What is the single most influential and beautiful creation of the human mind?

$$\oint_s \vec{E} \bullet d\vec{a} = \frac{Q_{encl}}{\varepsilon_o}$$

$$\int_s \vec{B} \bullet d\vec{a} = 0$$

$$\int_c \vec{E} \bullet d\vec{l} = -\frac{d\int_s B \bullet d\vec{a}}{dt}$$

$$\int_c \vec{B} \bullet d\vec{l} = \mu_o I_{encl} + \mu_o \varepsilon_o \frac{d\int_s \vec{E} \bullet d\vec{a}}{dt}$$

PHY 122P
Mastery Self Pace Course
Fall 2015

Tue. Sept 1, 2015
CRN 65170

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Dept. of Physics and Astronomy, University of Rochester

Note: Workshop starts TOMORROW (Sept. 2)

pre·req·ui·site
prēˈrekwəzət/
noun
plural noun: **prerequisites**
a thing that is required as a prior condition for something else to happen or exist.

P122 and P122P Prerequisites

1. PHY101 (Basic Math for Physics, 1 credit, pass/fail)- Exception for Freshmen- Freshmen can register for PHY101 concurrently with PHY122 , and when they pass the BMA test, they need not attend any more.

2. PHY121 or PHY121P - Mechanics, calculus based.

3. MTH162 – Integral calculus (completion of MTH143).

If you have not have taken these courses before, you cannot take PHY122 or PHY122P.

Textbook: Fundamentals of Physics 10th edition (Halliday, Resnick, Walker). This is used for P122.

For P122p, you may also use the 8th edition.

Note on Units

The Coulomb is the unit of electric charge.

It has symbol C.

Not to be confused with

C for speed of light

C for heat capacitance

C for capacitance

C for calorie

…

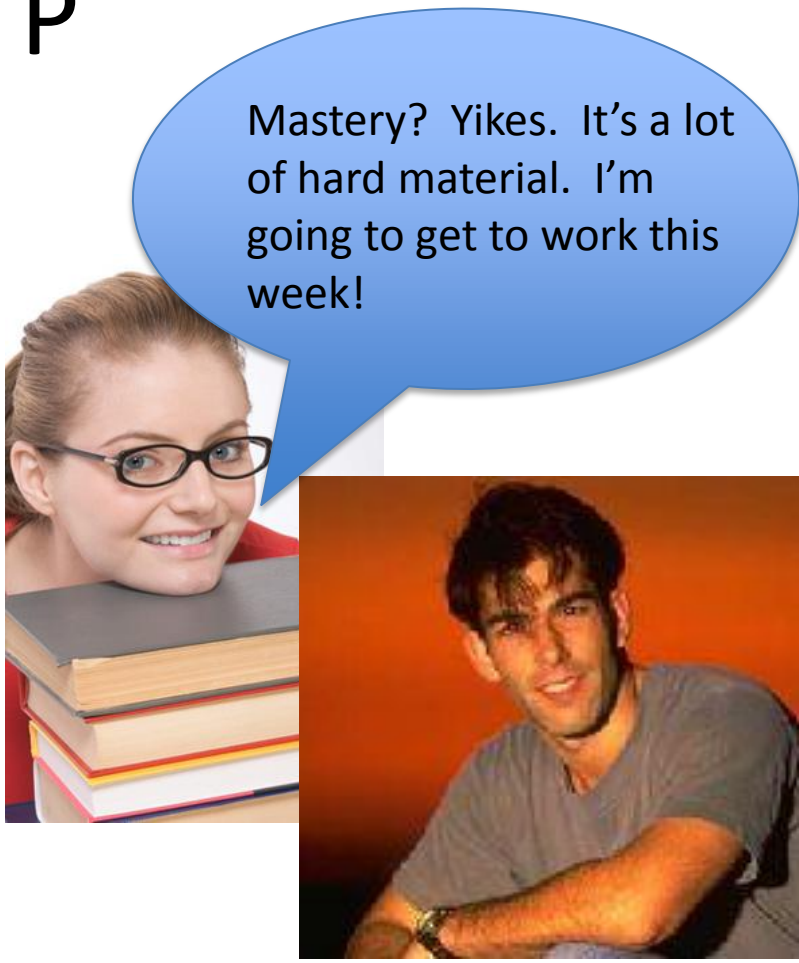
Note on Units

Sometimes in the workshop modules, we write Coul. for Coulomb. The book uses C, which we will use also.

