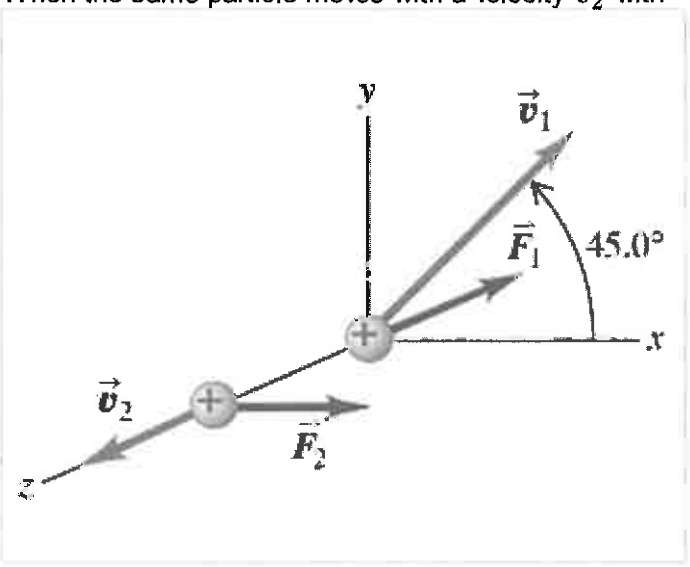
HW Bonus 2

Due: 11:00am on Wednesday, April 2, 2014

You will receive no credit for items you complete after the assignment is due. Grading Policy

Problem 27.55

When a particle of charge $q > 0$ moves with a velocity of $\vec{v}_1$ at 45.0 ° from the $+x$-axis in the xy-plane, a uniform magnetic field exerts a force $\vec{F}_1$ along the $-z$-axis (the figure). When the same particle moves with a velocity $\vec{v}_2$ with the same magnitude as $\vec{v}_1$ but along the $+z$-axis, a force $\vec{F}_2$ of magnitude F_2 is exerted on it along the $+x$-axis.



Part A

What is the magnitude (in terms of q, v_1, and F_2) of the magnetic field?

ANSWER:

$B =$

Part B

What is the direction of the magnetic field?

ANSWER:

- ○ $+x$-direction
- ○ $-x$-direction
- ○ $+y$-direction
- ○ $-y$-direction
- ○ $+z$-direction
- ○ $-z$-direction

Part C

What is the magnitude of $\vec{F}_1$ in terms of F_2?

ANSWER:

F_1 =

Problem 27.59

You wish to hit a target from several meters away with a charged coin having a mass of 4.8g and a charge of +2900μC. The coin is given an initial velocity of 14.0m/s, and a downward, uniform electric field with field strength 27.0N/C exists throughout the region.

Part A

If you aim directly at the target and fire the coin horizontally, what magnitude of uniform magnetic field are needed in the region for the coin to hit the target?

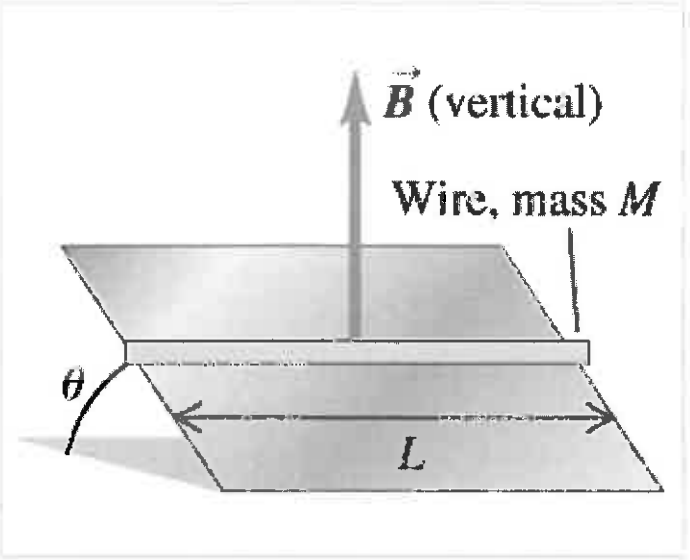
Express your answer using two significant figures.

