

College Physics | Table of Contents

Chapter 1: Introduction: The Nature of Science and Physics

1.1 Physics: An Introduction

- Define physics and identify some of its applications
- Identify aspects of the scientific method
- Distinguish between classical and modern physics

1.2 Physical Quantities and Units

- Identify physical quantities and units of measurement
- Analyze the dimensions of an expression
- Use metric prefixes to express quantities of length, mass, and time
- Convert a quantity from one set of units to another

1.3 Accuracy, Precision, and Significant Figures

- Distinguish between accuracy and precision
- Determine the percent uncertainty of a calculated quantity
- Identify the number of significant digits in a number
- Express the result of a calculation to the correct number of significant digits

1.4 Approximation

- Utilize approximation techniques in calculations

Chapter 2: Kinematics

2.1 Displacement

- Define and distinguish between position, displacement, and distance traveled
- Calculate position, displacement, and distance traveled

2.2 Vectors, Scalars, and Coordinate Systems

- Define and distinguish between vectors and scalars

2.3 Time, Velocity, and Speed

- Define and distinguish between average speed and average velocity
- Define and distinguish between average and instantaneous velocity and speed
- Calculate average velocity, average speed, and time

2.4 Acceleration

- Describe acceleration
- Identify the direction of acceleration
- Calculate acceleration, change in velocity, and time

2.5 Motion Equations for Constant Acceleration in One Dimension

- Identify the equations of one-dimensional kinematics for constant acceleration
- Solve problems dealing with the equations of one-dimensional kinematics
- Solve one-dimensional kinematics problems dealing with one object that experiences two or more different constant accelerations

2.6 Problem-Solving Basics for One-Dimensional Kinematics

- Choose a coordinate system for a one-dimensional kinematics problem
 - Identify the knowns and unknowns in a one-dimensional kinematics problem
 - Choose the correct equation to solve a one-dimensional kinematics problem
-

2.7 Falling Objects

- Identify free-fall problems
- Apply the equations of one-dimensional kinematics to freely-falling objects
- Solve additional problems in one-dimensional kinematics

2.8 Graphical Analysis of One-Dimensional Motion

- Calculate the slope of a straight-line graph
- Describe the utility of graphs in one-dimensional kinematics
- Calculate velocity from a position versus time graph
- Calculate acceleration from a velocity versus time graph

Chapter 3: Two-Dimensional Kinematics

3.1 Kinematics in Two Dimensions: An Introduction

- Describe motion in two dimensions
- Calculate the magnitude of a displacement vector

3.2 Vector Addition and Subtraction: Graphical Methods

- Define two-dimensional vectors
- Use the head-to-tail method to add vectors graphically
- Use the head-to-tail method to subtract vectors graphically

3.3 Vector Addition and Subtraction: Analytical Methods

- Identify a vector by its components or its magnitude and direction
- Determine the magnitude of a vector
- Determine the direction of a vector
- Determine the components of a vector
- Add and subtract vectors using analytical methods

3.4 Projectile Motion

- Define projectile motion
- Identify symmetries and implicit data in projectile motion
- Solve horizontal launch problems in projectile motion
- Solve general launch angle problems in projectile motion
- Solve additional problems in projectile motion

3.5 Addition of Velocities

- Describe relative velocity
- Solve problems dealing with relative velocity

Chapter 4: Dynamics: Force and Newton's Laws of Motion

4.1 Development of Force Concept

- Define force
- Define free-body diagram

4.2 Newton's First Law of Motion: Inertia

- Define Newton's first law
 - Apply Newton's first law
-

4.3 Newton's Second Law of Motion: Concept of a System

- Define Newton's second law
- Define the base SI units of force
- Define and calculate weight
- Define free fall
- Make a free-body diagram for a system of interest
- Use Newton's second law to calculate net force, mass, and acceleration

4.4 Newton's Third Law of Motion: Symmetry in Forces

- Define Newton's third law
- Identify pairs of forces that are equal and opposite due to Newton's third law
- Identify the correct system in a multi-system scenario

4.5 Normal, Tension, and Other Examples of Forces

- Identify normal forces and their directions
- Identify tension forces and their directions
- Identify frictional forces and their directions
- Identify the x and y components of forces and their directions
- Identify the direction of forces and their components for an object on an inclined plane

4.6 Problem-Solving Strategies

- Make a free-body diagram of an object for which all forces are parallel to the coordinate axes
- Make a free-body diagram of an object for which at least one force has non-zero x and y components
- Make a free-body diagram of an object on an incline
- Write the net force equations for an object for which all forces are parallel to the coordinate axes
- Write the net force equations for an object for which at least one force has non-zero x and y components
- Write the net force equations for an object on an incline

