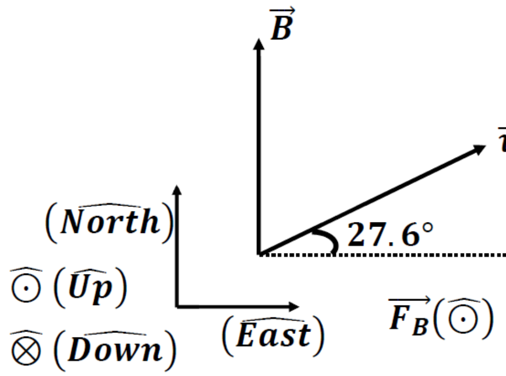
Exam Average **63.8** **Exam High Score** **100**

PH 202 **Exam # 02 (100 pts)** **Name** **Solution**

1

An object has a net charge Q on it. It is has a velocity of $\vec{v} = 8.23 \text{ x } 10^6 \ {}^{m}/_{s}$ @ an angle of $27.6°$ $(\widehat{\text{North}})$ of $(\widehat{\text{East}})$. There is a magnetic field given by $\vec{B} = 103.\text{T} \ (\widehat{\text{North}})$. This results in a magnetic force of $\overrightarrow{F_B} = 7.74 \text{ x } 10^4 \text{ N} \ (\widehat{\odot})$. What is the net charge Q on the object?



A. $\boldsymbol{+1.03 \text{ x } 10^{-4} \text{ C}}$

B. $-1.03 \text{ x } 10^{-4} \text{ C}$

C. $+1.97 \text{ x } 10^{-4} \text{ C}$

D. $-1.97 \text{ x } 10^{-4} \text{ C}$

$$\overrightarrow{F_B} = 7.74 \ x \ 10^4 \ N \ (\widehat{\odot}) = Q\vec{v} \ x \ \vec{B} = QvB \sin(\theta_{vB}) \ (\widehat{\odot})$$

So $\vec{v} \ x \ \vec{B}$ as shown gives the proper direction, so Q must be positive. Solve now for Q

$$Q = \frac{F_B}{vB \sin(\theta_{vB})} = \frac{7.74 \ x \ 10^4 \ N}{(8.23 \ x \ 10^6 \ {}^{m}/_{s})(103.T) \sin(90° - 27.6°)} = \frac{7.74 \ x \ 10^4 \ N}{7.51 \ x \ 10^8 \ {}^{N}/_{C}}$$

$$Q = \frac{7.74 \ x \ 10^4 \ N}{7.51 \ x \ 10^8 \ {}^{N}/_{C}} = 1.03 \ x \ 10^{-4} \ C$$

So, the correct answer is A !

2

An electrical cable is $40.0\ \mathrm{m}$ long and has a mass of $37.3\ \mathrm{kg}$. It is carrying a current either $(\widehat{\mathrm{East}})$ or $(\widehat{\mathrm{West}})$. An external magnetic field has a magnetic field strength of $2.83 \times 10^{-4}\ \mathrm{T}$ which is directed due $(\widehat{\mathrm{North}})$. How much current and in which direction is it flowing in the wire, so that the wire's weight is balanced by the magnetic force?

A. $3.10 \times 10^{-5}\ \mathrm{A}\ (\widehat{\mathrm{East}})$

B. $\mathbf{3.23 \times 10^{4}\ A\ (\widehat{East})}$

C. $3.23 \times 10^{4}\ \mathrm{A}\ (\widehat{\mathrm{West}})$

D. $3.10 \times 10^{-5}\ \mathrm{A}\ (\widehat{\mathrm{West}})$

We have two possible directions for the current $(\widehat{\mathbf{East}})$ or $(\widehat{\mathbf{West}})$. We know the B field points $(\widehat{\mathbf{North}})$ and the magnetic force must point up to balance weight. So, using the magnetic force equation

$$\vec{F_B} = i\vec{L} \times \vec{B}$$

We can try both current directions:

$$(\widehat{\mathbf{East}}) \times (\widehat{\mathbf{North}}) = \widehat{Up} \quad and\ (\widehat{\mathbf{West}}) \times (\widehat{\mathbf{North}}) = \widehat{Down}$$

Therefore, we know the current goes $(\widehat{\mathbf{East}})$! Now we can determine the magnitude of the current by solving for it

$$i = \frac{F_B}{LB} = \frac{mg}{LB}$$

Since the magnetic force must equal the weight of the wire

$$i = \frac{mg}{LB} = \frac{(37.3\ kg)\left(9.80\ {}^{m}/_{s^2}\right)}{(40.0\ m)(2.83 \times 10^{-4}\ T)} = \frac{365.54\ N}{1.132 \times 10^{-2}\ T\ m} = 3.229 \times 10^{4}\ A$$

So, the correct answer is B !

