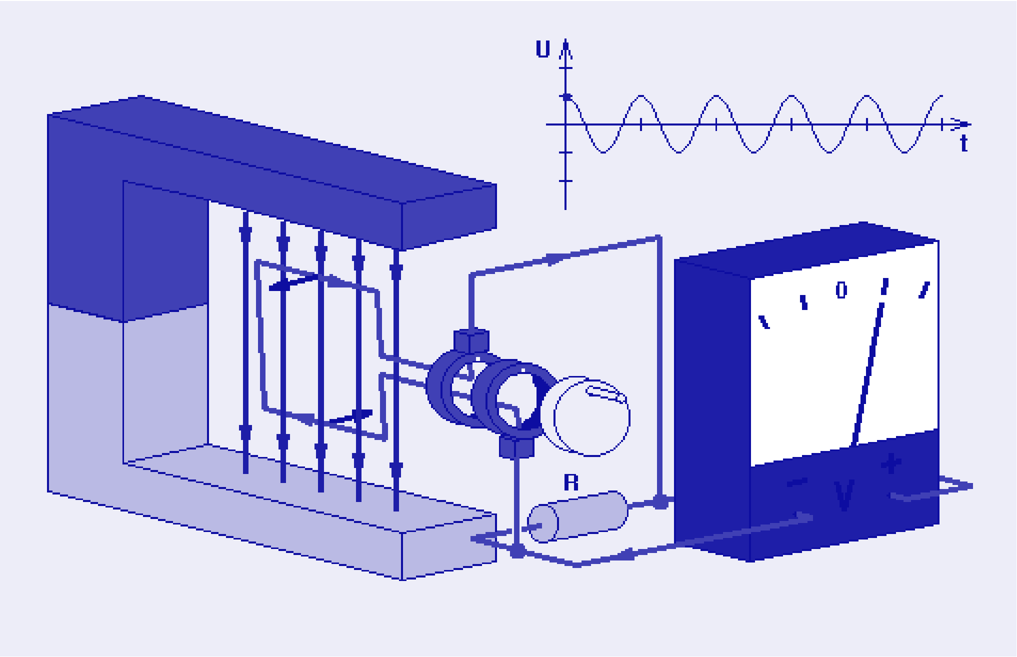
Welcome to Physics 212



http://courses.physics.illinois.edu/phys212/sp2013/

This lecture is VERY full. Please sit next to someone nice. (There won't be many empty seats!).

Physics 212 - Logistics

http://courses.physics.uiuc.edu/courses/phys212

Everything can be found online – GO THERE

- You have web based pre-lectures and pre-flights due before every lecture.
- You have web based homework due every week.
- Be sure to complete Prelecture 2 and Checkpoint 2 before 8 am on Thursday.
- Bring pen & notebook to lecture – you will be working on problems
- Register your clicker ASAP so you can see your participation grade.

Labs & Discussions (check Syllabus)

- Discussion Sections meet this week.
- Labs start January 22nd, must have pre-lab done before!
- Check Excused absence policy on web site, no switching/makeups

How Your Grade will be Calculated

We drop lowest three

- Prelectures: 50
- Preflights: 25
- Lecture participation: 25

Prelectures + Preflights + Lectures	100
14 Homework + 10 Quizzes	250
Labs	150
Hour exams (3 x 100 each)	300
Final Exam	200

Your top 22 HW/Quiz scores determine your grade out of 250.

Bonus Points: You can earn up to 1 extra bonus point in every lecture (for a maximum of 25 bonus points for the semester) by getting the right answers to all of the clicker questions.

At the end of the semester your lecture bonus points are added to your HW/Quiz score (250 max).