Similarly for other units. Sometimes we use Nt. for Newtons instead of N. (N is also use for normal force, Avogadro's number, etc.)

PHY 122 P

Mastery self-paced course



PHY 122 P

Same folks on December 10

Can you believe it? They didn't have slots for me to take even the few module quizzes I left myself time to do.

Woohoo! Hard for sure. But we made it though!

Aim of PHY 122 P

- To make sure that students fully understand the material in each module before they move on to the next module (12 modules)
- The course material is spread over 12 workshop modules corresponding to the 12 weeks in the course. There 15 weeks in the course and three weeks are for catchup (as shown on the next slide)
- In order to fully understand the material, students have option of attending additional workshops during any afternoon till they understand the material.
- Additional help from volunteers in Physics and Astronomy library 3rd floor BL every day 7-9 pm.
- See http://www.pas.rochester.edu/~dmw/MSP/MSP_Physics.pdf for more details on the difference between PHY122 and PHY122P

PHY122P Fall 2015 - Standard Pace

Fall 2015

Week Of	Module (work on and pass this week)	Week
31-Aug	*1: Electrostatics*	1
7-Sep	*2: Gauss Law*	2
15-Sep	*3: Electric Potential*	3
21-Sep	*4: Capacitance*	4
28-Sep	*5: Ohm's Law*	5
Oct 5 (Fall break)	*Catch up*	6
12-Oct	*6: Kirchoff's Laws*	7
19-Oct	*7: Magnetism*	8
26-Oct	*8: Biot Savart & Ampere's Law*	9
2-Nov	*9: Faraday's Law*	10
9-Nov	*10: Self/Mutual Inductance*	11
16-Nov	*11: Magnetic Oscillations & AC Circuits*	12
Nov 23 (Week of Thanksgiving	*Catch up*	13
30-Nov	*12: Electromagnetic Waves & Complex Circuits*	14
7-Dec	*Catch up (Classes End Fri Dec 11)*	15
14-Dec	*Finals Dec 11-Dec 20*	16

Who does what?

- Professor Yongli Gao is responsible for PHY122 class and lectures

- Professors Arie Bodek and Steve Manly
  are responsible for PHY122P

- 122P head TA: Marissa Adams

BL 208 staffing

- 1 graduate or undergraduate TA in B&L 208 running workshop
- 1 graduate or undergraduate TA in B&L 208 doing prescreening and possibly helping with workshop.
- 1 (or 2) graduate TA(s) administers the quizzes and grades the quizzes once done in BL208B. The graduate TA provides the student the grade and feedback.

Lectures

- PHY122P students are welcome attend the regular PHY122 Lectures by **Prof. Yongli Gao** **MWF 11:50- 12:40** in HOYT

- These lectures are videotaped and posted on Blackboard/YouTube for PHY122P students who cannot attend the PHY122 lecture.

- The PHY122P MW 14:00 1515 time slot in HOYT will not be used, except for a special lectures/meeting (e.g. like today), as announced.

- Manly will post links to slides and audio files from relevant lectures from P142 and P114 on the P122P website (yes, they are still useful/appropriate)

- May also post lectures from last year's Physics 122 (Howell)

- Give it all a try and DO WHAT WORKS FOR YOU!

- Students in PHY122P have no scheduled midterm exams. Instead, they have 12 quizzes (one on each module). Quiz problems are similar to workshop problems.

- No homework needs to be handed in PHY122P. However, Students should do all **workshop** problems (at workshops or at home). Students can also do additional practice problems to get ready to take the quizzes. **Student are pre-screened before they can take the quiz on each module**. Students may be presecreened at any time that the workshop room is open.

- Workshop room open from 2 pm – 10 pm(MTWR), 2-7:20 pm (F) in room B208.

- There are 3 afternoon workshops time slot per day. The time slots are 2:00-4:40, 4:40-7:20, 7:20-10:00 (please attend the workshop which is closest in time to your "official registered" workshop time)***. Attendance will be recorded at your "official workshop" and will be part of your grade. You may attend additional workshops if you need more time (but will not get attendance score there). You may attend a night workshop instead of your official workshop if you have a good reason and receive attendance credit for that workshop.***

- ***There are no quiz grading slots on Fridays. All quiz grading is done on M, T, W, R.***

Workshops

What is the point of going to workshop?