3

The source that creates a magnetic field in space is best described by?

A. Stationary Electrical Charges

B. Strong Force Interactions (Gluons)

C. **Moving Electrical Charges**

D. Sunspots

So, the correct answer is C !

4

A solenoid coil has a radius of $0.558\ \mathrm{m}$, a length of $0.230\ \mathrm{m}$, and has 7735 turns of wire wrapped around it. At the center of the coil a magnetic field is found to have a field strength of $0.417\ \mathrm{T}$. What is the magnitude of the current flowing in the wire?

A. $15.2\ \mathrm{A}$ **B.** $150.\ \mathrm{A}$ **C.** $47.9\ \mathrm{A}$ **D.** $\mathbf{9.87\ A}$

For a solenoid the magnetic field generated at the center is found by

$$\boldsymbol{B_{Solenoid} = \frac{\mu_0 N i}{L}}$$

Solve for current

$$\boldsymbol{i = \frac{BL}{\mu_0 N} = \frac{(0.417\ T)(0.230\ m)}{\left(4\ \pi\ x\ 10^{-7}\ {}^{T\ m}/_{A}\right)(7735)} = \frac{0.0959\ T\ m}{9.720\ x\ 10^{-3}\ {}^{T\ m}/_{A}} = 9.867\ A}$$

So, the correct answer is D !

5

A power line is located $14.0\ \mathrm{m}$ above the ground. The current in the wire is $1500.\ \mathrm{A}$ and it is going in the $\left(\widehat{\mathrm{South}}\right)$ direction. What is the magnitude and direction of the magnetic field created by this current carrying wire on the ground directly below the wire?

A. $6.73\ \mathrm{x}\ 10^{-5}\ \mathrm{T}\ \left(\widehat{\mathrm{West}}\right)$

B. $6.73\ \mathrm{x}\ 10^{-5}\ \mathrm{T}\ \left(\widehat{East}\right)$

C. $2.14\ \mathrm{x}\ 10^{-5}\ \mathrm{T}\ \left(\widehat{\mathrm{West}}\right)$

D. $\mathbf{2.14\ x\ 10^{-5}\ T\ \left(\widehat{East}\right)}$

$$\boldsymbol{\overrightarrow{B_{long\ straight\ wire}} = \frac{\mu_0 i}{2\pi r} Rt\ \widehat{Hand}\ Rule}$$

With current going to the South putting your thumb along the South, below your fingers point to East.

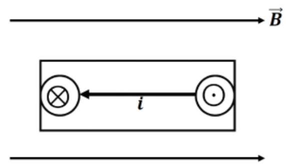
$$\boldsymbol{\overrightarrow{B_{l.s.\ wire}} = \frac{\mu_0 i}{2\pi r}\left(\widehat{East}\right) = \frac{\left(4\pi\ x\ 10^{-7}\ {}^{T\ m}/_{A}\right)(1500.\ A)}{2\pi(14.0\ m)}\left(\widehat{East}\right) = \frac{1.885\ x\ 10^{-3}\ T\ m}{87.96\ m}\left(\widehat{East}\right)}$$

$$\boldsymbol{\overrightarrow{B_{l.s.\ wire}} = \frac{1.885\ x\ 10^{-3}\ T\ m}{87.96\ m}\left(\widehat{East}\right) = 2.143\ x\ 10^{-5}\ T\ \left(\widehat{East}\right)}$$

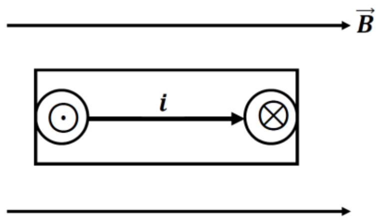
So, the correct answer is D !

6

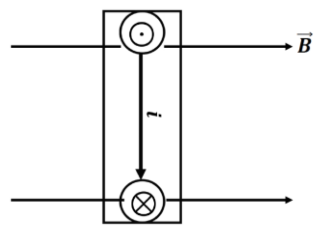
Pictured below is a rectangular coil carrying a current i which is going to the left for the side of the coil nearest you as indicated. The coil is oriented sideways with two sides perpendicular to the paper, one side behind the paper and the other in front of the paper. In the side to the right, the current comes out of the paper and on the left, it goes into the paper. A magnetic field $\vec{B}$ is applied going to the right as shown. The coil is allowed to rotate. Which of the following is the final orientation that will result?



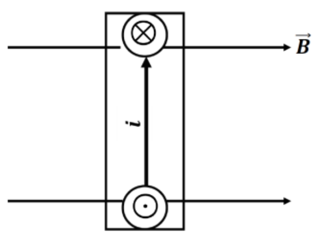
A.



