This course supports the assessments for Physics: Mechanics. The course covers 8 competencies and represents 2 competency units.

Introduction

Overview

Physics: Mechanics introduces foundational concepts of mechanics, including motion, gravitation, work and energy, momentum and collisions, rotational motion, static equilibrium, fluids, and oscillation.

Getting Started

Welcome to Physics: Mechanics! In this course you will learn about mechanics, the study of motion and how things change over time. You will have access to e-texts that incorporate readings, videos, and practice quizzes. You will also use the Physics LabPaq from Hands-On Labs to complete experiments on concepts like acceleration, momentum, and rotational motion. For the best experience, work through the topics in the order they're presented. Your competency will be demonstrated by successful completion of a performance assessment.

Competencies

This course provides experiences designed to help you demonstrate the following 8 competencies:

- **Competency 207.1.2: Describing Motion**
  The graduate applies vector mathematics to solve motion problems.
- **Competency 207.1.3: Dynamics: Newton's Laws of Motion**
  The graduate applies Newton's laws of motion to solve problems involving force.
- **Competency 207.1.4: Gravitation and Newton's Synthesis**
  The graduate applies the law of gravitation and Kepler's laws to solve problems.
- **Competency 207.1.5: Work and Energy**
  The graduate applies the concepts of work and energy to solve problems.
- **Competency 207.1.6: Momentum and Collisions**
  The graduate applies the concepts of momentum and impulse to solve problems.
- **Competency 207.1.7: Rotational Motion**
  The graduate applies concepts of rotational motion to solve problems involving torque.
- **Competency 207.1.9: Fluids**
  The graduate applies the concepts of static and dynamic fluids to solve problems.
- **Competency 207.1.10: Oscillations**
  The graduate applies the concepts of periodic motion to solve problems.

Teaching Dispositions Statement

Please review the Statement of Teaching Dispositions

Course Instructor Assistance

While you prepare to demonstrate competency in this subject, remember that course instructors are ready to help you reach your educational goals. As subject matter experts, instructors enjoy and take pride in helping students become reflective learners, problem solvers, and critical thinkers. Course instructors are excited to hear from you and eager to work with you.

Successful students report that working with a course instructor is the key to their success. Course instructors are able to share tips on approaches, tools, and skills that can help you apply the content you are studying. They also provide guidance in assessment preparation strategies, troubleshoot areas of deficiency, and guide you through the revision process if necessary. You should expect to work with course instructors for the duration of your coursework, so you are welcome to contact them as soon as you begin. Course instructors are fully committed to your success!

Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

How to Access and Order Your Resources

For many resources, WGU provides access through links in your courses. However, you may need to enroll manually or acquire other resources independently. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

You will need to order your LabPaq. Please follow the instructions below carefully.

VitalSource E-Texts

The following textbooks are available to you as e-texts within this course. You will be directly linked to the specific readings required within the activities that follow.

- Hewitt, P. G. (2009). *Conceptual physics* (12th ed.). San Francisco, CA: Addison-Wesley. ISBN-13: 978-0-321-56809-0
- Young, H. D. & Freedman, R. A. (2012). *Sears and Zemansky's university physics with modern physics* (14th ed.). Boston: Addison-Wesley. ISBN-13: 978-0-321-69686-1

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase a hard copy at your own expense through VitalSource or a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition. The following sites provide instruction on how to create a VitalSource account, use features such as downloading your e-texts for offline use, and purchase a print-on-demand option, if available.

VitalSource Navigational Video

Print-On-Demand Option

Thinkwell (Optional)
You will have the option to access Thinkwell materials if you feel you need additional instruction or to practice a given topic. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

- Thinkwell Physics I, Physics Majors, CRN HOB

Physics LabPaq
The cost of the lab kit (LabPaq) is covered by your program lab fee and is used across three courses within your physics program: Mechanics, Waves and Optics, and Electricity and Magnetism. If you have not done so already, you will need to order your Physics LabPaq from Hands-On Labs. If you have previously ordered this kit for another course, there is no need to order another. This kit contains the science equipment and supplies you will need to complete experiments at home and will be shipped to you.

The experiments you will complete in each course support and reinforce the science content and also teach laboratory techniques.

Follow these instructions to order your Physics LabPaq.

Lab manuals and specific instructions for completion of each relevant lab are linked within the course, but you will need to enter the Kit Code from your LabPaq to access these materials the first time.

Additional Preparations

Graphing Calculator
Acquire a graphing calculator and familiarize yourself with how to use it. Refer to the "WGU Calculator and Scratch Paper Guidelines" document for calculators permitted on WGU exams. If you are in a secondary mathematics program, refer to the “WGU Calculator Recommendations for Secondary Math and Science Programs” document for calculator suggestions for your degree program.

If you are not in a secondary mathematics program, contact your instructor to discuss calculators appropriate to your degree program.

Pacing Guide

The pacing guide suggests a weekly structure to pace your completion of learning activities. It is provided as a suggestion and does not represent a mandatory schedule. Follow the pacing guide carefully to complete the course in the suggested time frame.