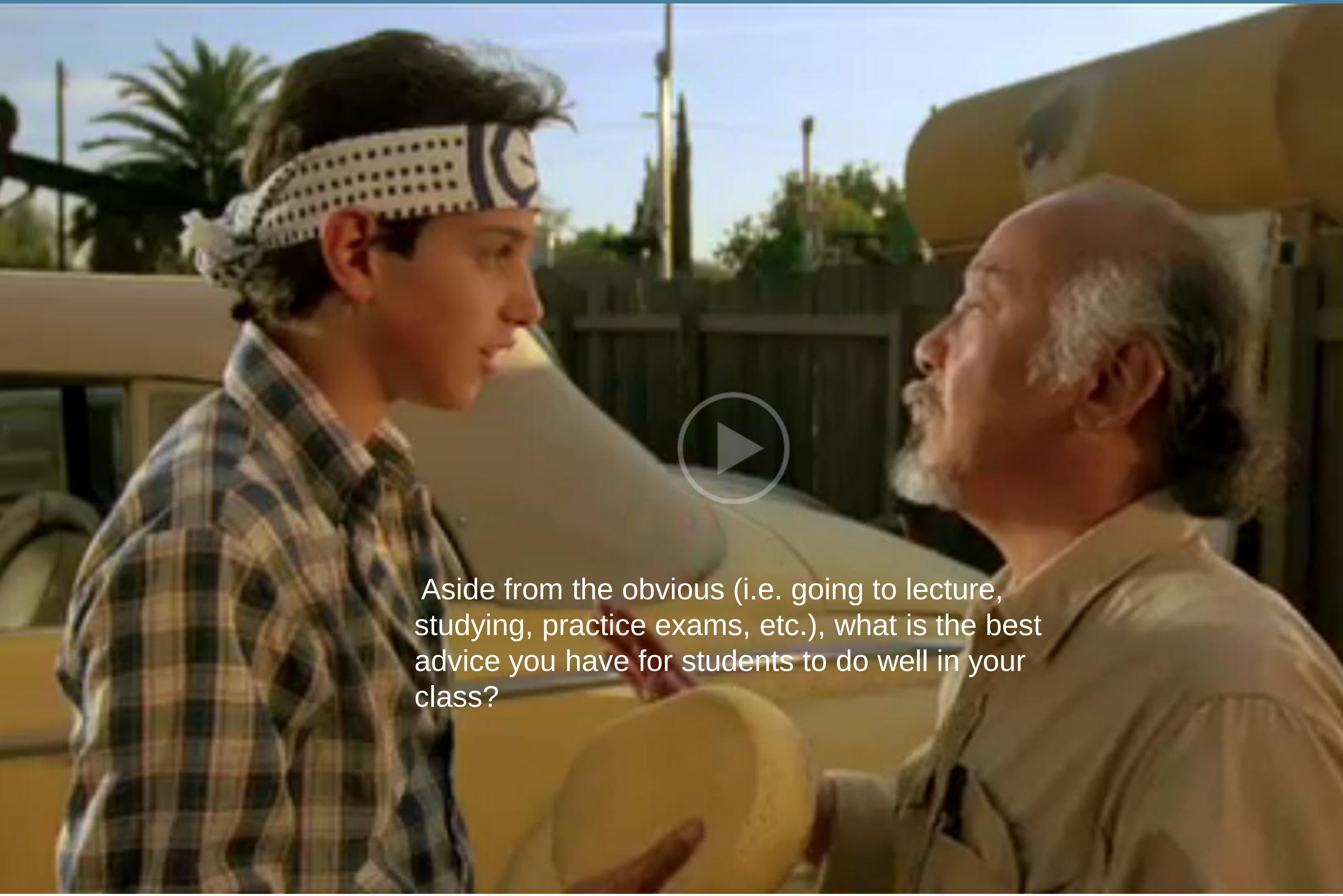
You can make up for several bad quizzes by answering correctly in class.

Rumors about Physics 212

Physics 212 is a **LOT** harder than Physics 211

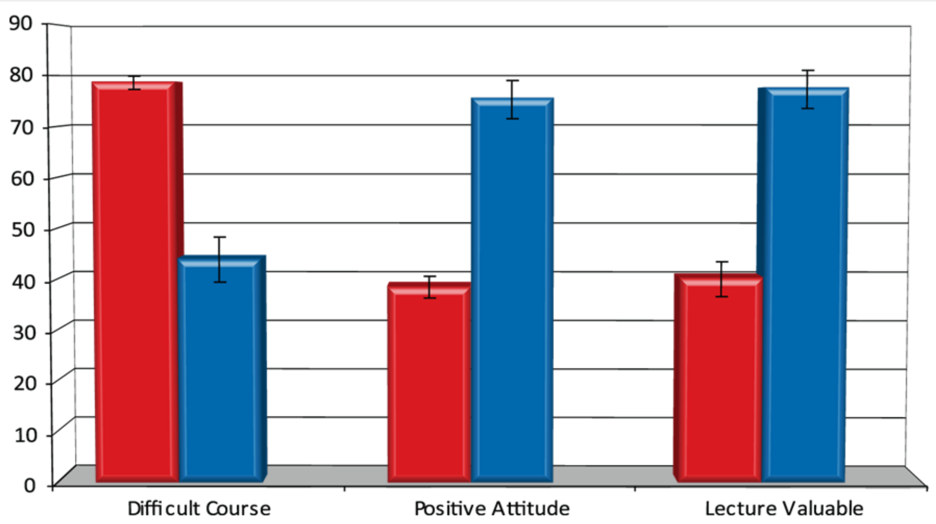
Have you heard the rumors about 212?

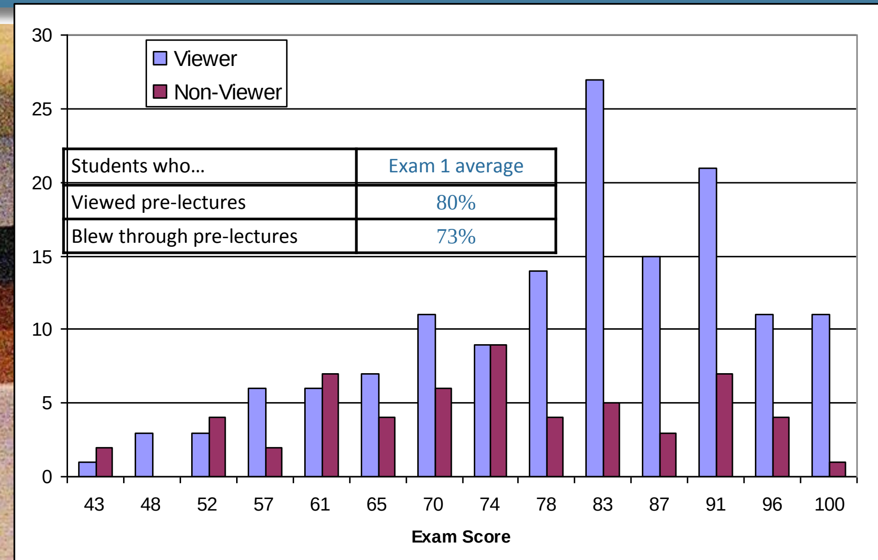
A) Yes
B) No
C) I forgot my iclicker



Aside from the obvious (i.e. going to lecture, studying, practice exams, etc.), what is the best advice you have for students to do well in your class?