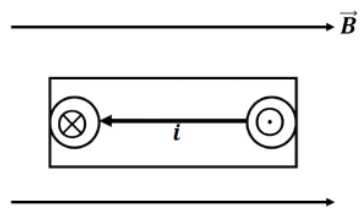
C.



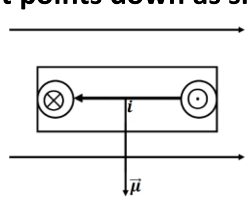
B.



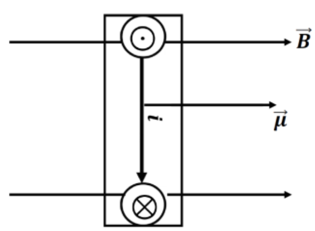
D.



Using the right hand-rule, we can find the direction of the magnetic moment of the coil due to the current going as indicated and we find it points down as shown below



The torque created by the magnetic field wants to align the magnetic moment with the magnetic field. So, the magnetic moment will be turned counter-clockwise to the position shown above



So, the correct answer is C !

7

A coil has an area of 0.663 m^2 and carries a current of 6.17 A around it. This results in a magnetic moment of $4.89 \text{ x } 10^3 \text{ A m}^2$. How many turns of wire wrap around this coil?

A.	$1.80 \text{ x } 10^3 \text{ Turns}$	**C.**	$9.73 \text{ x } 10^2 \text{ Turns}$
B.	$\mathbf{1.20 \text{ x } 10^3 \text{ Turns}}$	**D.**	$2.97 \text{ x } 10^3 \text{ Turns}$

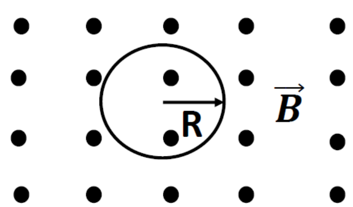
$$\boldsymbol{\mu = NiA}$$

Solve for N

$$\boldsymbol{N = \frac{\mu}{iA} = \frac{4.89 \ x \ 10^3 \ Am^2}{(6.17 \ A)(0.663 \ m^2)} = \frac{4.89 \ x \ 10^3 \ Am^2}{4.091 \ Am^2} = 1.195 \ x \ 10^3 \ Turns}$$

So, the correct answer is B !

8



An ion is found orbiting in a circle inside a magnetic field as shown on the left. The magnetic field is given by $\vec{\text{B}} = 7.12 \text{ T} (\widehat{\odot})$. The mass of the ion is $6.27 \text{ x } 10^{-25} \text{ kg}$, and its orbiting speed is $9.77 \text{ x } 10^4 \ {}^{\text{m}}/_{\text{s}}$. The radius of the circle is $2.91 \text{ x } 10^{-2} \text{ m}$. The ion is making rotations counter-clockwise as viewed by you. What is the charge of the ion?

A.	$\mathbf{-2.96 \text{ x } 10^{-19} \text{ C}}$	**C.**	$-3.38 \text{ x } 10^{-18} \text{ C}$
B.	$+2.96 \ x \ 10^{-19} \text{ C}$	**D.**	$+3.38 \text{ x } 10^{-18} \text{ C}$

Since the orbit is counter-clockwise, using the right-hand rule, consider the ion at the 12 O'clock position it would have its velocity going left, left crossed out of paper would be up. For a particle to go around the circle the force has to point towards the center. So, the charge must be negative! A positive charge would have to be going clockwise. So, the charge is negative. Now find the charge from Newton's second law for uniform circular motion:

$$\boldsymbol{\sum F_R = QvB = m\frac{v^2}{R}}$$

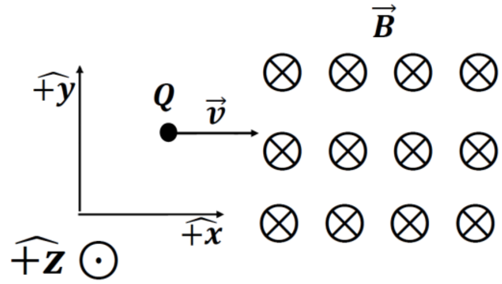
Solve for Q

$$\boldsymbol{Q = \frac{mv}{BR} = \frac{(6.27 \ x \ 10^{-25} \ kg)(9.77 \ x \ 10^4 \ {}^{m}/_{s})}{(7.12 \ T)(2.91 \ x \ 10^{-2} \ m)} = \frac{6.126 \ x \ 10^{-20} \ {}^{kg \ m}/_{s}}{2.072 \ x \ 10^{-1} \ T \ m} = 2.96 \ x \ 10^{-19} \ C}$$

So, the correct answer is A !

