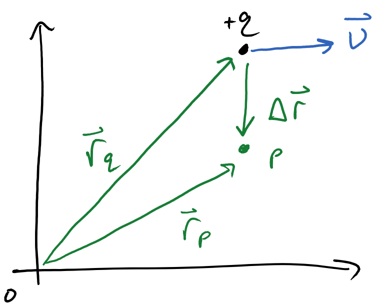
Magnetic Fields (completed)

Wednesday, May 25, 2016 2:42 PM

B-field from point q



Convention

⊗	into page
⊙	out of page

find $\vec{B}(p)$

Biot-Savart Law

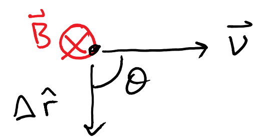
cross product

$$\vec{B} = \frac{\mu_0}{4\pi} q \frac{\vec{v} \times \Delta\hat{r}}{|\Delta\vec{r}|^2}$$

mag

$$|\vec{B}| = \frac{\mu_0}{4\pi} |q| \frac{|\vec{v}|\,\cancel{|\Delta\hat{r}|}^{\,1} \sin\theta}{|\Delta\vec{r}|^2}$$

Vector op



dir

RHR: Cross-products

1. fingers in direction of 1st vector ($\vec{v}$)
2. Curl them towards 2nd Vector ($\Delta\hat{r}$)
3. thumb points in resultant ($\vec{B}$)

* Note $\vec{B} \perp$ to both $\vec{v}$ & $\Delta\hat{r}$

* what if q is negative?
* all $\vec{B}$ directions opposite
* or use Left hand. *

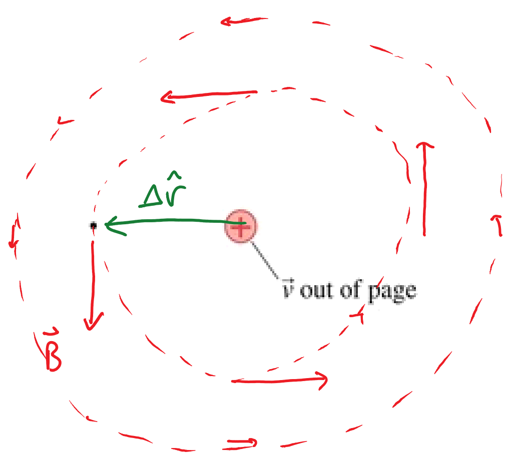
The positive charge is moving straight out of the page. Sketch the magnetic field vector at the position of the dot?

$\vec{B}$ direction

RHR for cross-products

$\vec{v} \times \Delta\hat{r}$

* Note resultant $\perp$ to both $\vec{v}$ & $\Delta\vec{r}$



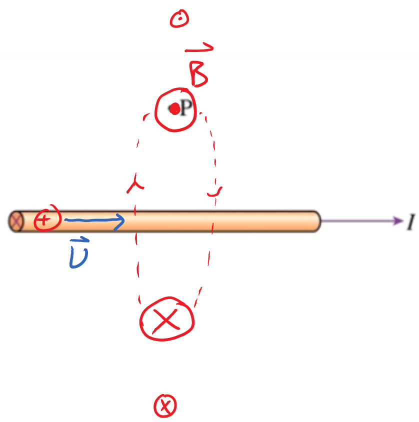
---- Note Alternative

... direction of $\vec{v}$

- Thumb in direction of $\vec{v}$
- Fingers curl in direction of $\vec{B}$

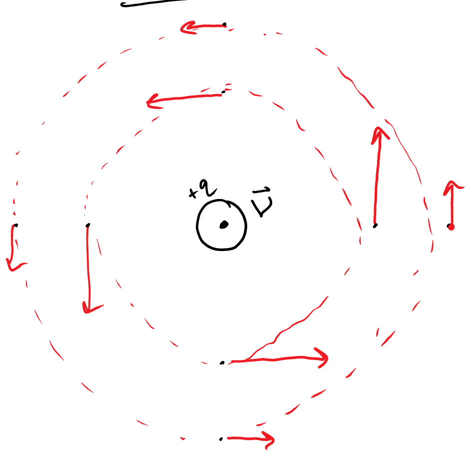
The magnetic field at the position P points

1. **Into the page**
2. **Up**
3. **Down**
4. **Out of the page**
5. **zero**

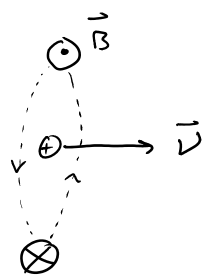


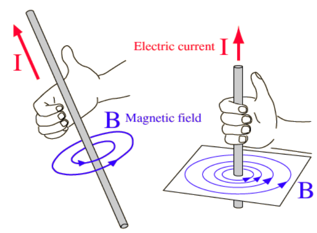
B-field from an ~~∞~~ straight wire

Heads on View



Side View





$$|\vec{B}| = \frac{\mu_0 I}{2\pi r}$$

r ← distance from wire

RHR: $\vec{B}$ direction from $\vec{v}$ (current I)

① Thumb in direction of $\vec{v}$ (or I)

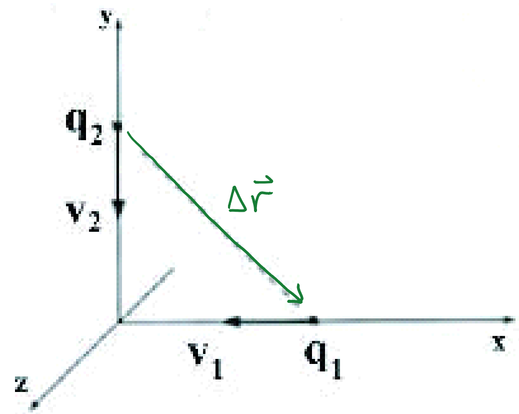
② Fingers curl in direction of $\vec{B}$

Suppose q1 and q2 are positive charges. The magnetic field due to charge q2 at the location of q1

1. points towards the +x direction
2. points towards the +y direction
3. points towards the +z direction
4. points towards the -x direction
5. points towards the -y direction
6. points towards the -z direction
7. points nowhere because it is zero
8. points in some other direction

$\vec{v} \times \Delta\hat{r}$

RHR: cross-products



The magnetic field due to charge q1 at the location of q2? $-\hat{z}$ direction

The magnetic field at the point Q

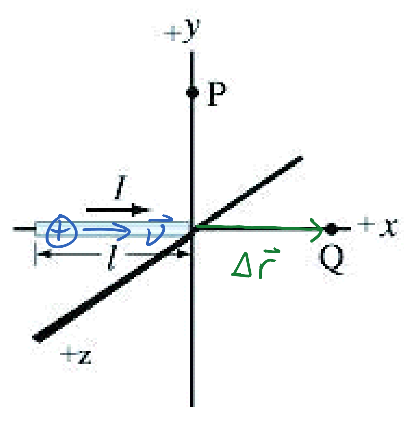
1. points towards the +x direction
2. points towards the +y direction
3. points towards the +z direction
4. points towards the -x direction
5. points towards the -y direction
6. points towards the -z direction
7. points nowhere because it is zero

$\vec{v} \times \Delta\hat{r}$ ... max when

$\vec{v} \perp$ to $\Delta\hat{r}$

... zero if

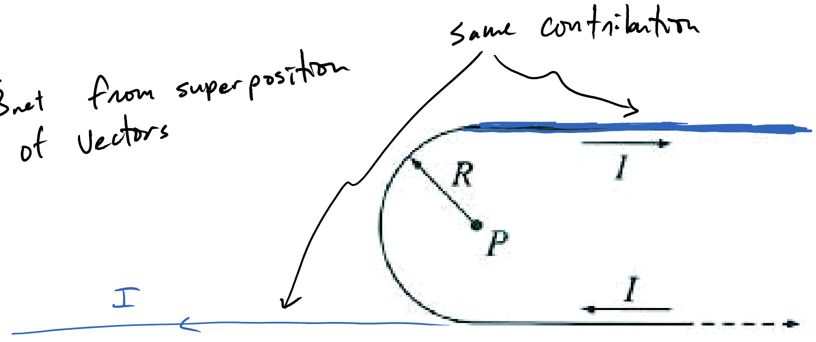
$\vec{v}$ + $\Delta\hat{r}$ are //



The magnetic field at the point P is

1. equal to the field of a semicircle loop
2. equal to the field of a semicircle loop plus the field of a very long straight wire
3. equal to the field of a semicircle loop minus the field of a very long straight wire
4. none of the above

