

11am/1pm

9/10

**PHYS-2070<sup>†</sup> (9/10) Electricity & Light (41285/41286-Kaldon)**

*Western Michigan University*

Dr. Philip Edward Kaldon  
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Class: MTuWTh 11:00-11:50am  
F 1:00 - 1:50pm  
Class: MTuWThF 1:00 - 1:50pm  
Office Hours: MTuThF @ 10:30am, MTuWThF @ Noon-2pm, MTuTh@3pm –  
also TuThF 3:00-5:00pm E-209 CEAS Parkview Campus or stop in or by appointment.

Fall 2005  
Version 9.01  
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<http://homepages.wmich.edu/~kaldon/>

1104 Rood Hall (9)  
1104 Rood Hall

1104 Rood Hall (10)

<http://homepages.wmich.edu/~kaldon/classes/ph207-9-10.htm>

**PHYS-207, -208, -215 have been renumbered as PHYS-2070, -2080 and -2150.**

**PHYS-2080 (Laboratory) is a separate course.**

**You must be registered for PHYS-2080 to take the lab.**

**Labs start the second week of class (week of 6 September 2005); check outside lab door.**

**Three-Times Rule:** It is University policy that the number of times a course can be taken is limited to three (including withdrawals). A student whose current enrollment is in violation of this policy must drop this course as soon as possible and no later than the deadline for no refund of tuition.

**C-or- Better Requirement:** It is Department policy that a grade of "C" or better in a prerequisite course is required before enrollment is permitted in the next-sequence course. A student who does meet this requirement must drop this course as soon as possible and no later than the no-refund deadline.

**Required Texts and Supplies:**

Physics for Scientists and Engineers (6th edition) / Serway and Jewett  
Volume 2 or Second Half of Full Textbook

Standard inexpensive calculator with trig functions and logs. **NO TI-92/89MACHINES!**

**Optional Materials:**

None, really. If you require an integral table or other math handbook, CRC Press' Standard Math Tables (or whatever it is currently called) is highly recommended; this is the source for the integral tables in the textbook. Study guides from Schaum's, or the textbook's A Student Solutions Manual and Study Guide, are available (or can be ordered, but probably not in time for this short spring course) from the bookstore. These may be helpful for some people, but are not required and have not been used in the preparation of this course. There are also study software packages for Physics, but I haven't seen one that looked worth the money; so you might as well work the assigned Homework!

<sup>†</sup> This Syllabus may also cover anyone enrolled in PHYS-2150 *Electricity and Light Problems* (Pre-Requisites PHYS-1150 and MATH-1230 and MATH-2720 (or MATH-2300) concurrently, or equivalent) – PHYS-2150 is the one credit hour conversion course from the Algebra Physics sequence to the Calculus Physics sequence. To register, you must get the CRN from the Physics Dept. Office, 1120 Everett Tower. Other than registration, the PHYS-2150 course is the same as PHYS-2070, except that it only costs one credit.

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**Prerequisites:** PHYS-2050 and MATH-1230 (or equivalent) is required for PHYS-2070, with a grade of "C" or higher. A working knowledge of calculus, algebra, geometry and trigonometry is expected for this course. Since Physics is a kind of applied mathematics, if you feel uncomfortable about your math skills, don't delay getting help!

**Co-requisites:** PHYS-2080 (the lab) and MATH-2720 (or MATH-2300) are co-requisites for PHYS-2070.

**Course Descriptions from the WMU Undergraduate Catalog via Registrar's Web Site**

(GoWMU)

**PHYS 2050 Mechanics and Heat**

**4 hrs. Fall, Winter, Spring**

This first course of a sequence of three in general college physics employing calculus deals with mechanics and heat. It is required of physics majors, engineering students, and future physics teachers, and is strongly recommended for majors in other sciences. Prerequisite: MATH-1230 concurrently. Open to qualified first year students. A student may not receive credit for both PHYS-2050 and any of the following: PHYS-1070, PHYS-1090, or PHYS-1130.

**PHYS 2070 Electricity and Light**

**4 hrs. Fall, Winter, and Summer**

This course follows PHYS-2050 and consists of studies in electricity, magnetism, and light. Prerequisites: PHYS-2050, MATH-1230, and MATH-2720 (or MATH-2300) concurrently. A student can receive credit for only one of the following courses: PHYS-1070, PHYS-1090, PHYS-1150, or PHYS-2070.

**PHYS 2080 Electricity and Light Laboratory**

**1 hr. Fall, Winter, and Summer**

This is a laboratory course which includes exercises related to topics covered in PHYS 2070. Normally this course is taken concurrently with PHYS 2070. A student may not receive credit for both PHYS 2080 and PHYS 1160. Prerequisite: PHYS 2070 concurrently.

**Significant Dates:**

Aug. 29 Mon - Classes start at 4pm  
Aug. 30 Tue - PHYS-2070 Begins  
Sept. 2 Fri - Regular Bi-Weekly Quizzes Begin  
Sept. 2 Fri - Drop/Add ends (100% refund)  
Sept. 5 Mon - Labor Day Recess  
Sept. 12 Mon - End of 50% refund for withdrawal.  
**Sept. 30 Fri - Exam 1**  
Oct. 17 Mon - Spring registration begins  
Oct. 19 Wed - End of 25% refund for withdrawal.  
**Oct. 28 Fri - Exam 2**  
Oct. 31 Mon - Last day to withdraw from Fall.  
**Nov. 17 Thu - Topic 1 (Book Report) (due by 5pm Thursday, but...)**  
**Nov. 18 Thu - Exam 3**  
**Nov. 21 Mon - ... Grace Period for Topic 1 ends at 5pm**  
Nov. 23 Wed - Thanksgiving Recess begins at Noon. [No PHYS-2070 classes]  
Nov. 28 Mon - Classes resume  
Dec. 2 Fri - Last Day of Class  
Dec. 5 Mon - Finals Week begins  
**Dec. 5 Mon - 11am PHYS-2070 Final Exam 10:15am-12:15am (2 hours) \*\***  
**Dec. 6 Tue - 1pm PHYS-2070 Final Exam 2:45pm- 4:45pm (2 hours) \*\***

Dec. 10 Sat - Semester ends  
Dec. 13 Tue - Fall grades due at Noon.

