# Electromagnetic Induction and Alternating

## Question1

**Let us consider two solenoids A and B, made from same magnetic material of relative permeability μr and equal area of cross-section. Length of A is twice that of B and the number of turns per unit length in A is half that of B. The ratio of self inductances of the two solenoids, $L_A$ : $L_B$ is**

**[NEET 2024 Re]**

**Options:**

A.

1 : 2

B.

2 : 1

C.

8 : 1

D.

1 : 8

**Answer: A**

**Solution:**

$$L = \mu_0 \mu_r \times n \times A \times N$$

$$L = \mu_0 \mu_r n \times A \times \frac{N}{I} \times I$$

$$L = \mu_0 \mu_r \times n^2 \times A \times l \Rightarrow L \propto n^2 l$$

$$\Rightarrow \frac{L_A}{L_B} = \frac{n_A^2}{n_B^2} \times \frac{l_A}{l_B}$$

$$\Rightarrow \frac{L_A}{L_B} = \frac{1}{4} \times 2 = \frac{1}{2}$$

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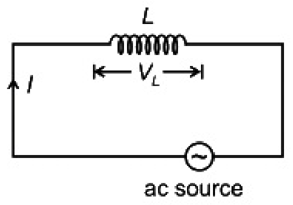
## Question2

**In the circuit shown below, the inductance L is connected to an ac source. The current flowing in the circuit is $I = I_0 \sin \omega t$. The voltage**

**drop ($V_L$) across L is**




## [NEET 2024 Re]

**Options:**

A.

$\omega L I_0 sin\omega t$

B.

$\frac{I_0}{\omega L} sin\ \omega t$

C.

$\frac{I_0}{\omega L}\cos\omega t$

D.

$\omega L I_0 \cos\omega t$

**Answer: D**

## Solution:

$V_L$ leads current I by $\frac{\pi}{2}$

$\therefore V_L = V_0 sin\left(\omega t + \frac{\pi}{2}\right)\ (\because I = I_0 sin\ \omega t)$

$V_0 = I_0 X_L$

$\Rightarrow V_L = I_0 X_L \cos(\omega t) = 10\omega L \cos(\omega t)$

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# Question3

**A step up transformer is connected to an ac mains supply of 220V to operate at 11000V, 88 watt. The current in the secondary circuit, ignoring the power loss in the transformer, is**

## [NEET 2024 Re]

**Options:**

A.

8 mA

B.

4 mA

C.

0.4A

D.

4A

**Answer: A**

## Solution:

In secondary circuit, $P = Vi$

$\Rightarrow \quad 88 = 11000i$

$\Rightarrow \quad i = \dfrac{88}{11 \times 10^3} = 8 \times 10^{-3}\text{A}$

$\Rightarrow \quad i = 8\,\text{mA}$

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# Question4

## The amplitude of the charge oscillating in a circuit decreases exponentially as $Q = Q_0 e^{-Rv2L}$ , where $Q_0$ is the charge at t = 0 s . The time at which charge amplitude decreases to 0.50 $Q_0$ is nearly:

## [Given that R = 1.5Ω, L = 12 mH, ln(2) = 0.693]

## [NEET 2024 Re]

**Options:**

A.

19.01 ms

B.

11.09 ms

C.

19.01 s

D.

11.09 s

**Answer: B**

## Solution:

Given $Q = Q_0 e^{-RU/L}$

$R = 1.5\Omega$, $L = 12$ mH, $\ln(2) = 0.693$

$Q = 0.5Q_0$, $t = ?$

$0.5Q_0 = Q_0 e^{-Rt/2L}$

$\Rightarrow \frac{1}{2} = e^{-Rt/2L}$

Taking log on both sides

$\ln\left(\frac{1}{2}\right) = \ln e^{-Rt/2L}$

$\Rightarrow \ln 2 = \frac{Rt}{2L}$

$t = \frac{2L \ln 2}{R} = \frac{2 \times 12 \times 10^{-3} \times 0.693}{1.5}$

$t = 11.09$ ms

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# Question5

**In an ideal transformer, the turns ratio is $\frac{N_p}{N_S} = \frac{1}{2}$. The ratio $V_S : V_p$ is equal to (the symbols carry their usual meaning) :**

## [NEET 2024]

**Options:**

A.

1 : 2

B.

2 : 1

C.

1 : 1

D.

