple Machines

component 5.2 Vector Addition and Subtraction: Analytical Methods

Compton 21.3 The Dual Nature of Light

Compton effect 21.3 The Dual Nature of Light

concave lens 16.3 Lenses

concave mirror 16.1 Reflection

Condensation 11.3 Phase Change and Latent Heat

conduction 11.2 Heat, Specific Heat, and Heat Transfer, 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

conductors 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

conservation 8.2 Conservation of Momentum

Constant acceleration 3.2 Representing Acceleration with Equations and Graphs
 constructive interference 13.3 Wave Interaction: Superposition and Interference
 convection 11.2 Heat, Specific Heat, and Heat Transfer
 conventional current 19.1 Ohm's law
 converging lens 16.3 Lenses
 conversion factor 1.3 The Language of Physics: Physical Quantities and Units
 convex lens 16.3 Lenses
convex mirror 16.1 Reflection
 Copernican model 7.1 Kepler's Laws of Planetary Motion
corner reflector 16.2 Refraction
 Coulomb 18.2 Coulomb's law
 coulomb force 23.1 The Four Fundamental Forces
Coulomb's constant 18.2 Coulomb's law
 Coulomb's law 18.2 Coulomb's law
 critical angle 16.2 Refraction
 critical mass 22.4 Nuclear Fission and Fusion
 Curie temperature 20.1 Magnetic Fields, Field Lines, and Force
 cyclical process 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
 cyclotron 23.1 The Four Fundamental Forces
 D
 damping 14.4 Sound Interference and Resonance
 decay constant 22.3 Half Life and Radiometric Dating
 decibels 14.2 Sound Intensity and Sound Level
 deformation 5.5 Simple Harmonic Motion
 degree Celsius ($^{\circ}\text{C}$) 11.1 Temperature and Thermal Energy
 degree Fahrenheit ($^{\circ}\text{F}$) 11.1 Temperature and Thermal Energy
 dependent variable 1.3 The Language of Physics: Physical Quantities and Units, 2.3 Position vs. Time Graphs
 Deposition 11.3 Phase Change and Latent Heat
 derived quantity 1.3 The Language of Physics: Physical Quantities and Units

derived unit 1.3 The Language of Physics: Physical Quantities and Units
 destructive interference 13.3 Wave Interaction: Superposition and Interference
 dielectric 18.5 Capacitors and Dielectrics
 differential interference contrast (DIC) 17.2 Applications of Diffraction, Interference, and Coherence
 diffraction 17.1 Understanding Diffraction and Interference
 diffraction grating 17.2 Applications of Diffraction, Interference, and Coherence
 diffused 16.1 Reflection
 direct current 19.1 Ohm's law
 direction 2.1 Relative Motion, Distance, and Displacement
 dispersion 16.2 Refraction
 displacement 2.1 Relative Motion, Distance, and Displacement, 2.4 Velocity vs. Time Graphs, 3.1 Acceleration, 3.2 Representing Acceleration with Equations and Graphs
 distance 2.1 Relative Motion, Distance, and Displacement
 diverging lens 16.3 Lenses
 domains 20.1 Magnetic Fields, Field Lines, and Force
 Doppler effect 14.3 Doppler Effect and Sonic Booms
 down 23.2 Quarks
 dynamics 1.1 Physics: Definitions and Applications, 4.1 Force
 E
 E.O. Lawrence 23.1 The Four Fundamental Forces
 eccentricity 7.1 Kepler's Laws of Planetary Motion
 Edwin Hubble 23.3 The Unification of Forces
 efficiency output 9.3 Simple Machines
 Einstein 21.2 Einstein and the Photoelectric Effect
 elastic collision 8.3 Elastic and Inelastic Collisions
 electric circuits 19.2 Series Circuits
 Electric current 19.1 Ohm's law
 electric eye 21.2 Einstein and the Photoelectric Effect
 electric field 15.1 The Electromagnetic Spectrum, 18.3 Electric Field
 Electric motors 20.2 Motors, Generators, and Transformers

