PHY 114 B – General Physics II

11-11:50 MWF Olin 101

1. **Welcome & overview**
2. **Class structure**
3. **Announcements**
4. **Electrical charges and forces**

Welcome –

Instructor: Natalie Holzwarth

Office: Olin 300

Email: natalie@wfu.edu

Phone: x5510

Office hours – (make an appointment almost any time)

Formulate good questions and seek the answers.

Tentative schedule

Spring 2005 Schedule
for N. A. W. Holzwarth

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8:00-9:00	Lecture preparation	Physics Research	Lecture preparation	Physics Research	Lecture preparation	Physics Research
9:00-10:00	PHY 712		PHY 712		PHY 712	
10:00-11:00	Lecture preparation		Lecture preparation		Lecture preparation	
11:00-12:00	PHY 114	Faculty Mtg	PHY 114	Office hours	PHY 114	
12:00-1:00	Office hours	Office hours	Office hours	Visit with physics colloquium speaker	Office hours	
1:00 -3:30	Physics Research	Physics Research	Physics Research		Physics Research	
3:30-5:00				Physics colloquium		

Class structure --

Course webpage: http://www.wfu.edu/~natalie/s05phy114/

Text: Halliday, Resnick and Walker, Fundamentals of **Physics**, Chapters 22-44.

Tentative grading distribution

4 hour exams	45 %
Final exam	25 %
Problem sets (WebAssign)	15 %
Laboratory work	10 %
Quizzes, participation	5 %

Extra credit opportunities

Overview --

Important concepts from General Physics I

$\mathbf{F} = m\,\mathbf{a}$ (force ⇔ acceleration)

$K_f + U_f = K_i + U_i + W_{(other)}$ (energy relationships)

Important concepts in General Physics II

General Physics I **is still true**

Electricity & Magnetism

Light

"Modern" Physics

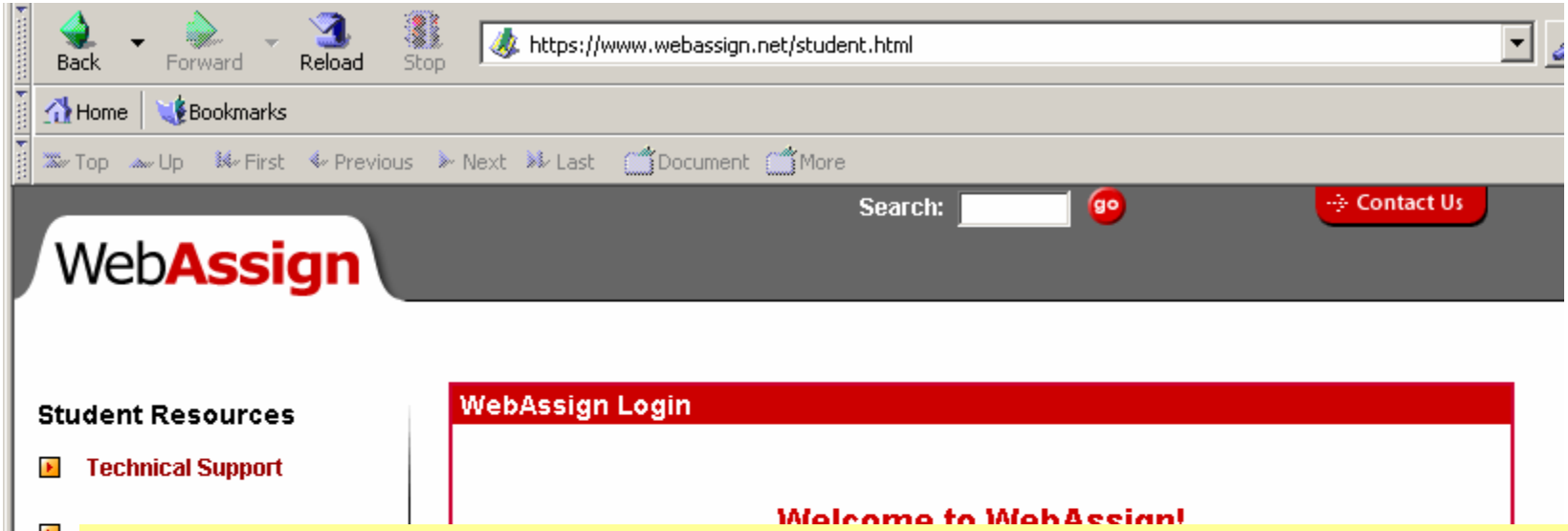
Tentative schedule (subject to change!!)