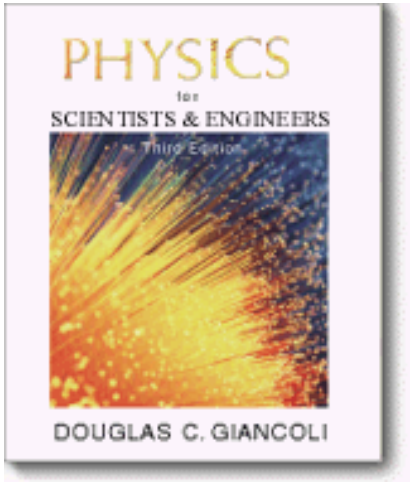
Why do we ask that you attend your scheduled workshop?

What is the TA in the workshop room supposed to be doing during your workshop?

A long time ago in a classroom far, far away … P114 (non-physics and engineering science majors) split class experiment:

41 students randomly assigned to workshops

110 assigned to "typical" recitations



B- or better →

Students attending >5 workshops → 93%

Students attending recitations → 63%

➢ Similar results in the following years (also in Physics 121) – not split classes, but grade success correlates strongly with attendance *and engaging in the model properly*

Workshops

- **Students should attend the workshop for which they are registered. They will get to know their TA.** Students may also attend more than one workshop per week if they require more time. If you miss your "registered workshop" please attend one of the night workshops during that week to get attendance credit for that week.

- Make sure that you arrive at the start time of the workshop so that you can be paired with other student who are on the same module. You may not attend the workshop if you show up late. During workshop, students can work on any of the workshop modules with other students. **Except for prescreening, Students who are late will be asked to wait till the next workshop starts**

- Read the chapters in the book before you arrive at workshop. Print the workshop module and get started. Bring the printed module to workshop.

- Keep all of your completed workshops in the binder. This binder will be your PHY122P Portfolio. You should also keep all of *your TA feedback forms* and completed labs in this binder.

Sample Attendance sheet for Monday afternoon workshop

Attendance Sheet for PHY122P Workshop 65357 **TA/TI name:**

Section: MA **TA/TI name:**

			week of 31-Aug	week of 7-Sep	week of 14-Sep	week of 21-Sep	week of 28-Sep	week of 5-Oct	week of 12-Oct	week of 19-Oct	week of 26-Oct	week of 2-Nov	week of 9-Nov	week of 16-Nov	week of 23-Nov	week of 30-Nov
	Last, First Name	Email	week 1	week 2	week 3	week 4	week 5	catchup 6	week 7	week 8	week 9	week 10	week 11	week 12	catchup 13	week 14	catchup 15
1	Berg, Charlotte	cberg2@u.rochester.edu															
2	Boldt, Nicholas	nboldt@u.rochester.edu															
3	Brigham, Renee	rbrigham@u.rochester.edu															
4	Callahan, Alex	acallah2@u.rochester.edu															
5	Divan, Nisha	ndivan@u.rochester.edu															
6	Harris, Mackenzie	mharr26@u.rochester.edu															
7	Hrbac, Anna	ahrbac@u.rochester.edu															
8	Jara, Natalie	njara@u.rochester.edu															
9	Nguyen, Huy	hnguy15@u.rochester.edu															
10	Phelps, Riley	rphelps3@u.rochester.edu															
11	Silvestri, Jillian	jsilves3@u.rochester.edu															
12	Su, Yuhan	ysu8@u.rochester.edu															
13	Wright, Anyah	awrig18@u.rochester.edu															
14	Xu, Weijing	wxu14@u.rochester.edu															
15																	
16																	
17																	
18																	
19																	
20																	

Quizzes

- There 12 quizzes correspond to the 12 modules in the course. Each quiz is 2-3 problems. Students are interviewed by the TA to make sure that they are ready to take the quiz. An interview consists of showing the TA your portfolio of competed workshops. Students should have done all the problems on the workshop. The TA will ask you to do one of the workshop problems again, to make sure that you are ready (prescreened). You are then scheduled to take a quiz.

- A grade of 90 % or more is required on a quiz before students can move on to the next module quiz. If you get 90% or more, it gets rounded off to 100%. … MASTERY

- Students can take a quiz on the same module a second time (if they get more than 70% and less than 90% on the first try). However, If they get less than 70% they should be prescreened again.

- The pre-screening for taking a 3nd quiz on the same material is tougher. Students will need to complete a problem set.