$\vec{B}_{net}$ from superposition of vectors

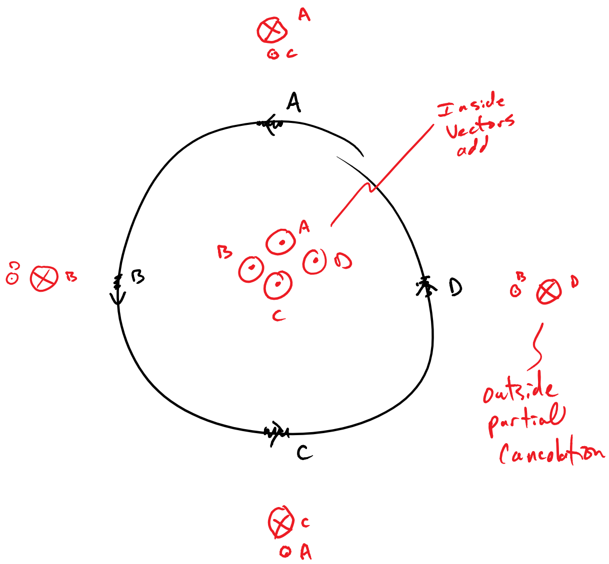


Which of the following statements is true

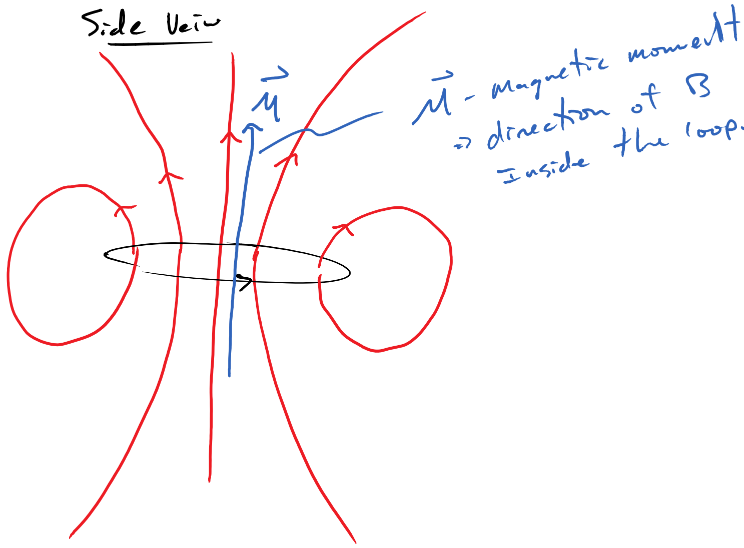
1. the magnetic field is stronger where the magnetic field lines are closer together
2. the magnetic field is stronger where the magnetic field lines are farther apart
3. the magnetic field strength has nothing to do with the proximity of the magnetic field lines

B-field from current loop

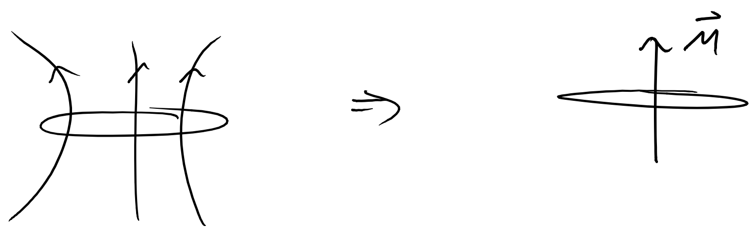
top veiw



Side Veiw



Simplify representation



RHR: B-field from loops ($\vec{\mu}$)

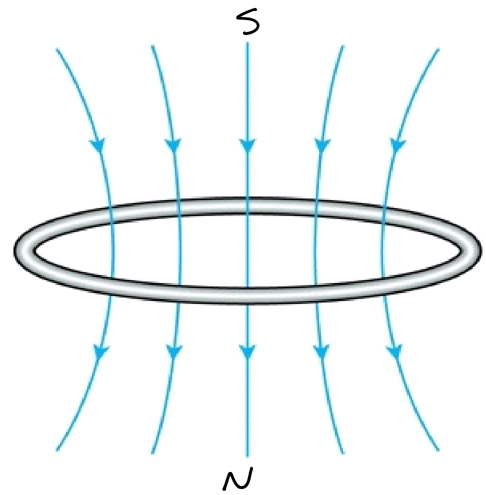
1. fingers in direction of I
2. thumb points in direction of $\vec{\mu}$

What is the current direction in this loop as viewed from above? And which side of the loop is the north pole?

1. Current counterclockwise, north pole on bottom

What is the current direction in this loop as viewed from above? And which side of the loop is the north pole?

1. **Current counterclockwise, north pole on bottom**
2. **Current clockwise; north pole on bottom**
3. **Current counterclockwise, north pole on top**
4. **Current clockwise; north pole on top**



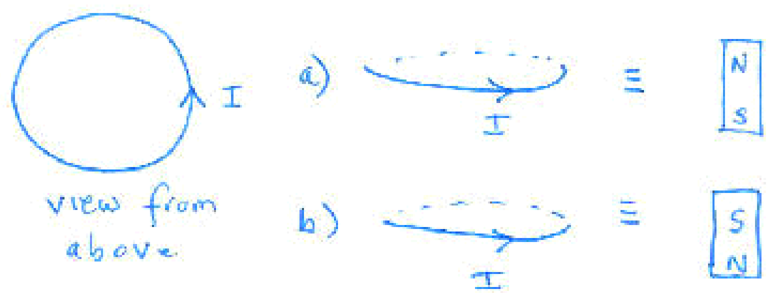
RHR: Current loops

- wrap fingers in direction of I
  - Thumb points in direction of $\vec{B}$

Suppose a coil of wire lying in a horizontal plane has current flowing in a counterclockwise direction as viewed from the above. The magnetic field of the coil resembles a bar magnet with

1. **the north pole of the magnet pointing upwards**
2. **the north pole of the magnet pointing downwards**

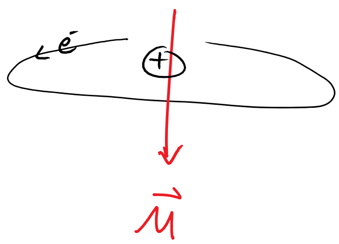
$\vec{B}$-field from magnets same as from current loops



In the classical model of the hydrogen atom, an electron moves in a circular orbit about a proton under the action of an electrical force. Assume that the electron is traveled in a counterclockwise direction when observed from above. The direction of the magnetic moment of the electron due to this orbital motion is

1. **up**
2. **down**
3. **points in the plane of the orbit**
4. **not specified by the information given**

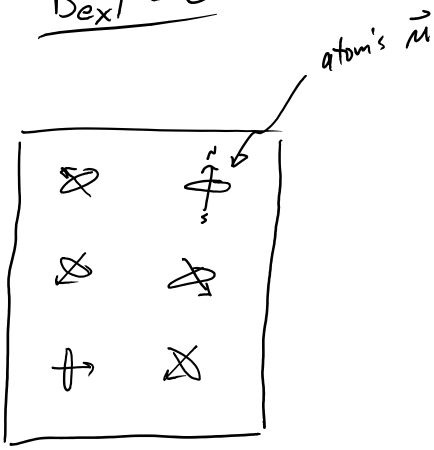
RHR: current loops
(but neg. charge)



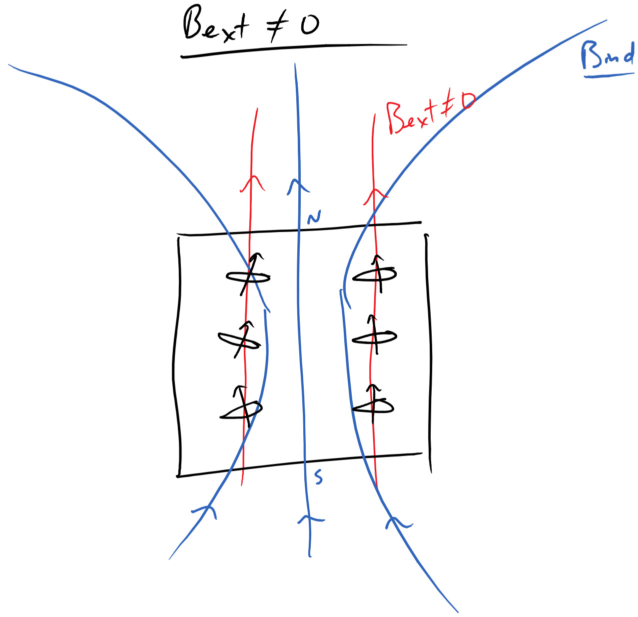
Magnetism

$\vec{B}$-field from paramagnet → Can be temporarily magnetized (Induced B-field)

