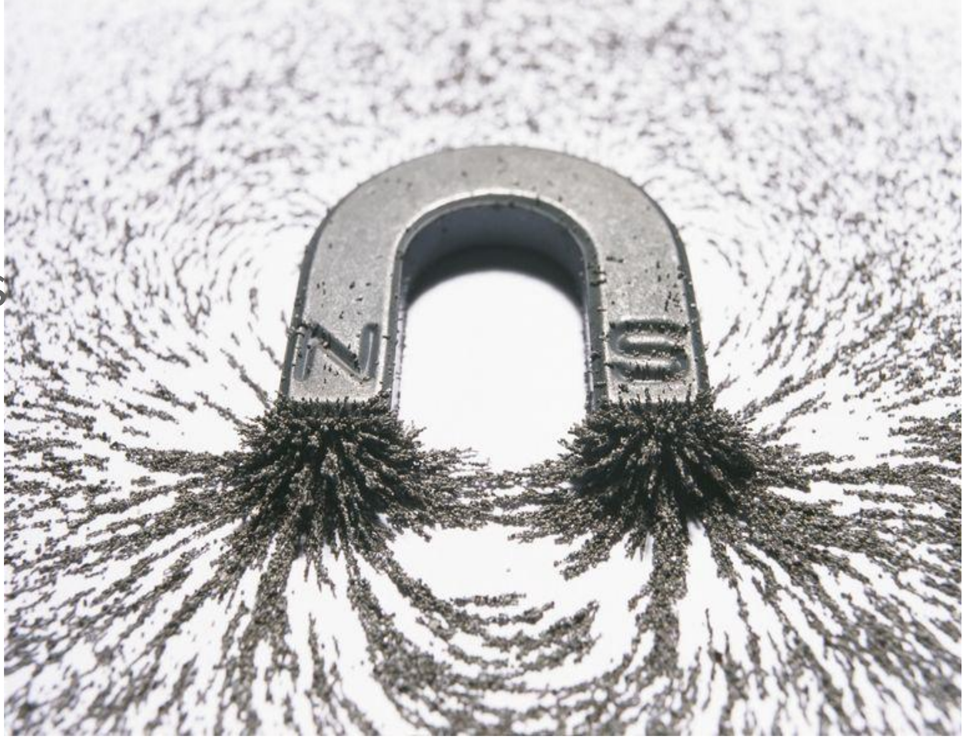
Magnetism!

Emperor John Moore, **King** Shivam Patel, **Prime Minister** Ian Lee, **Home Boi** Hakob Shamilian, **Baron** Jack Weirick, **Duke** Alex Barsom, and **Prince** Thomas Mayer

What is Magnetism? (Alex)

- Attractive and repulsive forces between objects
  - caused by *motion* of charges, which can be motion of electrons in atoms
    - Electrons rotate and spin on their own axis, and revolve around atom’s nucleus



Rotation of electrons usually creates a stronger field than revolution of electrons

What is a Magnet? (Alex)

- An object in which the magnetic field is very strong, therefore an object in which all individual magnetic fields of moving charges are aligned
  - When clusters of atoms with moving charges become aligned, they create a *domain*
    - When all domains in an object align, that object becomes a magnet

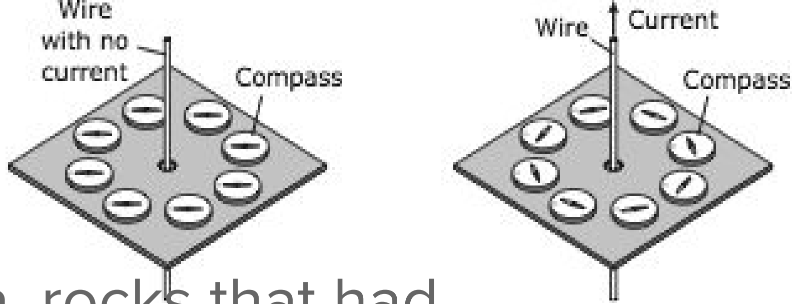
Domains (Jack)

- As previously stated, a domain is a cluster of aligned atoms. The domains of different materials differ in that some are permanent and others are temporary.
    - Permanent: This is a magnet where the domains are constantly aligned and do not need another magnet to align their clusters of atoms. However, if dropped or heated, a permanent magnets domains may get out of alignment.
    - Temporary: An iron nail is an example of this. If an iron nail were to be placed next to a permanent magnet, the atoms would become aligned clusters in the iron nail creating a temporary magnet which exerts a temporary magnetic field. This will go away as in order to keep the iron nail a magnet, another magnet would have to be constantly exerting a magnetic force on the nail.

