L15 – Motor Effect and Circular Motion

L13 - Motor Effect on a Point Charge:

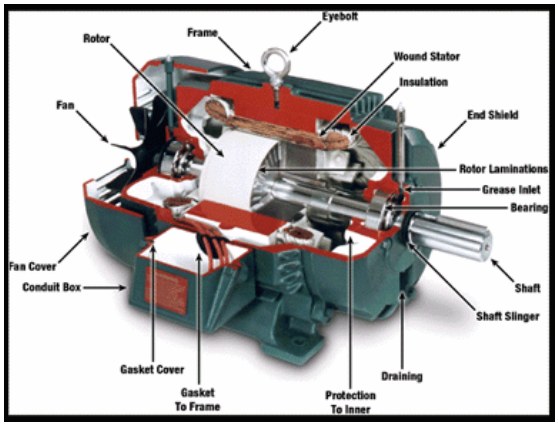
$$|\vec{F}_m| = qv_\perp|\vec{B}|$$

L14 - Motor Effect on a Wire:

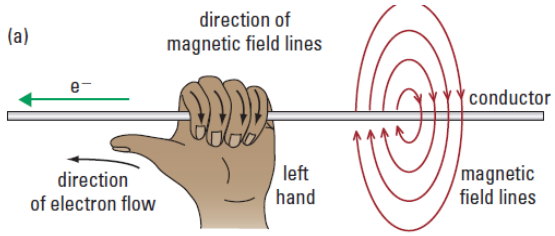
$$I = \frac{q}{t} \qquad |\vec{F}_m| = Il_\perp|\vec{B}|$$

L15 - Motor Effect and Circular Motion:

$$|\vec{F}_m| = qv_\perp|\vec{B}| \quad |\vec{a}_c| = \frac{v^2}{r} \quad |\vec{v}_c| = \frac{2\pi r}{T}$$



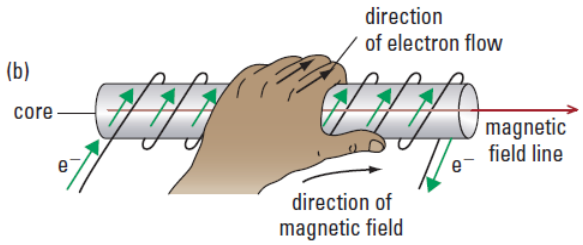
Review of Left-Hand Rules



Thumb: Direction of negative charge movement (straight line).

...Results In...

Fingers: Resulting magnetic field (curving).



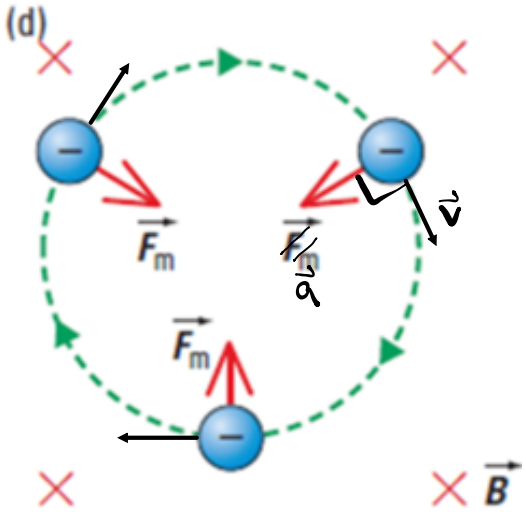
Fingers: Direction of negative charge movement (curving).

...Results In...

Thumb: Resulting magnetic field (straight line).

Motor Effect and Circular Motion

Magnetic Force and Circular Motion



$$|\vec{F}_m| = qv_\perp|\vec{B}|$$

$$|\vec{a}_c| = \frac{v^2}{r} \quad F_c = ma_c \quad F_c = \frac{mv^2}{r}$$ (memorize)

$$|\vec{v}_c| = \frac{2\pi r}{T}$$

+1c

Q1: Ions, with a charge of 1.60×10^{-19} C and a mass of 8.12×10^{-26} kg, travel perpendicularly through a region with an external magnetic field of 0.150 T. If the perpendicular speed of the ions is 8.00×10^4 m/s, determine

(a) the magnitude of the deflecting force on the ion

(b) the radius of curvature of the motion of the deflected ion

$$|\vec{F}_m| = qv_\perp|\vec{B}| \quad |\vec{a}_c| = \frac{v^2}{r} \quad |\vec{v}_c| = \frac{2\pi r}{T}$$

(A) $F_m = qvB$

$F_m = (1.60\times10^{-19})(8\times10^4)(0.15)$

$= 1.92\times10^{-15}$ N

(B) $F_m = F_c$

$qvB = \frac{mv^2}{r}$

$qB = \frac{mv}{r}$

$\cdot r \quad \cdot r$

$rqB = mv$

$\div qB \quad \div qB$

$r = \frac{mv}{qB}$

$r = \frac{(8.12\times10^{-26})(8.00\times10^4)}{(1.60\times10^{-19})(0.15)}$

$r = 0.27$ m