

Discussion Week 11 Question 1

“Gee Brain, what do you want to do in physics discussion?”

“The same thing we do every discussion, Pinky, try to take over the world! The Earth has a magnetic dipole moment of 8.0×10^{22} J/T. We will wrap a copper wire around the geomagnetic equator of the earth to produce an artificial dipole! Not only will we confuse the homing pigeons of the world we will mess up all the compasses of the world, causing the navigation systems of the planet to fail, resulting in the leaders of the world to have to come to me to know the strength of my artificial dipole and make me the ruling of the World!”

“How much current would we need to run through the wire to have the same dipole moment of the Earth? Can we really cancel the Earth’s magnetic field far away from the surface or close to the surface?”



Earth’s Magnetic Dipole

Discussion Week 11 Question 2

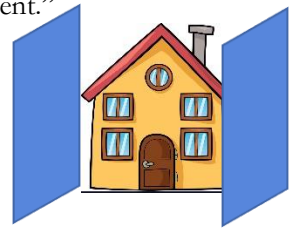
“What interconnected system does the world depend on, Pinky?”

“Household plumbing?”

“No, Pinky! The population of the Earth is depended on electrical currents! Right now, everyone reading this is using a computer to communicate with an educator. Plus, thousands of business transactions and intergovernmental commerce depend on online meetings! We will disrupt the worldwide economy by inducing artificial currents in wires across America!”

“And how are we going to do that?”

“We will install 30mF parallel-plate capacitors at the sides of each building to produce a displacement current of 100 A to induce an changing E-Field in all the electrical devices! I just need to calculate the rate of change of potential difference we need on the capacitors to produce such a displacement current.”



Discussion Week 11 Question 3

“This plan will work, Pinky! The United State Government stores important information on microfilm and tapes that can be erased by strong electro-magnetic field.”

“Gee, Brain, are we going to carry a large magnet there?”

“No, one does not simply walk into one of the most heavily secured rooms in the United States government with a large magnet! No, we shall install capacitor plates of edge length 50m above and below the government building and discharge a mere 75kA current! Now the room we are looking at has dimensions 4 by 8 meters, as picture here in the diagram from a head on view. We need to calculate the value of $\oint \vec{B} \cdot d\vec{s}$.”