Week 1: Introduction to Physics

- Enroll in learning resources
- The Nature of Physics

- Mathematical Topics
- Visit Your Physics Laboratory Site
- Physics Labs:
    - “Experimental Errors and Uncertainty”
    - “Measurement—Length, Mass, Volume, Density, and Time”
    - “Trigonometric Measurements”

Week 2: Describing Motion

- One-Dimensional Motion
- Physics Lab: “Data Collection”
- Two-Dimensional Motion
- Relative Motion

Week 3: Newton's Laws of Motion and the Acceleration Performance Task

- Newton's Laws
- Misconceptions about Newton's Laws
- Task 1: Acceleration

Week 4: Circular Motion, the Centripetal Acceleration Performance Task, and Work and Energy

- Circular Motion
- Physics Lab: “Centripetal Acceleration”
- Task 2: Centripetal Acceleration
- Work, Energy, and Power

Week 5: Momentum, Collisions, and Rotational Motion

- The Conceptual Basis of Momentum and Collisions
- Physics Lab: “Conservation of Momentum”
- Rotational Motion
- Physics Labs:
    - “Simple Machine—Lever”
    - “Simple Machine—Pulleys”

Week 6: Fluid, Archimedes's Principle, and the Buoyancy Performance Task

- The Conceptual Basics of Fluids and Matter
- Fluid Mechanics
- Task 3: Buoyancy

Week 7: Gravitation and Newton's Synthesis, and Oscillations

- The Conceptual Basics of Gravitation
- Oscillations

- Physics Labs:
  - “Hooke’s Law”
  - “Pendulum and the Calculation of g”

Week 8: Final Steps

- Complete and submit any remaining work

Physics: Mechanics

Nature is inclined to be orderly. By reading a physics textbook you can learn about the rules that define and describe the order found within various aspects of nature. However, to fully engage in physics you need to learn how to verify, refine, and discover these rules. You can build this competence by studying historical examples of discoveries in physics and the applications that resulted from these discoveries.

Introduction to Physics

Before you begin, be sure you have access to, and have enrolled in, all necessary learning resources as listed in the Learning Resources section. Complete the activities below.

The Nature of Physics

Read: As you are reading, think about what physics is and how it relates to the other sciences.

- Chapter 1: "About Science" from *Conceptual Physics*
- Chapter 1: "Units, Physical Quantities, and Vectors" from *University Physics with Modern Physics*
  - 1–1 ("The Nature of Physics?")
  - 1–2 ("Solving Physics Problems")
  - 1–3 ("Standards and Units")
  - 1–4 ("Unit Consistency and Conversions")

Mathematical Topics

Next, you should review the following mathematical topics:

- the area and volume of common shapes
- using logarithms
- what trigonometric functions are and how they are used
- right triangle trigonometry to find values for vector components
- calculations of simple derivatives and integrals

If you would like additional resources for any of the listed math topics, please contact your course instructor.

Visit Your Physics Laboratory Site

Use any of the links provided to access a list of the Physics activities and labs you will complete in this course. You will need to enter the kit code provided in your LabPaq kit the first time you visit the site.

Complete

- Getting Started
- Laboratory Safety

Review

Study expectations for lab reports by reviewing the following web pages:

- "Writing Lab Reports & Scientific Papers"
- "Writing Lab Reports and Scientific Papers"
- "Rounding Numbers" (overview of rounding and significant digits)
- "Exponents: Scientific Notations" overview of scientific notation

Complete

- Physics Lab: "Experimental Errors and Uncertainty"
- Physics Lab: "Measurement—Length, Mass, Volume, Density, and Time"
- Physics Lab: "Trigonometric Measurements"

After completing each lab, you are welcome to submit your work to receive feedback from your course instructor.

Describing Motion

Everything is in motion. Even as you sit and read through this, you are on a planet that is revolving around the sun, which is part of a solar system revolving around the center of the galaxy.

One-Dimensional Motion

Read

- Chapter 3: "Linear Motion" from *Conceptual Physics*
- Chapter 2: "Motion Along A Straight Line" from *University Physics with Modern Physics*

Complete

- Physics Lab: "Data Collection"

You are welcome to submit your work to receive feedback from your course instructor.

Two-Dimensional Motion

Read

- Chapter 3: "Motion in Two or Three Dimensions" from *University Physics with Modern Physics*

Relative Motion

Read

- Read section 37.1 ("Invariance of Physical Laws") in Chapter 37 of *University Physics with Modern Physics*

Newton's Laws of Motion and the Acceleration Performance Task

Isaac Newton is known as the father of physics. He was able to use the knowledge and observations of previous thinkers to conclude three basic laws of motion. From these laws, Newton accurately described the complex motion of bodies being acted upon by forces, as seen occurring everywhere in the world of natural science.