electric potential 18.4 Electric Potential
 Electric potential energy 18.4 Electric Potential
 electric power 19.4 Electric Power
 electrical charge 18.2 Coulomb's law
 Electricity 1.1 Physics: Definitions and Applications
 electromagnet 20.1 Magnetic Fields, Field Lines, and Force
 electromagnetic force 23.1 The Four Fundamental Forces
 electromagnetic radiation (EMR) 15.1 The Electromagnetic Spectrum
 electromagnetism 20.1 Magnetic Fields, Field Lines, and Force
 electron 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 electron cloud model 1.2 The Scientific Methods
 Electroweak Epoch 23.3 The Unification of Forces
 electroweak theory 23.3 The Unification of Forces
 emf 20.3 Electromagnetic Induction
 emission spectrum 22.1 The Structure of the Atom
 energy 9.1 Work, Power, and the Work–Energy Theorem, 13.1 Types of Waves
 energy-level diagram 22.1 The Structure of the Atom
 energy-mass curve 22.4 Nuclear Fission and Fusion
 Enrico Fermi 23.1 The Four Fundamental Forces
 entropy 12.3 Second Law of Thermodynamics: Entropy
 equilibrium position 5.5 Simple Harmonic Motion
 equivalent resistor 19.2 Series Circuits
 Ernest Rutherford 22.1 The Structure of the Atom
 ether 10.1 Postulates of Special Relativity
 excited states 22.1 The Structure of the Atom
 experiment 1.2 The Scientific Methods
 exponential relationship 1.3 The Language of Physics: Physical Quantities and Units
 external force 4.1 Force
 eyepiece 16.3 Lenses
 F

Fahrenheit scale 11.1 Temperature and Thermal Energy
 Faraday 18.3 Electric Field
 Fermi National Accelerator Laboratory 23.1 The Four Fundamental Forces
 ferromagnetic 20.1 Magnetic Fields, Field Lines, and Force
 Feynman diagram 23.1 The Four Fundamental Forces
 first law of thermodynamics 12.2 First law of Thermodynamics: Thermal Energy and Work
 flavors 23.2 Quarks
 Fletcher 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
focal length 16.1 Reflection
focal point 16.1 Reflection
 Force 4.1 Force, 8.1 Linear Momentum, Force, and Impulse
force field 18.3 Electric Field
 frame of reference 10.1 Postulates of Special Relativity
 frame-dragging effect 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity
 frames of reference 10.2 Consequences of Special Relativity
 Fraunhofer lines 22.1 The Structure of the Atom
 free-body diagram 4.1 Force
 freefall 4.3 Newton's Second Law of Motion
 Freezing 11.3 Phase Change and Latent Heat
 Frequency 5.5 Simple Harmonic Motion, 13.1 Types of Waves, 14.1 Speed of Sound, Frequency, and Wavelength, 15.1 The Electromagnetic Spectrum
frequency modulation 15.1 The Electromagnetic Spectrum
 friction 4.2 Newton's First Law of Motion: Inertia
 fulcrum 6.3 Rotational Motion, 9.3 Simple Machines
 fundamental 14.4 Sound Interference and Resonance
 fundamental physical 1.3 The Language of Physics: Physical Quantities and Units
 fusion reactors 22.4 Nuclear Fission and Fusion
 G

Galilei Introduction

Galileo 2.1 Relative Motion, Distance, and Displacement

gamma (γ) rays 15.1 The Electromagnetic Spectrum

Gamma decay 22.2 Nuclear Forces and Radioactivity

gauge pressure 14.1 Speed of Sound, Frequency, and Wavelength

Geiger tube 22.2 Nuclear Forces and Radioactivity

General relativity Introduction

generator 20.2 Motors, Generators, and Transformers

geodetic effect 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity

geometric optics 16.1 Reflection

George Zweig 23.2 Quarks

glass rods 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

gluon 23.2 Quarks

gluons 23.1 The Four Fundamental Forces

Grand Unification Epoch 23.3 The Unification of Forces

Grand Unified Theory (GUT) 23.3 The Unification of Forces

graph 2.3 Position vs. Time Graphs, 2.4 Velocity vs. Time Graphs

graphical 5.1 Vector Addition and Subtraction: Graphical Methods

gravitational 4.4 Newton's Third Law of Motion

gravitational constant 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity

gravitational force 4.1 Force, 4.3 Newton's Second Law of Motion, 23.1 The Four Fundamental Forces

