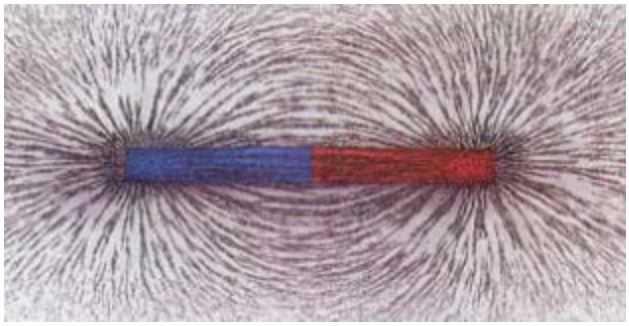
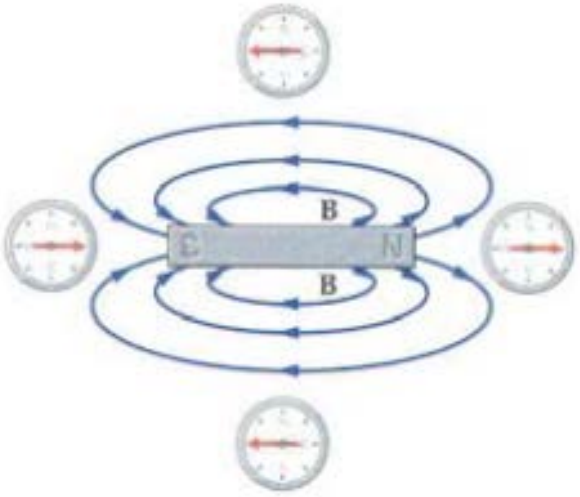
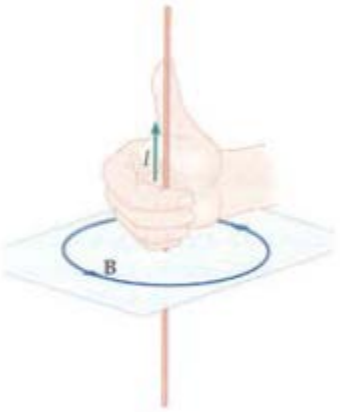
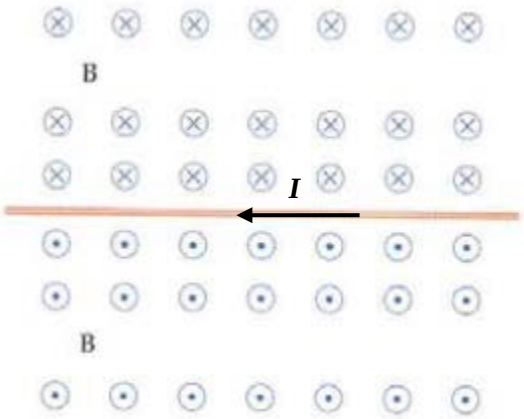
Magnetic fields



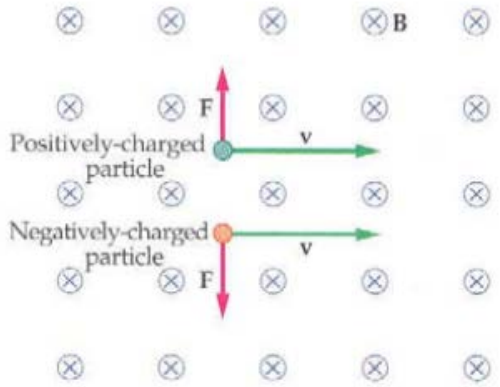


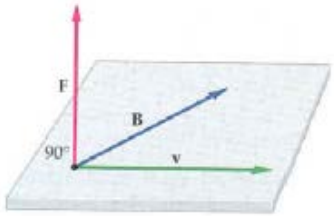
## Relation between current and magnetic field



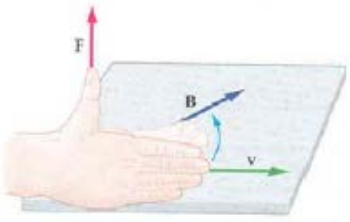




## Force on moving charge in a magnetic field: The magnetic force



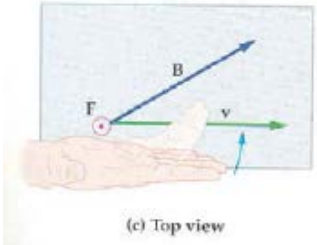

(a)




(b)

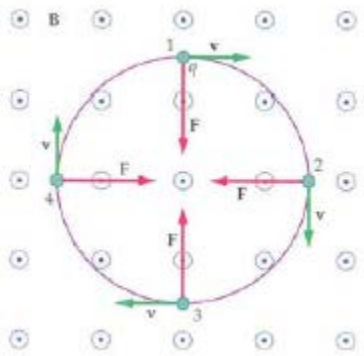
The direction of the magnetic force is given by the magnetic force right-hand rule (RHR), which states as follows.

