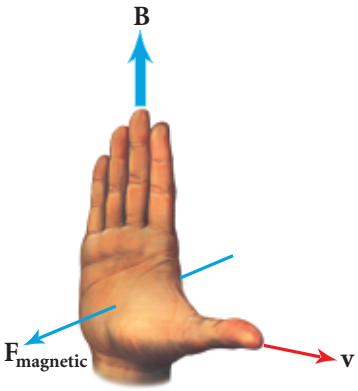


Figure 9
Use this alternative right-hand rule to find the direction of the magnetic force on a positive charge.

Conventional laboratory magnets can produce magnetic fields up to about 1.5 T. Superconducting magnets that can generate magnetic fields as great as 30 T have been constructed. For comparison, Earth's magnetic field near its surface is about 50 μT (5×10^{-5} T).

An alternative right-hand rule can be used to find the direction of the magnetic force

Experiments show that the direction of the magnetic force is always perpendicular to both the velocity, **v,** and the magnetic field, **B.** To determine the direction of the force, use the right-hand rule. As before, place your fingers in the direction of **B** with your thumb pointing in the direction of **v,** as illustrated in **Figure 9.** The magnetic force, $\mathbf{F}_{\mathbf{magnetic}}$, on a positive charge is directed *out* of the palm of your hand.

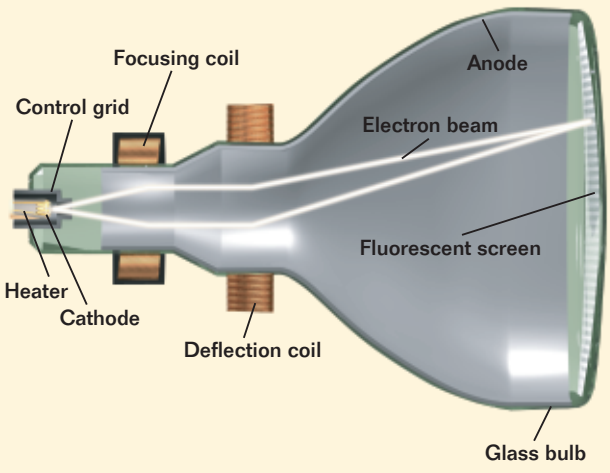
If the charge is negative rather than positive, the force is directed *opposite* that shown in **Figure 9.** That is, if q is negative, simply use the right-hand rule to find the direction of $\mathbf{F}_{\mathbf{magnetic}}$ for positive q, and then reverse this direction for the negative charge.

Why it Matters

Television Screens

The force on a moving charge due to a magnetic field is used to create pictures on a television screen. The main component of a television is the *cathode ray tube,* which is essentially a vacuum tube in which electric fields are used to form a beam of electrons. Phosphor on the television screen glows when it is struck by the electrons in the beam. Without magnetism, however, only the center of the screen would be illuminated by the beam. The direction of the beam is changed by two electromagnets, one deflecting the beam horizontally, the other deflecting the beam vertically. The direction of the beam can be changed by changing the direction of the current in each electromagnet. In this way, the beam illuminates the entire screen.

In a color television, three different colors of phosphor—red, green, and blue—make up the screen. Three electron beams, one for each color, scan over the screen to produce a color picture.



In a cathode ray tube, the *cathode* is a heated filament inside a vacuum tube, similar to the filament in a light bulb. The *ray* is a stream of electrons that come off the heated filament into a vacuum.