Gravitational potential energy 9.1 Work, Power, and the Work–Energy Theorem

graviton 23.1 The Four Fundamental Forces, 23.1 The Four Fundamental Forces

Gravity 3.2 Representing Acceleration with Equations and Graphs, 4.3 Newton's Second Law of Motion

ground state 22.1 The Structure of the Atom

gun-type bomb 22.4 Nuclear Fission and Fusion

H

hadrons 23.2 Quarks
 half-life 22.3 Half Life and Radiometric Dating
 harmonic motion 14.1 Speed of Sound, Frequency, and Wavelength
 harmonics 14.4 Sound Interference and Resonance
 head 5.1 Vector Addition and Subtraction: Graphical Methods
 head-to-tail method 5.1 Vector Addition and Subtraction: Graphical Methods
 Hearing 14.2 Sound Intensity and Sound Level
 Heat 11.1 Temperature and Thermal Energy
 heat capacity 11.2 Heat, Specific Heat, and Heat Transfer
 heat engine 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
 Heat pumps 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
 Heisenberg uncertainty principle 22.1 The Structure of the Atom
 hertz 5.5 Simple Harmonic Motion
 Hideki Yukawa 23.1 The Four Fundamental Forces
 Higgs boson 23.2 Quarks
 Higgs field 23.2 Quarks
 Hooke's law 5.5 Simple Harmonic Motion
 Huygens's principle 17.1 Understanding Diffraction and Interference
 hydrogen-like atoms 22.1 The Structure of the Atom
 hypothesis 1.2 The Scientific Methods
 I
 ideal gas law 12.2 First law of Thermodynamics: Thermal Energy and Work
 ideal mechanical advantage 9.3 Simple Machines
 illuminance 15.2 The Behavior of Electromagnetic Radiation
 impulse 8.1 Linear Momentum, Force, and Impulse
 impulse-momentum theorem 8.1 Linear Momentum, Force, and Impulse
 in parallel 19.3 Parallel Circuits
 in series 19.2 Series Circuits
incident ray 16.2 Refraction

inclined plane 9.3 Simple Machines

independent 5.3 Projectile Motion

independent variable 1.3 The Language of Physics: Physical Quantities and Units, 2.3 Position vs. Time Graphs

index of refraction 16.2 Refraction

induction 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge, 20.3 Electromagnetic Induction

inelastic collision 8.3 Elastic and Inelastic Collisions

Inertia 4.2 Newton's First Law of Motion: Inertia

inertial reference frame 10.1 Postulates of Special Relativity

Inflationary Epoch 23.3 The Unification of Forces

infrared (IR) radiation 15.1 The Electromagnetic Spectrum

infrasound 14.2 Sound Intensity and Sound Level

input work 9.3 Simple Machines

instantaneous acceleration 3.1 Acceleration

instantaneous speed 2.2 Speed and Velocity

instantaneous velocity 2.2 Speed and Velocity

insulator 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

interference 15.2 The Behavior of Electromagnetic Radiation

Internal energy 12.2 First law of Thermodynamics: Thermal Energy and Work

Inverse proportionality 1.3 The Language of Physics: Physical Quantities and Units

inverse relationship 1.3 The Language of Physics: Physical Quantities and Units

inverse-square law 18.2 Coulomb's law

Inversely proportional 4.3 Newton's Second Law of Motion

inversion 13.3 Wave Interaction: Superposition and Interference

Ionization 11.3 Phase Change and Latent Heat

ionizing radiation 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation

iridescence 17.2 Applications of Diffraction, Interference, and Coherence

isolated system 8.2 Conservation of Momentum

isotope 22.2 Nuclear Forces and Radioactivity

J

joule 9.1 Work, Power, and the Work–Energy Theorem

K

kelvin 1.3 The Language of Physics: Physical Quantities and Units, 11.1 Temperature and Thermal Energy

Kelvin scale 11.1 Temperature and Thermal Energy

Kepler Introduction

Kepler’s laws of planetary motion 7.1 Kepler's Laws of Planetary Motion

kinematic equations 3.2 Representing Acceleration with Equations and Graphs

kinematics 1.1 Physics: Definitions and Applications, 2.1 Relative Motion, Distance, and Displacement, 2.3 Position vs. Time Graphs, 4.1 Force

kinematics of rotational motion 6.3 Rotational Motion

kinetic 10.2 Consequences of Special Relativity

kinetic energy 8.3 Elastic and Inelastic Collisions, 9.1 Work, Power, and the Work–Energy Theorem, 18.4 Electric Potential