1 : 4

**Answer: B**

## Solution:

According to transformer ratio,

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = 2:1$$

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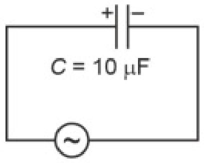
# Question6

## A 10μF capacitor is connected to a 210V,50Hz source as shown in figure. The peak current in the circuit is nearly (π = 3.14) :




## [NEET 2024]

**Options:**

A.

0.58A

B.

0.93A

C.

1.20A

D.

0.35A

**Answer: B**

## Solution:

Capacitive Reactance $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 50 \times 10 \times 10^{-6}}$

$= \frac{1000}{3.14}$

$V_{rms} = 210V$

$i_{rms} = \frac{V_{rms}}{X_C} = \frac{210}{X_C}$

Peak current $= \sqrt{2} i_{rms} = \sqrt{2} \times \frac{210}{1000} \times 3.14 = 0.932$

$= 0.93A$

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# Question7

**The net magnetic flux through any closed surface is**

**[NEET 2023]**

**Options:**

A.

Positive

B.

Infinity

C.

Negative

D.

Zero

**Answer: D**

## Solution:

$\oint \vec{B} \cdot \vec{ds} =$ zero Magnetic monopole doesn't exist.Hence net magnetic flux through any closed surface is zero.

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# Question8

## The magnetic energy stored in an inductor of inductance 4μH carrying a current of 2A is

**[NEET 2023]**

**Options:**

A.

4mJ

B.

8mJ

C.

8μJ

D.

4μJ

**Answer: C**

## Solution:

Magnetic energy stored in an inductor

$$U = \frac{1}{2}Li^2$$

$$= \frac{1}{2} \times 4 \times 10^{-6} \times (2)^2$$

$$= 8 \times 10^{-6} \text{J}$$

$$U = 8\mu\text{J}$$

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# Question9

## In a series LCR circuit, the inductance L is 10mH, capacitance C is 1μF and resistance R is 100Ω. The frequency at which resonance occurs is

## [NEET 2023]

**Options:**

A.

15.9kHz

B.

1.59rad/ s

C.

1.59kHz

D.

15.9rad/ s

**Answer: C**

## Solution:

Sol. For resonance frequency $= \frac{1}{2\pi\sqrt{LC}}$

$$\Rightarrow f = \frac{1}{2 \times \pi \times \sqrt{10 \times 10^{-3} \times 1 \times 10^{-6}}} = \frac{10^4}{2\pi}$$

$$= 1.591 \times 10^3$$

$$= 1.591 \text{ kHz}$$

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# Question10

## A 12V,60W lamp is connected to the secondary of a step-down

**transformer, whose primary is connected to ac mains of 220V. Assuming the transformer to be ideal, what is the current in the primary winding?**

**[NEET 2023]**

**Options:**

A.

2.7A

B.

3.7A

C.

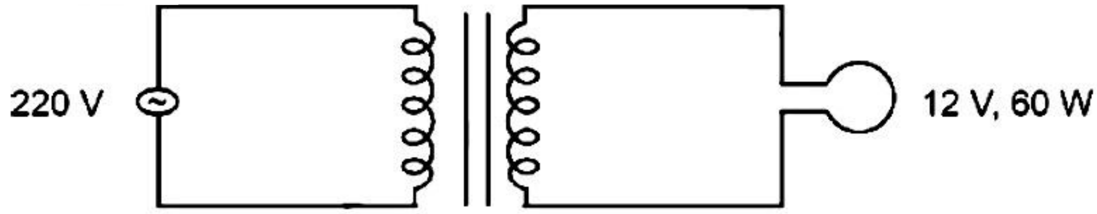
0.37A

D.

0.27A

**Answer: D**

## Solution:




For ideal transformer

$P_{input} = P_{output}$

$(VI)_{in} = 60$

$220 \times I = 60$

$I = 0.27A$

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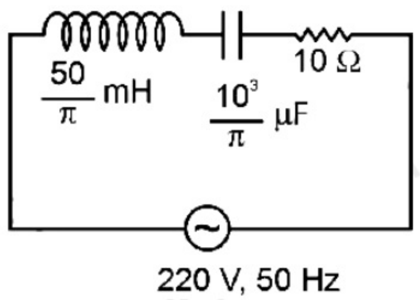
# Question11

## The net impedance of circuit (as shown in figure) will be




**[NEET 2023 mpr]**

**Options:**

A.

$15\Omega$

B.

$5\sqrt{5}\Omega$

C.

$25\Omega$

D.