“All Exam dates are fixed in stone.” See Dr. Phil otherwise.

\*\* - Because we have two different Monday class times, we get two Final Exam date/times. You will be able to choose either one, though most of the 11am people will probably want to take the first Final Exam and most of the 1pm people will want the second. The two Final Exams will be graded and curved SEPERATELY, so there is no advantage to taking one over the other.

 **750,000 POINTS** 

For many of you, the minimum grade you need in this course is a “C”. That means you need to earn at least 750,000 points. Read this Syllabus carefully and keep current in class.

**Grading Scheme:**

	A	AB	B	BC	C	CD	D	E
%-age	100-95	94-90	89-85	84-80	79-75	74-70	69-65	64-0

Raw exam scores may be curved.

#### The Million Point Grading Scale:

Quizzes	(20)	300,000 points	23 given; 3 dropped
Papers	(1)	100,000 points	
Exams	(3)	300,000 points	
Final	(1)	200,000 points	
☆ Star Points		100,000 points	
		-----	
		1,000,000 points	

**Homework:** Homework may be assigned for each chapter. Serway offers two kinds of problems at the end of each chapter: *Conceptual Questions* and *Problems*. The Conceptual Questions tend to be descriptive thought questions, rather than pound-equations-into-your-calculator problems. You should skim through these as a review, to see if you understand the material. A few of these are included in the H.W. assignments; they are marked C for Conceptual. Most quantitative problems keyed to each section, as well as Additional Problems, which tend to cut across sections. Each Problem has been coded in the text: black, blue and red (or *easy to hard*). H.W. will not be turned in, but you will be responsible for it. You are expected to be able to do the assigned Problems, but do not waste too much time if you can't see how to solve a Problem. Odd-numbered problems have answers given in the back of the book; an instructor's solution manual (if I can locate one) will be brought to class for you to check out specific questions. It does no good to just hand out detailed solutions for all the problems, because then people tend not to actually work on the H.W.

**Work To Hand In:** All work that is to be handed in (which includes Quizzes, Exams, Papers, Special Topics) must include your name (you'd think that would be obvious, but...). – PAPERS WITHOUT NAME AND SECTION NUMBER MAY NOT BE GRADED! **Staples:** Any papers turned in that are supposed to be stapled, but aren't, are subject to a 3000 point penalty. Any papers turned in with a *fold-and-tear* corner will get an automatic 5000 point penalty. **Late Papers:** lose 10% (one letter grade) per day, but it is better to *do the work at all* than turn in nothing.

**Writing Assignments:** There will be an outside reading and writing assignments: IF YOU HAVE HAD DR. PHIL BEFORE, YOU MUST READ A DIFFERENT BOOK! Complete instructions will be in the booklet handout. It is due Thursday November 17th by 5pm. There will be a penalty for each day a paper is late. *A grace period is included in the schedule. Be sure to read the assignment at the end of the booklet!*

**Quiz Schedule:** Expect to have a quiz twice a week (starting September 2nd). Quiz problems will be based on the assigned homework UNITS, SIGN, POWER OF TEN and VALUE of your ANSWER will all be evaluated on numerical problems. Reasonable units and significant figures are required. You must CIRCLE your ANSWER. Work must be shown to receive credit, though the work itself may not be evaluated. There will be twenty-three 15,000 point quiz problems; the lowest three will be dropped. There will be no further adjustment of quiz grades. Quizzes may sometimes be graded on an “all-or-nothing” basis and cannot be made up, though up to three zeroes can be dropped.

**Exam Schedule:** There will be three hour exams, tentatively scheduled for: **30 September 2005, 28 October 2005 and 18 November 2005 – all these are on FRIDAY.** Each exam will cover about three weeks of material and you can have the entire period to work. These exams will be closed-book, but you will be allowed to bring a **FORMULA CARD**. On this “card” (includes cards, paper, spiral bound note cards), you may write down any formula, physical constant, definition or a brief note on any historical figure that you feel is relevant or useful; a sketch or description of the setup is allowed, but *you may not include worked out problems*. Formula cards will be turned in with the exam, with a deduction for an illegal formula card. Each exam is worth 100,000 points (see note below on ☆ Star Points). Scores may be adjusted on a curve to meet the Grading Scheme noted above. Exam questions will vary, but will include some complex problems that will test your understanding of and ability to apply the material. You may be surprised to hear this, but I do not expect you to be able to do 100% of the exam; in all likelihood, you've probably never taken exams like this before. They won't really get any easier, but you will get used to them. The Final Exam will be **Monday December 5<sup>th</sup> OR Tuesday December 6<sup>th</sup> \*\*** (see page 3) with a REVIEW class on Friday December 2<sup>nd</sup>. The Final is worth 200,000 points. It is cumulative and you can use your previous formula cards. It may emphasize concepts and relationships over number crunching. If a curve is used on the Final, it will only bring grades up.

#### Exam and Quiz Policy

For all exams, you are expected to sit with at least one space between you and the next person in your row. Hmm... We are stuffed into a small room here. We'll work it out. For all exams and in-class quizzes: You are allowed your “legal” calculator and formula card(s), and a pen or pencil (do not use red – it will be returned with a grade of ZERO). Pre-printed commercial physics and math summary sheets, such as are available laminated in the bookstore, do NOT count as your self-made formula card. Dr. Phil can be very generous, but when he calls for all papers to be turned in, you must turn them in – if you want it graded.