Kinetic friction 5.4 Inclined Planes

L

laminated-coil transformer 20.2 Motors, Generators, and Transformers

Large Hadron Collider 23.1 The Four Fundamental Forces

laser 17.2 Applications of Diffraction, Interference, and Coherence

Laser Interferometer Gravitational-Wave Observatory 23.1 The Four Fundamental Forces

latent heat 11.3 Phase Change and Latent Heat

latent heat of fusion 11.3 Phase Change and Latent Heat

latent heat of vaporization 11.3 Phase Change and Latent Heat

law of conservation of charge 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

law of conservation of energy 9.2 Mechanical Energy and Conservation of Energy

law of conservation of momentum 8.2 Conservation of Momentum, 8.3 Elastic and Inelastic Collisions

law of inertia 4.2 Newton's First Law of Motion: Inertia

law of reflection 16.1 Reflection

law of refraction 16.1 Reflection
 length contraction 10.2 Consequences of Special Relativity
 Leptons 23.2 Quarks
 lever 9.3 Simple Machines
 lever arm 6.3 Rotational Motion
 light years 15.2 The Behavior of Electromagnetic Radiation
 LightSail-1 21.3 The Dual Nature of Light
 line graph 1.3 The Language of Physics: Physical Quantities and Units
 linear acceleration 6.3 Rotational Motion
 Linear momentum 8.1 Linear Momentum, Force, and Impulse
 linear relationships 1.3 The Language of Physics: Physical Quantities and Units
 liquid drop model 22.4 Nuclear Fission and Fusion
 log-log plot 1.3 The Language of Physics: Physical Quantities and Units
 logarithmic (log) scale 1.3 The Language of Physics: Physical Quantities and Units
 longitudinal wave 13.1 Types of Waves
 longitudinal waves 14.1 Speed of Sound, Frequency, and Wavelength
 loudness 14.2 Sound Intensity and Sound Level
 Louis de Broglie 22.1 The Structure of the Atom
 lumens 15.2 The Behavior of Electromagnetic Radiation
 luminous flux 15.2 The Behavior of Electromagnetic Radiation
 lux 15.2 The Behavior of Electromagnetic Radiation
 M
 magnetic dipoles 20.1 Magnetic Fields, Field Lines, and Force
 magnetic field 15.1 The Electromagnetic Spectrum, 20.1 Magnetic Fields, Field Lines, and Force
 magnetic flux 20.3 Electromagnetic Induction
 magnetic induction 20.3 Electromagnetic Induction
 magnetic pole 20.1 Magnetic Fields, Field Lines, and Force
 Magnetism 1.1 Physics: Definitions and Applications
 magnetized 20.1 Magnetic Fields, Field Lines, and Force

magnitude 2.1 Relative Motion, Distance, and Displacement
 Manhattan Project 22.4 Nuclear Fission and Fusion
 Mass 4.2 Newton's First Law of Motion: Inertia, 4.3 Newton's Second Law of Motion, 8.1 Linear Momentum, Force, and Impulse
 mass defect 10.2 Consequences of Special Relativity
 mass number 22.2 Nuclear Forces and Radioactivity
 maximum height 5.3 Projectile Motion
 maximum height of a projectile 5.3 Projectile Motion
 Maxwell's equations 15.1 The Electromagnetic Spectrum
 mechanical advantage 9.3 Simple Machines
 mechanical energy 9.1 Work, Power, and the Work–Energy Theorem
 mechanical waves 13.1 Types of Waves
 medium 13.1 Types of Waves
 Melting 11.3 Phase Change and Latent Heat
 meson 23.1 The Four Fundamental Forces
 mesons 23.2 Quarks
 method of adding percents 1.3 The Language of Physics: Physical Quantities and Units
 metric system 1.3 The Language of Physics: Physical Quantities and Units
 metric units 1.3 The Language of Physics: Physical Quantities and Units
 Michelson–Morley experiment 10.1 Postulates of Special Relativity
 microwave radiation 15.1 The Electromagnetic Spectrum
 Millikan 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 model 1.2 The Scientific Methods
 modern physics 1.1 Physics: Definitions and Applications
 moment of inertia 8.2 Conservation of Momentum
 momentum 8.2 Conservation of Momentum, 8.3 Elastic and Inelastic Collisions, 10.2 Consequences of Special Relativity
 monochromatic 17.1 Understanding Diffraction and Interference
 monochromators 17.2 Applications of Diffraction, Interference, and Coherence
 motion 2.1 Relative Motion, Distance, and Displacement, 2.2 Speed and Velocity