Lecture Prep+Participation: Just Do It





Students who...	Exam 1 average
Viewed pre-lectures	80%
Blew through pre-lectures	73%

Homework

smartPhysics

Physics 212 Electricity and Magnetism
University of Illinois

Administrator Links

Instructor | Student Stelzer, Timothy

Unit 1: PreLecture / Checkpoint / Homework /

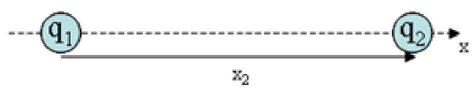
Homework: Coulomb's Law

Deadline: 100% until Tuesday, September 4 at 8:00 AM

Point Charges in One Dimension

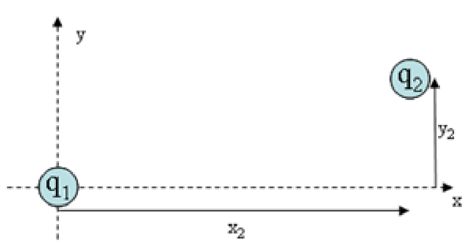
✓ ✓ ✓ ✓ ✓

A point charge q_1 = -3.9 μC is located at the origin of a co-ordinate system. Another point charge q_2 = 5.7 μC is located along the x-axis at a distance x_2 = 7.7 cm from q_1.



1) What is $F_{12,x}$, the value of the x-component of the force that q_1 exerts on q_2?

1e-12*k*q1*q2 / (0.077)^2 N Submit



2) Charge q_2 is now displaced a distance y_2 = 3.6 cm in the positive y-direction. What is the new value for the x-component of the force that q_1 exerts on q_2?

1e-12*k*q1*q2*0.906 / (0.07 N Submit

Problems

Worked Example
Coulomb's Law
-- Optional --

Standard Exercise
Point Charges in One Dimension

Standard Exercise
Point Charges in Two Dimensions

Interactive Example
Three Charges

Worked Example
Electric Fields
-- Optional --

Interactive Example
Zero

Standard Exercise
Electric Field from Point Charges

Standard Exercise
Electric Field from Arc of Charge

Homework: Delayed Feedback

Purpose:
Promote
REFLECTION

Problem: No office hours before HW1 is due!

Solution: 100% credit will be given up to second deadline for HW1 (Jan 29th)

4) How would you change q_1 (keeping q_2 and q_3 fixed) in order to make the net force on q_2 equal to zero?

- ○ Increase its magnitude and change its sign
- ○ Decrease its magnitude and change its sign
- ● Increase its magnitude and keep its sign the same
- ○ Decrease its magnitude and keep its sign the same
- ○ There is no change you can make to q_1 that will result in the fet force on q_2 being equal to zero.

Submit

5) How would you change q_3 (keeping q_1 and q_2 fixed) in order to make the net force on q_2 equal to zero?

- ○ Increase its magnitude and change its sign
- ○ Decrease its magnitude and change its sign
- ○ Increase its magnitude and keep its sign the same
- ● Decrease its magnitude and keep its sign the same
- ○ There is no change you can make to q_3 that will result in the fet force on q_2 being equal to zero.

Submit

These questions serve as a test of your understanding of the questions posed as immediate feedback.

After first deadline
Delayed feedback questions turn into immediate feedback questions. 80% credit can be obtained by answering these questions correctly before the second deadline.

Homework: Tipler Problems (optional)

Unit 1: PreLecture / / Checkpoint / Homework /

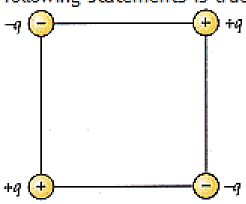
Homework: Coulomb's Law

Deadline: 100% until Tuesday, January 22 at 8:00 AM

Tipler6 21.P.012.

1

1) Four charges are fixed in place at the corners of a square as shown below. No other charges are nearby. Which of the following statements is true?



- $\vec{E}$ is zero at the center of the square
- $\vec{E}$ is zero at the midpoints of all four sides of the square
- $\vec{E}$ is zero midway between the top two charges and midway between the bottom two charges

Submit

Problems

Print Assignment View

Worked Example
Coulomb's Law
-- Optional --

Standard Exercise
Point Charges in One Dimension

Standard Exercise
Point Charges in Two Dimensions

Interactive Example
Three Charges

Worked Example
Electric Fields
-- Optional --

Interactive Example
Zero

Standard Exercise
Electric Field from Point Charges

Standard Exercise
Electric Field from Arc of Charge

Standard Exercise
Tipler6 21.P.012.
-- Optional --

Standard Exercise
Tipler6 21.P.030.
-- Optional --

Standard Exercise
Tipler6 21.P.032.
-- Optional --

Standard Exercise
Tipler6 21.P.031.

Tipler problems are ONLY if you want more practice.

Worked Examples are optional but recommended!

