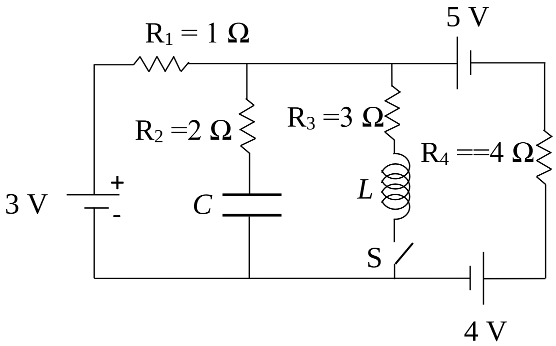
1

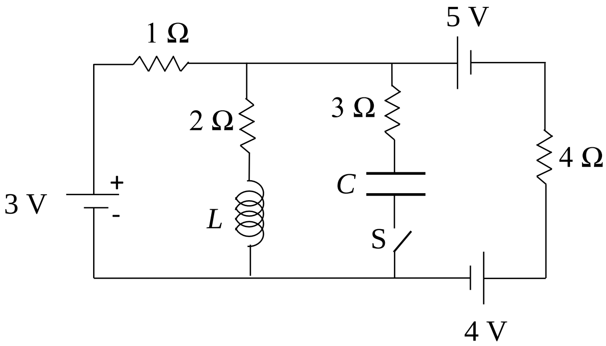
Find the current across the resistor R_4 =4 Ω while the switch S is open for long time.



A) 1.2 (A) **B)** 1.5 (A) **C)** 1.0 (A) **D)** 0.75(A) **E)** 2.0(A)

2

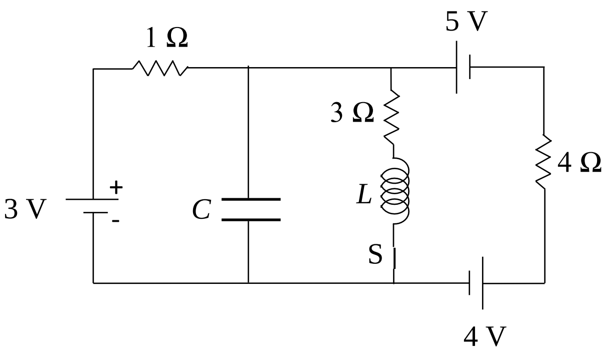
Find the current across the resistor 4 Ω while the switch S is open for a long time.



A) $\frac{21}{14}$ (A) **B)** $\frac{21}{17}$ (A) **C)** $\frac{21}{20}$ (A) **D)** $\frac{21}{26}$ (A) **E)** $\frac{21}{32}$ (A)

3

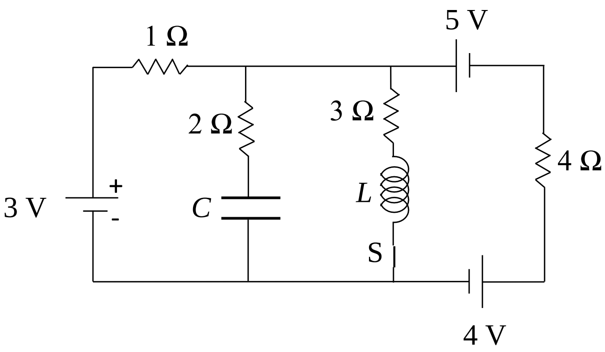
Find the current across the resistor 3 Ω in Ampere while the switch S is closed for a long time.



A) $\frac{21}{19}$ **B)** $\frac{21}{14}$ **C)** $\frac{21}{29}$ **D)** $\frac{21}{34}$ **E)** $\frac{21}{39}$

4

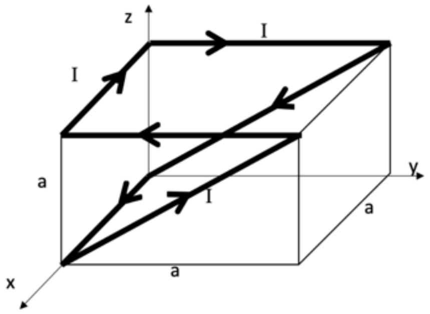
After the switch S is kept open for a long time, it is closed at t=0. What is the current across the resistor of 3 ohm at t=0 in Ampere?