Murray Gell-Mann 23.2 Quarks

N

natural frequency 14.4 Sound Interference and Resonance

negative acceleration 3.1 Acceleration

negative charges 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

net external force 4.3 Newton's Second Law of Motion, 4.4 Newton's Third Law of Motion

net force 4.1 Force, 4.4 Newton's Third Law of Motion, 4.4 Newton's Third Law of Motion

neutrino 22.2 Nuclear Forces and Radioactivity, 23.2 Quarks

Newton Introduction, 4.3 Newton's Second Law of Motion

Newton's first law of motion 4.2 Newton's First Law of Motion: Inertia

Newton's laws of motion Introduction, 4.1 Force

Newton's second law of motion 1.2 The Scientific Methods, 4.3 Newton's Second Law of Motion

Newton's third law of motion 4.4 Newton's Third Law of Motion

Newton's universal law of gravitation 7.2 Newton's Law of Universal Gravitation and Einstein's Theory of General Relativity

Niels Bohr 22.1 The Structure of the Atom

node 14.4 Sound Interference and Resonance

nodes 13.3 Wave Interaction: Superposition and Interference

nonohmic 19.1 Ohm's law

normal force 4.1 Force, 4.2 Newton's First Law of Motion: Inertia, 4.4 Newton's Third Law of Motion

north pole 20.1 Magnetic Fields, Field Lines, and Force

nuclear fission 22.4 Nuclear Fission and Fusion

Nuclear fusion 22.4 Nuclear Fission and Fusion

Nuclear physics 1.1 Physics: Definitions and Applications

nuclear strong force 22.4 Nuclear Fission and Fusion

nucleons 22.2 Nuclear Forces and Radioactivity, 23.1 The Four Fundamental Forces

nuclide 22.2 Nuclear Forces and Radioactivity

O

objectives 16.3 Lenses

observation 1.2 The Scientific Methods

ocular 16.3 Lenses

Ohm's law 19.1 Ohm's law

ohmic 19.1 Ohm's law

oil-drop 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

open-pipe resonator 14.4 Sound Interference and Resonance

optics 1.1 Physics: Definitions and Applications

order of magnitude 1.3 The Language of Physics: Physical Quantities and Units

oscillate 5.5 Simple Harmonic Motion

output work 9.3 Simple Machines

overtones 14.4 Sound Interference and Resonance

P

pair production 23.2 Quarks

parfocal 16.3 Lenses

Particle physics Introduction

particle-wave duality 21.3 The Dual Nature of Light

Pascal's principle 1.2 The Scientific Methods

perihelion 7.1 Kepler's Laws of Planetary Motion

period 5.5 Simple Harmonic Motion, 7.1 Kepler's Laws of Planetary Motion,
13.1 Types of Waves

Periodic motion 5.5 Simple Harmonic Motion

periodic wave 13.1 Types of Waves

permanent magnet 20.1 Magnetic Fields, Field Lines, and Force

permittivity of free space 18.5 Capacitors and Dielectrics

Peter Higgs 23.2 Quarks

phase change 11.3 Phase Change and Latent Heat

phase diagram 11.3 Phase Change and Latent Heat

photoelectric effect 21.2 Einstein and the Photoelectric Effect

photoelectron 21.2 Einstein and the Photoelectric Effect

photon 23.1 The Four Fundamental Forces
 photon momentum 21.3 The Dual Nature of Light
 photons 21.2 Einstein and the Photoelectric Effect
 photovoltaic cells 21.2 Einstein and the Photoelectric Effect
 physical models 1.2 The Scientific Methods
 physical science 5.2 Vector Addition and Subtraction: Analytical Methods
 physics 1.1 Physics: Definitions and Applications
pigment 15.1 The Electromagnetic Spectrum
 pion 23.1 The Four Fundamental Forces
 pitch 14.2 Sound Intensity and Sound Level
 pivot point 6.3 Rotational Motion
 Planck 21.1 Planck and Quantum Nature of Light
 Planck Epoch 23.3 The Unification of Forces
 Planck's constant 21.1 Planck and Quantum Nature of Light
 planetary model of the atom 22.1 The Structure of the Atom
 plasma 11.3 Phase Change and Latent Heat
plum pudding model 22.1 The Structure of the Atom
 point charge 18.3 Electric Field
 point masses 8.3 Elastic and Inelastic Collisions
 polarization 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 polarized light 15.2 The Behavior of Electromagnetic Radiation
 position 2.1 Relative Motion, Distance, and Displacement, 2.3 Position vs. Time Graphs, 2.4 Velocity vs. Time Graphs
 positive charges 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 positron 23.2 Quarks
 Positron emission tomography 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 postulates 10.1 Postulates of Special Relativity
 potential difference 18.4 Electric Potential

potential energy 9.1 Work, Power, and the Work–Energy Theorem, 10.2 Consequences of Special Relativity, 18.4 Electric Potential

