

Syllabus for Algebra-Based Physics-1: Mechanics (PHYS135A)

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

August 16, 2021

Abstract

The concepts of algebra-based mechanics will be presented within the context of interactive problem-solving. First, the concepts of displacement, velocity, and acceleration in one and two dimensions will be introduced, building up to Newton's Laws of motion. Next, the concepts of friction and rotational motion will be added. More complex problems will be introduced through the conservation of energy and linear momentum, followed by the rotational equivalents. The course work will include analytic textbook problems, interactive computational exercises, and lab-based activities.

Pre-requisites: None

Course credits, Liberal Arts Categorization: 4 Credits, None

Regular course hours and location: Monday and Wednesday, SLC232, 8:50-10:50, predominantly synchronous time.

Instructor contact information:

1. Email: jhanson2@whittier.edu
2. Cell: 562.351.0047
3. Zoom ID / pass: 796 092 0745 / 667725
4. YouTube Channel: www.youtube.com/918particle
5. Book online appointments: <https://fgucmvjkyllumqfscsco.10to8.com>

Office hours: Booking service to schedule meeting: [10to8.com](https://fgucmvjkyllumqfscsco.10to8.com) as above, and indicate in-person or online.

Attendance/Absence: Students are required by Whittier College to sign in to class.

Late work policy: Late work is generally not accepted, but is left to the discretion of the instructor.

Text: OpenStax College Physics. Go to <https://openstax.org/details/books/college-physics> for access (free).

Homework and Reading: OpenStax Tutor: <https://tutor.openstax.org/enroll/372180/College-Physics-Fall-2021>.

Homework sets will usually require 10 exercises per week, and is integrated with the open-access text from which reading assignments will be given. This system costs 10 dollars, but the textbook is free.

Online Laboratories: Some laboratory activities will be through pivotinteractives.com. Instructions will be posted on Moodle for how to sign up. There is no cost to the student.

Grading: There will be one midterm, one (optional) final exam, and daily warm-up exercises. There will also be homework problem sets, submitted via OpenStax Tutor. Finally, there will be a self-designed project and presentation given at the end of the term. Grading percentages are shown in Tab. 1. Note that the final exam will be optional. The final project is a good opportunity for the use of Digital Storytelling. For more information, see <https://diglibarts.whittier.edu> and contact Sonia Chaidez: schaidez@whittier.edu.

Item	Percentage	Item	Percentage
Daily exercises	10 %	Daily exercises	15 %
Homework sets and labs	30 %	Homework sets and labs	35 %
Midterm	20 %	Midterm	25 %
Final	20 %	Final	- -
Final Project + Presentation	20%	Final Project + Presentation	25%

Table 1: (Left) These are the grade settings with the final exam included. (Right) These are the grade settings without the final exam. The final exam is optional. **Grade Settings:** $\geq 60\%$, $< 70\%$ = D, $\geq 70\%$, $< 80\%$ = C, $\geq 80\%$, $< 90\%$ = B, $\geq 90\%$, $< 100\%$ = A. Pluses and minuses: 0-3% minus, 3%-6% straight, 6%-10% plus (e.g. 79% = C+, 91% = A-).

Student Disability Services: Whittier College is committed to make learning experiences as accessible as possible. If you experience physical or academic barriers due to a disability, you are encouraged to contact Student Disability Services (SDS) to discuss options. To learn more about academic accommodations, email disabilityservices@whittier.edu, call (562) 907-4825, or go to SDS which is located on the ground floor of Wardman Library.

Academic Honesty Policy: <http://www.whittier.edu/academics/academichonesty>

Policy due to COVID-19:

1. Students are required to be vaccinated against COVID-19 and wear a mask indoors.
2. Group project results will be designed, constructed, and executed outside of class. Projects will be presented in-person during the last week of class.
3. Students may opt-out of taking the final exam. If one does not take it, the assignment weights for the final grade will be those given in Tab. 1 (right).
4. The final project can be created in one of two options. **Option A:** A 10 minute traditional presentation with several minutes for questions. **Option B:** Digital liberal arts style, in the form of video or digital book form that educates the class on a topic.

Course Objectives:

- To practice written and oral expression of scientifically technical ideas.
- To solve word problems pertaining to physics and mathematics.
- To construct mathematical models of mechanical systems.
- To apply logical thinking to conceptually-posed physics problems.
- To practice scientific experimentation, data analysis, and reporting of results.