Electricity & Magnetism
Lecture 1

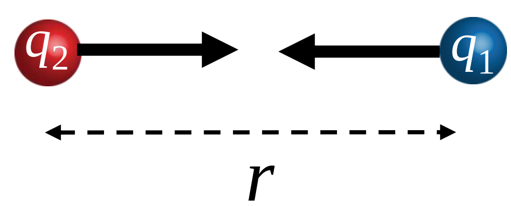
Today's Concepts:

A) Coulomb's Law

B) Superposition

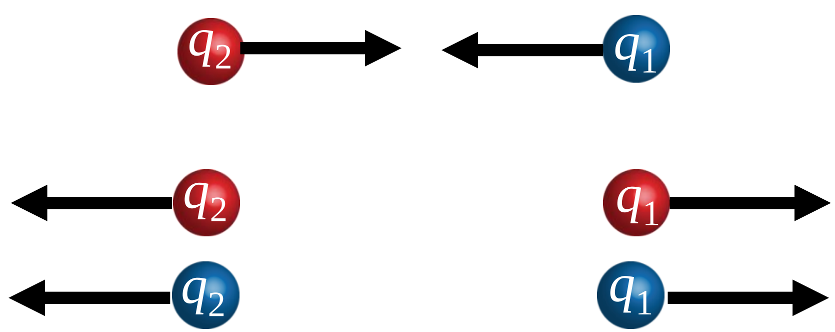
Coulomb's Law:

The force on a charge due to another charge is proportional to the product of the charges and inversely proportional to the separation squared.



$$F \propto \frac{q_1 q_2}{r^2}$$

The force is always parallel to a line connecting the charges, but the direction depends on the signs of the charges:

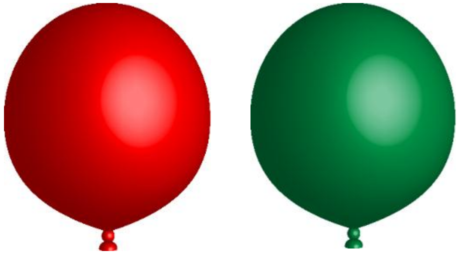


Opposite signs attract

Like signs repel

Balloons

Take two balloons and rub them both with a piece of cloth.
After you rub them they will:

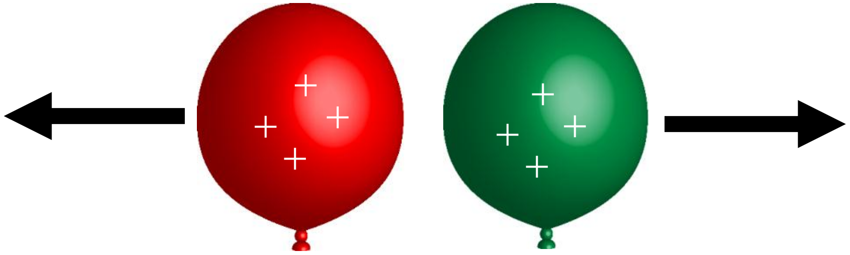


A) Attract each-other
B) Repel each-other
C) Either – it depends on the material of the cloth

Balloons

If the same thing is done to both balloons they will acquire the same sign charge.

They will repel!



Coulomb's Law

Are we supposed to fully understand fields at this point, or was that just an intro? Also, can you explain the "r" with the ^ on top of it in the numerator or the F=kq1q2/r^2 equation? Is that for notation of direction?

$$\vec{F}_{1,2} = \frac{kq_1q_2}{r_{1,2}^2}\hat{r}_{1,2}$$

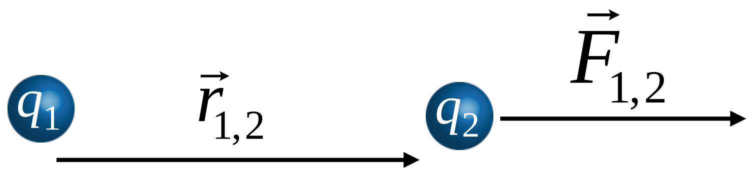
Our notation:

$\vec{F}_{1,2}$ is the force by 1 *on* 2 (think "*by-on* ")

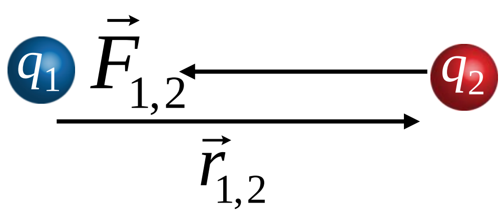
$\hat{r}_{12}$ is the unit vector that points *from* 1 *to* 2.

Examples:

If the charges have the same sign, the force **by** charge 1 on charge 2 would be in the direction of r_{12} (to the right).



If the charges have opposite sign, the force **by** charge 1 on charge 2 would be opposite the direction of r_{12} (left).



Example: Coulomb Force

Two paperclips are separated by 10 meters. Then you remove 1 electron from each atom on the first paperclip and place it on the second one.

$$\vec{F} = k\frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$$

k = 9 x 10^9 N m^2 / C^2

electron charge = 1.6 x 10^{-19} Coulombs

N_A = 6.02 x 10^{23}

What will the direction of the force be?

A) Attractive

B) Repulsive

Example: Coulomb Force

Two paperclips are separated by 3 meters. Then you remove 1 electron from each atom on the first paperclip and place it on the second one.

$$\vec{F} = k\frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$$

k = 9 x 10^9 N m^2 / C^2

electron charge = 1.6 x 10^{-19} Coulombs

N_A = 6.02 x 10^{23}

Which weight is closest to the approximate force between those paperclips (recall that weight = mg, g = 9.8 m/s^2)?