$B_{ext} = 0$



$B_{ext} \neq 0$

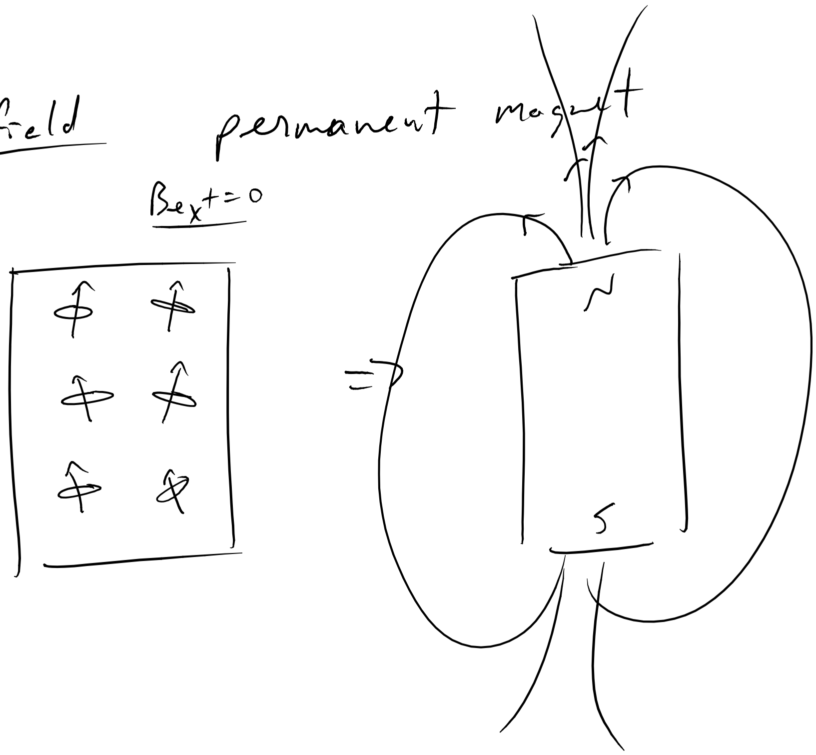


* Vector cancelation of atoms $\vec{\mu}$

* Vector cancelation of atoms $\vec{\mu}$ generates no $\vec{B}_{induced}$

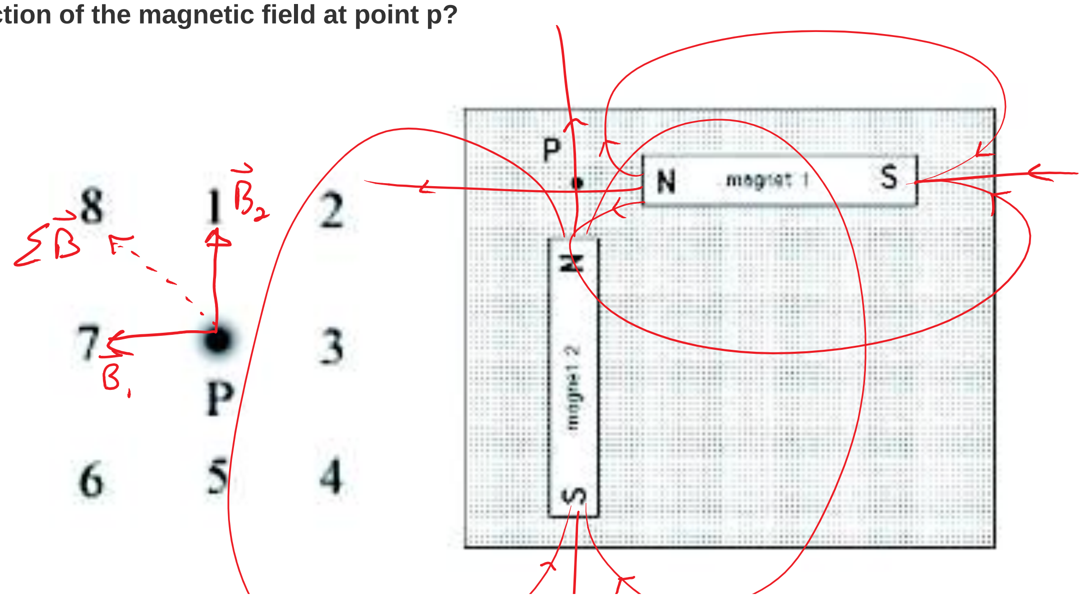
* each $\vec{\mu}$ of atoms lines up & vector addition yields $B_{ind} \neq 0$

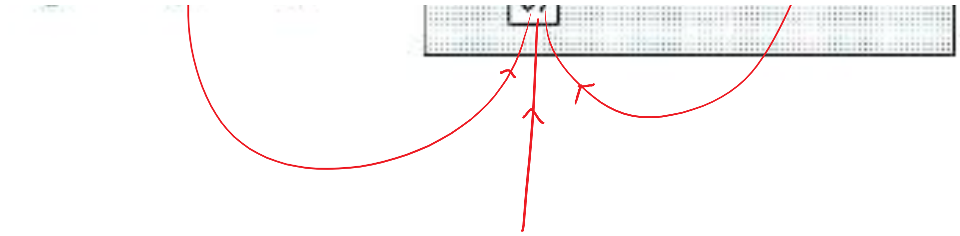
B-field permanent magnet



Imagine that two identical bar magnets are placed at right angles to one another with their north poles oriented as shown in the figure. The magnets are equidistant from point P, the point that lies along the centerlines of both magnets. What is the direction of the magnetic field at point p?

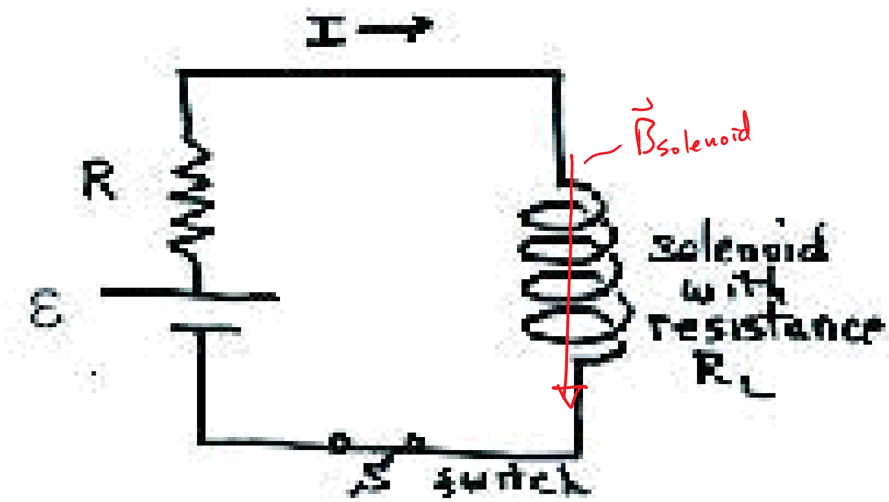
1. towards 1
2. towards 2
3. towards 3
4. towards 4
5. towards 5
6. towards 6
7. towards 7
8. towards 8





Consider a circuit with the wire coiled in the form of a solenoid. When the switch is closed, what is the direction of the magnetic field through the solenoid?

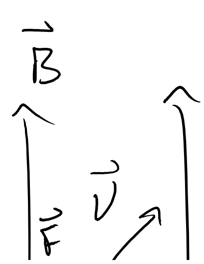
Many loops all w/ $\vec{B}$ in same direction



Magnetic Force

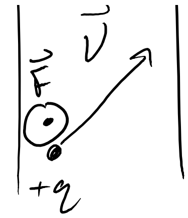
$$\vec{F}^B = q \vec{v} \times \vec{B}$$

ex.



