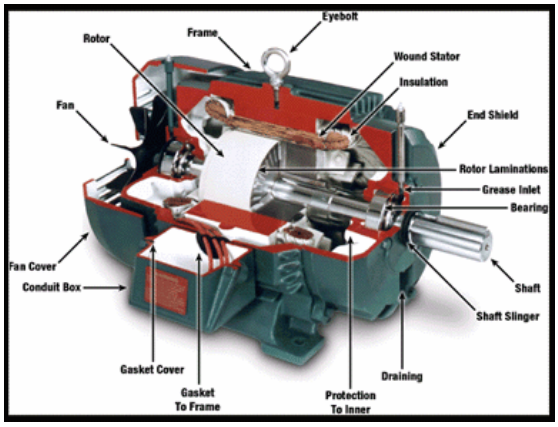
L14 – Motor Effect on a Wire



L13 - Motor Effect on a Point Charge:

$$\left|\vec{F}_{\mathrm{m}}\right| = qv_{\perp}\left|\vec{B}\right|$$

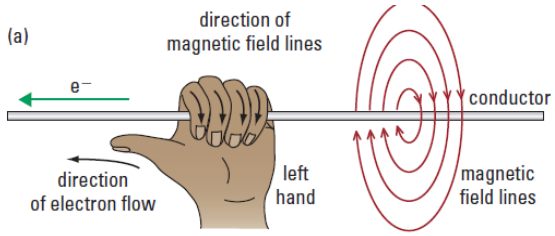
L14 - Motor Effect on a Wire:

$$I = \frac{q}{t} \qquad \left|\vec{F}_{\mathrm{m}}\right| = Il_{\perp}\left|\vec{B}\right|$$

L15 - Motor Effect and Circular Motion:

$$\left|\vec{F}_{\mathrm{m}}\right| = qv_{\perp}\left|\vec{B}\right| \quad \left|\vec{a}_{\mathrm{c}}\right| = \frac{v^2}{r} \quad \left|\vec{v}_{\mathrm{c}}\right| = \frac{2\pi r}{T}$$

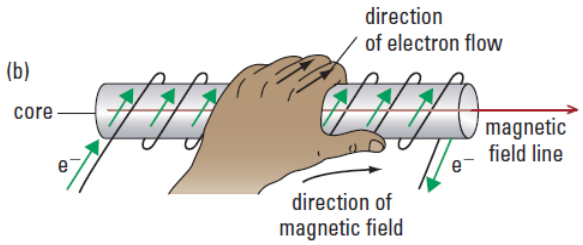
Review of Left-Hand Rules



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

...Results In...

Fingers: Resulting magnetic field (curving).



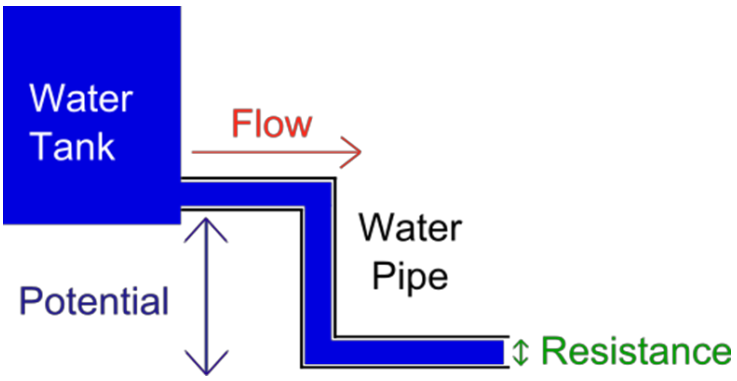
Fingers: Direction of negative charge movement (curving).

...Results In...

Thumb: Resulting magnetic field (straight line).

Electrical Circuits (Grade 9)

$V = I*R$



Electrical Circuits (Grade 12)

Current is the amount of charge that flows through a wire in a given unit of time.

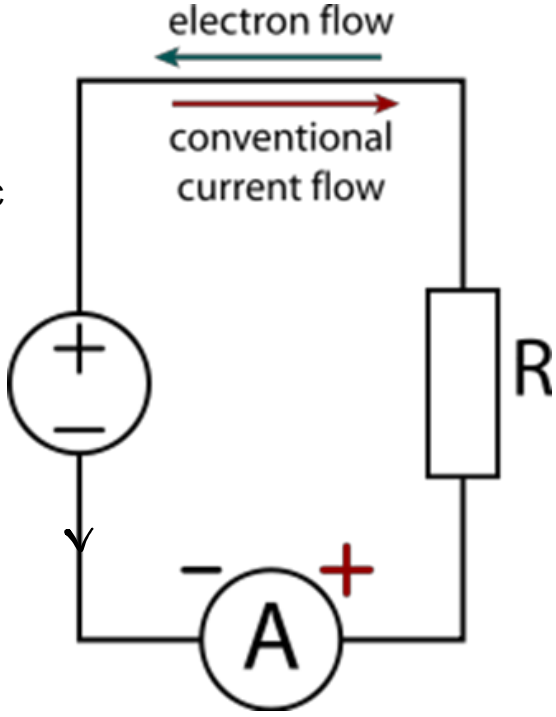
$$I = \frac{q}{t}$$

Current (A) ↙ ; q → Charge (C) ; t → time (s)

Q1: Calculate the current in a wire through which 20.0 C of charge passes in 4.00 s.