 **Star Points:**

[Read more than once – no one seems to understand this concept the first time!]

In addition to the normal scoring of the 3 Exams and the Final, each of these tests will have four parts designated with a star (☆). There are 100,000 Star Points that will be awarded on a primarily all-or-nothing basis in addition to any partial credit you earn during normal test scoring (20,000 Star Points on each regular Exam; 40,000 Star Points on the Final). All Star Problems will involve the use of calculus, and Star Points will be awarded on the basis of a correct calculus set-up and evaluation (if required). A quick analysis of the points and the grading scale, should convince you that it will be impossible to get an “A” (and hard to get a “C”) in the course on the basis of using algebra, trig and geometry alone. This is

intended to keep everyone honest, including Dr. Phil, and to identify some of the key points of the course. *You may be very surprised to find that working, practical calculus is not like what you did in math class!*

**The Professional Concerns Committee of the Faculty Senate recommends that all faculty include the following paragraph in each syllabus that they prepare for the upcoming semester:**

"You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate (pp. 274-276) [Graduate (pp. 25-27)] Catalog that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with me if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test."

#### Sorta Important Stuff

**The First Thing You Should Do Each Day When You Come Into Class...**

(after getting comfortable and pulling out your notebook and pencil)

**...Is To Take OUT Your Calculator And Have It Ready At All Times**

(it doesn't do you any good all closed up in your book bag, or at home)

#### **Grading:**

The process and the concepts are so important, that getting the correct numerical answer is sometimes the least important part of a calculation. Therefore, there will be some partial credit on some exam problems for taking the correct line of reasoning, even if the answer is wrong. This does not excuse you from taking reasonable care in a calculation. (Grading this way is very labor intensive, but your patience will be rewarded.) You can argue all day long that you had the "right answer", but if you did not show sufficient work or physically correct work, you will not get the points. Your answer is a dialogue between you and the graders – it must be intelligible and "legal" math and physics – we cannot grade "what you meant".

#### **Units, Numbers and other parts**

For a business that relies so heavily on numbers, it is very rare that the answer to a Physics problem is just a number, like "five". "Five what?" is usually a reasonable question, so units are a very important part of a number. Units will save your life, if you bother to keep them with their numbers and learn to reconcile them. Otherwise, you will be doomed to getting useless results because you plug  $9.8 \text{ m/s}^2$  into a length or a velocity, or end up with a resistance in meters instead of ohms.

So many errors in Physics problems can be traced back to the use of the wrong "thing" in a variable, sometimes to the point where even I can't figure out what you were doing, that we are going to be **very, very, very** hard on units this semester. So here's the new rule:

### **UNITS ARE TO BE CONSIDERED PERMANENTLY STAPLED TO A NUMBER.**

Every time you write down a number, you write down the units as well. This means (a) when you write down the numbers in the beginning of the problem, (b) when you write down your answer and (c) *most importantly*, what Dr. Phil calls *Internal Units* – that means when you are writing down a number in an algebraic expression before you haul out your calculator. There will be no alternative here, because otherwise you won't be scoring any points here on quizzes and exams. You'll notice that Dr. Phil always includes units with his numbers on the blackboard – take that as a hint.

Likewise, the sign of an answer can be very important in some problems. Your bank has no trouble with telling the difference between having a \$500 checking account balance and being overdrawn with a -\$500 balance, for example; these are very different answers. One must also watch out for powers of 10, since the metric system is based on a decimal system, just like the American money system. Another number problem: 4.97 is a number that is about five, but 4.97 is not the same as 5.00. Your calculator is not very intelligent, so you must determine which numbers in the display represent significant figures, based on the actual numbers you used as input to your calculations. This is particularly important in lab; in lecture and discussion, you will find that we tend to use "reasonable" numbers in answers. I cannot guarantee that you will get exactly the same answer as I do, since the order you do math operations and the brand of calculator can have some impact on the final result. As a general rule, do *not* truncate or round numbers too much in intermediate calculations or dump your entire calculator display into a final answer.

Also – we do not normally deal in fractions.  $1 \frac{2}{3}$  is 1.67 to three significant figures.

#### **Laboratory:**

Lab is an integral part of any serious study of Physics. You may or may not be taking the lab course, PHYS-2080, at this time. I can help you with general physics questions, but I am neither responsible for the laboratory nor inclined to help you write-up your results.

#### **Make-Ups:**

In-class Quizzes cannot be made up. You are expected to attend classes anyway, but this is especially true of laboratories and examinations. Provided you have a valid reason for missing class (illness, etc.), if you miss: (1) a lab you must contact the appropriate instructor as soon as possible to see if you can make up the lab; (2) an exam, you must contact me as soon as possible to arrange an exam within a few days. There are no guarantees that late exams will be the same (or of the same difficulty) as the in-class exam.

This is Fall in Michigan – Land of Driving Adventures.

Dr. Phil has a long commute (154 miles/day) and Lake Michigan is a powerful force of nature. Dr. Phil will make gallant efforts to be here on time every day – *but* ultimately all of us have to be intelligent enough to make decisions between *trying to get to class* and oh, say... *living*. Physics is important, but if you or your vehicle can't make it, then you can't make it.

#### **Late Quizzes:**

Most take-home quizzes can be turned in by 5pm on their due date if they are not ready to turn in at class time. Some take-home quizzes *may* be made up, provided the solutions have not been given in class. If Dr. Phil starts going over a quiz problem you have not turned in, please turn it in immediately. If two or more quizzes are being turned in on any given day, PLEASE make sure that they are in separate piles.