Start online quiz →

1st HW set @ 11:59 PM →

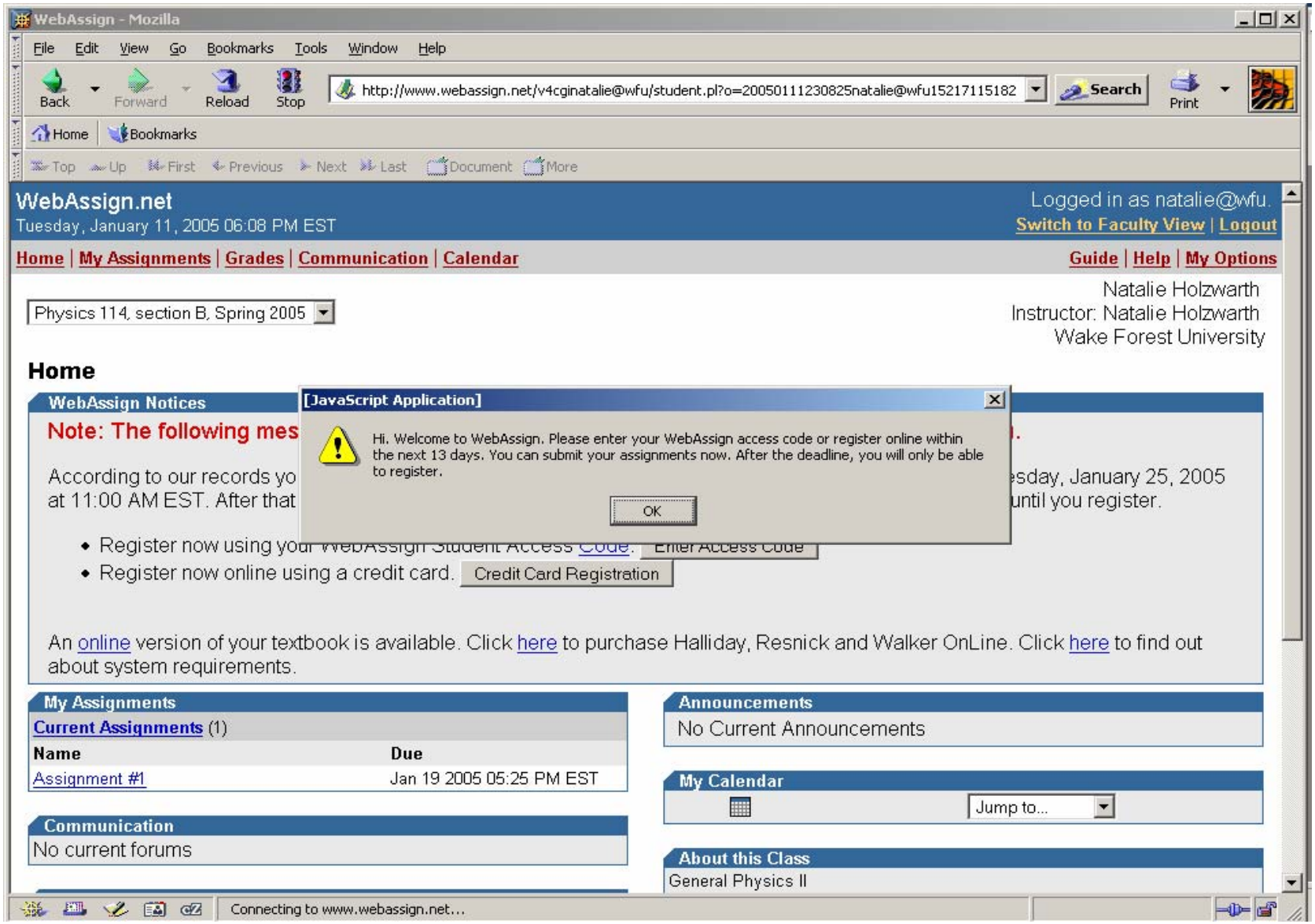
No.	Lecture Date	Topic	Text Sections	Problem Assignments	Assignment Due Date
1	1/12/05	Electrical forces	22.1-22.6	22.2,5,8	1/19/05
2	1/14/05	Electrical field	23.1-23.9	23.4,10,13,15	1/19/05
	1/17/05	(*MLK Holiday*)			
	1/19/05	Gauss's law	24.1-24.9	24.2,9,26,29	1/21/05
4	1/21/05	Electric potential	25.1-25.11		1/24/05
5	1/24/05	Capacitance	26.1-26.8		1/26/05
6	1/26/05	Current	27.1-27.4		1/28/05
7	1/28/05	Resistance	27.5-27.9		1/31/05
9	1/31/05	DC Circuits	28.1-28.8		2/2/05
	2/2/05	Review			
	2/4/05	Exam			
10	2/7/05	Magnetic fields	29.1-29.9		2/9/05

