Magnetic Field Forces and Sources:

(1) A positive point charge is moving along the x axis toward $x = 0$. There is a uniform magnetic field $\mathbf{B}$ at all points in space, directed along the $+z$ axis. In what direction is the force exerted by the field on the charge?

Answer: The charge has a velocity in direction $-\widehat{\mathbf{i}}$. The magnetic field has direction $\widehat{\mathbf{k}}$. Sweeping the fingers of your right hand from vector $-\widehat{\mathbf{i}}$ to $\widehat{\mathbf{k}}$, you will find your thumb points in the $+\widehat{\mathbf{j}}$ direction. That is the direction of the resulting force on a positive charge.

(2) Now the positive charge is moving in the $+\widehat{\mathbf{k}}$ direction, with the field in the same direction as question (1). What is the direction of the force on the positive charge?

Answer: there is no force. In order for a force to exist, there must be some finite angle θ between the velocity vector $\mathbf{v}$ and the field $\mathbf{B}$.

(3) A current-carrying wire lies along the y axis, with a current flowing in the $+y$ direction. There is a uniform magnetic field $\mathbf{B}$ in the $+\widehat{\mathbf{i}}$ direction. In what direction is the force on the current, due to the field?

Answer: Sweep your fingers from the current to the field, in other words from $+\widehat{\mathbf{j}}$ to $+\widehat{\mathbf{i}}$. Your thumb points in the $-\widehat{\mathbf{k}}$ direction, in other words down the $-z$ axis.

(4) A current-carrying wire lies along the z axis, with a current flowing in the $+z$ direction. The wire is at $x = y = 0$. If we come out to a distance $x > 0$ from the wire, in what direction does the magnetic field due to the current point at that position?

Answer: the $\mathbf{B}$ field wraps around the wire like the fingers of your right hand, if your thumb points in the direction of the current. So on the $x > 0$ axis, the $\mathbf{B}$ field points in the $\widehat{\mathbf{j}}$ direction.

(5) A current loop lies on the table in front of you. As seen from above, the current in the loop circulates counter-clockwise. In what direction is the $\mathbf{B}$ field at the center of the loop?

Answer: Sweep the fingers of your right hand around the loop in the direction of the current. You note that your thumb points downward. So the magnetic field at the center of the loop is perpendicular to the table, directed downward into it.