Quizzes (Fall 2025)

PHYS 205B-001: UNIVERSITY PHYSICS

School of Physics and Applied Physics, Southern Illinois University–Carbondale

Due date: At 9:30 AM before each class, on D2L

Instructions

- This document collects the quizzes for the complete semester. One question below is due on each day of lecture.
- Assessment of quizzes does not look for correctness. Instead, it expects you to be critical and creative.
- The questions are conceptual. They might be open ended, thus, it is not recommended to spend more than ten minutes on a question. You are encouraged to ponder about it though.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assessments → Assignments). The question number syntax Q-MMDD is derived from date of lectures. The deadline has an (undisclosed) buffer period, so do not hesitate to try submissions after the deadline.

Questions

Electric charge and electric forces

(**Q-0819:**) Watch the following YouTube video by Bruce Yeany

https://youtu.be/jcoTqhXehDQ
https://youtu.be/U6bKDaZiy_k

to gain insight on how we can manipulate the electric charges in materials. Explain the demonstration using the idea of transfer of charges.

(**Q-0821:**) A charged conducting sphere is brought close to another neutral conducting sphere. (The spheres are not allowed to touch.) Is the electric force between the spheres zero? If not, is the force attractive or repulsive?

Check out the following presentation at Jefferson Lab,

https://youtube.com/embed/n3tauzN6-Uk?start=150&end=332,

that demonstrates this efect between timestamps 2:30 to 5:32 minutes.

Electric field

(**Q-0826:**) The following is a video illustrating the idea of Faraday cage in the SPARK Museum of Electrical Invention in Bellingham, Washington,

https://youtu.be/uAJfw3tALbI.

A perfect Faraday cage shields one from electric force. Imagine ways to shield from gravitational force.

(**Q-0828:**) The following is a short 3D animation from the Physics and Astronomy Animation Project at Penn State Schuylkill,

https://youtu.be/LB8Rhcb4eQM

Sketch the electric field lines of three identical positive charges at the corners of an equilateral triangle. Repeat the exercise after you replace one of the positive charge with a negative charge.

Continuous charge distributions and Gauss's law

(**Q-0902:**) The following 30 minute video produced by The Physical Science Study Committee (PSSC) on Coulomb's law,

https://youtu.be/o1kKGeLE1xI,

is presented by Eric M. Rogers from Princeton University. In particular, watch the the segement around timestamp 23:25 and discuss how a null force on a charge inside a spherical conductor is a verification of the inverse square law.

(**Q-0904:**) Watch the last ten minutes of Prof. Walter Lewin's lecture on Gauss's law,

https://www.youtube.com/watch?v=Zu2gomaDqnM&t=2498s.

Why does a ping-pong ball bounce back and forth in between two parallel oppositely charged plates?

Next, contrast the electric field distribution for the following configurations.

(a) Consider a spherically symmetric, uniformly charged, solid conducting sphere of radius R. What is the electric field inside the sphere? What is the electric field outside the sphere?

(b) Consider a spherically symmetric, uniformly charged, conducting spherical shell of radius R. What is the electric field inside the sphere? What is the electric field outside the sphere?

(c) Consider a spherically symmetric, uniformly charged, solid, dielectric sphere of radius R. Is the electric field inside the sphere zero? What is the electric field outside the sphere?

(d) Consider a spherically symmetric, uniformly charged, dielectric spherical shell of radius R. What is the electric field inside the sphere? What is the electric field outside the sphere?

Electric potential

(**Q-0909:**) Draw equipotential surfaces for the following configurations.

(a) Single point charge.

(b) Two positive charges of equal magnitude.

Then, attempt drawing equipotential surfaces inside a uniformly charged spherical shell. Are equipotential surfaces always surfaces?

(**Q-0911:**) A tube light glows when brought close to a van de Graaff generator. Electric charge from friction is collected on the dome of a van de Graaff generator using a moving belt. Watch the last five minutes of Prof. Walter Lewin's lecture on electric potential,

https://youtu.be/QpVxj3XrLgk.

A charged sphere creates a potential difference radially outwards around it. Can you use this procedure to generate potential differences to power your phone? In other words, how can you harness energy from static electricity generated due to friction?

Capacitance

(**Q-0916:**) Watch the following video by Khan Academy,

`https://youtu.be/u-jigaMJT10`,

on capacitors and capacitance. For the same amount of voltage applied how does the geometry (size) of the capacitor determine the charge stored in the capacitor?

(**Q-0923:**) Watch the following YouTube video by National High Magnetic Field Laboratory in Florida,

`https://youtu.be/5hFC9ugTGLs`,

on capacitors. Recall the definition of power as energy per unit time. Then, inquire if capacitor is employed for operations requiring high power or low power. Imagine processes where you would employ a capacitor over a battery.

DC Circuits

(**Q-0925:**) Watch the following YouTube video by Higgsino Physics,

https://youtu.be/h6FYs_AUCsQ,

on superconductors. Ohm's law is applicable for normal conductors and superconductors are instead described by London equation. What is the resistance of a superconductor?

(**Q-0930:**) Watch the following YouTube video created by students in MIT,

https://youtu.be/-G-dySnSSG4,

on Wheatstone bridge. It illustrates how measuring differences in a quantity can reduce the error in a measurement. The Wheatstone bridge and its extended version, the Kelvin bridge, is especially useful for measuring small resitances accurately. Imagine situations where you would employ a Wheatstone bridge.

Magnetic force

(**Q-1002:**) A charged particle in a magnetic field goes in circles (or in helices). Recall that positron is the antiparticle of electron. Describe the motion of a positron in a magnetic field, and contrast it to that of an electron in a magnetic field. How will the ionization track of electron and positron differ in a bubble chamber? For example, refer to the picture at 34:21 minute in the lecture by Frank Close, part of

Christmas Lectures, 1993.

(**Q-1007:**) Plate tectonics explains the spreading of sea floor and periodic magnetic reversals on the sea floor. The following YouTube videos

https://youtu.be/JJEZ3Vizdww
https://youtu.be/BCzCmldiaWQ

explains this. What is the implication of the observation that the magnetic reversals on the sea floor have distinct boundaries and are not varying continuously?

(**Q-1014:**) Aurora Borealis (northern lights) and Aurora Australis (southern lights) is a spectacular display of light shimmering across the night sky, often observed around magnetic poles of the Earth, when charged particles emitted by the Sun and guided along by the magnetic field of the Earth enter the atmosphere. Check out an animation of this phenomenon as seen from space, released by NASA Earth Observatory,

Aurora Australis on 2005 Sep 11,

which to an observer on Earth would appear as a curtain of shimmering light. Where is the magnetic north pole?

(**Q-1016:**) [Meissner effect.] A superconductor, below a critical temperature, expels all the magnetic field from its interior. The following video by Harvard Natural Sciences Lecture Demonstrations,

https://youtu.be/HRLvVkkq5GE,

demonstrates how this could be exploited for levitation. What is a SQUID (superconducting quantum interference device)?