WebAssign homework submissions -- http://www.webassign.net/student.html



- If you are not yet officially registered for the class, make sure that I have your data for setting up your WebAssign account.
- Although the first assignment is not officially due until Jan. 19th, try out your account ASAP.
- Let me know about any problems you experience.
- Register with WebAssign ($9.95 with credit card).

Webassign details



Sample WebAssign session:

Remember:

•Problems are due at 11:59 PM on the lecture day following their assignment.

•Extensions are available (within reason).

•Maximum number of submissions set to 20.

•Keep a notebook with your solution steps. These will be very helpful in preparing for exams.

Labs begin Tuesday 1/18/05

- If you need to register for lab or change sections, see Machele Cable, Rm. 110 (x 5532, cablem@wfu.edu)
- Purchase lab book from the bookstore.
- You must pass the lab in order to receive a passing grade in this course.

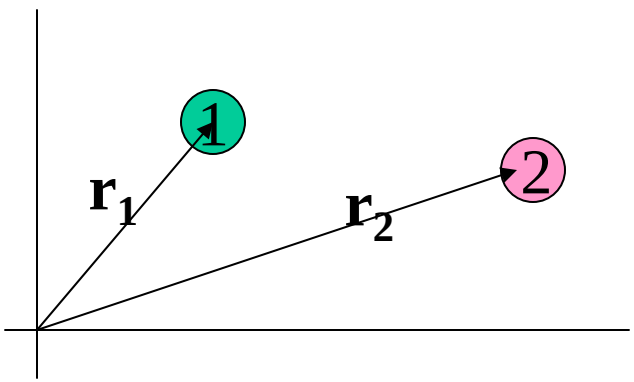
Tutorial sessions

- Weekly session by NAWH (suggestions of time)
- Daily tutorials by graduate students or undergraduate physics majors

Charging ahead....

- Most matter is made up of charged particles
  - labeled + (proton: $q_p = 1.60217733 \times 10^{-19}$ C)
  - – (electron: $q_e = -1.60217733 \times 10^{-19}$ C)
- Coulomb's law describes the electrical force between two charged particles:

$$\mathbf{F} = k_e \frac{q_1 q_2}{|\mathbf{r}_1 - \mathbf{r}_2|^2} \hat{\mathbf{r}}_{12}$$



Coulomb's law:

$$\mathbf{F} = k_e \frac{q_1 q_2}{|\mathbf{r}_1 - \mathbf{r}_2|^2} \hat{\mathbf{r}}_{12} \equiv \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{|\mathbf{r}_1 - \mathbf{r}_2|^2} \hat{\mathbf{r}}_{12}$$

$8.987551787 \times 10^9\ \mathrm{N \cdot m^2/C^2}$

(recall $G = 6.67259 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$

Peer instruction question

Suppose two identical charged particles are separated by 1m and the force experienced by one of the charges due to the Coulomb force of the other charge is measured to be 1 Newton. What is the approximate magnitude of the charge on each particle?

(A) 10 C (B) 1 C (C) 1×10^{-3} C (D) 1×10^{-5} C

At the subatomic level, charges are discrete (and also discreet)

$|e| = 1.60217733 \times 10^{-19}$ C

$N_A |e| = 9.6485 \times 10^{4}$ C

However, since electrical forces are so very strong, most materials have an equal number of positive and negative charges.