- A quiz should take 20 min to do and in 50 min students can check everything. Students can stay as long as they need. They will not be asked to leave, except at the end of the day. If students are approved for extra time, you do not need to tell us. Just stay as long as you need.

- The 2nd quiz is different from the first quiz, but it is the same material. We have several different versions of the quiz for each module.

Quizzes

- Graduate TAs administers quizzes
- The quizzes are graded immediately in BL208B.
- The quiz stays with the TA. Students cannot remove quizzes from BL208. You need to show your ID before taking the quiz (and pass a quick screening oral).
- The screening oral can be taken any time a student is ready, and the quiz can be taken immediately (if a time slot is free) or scheduled for later.
- Quizzes are closed book, no notes (leave your backpack and phone(s) in room B208 before you take the quiz in BL208B). Yes, Big Brother is watching and will be enormously pissed if you attempt to leave BL208B with any copy or pic or whatever of any of the quizzes. See the policy on academic honesty at UR: https://www.rochester.edu/college/honesty/
- They are only scheduled for pre-screened students.

Course pace and add/drop

- The number of quiz slots/week is fixed.
- The number of quiz slots/week will not rise at the end of the term.
- You MUST not let yourself fall behind significantly in this class.
- September 28 is last drop/add date. By this date, you should have finished your 4^{th} module and quiz.
- If you have not completed 2 modules and quizzes successfully by Sept. 28, we will suggest that you drop the class.

Many students feel like they got hit by a truck when they face electric field calculations from continuous distributions and Gauss' Law for the first time.

Getting through the first two modules of P122P is not trivial. The start of P122 is much harder than the start of P121. It takes time to get the hang of it. Be forewarned.

DEPARTMENT OF PHYSICS AND ASTRONOMY

UNIVERSITY of ROCHESTER

Physics 122P: Fall 2015 Feedback Form

Date: _____

Student Name: _____

Module Number: _____

Grade: _____

Comments:

Grader Name : _____

Grader Signature: _____

Typical student feedback form given to a student after a quiz.

Keep your feedback forms together with your complete workshops in a portfolio.

The feedback form is proof that your passed the exam (in case of recording error).

If you did not pass the exam, the feedback form states what topics you need to learn,

Three methods to schedule a quiz: Just in Time, Immediate, and Remote.

1 The first method (**Just in Time Scheduling)** is straight forward. If a student who has been pre-screened observes there is an open spot on the exam schedule they can just walk in and take the exam without any formal scheduling.

2. The second method **(Immediate Scheduling**) can occur as soon as the student has finished the Prescreen. The workshop leader at the end of the Prescreen can offer the student the opportunity to schedule an exam time

If you do not wish to schedule an exam after the Prescreen you can try you luck with the **Just in Time Scheduling** or send an email for **remote scheduling.**

3. **Remote Scheduling**. Send Marissa Adams **madams@pas.rochester.edu** an email. We will need your full name, student ID number, the module number for the exam you wish to take, and also you top three preferences for when to take the exam

Quiz grades

- Quizzes count for 59% of the grade. The grade is just the fraction of quizzes that were passed with more than 90%. When a student achieves more than 90% on a quiz, the grade is recorded as 100% and the student can move on to the next quiz.
- Workshop attendance in the student's official workshop time counts 6%.
- If a student completes all 12 modules, he/she get a 12/12 = 100% for the quiz part of the grade.
- If a student is two modules behind at the end of the course, he/she gets 10/12 = 83% for the quiz part of the grade (which counts 63% of the final grade).
- A minimum of 7 modules out of the 12 (58%) is required to pass the course. Students who have not done at least 7 modules by the end of the course will not be given a passing grade.
- The drop/add deadline is Sept. 28, 2015. Students who have not attended workshops and passed 2 quizzes by this point will be advised to drop the course.

Grades are based on: Quizzes 59%, workshop attendance 6%. Prelabs 5%, postlabs 5%, final 25%.

Self Paced … sort of

- Students can take the quizzes when they are ready to take them.
- However they must attend a workshop every week.
- The number of students in a workshop is restricted to 20. Priority is given to the students who are officially registered for the workshop. So if there are 15 students registered for a workshops, there are 5 additional slots for additional students.
- Only a few students signed up for night workshops, Students who need to attend more than one workshop are advised to attend the night workshops.
- For pre-screening, students can attend any workshop
- If a student completes the 12 modules before the end of the term, they will be given full credit for workshop attendance for the weeks they miss after completing the modules.