9

A charge $(Q = -34.6\ \mathrm{mC})$ is traveling with a velocity $\left(\vec{v} = 47.3\ {}^{m}/_{s}\ (\widehat{+x})\right)$ when it enters a magnetic field given by $\left(\vec{B} = 2.77\ \mathrm{T}\ (\widehat{-z})\right)$. What is the magnitude and direction of an electric field that must be present so that the charge continues to travel in a straight line?



A. $\mathbf{131.\ {}^{N}/_{C}\ (\widehat{-y})}$

B. $17.1\ {}^{N}/_{C}\ (-\hat{y})$

C. $17.1\ {}^{N}/_{C}\ (\widehat{+y})$

D. $131.\ {}^{N}/_{C}\ (\widehat{+y})$

For the charge to travel in a straight line the magnetic force must be balanced by the electric force

$$\overrightarrow{F_B} + \overrightarrow{F_E} = 0$$

$$\overrightarrow{F_B} = Q\vec{v}\ x\ \vec{B} = -\overrightarrow{F_E} = -Q\vec{E}$$

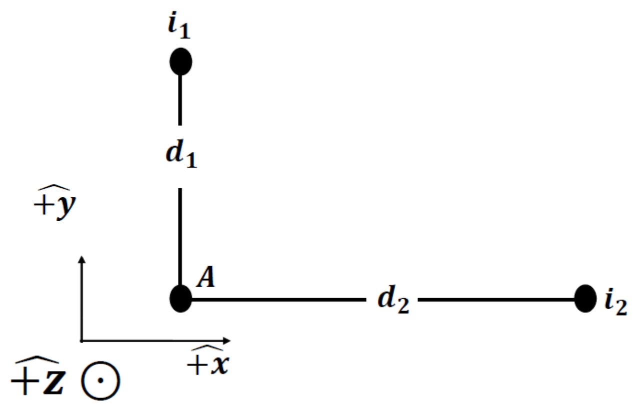
The magnetic force is going to be in the $(\widehat{-y})$ direction since $\vec{v}\ x\ \vec{B}$ gives $(\widehat{+x})\ x\ (\widehat{-z}) = (\widehat{+y})$ using the right-hand rule. The charge is negative so the direction of the magnetic force does flip. To oppose this the Electric force must go in the opposite direction $(\widehat{+y})$. Again, a negative charge will flip it. So, we know the Electric Field must point in $(\widehat{-y})$

Solve for E

$$E = \frac{QvB}{Q} = vB = (47.3\ {}^{m}/_{s})(2.77\ T) = 131.\ {}^{N}/_{C}$$

So, the correct answer is A !

10



On the left we have two long straight wires that are passing into the plane of the page. The top one is current 1 $\left(\mathrm{i}_1 = 1200.\,\mathrm{A}\,(\widehat{\otimes})\right)$. The wire on the right is current 2 $\left(\mathrm{i}_2 = 1400.\,\mathrm{A}\,(\widehat{\otimes})\right)$. The distance from current 1 to location A is $(\mathrm{d}_1 = 4.73 \text{ x } 10^{-4}\ \mathrm{m})$. The distance from current 2 to location A is $(\mathrm{d}_2 = 3.81 \text{ x } 10^{-4}\ \mathrm{m})$. What is the total magnetic field at location A due to the two currents?

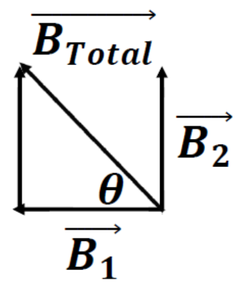
A. $0.893\ \mathrm{T}\ @\ 55.4°\ \text{Above}\ (\widehat{+\mathrm{x}})$

B. $\mathbf{0.893\ T\ @\ 55.4°\ Above\ (\widehat{-x})}$

C. $0.893\ \mathrm{T}\ @\ 55.4°\ \text{Below}\ (\widehat{+\mathrm{x}})$

D. $0.893\ \mathrm{T}\ @\ 55.4°\ \text{Below}\ (\widehat{-\mathrm{x}})$

Since these are long straight wires, the magnetic field created by each will be circles. For current 1, since the current is going into the page, the field will be going Clockwise. So, at point A, the field of current 1 will point in the $(\widehat{-x})$ direction. For current 2 since the current is also going into the page, the circles are Clockwise. At point A, the direction for the field of current 2 will be $(\widehat{+y})$. So, we have two perpendicular vectors to add the situation looks like:



$$\overrightarrow{B_1} = \frac{\mu_0 i_1}{2\pi d_1}\,(\widehat{+x}) = \frac{(4\pi\ x\ 10^{-7}\ {}^{T\,m}/_{A})(1200\ A)}{2\pi(4.73\ x\ 10^{-4}\ m)}(\widehat{+x}) = \mathbf{0.507}\ T\ (\widehat{-x})$$