Power 9.1 Work, Power, and the Work–Energy Theorem, 14.2 Sound Intensity and Sound Level

Precision 1.3 The Language of Physics: Physical Quantities and Units

pressure 12.2 First law of Thermodynamics: Thermal Energy and Work

primary and secondary coils 20.2 Motors, Generators, and Transformers

principles 1.2 The Scientific Methods

projectile 5.3 Projectile Motion

Projectile motion 5.3 Projectile Motion

Proper length 10.2 Consequences of Special Relativity

proportionality 4.3 Newton's Second Law of Motion

proton decay 23.3 The Unification of Forces

proton-proton cycle 22.4 Nuclear Fission and Fusion

protons 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

Ptolemaic model 7.1 Kepler's Laws of Planetary Motion

pulley 9.3 Simple Machines

pulse wave 13.1 Types of Waves

Q

quadratic relationship 1.3 The Language of Physics: Physical Quantities and Units

quantized 21.1 Planck and Quantum Nature of Light

quantum 21.1 Planck and Quantum Nature of Light

quantum chromodynamics 23.1 The Four Fundamental Forces, 23.2 Quarks

quantum electrodynamics 23.1 The Four Fundamental Forces

quantum mechanics 1.1 Physics: Definitions and Applications, 21.1 Planck and Quantum Nature of Light

Quark Era 23.3 The Unification of Forces

quarks 23.2 Quarks

R

rad 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation

Radar 15.1 The Electromagnetic Spectrum
 radian 6.1 Angle of Rotation and Angular Velocity
 radiation 11.2 Heat, Specific Heat, and Heat Transfer
 radio waves 15.1 The Electromagnetic Spectrum
 radioactive 22.2 Nuclear Forces and Radioactivity
 Radioactive dating 22.3 Half Life and Radiometric Dating
 radioactive decay 22.2 Nuclear Forces and Radioactivity
 Radioactivity 22.2 Nuclear Forces and Radioactivity
 radiopharmaceutical 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 Radiotherapy 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 radius of curvature 6.1 Angle of Rotation and Angular Velocity
 rarefactions 14.1 Speed of Sound, Frequency, and Wavelength
 rate 2.2 Speed and Velocity
ray 16.1 Reflection
 Rayleigh criterion 17.2 Applications of Diffraction, Interference, and Coherence
 real image 16.1 Reflection
 reciprocal 9.1 Work, Power, and the Work–Energy Theorem
 recoil 8.3 Elastic and Inelastic Collisions
 Recombination 11.3 Phase Change and Latent Heat
 reference frame 2.1 Relative Motion, Distance, and Displacement
 reflection 13.3 Wave Interaction: Superposition and Interference, 16.1 Reflection
refracted ray 16.2 Refraction
 refraction 13.3 Wave Interaction: Superposition and Interference
 relative biological effectiveness 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 relative speed 10.2 Consequences of Special Relativity
 Relativistic 10.2 Consequences of Special Relativity
 relativistic energy 10.2 Consequences of Special Relativity
 relativistic factor 10.2 Consequences of Special Relativity
 Relativistic momentum 10.2 Consequences of Special Relativity