Newton's Laws

Read:

- Chapter 2: "Newton's First Law of Motion" from *Conceptual Physics*
- Chapter 4: "Newton's Second Law of Motion" from *Conceptual Physics*
- Chapter 5: "Newton's Third Law of Motion" from *Conceptual Physics*

Misconceptions about Newton's Laws

Review

Read about misconceptions related to Newton's Laws:

- "Misconceptions About Motion"
- "Newton's Second Law of Motion: The Big Misconception"

Read

- Chapter 4: "Newton's Laws of Motion" from *University Physics with Modern Physics*

Task 1: Acceleration Performance Task

Complete in Taskstream:

- Physics: Mechanics, Task 1

Additional information:

- For details about this performance assessment, see the "Assessment" tab in this course.
- Go to task hints and tips for an overview of the task.
- Before submitting, check that you have covered all the requirements outlined in the rubric. If you need help, contact the course instructor.

Circular Motion, the Centripetal Acceleration Performance Task, and Work and Energy

In this section you will apply some of the same principles that describe linear motion to an object

moving in a circle.

Circular Motion

Read

- Chapter 5, Section 5–4 ("Dynamics of Circular Motion") from *University Physics with Modern Physics*

Complete

- Physics Lab: Centripetal Acceleration

You are welcome to submit your work to receive feedback from your course instructor.

Task 2: Centripetal Acceleration Performance Task

Complete in Taskstream:

- Physics: Mechanics, Task 2

Additional information:

- For details about this performance assessment, see the "Assessment" tab in this course.
- Go to task hints and tips for an overview of this task.
- Before submitting, check that you have covered all the requirements outlined in the rubric. If you need help, contact the course instructor.

Work, Energy, and Power

Read

- Chapter 7: "Energy" from *Conceptual Physics*
- Chapter 6: "Work and Kinetic Energy" from *University Physics with Modern Physics*
- Chapter 7: "Potential Energy and Energy Conservation" from *University Physics with Modern Physics*

Review

- Lesson 1: Basic Terminology and Concepts
- Work, Energy, Power, Momentum PowerPoint
- "Scalar Product of Vectors"
- "Work is a Result of Force"

Momentum, Collisions, and Rotational Motion

Anyone knows that it is harder to stop a heavy truck than it is to stop a small car, especially if the truck is moving faster than the car. This is because the truck has more momentum than the car. Momentum is the formulation of concepts earlier discussed; the combination of inertia and motion. When two or more objects (each with its own momentum) collide, the result could be a

bad car accident. In the real world, all collisions are inelastic because some energy is lost to friction, sound, or heat. However, in the world of ideal physics, totally inelastic collisions occur where the total energy within the collision system is conserved.

Momentum and Collisions

Read

- Chapter 6: "Momentum" from Conceptual Physics
- Chapter 8: "Momentum, Impulse, and Collisions" from University Physics with Modern Physics

Complete

- Physics Lab: "Conservation of Momentum"

You are welcome to submit your work to receive feedback from your course instructor.

Rotational Motion

Read

- Chapter 8: "Rotational Motion" from *Conceptual Physics*

Read

- Chapter 9: "Rotation of Rigid Bodies" from *University Physics with Modern Physics*
- Chapter 10: "Dynamics of Rotational Motion" from *University Physics with Modern Physics*

Complete

- Physics Lab: "Simple Machine—Lever"
- Physics Lab: "Simple Machine—Pulleys"

After completing the lab, send your lab notes to the course instructor to verify your answers.

Fluid, Archimede's Principle, and the Buoyancy Performance Task

In this subject, you will learn about density, volume, and pressure in fluids.

Fluids and Matter

Read

- Chapter 13: "Liquids" from *Conceptual Physics*
- Chapter 14: "Gases" from *Conceptual Physics*

Fluid Mechanics

Read:

- Chapter 12: "Fluid Mechanics" through section 12.3 on buoyancy from *University Physics with Modern Physics*

Task 3: Buoyancy Performance Task

Complete in Taskstream**:**

- Physics: Mechanics, Task 3

Additional information

- For details about this performance assessment, see the "Assessment" tab in this course.
- Go to task hints and tips for an overview of this task.
- Before submitting, check that you have covered all the requirements in the rubric. If you need help, contact the course instructor.

Gravitation and Newton's Synthesis, and Oscillations

In this topic you will learn about gravitation, synthesis, and oscillation.

Gravitation

Read

- Chapter 9: "Gravity" from *Conceptual Physics*
- Chapter 10: "Projectile and Satellite Motion" from *Conceptual Physics*
- Chapter 13: "Gravitation" from *University Physics with Modern Physics*

Review

- Geostationary Satellites

Oscillations

Read

- Chapter 14: "Periodic Motion" from *University Physics with Modern Physics*

Complete

- Physics Lab: Hooke's Law
- Physics Lab: Pendulum and the Calculation of g

Submit your work to receive feedback from your course instructor.

Final Steps

Congratulations on completing the activities in this course! This course has prepared you to complete the assessments associated with this course. If you have not already been directed to complete the assessments, schedule and complete your assessments now.