#### **"My Side" of the Table**

It's a small point, but the front lab table is divided in Dr. Phil's mind between "my side" and "your side". Please do not ever pick up papers from Dr. Phil's side of the table. Sometimes they are not for your class, sometimes they may be your papers that have not yet been recorded in my grading spreadsheets. (If they are never recorded, then they are still 0's.) You may think that it makes sense to grab graded papers from both sides of the lab table, but that blocks my access to my piles and the blackboard, which slows things down for everyone. So, "stay on your own side of the table" will make things move smoother for all.

#### **What's My Grade?**

Part of keeping up with the workload in PHYS-2070 is knowing where you stand in the class. There is a delay, however, between when work is handed in and when it gets back to you. We endeavor to get Exams back to you within one week of when they are given. Quizzes have tended to get batched and backlogged – a new system since Spring 2002 seems to get quizzes turned around faster. Grades are

recorded in a Microsoft Excel 7.0 spreadsheet. After the first exam is graded, Dr. Phil will create The Predictor, which basically fills in all the final grade columns with estimated answers, even though most of the work of the semester has not been actually done yet. The Predictor uses actual Exam, Star and Quiz scores to estimate what their final values will be, based on your past performance. By the time 7 to 10 quiz grades are recorded, The Predictor will start dropping your three current lowest quiz grades. The Topics (such as the Book Report) are automatically given the lowest "B" grade of 85%. Once The Predictor is set up, you can always stop by office and see what your current projected grade is, or send me e-mail (along with your WMU student ID number) and I will e-mail your current projected grade. Posting grades on Dr. Phil's office door or at the back of the lecture room is usually done around the exams, sorted by the 5 digits of your PID number (see Quiz 1), but this information has a short shelf-life. Check the Post date on the printout. During Spring 2001, someone kept stealing (or just throwing out) my printouts, which is very odd behavior.

#### What's The Answer?

I am currently making available solutions to the Exams, so that you will know what the correct (or at least Dr. Phil's version) answer to a problem is. Most quizzes will be gone over the next class period, again so that you will have the correct answer. (Check the class website!) This is easiest for the in-class quizzes – take-home quizzes have a tendency to dribble in over a few days, so there's no point in giving people the answer before they get their papers in! I do not usually give out answer sheets to the Sample Exam Problems, on the theory that you don't have the answers on a real exam, so you need to learn how to PTPBIP – and it encourages students to study together, compare notes or even come to Dr. Phil's office hours. Sometimes I feel like the Maytag™ repairman – it's lonely in my office at office hours.

#### Extra Credit:

I don't "do" extra credit. Students who wish extra credit primarily do so because they aren't using their time effectively already, so why would I wish you to divert even more of your valuable time on additional work?

#### Interesting (?) Thoughts

##### Natural Philosophy

Physics was once called Natural Philosophy in colleges and the term has some very good connotations. Physics is a study of Nature and how Nature operates. Physics is often a philosophical arena, where meaning and understanding are gleaned, debated and tested from observations of the real world, experiments in the laboratory, with theories and long "what-if?" and "what-about?" sessions. I often suggest to students that "We are here to change the way that you think" and this is borne out in the many students who comment at the end of the course that they do think about and see the world is a different way. Many tell of how sick to death their friends and family are to here them babble on about "this is how that works" or "don't you wonder why that happened?" Most people go through life not thinking those thoughts or asking those questions. (Or else believe that it must be too difficult for them to understand.)

##### The Million Point Grading Scale

You may have noticed the outrageous number of points assigned to our workload. Over the years I have found that many people don't have a good feel for very large and very small numbers, things we will be using a lot in PHYS-2070, so I created The Million Point Grading Scale as a kind of numerical literacy device. It breaks the usual mold of 100 point tests and eliminates haggling for points. Anyone who wants "a" point, can have one. You must complete all elements of the course in order to earn the rest of your points, however.

##### Common Sense

It is an asset to make a guess about what is going to happen in a problem. However, you must watch out that you let the Physics do its work and not talk yourself into a mistaken notion. It is sometimes thought that good Physics thinking is just good Common Sense. All of us have some idea how at least

part of the world works, but Common Sense doesn't always seem to be so Common among us, or so Sensible. Instead, we will work to a logical model of how things work, one that is independent of personal feeling (red cars don't really go faster than blue ones). This is not easily done, since most students don't get very much Physics education early on: a survey done a few years ago suggests that even students in graduate physics classes tend to write one thing on a test paper and believe in their "common sense experience" in everyday life. But don't despair – there are a lot of common sense experiences that do work in Physics under the appropriate conditions, such as "what goes up must come down."

#### The Good News and The Bad News

Now that we all have a certain understanding of the physics in the mechanical world, we will find that the PHYS-2050 material comes into play in PHYS-2070 over and over again. However, PHYS-2070 is full of large chunks of new material that you may be unfamiliar with. So on the one hand, you may not have a lot of experience with electric fields or quantum mechanics, so this material is really new (as opposed to already knowing that objects fall because there's gravity, or that applying heat makes the temperature go up), but on the other hand, you may not have a lot of experience with electric fields or quantum mechanics, so that your old non-physics world view won't get in the way. The good news is that for most of you, surviving one semester of Physics has shaped your mind to accept reasonable Physics concepts, so although the material is hard, you may feel better about it.