A) 0 **B)** 2 **C)** 1.5 **D)** 3 **E)** 1.7

5

Find the magnetic dipole moment $\vec{\mu}$ of the current loop given in the figure.



A) $Ia^2(-\hat{j})$

B) $Ia^2(\frac{1}{\sqrt{2}}\hat{j} - \frac{1}{\sqrt{2}}\hat{k})$

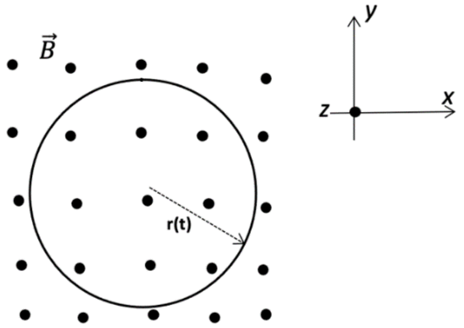
C) $Ia^2(-\hat{\imath} - \frac{1}{\sqrt{2}}\hat{j} - \frac{1}{\sqrt{2}}\hat{k})$

D) $Ia^2(-\hat{k})$

E) $Ia^2(-\hat{\imath} - \hat{j} + \hat{k})$

6

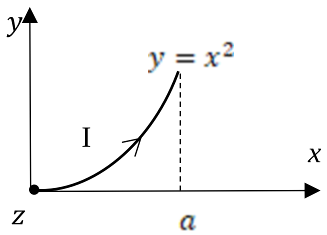
A circular, extensible and flexible conductive strip of radius $r(t)$ has a constant resistance $\boldsymbol{R}$. The circle is in a uniform magnetic field outward from the plane of the page given by $\vec{\boldsymbol{B}} = \boldsymbol{B_0}\hat{\boldsymbol{k}}$. Under the influence of the external force uniformly distributed over the circumference of the circle, the circle expands with constant velocity, starting from radius $\boldsymbol{r_0}$ to a larger radius $\boldsymbol{r}$. The radius changes with time as $\boldsymbol{r} = \boldsymbol{r_o} + \boldsymbol{v_0 t}$. Find the electromotive force $(\boldsymbol{\varepsilon})$ induced in the circle for $B_0 = 1.0\ (T)$ and $v_0 = 1.0\ \left(\frac{m}{s}\right)$. (π=3)



A) $6r$ **B)** $3r$ **C)** $12r$ **D)** $9r$ **E)** $36r$

7

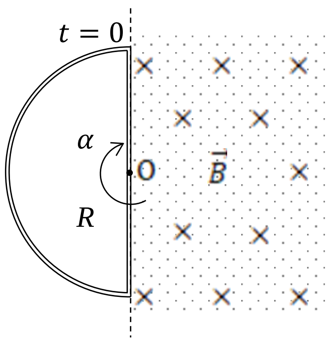
A current wire of $I = 3(A)$ is bent into a parabola given by $y = x^2$. Here x and y are in meters. The wire is placed in a magnetic field varying with position as $\vec{B} = 2x\hat{j}$ Tesla. Find the magnetic force vector acting on the part of the wire shown in the figure. Where $a = \sqrt{2}(m)$.



A) $6\hat{k}$ **B)** $9\hat{k}$ **C)** $6\sqrt{2}\hat{k}$ **D)** $3\sqrt{2}\hat{k}$ **E)** $3\hat{k}$

8

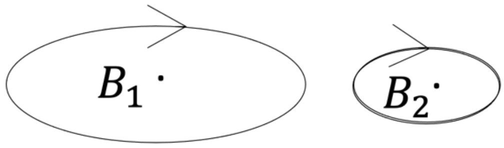
A conductive wire is bent into a semicircular loop of radius R as shown in the figure. The center of the loop is placed exactly at the boundary of the magnetic field, with the plane of the loop perpendicular to the magnetic field. As shown in the figure, at t=0, the loop starts to rotate around the O axis from rest with a constant angular acceleration of $\alpha = 6\left(\frac{rad}{s^2}\right)$. Here $B = 2\ (T), R = 1\ (m)$. What is the maximum electromotive force induced in the loop in Volts? $(\pi = 3)$



