A A A

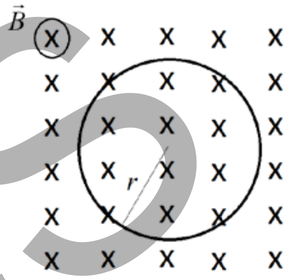
Name Surname: **Student No:** **Exam Duration: 100 mins.** **08.06.2022**

1) Which of the following relations expresses that there is no isolated magnetic charge (magnetic monopole)?

a) $\oint_A \vec{E}\cdot d\vec{A} = \dfrac{q}{\varepsilon_0}$ b) $\oint_A \vec{B}\cdot d\vec{A} = 0$ c) $\oint_C \vec{B}\cdot d\vec{S} = \mu_0 I + \varepsilon_0\mu_0 \dfrac{d\Phi_E}{dt}$

d) $\varepsilon = \oint_C \vec{E}\cdot d\vec{S}$ e) $\vec{B} = \dfrac{\mu_0}{4\pi}\int \dfrac{Id\vec{s}\times\hat{r}}{r^2}$

A circular loop of radius r and resistance R is placed in a magnetic field oriented perpendicular to the loop plane, as shown in the figure. The magnetic field changes with time (t), according to $B = B_0\cos(\omega t)$ relation where B_0 and ω are positive constants. Answer the following three questions (2-4) based on this information.



2) What is the magnetic flux passing through the circular loop?

a) $B_0\,\pi r^2\cos(\omega t)$ b) $B_0\,\pi r^2\sin(\omega t)$ c) $2B_0\,\pi r\cos(\omega t)$

d) $2B_0\,\pi r\sin(\omega t)$ e) $\dfrac{1}{2}B_0\,\pi r^2\cos(\omega t)$

3) What is the induced electromotive force in the circular loop?

a) $B_0\,\omega\pi r^2\cos(\omega t)$ b) $B_0\,2\omega\pi r\sin(\omega t)$ c) $B_0\,2\omega\pi r\cos(\omega t)$

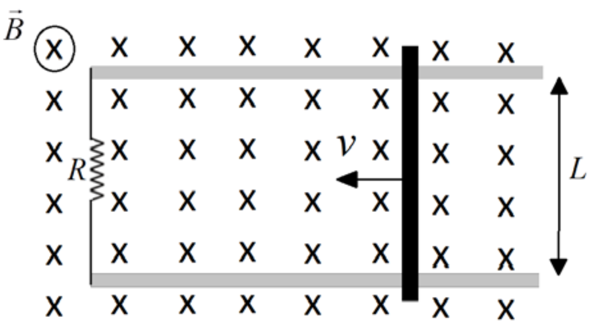
d) $B_0\,2\pi r\cos(\omega t)$ e) $B_0\,\omega\pi r^2\sin(\omega t)$

4) What is the magnitude of the induced electric current in the circular loop?

a) $\dfrac{B_0\,2\omega\pi r\left|\sin(\omega t)\right|}{R}$ b) $\dfrac{B_0\,\omega\pi r^2\left|\cos(\omega t)\right|}{R}$ c) $\dfrac{B_0\,2\omega\pi r\left|\cos(\omega t)\right|}{R}$

d) $\dfrac{B_0\,\omega\pi r^2\left|\sin(\omega t)\right|}{R}$ e) $\dfrac{B_0\,2\pi r\left|\cos(\omega t)\right|}{R}$

A 0.2 m long conducting bar moves to the left with constant velocity v along the conducting parallel rails in a uniform magnetic field of 0.6 T directed inward from the plane of the page. Assume that the rails have negligible resistance. A resistor R is connected between the conductor rails as shown in the Figure. Since the electromotive force (emf) induced in the moving rod is 12 mV, answer the following three questions (5-7) according to this information.



5) What is the speed of the rod in m/s unit?

a) 0.3 b) 0.4 c) 0.1 d) 0.2 e) 0.5

6) If the total resistance of the system is R=2.4 kΩ, what are the magnitude and direction of the induced electric current in the circuit?

a) 1 μA, clockwise
b) 1 μA, counter clockwise
c) 5 μA, clockwise
d) 5 μA, counter clockwise
e) 2,5 μA, clockwise

7) What is the power consumed across on the resistor in W unit while the conducting rod is moving?

a) 6×10^{-8} b) 3×10^{-8} c) 4×10^{-8} d) 5×10^{-8} e) 12×10^{-8}

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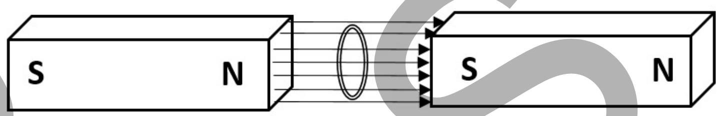
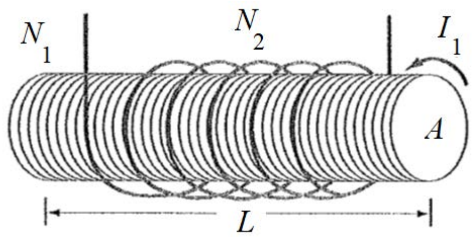
8) A metal ring with a diameter of 5 cm is placed between the north and south poles of two bar magnets. The ring plane is perpendicular to the magnetic field between the magnetic poles. The metal ring is initially exposed to a uniform magnetic field of 1.12 T. Afterwards, the intensity of the magnetic field started to decrease by 0.250 T per second, while the direction of the magnetic field remained constant. What is the magnitude of the electric field induced in the ring, in V/m?



a) 0.25×10^{-3} b) 5×10^{-3} c) 2.25×10^{-3} d) 2.5×10^{-3} e) 3.125×10^{-3}

A long solenoid with N_1 windings, length L and cross-sectional area A carries an electric current of magnitude I_1. As shown in the figure, an insulated coil with N_2 windings is wound around the solenoid with N_1 windings.