*To find the direction of magnetic force on a positive charge, start by pointing the fingers of your right hand in the direction of the velocity,* ***v****. Now curl your fingers forward the direction of* ***B****. Your thumb points in the direction of* ***F****.*

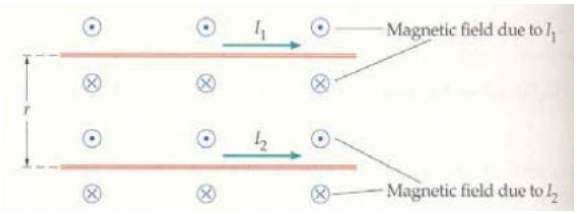


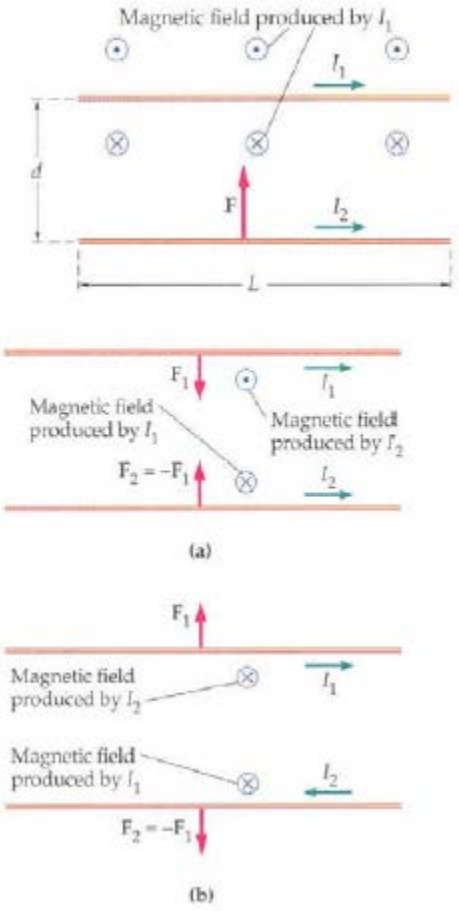

(c) Top view

## Circular motion of a moving charge



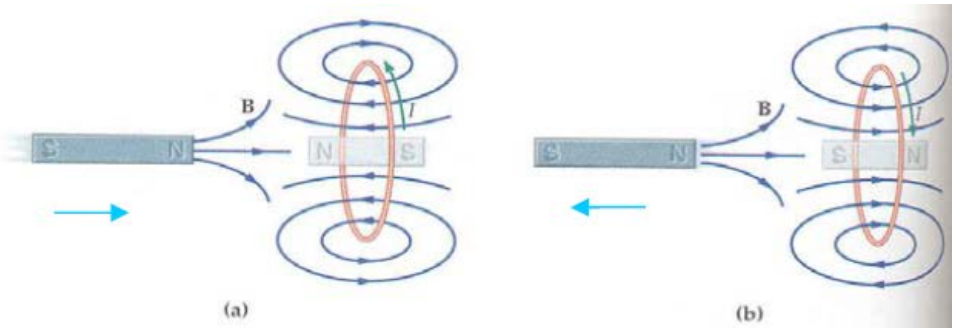

## Forces on current wires



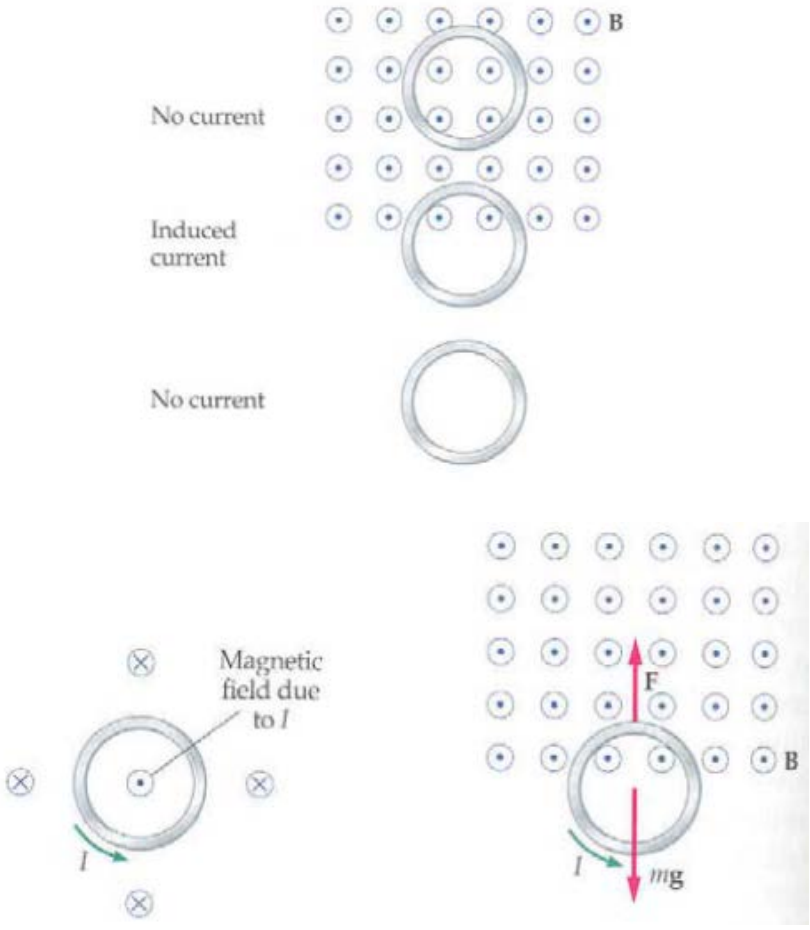



# Lenz's Law

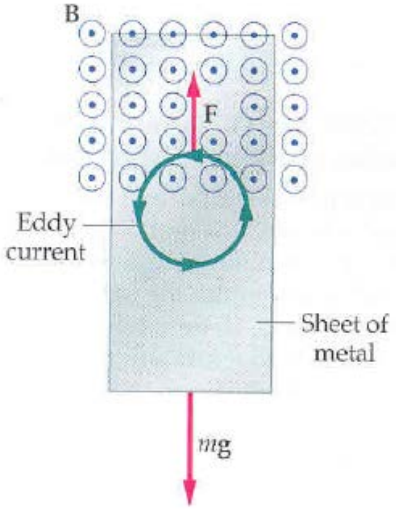
Lenz's law states that an induced current always flows in a direction that opposes the change that caused it.



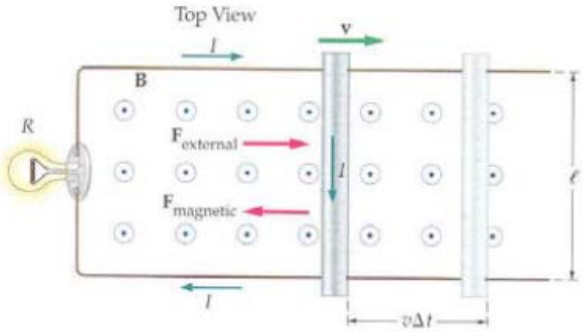

# Induced currents



## Example 1

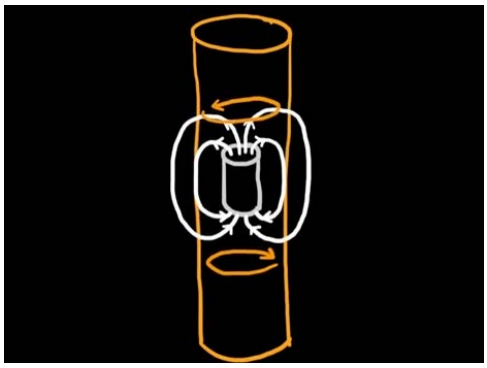