$F^B = q V \times B$

$\leftarrow$ cross product



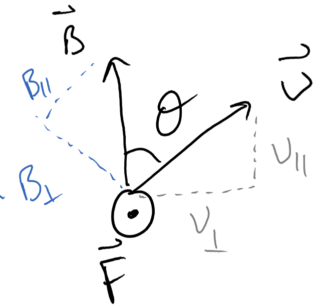
mag $|\vec F^B| = |q|\,|\vec v|\,|\vec B| \sin\theta$

$= |q|\, v_\perp\, |\vec B|$

$= |q|\, |\vec v|\, B_\perp$

* the more $\perp$ $\vec v$ + $\vec B$ the larger the force

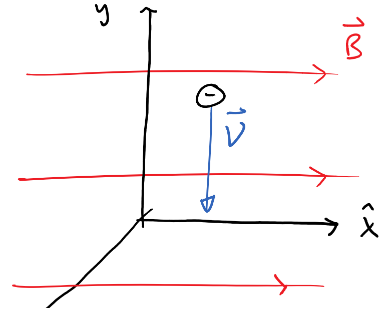
Vector op



direction w/ RHR cross products

An electron moves along the –y axis with a speed of 1.0 x 10^7 m/s. A 0.50 T magnetic field points in the positive x-direction. What is the force on the electron?

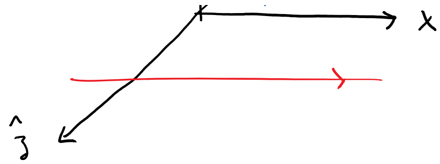
1. **8 x 10^{-13} N, negative z-direction**
2. **8 x 10^{-13} N, positive z-direction**
3. **7 x 10^{-12} N, negative x-direction**
4. **7 x 10^{-12} N, positive y-direction**
5. **6 x 10^{-11} N, negative z-direction**



mag

$|\vec F| = |q|\,|\vec v|\,|\vec B| \sin\theta = 8\times10^{-13}$ N

Mag $|\vec{F}| = |q||\vec{v}||\vec{B}|\cancel{\sin\theta}^{1} = 8\times10^{-13}$ N



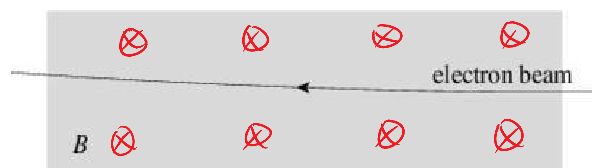
dir RHR: Cross-products

$-\hat{y} \times (+\hat{x}) = +\hat{z}$ ... but electron so $-\hat{z}$

A beam of electrons enters a region with a magnetic field as shown below. If the beam is deflected upward, the magnetic field must be oriented

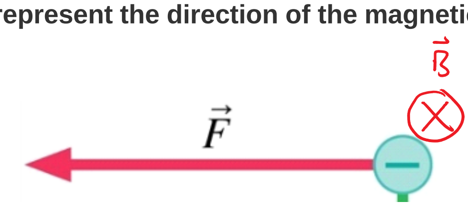
RHR: Cross-product

1. **downward.**
2. **up.**
3. **into the plane of the drawing.**
4. **out of the plane of the drawing.**
5. **to the left.**
6. **to the right.**
7. **None of the above -- it is at an angle.**
8. **Need more information to determine.**

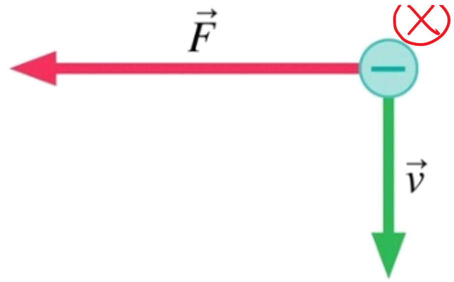


An electron moves perpendicular to a magnetic field. Sketch a vector to represent the direction of the magnetic field.

RHR: Cross-product

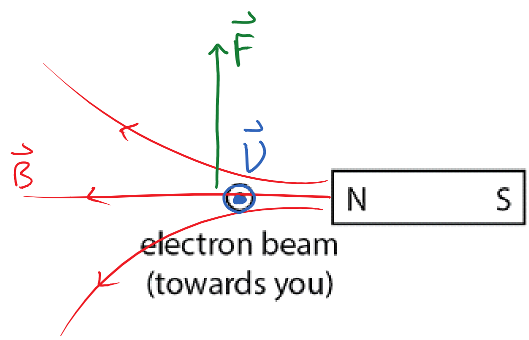


RHR: Cross-product



A beam of electrons moves toward you perpendicular to your screen. The North pole of a permanent bar magnet is brought near the beam, pointing toward the beam. Indicate the direction of the magnetic force on the electrons.

RHR: Cross-product



A negatively charged particle is released from rest between the plates of a capacitor under the combined influence of a magnetic field *B* (directed out of page) and the electric field in the capacitor. Which of the paths shown best represents the trajectory of the particle (ignore gravity)?

1. 1
2. 2

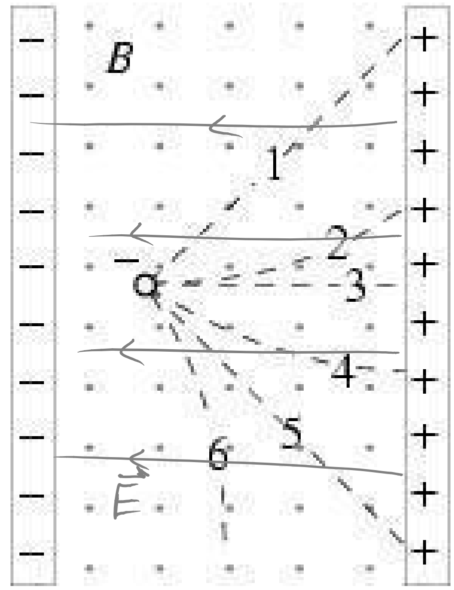
$\vec{E}$ accelerates to right

represents the trajectory of the particle (ignore gravity)?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. The particle remains at rest
8. The particle moves out of the plane of drawing

$\vec{E}$ accelerates to right

then $\vec{B}$ adds vertical acceleration

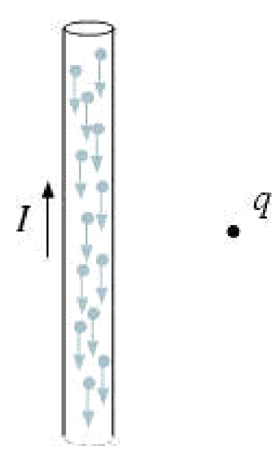


A positively charged particle is placed at rest near a wire carrying a steady upward current. The upward current is due to downward motion of negatively charged electrons in the wire. The wire exerts on the particle

1. an electric force.
2. a magnetic force.
3. both an electric and a magnetic force.
4. no force.

$\vec{F}^B = q\,\vec{v} \times \vec{B}$

w/ $\vec{v} = 0$, $\vec{F}^B = 0$

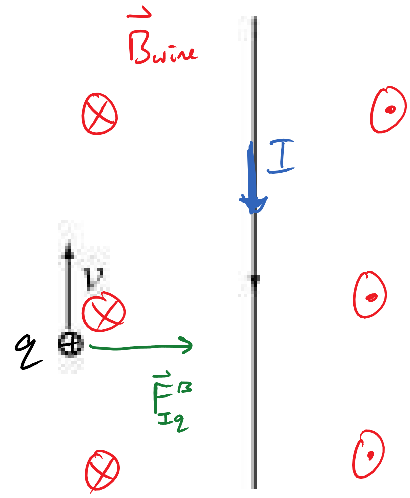


A negatively charged particle moves upward parallel to a wire carrying a downward electric current. In which direction is the magnetic force on the particle?

1. up
2. down
3. into the plane of the drawing
4. out of the plane of the drawing
5. left
6. right

* Find $\vec{B}_{wire}$ @ q

* $\vec{F}_q = q\,\vec{v} \times \vec{B}_{wire}$

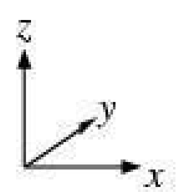


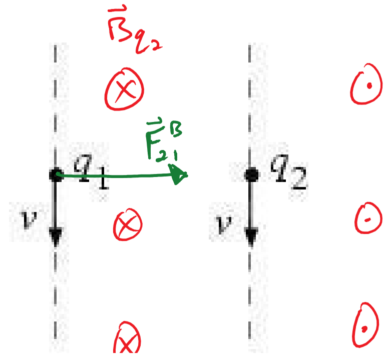
Two positive charges move parallel to each other as shown below. At the instant shown, in which direction is the magnetic force of q_2 on q_1?