Relativity Introduction
 Resistance 19.1 Ohm's law
 resistor 19.2 Series Circuits
 resolution 17.2 Applications of Diffraction, Interference, and Coherence
 resonance 14.4 Sound Interference and Resonance
 resonate 14.4 Sound Interference and Resonance
 rest mass 10.2 Consequences of Special Relativity
 restoring force 5.5 Simple Harmonic Motion
 resultant 5.1 Vector Addition and Subtraction: Graphical Methods
 resultant vector 5.1 Vector Addition and Subtraction: Graphical Methods
 revolution 6.1 Angle of Rotation and Angular Velocity
 Richard Feynman 23.1 The Four Fundamental Forces
 right-hand rule 20.1 Magnetic Fields, Field Lines, and Force
 roentgen equivalent man 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 rotational inertia 8.2 Conservation of Momentum
 Rotational motion 6.1 Angle of Rotation and Angular Velocity
 Rutherford 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 Rutherford scattering 22.1 The Structure of the Atom
 Rydberg constant 22.1 The Structure of the Atom
 S
 scalar 2.1 Relative Motion, Distance, and Displacement, 2.2 Speed and Velocity, 8.1 Linear Momentum, Force, and Impulse
 scientific law 1.2 The Scientific Methods
 scientific method 1.2 The Scientific Methods
 Scientific models 1.2 The Scientific Methods
 Scientific notation 1.3 The Language of Physics: Physical Quantities and Units
 scintillators 22.2 Nuclear Forces and Radioactivity
 screw 9.3 Simple Machines
 second law of thermodynamics 12.3 Second Law of Thermodynamics: Entropy
 semi-log plot 1.3 The Language of Physics: Physical Quantities and Units

shock wave 14.3 Doppler Effect and Sonic Booms
 significant figures 1.3 The Language of Physics: Physical Quantities and Units
 simple harmonic motion 5.5 Simple Harmonic Motion
 Simple machines 9.3 Simple Machines
 simple pendulum 5.5 Simple Harmonic Motion
 Simultaneity 10.1 Postulates of Special Relativity
 Single-photon-emission computer tomography 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 slope 1.3 The Language of Physics: Physical Quantities and Units
 Snap Lab 2.1 Relative Motion, Distance, and Displacement
Snell's law 16.2 Refraction
 solenoid 20.1 Magnetic Fields, Field Lines, and Force
 sonic boom 14.3 Doppler Effect and Sonic Booms
 Sound 14.1 Speed of Sound, Frequency, and Wavelength
 sound intensity 14.2 Sound Intensity and Sound Level
 sound intensity level 14.2 Sound Intensity and Sound Level
 south pole 20.1 Magnetic Fields, Field Lines, and Force
 special relativity Introduction, 10.1 Postulates of Special Relativity
 specific heat 11.2 Heat, Specific Heat, and Heat Transfer
 specular 16.1 Reflection
 speed 2.1 Relative Motion, Distance, and Displacement, 2.2 Speed and Velocity, 4.3 Newton's Second Law of Motion, 14.1 Speed of Sound, Frequency, and Wavelength
 Spin 6.1 Angle of Rotation and Angular Velocity
 Standard Model 23.2 Quarks
 standing waves 13.3 Wave Interaction: Superposition and Interference
 Stanford Linear Accelerator Center 23.1 The Four Fundamental Forces
 static friction 5.4 Inclined Planes
 statics 1.1 Physics: Definitions and Applications
 stationary 2.1 Relative Motion, Distance, and Displacement
 steady state 19.2 Series Circuits
 strange 23.2 Quarks

strong nuclear force 22.2 Nuclear Forces and Radioactivity, 23.1 The Four Fundamental Forces
 Sublimation 11.3 Phase Change and Latent Heat
 Super-Kamiokande 23.3 The Unification of Forces
 superforce 23.3 The Unification of Forces
 superposition 13.3 Wave Interaction: Superposition and Interference
 supersonic 14.3 Doppler Effect and Sonic Booms
 synchrotron 23.1 The Four Fundamental Forces
 system 4.2 Newton's First Law of Motion: Inertia
 systems 4.1 Force
 T
 tagged 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 tail 5.1 Vector Addition and Subtraction: Graphical Methods
 tangent 2.3 Position vs. Time Graphs
 tangential acceleration 6.3 Rotational Motion
 Tangential velocity 6.1 Angle of Rotation and Angular Velocity, 6.3 Rotational Motion
 temperature 11.1 Temperature and Thermal Energy
 tension 4.4 Newton's Third Law of Motion
 test charge 18.3 Electric Field
 The net external force 4.1 Force
 theory 1.2 The Scientific Methods
 Theory of Everything 23.3 The Unification of Forces
 theory of relativity 1.1 Physics: Definitions and Applications
 therapeutic ratio 22.5 Medical Applications of Radioactivity: Diagnostic Imaging and Radiation
 thermal efficiency 12.4 Applications of Thermodynamics: Heat Engines, Heat Pumps, and Refrigerators
 thermal energy 11.1 Temperature and Thermal Energy
 thermal equilibrium 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium
 thermodynamics 1.1 Physics: Definitions and Applications

