

PHYS 201 - Introductory Physics I

M/W/F 9:00 - Frey 150

M/W/F 10:00 - Frey 349

Prof: Dr. Randy Fish

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Office Hrs: M&W 1:00 – 2:00, Th. 10:30 – 11:30, F 10:00 – 11:00
by appointment or drop by and take your chances.

Text: *Physics* by Eugene Hecht, Brookes/Cole Pub. © 2003, 3rd ed.
Laboratory Manual Physics 201 Fall 2003



Additional Material: A graphing calculator will be very helpful for laboratory work and the many problems that will be done in class.

Course goals:

This course is a survey of classical mechanics, stressing concepts and problem solving using mathematical modeling. Topics include vectors, motion in one and two dimensions, Newton's laws, conservation of energy, linear, and angular momentum, harmonic motion, and wave models.

This course will allow you to gain skill at solving college-level physics problems and improving your mathematical, quantitative and computer skills. You will be given the opportunity to gain skill in solving problems of a mathematical nature.

While the text is based upon an understanding of Algebra and Trigonometry, Calculus may be used to explain motion and energy concepts.

Contact time consists of three lecture periods and three hours laboratory per week. This course meets the General Educational Laboratory Sciences requirement and is recommended for chemistry, computer science, and health sciences majors. Prerequisite (or co-requisite) MATH 108 or 111. (Offered yearly)

Mathematical Sciences Objectives:

By the completion of this course, the student will be able to demonstrate:

1. substantive knowledge of the content and investigative methodologies of a scientific topic.
2. an understanding of the scientific method and how the scientific community validates new knowledge.
3. the ability to conduct and analyze simple investigations in the natural sciences.
4. the ability to present scientific arguments orally and in writing using tables, graphs and charts.

Course policies:

1. Attendance

- a. Each student is expected to be present for every class.
- b. Each student is responsible for the material covered in every class. You should arrange with another student to obtain the Hand-outs, and to receive the announcements made at every class. If you are sick, have another student take notes for you and pick up any handout sheets for you.
- c. Exams: If you must miss an Exam, you need to receive prior approval and take the exam during or before the next scheduled class.

2. Group Work

- a. Plagiarism: You must cite the work of others. Copying another's work will be treated as plagiarism resulting in a zero for that assignment.
- b. Homework: You may work in groups but everyone must submit their own homework.
- c. Labs: See the syllabus provided by the instructor of your lab section for expectations.

Disability statement:

Messiah College welcomes students with disabilities. If you have a documented disability and wish to discuss needed academic accommodations for this course, please speak with Dr. Fish as soon as possible. Campus policy states that disability accommodations must be pre-approved through the Office of Disability Services located in Hoffman 101/102.

Grading:

Students will be evaluated by their performance on exams, homework and laboratory reports.

Exams (35 pts) There will be four in-class exams. The first is a "half-exam" worth 5 pts. The other three exams are worth 10 pts each

Final Exam (30 pts) The final exam will be split between coverage of the material from Ch.10&11 and cumulative review of the material from previous semester exams.

Homework (10 pts) Homework assigned in one class is due at the beginning of the next class. You may work in groups but everyone must submit their own homework. Each homework problem will be graded as Correct (100%), Partially Correct (50%) or Incorrect (0%). Example problems in the text are worked out in detail. The answers to all the odd problems are included in the book. The solutions for many homework problems are worked out in detail in the back of the book. These problems have bold problem numbers. Other homework solutions will be made available for your review and study.

Labs (25 pts) See the syllabus provided by the instructor of your lab section for expectations and grading.

Letter grades will be assigned based upon the total number of points earned via Exams, Homework and Labs as shown in the chart below.

Assignment of letter grades							
		B+	87.5	C+	77.5	D+	67.5
A	92.5	B	82.5	C	72.5	D	60
A-	90	B-	80	C-	70	F	Below 60

Preliminary Schedule:

These are preliminary dates for planning purposes. The actual date for exams will be announced at least two class periods prior to the exam.