$10\sqrt{2}\Omega$

**Answer: B**

## Solution:

$$L = \frac{50}{\pi} \text{mH}$$

$$X_L = 2\pi \times 50 \times \frac{50}{\pi} \times 10^{-3} = 5\Omega$$

$$C = \frac{10^3}{\pi} \times 10^{-6}$$

$$X_C = \frac{1 \times \pi}{2\pi \times 50 \times 10^3 \times 10^{-6}} = \frac{10^3}{100} = 10\Omega$$

$$Z = \sqrt{(X_C - X_L)^2 + R^2}$$

$$Z = \sqrt{(10-5)^2 + 10^2} = \sqrt{125} = 5\sqrt{5}\Omega$$

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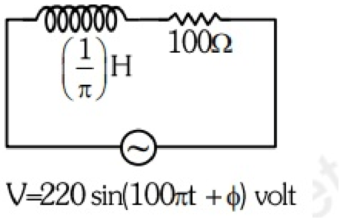
# Question12

## An ac source is connected in the given circuit. The value of φ will be :

$V = 220 \sin(100\pi t + \varphi)$ volt




## [NEET 2023 mpr]

**Options:**

A.

60°

B.

90°

C.

30°

D.

45°

**Answer: D**

## Solution:

$$\tan\varphi = \frac{X_L}{R}$$

$$X_L = \omega l = 100\pi \times \frac{1}{\pi} = 100\Omega$$

$$R = 100\Omega$$

$$\tan\varphi = \frac{100}{100} = 1$$

$$\varphi = 45^\circ$$

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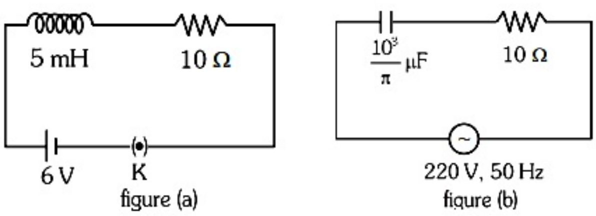
# Question13

**If $Z_1$ and $Z_2$ are the impedances of the given circuits (a) and (b) as shown in figures, then choose the correct option**




## [NEET 2023 mpr]

**Options:**

A.

$Z_1 < Z_2$

B.

$Z_1 = Z_2$

C.

$Z_1 + Z_2 = 20\Omega$

D.

$Z_1 > Z_2$

**Answer: A**

## Solution:

$Z_1 = \sqrt{X_L^2 + R^2}\ \ X_L = O$ (D.C. circuit)

$Z_1 = 10\Omega$

$Z_2 = \sqrt{X_C^2 + R^2}$

$X_C = \dfrac{1}{2\pi \times 50 \times \dfrac{10^3}{\pi} \times 10^{-6}} = 10\Omega$

$Z_2 = \sqrt{(10)^2 + (10)^2}$

$= 10\sqrt{2}$

$Z_1 < Z_2$

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# Question14

## The maximum power is dissipated for an ac in a/an:

## [NEET 2023 mpr]

**Options:**

A.

resistive circuit

B.

LC circuit

C.

inductive circuit

D.

capacitive circuit

**Answer: A**

## Solution:

**Solution:**

Power dissipated is maximum of purely resistive circuit.

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# Question15

## An emf is generated by an ac generator having 100 turn coil, of loop area 1m2. The coil rotates at a speed of one revolution per second and

**placed in a uniform magnetic field of 0.05T perpendicular to the axis of rotation of the coil. The maximum value of emf is :-**

**[NEET 2023 mpr]**

**Options:**

A.

3.14V

B.

31.4V

C.

62.8V

D.

6.28V

**Answer: B**

**Solution:**

$$\omega = 2\pi \frac{\text{rad}}{sec}$$

$$E_{max} = \text{NBA}\,\omega$$

$$= 100 \times 0.05 \times 1 \times 2\pi$$

$$= 10 \times \pi$$

$$= 31.4\text{V}$$

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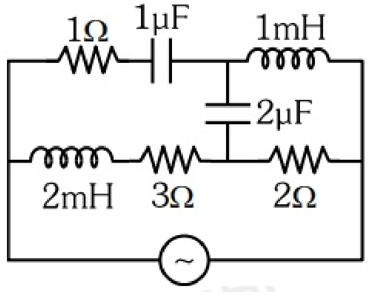
# Question16

**For very high frequencies, the effective impedance of the circuit (shown in the figure) will be :-**




**[NEET 2023 mpr]**

**Options:**

A.