1. The magnetic force is zero (v_1 // v_2)
2. $+x$
3. $-x$
4. $+y$
5. $-y$
6. $+z$
7. $-z$
8. Other

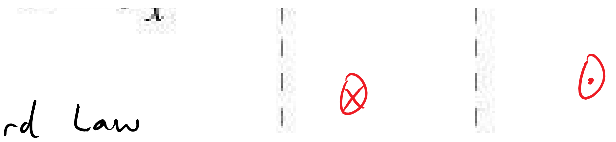
* Find $\vec{B}_2$ @ q_1

* $\vec{F}^B_{21} = q_1 \vec{v}_1 \times \vec{B}_2$





8. Other



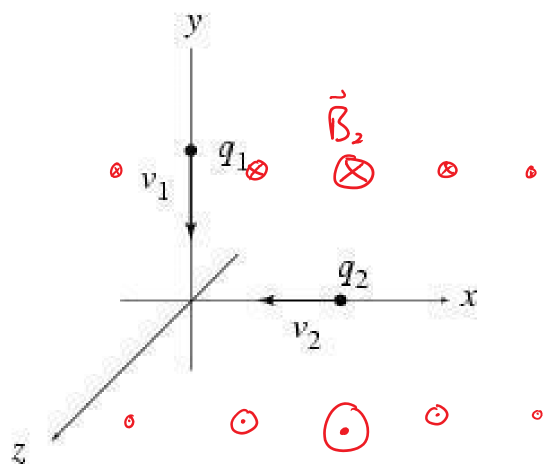
Direction of $\vec{F}_{12}$? .... Newton's 3rd Law

$$\vec{F}^B_{21} = -\vec{F}^B_{12}$$

Two positive charges move toward the origin as represented below. At the instant shown, in what direction is the magnetic force of q_2 on q_1?

1. The magnetic force is zero
2. +*x*
3. -*x*
4. +*y*
5. -*y*
6. +*z*
7. -*z*
8. Other

$$\vec{F}^B_{21} = q_1 \vec{v}_1 \times \vec{B}_2$$



Two parallel current-carrying wires are placed next to each other. When current flows in the opposite direction in the wires, they

1. attract each other.
2. repel each other.
3. don't interact.

look @ previous problem .... w/ $\vec{v}$ //, they attract

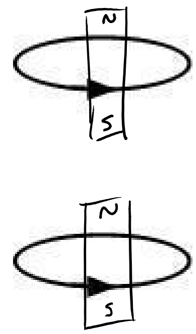
w/ $\vec{v}$ anti-//, they repel

Two identical current loops are placed one above other. If the currents flow in the direction indicated by the arrows, the two loops

1. repel.
2. attract.
3. do not interact.
4. exert torques on each other.
5. push each other sideways.

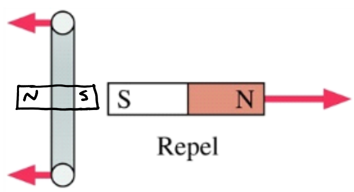
* // currents attract

* or think of Dipole Moment



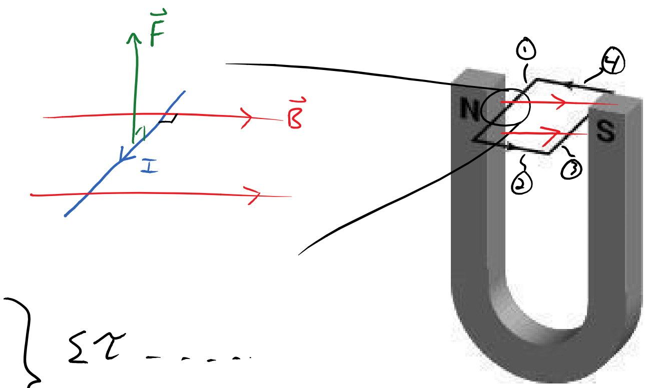
What is the current direction in the loop? (The red arrows are showing the forces on both the magnet and the loop)

1. Out of the page at the top of the loop, into the page at the bottom
2. Out of the page at the bottom of the loop, into the page at the top



A current loop is placed between the poles of a horseshoe magnet, as shown below. The loop tends to

1. **rotate, left side up.**
2. **rotate, right side up.**
3. **rotate, front side up.**
4. **rotate, rear side up.**
5. **none of the above -- it stays in place.**
6. **other.**



w/ $\vec{B}$-force

1 Force upward
2 + 4 zero Force
3 Force downward

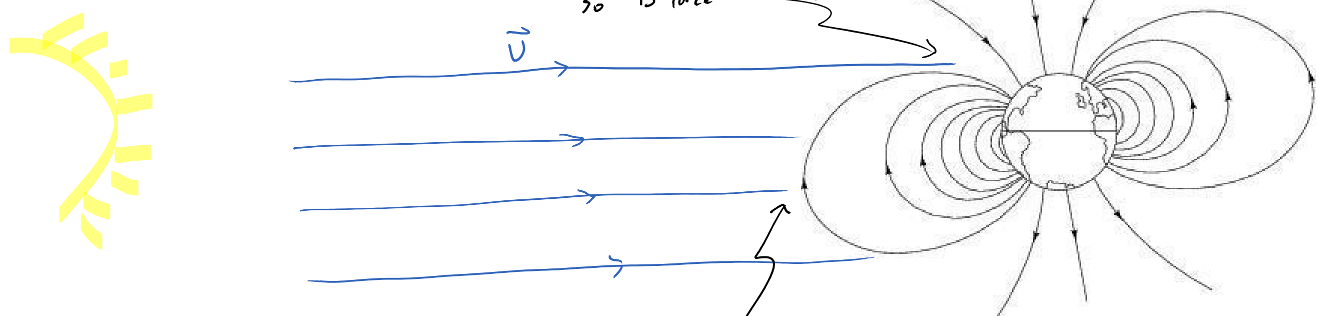
$\Sigma\tau$ - - - -

Current loops experience a torque that tends to line the loop $\vec{\mu}$ w/ the external field.

Cosmic rays (atomic nuclei stripped bare of their electrons) would continuously bombard Earth's surface if most of them were not deflected by Earth's magnetic field. Given that Earth is, to an excellent approximation, a magnetic dipole, the intensity of cosmic rays bombarding its surface is greatest at the

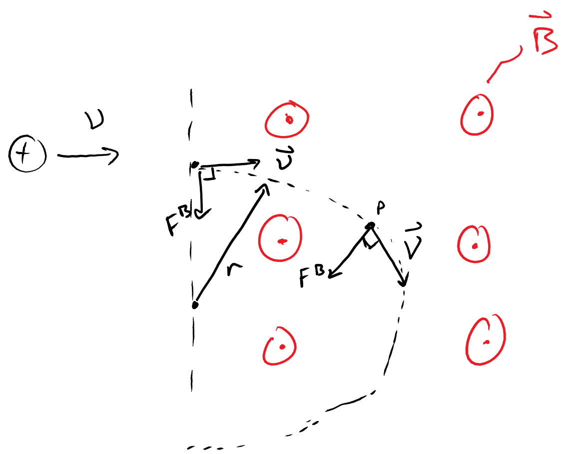
1. **poles.** ← Aurora
2. **mid-latitudes.**
3. **equator.**

$\vec{v}$ + $\vec{B}$ least ⊥
so $\vec{B}$-force weakest

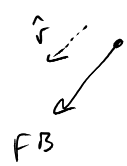


$\vec{v}$ & $\vec{B}$ most ⊥
so $\vec{B}$-force greatest

B-field & particle Uniform Circular Motion



FBD (p) $\quad \Sigma F_r \Rightarrow |q||\cancel{\vec{v}}||\vec{B}| \cancel{\sin\theta}^{\,1} = m\frac{\cancel{v^2}}{r}$



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

Two beams of particles enter the same magnetic field with the same velocity, perpendicular to the field. If the mass of particles in beam A is twice that of B and the charge of particles in A are four thirds that of B. What is the ratio of the radius of curvature of A to that of B?