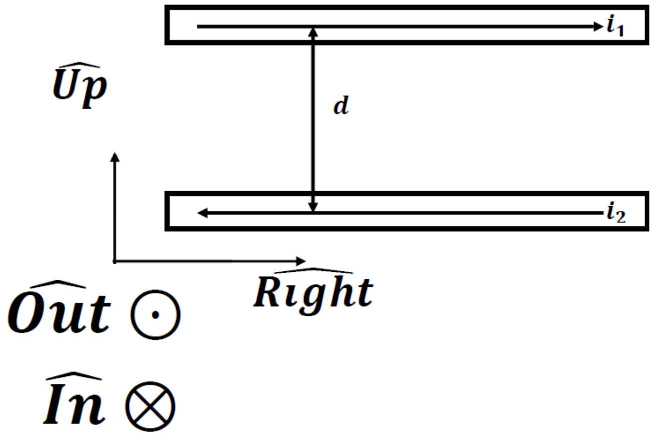
$$\overrightarrow{B_2} = \frac{\mu_0 i_2}{2\pi d_2}\,(\widehat{+y}) = \frac{(4\pi\ x\ 10^{-7}\ {}^{T\,m}/_{A})(1400\ A)}{2\pi(3.81\ x\ 10^{-4}\ m)}(\widehat{+y}) = \mathbf{0.735}\ T\ (\widehat{+y})$$

$$B_A = \sqrt{B_1^2 + B_2^2} = \sqrt{(0.507\ T)^2 + 0.735\ T^2} = 0.893\ T$$

$$\theta = \tan^{-1}\left(\frac{B_2}{B_1}\right) = \tan^{-1}\left(\frac{0.735\ T}{0.507\ T}\right) = 55.4°\ Above\ (\widehat{-x})$$

So, the correct answer is B !

11



Shown above there are two current carrying wires. The current in the top wire is going to the right and has a magnitude of $\mathrm{i}_1 = 32.1\ \mathrm{A}$, and the current in the bottom wire is going to the left with a magnitude of $\mathrm{i}_2 = 46.1\ \mathrm{A}$. The two wires lie a distance $\mathrm{d} = 0.229\ \mathrm{m}$ apart. What is the magnitude and direction of the force acting on a $12.3\ \mathrm{m}$ length of the bottom wire due to the magnetic field created by the top wire?

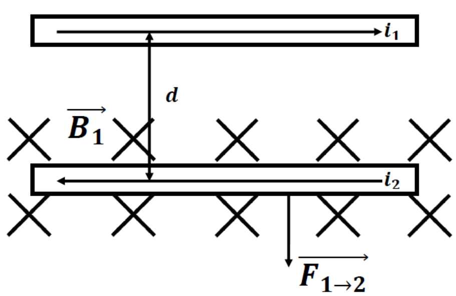
A. $1.29 \times 10^{-3}\ \mathrm{N}\ (\widehat{\mathrm{Down}})$

B. $1.59 \times 10^{-2}\ \mathrm{N}\ (\widehat{\mathrm{Up}})$

C. $\mathbf{1.59 \times 10^{-2}\ N\ (\widehat{Down})}$

D. $1.29 \times 10^{-3}\ \mathrm{N}\ (\widehat{\mathrm{Up}})$

Using the right-hand rule, we can find the magnetic field created by the top wire near the bottom wire. Since the current is going to the right, the magnetic field is going into the paper below the top wire. The force has a cross product so with current going to the left crossed with into the paper, we get a force going down as shown below



$$\overrightarrow{F_{1\to2}} = i_2\overrightarrow{L_2} \times \overrightarrow{B_1} = i_2\overrightarrow{L_2} \times \frac{\mu_0 i_1}{2\pi d}(\widehat{\otimes}) = \frac{\mu_0 i_1 i_2 L_2}{2\pi d}(\widehat{Left} \times \widehat{\otimes}) = \frac{\mu_0 i_1 i_2 L_2}{2\pi d}(\widehat{Down})$$

$$\overrightarrow{F_{1\to2}} = \frac{(4\pi \times 10^{-7}\ T\ m/A)(32.1\ A)(46.1\ A)(12.3\ m)}{2\pi(0.229\ m)}(\widehat{Down})$$

$$\overrightarrow{F_{1\to2}} = \frac{2.287 \times 10^{-2}}{1.439}\ N\ (\widehat{Down}) = 1.59 \times 10^{-2}\ N\ (\widehat{Down})$$

So, the correct answer is C !