#### E&M vs. EE's

Since many of the people taking PHYS-2070 are science and engineering majors, it is almost a fair question to ask whether some majors have an advantage. Funny you should ask, because the results aren't exactly what you think! When I was at Michigan Tech, we found that a lot of Electrical Engineering majors would breeze into the E&M course figuring that they had it made. The bad news for them is that although there is a certain amount of simple R, C and L circuits covered in PHYS-2070, it is, at best, only 5 of 17 chapters. Instead, we spend most of our time on the field theory that isn't covered in most EE courses. (Also, physicists sometimes view circuits differently than engineers do.) At Tech, we found that the students who had the highest grades often came from Mechanical and Civil Engineering (ME's and CE's), because they were knew they didn't know the material and therefore took the time to study, do the homework and learn it!

#### Newcomers

If you did not take PHYS-2050 the last time it was taught at Western Michigan University in Summer I of 2005 (or Spring 2005) then you should take some time to review the material presented in Chapters 1-22 in Serway. This is especially true of those who have used a different book or a previous edition of Serway. Feel free to stop by my office some time and see what you missed.

#### Bad Chapter Karma

From Chapter 23 to 39 in Serway is seventeen chapters. From August 30<sup>th</sup> to December 2<sup>nd</sup> is less than fourteen weeks of classes – in fact, there are 65 total classes, 3 of which are taken up by exams, 1 by introduction and 1 by review. It shouldn't take advanced differential equations to figure out that there is a mismatch here – that we have to keep going with nearly two chapters a week. On the other hand, we may adjust the topics list as we go, and we might drop some sections or chapters as we go along, or at the very least, touch on some topics without devoting critical exam and study time on them. Note the chapter lists that go with each exam.

#### Concepts

It is possible to teach an entire course in "Conceptual Physics", where one hardly ever sees a number or an equation. This isn't one of those courses, because the equations and the numbers have so much interesting meaning attached to them, that it would be a shame to leave them out. But it is very easy to lose sight of the Concepts amongst all the math. Short answer conceptual questions on exams should be almost "freebies", but usually aren't because the most basic definitions are forgotten in the cram for the

details of specific cases. Learn the definitions and the general concepts, and the specific cases will take care of themselves.

### Vocabulary

It is not surprising to think that a science such as Physics should have developed a vocabulary of its own. But Physics tries to be a precise description of the world and so therefore the meanings of many ordinary everyday words must take on a new precision of their own, too. We will see that mass and weight are very different, even though they might seem to describe the same thing. Or that work has a special definition, a precise meaning, that is understandable to physicists and physics students around the world. Indeed, the concept of doing “no work” in Physics is very different from the usage we have in everyday speech.

### Equations

Physicists are capable of driving other people crazy, as we can happily work all day with equations without ever once feeling the need to plug in a number. The concepts and the theory frame the question and the answer, it is the equations that supply the tools for our solution. In reducing numbers down to letters, we are limited by the number of upper and lower case letters in the English and Greek alphabets. Therefore, what “ $v$ ” might represent in any equation must not only be known, but “ $v$ ” and “ $V$ ” are also likely to be different from each other, as is “ $v$ ” (Greek lower-case  $\nu$ ).

### Formula Card

You will be allowed to bring your very own formula card to quizzes and exams. This being a “serious” physics course, you are responsible for maintaining this formula card. Dr. Phil will give you constants during a quiz or an exam, such as  $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$ , but he will *not* give you formulas. Factory made study sheets and formula cards from the bookstore are *not* allowed, because they are *not* your work.

### Theory

The theories presented in this course have a long and colorful history that is interesting in its own right. Much like case law to the legal profession, current Physics theory has been “tried and proven” over the years. Unlike law, however, it isn’t how slick or well-paid your physicist is versus mine, here the burden of proof falls on experimental verification. Even so, “proof” is too strong a word for some in science, rather one might say that something is true within these limitations. Much of what goes on at the forefront’s of Physics today involves the same topics that we will cover in PHYS-2070. However, much of the details of Modern Physics is left for a third semester course – PHYS-3090.

### Experiment

Years ago I saw a T-shirt that said “If it’s Green and Wriggles, it’s Biology; If it Stinks, it’s Chemistry; And if it doesn’t work, it’s Physics”. We say that the theory developed in Physics has been verified by Experiment, but surely we cannot mean Physics Lab! Still—reading, thinking and calculating can only take you so far; sometimes you have to see and measure for yourself. The purpose of lab is to put the scientific method into practice and see where event, observation and theory meet. But remember! The theory we develop in class has simplified and “cleaned” up Nature, so we cannot expect perfect experimental results; but careful and repeatable experiments will go a long way to helping you “see” the Physics.

### Time Management (Studying)

Since we have a lot of material to cover, and it is probable that you won’t have time to work out ahead of time every Physics problem in the book, it becomes important to manage your study time wisely. **It is very common to end up spending hours banging your head against one stupid little problem.** Mostly this involves doing the same solution over and over again, or dragging in every conceivable (and inappropriate) formula under the sun. Most of the textbook problems have only one or two elements in them, so in general you may need to simplify your work, not make it overly complicated. Problems marked in black are considered easy - if you are having trouble with a black problem and some of the blue problems, you are probably making them way too hard. Think basic definitions! If you find yourself spending long hours without getting any benefit, come and see me and we’ll try to help. Very few students can get by without doing any work outside of class. *The quizzes are most like the sectional*

*black and blue homework problems; the exams are more like the red and Additional Problems. You can’t do the latter until you understand the former.*

### Time Management (Exams)

Staring at an exam page is not the time to learn how to do Physics. Good exam time management starts with being familiar with the homework problems, the basic concepts and the formulas on your formula card. Beyond that, you should remember that most parts of the test are equally important, so don’t spend all your time on one problem or part. Go onto another problem that you can do. Don’t worry about what other students are doing. The student who gets up and hands their paper in halfway through the hour has used up as much time as they care to (for good or bad); it should have no bearing on your test. Do look through the whole test when you get it, making sure that yours is complete. Do keep units with your numbers and check to make sure that (a) the numbers and (b) the units of your answers makes sense. Don’t leave any parts blank if you can help it. *Remember the Star Points!*