$r = \frac{mv}{qB}$, $\vec{v}_A = \vec{v}_B \equiv \vec{v}$, $\vec{B}_A = \vec{B}_B \equiv \vec{B}$, $m_A = 2m_B$, $q_A = \frac{4}{3} q_B$

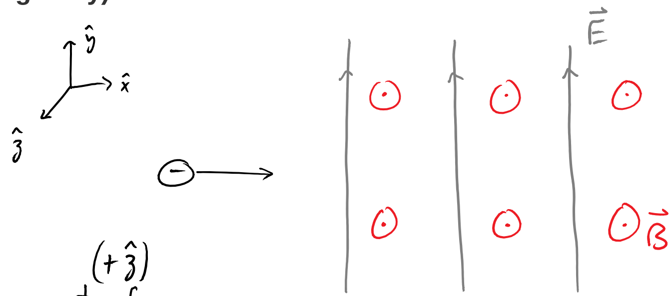
$\boxed{A}$ $\quad r_A = \frac{m_A v}{q_A B} = \frac{(3)2 m_B v}{4 q_B B}$

$\boxed{B}$ $\quad r_B = \frac{m_B v}{q_B B}$

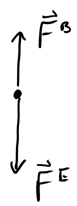
$$\frac{r_A}{r_B} = \frac{6\cancel{m_B}\cancel{v}}{4\cancel{q_B}\cancel{B}} \cdot \frac{\cancel{q_B}\cancel{B}}{\cancel{m_B}\cancel{v}} = \frac{3}{2}$$

An electron, moving in the positive x-direction at a speed of 200 km/s, enters a region where both an electric and magnetic field exist. The electric field points in the positive y-direction and has a magnitude of 1200 N/C. Which of the following magnitude and direction of the magnetic field will keep the electron in equilibrium? (ignore the effects of gravity)

1. **0.006 T, negative z-direction**
2. **0.006 T, positive z-direction**
3. **0.003 T, negative x-direction**
4. **0.003 T, positive y-direction**
5. **0.002 T, negative z-direction**



FBD (e^-)

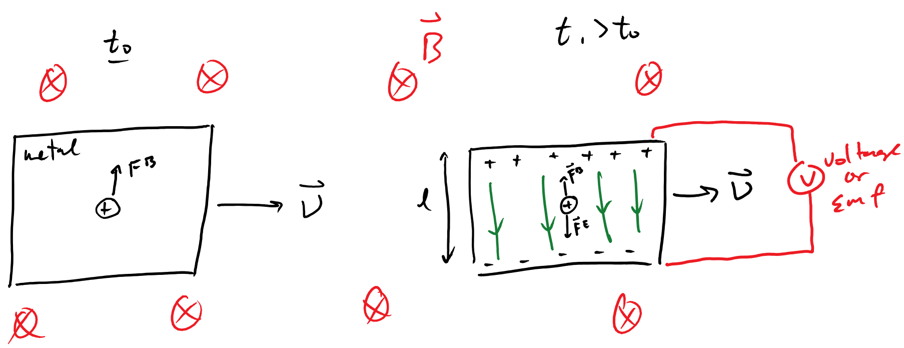


$\vec{B}$ must be out of page $(+\hat{z})$ for equilibrium

$$\Sigma F_y \Rightarrow qvB - qE = m\cancel{a_y}^{\,0}$$

$$\text{So } |\vec{B}| = \frac{|\vec{E}|}{|\vec{v}|} = 0.006\ T$$

Motional Emf (Voltage) : metal moving through B-field generate emf voltage



① Initially no F^E w/ no q seperation

② B-force begins to seperate q's, generates $\vec{E}$

③ @ equilibrium $|\vec{F}^E| = |\vec{F}^B|$ ... $qE = qvB\sin\theta$

w/ ∥ plate $E = -\frac{\Delta V}{\ell} \longrightarrow \boxed{\overset{\text{emf}}{\Delta V} = v\ell B\sin\theta}$

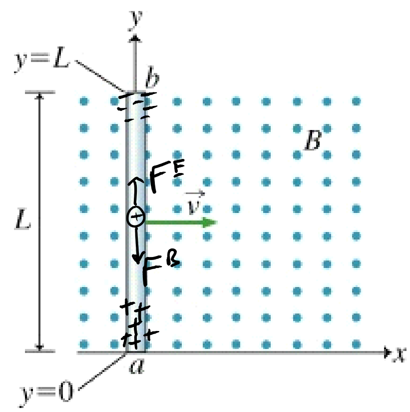
motional emf.

A metal rod is traveling through a magnetic field, as shown in the diagram. What point, a or b, is higher in potential?

1. **a**
2. **b**
3. **neither, both are at a high potential**
4. **neither, both are a a low potential**

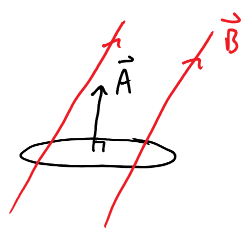
* $\vec{F}^B$ seperates q's

* Seperated q's generate $\vec{E}$

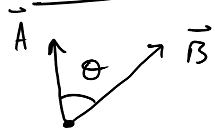


B- Induction

Magnetic Flux, Φ



Vector op



$\Phi = \vec{B} \cdot \vec{A}$ ← area vector

dot product

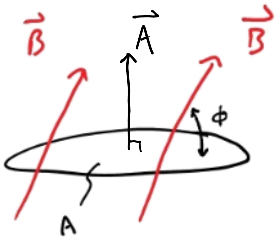
* Note Area vector is ⊥ to plane of the loop

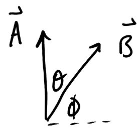
$= |\vec{B}|\,|\vec{A}|\cos\theta$

as $\theta \to 90°$, $\Phi \to 0$

$\theta \to 0°$, $\Phi \to \max$

A circular loop with area 2 m^2, has a uniform magnetic field of 0.02 T going through it at an angle of ϕ = 60 ° with respect to the plane of the loop. What is the magetic flux through the loop?





$$\Phi = \vec{B} \cdot \vec{A} = |\vec{B}||\vec{A}| \cos\theta$$

$$= 0.0346 \ T \cdot m^2$$

Faradays Law : find $|\mathcal{E}mf|$

$$|\mathcal{E}mf| = \frac{|-\Delta\Phi|}{\Delta t} ,$$

Voltage

ex. $\Delta\Phi = \Phi_f - \Phi_i$

$$= B_f A_f \cos\theta_f - B_i A_i \cos\theta_i$$

if B + θ are const.

then $\Delta\Phi = B \cos\theta \, \underbrace{\Delta A}_{A_f - A_i}$

if A + θ are const.

" " $= A \cos\theta \, \Delta B$

if A + B are const.

" " $= AB(\cos\theta_f - \cos\theta_i)$

if more than 1 not constant

A circular loop with area 2 m^2, has a uniform magnetic field of 0.02 T going through it at an angle of $\phi = 60°$ with respect to the plane of the loop. Which of the following actions will result in an induced current in the loop?

1. **rotate the coil** ← $\Delta(\cos\theta)$
2. **decrease the magnetic field**
3. **increase the magnetic field**

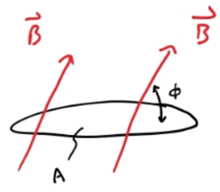
$\}\ \Delta\vec{B}$

4. **nothing, current is already induced in the coil**
5. **move the coil forward and backward**
6. **increase the radius of the loop**
7. **decrease the radius of the loop**

$\}\ \Delta A$

$$|\mathcal{E}mf| = \left|\frac{\Delta\Phi}{\Delta t}\right| = \left|\frac{\Delta(\vec{B}\cdot\vec{A})}{\Delta t}\right|$$

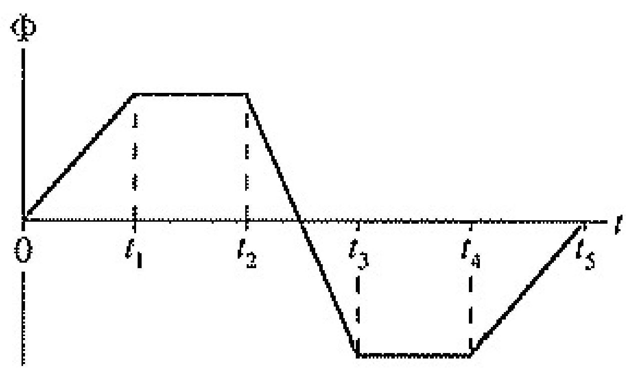
*need changing flux over time



The magnetic flux passing through a coil of wire varies as shown in the plot. During which time interval(s) will an induced current be present in the coil?

