Announcement

At the end of DL, everyone should make sure to pick up 2 magnets and a compass so that you can do your FNTs and be sure to bring these to the next DL

Model: Fields, Forces, Potential & Potential Energy

Act 9.2.2 FNT Review: Making Connections **45 minutes**

Learning Goals:

- Synthesize general relationships between F, PE, and E.
- Use these relationships to predict relationships involving electric potential, V
- Connect electric potential to ideas from 7B.

Act 9.2.3 Electric Field and Changes in Voltage **80 minutes**

Learning Goals:

- Understand the analogies between gravitational fields and electric fields
- Understand the electric potential (voltage) that exists around an electric charge
- Understand how electric potential relates to the electric field.
- Understand the field and voltage pattern within the plates of a capacitor
- Recognize that energy conservation holds regardless of the orientation or strength of the electrical fields present, or the sign or magnitude of the participating electrical charges
- Understand the relationship between an electric field E and its electric potential V

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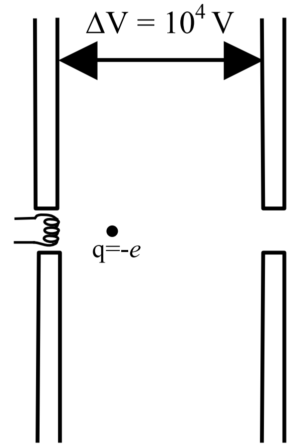
9.2-1) (Solidification) In a future DL we will use a beam of electrons that has been accelerated to a high velocity. How high? We will use two parallel plates with an electric potential difference between them on the order of 10,000 Volts. The picture to the right shows a schematic picture of what we will do. The plate on the left has a hole in it that has a filament in it. We will pass a large current through a filament (the electrical circuit connections for the filament are not shown) to heat up the filament and make it easier to tear electrons from the filament. We can assume that an electron leaving the filament has approximately zero velocity. This electron is then accelerated from left to right by the electric field between the plates.

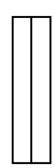


- **a)** Which plate is positively charged and which is negatively charged?
- **b)** What is the direction of the electric field between the two plates? Do the holes change this electric field direction? Do the holes change the magnitude?
- **c)** Does the plate on the right have the higher voltage or the plate on the left?
- **d)** Find the speed of the electron as it shoots out the hole on the right.

9.3-1) (Introduction) A compass always points in the direction of the magnetic field that it sees (for instance, the magnetic field of the earth points basically north so the compass points north). Use a compass to find the magnetic field shape around the two magnets. Check the magnetic field direction at many locations and draw a reasonable sketch of the magnetic field lines for each situation. In your sketches, the magnets should always be drawn looking at their edges and you should have lines on all sides. Like with electric dipoles, lines should be far apart where the magnetic field is weak, and close together where the field is strong. Lines should start and end on the surfaces of the magnet(s). Filed lines never cross each other.

- **a)** one magnet (is this a dipole field?) Look back at the field lines of an electric dipole in Act 9.14
- **b)** two magnets stuck together (is this a dipole field?)
- **c)** two magnets held together but repelling each other (is this a dipole field?)
- **d)** two magnets oriented so that they attract each other (when close) but are separated by a couple of inches (is this a dipole field?)
- **e)** two magnets oriented opposite to d) and separated by a couple of inches (is this a dipole field?)

a)



b)
attracting

c)
repelling

d)
attracting
when close

e)
repelling
when close