Domains Before Magnetization

Domains After Magnetization

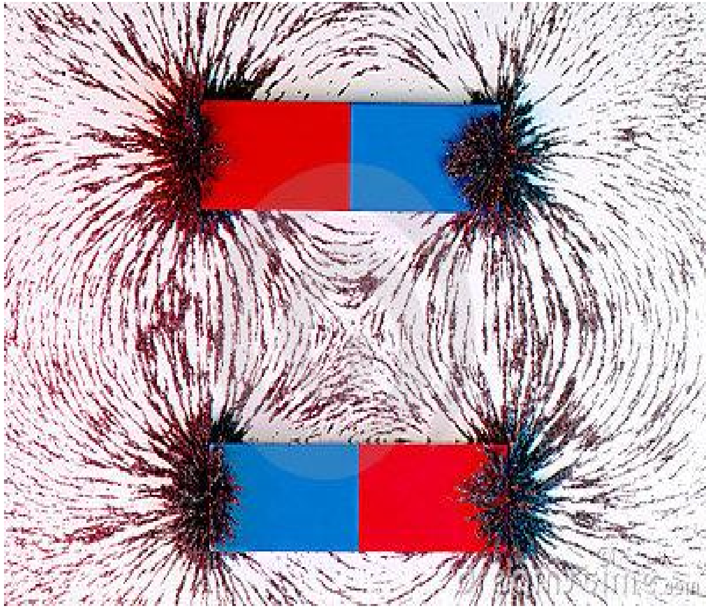
Discovery of Magnetism (Jack)



- Region in Greece called Magnesia, rocks that had magnetic elements (iron, cobalt,), would attract each other when brought close
    - Named magnets after the region of discovery
- In 1820, Hans Christian Oersted, a Danish physicist and chemist, discovered what caused magnetism
    - Placed a compass near a wire, and the compass needle moved when current was flowing through the wire
- Magnetism was produced by motion of electric charge

Magnetic Fields (Ian)

- An imaginary diagram displaying the direction of magnetic force.
  - The set of field lines go in the direction of North to South
  - Field lines never cross
  - Density of field lines is proportional to the strength of the field
  - Magnesium sand forms patterns in the shape of the field.

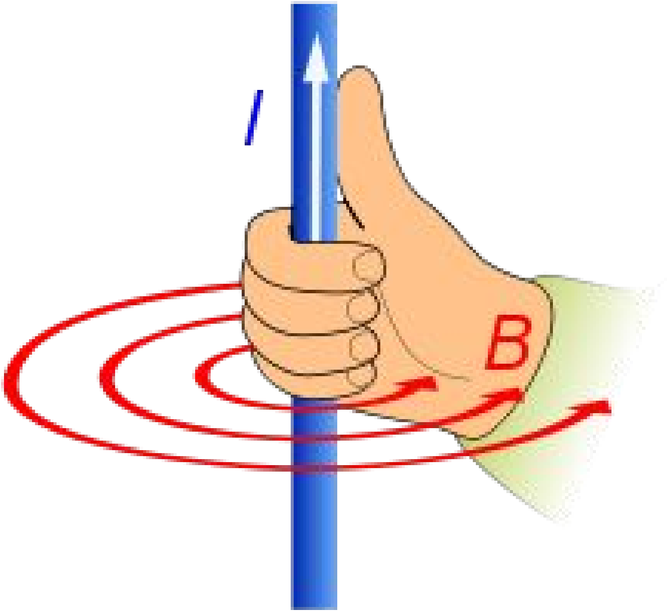


Magnetic Fields (Ian)

- Direction
  - The field and the direction of the field lines depends on the direction of the poles
  - Depends on direction and number of magnets
  - And depends on the direction of current
    - If you know the direction of the current, you can find the direction of the field as well