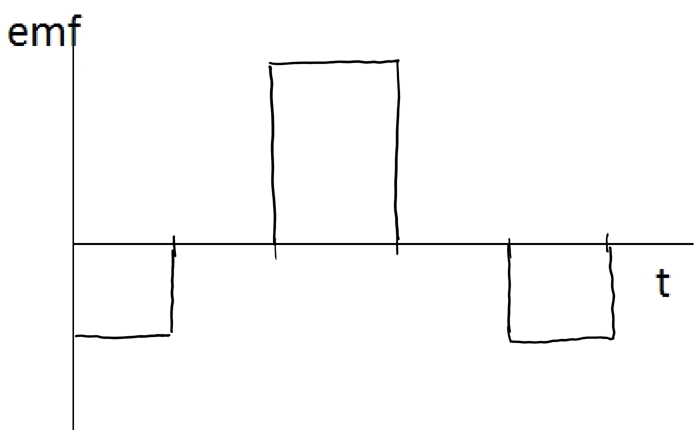
1. **t_0–t_1**
2. **t_1–t_2**
3. **t_2–t_3**
4. **t_3–t_4**
5. **t_4–t_5**

when Φ is not constant



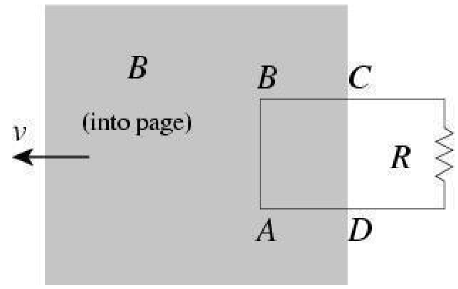
Sketch the induced emf in the coil as a function of time in plot provided.

$$\mathcal{E}mf = -\frac{\Delta\Phi}{\Delta t}$$ or neg the slope



Consider the arrangement shown below. As the magnetic field is moved to the left, a current is induced through the stationary loop. The charges are put in motion by

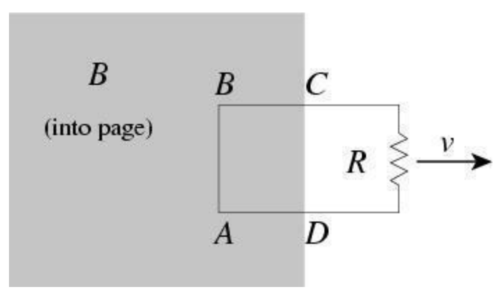
1. a magnetic force on *AB*.
2. a magnetic force on *AB* and *BC*.
3. an electric force.
4. a force that is partly magnetic and partly electric.
5. a new kind of force.



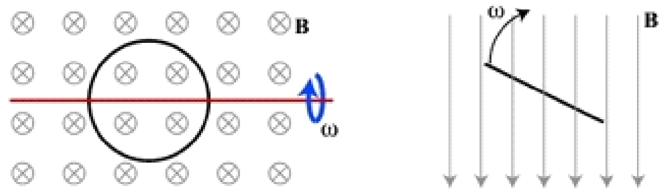
Emf is a Voltage difference
Caused by an Induced Electric field.
* difference E than Coulomb (which is divergent)
* This E is curly ... goes around a loop.

Consider the arrangement shown below. As the loop is moved to the right, a current is induced through the loop and the energy is dissipated in the resistor. The dissipated energy is supplied by

1. work by a magnetic force on *AB*.
2. work by a magnetic force on *AD* and *BC*. B-field does no work
3. the person moving the loop. ← there is resistance
4. a decrease in magnetic field energy. x
5. a change in charge configuration. x
6. none of the above.



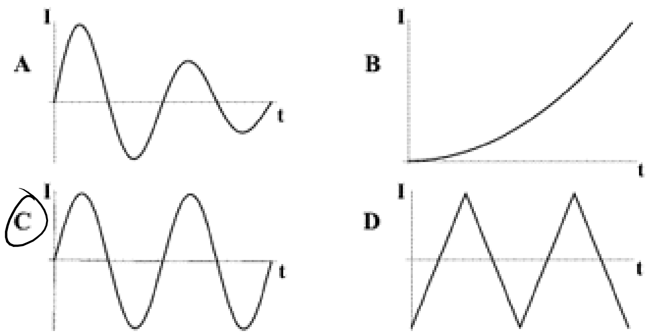
A metal loop with resistance R rotates in a magnetic field at constant angular velocity, as shown below. Which graph correctly depicts the dependence of the current in the loop on time?



$$|\mathcal{E}mf| = \left|\frac{\Delta\Phi}{\Delta t}\right| = \frac{|\vec{B}||\vec{A}|\,\Delta(\cos\theta)}{\Delta t}$$

$$\frac{\Delta(\cos\theta)}{\Delta t} \quad \ldots \quad \theta(t) = \omega t$$

I changes sinusoidally

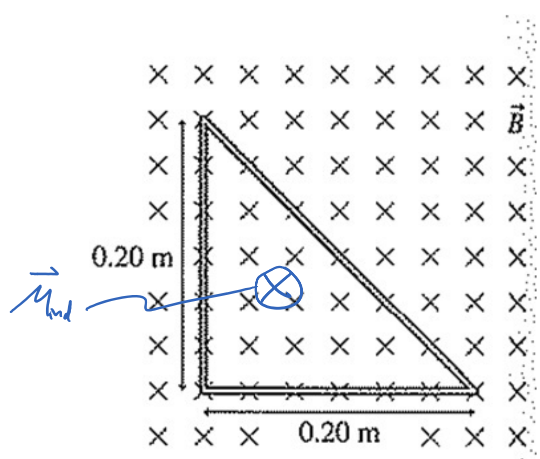


The figure shows a triangle loop of wire in a uniform magnetic field. If the field strength changes from 0.30 to 0.10 T in 50 ms, what is the average induced emf in the loop?

1. 0.08 V
2. 0.12 V
3. 0.16 V
4. 0.24 V
5. 0.36 V

$$\frac{\Delta\Phi}{\Delta t} = \frac{\Phi_f - \Phi_i}{\Delta t} = \frac{\Delta B\, A \cancel{\cos\theta}^{\,1}}{\Delta t}$$

$$= \frac{A}{\Delta t}(B_f - B_i) =$$



what is the direction of the induced current in the loop?

1. clockwise
2. counterclockwise
3. up
4. down
5. through

Φ_f $\Delta\Phi$ Φ_i

Side View

i f

3. up
4. down
5. through

$\longrightarrow \Phi_i$

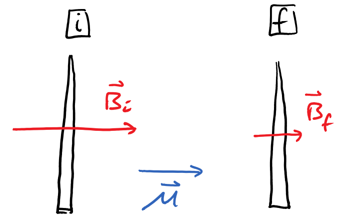
* find $\Delta\Phi$ $\longleftarrow$

* $\vec{\mu}_{induced}$ in opposite dir

so $\longrightarrow \vec{\mu}_{ind}$

* use RHR for current loops + $\vec{\mu}$

Side View



Lenz's Law: find direction of $B_{induced}$ ($\mu_{Induced}$) + thus I_{nduced}

1.) Find direction and mag. of Φ_i, create vector representation of flux initial
→ same dir. as B_{ext}.

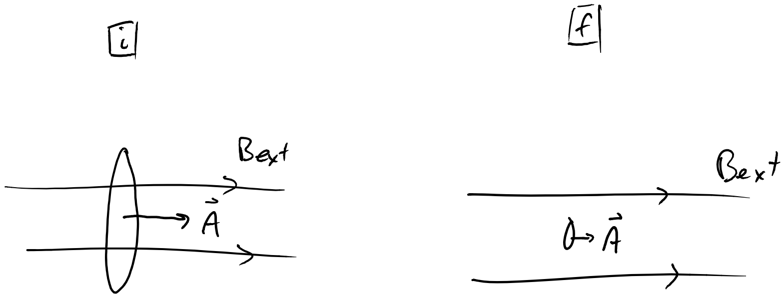
2.) " " " Φ_f " " " " final

3.) Use rules for vector sub. to find direction of $\Delta\Phi$ (point from initial to final)

4.) $B_{induced}$ ($\mu_{Induced}$) points in opposite direction of $\Delta\Phi$

5.) Use RHR for current loops to determine I_{nduced} direction

ex: $A \downarrow$



flux $\longrightarrow \Phi_i$ $\longrightarrow \Phi_f$

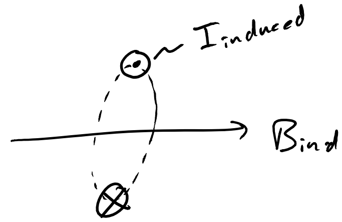
Vector op

$\longrightarrow \Phi_i$
Φ_f $\Delta\Phi$

w/ $\Delta\Phi \longleftarrow$ to left, $B_{ind} \longrightarrow$ to right

In opposite direction

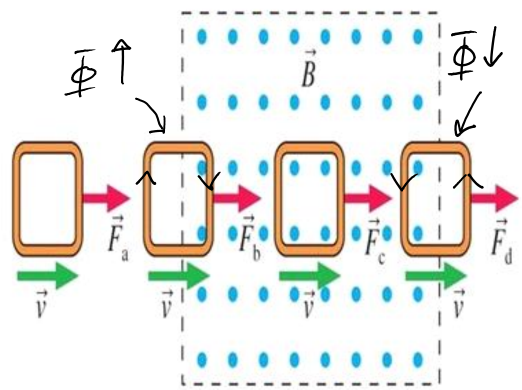
w/ RHR



A square loop of copper wire is pulled through a region of magnetic field at constant speed. Rank in order from largest ccw, to zero, and then to largest cw, the current that is induced in the loops.