A) 6 **B)** 12 **C)** 30 **D)** 16 **E)** 32

9

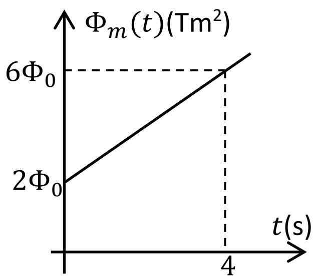
A wire of length L and <u>negligible thickness</u>, with current I flowing through it, is bent into a circle. At the center of the circle, the magnetic field strength created by the current is B_1. How many turns, the same wire of length L is bent in identical circles on top of each other that the magnetic field formed at the center of the new circles becomes $B_2 = 9B_1$



A) 3 **B)** 4 **C)** 5 **D)** 2 **E)** 6

10

The magnetic flux through a coil with a resistance of $10\,\Omega$ changes over time as shown in the figure. Which of the following is the inductance of the coil in Henry at $t = 1$ second?



A) 30 **B)** 20 **C)** 50 **D)** 80 **E)** 150

11

In the series RLC circuit connected to the alternating current source, the source voltage is given as $\Delta V = 200\sin(1000t)$. $R = 100\Omega$, $L = 0.5H$ and $C = 5\mu F$. What is the maximum value of the current I_{Max} in Amperes.

A) $\frac{\sqrt{10}}{5}$ **B)** $\frac{\sqrt{5}}{5}$ **C)** $\frac{2\sqrt{10}}{5}$ **D)** $\frac{\sqrt{10}}{2}$ **E)** $\frac{\sqrt{5}}{2}$

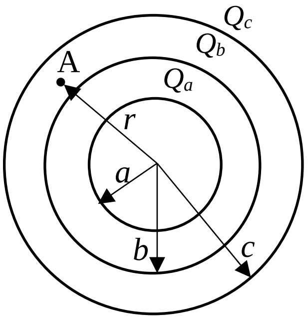
12

In a series RLC circuit, the effective value of current and the voltage are given as $I_{et} = 6\ (A)$ ve $V_{et} = 180\ (V)$. In this circuit, if the current leads to voltage by 37° what is the resistance of the resistor in ohms? $(cos37° = 0.8, sin37° = 0.6)$

A) 24 **B)** 32 **C)** 56 **D)** 48 **E)** 40

13

Very thin insulating spherical shells (membrane) with a radius of $a = 1(m)$, $b = 2(m)$, $c = 3(m)$ each with different charges are placed concentrically as in the figure. Charges are uniformly distributed on spherical shells are respectively $Q_a = -4\ (C)$, $Q_b = 3\ (C)$ and $Q_c = -2\ (C)$, respectively. In the figure r is the radial distance measured outward from the origin. What is the potential at point A distance $r = \frac{5}{2}(m)$ from the origin? (The potential at infinite is zero.)



A) $-\frac{16}{15}k$ **B)** $-\frac{37}{33}k$ **C)** $-\frac{83}{30}k$ **D)** $-\frac{46}{15}k$ **E)** $-\frac{41}{18}k$

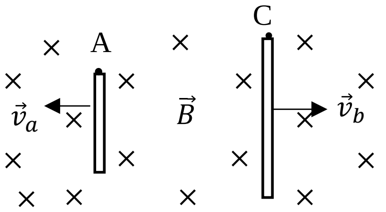
14

A parallel plate capacitor has square plates 1.0 (cm) on a side and 0.5 (cm) apart. If the voltage across the plates is increasing at the rate of 200 (V/ms), which of the followings is the displacement current in the capacitor?

A) $0.1\varepsilon_0$ **B)** $0.8\varepsilon_0$ **C)** $0.9\varepsilon_0$ **D)** $0.3\varepsilon_0$ **E)** $0.6\varepsilon_0$

15

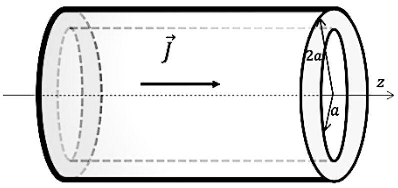
Two conducting rods with lengths $a = 1(m)$ and $b = 3(m)$ move in opposite directions with constant velocities v_a =10(m/s) ve v_b =5(m/s) on the page plane. The constant magnetic field $B = 0.5\ (T)$ is perpendicular to the plane as shown in the figure. What is the potential difference between the top points of the rods $|V_A - V_C|$ in volts?