## Example 2




## Example 3

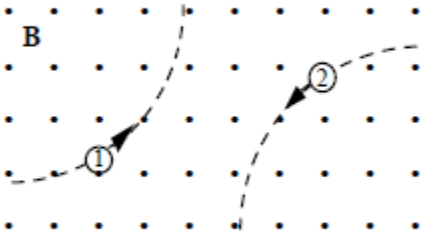
A magnet falling through a copper tube



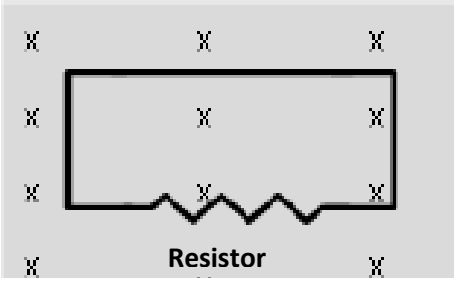
Eddy currents in the copper tube

# Puzzles

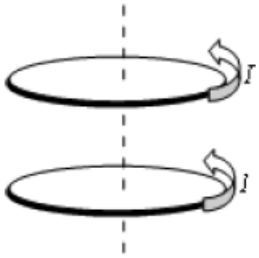
1. Determine the charge signs of particles 1 and 2?




2. State the ways to cause an induced current to flow through the resistor.




3. If the current in the upper loop suddenly drops to zero, what will happen to the current in the lower loop according to Lenz's law?



**Answers:**

1. Particle **1** is negatively charged; **2** is negative

2. - changing the area of the loop
   - changing the magnitude of the magnetic field
   - rotating the loop about an axis not perpendicular to the plane of circuit

3. The current in the lower loop will increase.