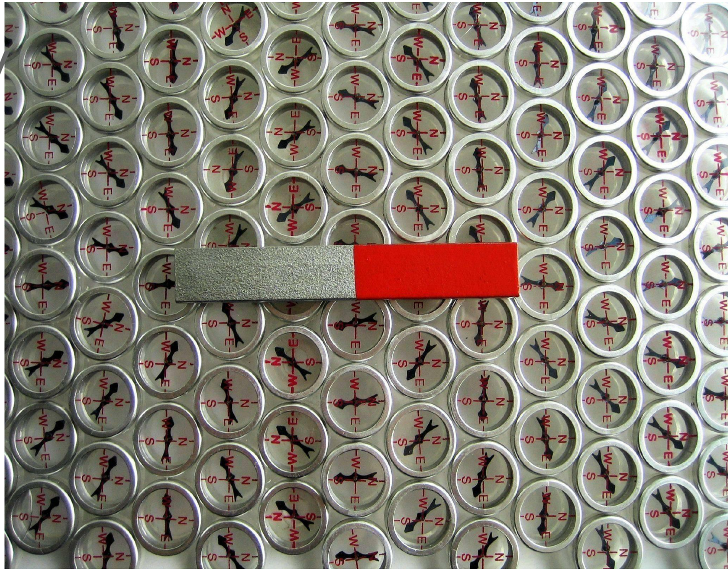
Right Hand Rule (H Dawg)

- Knowing that moving electric charge creates a magnetic field, this rule tells us which direction the field goes
  - If we know the direction of the current, we can find the direction of the field
- Point your right thumb in the direction the current travels - whichever way your fingers curl into your palm is the direction of the magnetic field



I = Current
B = Magnetic field (measured in Teslas (T))

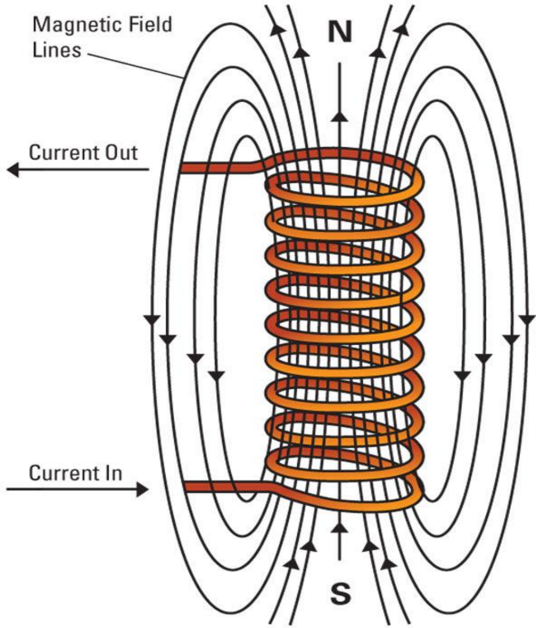
Calculations for Magnetic Field (H dawg)

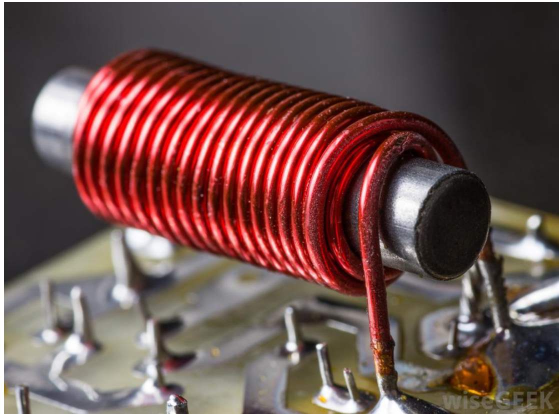


- Measured in Teslas (T), represented by variable B
- ***B = μ0I/2πr***
- μ0 represents the magnetic constant, known as the permeability of free space
    - Measure of amount of resistance and acceptance a vacuum has of magnetic field
        - μ0 = 4π×10-7 Tm/A, or 1.25663706 × 10^{-6} m kg s^{-2} A^{-2}

Electromagnetism (Shivam)

