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**Question 1**

Using the concept of Newton’s second law of motion, describe the magnitude and direction of the acceleration of an electron being shot horizontally into a closed space with a uniform field being directed upward.

Newton’s second law states that the acceleration of an object depends upon two variables – the net force acting on the object and the mass of the object.  The acceleration of the body is directly proportional to the net force acting on the body and inversely proportional to the mass of the body. This means that as the force acting upon an object is increased, the acceleration of the object is increased. Likewise, as the mass of an object is increased, the acceleration of the object is decreased.

This statement is expressed in equation form as,

a=Fnetm

The above equation can be rearranged to a familiar form as

F=ma

Since force is a vector, Newton’s second law can be written as

F⃗ =ma⃗

The equation shows that the direction of the total acceleration vector points in the same direction as the net force vector.

You can kind of think of an electric field as being produced by positive charges. If you remember from drawing field lines, the lines come out of the positives and go to the negatives. Also, the field that the positive charges produce repel other positive charges, making other positive charges flow tangentially toward the direction of the field line.

In our case we have an electron with negative charge. Since opposite charges attract, the electron with negative charge flows in the opposite direction of the field lines. It is being attracted by the electric field. If it were a positive charge in this uniform electric field, then yes it would be upward along with the electric field lines, but an electron does the opposite.

So the direction of the force depends not only on the charge of the electron but also on the charge of the EM field source. Remember that E = kQ/r^2 for a point charge Q field.

So if Q is positive and e, the electron is negative, which is will be by definition of an electron, then the net force f = kqQ/r^2 will be attractive and towards Q. But if Q is a negative charged source, the net force will be repulsive (hey if it can be attractive it surely can be repulsive) and the electron will be pushed away from Q.

Same deal for a uniform field E. If the plate or whatever is a positively charged anode and that's your source of the field, then the electron will be pulled toward that anode. But note that there will also be a negative, cathode plate some distance h from and parallel to the anode. So one can easily say the electron is being pushed, repelled by the cathode and the E field it's emitting.

As you "know" the answer is downward, then that must be the anode side of the plates emitting the uniform field between them. And the upper plate would be the cathode, negative plate.

I guess my point is this. The direction of the field E depends in part on the electron charge and in part on the source charge. So you have to know both charges before you can say what direction that field is pointing.

**Question 2**

**Describe electric field, magnetic field and electric current with respect to charges**

I understand that an electric field is created by electrons and protons. This force is attractive to particles carrying opposite charge and repulsive to like-charge particles. So then you get moving electrons and all of a sudden you have a "magnetic" field. I understand that the concept of a magnetic field is only relative to your frame of reference.

Electric field: When a balloon is rubbed against a sweater, the balloon becomes charged. Because of this charge, the balloon can stick to walls, but when placed beside another balloon that has also been rubbed, the first balloon will fly in the opposite direction. This phenomenon is the result of a property of matter called electric charge. Electric charges produce electric fields. Electric field are regions of space around electrically charged particles or objects in which other electrically charged particles or objects would feel force. An electric charge, which can be either positive or negative, is a property of matter that causes two objects to attract or repel. If the objects are oppositely charged (positive-negative), they will attract; if they are similarly charged (positive-positive or negative-negative), they will repel.

Magnetic field: Magnetic attraction or repulsion can be explained as the effect of one magnet on the other, or it can be said that one magnet sets up a **magnetic field** in the region around it that affects the other magnet. The magnetic field at any point is a vector. The direction of the magnetic field ( **B**) at a specified point is the direction that the north end of a compass needle points at that position. **Magnetic field lines**, analogous to electric field lines, describe the force on magnetic particles placed within the field. Iron filings will align to indicate the patterns of magnetic field lines.

**Magnetic force on a moving charge**: If a charge moves through a magnetic field at an angle, it will experience a force. The equation is given by **F** = q **v** × **B** or F = qvB sin θ, where q is the charge, **B** is the magnetic field, **v** is the velocity, and θ is the angle between the directions of the magnetic field and the velocity; thus, using the definition of the cross product, the definition for the magnetic field is



  Electric Current: It is the rate of flow of electrons in a conductor. The SI Unit of electric current is the Ampere. Electrons are minute particles that exist within the molecular structure of a substance. Sometimes, these electrons are tightly held, and the other times they are loosely held. When electrons are loosely held by the nucleus, they are able to travel freely within the limits of the body. Electrons are negatively charged particles hence when they move a number of charges moves and we call this movement of electrons as electric current. It should be noted that the number of electrons that are able to move governs the ability of a particular substance to conduct electricity. Some materials allow current to move better than others. Based on the ability of the material to conduct electricity, materials are classified into conductors and insulators.

Both electric and magnetic fields act on charge, but in different manner. Electric field is acting on charge as follows: it *accelerates* the momentum vector of the charged object in the direction of the vector

Magnetic field is acting on charge as follows:

* it *rotates* the momentum vector of the charged object around the direction of the vector