Balloon demo

A) Paperclip (1 g x g)

B) Text book (1 kg x g)

C) Truck (10^4 kg x g)

D) Aircraft carrier (10^8 kg x g)

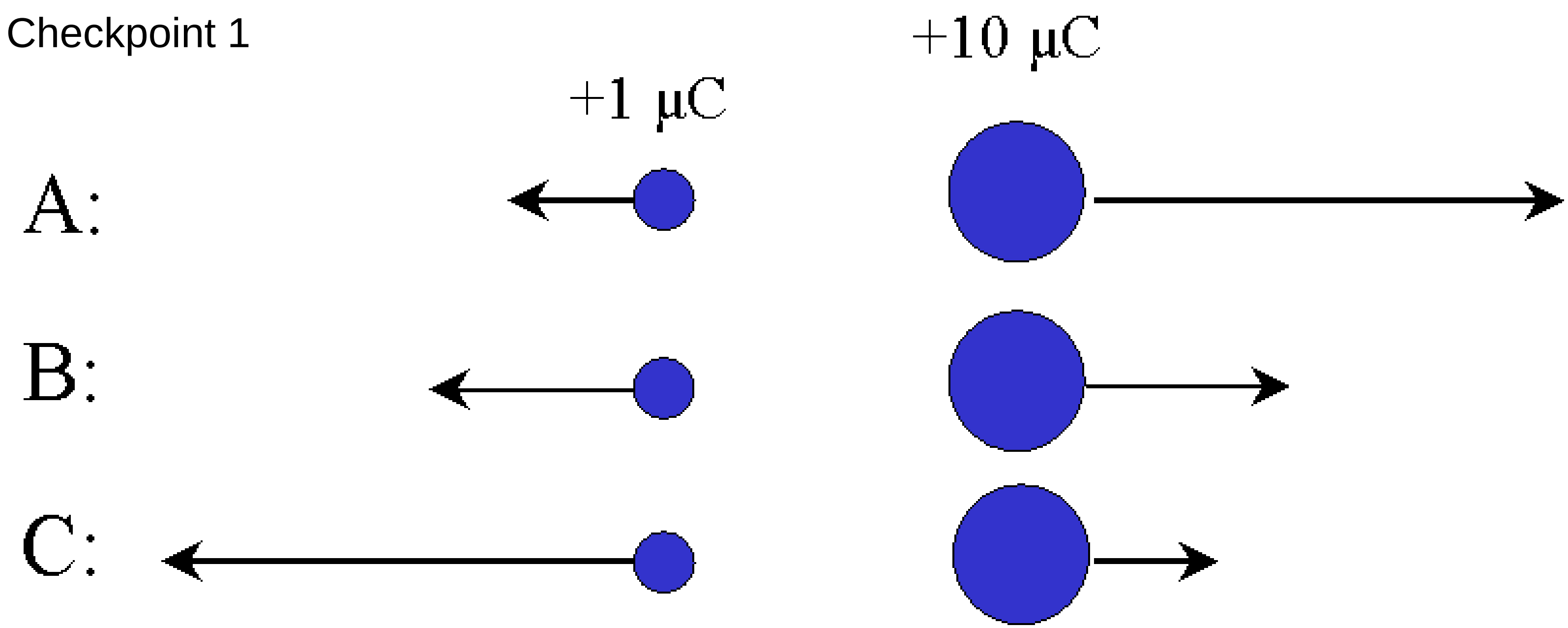
E) Mt. Everest (10^{14} kg x g)

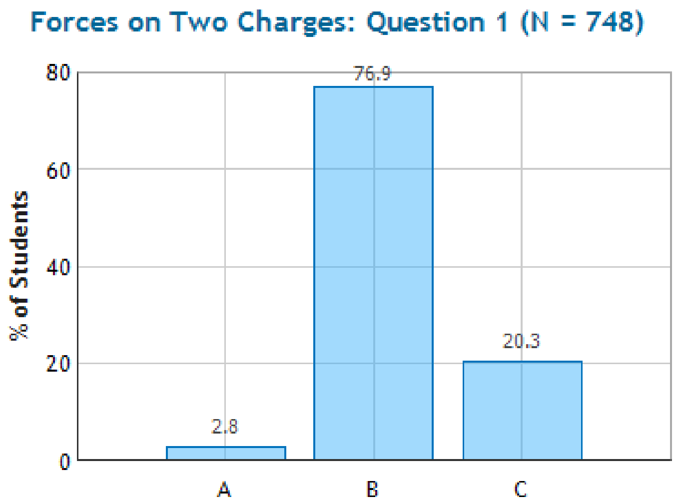
$$q = \frac{1\,mol}{56\,g}\cdot\frac{N_A}{mol}\cdot 1\,g \times 1.6\times10^{-19}\,C \approx \frac{10^{-19}\,10^{24}}{10^2} = 10^3$$

$$F = \frac{9\times10^9(10^3)^2}{3^2} \approx \frac{10^{10}\,10^6}{10} = 10^{15} = mg \approx m\,10$$

$$m = 10^{14}$$

1) Two charges $q = +1\ \mu C$ and $Q = +10\ \mu C$ are placed near each other as shown in the figure. Which of the following diagrams depicts the forces acting on the charges:





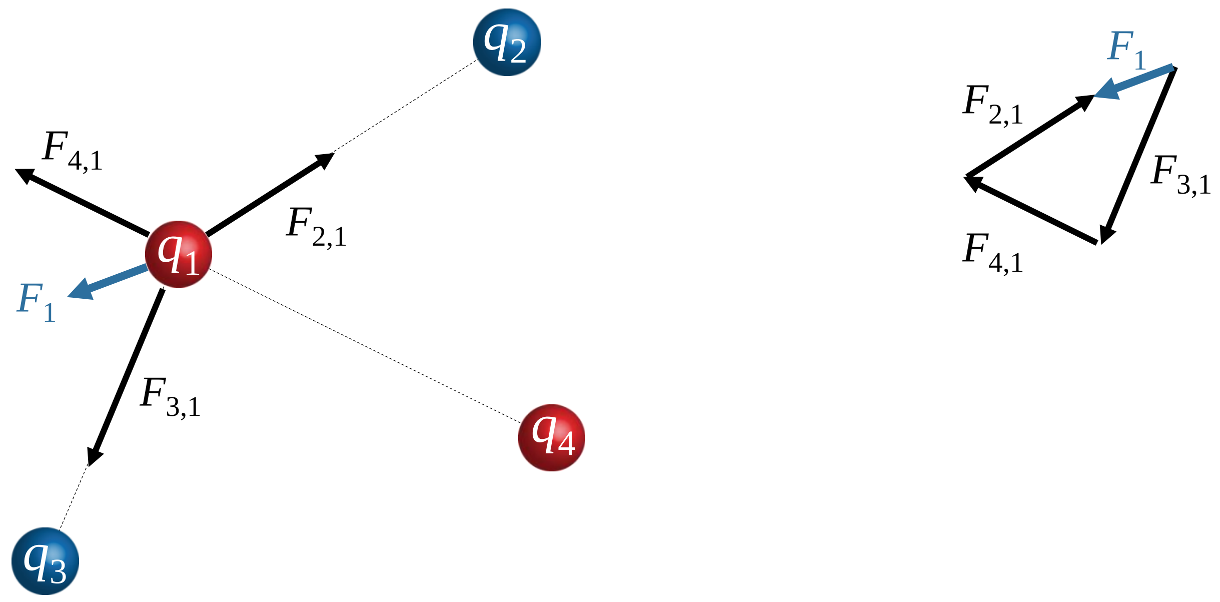
‘The force acting on charge Q = +10μC is much longer since the magnitude of Q = +10μC is ten times compared to q = +1μC.

‘The forces acting on the two charges must be equal in magnitude and opposite in direction, as per Newton's Laws.

‘the smaller particle moves faster than the larger particle

Superposition:

If there are more than two charges present, the total force on any given charge is just the vector sum of the forces due to each of the other charges:



$$\vec{F}_1 = \vec{F}_{2,1} + \vec{F}_{3,1} + \vec{F}_{4,1} + \ldots$$

Superposition Clicker Question

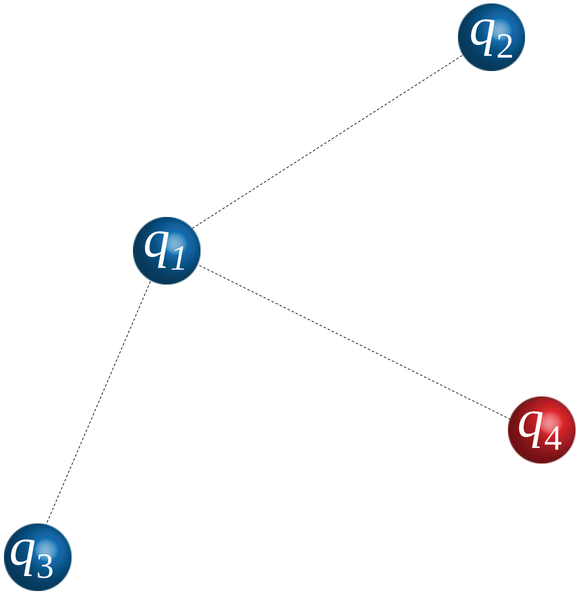
What happens to Force on q_1 if its sign is changed?