TA staff 16 hours a week, TI staff 2 workshops/week

PHY122P B208 STAFFING TA's alternate between Grading and Workshops

Workshops	Monday	Tuesday	Wednesday	Thursday	Friday
1400-1640	65357	65379	65311	65432	65220
students	15	13	7	10	7
wkshop	TI3	TI4	TI5	TI6	TI1
wkshop	TA1	TA2	TA3	TA4	TI2
Grader 1	TA2	TA1	TA4	TA3	no grader
Grader 2		TA5		TA5	no grader
1640-1920	65366	65344	65299	65300	65325
students	11	15	14	12	13
wkshop	TI3	TI4	TI5	TI6	TI1
wkshop	TA2	TA1	TA4	TA3	TI2
Grader 1	TA1	TA2	TA3	TA4	no grader
Grader 2		TA5		TA5	no grader
1920-2200	65398	65333	65382	65404	65476
students	4	5	6	7	6
wkshop					no workshop
wkshop	TA1	TA5	TA3	TA5	cancel
Grader 1	TA2	TA2	TA4	TA3	no grader
Grader 2		TA1		TA4	no grader
10 min exam slots	exam slots	exam slots	exam slots	exam slots	exam slots
	43	43	86	86	0

HEAD TA	1
TAs	5
TAs total	6
TIs total	6
	wkshps
TA1	3
TA2	2
TA3	3
TA4	2
TA5	2
	12
students registred	
163	course
145	
1.5	tries
exams needed	
per week	244.5
TOTAL exam slots	258

- Most students usually pass the quiz with more than 90% grade on the first time. The quizzes are similar to (but rarely exactly like) the workshop problems. The average is 1.4 times per module

- We will monitor student progress. Although it is self paced, we may intervene and try to find why a student is more than 2 units behind..

- PHY122 and PHY122P have the same final exam.

- If a student completed all the workshops and did well on the labs, they have a grade of 75% entering the final. The final counts 25% of the grade.

- Unlike previous years, we will not be adding extra exam time slots at the end of the course, so make sure that you keep up with the pace. There will not be any grade-a-thons at the end. Students may fall behind one or two modules, but are expected to catch up during the semester.

Coordination with PHY 122

PHY122P is coordinated with PHY 122

- Both use the same text: Fundamentals of Physics 10th edition (Halliday, Resnick, Walker). You may also use the 8th edition which is cheaper.
- Both use the same workshops (more or less …)
- Both use the same labs (10% of grade- 5% prelabs, 5% postlabs)
- Both have the same final (25% of grade).
- Both have the same lectures: PHY122 Lectures by **Prof. Yongli Gao** **MWF 11:50- 12:40** in HOYT
- PHY122P Lecture time TR 14:00 15:15 HOYT is used today only … and perhaps sporadically in response to some particular need.
- Lab lecture on statistics and data analysis is posted on blackboard.

- See http://www.pas.rochester.edu/~dmw/MSP/MSP_Physics.pdf for more details on the difference between PHY121/122 and PHY121P/122P

Labs start Monday September 14, 2015

- There are five labs in the course. All labs must be done to pass the course. All information is on www.pas.rochester.edu/~physlabs/
- There is a prelab that you need to do beforehand and hand in the the beginning of lab. These are graded and count as 5% of your course grade. Print the prelab and lab instructions and bring to the lab with you. There are two students per lab setup.
- The postlab analysis is done during the lab, they count as 5% of your course grade.
- Labs run on a two week cycle. With weeks A and B. **Make sure that you attend lab during the correct week** (e.g Monday MA lab section is week A, and Monday MB lab section is week B).
- **You must sign into the lab** and give the TA your completed prelab. At the end of the lab, you hand the TA your postlabs

Fall 2015
WEEK LAB CYCLE
APPLIES ONLY FOR PHY 113, 122/122P, 142

	Week		LAB 113, 122
9/14	Week	A	1, 6
9/21	Week	B	1, 6
9/28	Week	A	2, 7
10/5-6	Fall Break No Labs		
10/12	Week	B	2, 7
10/19	Week	A	3, 8
10/26	Week	B	3, 8
11/2	Week	A	4, 9
11/9	Week	B	4, 9
11/16	Week	A	5, 10
11/23	Thanksgiving No Labs		
11/30	Week	B	5, 10

Missing Labs: See lab web site for details

If you miss a lab due to illness, you must make it up by going to another lab during the two week cycle.

