Science-1A Lecture: Week-5, Friday, September 10, 2021

On Wednesday, we watched videos about static electricity, and also discussed the use of a digital multimeter to measure electrical variables. This lecture continues explaining what we imagined doing with the multimeter, and then gets started on magnetism.

Electric Current (CC 28) 8 min 22 s
https://www.youtube.com/watch?v=HXOok3mfMLM&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

Remember, an earlier video explained that the unit of charge is called the coulomb, abbreviated by C. One electron has a charge of $-1.6\times10^{-19}\text{C}$ as shown on the first line of the Chapter 6 section of the 3rd page of the Equation Sheet.

Pay attention to the discussion of the flow of electrons vs. the Benjamin Franklin flow of current. The conventional direction used for current calculations is **opposite** to the direction of electron flow.

I regularly used superconductors in my physics research. They were first discovered in 1905, but could not be explained until 50 years later after major advances were made in the theory called quantum mechanics.

The discussion of electric power is useful, and its equations are listed in our Equation Sheet, but you will not be tested on it.

DC Resistors and Batteries (CC 29) 10 min 47 s
https://www.youtube.com/watch?v=g-wjP1otQWI&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

The internal voltage of a battery is important, but not for our course. Listen and absorb what you can.

The discussion of series and parallel circuits relates to our lab measurements of two resistors in series and parallel.

Circuit Analysis (CC 30) 10 min 55 s
https://www.youtube.com/watch?v=-w-VTw0tQlE&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

Just enjoy watching this while knowing that you will not be tested on analyzing these more complicated circuits.

Notice, however, that Ohm's law is used over and over again until every voltage and current in the circuit is calculated.

Capacitors and Kirchhoff (CC 31) 10 min 37 s
https://www.youtube.com/watch?v=vuCJP_5KOlI&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

You do not need to know the content of this video, but I hope you will take the time to appreciate it. You might recall with dread that at the end of your algebra study you had to solve multiple equations with multiple unknown variables. That was to prepare you for this kind of analysis. In Science-1A, you are spared this type of calculation.

Magnetism (CC 32) 9 min 46 s
https://www.youtube.com/watch?v=s94suB5uLWw&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

Just like with charges, opposites attract. North poles of magnets are attracted to south poles, and poles of the same type repel.

Remember that dividing a magnet does not produce a separate north and south pole, but rather produces two new magnets, each with its own north and south poles. In lab, I like to take a bar magnet and pretend to wack it into two over and over again, each time producing two more magnets. When I finally get down to a single iron atom after 81 wacks, it will still have a north and south pole. So I wack that atom into pieces and get a nucleus and electrons, both of which are still magnets with north and south poles.

I can't resist making a correction: The video says the strongest superconducting magnets in the world are 10 T (10 tesla), but I wish to correct that. During the early 1990's I used an 18 T superconducting magnet when studying an amazing quantum effect called the quantum Hall effect. The current record appears to be 45 T.

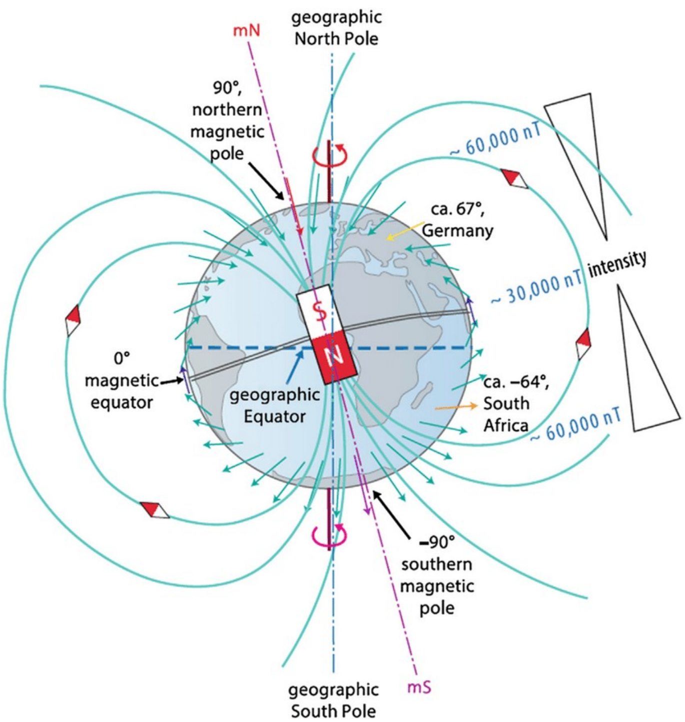
The Earth's magnetic field near Fresno is only about 50 μT .

You do not need to remember the right-hand rules or the formula for the force on a wire carrying an electric current.

You do, however, need to remember that magnetic field lines form loops and the line arrows outside the magnet point away from the north pole of the magnet and go around to point into its south pole.

Charges moving in a magnetic field are bent perpendicular to both their direction of motion and the direction of the magnetic field. In lab, I demonstrate this by bringing a magnet next to an oscilloscope, a kind of old-fashioned television set with a electron beam launched from an "electron gun" at its back side that sends electrons toward a phosphorescent screen at its front side. A magnet moved in front of its screen is seen to deflect the electron beam sideways.

When the video shows the magnetic field of the Earth, there is a fact that you might find on a test. Study the picture at the right, paying close attention to the direction of arrows and magnets.



The source of the Earth's magnetic field deep inside of the earth is shown by the large red and white bar magnet. Notice that its **south** pole is pointing toward the **north** geographic pole of the earth. So the earth magnetic pole near its north geographic pole is actually its south magnetic pole! (The drawing confusingly labels it the northern magnetic pole, but that just means that it is the magnet pole in the northern region of the Earth. It is not the Earth's north magnetic pole.)

The small red and white diamond shapes represent compass needles. When compasses were first created, the end that pointed northward was called the north pole of the compass because it pointed in the north direction. But since a magnet's north pole is attracted to a south pole, the Earth's south pole must be up near Greenland in order to pull the north pole of the compass in that direction. The Earth's north magnetic pole is in Antarctica. This is the opposite of what you might guess. Don't be fooled if you see a question about this on a quiz or test!