4.7 Further Applications of Newton's Laws of Motion

- Apply Newton's laws to objects for which all forces are parallel to the coordinate axes
- Apply Newton's laws to objects for which at least one force has non-zero x and y components
- Apply Newton's laws to objects on an incline
- Apply Newton's laws to connected objects
- Solve problems that deal with both Newton's laws and kinematics
- Apply Newton's laws to additional applications

4.8 Extended Topic: The Four Basic Forces—An Introduction

- Identify the four basic forces and their properties

Chapter 5: Further Applications of Newton's Laws: Friction, Drag, and Elasticity

5.1 Friction

- Describe kinetic friction and identify the direction of kinetic frictional forces
 - Describe static friction and identify the direction of static frictional forces
 - Describe the relationship between frictional force, the coefficient of friction, and the normal force
 - Solve problems dealing with objects experiencing frictional forces
 - Solve problems dealing with objects on an incline experiencing frictional forces
 - Solve additional problems dealing with frictional forces
-

5.2 Drag Forces

- Describe the general characteristics of drag forces and the equations that describe them
- Solve problems using the drag force equation
- Solve problems using Stokes' law

5.3 Elasticity: Stress and Strain

- Describe the relationship between tension, compression, and changes in length (Young's modulus)
- Describe the relationship between shear forces and shear deformation (shear modulus)
- Describe the relationship between pressure change and volume change (bulk modulus)
- Solve problems dealing with elasticity

Chapter 6: Uniform Circular Motion and Gravitation

6.1 Rotation Angle and Angular Velocity

- Convert a rotation angle from one set of units to another
- Describe the relationship between rotation angle, radius, and arc length
- Describe the relationship between angular velocity and linear velocity
- Solve problems dealing with angular velocity and linear velocity

6.2 Centripetal Acceleration

- Define centripetal acceleration
- Identify the direction of centripetal acceleration
- Solve problems dealing with centripetal acceleration

6.3 Centripetal Force

- Define centripetal force
- Write expressions for centripetal force
- Solve problems dealing with centripetal force

6.4 Fictitious Forces and Non-inertial Frames: The Coriolis Force

- Identify fictitious forces and the corresponding real forces
- Describe the Coriolis effect

6.5 Newton's Universal Law of Gravitation

- Describe Newton's universal law of gravitation
- Apply Newton's universal law of gravitation to two bodies
- Apply Newton's universal law of gravitation to three bodies
- Calculate the acceleration of gravity at the surface of planets and stars

6.6 Satellites and Kepler's Laws: An Argument for Simplicity

- Define Kepler's laws
- Apply Kepler's laws

Chapter 7: Work, Energy, and Energy Resources

7.1 Work: The Scientific Definition

- Define work and the equation for the work done by a constant force
 - Determine the angle between a force and a displacement, and the sign of the work done
 - Calculate the work done by a constant force
-

7.2 Kinetic Energy and the Work-Energy Theorem

- Describe kinetic energy
- Describe the work-energy theorem
- Apply the work-energy theorem
- Solve additional applications of the work-energy theorem

7.3 Gravitational Potential Energy

- Describe gravitational potential energy
- Identify energy transfers between kinetic energy and gravitational potential energy
- Solve problems dealing with energy transfers between kinetic energy and gravitational potential energy

7.4 Conservative Forces and Potential Energy

- Apply energy conservation to problems dealing with springs
- Identify conservative forces and their characteristics
- Describe potential energy stored in a spring
- Describe the principle of conservation of mechanical energy

7.5 Nonconservative Forces

- Identify nonconservative forces and their characteristics
- Describe the relationship between work done by nonconservative forces and changes in mechanical energy
- Solve problems in which work is done by nonconservative forces

7.6 Conservation of Energy

- Describe the law of conservation of energy

7.7 Power

- Describe Power
- Solve Problems dealing with power, work, and energy

7.8 Work Energy, and Power in Humans

- Describe energy transformations in humans

7.9 World Energy Use

- Describe world energy use

Chapter 8: Linear Momentum and Collisions

8.1 Linear Momentum and Force

- Define linear momentum
- Calculate total linear momentum and changes in linear momentum
- Describe the relationship between momentum and Newton's second law
- Solve problems dealing with the relationship between momentum and force

8.2 Impulse

- Define Impulse

8.3 Conservation of Momentum

- Describe the principle of conservation of linear momentum
 - Analyze concepts dealing with momentum conservation
 - Apply the principle of conservation of linear momentum
-

8.4 Elastic Collisions in One Dimension

- Define elastic collision
- Solve problems dealing with elastic collisions

8.5 Inelastic Collisions in One Dimension

- Define inelastic and perfectly inelastic collisions
- Solve problems dealing with inelastic and perfectly inelastic collisions

8.6 Collisions of Point Masses in Two Dimensions

- Define collisions in two dimensions
- Solve problems dealing with collisions in two dimensions

8.7 Introduction to Rocket Propulsion

- Identify the meaning of the equations that describe rocket propulsion
 - Solve problems dealing with rocket propulsion
-