### Time Management (Dr. Phil Exams)

A typical Dr. Phil Exam is 4 or 5 pages long, each page is a single long involved problem with usually five parts. Although the whole problem may be more complicated than you typically find in the homework, I generally try to lead you through the problem if you read it through carefully. Look at it this way: this would be one of those “choose four of the following five problems” tests, except you are allowed to work on all the problems. An excellent paper may only score 80% raw. Above all else, remember that you can ask questions during a test. Don’t sit there and write “I am lost on this problem”, “I am missing the formula here” or “I could do parts (b)-(e), if I knew how to get the answer to part (a).” Instead, if you’re stuck on (a), ask Dr. Phil for a number to “use” as an answer to part (a) and go on. Or you can state a *reasonable* assumption of your own, and continue. *“Just put it in writing.”* Dr. Phil is not a mind reader.

### Still Having Problems?

### Killer Equations

There is no one equation to “Life, The Universe and Everything”. Every equation developed has some built-in limitations and some very real restrictions on when you can and can not use them. There are plenty of examples done in class and in the text which result in equations to solve a particular case. Students are inevitably tempted to use such “killer equations” for any problem that involves those quantities, because they think that the work has been done for them. The range equation is a classic example in ballistics, but this equation cannot be used unless the launch points and landing points are at the same height. Despite that warning, freely given in class, the range equation will be used to find out how far away a arrow will land, even if the archer is standing on a hilltop. In most cases, you are better off using the more basic, more general, more useful equations than searching for that “killer equation” that will solve the problem with one plug-in. Somehow the latter hardly seems like the kind of examination that would prove that you had learned anything.

### InAppropriate Formulas (IAF!!!)

Even worse than trying to use Killer Equations, which at least have a passing connection to the subject at hand, is the use of just any old formula that happens to have the “right” letter variable in it! I am getting sufficiently tired of seeing Inappropriate Formulas on exams (one should really have a better laid out formula card and take more care in selecting equations), that you may not get *any* partial credit for the use of “IAF”s in a problem.

### Show ALL Work Means Having Some Work to Show

Something is not an equation if the two sides of the “=” aren’t the same thing with the same units. An integral isn’t an integral unless it has a differential, a derivative isn’t a derivative unless there is something to differentiate – and units do not undergo calculus! Dr. Phil does not allow you to whine that you “had the right answer” if you did not “show the work” that gets you there. **IN MANY CASES, THE ANSWER IS THE LEAST SIGNIFICANT PART OF THE PROBLEM. HOW YOU GOT THERE IS THE POINT.** A properly done worked out physics problem represents a technical conversation between the writer and the reader. You wouldn’t understand Moby Dick either if all you read is the first five pages and the last five.

### Graphing Calculators

Just in the years that I have been in school, I have seen the rise of the calculator, the decline of the slide rule, and a definite drop in the ability to do simple error-free mathematics. When I was in college, there were stories about MIT and Harvard being concerned over students “cheating” with programmable calculators. As a physics TA, I found a whole class of students who used the old *TI-30-II*’s white face between the keys to pencil in all their

formulas. Such cheating is not necessary, because I allow you a formula card up front. Today, the *Texas Instruments TI-81, TI-83 and TI-85* graphing calculators are virtually standard issue in many college math and physics departments. Top flight calculators like the *Hewlett-Packard HP-48GX* not only contain Physics, Math and Engineering equations built-in and powerful symbolic math programs that will handle fractions, algebraic and calculus equations, but will accept ROM cards with additional sets of science and engineering formulas. It is even possible to transfer data and equations between calculators via cables or infrared (IR) transmitters/receivers.

#### Buy a Cheaper Calculator!!

My view of the situation is this: Very few students who buy a fancy calculator in order to substitute its power for their studying, do very well. Frankly, from what I've seen, most of the built-in solutions are either too general, too specific or just too inconvenient to be useful, and most students find that either they use that big brick like a regular calculator, or they write their own functions, just as you would write out your own formula card. Why not just learn the Physics?

#### Knay on the TI-92 – It's Not a Calculator (And the TI-89 is gone too.)

The TI-92 machine has been around for a while – it's easy to spot because it has a QWERTY keyboard. Most of the students who used them in the past have found them to be a klutzy difficult calculator, but as the largest "calculator" on the market, they have real geek appeal. While I can appreciate that having something big and powerful is cool, the fact is that the TI-92 became a real pain in Fall 2000. Several students were using its symbolic math routines and it became *painfully* obvious that they could barely do the calculus on their own. Worse, because they don't know what they are doing, they don't get it right using their fancy machine anyway. So I am tired of messing with these things – the TI-92 and any other so-called calculator with a QWERTY keyboard are OUT. The TI-89, I believe, is the same as the TI-92 without the keyboard. It's OUT, too. Not allowed. End of story. If your more ordinary looking graphical calculator does symbolic math, better talk to Dr. Phil. This may include the HP-48, TI-85 and others – see the next section to learn about Dr. Phil's next calculator beef.

#### Algebra and Calculus *versus* The Solver

Solvers and graphical solutions to problems offer interesting checks to your work, but since one of the grading requirements is that you "show your work" on the paper, unless you intend to staple your calculator to each problem, you simply can't get any credit for simply using your Solver function. It is the same thing as "doing the work in my head" – unless you intend to staple your *head* to the paper, you won't get credit for the work. You should also know that these alternate calculator methods do not always work properly. Dr. Phil's suggestion is simple: Learn to do the math with pencil and paper.