ANSWER:

B = T

Problem 27.69

A straight piece of conducting wire with mass M and length L is placed on a frictionless incline tilted at an angle θ from the horizontal (the figure). There is a uniform, vertical magnetic field $\vec{B}$ at all points (produced by an arrangement of magnets not shown in the figure). To keep the wire from sliding down the incline, a voltage source is attached to the ends of the wire. When just the right amount of current flows through the wire, the wire remains at rest.



Part A

Determine the magnitude of the current in the wire that will cause the wire to remain at rest.

Express your answer in terms of the variables M, θ, L, B, and appropriate constants.

ANSWER:

$I =$

Part B

Determine the direction of the current in the wire that will cause the wire to remain at rest.

ANSWER:

- ○ The current in the wire must be directed from right to left.
- ○ The current in the wire must be directed from left to right.

Part C

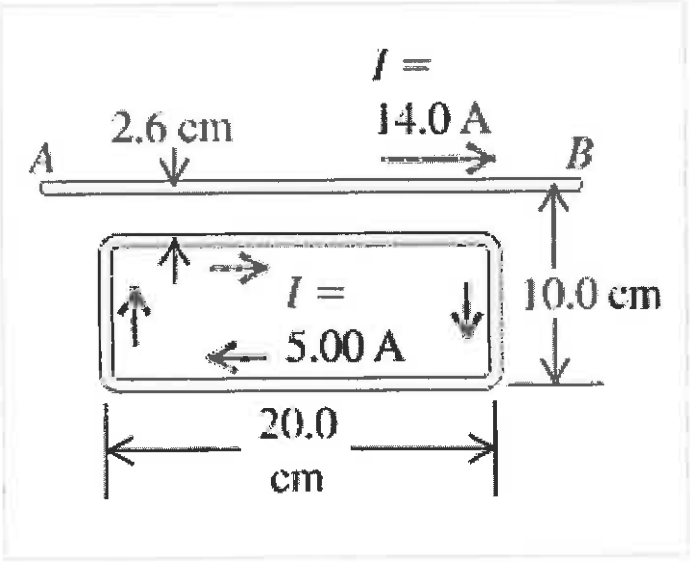
In addition viewing the wire from its left-hand end, show in a free-body diagram all the forces that act on the wire.

Draw the force vectors with their tails at the dot. The orientation of your vectors will be graded. The exact length of your vectors will not be graded but the relative length of one to the other will be graded.

ANSWER:

Problem 28.72

The long, straight wire *AB* shown in the figure carries a current of 14.0 A. The rectangular loop whose long edges are parallel to the wire carries a current of 5.00 A.



Part A

Find the magnitude of the net force exerted on the loop by the magnetic field of the wire.

ANSWER:

$F =$ N

Part B

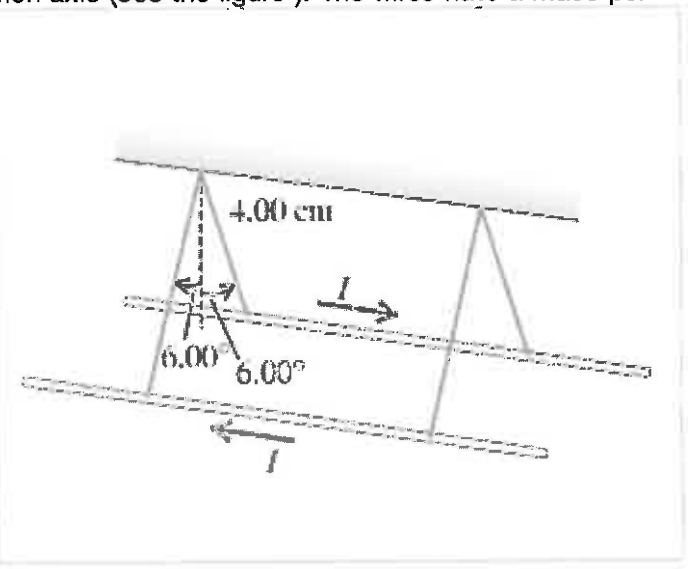
Find the direction of the net force exerted on the loop by the magnetic field of the wire.