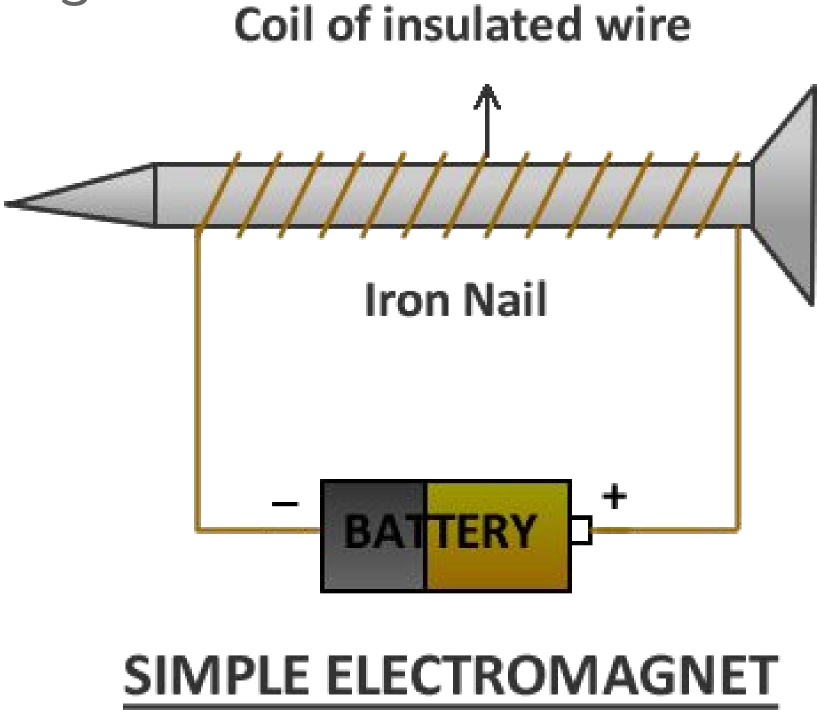
- When charge moves through wires, a magnetic field is created around the wire
- When this wire is made into one loop, the magnetic field on the inside of the loop amplifies
- When many loops of wire are placed together to form a coil, this amplifies the magnetic field within the entire coil





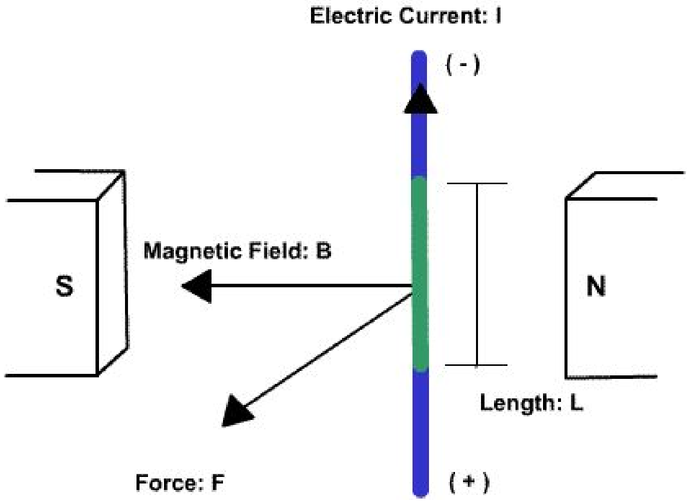
Electromagnetism (Shivam)

- Iron and other ferromagnets or magnetic material can be placed inside the coil of an electromagnet to further amplify the magnetic field



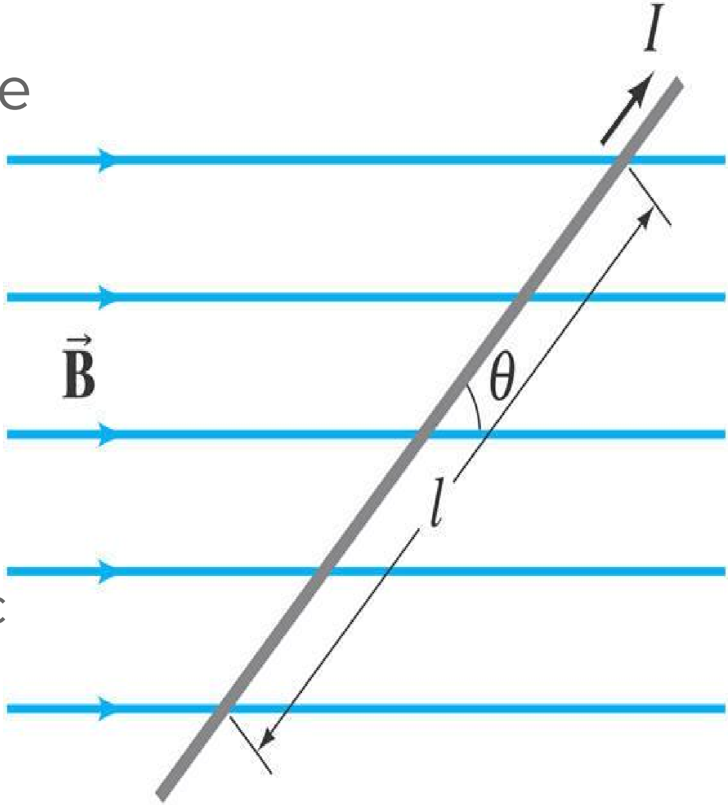
Magnetic Fields and Charges (John)