thermonuclear bomb 22.4 Nuclear Fission and Fusion
 thin-film interference 15.2 The Behavior of Electromagnetic Radiation
 Thomson 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge
 three-dimensional models 1.2 The Scientific Methods
 thrust 4.4 Newton's Third Law of Motion
 time 2.2 Speed and Velocity, 2.3 Position vs. Time Graphs, 2.4 Velocity vs. Time Graphs, 3.1 Acceleration, 3.1 Acceleration
 Time dilation 10.2 Consequences of Special Relativity
 top 23.2 Quarks
 torque 6.3 Rotational Motion, 8.2 Conservation of Momentum
torsion balance 18.2 Coulomb's law
 total energy 10.2 Consequences of Special Relativity
total internal reflection 16.2 Refraction
 trajectory 5.3 Projectile Motion
 transformer 20.2 Motors, Generators, and Transformers
 translational acceleration 8.2 Conservation of Momentum
 transmutation 22.2 Nuclear Forces and Radioactivity
 transverse wave 13.1 Types of Waves
 transverse waves 14.1 Speed of Sound, Frequency, and Wavelength
 trend line 1.3 The Language of Physics: Physical Quantities and Units
 twin paradox 10.2 Consequences of Special Relativity
 U
 U.S. customary units 1.3 The Language of Physics: Physical Quantities and Units
 ultrasound 14.2 Sound Intensity and Sound Level
 ultraviolet (UV) radiation 15.1 The Electromagnetic Spectrum
 ultraviolet catastrophe 21.1 Planck and Quantum Nature of Light
 uncertainty 1.3 The Language of Physics: Physical Quantities and Units
 uniform circular motion 6.2 Uniform Circular Motion
 uniform electric field 18.5 Capacitors and Dielectrics
 universal 1.2 The Scientific Methods

universal laws 4.1 Force

up 23.2 Quarks

V

Van de Graaff 18.1 Electrical Charges, Conservation of Charge, and Transfer of Charge

Van de Graaff generator 23.1 The Four Fundamental Forces

Vaporization 11.3 Phase Change and Latent Heat

variables 1.3 The Language of Physics: Physical Quantities and Units

vector 2.1 Relative Motion, Distance, and Displacement, 2.2 Speed and Velocity, 4.3 Newton's Second Law of Motion, 8.1 Linear Momentum, Force, and Impulse

vector addition 5.1 Vector Addition and Subtraction: Graphical Methods

vector quantities 3.1 Acceleration

Vector subtraction 5.1 Vector Addition and Subtraction: Graphical Methods

Velocity 2.2 Speed and Velocity, 2.4 Velocity vs. Time Graphs, Introduction, 3.1 Acceleration, 3.2 Representing Acceleration with Equations and Graphs, 4.1 Force, 4.3 Newton's Second Law of Motion, 6.2 Uniform Circular Motion, 8.1 Linear Momentum, Force, and Impulse

virtual image 16.1 Reflection

visible light 15.1 The Electromagnetic Spectrum

voltage 18.4 Electric Potential

W

W bosons 23.1 The Four Fundamental Forces

watts 9.1 Work, Power, and the Work–Energy Theorem

wave 13.1 Types of Waves

wave velocity 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

wavefronts 17.1 Understanding Diffraction and Interference

wavelength 13.2 Wave Properties: Speed, Amplitude, Frequency, and Period, 14.1 Speed of Sound, Frequency, and Wavelength, 15.1 The Electromagnetic Spectrum

weak nuclear force 23.1 The Four Fundamental Forces

wedge 9.3 Simple Machines

weight 4.2 Newton's First Law of Motion: Inertia, 4.3 Newton's Second Law of Motion, 4.4 Newton's Third Law of Motion

Werner Heisenberg 22.1 The Structure of the Atom

wheel and axle 9.3 Simple Machines

work 9.1 Work, Power, and the Work–Energy Theorem

work–energy theorem 9.1 Work, Power, and the Work–Energy Theorem

X

X-rays 15.1 The Electromagnetic Spectrum

Z

Z bosons 23.1 The Four Fundamental Forces

zeroth law of thermodynamics 12.1 Zeroth Law of Thermodynamics: Thermal Equilibrium