Quizzes (Spring 2022)

PHYS 203B-001: College Physics

Due date: At 10:00 AM before each class, on D2L

Instructions

- Assessment of quizzes does not look for correctness. Instead, it expects you to be critical and creative.
- The questions are often left 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 numbers **Q-MMDD** are derived from date.

Questions

(**Q-0110:**) Contrast a perfect insulator with a perfect conductor based on the mobility of electric charges inside these idealized materials. Give real examples of insulators and conductors.

(**Q-0112:**) Does the electric force between two uniformly charged spheres depend on the radii of the spheres?

(**Q-0119:**) What is a Van de Graaff generator? Check out the following YouTube Video by Physics Demos

https://www.youtube.com/watch?v=edkHglTYxLQ

describing electric breakdown of air using a Van de Graaff generator.

(**Q-0121:**) Electric charges are free to move around inside a perfect conductor. This freedom allows them to rearrange their charge distribution such that the electric field is always zero inside a perfectly conducting body. The idea of a Faraday cage is associated to this. Describe how a car acts as a Faraday cage during lightning.

(**Q-0124:**) Electric field lines is a visual representation of electric field.

(a) How does one (visually or qualitatively) read out the direction and magnitude of electric field (at a point) from the associated electric field lines?

(b) Can two lines in the electric field lines for a configuration of charges intersect? If yes, give an example, otherwise, why not?

(**Q-0126:**) Watch the following YouTube video by Bruce Yeany

https://youtu.be/-csQiBHoucI

to gain insight on how easy it is to charge styrofoam balls. Qualitatively estimate the charge on a styrofoam ball. The following video gives a way to estimate this in a quantitative manner,

https://youtu.be/xoW9w2MS3Hw.

(**Q-0128:**) Using Gauss's law show that electric field is always zero inside a conducting shell. As mentioned earlier, this allows one to shield from electrostatic phenomena and is termed the Faraday cage.

(**Q-0131:**) Describe how the working of photocopy machines and printers depends on the principle of electrostatics. (Refer Section 18.10 of your textbook, or other resources.)

(**Q-0202:**) No quiz for today.

(**Q-0209:**) Draw equipotential surfaces for a single point charge. Draw the electric field lines for this charge in the same diagram.

(**Q-0211:**) A tube light glows when brought close to a van de Graaff generator. The dome of a van de Graaff generator is a charged sphere, with eectric charge collected on the dome using a moving belt. 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?

(**Q-0214:**) A capacitor is a device that has the ability to store electrical energy. It is stored in the form of electric field that is confined inside the capacitor. Unlike batteries, a capacitor can store this electrical energy much faster, but typically can not store as much energy as a battery. A supercapacitor is a capcitor with capacitance hundred times larger than traditional capacitors. Imagine, or explore, applications for the supercapacitor.

(**Q-0216:**) 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.

(**Q-0218:**) 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-0221:**) Direct Current (DC) versus Alternating Current (AC), what is the difference?

(**Q-0223:**) 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-0225:**) 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-0228:**) Watch the following YouTube video by Institute for Quantum Computing,

https://youtu.be/SpZqmZPtj9I,

in which Professor Steven Girvin explains the classical Hall effect and the quantum Hall effect. How much is the Hall resistance (in ohms)?

(**Q-0302:**) No quiz for today.

(**Q-0314:**) Using a diagram illustrate the location of magnetic north and south poles of Earth relative to the location of geographic north and south poles of Earth. Find a city close to the magnetic south pole.

(**Q-0316:**) Sun is a magnet and has a magnetic field. Earth also has a magnetic field. Do all planets in our solar system have a magnetic field?

(**Q-0318:**) The following is a link to tiny one-minute clip,

https://youtu.be/S3xH97Su-KY,

from a fifty-minute lecture at the Royal Institution by Felix Flicker on the physics of magnetic monopoles. Can you separate the north and south poles of a magnet?

(**Q-0321:**) Compare Gauss's law in electrostatics with Ampère's law in magnetostatics.

(**Q-0323:**) The following YouTube video by Thomas Stevenson,

https://youtu.be/Y18N-hi5P1o,

explains Faraday's law of induction. Using a schematic diagram illustrate how this concept is used in converting wind energy into electrical energy?

(**Q-0325:**) In the following YouTube video,

https://youtu.be/k2RzSs4_Ur0,

William Berner, University of Pennsylvania, illustrates Lenz's law. Why doesn't the ring slow down when it is cut?

(**Q-0328:**) In the following YouTube video, by PublicResourceOrg,

https://youtu.be/OpL0joqJmqY,

they describe generators and motors. In the first five minutes of the video they define electromotive force (EMF). How is EMF related to the induced voltage V_{eff} defined in the class?

(**Q-0330:**) In the following YouTube video, by Physics Videos by Eugene Khutoryansky,

https://youtu.be/ozeYaikI11g,

they describe a transmission lines. What is the speed of transmission in such transmission lines?

(**Q-0401:**) Communication between Mars and Earth is limited by the constraint that one-way signal takes about 15 minutes. It will be awkward to have a usual conversation because of this time-lag. Design a communication protocol that could potentially get around this limitation.

(**Q-0404:**) In the following YouTube video,

https://youtu.be/kp33ZprO0Ck,

Bill Hammack, a professor in the Department of Chemical Engineering at the University of Illinois at Urbana-Champaign, explains how microwave oven heats food. What is the wavelength of microwave used in an oven?

(**Q-0406:**) No quiz for today.

(**Q-0411:**) Is the image that you see of yourself in a flat bathroom mirror a real image or a virtual image?

(**Q-0413:**) In the following YouTube video,

https://youtu.be/GAmWs6zfTj8,

John Howell, Professor of Physics at the University of Rochester, explains a simple cloaking device using four plane mirrors. What are the challenges in designing a cloaking device?

(**Q-0415:**) In the following YouTube videos,

https://youtu.be/7zv-4Zh-9R4,
https://youtu.be/qxlT19losBE,
https://youtu.be/3e-LZPHBA2M,

Dr. Boyd F. Edwards demostrates the images formed using a concave and convex mirror as a function of object distance. A rear-view mirror of a car is an example of convex or concave mirror?

(**Q-0418:**) Can the refractive index of a material be less than unity? Explain.

(**Q-0420:**) Explain why light seems to be bending in the following YouTube video by Harvard Natural Sciences Lecture Demonstrations,

https://youtu.be/XrWB0KLXpn8.

(**Q-0422:**) In the following YouTube video,

https://youtu.be/xbfB3Ns6_bs,

Dr. Boyd F. Edwards demostrates the image formed by a convex lens. Suggest an experimental method to determine the focal length of a convex lens.

(**Q-0425:**) In the following YouTube video,

https://youtu.be/J4Ecq7hIzYU,

Prof. Shaoul Ezekiel describes interference between to laser beams. Why do the fringes move when he leans on the table?

(**Q-0427:**) In the following YouTube video,

https://youtu.be/WTxDyYHaYAI,

Bryan Rolfe describes thin film interference. Why is the top part of the vertically hung soap film in the video dark?

(**Q-0429:**) No quiz for today.