A) $|F_1|$ increases

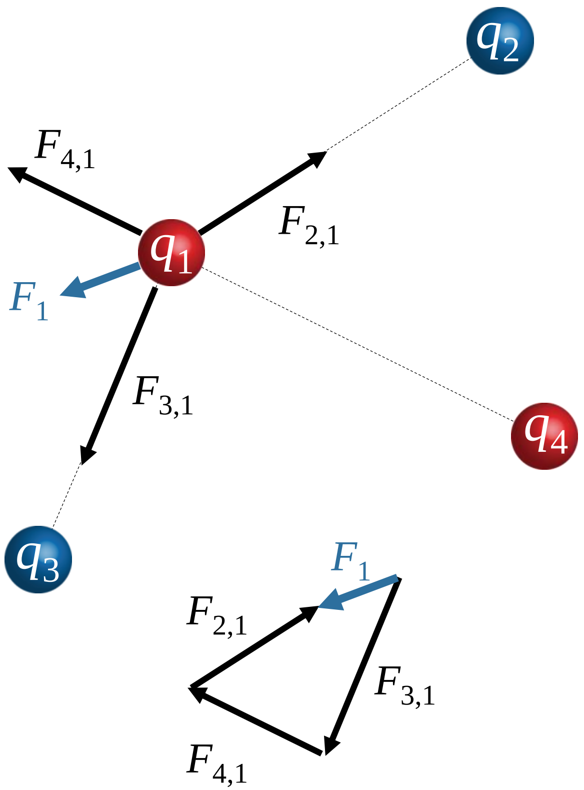
B) $|F_1|$ remains the same

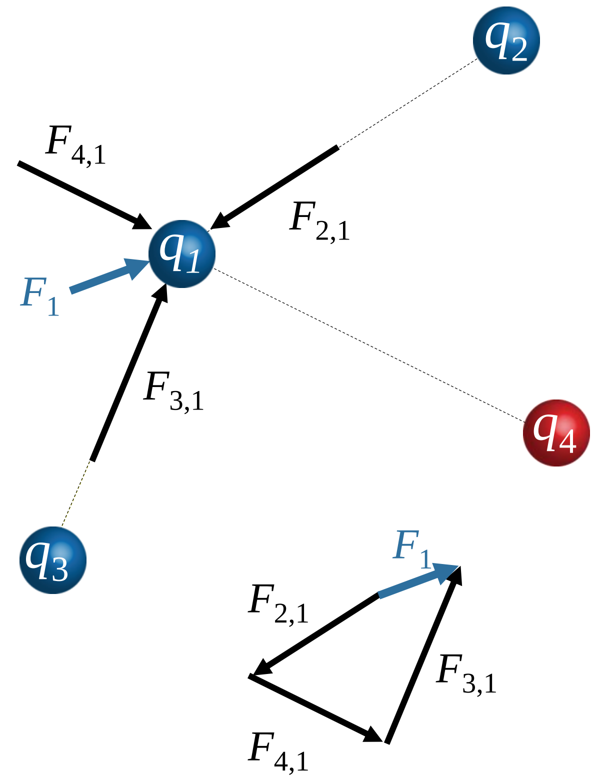
C) $|F_1|$ decreases

D) Need more information to determine



The direction of all forces changes by 180° – the magnitudes stay the same:





$$\vec{F}_1 = \vec{F}_{2,1} + \vec{F}_{3,1} + \vec{F}_{4,1} + \ldots$$

$$-\vec{F}_1 = -\vec{F}_{2,1} - \vec{F}_{3,1} - \vec{F}_{4,1} - \ldots$$

CheckPoint

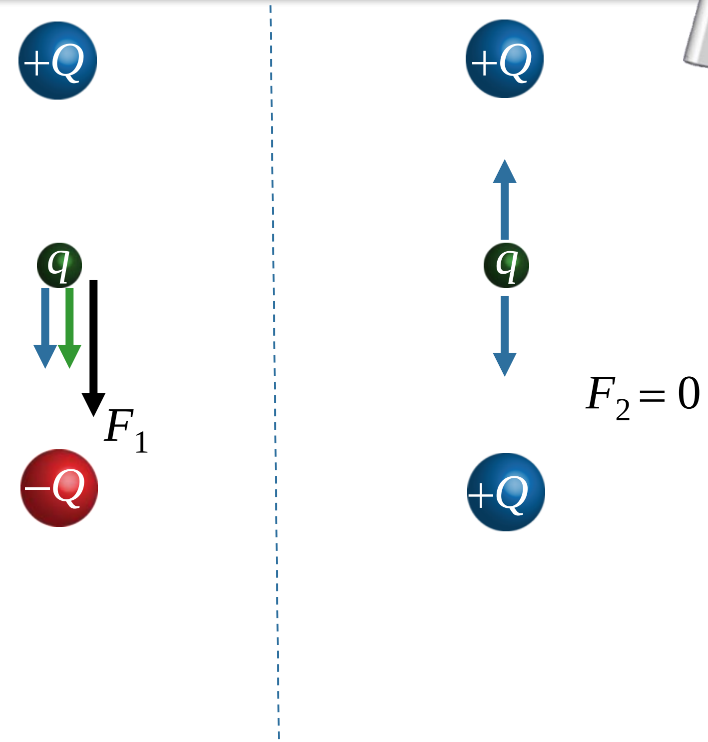
Compare the magnitude of the net force on q in the two cases.

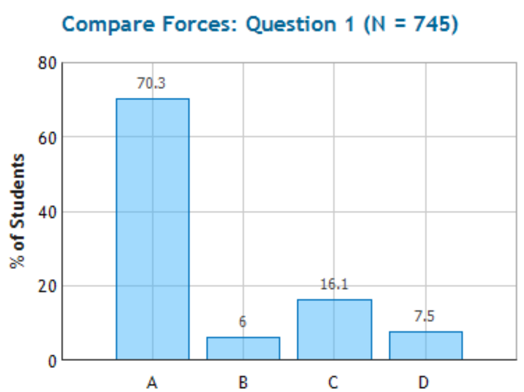
A) $|F_1| > |F_2|$

B) $|F_1| < |F_2|$

C) |F1 | = |F2|

D) Depends on sign of q





The forces in Case 2 will cancel out no matter what the charge of q is.

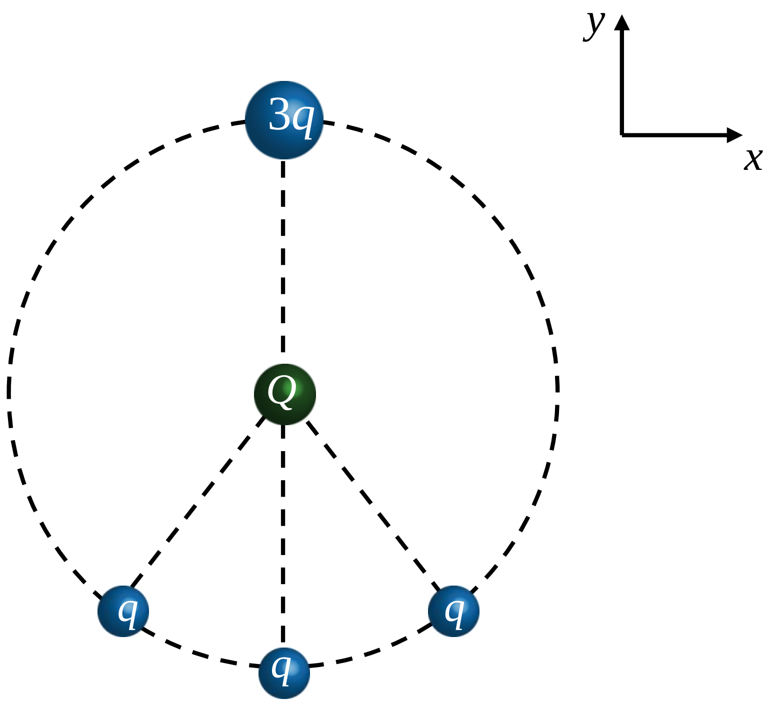
The forces in case 2 would add together while the forces in case one would negate each other. .