A) $\frac{5}{2}$ **B)** $\frac{15}{2}$ **C)** 13 **D)** 10 **E)** 0

16

As in the figure, the long cylindrical slice with inner radius a and outer radius $2a$ has a current density given by $J = J_0 \frac{r}{a}$. Where r is the radial distance from the axis of the cylinder. If the current flowing in the z direction is $I = 2\ (A)$ and $a = 2\ (m)$, what is the constant J_0 in $\frac{A}{m^2}$? $(\pi = 3)$



A) $\frac{1}{28}$ **B)** $\frac{1}{8}$ **C)** $\frac{1}{7}$ **D)** $\frac{1}{21}$ **E)** $\frac{3}{7}$

17

As in the figure, a constant current $I = 6\ (A)$ flows in the z direction through the long cylindrical slice with inner radius $a = 1\ (m)$ and outer radius $2a$. What is the magnitude of the magnetic field at $r = (3a/2)$ in Tesla? $(\pi = 3)$

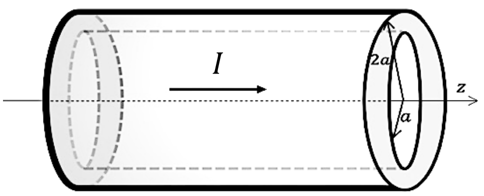
A) $\frac{5}{18}\mu_0$

B) $\frac{5}{24}\mu_0$

C) $\frac{15}{32}\mu_0$

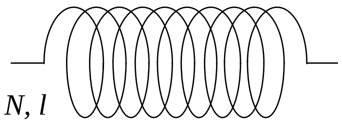
D) $\frac{5}{4}\mu_0$

E) $\frac{7}{72}\mu_0$



18

A long coil of $N = 2000$ turns, $R = 0.2$ (m) and and $l = 5$ (m) length carries a current of $I(t) = 20(1 - e^{-4t})$ (A). Calculate the magnitude of the induced electric field at distance r from the coil axis. ($r < R$)



A) $16 \times 10^3 \mu_0 r e^{-4t}$

B) $8.0 \times 10^3 \mu_0 r e^{-4t}$

C) $20 \times 10^3 \mu_0 r e^{-4t}$

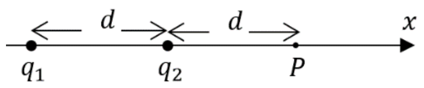
D) $1.0 \times 10^3 \mu_0 r e^{-4t}$

E) $5.0 \times 10^3 \mu_0 r e^{-2t}$

19

How much work must be done to bring the charge $q_3 = 2(nC)$ from infinite to point P in nano-Joule?

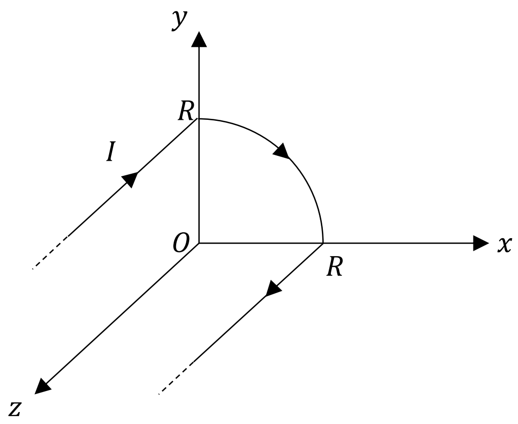
$q_1 = 2(nC), q_2 = 1(nC), d = 4(m), k = 9\text{x}10^9(\frac{Nm^2}{C^2})$



A) 9 **B)** 15 **C)** $-\frac{45}{2}$ **D)** 18 **E)** 0

20A

Find the magnetic field vector at the origin of the current wire, which consists of two semi-infinite straight wires and a quarter circle, as shown in the figure.



A) $\frac{\mu_0 I}{4\pi R}(-\hat{\imath} - \hat{\jmath} - \frac{\pi}{2}\hat{k})$

B) $\frac{\mu_0 I}{4\pi R}\left(-\hat{\imath} - \frac{\pi}{2}\hat{\jmath} - \hat{k}\right)$

C) $\frac{\mu_0 I}{2\pi R}(-\hat{\imath} - \frac{\pi}{2}\hat{\jmath} - \hat{k})$

D) $\frac{\mu_0 I}{4\pi R}(-\frac{\pi}{2}\hat{\imath} - \hat{\jmath} - \hat{k})$

E) $\frac{\mu_0 I}{2\pi R}(-\hat{\imath} - \hat{\jmath} - \frac{\pi}{2}\hat{k})$