12

A cargo container, used as a trailer for a semi-truck, has a width of 2.39 m. The truck is being driven with a velocity of $28.6\ {}^{\text{m}}/_{\text{s}}\ (\widehat{\text{East}})$. The magnetic field in this region runs between $(\widehat{\text{Up}})$ and $(\widehat{\text{Down}})$. An emf of 0.895 V is induced between the north and south of the container, with the south side being more positive. What is the magnitude and direction of the magnetic field the container is being driven through?

A.	$7.64 \text{ x } 10^{1}\text{ T }(\widehat{\text{Down}})$	**C.**	$1.31 \text{ x } 10^{-2}\text{ T }(\widehat{\text{Down}})$
B.	$7.64 \text{ x } 10^{1}\text{ T }(\widehat{\text{Up}})$	**D.**	$\mathbf{1.31 \text{ x } 10^{-2}\text{ T }(\widehat{\text{Up}})}$

Using the right-hand rule $\vec{v}\ x\ \vec{B} = (\widehat{East}\ )x\ (\widehat{??}\ )$ must equal $(\widehat{South})$. So $(\widehat{East}\ )x\ (\widehat{Up}) = (\widehat{South})$. So, if the magnetic field is going $(\widehat{Up})$, the south side of the container would be more positive which is what we find. So, the magnetic field is going $(\widehat{Up})$!

$$\varepsilon = BLv$$

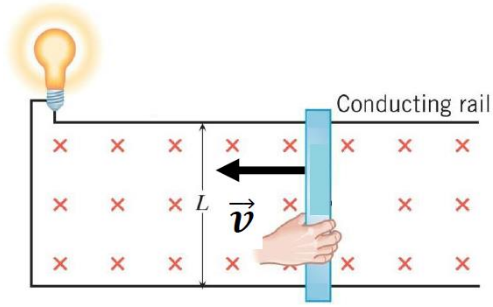
Solve for B

$$B = \frac{\varepsilon}{Lv} = \frac{0.895\ V}{(2.39\ m)(28.6\ {}^{m}/_{s})} = \frac{0.895\ V}{68.35\ {}^{m^2}/_{s}} = 1.31\ x\ 10^{-2}\ T$$

So, the correct answer is D !

13

A bar has a length (0.743 m) is moving to the left along conducting rails with a speed $(\text{v} = 8.82 \text{ m}/\text{s})$ as indicated in diagram below. The magnetic field shown can be expressed as $\vec{\text{B}} = 26.7 \text{ T} (\widehat{\otimes})$. The light bulb has a resistance of $(260.0 \ \Omega)$. What is the magnitude and direction of the current induced in the light bulb?



A. $1.49 \text{ A}, (\text{Clockwise})$

B. $1.49 \text{ A}, (\text{Counter} - \text{Clockwise})$

C. $0.673 \text{ A}, (\text{Counter} - \text{Clockwise})$

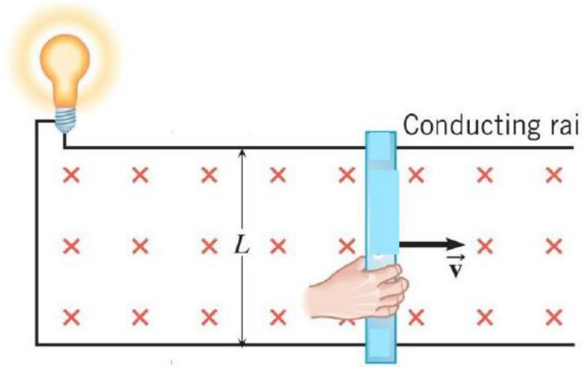
D. $\mathbf{0.673 \text{ A}, (\text{Clockwise})}$

$$\boldsymbol{i = \frac{\varepsilon}{R} = \frac{BLv}{R} = \frac{(26.7\ T)(0.743\ m)(8.82\ m/s)}{260.0\ \Omega} = \frac{175.0\ V}{260.0\ \Omega} = 0.673\ A}$$

As for direction, well from motional emf, using $\overrightarrow{F_B} = Q\vec{v}\, x\, \vec{B}$, $\vec{v}\, x\, \vec{B}$ is $(\widehat{left})\ x\ (\widehat{\otimes})$ which is $(\widehat{down})$, so positive charges are pushed to bottom of bar, that makes the current go Clockwise! Alternatively, from a change in flux point of view, the area is decreasing, so the flux is decreasing. An induced magnetic field must go in the same direction to strengthen the flux, so into the paper, a current must go clockwise for that to be created! So Clockwise is the direction.

