PHYS-1210: COLLEGE PHYSICS I

Cuyahoga Community College

Viewing: PHYS-1210 : College Physics I

Board of Trustees:

September 2023

Academic Term:

Fall 2024

Subject Code

PHYS - Physics

Course Number:

1210

Title:

College Physics I

Catalog Description:

Kinematics, vectors, and Newtonian mechanics (forces and motion, gravitation, energy, momentum, rotational motion, simple harmonic motion), fluids, heat, and thermodynamics. Emphasis on problem solving using algebra.

Credit Hour(s):

4

Lecture Hour(s):

3

Lab Hour(s):

3

Other Hour(s):

0

Requisites

Prerequisite and Corequisite

MATH-0965 Intermediate Algebra; or qualified Math placement; or departmental approval.

Note: MATH-1200, 1270 or MATH-1280 taken prior to Fall 2016 will meet prerequisite requirements for this course.

Outcomes

Course Outcome(s):

Develop effective critical thinking and problem-solving skills by applying the fundamental principles of physics to address and solve problems.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Accurately describe the motion of an object by interpreting or creating motion diagrams and motion graphs.
2. Apply and explain the relationships between an object's position, velocity, and acceleration using algebra and graphical methods.
3. Use algebra to apply the linear and rotational kinematic equations to explain, solve, and predict the motion of an object moving with constant linear and angular acceleration in one and two dimensions.
4. Relate the motion of two objects relative to each other.
5. Evaluate and apply vector analysis (addition, subtraction, and multiplication) in various coordinate systems to describe and solve problems in one and two.

6. Draw proper free-body diagrams for an object or system under the influence of various forces and determine the net force and acceleration.
7. Identify the conditions appropriate to apply Newton's laws of motion to solve problems requiring one to predict and evaluate the trajectory of an object in one and two dimensions.
8. Define the centripetal force and its relationship to the velocity of an object in a circular motion.
9. Relate the description of translational dynamics using Newton's laws to describe rotational dynamics to explain and solve rotational problems
10. Define the relationship between torque, rotational inertia, and angular acceleration to solve rotational motion problems.
11. Apply the condition for equilibrium to assess the stability of extended rigid objects or systems.
12. Use algebra and symmetric observation to determine the center of mass and rotational inertia of extended rigid systems.
13. Determine the work done by constant and variable forces.
14. Apply linear momentum and energy to explain or predict the outcome of linear collisions in one and two dimensions.
15. Apply angular momentum and rotational energy to explain or predict the outcome of collisions involving rotating systems.
16. Explain or predict the motion of objects (position, velocity, acceleration) in simple harmonic motion.
17. Describe the pressure in a fluid as a function of the depth in a fluid.
18. Apply Archimedes' Principle to determine the buoyant force on an object submerged or partially submerged in a fluid.
19. Use Pascal Principle to explain hydraulic lifts.
20. Predict the variation of velocity and pressure of an incompressible fluid flowing through pipes of various diameters and heights.
21. Determine the coefficient of linear expansion.
22. Use the First Law of Thermodynamics to model the energy transfer between systems.
23. Describe the state of an ideal gas in terms of the volume, pressure, temperature, and number of moles.
24. Describe and predict the properties of an ideal gas using the Ideal Gas Law.
25. Describe simple thermodynamic processes using PV diagrams.
26. Calculate the work done by gas as it undergoes thermal processes using algebra concepts and methods.
27. Describe the properties of matter and their transformations.
28. Use the kinetic theory of gases to relate macroscopic and microscopic properties of matter.
29. Solve problems using heat flow and a substance's specific heat to predict temperature changes.
30. Solve problems involving latent heat and energy transfer to predict phase transformations.
31. Classify processes as reversible or irreversible.
32. Use heat, work, and internal energy in energy-transfer models to describe the operation of heat engines and heat pumps.
33. Describe heat transfer mechanisms; conduction, convection, and radiation.
34. Describe the limitation and calculate the maximum efficiency of heat pumps and heat engines using the second law of thermodynamics.
35. Combine various core physics concepts across topics to solve convoluted problems in a sound, systematic manner that may be assessed as a logical solution to a real-world scenario.

Course Outcome(s):

Perform laboratory experiments involving the course topics with the appropriate data collection and analysis to support the conclusion of laboratory experiments expressed in written form.

Essential Learning Outcome Mapping:

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Apply the scientific method involving physics principles to design and set up laboratory experiments using the appropriate experimental apparatus to investigate, collect and analyze data to draw evidence-based conclusions.
2. Modify experimental procedures in response to synchronous instructor feedback on the proper use of laboratory equipment, measuring techniques, and safety.
3. Convert between different systems of units.
4. Represent data clearly and concisely through tables, charts, and graphs with appropriate units and significant figures.
5. Identify relationships through graphical data analysis using model fits as solutions to a real-world problem.
6. Identify what information is needed to solve a problem.
7. Assess data and apply the appropriate physics concept and mathematical relationship to determine a solution.
8. Evaluate the validity of experimental results through the reproducibility of data.
9. Determine percent error/difference of experimental results and identify sources of experimental error and limitations.