ANSWER:

- O to the left
- O to the right
- O upward
- O downward

Problem 28.71

Two long, parallel wires hang by 4.00-cm-long cords from a common axis (see the figure). The wires have a mass per unit length of $1.00\times10^{-2}\text{kg/m}$ and carry the same current in opposite directions.



Part A

What is the current in each wire if the cords hang at an angle of 6.00 ° with the vertical?

ANSWER:

$I =$ A

Problem 28.65

Two identical circular, wire loops 50.0cm in diameter each carry a current of 4.50A in the same direction. These loops are parallel to each other and are 20.0cm apart. Line *ab* is normal to the plane of the loops and passes through their centers. A proton is fired at 2850m/s perpendicular to line *ab* from a point midway between the centers of the loops.

Part A

Find the magnitude of the magnetic force these loops exert on the proton just after it is fired.

ANSWER:

$F =$ N

Problem 29.61

A satellite, orbiting the earth at the equator at an altitude of $400\ \text{km}$, has an antenna that can be modeled as a 2.0-m-long rod. The antenna is oriented perpendicular to the earth's surface. At the equator the earth's magnetic field is essentially horizontal and has a value of $8.0 \times 10^{-5}\ \text{T}$; ignore any changes in B with altitude.

Part A

Assuming the orbit is circular, determine the induced emf between the tips of the antenna.

Express your answer using two significant figures.

ANSWER:

$\mathcal{E} =$ V

Problem 29.72

An airplane propeller of total length L rotates around its center with angular speed ω in a magnetic field B that is perpendicular to the plane of rotation.

Part A

Modeling the propeller as a thin, uniform bar, find the potential difference between the center and either end of the propeller.

Express your answer in terms of the given quantities.

ANSWER:

$\mathcal{E}$ =

Part B

Modeling the propeller as a thin, uniform bar, find the potential difference between the two ends.

Express your answer in terms of the given quantities.

ANSWER:

$\mathcal{E}$ =

Part C

If the field is the earth's field of 0.50 G and the propeller turns at 210rpm and is 2.0m long, what is the potential difference between the middle and either end?

Express your answer using two significant figures.

ANSWER:

$\mathcal{E}$ = V

Problem 29.55

As a new electrical engineer for the local power company, you are assigned the project of designing a generator of sinusoidal ac voltage with a maximum voltage of 120 V. Besides plenty of wire, you have two strong magnets that can produce a constant uniform magnetic field of 1.9T over a square area with a length of 10.2cm on a side when the magnets are separated by a distance of 12.6cm . The basic design should consist of a square coil turning in the uniform magnetic field. To have an acceptable coil resistance, the coil can have at most 360 loops.

Part A

What is the minimum rotation rate of the coil so it will produce the required voltage?

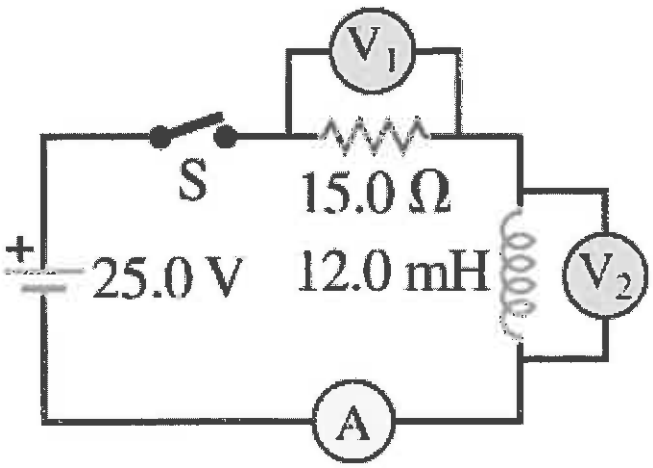
Express your answer using two significant figures.