4Ω

B.

6Ω

C.

1Ω

D.

3Ω

**Answer: D**

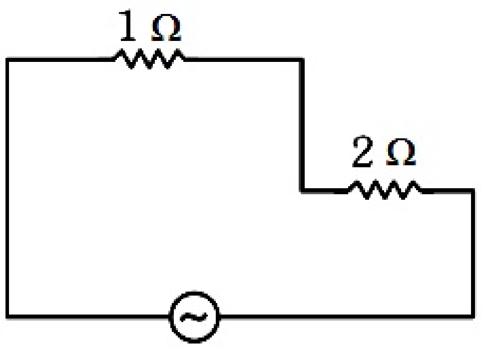
## Solution:

as frequency is very high

$X_C \approx 0$

$X_L \rightarrow \alpha$

Effective circuit will be




Effective impedance of circuit will be $= 3\Omega$

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# Question17

## The magnetic flux linked to a circular coil of radius R is: $\varphi = 2t^3 + 4t^2 + 2t + 5\,\text{Wb}$ The magnitude of induced emf in the coil at t = 5s is: [NEET Re-2022]

**Options:**

A. 192V

B. 108V

C. 197V

D. 150V

**Answer: A**

## Solution:

$$\varphi = 2t^3 + 4t^2 + 2t + 5$$

$$|e| = \left|\frac{d\varphi}{dt}\right| = \frac{d}{dt}[2t^3 + 4t^2 + 2t + 5] = 6t^2 + 8t + 2$$

$$e(t) = 6t^2 + 8t + 2$$

$$e(t = 5) = 6(5)^2 + 8(5) + 2$$

$$= 150 + 40 + 2$$

$$= 192\text{V}$$

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# Question18

**Given below are two statements.**
**Statement I:**
**In an ac circuit, the current through a capacitor leads the voltage across it.**
**Statement II:**
**In a.c circuits containing pure capacitance only, the phase difference between the current and the voltage is π.**
**In the light of the above statements, choose the most appropriate answer from the options given below**
**[NEET Re-2022]**

**Options:**

A. Statement I is incorrect but Statement II is correct

B. Both Statement and Statement II are correct

C. Both Statement I and Statement II are incorrect

D. Statement I is correct but Statement II is incorrect

**Answer: D**

## Solution:

**Solution:**

In AC circuit current through the capacitor leads the potential difference across it by a phase *π/2.*

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# Question19

**An inductor of inductance 2 mH is connected to a 220V, 50 Hz a.c. source. Let the inductive reactance in the circuit is $X_1$. If a 220V dc source replaces the ac source in the circuit, then the inductive reactance in the circuit is $X_2$. $X_1$ and $X_2$ respectively are**
**[NEET Re-2022]**

**Options:**

A. 0.628Ω, infinity

B. 6.28Ω, zero

C. 6.28Ω, infinity

D. 0.628Ω, zero

**Answer: D**

## Solution:

**Solution:**

Given $L = 2mH$, $f = 50\,\text{Hz}$

when A. C. source is applied

$X_1 = wL = 2\pi f L$

$= 2\pi \times 50 \times 2 \times 10^{-3}$

$= .628\Omega$

when D. C. source is applied

$X_2 = wL = 2\pi f L$

$(\because f = 0)$

$X_2 = 0$

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# Question20

## A standard filament lamp consumes 100W when connected to 200V ac mains supply. The peak current through the bulb will be: [NEET Re-2022]

**Options:**

A. 2A

B. 0.707A

C. 1A

D. 1.414

**Answer: B**

## Solution:

Given, $P = 100\text{W}$

$V_{\text{rms}} = 200\text{V}$

$i_{\text{rms}} = \dfrac{P}{V_{rms}} = \dfrac{1}{2}$

$i_0 = i_{rms} \times \sqrt{2} = \dfrac{1}{\sqrt{2}}$

$i_0 = 0.707\text{A}$

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# Question21

## The peak voltage of the ac source is equal to [NEET-2022]

**Options:**

A. The value of voltage supplied to the circuit

B. The rms value of the ac source

C. $\sqrt{2}$ times the rms value of the ac source

D. $1 / \sqrt{2}$ times the rms value of the ac source

**Answer: C**

## Solution:

**Solution:**

We know,

RMS value of A.C. $E_{rms} = \dfrac{E_0}{\sqrt{2}}$

$E_0 = \sqrt{2} E_{rms}$

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# Question22

## A square loop of side 1m and resistance 1Ω is placed in a magnetic field of 0.5T . If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is [NEET-2022]