You should send email to the mechanics lab coordinator and request to go to another lab section:

Physlabs.em @ pas.rochester.edu

There are only 10 setups in each lab, so no more than 20 students can attend a specific section. The lab coordinator will make sure that no more than 20 students in each section. Therefore, it is better to request to attend a lab section which has a small number of students. (See www.pas.rochester.edu/~physlabs for that information).

If you do not hear back then, go to one of the sections marked MAKEUPS – these sections have more open slots.

PHY 122/ 122P/ P142/182 EM Lab sections Lab. Times: Afternoon: 2:00-4:40, Evening: 4:50-7:30, Night: 7:40-10:20

Lab. Times: Afternoon: 2:00-4:40, Eve: 4:50-7:30, Night: 7:40-10:20 P142, P122P,122, P182 = 45+164+185+1=395

If you miss or cannot make your section, you must make up the lab during the two week period (A/B) for that lab

	A&B	A&B	A&B	A&B	A&B	A&B	A&B	A&B	A&B	A&B	A&B
Week A	Mon Aft	Mon Eve	Mon N	Tue Aft	Tue Eve	Tue Night	Wed Aft	Wed Eve	Wed Night	Thu Aft	Thu Eve
142	65696 MA 1	65729 MEA 1	65895 MNA 3	65801 TA 5	65852 TEA 0	65684 TNA 1	65642 WA 2	65883 WEA 0	65730 WNA 5	65908 RA 3	65748 REA 1
122P	65288 MA 4	65410 MEA 10	65428 MNA 7	65455 TA 2	65251 TEA 10	65278 TNA 1	65493 WA 4	65197 WEA 9	65217 WNA 9	65280 RA 4	65234 WEA 11
122	64835 MA 14	64870 MEA 8	65085 MNA 8	64853 TA 11	65141 TEA 7	64936 TNA 14	64954 WA 12	65164 WEA 6	65009 WNA 4	65135 RA 6	64888 REA 7
182						1				MAKEUPS	
	19 students 2:00-4:40	19 students 4:50-7:30	18 students 7:40-10:20	18 students 2:00-4:40	17 students 4:50-7:30	17 students 7:40-10:20	18 students 2:00-4:40	18 students 4:50-7:30	17 students 7:40-10:20	13 students 2:00-4:40	19 students 4:50-7:30
142	65712 MB 1	65874 MEB 2	65816 MN 1	65838 TB 3	67703 TEB 1	65781 TNB 2	65840 WB 2	65775 WEB 0	65827 WNB 3	65756 RB 4	65767 REB 4
122P	65547 MB 6	65536 MEB 9	65226 MNB 8	65461 TB 6	65202 TEB 1	65487 TNB 10	65505 WB 6	65506 WEB 6	65518 WNB 9	65265 RB 8	65243 REB 5
122	65153 MB 11	64920 MEB 7	65014 MNB 9	65037 TB 9	64918 TEB 16	65947 TNB 3	64963 WB 10	64864 WEB 12	65119 WNB 4	65122 RB 6	65106 REB 9
Week B	18 students	18 students	18 students	18 students	18 students	15 students	18 students	18 students	16 students	18 students	18 students
395											
387						MAKEUPS			MAKEUPS		
Time	2:00-4:40	4:50-7:30	7:40-10:20	2:00-4:40	4:50-7:30	7:40-10:20	2:00-4:40	4:50-7:30	7:40-10:20	2:00-4:40	4:50-7:30
TA1											
TA2											
Total	Mon Aft	Mon Eve	Mon N	Tue Aft	Tue Eve	Tue Night	Wed Aft	Wed Eve	Wed Night	Thu Aft	Thu Eve
Aug 4 2015	DAY	EVE	NIGHT	DAY	EVE	NIGHT	DAY	EVE	NIGHT	DAY	EVE

Sign%in'Sheet'Physics'Laboratories"

Date:'_____/_____/_____" **Course**

Course: PHY 113A/P113B/121/121P/181; 122/122P/142/182; 114/184; **Section CRN**

Section: M ME MN T TE TN W WE WN R RE RN F FE Makeup **SECTION**

TA/TI names: _ **Week: A or B**

	Signature	Last Name	First Name	user Name	Course	Exp. #	Prelab *(time)*	TA/TI *(initial)*	Postlab *(time)*	TA/TI *(initial)*	Partners	Grades Pre-Lab	Grades Post-Lab
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
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23													
24													
25													
26													