9/2 & 4	- Chapter 1 – “An Introduction To Physics”
9/7, 9, 11	- Chapter 2 – “Kinematics: Speed and Velocity”
9/14	- Half Exam
9/16, 18, 21	- Chapter 3 – “Kinematics: Acceleration”
9/ 23, 25, 28, 30, 10/2,5	- Chapter 4 – “Newton’s Three Laws”
10/7	Exam (Ch. 3 & 4)
10/ 9, 12, 14, 16	- Chapter 5 – “Centripetal Force & Gravity”
10/19, 21, 26, 28, 30	- Chapter 6 – “Energy”
10/23(break)	
11/2	- Exam (Ch. 5 & 6)
11/4, 6, 9	- Chapter 7 – “Momentum & Collisions”
11/11, 13, 16, 18	- Chapter 8 – “Rotational Motion”
11/20	- Exam (Ch. 7 & 8)
11/23	Chapter 10 – “Elasticity & Oscillations”
11/25, 27	Thanksgiving Recess
11/30, 12/2, 4, 7	- Chapter 10 – “Elasticity & Oscillations”
12/ 9, 11, 14, 16	- Chapter 11 – “Waves & Sound”

Homework Problems: (This needs revision 8/21/2009)

Note: The homework problems listed below refer to the “Problems + Coordinated Problems + Progressive Problems + Solutions” section at the end of each chapter. They do not refer to the “Discussion Questions” or the “Multiple Choice” questions.

Ch.1 - An Introduction to Physics

1, 2 [trillion = 10^{12}], 3, 5, 9, 11, 12, 15, 17, 19, 24, 33, 35, 36, 37

Ch.2 - Kinematics: Speed and Velocity

6 [answer 3.33×10^6 s; How many years? ____ Reasonable? ____],

#13 – Draw a distance Y time X axis graph. Show all three velocities,

#21, 23, 25, 31, 41, 43, 51, 71, 72, 73, 81 + **Relative velocity problems** in syllabus.

➡ **Half Exam.**

Ch. 3 - Kinematics: Acceleration “The Four Fearsome Formulas”

3, 5, 7, 15, 19, 21, 24, 27, 41, 45, 49, 55, 57, 81, 85, 90, 95, 97, 108, 115, 117

Ch. 4 - Newton's Three Laws

5, 11, 17, 21, 27, 29, 37, 39, 45,

#52 [both uses of the unit pound are the same i.e. a force of 1 pound which is 4.45 N],

#58, 69, 81, 83, 85, 89, 91, 93,

#112 [this is a muscle problem. It is symmetric, so solve for just one force at $160^\circ/2 = 80^\circ$ and double the answer!],

#130

➡ **EXAM.**

Ch.5 - Centripetal Force & Gravity

1, 3, 7, 9, 17, 19, 23, 27, 29, 33, 37, 67

Ch.6 - Energy [Work]

1, 3, 11, 15, 17, 29, 31, 41, 49, 59, 61, 69, 72 solution given, 75,

#77 + **Energy/Power problems** in Syllabus.

➡ **EXAM.**

Ch.7 - Momentum and Collisions

230# 3, 5, 7, 9, 17, 19, 25, 29, 31, 37, 39, 41, 55

Ch.8 - Rotational Motion

5, 7, 9, 11, 15, 19, 25, 29, 35, 39, 55, 57, 61, 63, 65,

#70 [$T_e = 5.80 \text{ N}\cdot\text{m}$; $T_s = 11.0 \text{ N}\cdot\text{m}$],

#71, 72 [$4.60 \text{ N}\cdot\text{m}$], 73, 77, 89, 123, 125 + **Centripetal Force Problems** in Syllabus

➡ **EXAM**

Ch.10 - Elasticity and Oscillations - Simple Harmonic Motion

1, 3, 5, 7, 9, 13, 65, 67, 69, 71, 97, 99,

#100 [What is k for springs in series & in parallel? What is a series arrangement? What is a Parallel arrangement?],

#110 + Simple Harmonic motion problem in syllabus

Ch.11 - Waves and Sound

3, 7, 11, 15, 21, 25, 31, 33, 35, 67, 69, 99, 101, 103, 113, 117, 119, 125, 131



Final EXAM at the scheduled time!

COLUMN UNIT METHOD with conversions:

(Almost every number in your report should be accompanied by a unit, like 1.23×10^6 hertz, or 2.34 newtons, or 1.57 m. See the table below for common nomenclature and conversion equations. Note that **three significant figures** is the rule for almost all physics calculations.) rev. 8-4-07