**Options:**

A. 2 weber

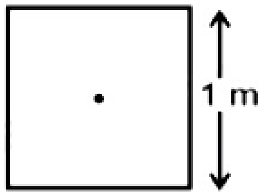
B. 0.5 weber

C. 1 weber

D. Zero weber

**Answer: B**

## Solution:




Magnetic flux $(\varphi_B) = \vec{B} \cdot \vec{A}$

$\vec{B}$ and $\vec{A}$ are in same direction, therefore

$\varphi_B = B \cdot A = 0.5 \times 1^2$

$= 0.5 Wb$

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# Question23

## A series LCR circuit with inductance 10H , capacitance 10μF , resistance 50Ω is connected to an ac source of voltage, V = 200 sin(100t) volt. If the resonant frequency of the LCR circuit is $v_0$ and the frequency of the ac source is v, then [NEET-2022]

**Options:**

A. $v_0 = v = 50 Hz$

B. $v_0 = v = \frac{50}{\pi} Hz$

C. $v_0 = \frac{50}{\pi} Hz$, $v = 50 Hz$

D. $v = 100 Hz$; $v_0 = \frac{100}{\pi} Hz$

**Answer: B**

## Solution:

**Solution:**

$\omega L = \frac{1}{\omega C}$

$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10 \times 10 \times 10^{-6}}}$

$\omega = 100$

$\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi}$

$v_0 = f_0 = \frac{100}{2\pi} = \frac{50}{\pi} Hz, \quad \omega = 100$

$v = f = \frac{100}{2\pi} = \frac{50}{\pi}$

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# Question24

**A big circular coil of 1000 turns and average radius 10m is rotating about its horizontal diameter at 2 rad $^{-1}$. If the vertical component of earth's magnetic field at that place is $2 \times 10^{-5}$T and electrical resistance of the coil is 12.56Ω, then the maximum induced current in the coil will be**
**[NEET-2022]**

**Options:**

A. 0.25A

B. 1.5A

C. 1A

D. 2A

**Answer: C**

## Solution:

$\varphi_B = NBA \cos \omega t$

$\varepsilon = \frac{-d\varphi_B}{dt} = -NBA\omega(-\sin \omega t)$

$\varepsilon = NBA\omega \sin \omega t$

$i_{max} = \frac{\varepsilon_{max}}{R} = \frac{NBA\omega}{R}$

$= \frac{1000 \times 2 \times 10^{-5} \times \pi(10)^2 \times 2}{12.56}$

$= 1A$

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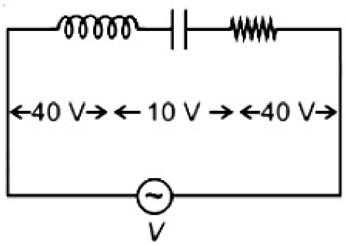
# Question25

**An inductor of inductance L, a capacitor of capacitance C and a resistor of resistance ' R ' are connected in series to an ac source of potential difference ' V volts as shown in figure.**
**Potential difference across L, C and R is 40V , 10 V and 40V , respectively. The amplitude of current flowing through angle C R series circuit is $10\sqrt{2}$A. The impedance of the circuit is An inductor of inductance L, a capacitor of capacitance C and a resistor of resistance ' R ' are connected in series to an ac source of potential difference ' V volts as shown in figure.**




**[NEET 2021]**

**Options:**

A. $4\sqrt{2}\Omega$

B. $\frac{5}{\sqrt{2}}\Omega$

C. $4\Omega$

D. $5\Omega$

**Answer: D**

## Solution:

$V_L$ = 40 volt
$V_R$ = 40 volt
$V_C$ = 10 volt
Now, $V_{RMS} = \sqrt{V_R^2 + (V_L - V_C)^2}$
$= \sqrt{(40)^2 + (40 - 10)^2} = 50V$
$I_{RMS} = \frac{I_0}{\sqrt{2}} = \frac{10\sqrt{2}}{\sqrt{2}} = 10A$
$\because V_{RMS} = I_{RMS} \times Z$
$\therefore Z = \frac{V_{RMS}}{I_{RMS}} = \frac{50}{10} = 5\Omega$

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# Question26

**A step down transformer connected to an ac mains supply of 220 V is made to operate at 11 V, 44 W lamp. Ignoring power losses in the transformer, what is the current in the primary circuit?**
**[NEET 2021]**