INTRODUCTORY PHYSICS			
LABORATORIES SCHEDULE FALL 2015 For TAs			
			Prof A. Bodek
30 July 2015			**Each lab has 11 setups (for 20 students and one spare)**
The Labs for Fall 2015 semester will begin on September 14th			
Week of	**Laboratory**		**Grading/*Notes***
Aug 24-28			*TA Training by University and Dept.-*
			TA Training by University and Dept.-
Aug 24- Sep 10			*Practice Labs (B&L 267 Mechanics and B&L 268 E & M)*
Aug. 30			*Classes Start*
Sept 9 (Wed)			***TA & TI Lab section assignment(s) Meeting w/Prof. Bodek B&L 372, 5-7:30***
Sept 10 (Thursday)			*TA & TI Training Labs 2-4 w/Lab Head TA's, B&L 268 & 267, 9:00 am*
Sept 11 Friday			***Set up 12 setups for Lab 1***
Sep 14	**Labs 1 & 6**	**week A**	**Labs Start**
Sep 21	**Labs 1 & 6**	**week B**	**Sept. 26, Grading Due Lab 1**
Sep 28	**Labs 2 & 7**	**week A**	
Oct 5	No Labs	--	***Fall break Oct 5-6 (Classes resume Oct 7)***
Oct 12	**Labs 2 & 7**	**week B**	**Oct 17 – Grading Due Lab 2**
Oct 19	**Labs 3 & 8**	**week A**	
Oct 26	**Labs 3 & 8**	**week B**	**Oct 31 - Grading Due Lab 3**
Nov 2	**Labs 4 & 9**	**week A**	***Missing Lab Warning to Students/Instructors***
Nov 9	**Labs 4 & 9**	**week B**	**Nov 14 - Grading Due Lab 4**
Nov 16	**Labs 5 & 10**	**week A**	
Nov 23	No Labs		***Thanksgiving (starts 11/25 noon, resumes 11/30)***
Nov 30	**Labs 5 & 10**	**week B**	**Dec 5 – ; Grading Due Lab 5 & Last Missing Lab Warning**
Dec 7			**Dec 11 - Last Day of Class, Makeup Grading Due**
			Finals start Dec 15
Dec 16			***All Lab grades to Instructors Monday, Dec 14th (exams start Dec 15 - end Dec 20)***

See blackboard for more details about PHY122P

See lab web site

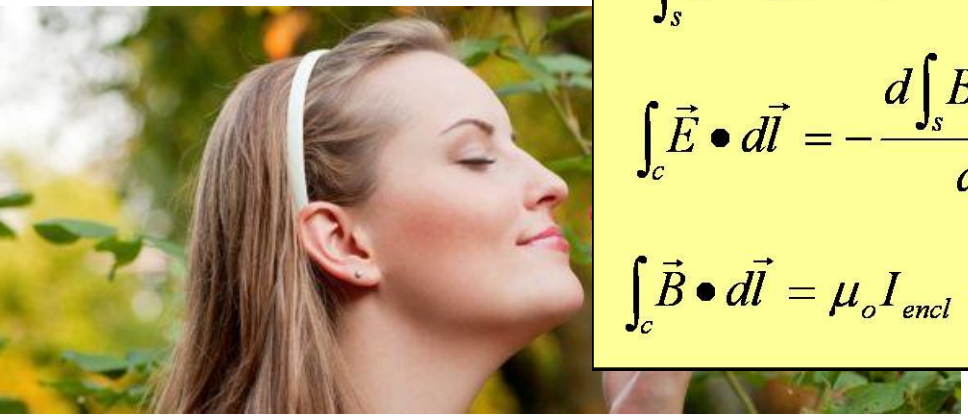
www.pas.rochester.edu/~physlabs/

for details about labs

admire physics

Most importantly … take the time to ~~smell~~ the ~~roses~~.

Electromagnetism is a beautiful subject. Have fun with it!



$$\oint_s \vec{E} \bullet d\vec{a} = \frac{Q_{encl}}{\varepsilon_o}$$

$$\int_s \vec{B} \bullet d\vec{a} = 0$$

$$\int_c \vec{E} \bullet d\vec{l} = -\frac{d\int_s B \bullet d\vec{a}}{dt}$$

$$\int_c \vec{B} \bullet d\vec{l} = \mu_o I_{encl} + \mu_o \varepsilon_o \frac{d\int_s \vec{E} \bullet d\vec{a}}{dt}$$