1. $I_b = I_d > I_a = I_c$
2. $I_c > I_b = I_d > I_a$
3. $I_c > I_d > I_b > I_a$
4. $I_d > I_a = I_c > I_b$

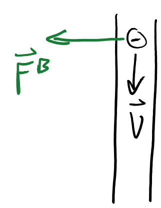
when $\Phi \uparrow$, $\vec{\mu}_{ind}$ in opposite direction as $\vec{B}_{ext}$



Rank in order, from strongest to weakest, the pulling forces Fa, Fb, Fc and Fd that must be applied to keep the loop moving at constant speed.

1. $F_b = F_d > F_a = F_c$
2. $F_c > F_b = F_d > F_a$
3. $F_c > F_d > F_b > F_a$
4. $F_d > F_b > F_a = F_c$

look @ (b) RHS

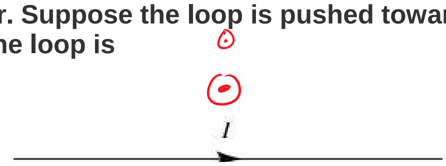


* Both resistive forces
* $\vec{F}$ applied does work to account Power @ resistor

A long, straight wire carries a steady current *I*. A rectangular conducting loop lies in the same plane as the wire, with two sides parallel to the wire and two sides perpendicular. Suppose the loop is pushed toward the wire as shown. Given the direction of *I*, the induced current in the loop is

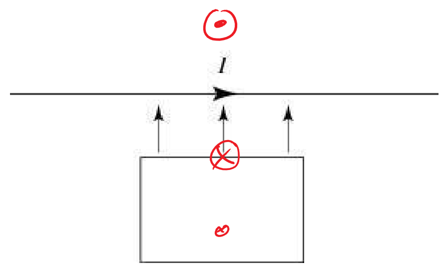
1. clockwise.
2. counterclockwise.

* Φ is increasing into page.



1. clockwise.
2. counterclockwise.
3. need more information

* Φ is increasing into page.
* So $\vec{\mu}_{ind}$ is out of page
* I is CCW



A conducting ring is held a certain distance above a loop carrying a *decreasing* current as illustrated below. As viewed from above, the current through the bottom loop induces an emf in the top ring that causes a current in the following direction

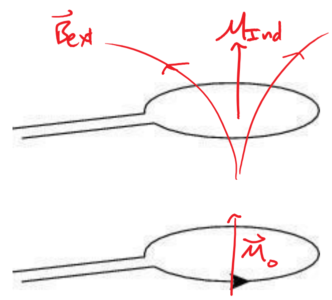
1. clockwise.
2. counterclockwise.
3. the answer depends on the distance between the two.
4. none of the above.

$\Phi_i \uparrow$, $\Phi_f \uparrow$

$\Delta\Phi$ ← to oppose

$\mu_{ind} \uparrow$

* I is C.C.W (same direction as Bottom)

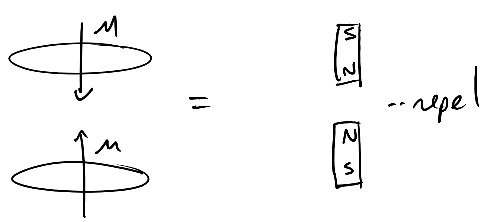


If the current through the bottom loop increases, the two loops

1. attract.
2. repel.
3. exert no force on each other.
4. exert torques on each other.

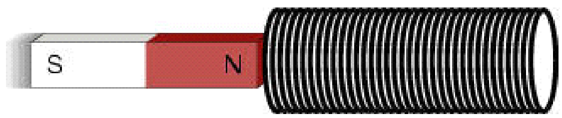
opposite from above so $\mu_{ind} \downarrow$

Now



A magnet is inserted into 20 turns of copper wire at a certain speed. Which of the following is correct?

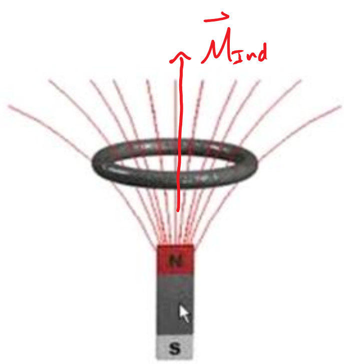
1. **No resistance to insertion is felt; in fact, the magnet is drawn in.**
2. **Resistance to insertion is felt, and work must be done to push the magnet in.**



* Energy dissipated in coil's resistance must come from somewhere
... from work on magnet.

The magnetic is falling downward away from the stationary loop. What, if any, is the direction of the induced current in the loop as viewed from above?

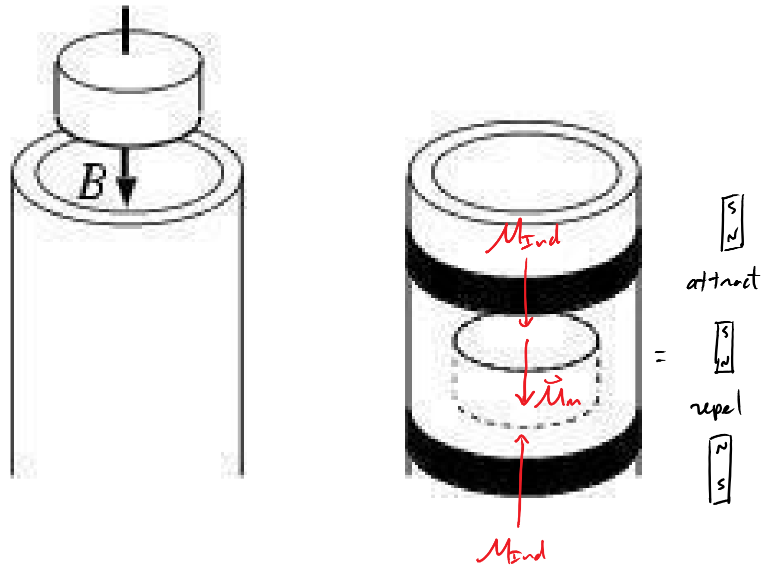
1. **No induced current**
2. **Yes, clockwise**
3. **Yes, counterclockwise**
4. **No, clockwise**



A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely falling magnet, the magnet through the tube drops

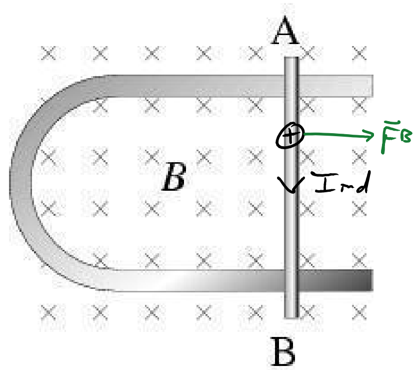
1. more slowly.
2. exactly the same way.
3. faster.
4. Need more information.

Hint: Consider the effects of induced currents through strips ahead of and behind the dropped magnet.

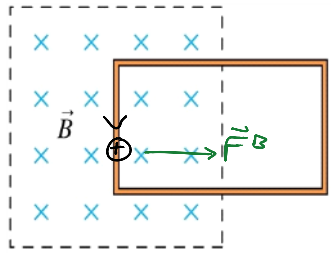


Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page).
If the magnetic field strength is decreased, the rod

1. remains stationary.
2. slides to the right. — to oppose a decreasing flux the rod wants to Increase area so flux remains Constant
3. slides to the left.
4. rotates clockwise.
5. moves up (out of page).
6. moves down (into page).
7. none of the above



A conducting loop is halfway into a magnetic field. Suppose the magnetic field begins to increase rapidly in strength. What happens to the loop?



1. The loop is pulled to the left, into the magnetic field
2. The loop is pushed to the right, out of the magnetic field
3. The loop is pushed upward, toward the top of the page
4. The loop is pushed downward, toward the bottom of the page
5. The tension is the wires increases but the loop does not move