ANSWER:

ω = rpm

Problem 30.66

In the circuit shown in the figure , the battery and the inductor have no appreciable internal resistance and there is no current in the circuit.



Part A

Immediately after the switch is closed, find the reading of the ammeter A .

ANSWER:

I_1 = A

Part B

Immediately after the switch is closed, find the readings of the voltmeters (V_1 and V_2) .

Separate your answer with a comma.

ANSWER:

V_1, V_2 = V

Part C

Find the reading of the ammeter A after the switch has been closed for a very long time.

ANSWER:

I_2 = A

Part D

Find the readings of the voltmeters (V_1 and V_2) after the switch has been closed for a very long time.

Separate your answer with a comma.

ANSWER:

V_1, V_2 = V

Part E

Which answers in parts A, B, C and D would change if the inductance were 24.0mH instead?

ANSWER:

- O All the answers would change.
- O The answers in part A and B would change.
- O The answers in part C and D would change.
- O None of the answers would change.

Problem 30.78

Two coils are wrapped around each other as shown in Fig.30.3 in the textbook. The current travels in the same sense around each coil. One coil has self-inductance L_1, and the other coil has self-inductance L_2. The mutual inductance of the two coils is M.

Part A

If the two coils are connected in series, find the equivalent inductance of the combination. (Hint: For either a series or a parallel combination, the potential difference across the combination is $L_{\text{eq}}(di/dt)$ where i is the current through the combination. For a parallel combination, i is the sum of the currents through the two inductors.)

Express your answer in terms of the variables L_1, L_2, and M.

ANSWER:

L_{eq} =

Part B

If the two coils are connected in parallel, find the equivalent inductance of the combination.

Express your answer in terms of the variables L_1, L_2, and M.

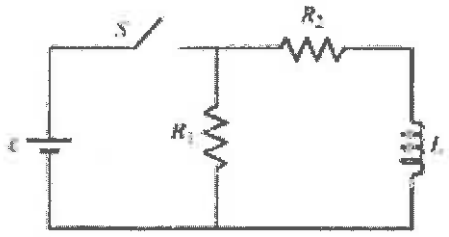
ANSWER:

L_{eq} =

Problem 30.22

Part A

Consider the circuit shown in the figure. The battery has emf ε = 20 volts and negligible internal resistance. The inductance is L = 0.8 H and the resistances are R_1 = 12 Ω and R_2 = 9.0 Ω. Initially the switch S is open and no currents flow. Then the switch is closed.



What is the current in the resistor R_1 just after the switch is closed?

Express your answer using two significant figures.

ANSWER:

A

Part B

After leaving the switch closed for a very long time, it is opened again. Just after it is opened, what is the current in R_1?

Express your answer using two significant figures.

ANSWER:

A

Problem 31.39

A coil has a resistance of 49.0Ω . At a frequency of 78.0Hz the voltage across the coil leads the current in it by $54.6°$.

Part A

Determine the inductance of the coil.

ANSWER:

L = H

Problem 31.41

A parallel-plate capacitor having square plates 4.50cm on each side and 8.00mm apart is placed in series with an ac source of angular frequency 650rad/s and voltage amplitude 22.5V , a 75.0Ω resistor, and an ideal solenoid that is 9.00cm long, has a circular cross section 0.500cm in diameter, and carries 125 coils per centimeter.

Part A

What is the resonance angular frequency of this circuit?

ANSWER:

ω_0 = rad/s

Problem 31.47

In a series *R-L-C* circuit, $R = 280\Omega$, $X_C = 280\Omega$ and $X_L = 440\Omega$. The average power consumed in the resistor is 60.0W .

Part A

What is the power factor of the circuit?

ANSWER:

$\cos\phi$ =

Part B

What is the rms voltage of the source?

ANSWER:

V_{rms} = V

Score Summary:

Your score on this assignment is 0.0%.
You received 0 out of a possible total of 15 points.