#### MTBF (Mean Time Between Failures)

No, this isn't some sick statistic on awarding F's to students. MTBF is actually a term to describe how often computer equipment breaks down. I have seen many three and four year old calculators get chewed up in PHYS-2070 and learning to use a new calculator in the middle of a course can be traumatic. It became a common sight in the mid-70's to see many of us carrying two calculators to exams, just in case one of them tubed out on us. Today's calculators are a lot more reliable than in those "old" days, but there are still plenty of "biodegradable" calculators that were never built to survive more than a year or two. While I can appreciate that no one wants to spend more money, we do depend a lot on our calculators in a course like this, and having a calculator that has keys that don't work right is just begging for trouble. Do yourself a favor: if you need a new calculator, buy it now, before a change becomes unsettling. At the very least, many older calculators need new batteries right about now. You'll thank me later. *Dr. Phil just changed the AAA's again in his 1995 HP-48GX in Summer 2002 – one set of batteries seems to last me 2 to 2½ years... not forever.*

#### "I Understand the Physics, I Just Can't Do The Problems"

This is a refrain that is heard all the time. Yet the truth is that if you can't do the problems, then you probably don't really understand the physics. Physics isn't just equations, however, it is what you do with them. Often, people who have trouble with doing the problems, also don't have a clue as to what the correct answer should look like. If you *really* understood the physics...

#### Practice, Practice, Practice

Very few people are so talented that they can leap into any new endeavor and have permanent success without every practicing. Beginner's luck usually doesn't last very long. So you're in a Physics class... what do you do? Well, besides coming to class, reviewing you notes, opening your textbook occasionally, the best advice is to do some Physics problems. Start with the assigned (i.e. recommended) problems. If you have problems, don't just

race to the answers in the back of the book, or look for posted solutions, try looking at the worked out examples in the text or from the class and reproduce that work.

#### PTPBIP (Put The Physics Back Into the Problem)

So you've read the problem, figured out what's given, determined what is being asked for, decided on what equation(s) you need and played plug-'n- chug on your calculator. So you're done, right? Well, how do you know if the answer is right? Well, first off, you can check to see if the answer makes sense. This is what I refer to as "PTPBIP", Putting The Physics Back Into the Problem. It is very important, "real" physicists do it all the time. You needn't write anything extra down, but if you expect that the block should go to the right, then it is very satisfying if your answer also says that the block will go to the right. It may be that the block will go to the left, and that the Physics is trying to tell you something, but rarely will a horizontally moving block travel up. That would be a hint that something funny is going on.

#### Expectations:

Make a mental note of two things: (1) the grade you realistically would like to get in PHYS-2070 and (2) the minimum grade that you have to get. If you aren't sure of the latter, now is the time to check with your department (or your school, for those of you not full-time WMU students). These two grades should represent attainable goals, and given your quiz and exam performance you can plan your study schedule accordingly. Week 12 is not the time to realize that your GPA is too low for you to keep your scholarship.

#### Corrections and Explanations:

Faculty and graders are humans and sometimes mistakes are made. Sometimes we just can't read your handwriting (that's okay – no one can read Dr. Phil's terrible handwriting either). If you have questions about any grade you've received, the time to ask questions is BEFORE grades are turned in. While no one will begrudge you for "trolling for points" to improve your grade, finding out what you need to do is best done while there is time for improvements.

#### Dr. Phil to English Translation:

Speaking of Dr. Phil's handwriting, you should realize that writing on the blackboard is not the same as writing on a piece of paper. I'm only a few inches from my writing – I can see it and read *just fine*. If you can't, then either (1) put on your glasses, (2) sit closer or if you've already done that, (3) jump up and down and shout "Dr. Phil, I can't read THAT!", and Dr. Phil (after he climbs down from the ceiling) will cheerfully go back to writing larger and more legibly. You'd be amazed at how many "lurkers" in the back of the lecture hall have faulty equations on their formula cards, terrible notes and oh-by-the-way have stinky Physics grades. Don't be embarrassed if you can't read my handwriting – I probably can't read yours either! (This is an occupational hazard of typing on a PC so much – I never *write* anymore!)

#### Drop Dates:

You may wonder why drop dates are so prominently mentioned in this syllabus. Actually it is to make everyone's life easier. Let's face it: most of you aren't so interested (right now) in learning some Physics as in surviving the course and putting that grade in the bank. You will have just taken the second exam on the last possible drop date. If you are concerned with passing the course, I would be happy to consult with you after the second exam (but before they are graded) to give you a quick read on where you stand.

#### Overloads:

It's a Y2K5 college fact: You are probably taking too many classes and working too many hours. In a perfect world, the best way to do Physics is to abandon everything else and just do the Physics. Since you probably can't do that, now is the time to figure out what you can cut out of your schedule. Hey, it's only for a few weeks, and believe me, you'll thank me later if you at the very least arrange a few days off before each exam. A good work ethic is a fine thing to have, but YOU'RE IN COLLEGE!

#### Study Groups:

You may find that studying by yourself can be difficult. As is stated elsewhere, we are trying to change the way that you think – sometimes this means you need a different perspective. This is where working with someone may prove useful. Study groups of 2 to 4 students meeting a couple of times a week seem to be effective. As many questions as you have, it is almost always the case that you can help someone else.

#### Office Hours:

It will take a few days to shake down everyone's schedule and get into a rhythm. Frankly, I don't get enough business during office hours, but boy do I hear the kvetching about how hard Physics is and how awful the Quizzes are. If my office hours are not convenient to your schedule, then it is up to you to make an appointment or swing by the office and see if I'm in. Or call. You've got the number.

**Physics is Phun:**

No one ever believes that on the first day. And for some, it never is fun. But we can try! Really!