NAME & SYMBOL in formulas	SI (International system)	ENGLISH	Conversion or notes
length (L)	meter (m)	foot	1 m = 39.4 in = 3.28 ft, 1 fermi = 10^{-15} m 1 mi = 1610 m 1 nm = 10^{-9} m
mass (M)	kilogram (kg)	slug	1 slug = 32.2 pounds (lb) 1 kg = 2.21 pounds (mass)
time (T)	sec (s) =	= sec (s)	1 year = 60·60·24·365.25 s = 3.16×10^7 s 1 hour = 3600 s
velocity (v) = L/T	meters/sec (m/s)	feet/sec	1 km/h \approx 5/8 mi/h c = 3×10^8 m/s 1 m/s = 2.25 mi/h = 3.6 km/h
acceleration (a) =	meters/sec ²	feet/sec ²	acceleration of gravity(earth) g = 32.2 ft/s ² = 9.8 m/s ²
Force (F) [F = ma]	newton (N)	pound (lb) 4.45 N = 1 lb	1 N = 1 kg·1 m/s ² = ma G = 6.67x10-11 N·m ² /kg ²
energy (E) heat	joule (J) calorie (heat) = 1 gm of water 1°C)	foot·pounds BTU (British thermal unit)	1 J = 0.239 cal = 0.738 ft·lb = 2.78x10 ⁻⁷ kWh 1 BTU = 252 calories
power (P)	watt (W) W = V·I = I ² R = V ² /R	Horse power	1 W = 1 J/s 1 Horse power (Hp) = 746 W 1 Hp = 550 ft·lb/s
voltage (V) Potential	volt (V) = joule/coulomb	English uses SI	It is a unit of energy per C of charge
charge (Q)	coulomb (C)	English uses SI	1 C = coulomb = 6.24×10^{18} electrons
current (I)	ampere (A) = coulomb/s	English uses SI	Flow unit: I = Q/t 1 W = 1 V · 1 A 1 J = 1 V · 1 C
impedance (Z): Resistance R Capacitance C Inductance L	ohm, Ω microfarad, μ F millihenries, mH	English uses SI V = I·R V = I/(2 π fC) V = I·(2 π fL)	Impedance is like resistance but there is a phase change and a dependence on frequency.

Exponent Names - Unit Prefixes

$$1 \text{ k} = \text{kilo} = \text{thousand} = 10^3$$

$$1 \text{ G} = \text{giga} = 10^9$$

$$1 \text{ c} = \text{centi} = 10^{-2}$$

$$1 \text{ n} = \text{nano} = 10^{-9}$$

$$1 \text{ M} = \text{mega} = \text{million} = 10^6$$

$$1 \text{ T} = \text{Tera-} = \text{trillion} = 10^{12}$$

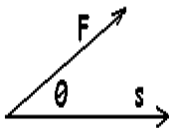
$$1 \text{ m} = \text{milli} = 10^{-3}$$

$$1 \text{ p} = \text{pico} = 10^{-12}$$

$$1 \mu = \text{micro} = 10^{-6}$$

$$25 \text{ cm} = 25 \cdot 10^{-2} \text{ m} = 0.25 \text{ m}$$

PHYSICS HELP SHEET ON ENERGY

NAME	FORMULA	REMARKS
Work	$F \cdot s$ (Dot Product)	$W = f s \cos\theta$ 
Kinetic (linear)	$K.E. = \frac{1}{2}mv^2$	Motion energy
Kinetic (rotational)	$K.E. = \frac{1}{2}I\omega^2 = \frac{1}{2}I(2\pi f)^2$	$I = mR^2$ or $\frac{1}{2}mR^2$ (Cylinder) or $\frac{2}{5}mR^2$ (sphere)
Gravitational Potential - close to a planet	$P.E. = mgh$ $g \approx \text{constant}$	Position energy - change is NOT path dependant
Gravitational Potential - large scale	$G.P.E. = GmM(1/r_i - 1/r_f)$ $g \neq \text{constant}$	NOT path dependant
Friction	$f_k \cdot \text{distance}$	non conservative - energy change is path dependant
Thermal	water: $m \cdot \Delta T$ (kg • Change in Celsius) other mats: $c \cdot m \cdot \Delta T$ where c is the specific heat of water, the material's heat capacity relative to water	Heating - Most friction energy ends up as heat or thermal energy. 1 Calorie = 1 kg of water rising 1 deg. C 1 J = 2.39×10^{-4} Calorie = 2.78×10^{-7} kWh 1 BTU = 0.252 Calories Heat of combustion = energy available from burning From p467 1 gal of gas = 1.3×10^8 J 1 pound of wood = 6.8×10^7 J
Chemical - changes in electron position;	$XX \rightarrow XX^+ + 1e^- + XX \text{ eV}$ $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$	Battery, Food/Fuel/Fire/wood rotting
Deformation	Force • distance	Mechanical work into heat energy
Spring (Compression)	Spring Energy = $\frac{1}{2}kx^2$ $k = \text{spring constant}$	Conservative Force
Mass	$E = mc^2$	The atomic bomb is actually a nuclear bomb. Chemical bombs like TNT involve the electrons, but atomic bombs involve changes in elements or nuclei .
Deformation	$F \cdot s$	Usually ending up as heat - thermal En. Car crashes involve dissipating much KE – new car come with “crumple zones” to absorb KE! They increase s in the $F \cdot s$ equation.