Course Outline:

1. Unit 0 - **Chapters 1.2 - 1.4**
 - (a) Introduction to iClicker, class procedures, reading syllabus.
 - (b) Warm-up activity: gas mileage, speed, calories and energy.
 - (c) Unit-analysis, approximation, and coordinate systems.
 - (d) Adding and subtracting vectors, displacement and translational motion.
2. Unit 1 - **Chapters 2.1 - 2.4**
 - (a) Monday reading quiz: chapter 2.3
 - (b) Wednesday reading quiz: chapter 2.4
 - (c) Topics covered:
 - i. Vector displacement, scalar distance, and coordinate systems.
 - ii. Time, velocity vector, acceleration vector.
3. Unit 2 - **Chapters 2.5 - 2.8**
 - (a) Monday reading quiz: chapter 2.5.
 - (b) Wednesday reading quiz: chapter 2.5.
 - (c) Topics covered:
 - i. Kinematic equations.
 - ii. Kinematic equations with vectors.
 - iii. Graphical analysis of kinematics.
4. Unit 3 - **Chapters 3.1 - 3.4**
 - (a) Monday reading quiz: chapter 3.1
 - (b) Wednesday reading quiz: chapter 3.3
 - (c) Topics covered:
 - i. Kinematics in 2D.
 - ii. Addition and subtraction of vectors: a review.
 - iii. Projectile motion.
5. **Midterm: October 6th, 2021.** This exam is worth 20-25% of the grade (see Tab. 1), and will cover Units 0-3. The emphasis is on working with units, vectors, and applying kinematic equations in 1D.
6. Unit 4 - **Chapters 4.1-4.4**
 - (a) Monday reading quiz: chapter 4.2

(b) Wednesday reading quiz: chapter 4.3

(c) Topics covered:

- i. Newton's First Law
- ii. Newton's Second Law
- iii. Newton's Third Law

7. Unit 5 - **Chapters 4.5, 5.1 - 5.3**

(a) Monday reading quiz: chapter 4.5

(b) Wednesday reading quiz: chapter 5.1

(c) Topics covered:

- i. Normal forces and tension.
- ii. Drag and friction.
- iii. Elasticity

8. Unit 6 - **Chapters 6.1 - 6.3, 6.5 - 6.6**

(a) Monday reading quiz: chapter 6.1

(b) Wednesday reading quiz: chapter 6.5

(c) Topics covered:

- i. Rotational kinematics
- ii. Centripetal force
- iii. *Special topic: gravity and Kepler's Laws*

9. Unit 7 - **Chapters 7.1 - 7.4, 7.6 - 7.8**

(a) Monday reading quiz: chapter 7.2

(b) Wednesday reading quiz: chapter 7.3

(c) Topics covered:

- i. Work, kinetic energy, work-energy theorem.
- ii. Potential energy.
- iii. Energy conservation and power.
- iv. *Special topic: work, energy and power in human beings*

10. **Final project proposal due: November 12th, 2021.** The final project proposal is a 1-2 page report describing the hypothesis, data to be collected, experimental procedures, and parts required. Submit one document per group, and include all names and student IDs.

11. Unit 8 - **Chapters 8.1, 8.3 - 8.6**

(a) Monday reading quiz: chapter 8.1

(b) Wednesday reading quiz: chapter 8.4

(c) Topics covered:

- i. *Math review: solving systems of equations*
- ii. Linear momentum, conservation of momentum.
- iii. Elastic scattering.
- iv. Inelastic scattering.
- v. Scattering in 2D

12. Unit 9 - **Chapters 10.1 - 10.4**

(a) Monday reading quiz: chapter 10.1

(b) Wednesday reading quiz: chapter 10.4

(c) Topics covered:

- i. Angular acceleration and rotational kinematics.
- ii. Inertia and rotational kinetic energy.

13. Unit 10 - **Chapters 10.5 - 10.6**

(a) Monday reading quiz: chapter 10.5

(b) Wednesday reading quiz: chapter 10.6

(c) Topics covered:

- i. Angular momentum conservation.
- ii. Collisions with rotations.

14. **December 1st, 2021: students receive final exam study guide.** The final exam is optional and the emphasis is on energy and power, energy and momentum conservation, and angular momentum.

15. Unit 11 - **Class Presentations and Final Review**

(a) No reading quizzes

(b) Group presentations:

- i. Worth 20-25% of the course grade (See Tab. 1).
- ii. Given as a group
- iii. 10-15 minute presentation with slides or board work

(c) Final exam reviews will be given Dec. 3rd.