Physics 222

2017 Fall Semester

Sections 1 – 5

Please find a seat.

Keep all walkways free for safety reasons and to comply with the fire code.

Electronic Devices

Please separate your professional from your social life.

Do not use social media during class.

Physics 222

Class entry point: Canvas (online.utk.edu)
Website: http://labman.phys.utk.edu/phys222/

This course is taught in a hybrid format.
Students will only meet once per week for one hour and 15 minutes in a large lecture hall, and once per week, by section, for 2 hours and 30 minutes in a studio physics classroom.

The traditional second meeting in the large lecture hall is replaced by online activities that students schedule themselves.

Class structure

- Study the online class material and consult the textbook for additional information before Thursday. The online material substitutes for one lecture. You have to read it yourself and explore the links. Read the corresponding chapters in the textbook.
- Come to class on Thursday in room 415, Nielsen.
- Complete a pre-lab assignment before 11:59 pm on Monday.
- Go to your studio session on Tuesday or Wednesday in room 207, Nielsen.
- Complete homework assignment before 11:59 pm on Wednesday.
- Repeat.

Online Class Material

- You must study the online notes.
- The online notes include links to other web materials, such as videos, animations, and simulations. I suggest that you review this material.
- The textbook expands on the material covered in the notes and offers more worked problems and practice problems.
- Completing OpenStax Tutor questions in the online textbook can earn you extra credit points.
- The tests will only cover topics that are addressed in the notes, the class meetings, the studio sessions, and the assignments.

Textbook

"College Physics“ is a free, online textbook by OpenStax College. The link to the HTML version is on Canvas and in the syllabus. A PDF copy can be downloaded.

You get 2 points extra credit if, before a class meeting, you read through the subsections linked on the schedule and complete at least 80% of the questions and answer at least 50% of these OpenSta Tutor questions correctly. If by the end of the class you have 18 or more Concept Coach extra credit points, I will add one extra point.

Class meetings

- We will review what you have learned from studying the notes and the textbook.
- You will solve problems similar to the homework problems by yourself or in consultations with your neighbors. You will check by answering clicker questions.
- You can earn in-class extra credit by answering 50% (1 point) or 80% (2 points) of the clicker questions correctly.
- Attendance is required. Attending class and answering clicker questions gives you class participation credit. You must answer at least 2 clicker questions correctly.

Studio sessions

The Studio are not just labs, and students are required to participate in all activities and stay until the session is dismissed.

Studio sessions have two components.

- This is a class with a laboratory, so you will test some of the physics principles experimentally, and you will work with simulations to develop a better conceptual understanding. A write-up for this portion of the studio sessions is provided online.

- The studio sessions will also have a problem solving and question and answer component. Your session instructors will help you to develop math skills and problem solving skills to solve physics problems.

Attendance is required. Session instructors will inform you about grading details (log, quizzes, participation).

no work <--> no credit

You cannot hide in your group.

Assignments

- Assignments are on Canvas.
- Each week you must submit a pre-lab and a homework assignment on time.
- You can submit 3 times, the highest score counts. If you submit an incorrect answer to a problem, you may get a hint.
- Make sure you know how to solve the problems on the assignments. At least for your first submission, work alone. If you do not understand why an answer is wrong, you may then consult with other students and tutors.

Please: Permit yourself to think!
Ask yourself "What does it mean?" and "How do I know?".

Do not try to "remember" physics, try to understand the concepts.

Tests

Test 1 and Test 2 are scheduled for the first hour of studio sessions 6 and 10, respectively. Test 3 is scheduled for different sections at different times during the exam period.

Practice tests for each test will be available on Canvas.

Students must use the Lockdown Browser on a Physics Department computer.

- Each student will get an individual test, drawn from a large pool of questions. No two students will have exactly the same test.
- The pool has brand-new questions, questions from the assignments, the practice test, and from in class. Students who do work the assignments and practice test and actually participate in class will have a huge advantage.

Grades

Test 1 and 2:	75 points each
Final exam:	100 points
Studio sessions:	125 points
Assignments:	75 points
Class participation:	50 points

Extra credit points are added to your total score.