So, the correct answer is D !

14



As shown above a bar $(\mathrm{L} = 0.373\ \mathrm{m})$ is being moved along conducting rails to the right with a speed of $(\mathrm{v} = 7.79\ ^{\mathrm{m}}/_{\mathrm{s}})$. A magnetic field is going into the paper as shown with a field strength of $(\mathrm{B} = 22.7\ \mathrm{T})$. The light bulb is lit by the induced current which has a value of $(\mathrm{i}_{\mathrm{induced}} = 0.550\ \mathrm{A})$. The resistance of the light bulb is measured to be $(120.0\ \Omega)$. What is the magnitude and direction of the force the magnetic field exerts on the bar as it is moving to the right?

A. $4.66\ \mathrm{N}\ (\widehat{\mathrm{Right}})$

B. $15.4\ \mathrm{N}\ (\widehat{\mathrm{Left}})$

C. $\mathbf{4.66\ N\ (\widehat{Left})}$

D. $15.4\ \mathrm{N}\ (\widehat{\mathrm{Right}})$

The induced current direction is needed. Using the change in flux, the area is getting larger so the flux is getting bigger. Induced field must oppose this change so it must be induced out of the paper. A counter clockwise current is therefore created. In the bar, then this means the current goes from the bottom of the bar to the top of the bar.

$$\overrightarrow{F_B} = i\vec{L}\ x\ \vec{B}$$

From this cross product, Up cross into the paper, makes a force pointing Left! The magnitude is

$$F_B = iLB = (0.550\ A)(0.373\ m)(22.7\ T) = 4.66\ N$$

So, the correct answer is C !

15

A square coil $(1662 \text{ Turns}, \text{Area} = 1.13 \text{ x } 10^{-1} \text{ m}^2)$ is rotating inside a constant magnetic field $(\text{B} = 9.86 \text{ x } 10^{-3} \text{ T})$. In a time of 0.0030 seconds, the normal to the area of the coil turns from an angle of $30.0°$ to $50.0°$. What is the magnitude of the emf induced in the coil?

A. 1.24 V **B.** $\mathbf{138.\,V}$ **C.** $122.\text{ V}$ **D.** 0.0828 V

$$\varepsilon_{induced} = -N\frac{\Delta\Phi_B}{\Delta t} = -NBA\frac{\left(\cos(\theta_f) - \cos(\theta_0)\right)}{\Delta t} = -\frac{NBA}{\Delta t}\left(\cos(\theta_f) - \cos(\theta_0)\right)$$

$$\varepsilon_{induced} = -\frac{(1662)(9.86\ x\ 10^{-3}\ T)(1.13\ x\ 10^{-1}\ m^2)}{0.0030\ s}(\cos(50.0°) - \cos(30.0°))$$

$$\varepsilon_{induced} = -\frac{1.852\ T\ m^2}{0.0030\ s}(-0.223) = -617.3\ V(-0.223) = 137.7\ V$$

So, the correct answer is B !

16

A specialized generator must provide a peak voltage of $510.\text{ V}$ to a security system. The generator has a coil with 1775 Turns and an area of $3.89 \text{ x } 10^{-2} \text{ m}^2$. The magnetic field the coil rotates in has a strength of 0.376 T. What is the angular speed that the coil is rotating with to produce this peak voltage?

A. $\mathbf{19.6\ {}^{rad}/_{s}}$ **B.** $13200.\ {}^{\text{rad}}/_{\text{s}}$ **C.** $238.\ {}^{\text{rad}}/_{\text{s}}$ **D.** $0.219\ {}^{\text{rad}}/_{\text{s}}$

$$\varepsilon_0 = NAB\omega$$

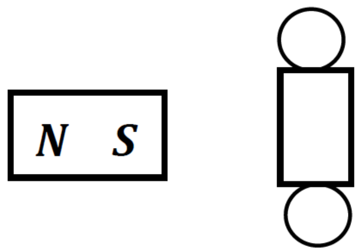
Solve angular speed

$$\omega = \frac{\varepsilon_0}{NAB} = \frac{510.\ V}{(1775)(3.89\ x\ 10^{-2}\ m^2)(0.376\ T)} = \frac{510.\ V}{25.96\ T\ m} = 19.6\ {}^{rad}/_{s}$$

So, the correct answer is A !

17

A simple bar magnet as shown below is at rest a small distance from a coil. The coil is pictured above as the square to represent the cross-sectional area of the opening inside the coil of wire. The two circles above and below are the wire going around the open area. The coil is being cut in half by the paper. Half lies in front of the paper and half lies behind the paper. Will there be a current induced in the coil due to the bar magnet's motion? If so will the current at the top of the coil be coming out of the paper, or going into the paper?