10. Gather information on scientific topics relevant to the physics topics being investigated from credible sources to assess the accuracy of experimental results.
11. Present results of laboratory experiments in written reports with evidence-based conclusions.

Course Outcome(s):

Apply physics concepts to understand modern-day applications, explain or predict natural phenomena, and assess the validity of data analysis as an appropriate solution to a real-world scenario.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Evaluate the limitations of Newton’s laws of motion in describing motion in real-world applications.
2. Identify appropriate conditions where the kinetic theory of an ideal gas and the ideal gas laws are applicable to model real gases.
3. Form relevant assumptions using sound reasoning to establish scenarios where conservation laws (conservation of energy, conservation of momentum, conservation of angular momentum) may be implemented to solve or estimate a reasonable solution.
4. Assess the efficiency and feasibility of heat engines and refrigerators using the laws of thermodynamics.
5. Identify the limitations of laboratory analysis that may create variations compared to a real-world scenario.
6. Determine the upper and lower limits set by the law of conservation of energy to energy-related real-world applications.
7. Combine Newton’s laws of motion, rotational motion, and Newton’s Law of gravity to model and solve problems involving planetary orbits and space flight.
8. Design realistic heat engines and heat pumps that consider the limitations set by laws of thermodynamics for real-world applications.

Methods of Evaluation:

1. Quizzes
2. Hour examinations
3. Final examination
4. Formal laboratory reports
5. Informal laboratory reports
6. Problem assignments
7. Group work
8. Student presentations
9. Other or some combination of the above

Course Content Outline:

1. Measurement and units
    a. Metric units
    b. Scientific notation
    c. Uncertainty
    d. Significant figures
2. Scientific method
    a. Steps
    b. Reproducibility
3. Linear motion
    a. Distance
    b. Displacement
    c. Speed
    d. Velocity
    e. Acceleration
    f. Kinematic equations
4. Vectors

    a. Vector components
    b. Kinematic equations in 2-D
    c. Projectile motion
5. Forces
    a. Force
    b. Gravity
    c. Weight
    d. Tension
    e. Friction
    f. Centripetal Force
6. Newton’s laws of motion and gravitation
    a. Inertia
    b. Newton’s 1st law
    c. Net force
    d. Free body diagrams
    e. Newton’s 2nd law
    f. Newton’s 3rd law
7. Energy
    a. Energy
    b. Work
    c. Kinetic energy
    d. Gravitational potential energy
    e. Elastic potential energy
    f. Conservation of Energy
    g. Power
8. Linear momentum
    a. Center of mass
    b. Linear momentum
    c. Conservation of momentum
    d. Impulse
9. Rotational motion and equilibrium
    a. Rotation
    b. Angular displacement
    c. Angular velocity
    d. Angular acceleration
    e. Torque
    f. Moment of inertia
    g. Angular momentum
    h. Conservation of angular momentum
10. Simple harmonic motion
    a. Period
    b. Frequency
    c. Pendulums
    d. Oscillating masses
11. Fluid statics and mechanics
    a. Density
    b. Pressure
    c. Units of pressure
    d. Absolute pressure
    e. Gauge pressure
    f. Pascal’s Principle
12. Heat
    a. Heat
    b. Specific heat capacity
    c. Latent heat
    d. Calorimetry and conservation of heat energy
    e. Heat transfer via conduction, convection, and radiation
13. Thermodynamics

    a. Temperature scales
    b. Ideal Gas Law
    c. 1st Law of Thermodynamics
    d. Pressure-volume diagrams
    e. Entropy
    f. 2nd Law of Thermodynamics
14. Laboratory work
    a. Safety in the laboratory
    b. Physical measurement
    c. Experimental error
    d. Percent error
    e. Percent difference
15. Source evaluation
    a. Currency
    b. Relevance
    c. Authority
    d. Purpose
    e. Evaluate arguments

Resources

Knight, Randall D; Jones, Brian; and Field, Stuart. *College Physics: A Strategic Approach*. 4th. Pearson, 2019.

Cutnell, John. *Physics*. 11th ed. Wiley, 2018.

Giancoli, Douglas. *Physics: Principles With Applications*. 7th ed. Pearson, 2014.

Giambattista, Alan. *College Physics.* 4th ed. McGraw-Hill, 2013.

Urone, Paul Peter; Hinrichs, Roger; et al. *College Physics*. Houston, Texas: OpenStax, Rice University, 2022. https://openstax.org/details/books/college-physics

Vacha, Terrance H. *Lab Manual for 1210.* Cuyahoga Community College, 2001.

Walker, James S. *Physics*. 5th. Pearson, 2017.

Wilson, Jerry D. *Physics Laboratory Experiments.* 8th ed. Boston, New York: Houghton Mifflin, 2014.

Zatko, Frank. *Physics Labs with Computers, Vols 1 2.* PASCO Scientific, 1999.

Resources Other

1. Audio-visual materials: videos, DVDs, audio recordings, computer programs and simulations
2. Laboratory experiments developed by current and past instructors
3. Online homework and study programs

Instructional Services

OAN Number:
Ohio Transfer 36 TMNS and Transfer Assurance Guide OSC014 and OSC021 (1 of 2 courses for OSC021, both must be taken)

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