Peer instruction question from Eric Carlson:

My body contains about 3×10^{28} electrons, all repelling each other. How come I don't explode?

A. Electrons actually attract each other.
B. The gravitational forces in my body compensate the electric forces.
C. My body also has positive charges which can compensate for the electrical forces between the electrons.
D. Exploding in class violates the Wake Forest ethics code.

Problem solving steps

1. Visualize problem – labeling variables
2. Determine which basic physical principle(s) apply
3. Write down the appropriate equations using the variables defined in step 1.
4. Check whether you have the correct amount of information to solve the problem (same number of knowns and unknowns).
5. Solve the equations.
6. Check whether your answer makes sense (units, order of magnitude, etc.).

Sample problem from HW assignment #1 --

1. [HRW6 22.P.002.] A point charge of +2.60 × 10^{-6} C is 12.0 cm distant from a second point charge of -2.00 × 10^{-6} C. Calculate the magnitude of the force on each charge.

N

$+2.60\text{x}10^{-6}$ $-2.00\text{x}10^{-6}$

$$\mathbf{F}_{12} = k_e \frac{q_1 q_2}{|\mathbf{r}_1 - \mathbf{r}_2|^2} \hat{\mathbf{r}}_{12} = -\mathbf{F}_{21}$$

$$|\mathbf{F}_{12}| = 8.99 \times 10^9 \frac{Nm^2}{C^2} \frac{(2.6 \times 10^{-6} C)(-2.0 \times 10^{-6} C)}{(0.12m)^2} = 3.25N$$

Direction?

Directional nature of Coulomb's law:

2. [HRW6 22.P.005.] In Fig. 22-23, what are the horizontal and vertical components of the resultant electrostatic force on the charge in the lower left corner of the square if q = 1.3 × 10^{-7} C and a = 6.6 cm? (Assume the positive directions are upward and to the right.)

_____ N (horizontal component)

_____ N (vertical component)

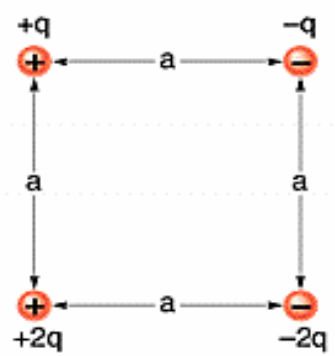
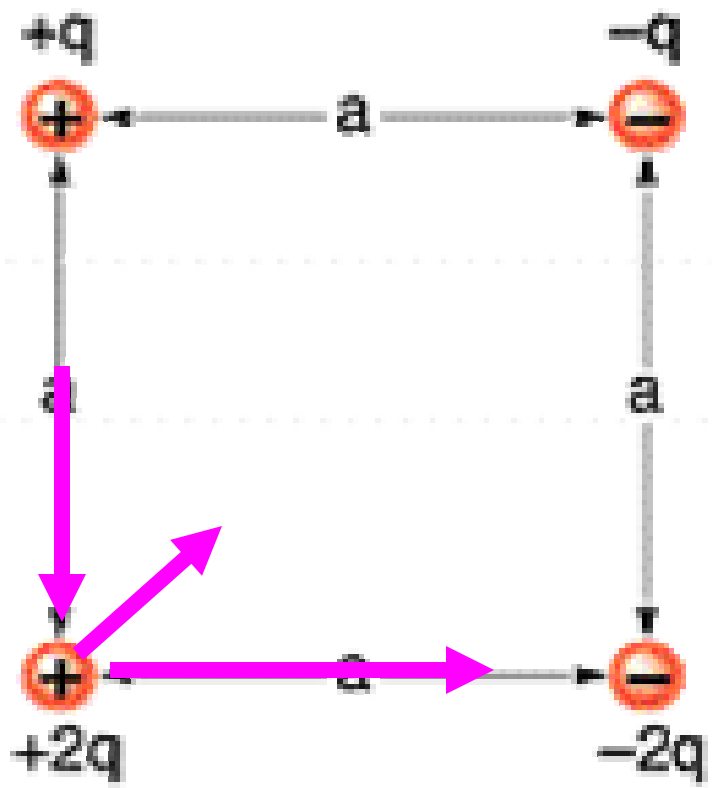


Figure 22-23.



Net force is **vector** sum.