Answer the following two questions (9-10) based on this information.

9) Assuming that all of the magnetic flux through the N_2-wound coil originates from the N_1-wound solenoid, what is the mutual inductance, M ?

a) $\mu_0 N_1 N_2 A L$ b) $\dfrac{\mu_0 N_1 N_2 A}{L}$ c) $\dfrac{\mu_0 N_1 N_2 L}{A}$ d) $\dfrac{N_1 N_2 L}{\mu_0 A}$ e) $\dfrac{\mu_0 N_1 A}{N_2 L}$

10) Which of the following relation describes the mutual inductance M depending on the self-inductances of the solenoid (L_1) and coil (L_2)?

a) $M = (L_1 L_2)^2$ b) $M = \sqrt{\dfrac{L_2}{L_1}}$ c) $M = \sqrt{\dfrac{L_1}{L_2}}$ d) $M = \sqrt{L_1 L_2}$ e) $M = L_1 L_2$

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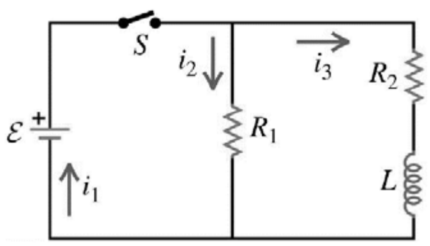
11) A long solenoid with length L and radius R consists of N turns of wire and carries electric current I. What is the energy density stored in the magnetic field of the solenoid?

a) $\dfrac{\mu_0 L I^2}{N^2}$ b) $2\dfrac{\mu_0 L^2 I^2}{N^2}$ c) $\dfrac{1}{2}\dfrac{\mu_0 N^2 I^2}{L^2}$ d) $\dfrac{\mu_0 N^2 I^2}{L^2}$ e) $\dfrac{1}{2}\dfrac{\mu_0 L^2 I^2}{N^2}$

An inductor with inductance L and negligible resistance is connected to a battery, a switch S, and two resistors, R_1 and R_2 as shown in the figure. The electromotive force of the battery is ε and the internal resistance of the battery is negligibly small. S is closed at $t=0$.



Answer the following two questions (12-13) based on this information.

12) What are the currents i_1, i_2, and i_3, respectively, just after the switch S is closed?

a) $\frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_1}, 0$ b) $\frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}, 0$ c) $\frac{\varepsilon}{R_2}, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_1+R_2}$

d) $\frac{\varepsilon(R_1+R_2)}{R_1R_2}, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}$ e) $0, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}$

13) What are the currents i_1, i_2, and i_3, respectively, after the switch S has been closed a long time?

a) $\frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_1}, 0$ b) $\frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}, 0$ c) $\frac{\varepsilon}{R_2}, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_1+R_2}$

d) $\frac{\varepsilon(R_1+R_2)}{R_1R_2}, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}$ e) $0, \frac{\varepsilon}{R_1}, \frac{\varepsilon}{R_2}$

The current passing through a solenoid is smoothly increased from 1 A to 7 A within 3 s, and the electromotive force formed between the ends of the solenoid is measured as 16 mV.
Answer the following three questions (14-16) based on this information.

14) What is the inductance of the solenoid in H unit?

a) 1.6×10^{-3} b) 8×10^{-3} c) 3.2×10^{-3} d) 0.8×10^{-3} e) 1.2×10^{-3}

15) If the length of the solenoid is 12 m and the cross-sectional area is 8 mm^2, what is the number of turns per unit length (turns/m) of the solenoid? ($\pi \sim 3$)

a) $\frac{1}{20}\times10^5$ b) $\frac{1}{36}\times10^5$ c) $\frac{1}{6}\times10^5$ d) $\frac{1}{144}\times10^5$ e) $\frac{1}{12}\times10^5$

16) What is the work done as the current rises from 1 A to 7 A in mJ unit?

a) 112 b) 48 c) 96 d) 384 e) 192

A 2 Ω resistor, an 8 mH inductor and a 5 μF capacitor are connected in series.
Answer the following two questions (17-18) based on this information. ($\pi \sim 3$)

17) What is the resonant frequency of this system in Hz unit?

a) 1000 b) 4000 c) $\frac{2500}{3}$ d) 1500 e) $\frac{1250}{3}$

18) Assume that these circuit elements connected in series are connected to a voltage source with $V_{rms} = 5$ V and frequency f. What is the maximum value of I_{rms} current in A unit? (rms: root mean square)

a) 1 b) 2.5 c) 4 d) 5 e) 1.25

A circuit consists of a resistor and a capacitor connected in series with a voltage source of V_{rms} = 240 V. The reactance of the capacitor is 50 Ω, and the rms value of the current in the circuit is 3 A. (rms: root mean square)

Answer the following two questions (19-20) based on this information.

19) What is power factor of the circuit?

a) $\frac{\sqrt{39}}{3}$ b) $\frac{\sqrt{17}}{4}$ c) $\frac{\sqrt{13}}{2}$ d) $\frac{\sqrt{39}}{8}$ e) $\frac{\sqrt{13}}{4}$

20) What is the average power supplied by the source in Watt unit?

a) $90\sqrt{39}$ b) $90\sqrt{17}$ c) $60\sqrt{13}$ d) $60\sqrt{39}$ e) $60\sqrt{17}$

No	A	No	A
1.	B	**11.**	C
2.	A	**12.**	A
3.	E	**13.**	D
4.	D	**14.**	B
5.	C	**15.**	E
6	C	**16.**	E
7	A	**17.**	C
8.	E	**18.**	B
9.	B	**19.**	D
10.	D	**20.**	A