Only the direction of the net force would be changed. The magnitude of the net force will remain the same in both cases.

The net force changes depending on sign.

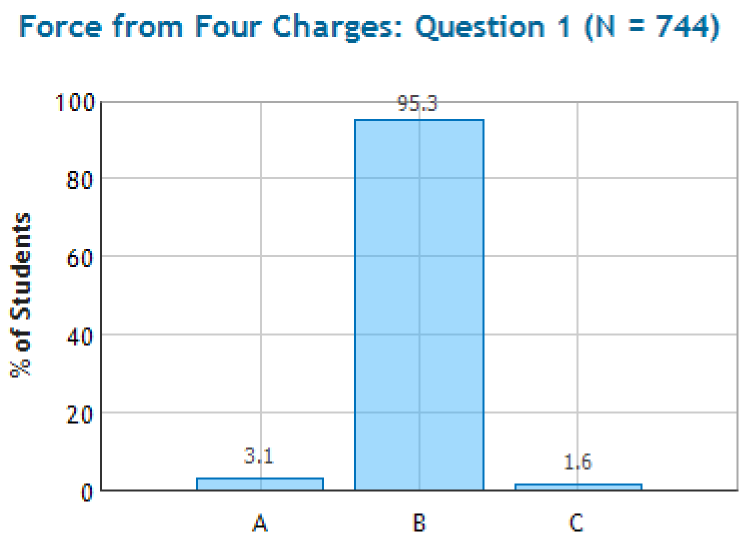
CheckPoint

Four positively charged particles are placed on a circular ring with radius 3 m as shown below. A particle with charge Q is placed in the center of the ring.



What is the direction of horizontal force on Q?

A) $F_x > 0$ B) $F_x = 0$ C) $F_x < 0$

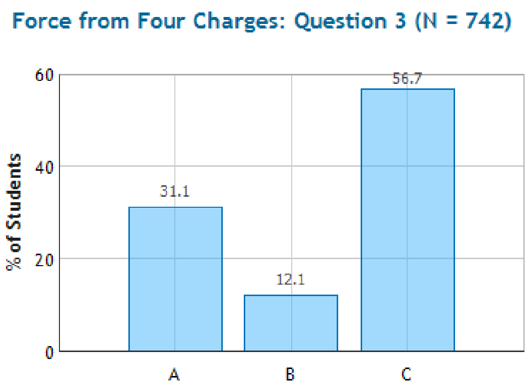


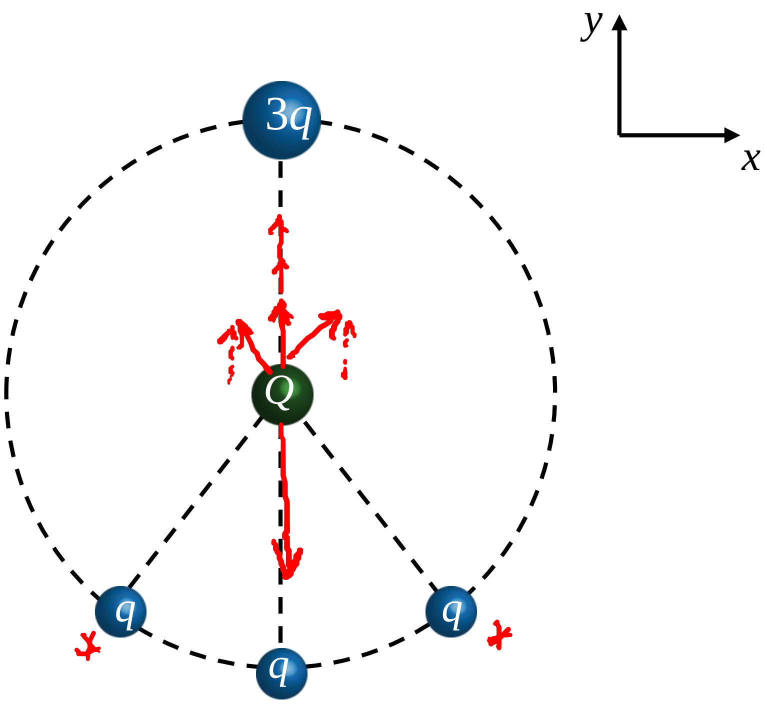
CheckPoint

Four positively charged particles are placed on a circular ring with radius 3 m as shown below. A particle with charge Q is placed in the center of the ring.

What is vertical force on Q?

A) $F_y > 0$ B) $F_y = 0$ C) $F_y < 0$





Two of the smaller q charges are placed placed closer to Q than 3q and will have a larger force on Q.

They balance each other since the bottom three charges are symmetric and they balance the 3q charge on the other side

The y-componants of the leftmost and rightmost charges are shorter than the charges along the y-axis, so the forces directed in the y-direction aren't enough to cancel the force due to the 3q charge.

See you Thursday!

Discussion Sections meet this week!

Be sure to complete prelecture 2 and preflight 2.

Labs begin January 22nd.

No office hours MLK weekend