**Credentials:** **Dr. Philip Edward Kaldon** - Born western upstate New York; Junior High near New York City; High School in Greensboro, North Carolina (1976). B.A. Integrated Sciences, Northwestern University (1980); M.S. Physics, Michigan Technological University (1986/88); Ph.D. in Applied Physics, Michigan Technological University (1989). Physics Teaching: WMU, KVCC, GVSU, Hope College. **Past** President—Michigan Section of the American Association of Physics Teachers (MIAAPT). Dr. Phil pursues many science and science literacy efforts, and on the first day of class, he is on Day 2802 of writing a massive science fiction romantic epic novel. A fourth readable draft of a complete novel, The Devil's Coffin, set in the same sci-fi universe, is on Day 1621. No – it's not ready for you guys to read yet. After sending out thirty-one short stories seventy-one times, Dr. Phil has one story published in an anthology and two more slated for publishing in 2006. And "The Pulse of the Sea", Dr. Phil's first commercial sale, will be published this first week of September. No – Dr. Phil has no intentions of making you read his fiction. But he did attend the prestigious 2004 Clarion Science Fiction and Fantasy Writers Workshop, an intensive six-week boot camp for SF writing last summer, so he is well on his way to becoming a published science fiction author!

**Why We Do All This:**

**science literacy** *n.* An exposure to science in a historical context that serves to allow a person to observe the world around them with understanding, deal with technological applications at home and work, appreciate the distinction between fact and speculation in the media and politics, have a working knowledge of numbers and the scale of the universe, and be able to pursue more information if desired, as a function of everyday life.

Philip Edward Kaldon, Fall 1995

**The Disclaimer**

This Syllabus has been revamped, rewritten, respellchecked, reedited, re-etc., more times than I can count for different Physics courses. Occasionally old, out of date material remains from GVSU or WMU or KVCC, for which I apologize. If there are real errors, you will be notified!

We Are Here To Change The Way You Think - There Are No Stupid Questions (Just Ones That Half The Class Wanted Asked Anyway) - UNITS Will Save Your Life - PTPBIP! (Put The Physics Back Into the Problem!) - Physics is Phun - (This is the Fun part. Are we having Fun yet?)

**PHYS-2070 (9/10) (Kaldon) < MTuWTh 11am – MTuWThF 1pm 1104 Rood >** Rev. 9/05/2005  
*Chapter assignments are approximate – actual chapters will depend on our actual pace.*

<b>Week</b>	<b>Class Dates</b>	<b>Topic (Serway – 6<sup>th</sup> ed.)</b>	<b>Special</b>
1.	29 August 30, 31 August 1, 2 September	Office Day Introduction & Ch. 23 Electric Charge	Topic 1 Assigned <i>Quiz 1 (9/2)</i>
2.	<b>5 September</b> 6,7,8,9 Sept.	<b>Labor Day &lt; No Classes Monday &gt;</b> Ch. 23 (cont.) Electric Fields Ch. 24 - Gauss's Law	<i>Quiz 2 (9/6), 3 (9/9)</i>
3.	12,13 September 14,15,16 Sept.	Ch. 25 - Electric Potential Ch. 26 - Capacitance and Dielectrics	<i>Quiz 4 (9/13), 5 (9/16)</i>
4.	19,20 September 21,22,23 Sept.	Ch. 27 - Current & Resistance	<i>Quiz 6 (9/20), 7 (9/23)</i>
5.	26,27,28,29 Sept. <b>30 September</b>	Ch. 28 - Direct Current Circuits	<i>Quiz 8 (9/27)</i> <b>Exam 1 – 9/30 Fri.</b> (Ch. 23 - 26)
6.	3,4 October 5,6,7 Oct	Ch. 29 - Magnetic Fields	<i>Quiz 9 (10/4), 10 (10/7)</i>
7.	10,11 Oct 12,13,14 October	Ch. 30 - Sources of the Magnetic Field	<i>Quiz 11 (10/11), 12 (10/14)</i>
8.	17,18 October 19,20,21 October	Ch. 31 - Faraday's Law Ch. 32 - Inductance	<i>Quiz 13 (10/18), 14(10/21)</i>
9.	24,25,26, 27 Oct. <b>28 October</b>	Ch. 33 - Alternating Current Circuits	<i>Quiz 15 (10/25)</i> <b>Exam 2 - 10/28 Fri.</b> (Ch. 27 - 30)
10.	31 October 1,2,3,4 November	Ch. 34 - Electromagnetic Waves	<i>Quiz 16 (11/1), 17 (11/4)</i>
11.	7, 8 November 9,10,11 November	Ch. 35 - The Nature of Light and the Laws of Geometric Optics	<i>Quiz 18 (11/8), 19 (11/11)</i>
12.	14,15,16,17 Nov. <b>18 November</b>	Ch. 36 - Geometrical Optics Ch. 37 - Interference and Light Waves	<i>Quiz 20 (11/15)</i> Topic 1 due – 11/17 @ 5pm <b>Exam 3 - 11/18 Fri.</b> (Ch. 31 - 35)
13.	21,22 November <b>23, 24, 25 Nov.</b>	Ch. 38 - Diffraction and Polarization <b>Thanksgiving Break - &lt;No Classes&gt;</b>	<i>Quiz 21 (11/25)</i> <b>NO Class on 11/23 Wed</b>
14.	28,29,30 Nov. 1,2 December	Ch. 39 - Relativity	<i>Quiz 22 (11/29), 23 (12/1)</i> <i>Review Class 12/2</i>
15.	<b>5-9 December</b>	<b>FINAL WEEK</b>	<b>Final Exam - 12/10 Tue.</b> <b>10:15am-12:15pm</b> (Ch. 23 - 39)
16.	13 December	Grades Due at Noon (Tuesday)	