- A magnetic field exerts a force on electric charge, as a charge exerts a force on a magnetic field
- A current-carrying wire going through a magnetic field will be pushed or pulled by the force exerted on the charge within the wire



Magnetic Fields and Charges (John)

- The formula to find the magnitude of force exerted on a current-carrying wire by a magnetic field:
  - **F = IℓBsinθ**
    - I = current in wire (Amps)
    - ℓ = length of wire in magnetic field
    - B = strength of magnetic field
    - θ = Angle between wire and magnetic field



Magnetic Fields and Charges (Thomas)

- Formula to find the force exerted on a moving charge by a magnetic field:
  - **F = qvBsinθ**
    - q = charge of particle
    - v = velocity of particle
    - B = strength of magnetic field
    - θ = angle of moving charge to the magnetic field

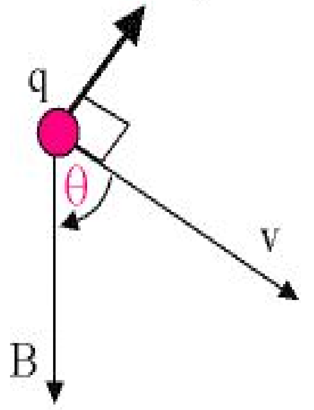
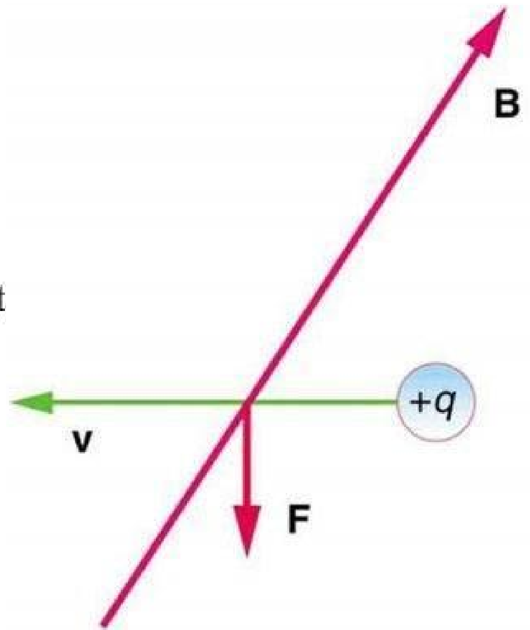
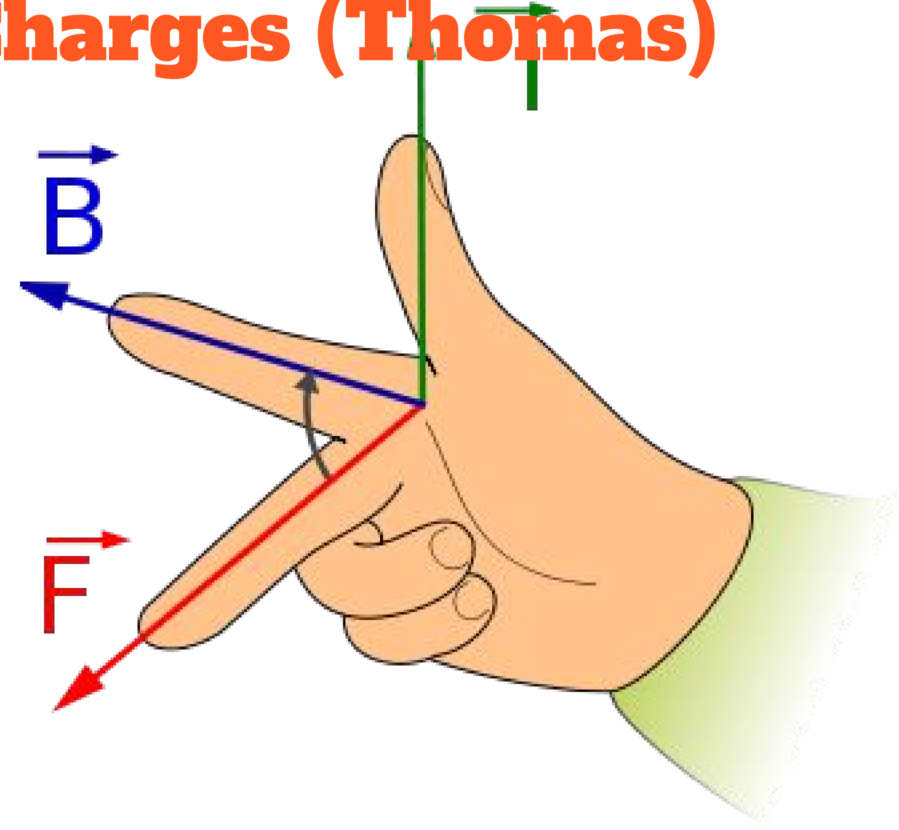