$I = \frac{q}{t} = \frac{20.0\,C}{4\,s}$

$I = 5\,A$



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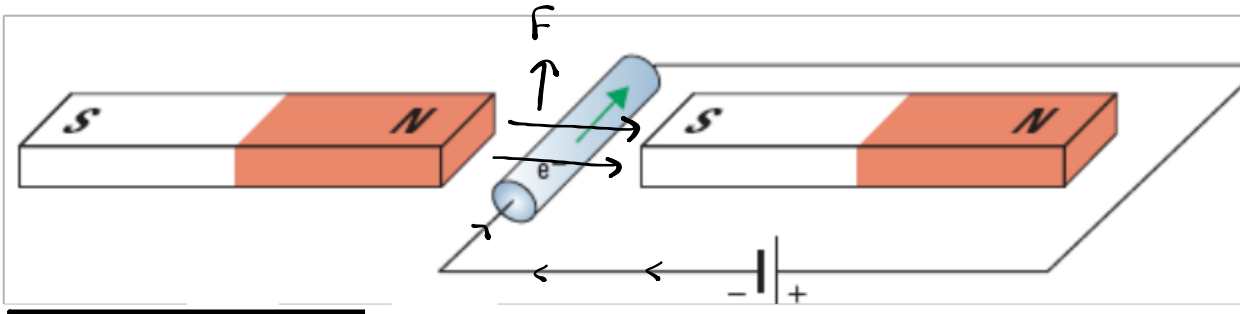
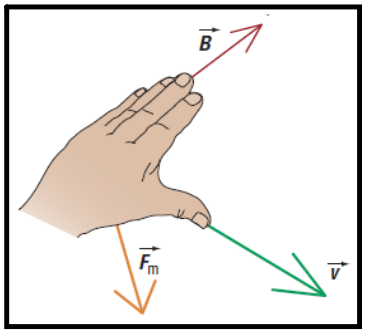
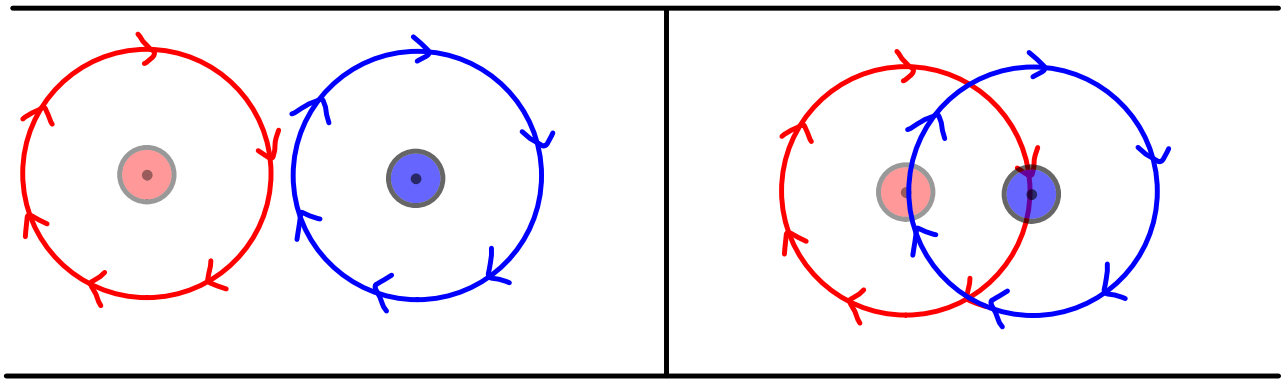
Left-Hand Rule and Electron Flow

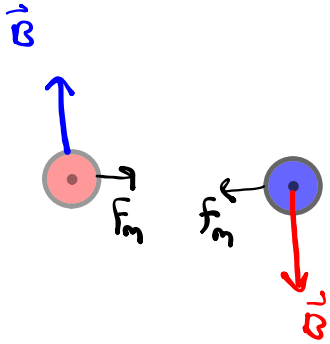
Q2: In the diagram below, in what direction is the force acting on the wire?





Q3: If I have two wires parallel to each other what is the direction of force if the currents are in the same direction.





Motor Effect Equation for a Current Carrying Wire

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

F = Force (N)
I = Current (A)
L = length (m)
B = Mag. Field (T)

Q4: An 8.50 cm length of conducting wire lies perpendicular to an external magnetic field of magnitude 4.20 mT. If there is a negative charge flow of 2.10 A in the conductor, calculate the magnitude and determine the direction of the magnetic force of the wire.

L = 0.085m
B = 4.2×10^{-3} T
I = 2.1A
F_m = ?

$F_m = ILB$
$= 7.497 \times 10^{-4}$ N

$F_m = ILB$ → Current in a wire

$F_m = qvB$ → Single moving point charge