You have many different opportunities to show that you are making progress in mastering the material.

- Studying the online material and completing the homework assignments are essential components. You are encouraged to study with others, but if you do not understand your answers, you will probably pay for it with low test scores.
- Session instructors have rules for determining your lab grade.
- Class participation and in-class extra credit encourage you to actively participate in reviews of the material.

Academic Honesty

The honor statement that every UTK student has signed prohibits academic dishonesty. Penalties range from a warning to permanent dismissal.

NO!

Summary

There are no formal lectures. If you do not work through the class material before coming to class, you will waste your time in class.

Do not think that you can remember every detail. You must acquire a conceptual understanding of the material, and the class meeting will help you with this. Then, what looks like a large amount of material will condense into a manageable amount of simple principles and their applications.

Ask questions! Think for yourself, ask the instructors, the tutors, your fellow students!

Take advantage of extra credit opportunities.

Questions?

You may feel that we do not teach you very much in class and that you have to spend a lot of time engaging with the material by yourself. That is how Physics works. You have to take ownership of your learning.

Physics 222, August 24

Key Concepts:

- Electric charge
- Separating charges

What do you know already about atoms, elementary particles, and charges? Select multiple answers!

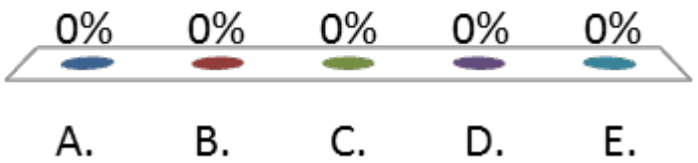
A. Protons and neutrons and electrons are all charged particles making up atoms.

B. Protons and electrons have charges q_e and $-q_e$, respectively, where q_e is the smallest quantum of charge.

C. Electrically neutral materials contain the same number of protons and electrons.

D. Neutral objects become positively charged by acquiring additional protons from other objects.

E. Neutral objects become negatively charged by acquiring additional electrons from other objects.



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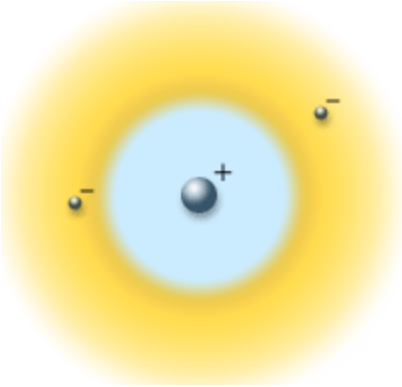
Electromagnetic phenomena

The “elementary particle” constituents of ordinary matter are **protons**, **neutrons**, and **electrons**.
All these particles have a fundamental property called mass.
Massive particles interact via the gravitational force.
Massive particles attract each other.



Protons and electrons have another fundamental property called charge.
Charged particles interact via the electromagnetic force.
Initially we only consider charged particles at rest. Then the electromagnetic force is the Coulomb force.
Charged particles at rest attract or repel each other.

Electric Charge

- There are two kinds of charge.
  Electric charge can be either positive or negative.

- Charge is quantized. I comes in individual units, or quanta, in multiples of the charge on the electron or proton, with magnitude $q_e = 1.6 * 10^{-19}$ C.
  Consequences:
  In most **macroscopic objects** the positive and negative charges exactly cancel each other producing a neutral object with net charge = 0.
  The interaction of charges at rest is not something we readily observe in everyday life.

- Charge is conserved.
  In an isolated system, the total electric charge is conserved and remains constant in time.

What do you already know about the electrostatic force that can exist between two interacting objects? Pick the correct statements from the choices below.

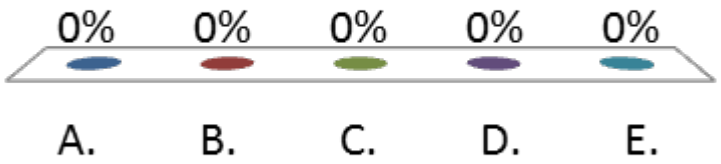
A. It depends on the net charge of each of the interacting objects.