Fig. 1 Charge q moves slanted with respect to B



Magnetic Fields and Charges (Thomas)

- Once you know how to find the magnitude of the force exerted on the wire, you can also find the direction of the force
- Right hand rule
    - I = direction of current
    - B = direction of magnetic field
    - F = direction of force on wire



Common Misconceptions

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Common Misconceptions (Alex)

One common misconception is that the magnetic field is the same thing as the electric field. This is an easy mistake to make since they both seem similar in many aspects, but it is important to remember that they have different properties that distinguish them from each other. It is important to note that an electric field induces a magnetic field and a changing magnetic field induces a voltage. The process of a changing magnetic field inducing a voltage is called electromagnetic induction.

Another misconception occurs with some of the units. Some people may mistake volts for power and watts for voltage.

Misconceptions Continued (List of lies) (Thomas)

All metals are attracted to a magnet.

All magnets are made of iron.

Larger magnets are stronger than smaller magnets.

The magnetic and geographic poles of the earth are located at the same place.

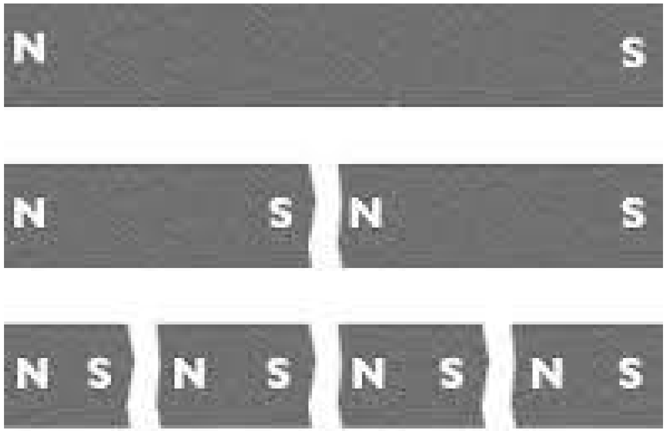
The magnetic pole of the earth in the northern hemisphere is a north pole, and the pole in the southern hemisphere is a south pole.

A magnetic field is a pattern of lines (not a field of force) that surrounds a magnet.

In a magnet, the magnetic field lines exist only outside the magnet.

Can there be Monopoles?? (John)

Although theoretically monopoles can exist, no monopoles have ever been observed



Transformers (H Dawg)

Aight so here's the big idea. A transformer, essentially, transformically transforms an alternating potential difference, which some hipsters call “voltage”. Short story made long, the transformer can make the voltage higher or lower by going step up or step down. It does this by increasing the number of turns or coils, causing the voltage to increase. This would be called a step up. To take a baby step down, the transformer decreases in number of coils or turns, causing the voltage to decrease. Furthermore, transformers utilize electromagnetic induction. “Fun” fact: The voltage supplied by all standard American power outlets are 120 volts. Yet, transformers enable us to use electronics that require differing voltages since they either step it up a notch, or step it down a notch.

Question (Shivam)

A happy-go-lucky pikachu waddles towards a powerful power line with a velocity of 6.020000 x 10^23 m^5/s^5 perpendicular to the power line. The power line carries 13.20 amps of current to the pikachu's right, and the pikachu itself carries a static charge of 8.7000 x 10^-9 C.

What is the magnitude of the magnetic field 3 centimeters from the power line. (From the pikachu's perspective)? *Round to any decimal place that makes you happy.*

$2 = -e^{-x}$

$3x^2e^x - \left(-xe^{-x} + \int e^{-x}\right) - 2e^{-x} + c$

$\int 3x^2e^x + xe^{-x} + e^{-x} - 2e^{-x} + c$

$B = (\mu_0 I) / (2\pi r)$

$$B = \frac{(4\pi \times 10^{-7})(13.2)}{(2\pi \cdot .03)}$$

ters

cm $\times \frac{1m}{100cm} = .03m$

$r = .03m$

$B = .0000088$ Tesla

The Big Kahoot

Kahoot time yo

https://play.kahoot.it/#/lobby?quizId=c986895e-6418-4b9f-bf70-c5cfac0cd50a