A. **No Current will be induced**

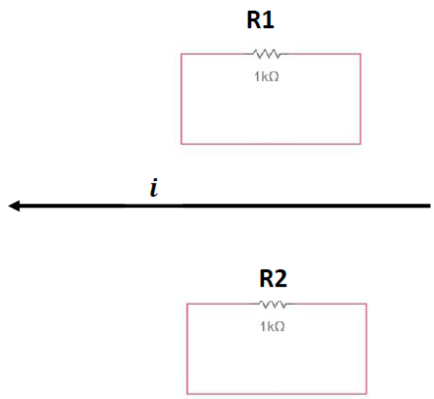
B. At the top, current will come out of the paper

C. At the top, current will go into the paper

Since the magnet is not moving, while there is a magnetic flux through the coil, it will not change. No changing magnetic flux, no emf induced and therefore, no current will be induced!

So, the correct answer is A !

18



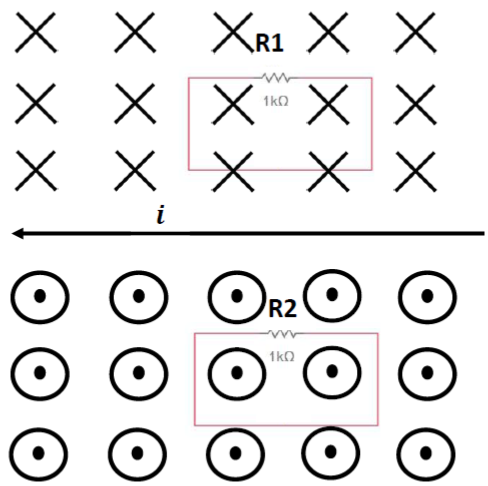
Pictured to the left is a current moving to left as shown. Two loops are placed near the wire. Each has a resistor as shown. If the current, i, decreases over time, each loop will have a current induced in it. Which of the choices below provide the proper direction these induced currents will pass through the respective resistors R1 and R2?

A. R1 goes right to left
R2 goes left to right

B. **R1 goes left to right**
R2 goes right to left

C. R1 goes left to right
R2 goes left to right

D. R1 goes right to left
R2 goes right to left



The magnetic field created by the current going to the left is as shown above. Since the current is decreasing the magnetic fields are each are decreasing in the direction shown. Therefore, the induced magnetic fields must go in the same way to oppose the change in magnetic flux. So, in loop 1, the induced field must into the paper, which means a clockwise current, or in R1, the current must go left to right.

In loop 2 the induced field is out of the paper so the induced current must go counter-clockwise and therefore the current through R2 must go right to left

So, the correct answer is B !

19

A refrigerator/freezer compressor motor has an armature with a resistance of $6.10\ \Omega$. The motor is connected to an electrical outlet which has a voltage of $115.\ \mathrm{V}$. When the motor has settled into its long-term running state, it uses $7.02\ \mathrm{A}$ of current. What is the back emf created when the compressor is in its stable "running" state?

A. $7.02\ \mathrm{V}$ **B.** $42.8\ \mathrm{V}$ **C.** $\mathbf{72.2\ V}$ **D.** $114.\ \mathrm{V}$

$$i_{running} = \frac{V - \varepsilon_{back}}{R_{Arm}}$$

Solve for back emf

$$\varepsilon_{back} = V - i_{running}R_{Arm} = 115.V - (7.02\ A)(6.10\ \Omega) = 115.V - 42.8\ V = 72.2\ V$$

So, the correct answer is C !

20

A transformer has a primary coil with 100 turns of wire and a secondary coil with 10,000 turns of wire. If the primary coil has a current of $60.0\ \mathrm{A}$ running through it, what is the current induced in the secondary and is the transformer a step-up or a step-down transformer?

A. $0.600\ \mathrm{A}$, Step-Down

B. $6000.\ \mathrm{A}$, Step-Down

C. $6000.\ \mathrm{A}$, Step-Up

D. **$0.600\ \mathrm{A}$, Step-Up**

The Transformer equation is

$$\frac{\varepsilon_S}{\varepsilon_P} = \frac{N_S}{N_P} = \frac{i_P}{i_S}$$

Now a step-up transformer is when $N_S > N_P$ so since

$$N_S = 10,000\ turns > N_P = 100\ turns$$

This is a Step-Up Transformer

$$i_S = \left(\frac{N_P}{N_S}\right) i_P = \left(\frac{100}{10,000}\right)(60.0\ A) = \frac{1}{100}(60.0\ A) = 0.600.A$$

So, the correct answer is D !

Please send any comments or questions about this page to ddonovan@nmu.edu

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