B. It requires physical contact between the interacting objects.

C. It varies inversely as 1/r, where r is the distance between the interacting objects.

D. It can be attractive.

E. It can be repulsive.



Force laws

Newton's law of gravitation gives the force between two point masses, m_1 and m_2, separated by a distance r_{12}. Let $\mathbf{F}_{12}$ be the force object 1 exerts on object 2.

$$\mathbf{F}_{12} = -G\frac{m_1 m_2}{r_{12}^2}\hat{\mathbf{r}}_{12}$$

$G = 6.67*10^{-11}\ Nm^2/kg^2$ = gravitational constant

Forces are interactions. $\mathbf{F}_{12} = -\mathbf{F}_{21}$ (Newton's third law)

Coulomb's law gives the force between two point electric charges, q_1 and q_2, separated by a distance r.

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

$k_e = 9*10^9\ Nm^2/C^2 = 9*10^9\ Nm^2/C^2$ = electrical constant

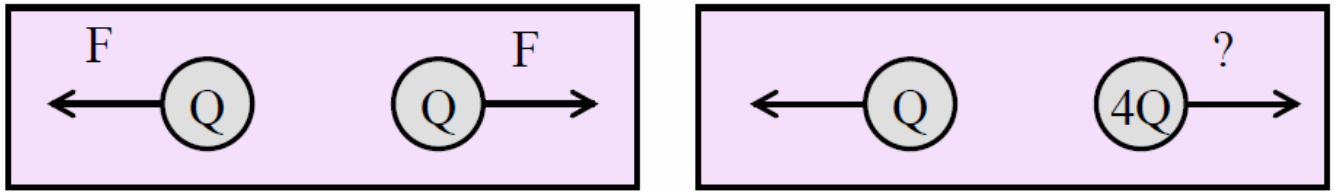
SI unit of charge: Coulomb (C)

Compare these force laws! Similarities? Differences?

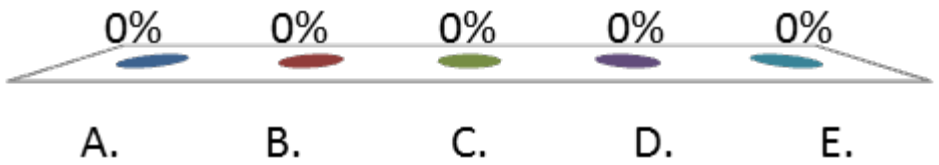
Principle of superposition: $\mathbf{F}_1 = \mathbf{F}_{21} + \mathbf{F}_{31} + \mathbf{F}_{41} + \ldots$

Total force on object 1 = vector sum of all forces acting on object 1

Two small objects each with a net charge of Q exert a force of magnitude F on each other. We replace one of these with a charge 4Q. What is the magnitude of the force after the replacement?

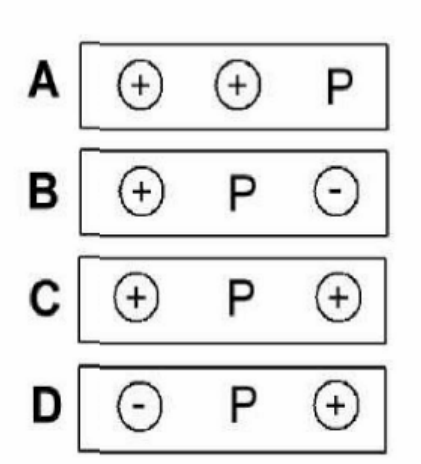


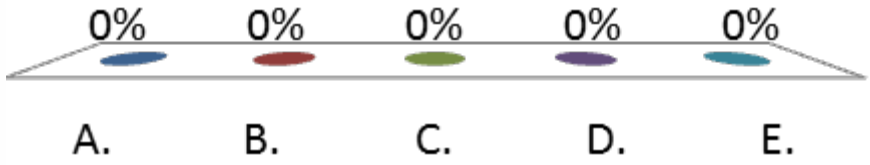
A. 16F
B. 4F
C. F
D. F/4
E. None of the above



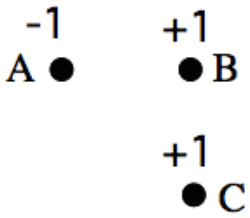
Four arrangements of charge are shown. Each charge has the same magnitude, but some are positive (+) and some are negative (-). All distances are to the same scale. In which arrangement would the magnitude of the force felt by a positive test charge placed at P be the largest?

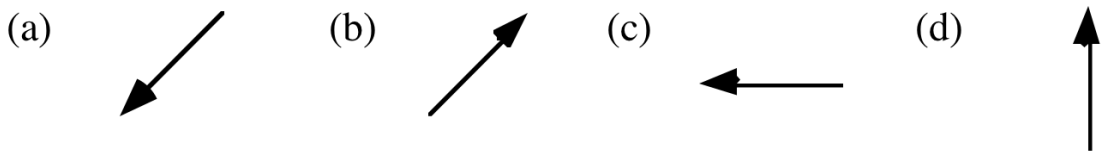
A. A only
B. B only
C. C only
D. A and C
E. B and D



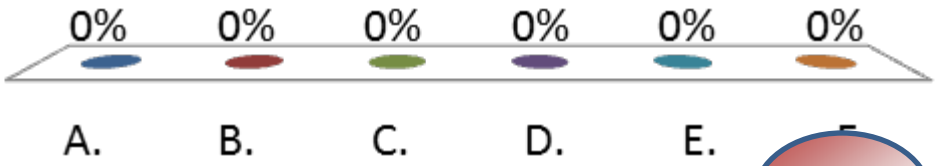


Choose the force vector that correctly shows the direction of the net force on charge B due to the other two charges. Charge is given in arbitrary units.





A. (a)
B. (b)
C. (c)
D. (d)
E. none of these, the net force is zero
F. none of these, the vector should point up and left.



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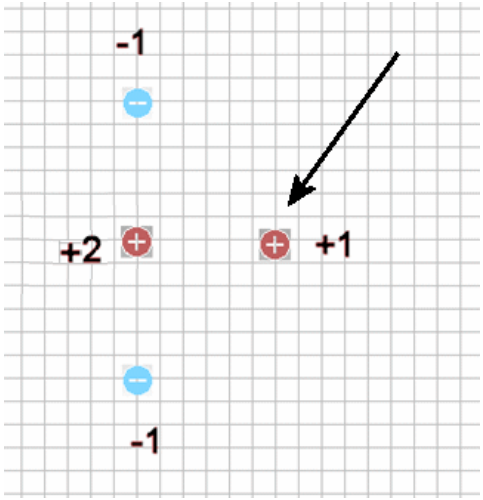
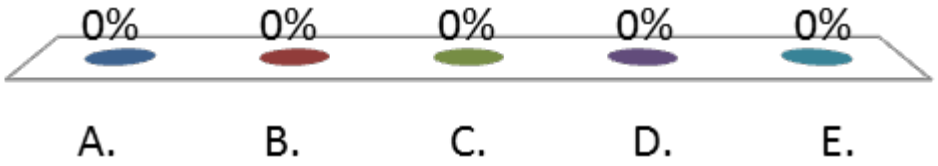
What is the direction of the Coulomb force on the charge pointed at by the arrow? (Charge is given in arbitrary units.)



A. There is no direction, the net force is zero.
B. Towards the left
C. Towards the right
D. Up
E. Down



How can we separate charges?

On a macroscopic scale charge can be separated by various means.

Examples:

- Contact electricity: Electrons are more or less strongly bound in different materials and can be transferred from one material to the other through rubbing, etc.
- Chemical separation: In a battery a chemical reaction separates charges.
- Diffusion: The permeable wall of living cells let different ions pass through at different rates. This can result in net charges of opposite sign inside and outside the cell.
- Convection: Charge is separated by convection in thunderclouds.

Energy input is needed to separate charges. This energy is released again when the charges recombine, for example in a spark.

Clothes taken from a clothes dryer sometimes cling together. Consider a load of wool socks and cotton-polyester shirts.

A. The socks will cling to the shirts, but not to each other.

B. Socks will cling to socks and shirts will cling to shirts.

C. Everything will cling together.

D. All pieces will repel each other.

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