Options:

A. 0.2 A

B. 0.4 A

C. 2 A

D. 4 A

**Answer: A**

## Solution:

In ideal transformer:
Input power = Output power
$\Rightarrow V_P I_P = V_S I_S =$ Given power
$\Rightarrow 220 \times I_P = 44$
$\Rightarrow I_P = 0.2A$

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# Question27

## A series LCR circuit containing 5.0 H inductor, 80 μF capacitor and 40 resistor is connected to 230 V variable frequency ac source. The angular frequencies of the source at which power transferred to the circuit is half the power at the resonant angular frequency are likely to be [NEET 2021]

**Options:**

A. 25 rad/s and 75 rad/s

B. 50 rad/s and 25 rad/s

C. 46 rad/s and 54 rad/s

D. 42 rad/s and 58 rad/s

**Answer: C**

## Solution:

**Solution:**
The resonance frequency of LCR series circuit is given as $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{5 \times 80 \times 10^{-6}}} = 50\text{rad} / \text{s}$ Now half power frequencies are given as
$\omega = \omega_0 \pm \frac{R}{2L}$
i.e. $\omega_L = 50 - \frac{40}{2 \times 5} = 46$ rad/s
$\omega_H = 50 + \frac{40}{2 \times 5} = 54$rad/s

# Question28

**Two conducting circular loops of radii $R_1$ and $R_2$ are placed in the same plane with their centres coinciding. If $R_1 >> R_2$, the mutual inductance $M$ between them will be directly proportional to**
**[NEET 2021]**

**Options:**

A. $\frac{R_1}{R_2}$

B. $\frac{R_2}{R_1}$

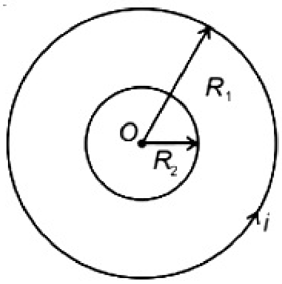
C. $\frac{{R_1}^2}{R_2}$

D. $\frac{{R_2}^2}{R_1}$

**Answer: D**

## Solution:

**Solution:**
Two concentric coils are of radius $R_1$ and $R_2$ as shown




Let current in outer loop be i

Magnetic field at centre $= B = \frac{\mu_0 i}{2R_1}$

Magnetic flux through inner coil $= B \times \pi {R_2}^2$

$\phi = \frac{\mu_0 i}{2R_1} \times \pi {R_2}^2$

$\phi = \frac{\mu_0 i}{2} \times \frac{\pi {R_2}^2}{R_1}$

as per definition, $\phi = M i$

$\Rightarrow M = \left(\frac{\mu_0 \pi}{2}\right) \frac{{R_2}^2}{R_1}$

$\therefore M \propto \frac{{R_2}^2}{R_1}$

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# Question29

**A 40μ F capacitor is connected to a 200V , 50H z ac supply. The rims**

**value of the current in the circuit is, nearly:**
**[2020]**



**Options:**

A. 2.05A

B. 2.5A

C. 25.1A

D. 1.7A

**Answer: B**

## Solution:

(b) Given :
Capacitance, $C = 40\mu F = 40 \times 10^{-6} F$
Frequency, $f = 50 Hz$
$\therefore \omega = 2\pi f = 100\pi$

$\varepsilon_{rms} = 200V \ \therefore I_{rms} = \frac{\varepsilon_{rms}}{X_C} = \frac{\varepsilon_{rms}}{\frac{1}{C\omega}}$

$= 200 \times 40 \times 10^{-6} \times 2\pi \times 50 = 2.5A$

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# Question30

**A series LCR circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is $\frac{\pi}{3}$. If instead C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$ between current and voltage. The power factor of the circuit is:**
**(2020)**

**Options:**



A. 0.5

B. 1.0

C. -1.0

D. zero

**Answer: B**

## Solution:

(b) When L is removed,
Phase difference

$$\tan\varphi = \frac{|X_C|}{R} = \tan\frac{\pi}{3} = \frac{X_C}{R} \quad \cdots\cdots\cdots\cdots (1)$$

When C is removed, Phase difference

$$\tan\varphi = \frac{|X_L|}{R} = \tan\frac{\pi}{3} = \frac{X_L}{R} \quad \cdots\cdots\cdots\cdots (2)$$

From eqs. (1) and (2), $X_L = X_C$
since, $X_L = X_C$, the circuit is in resonance.

In this case, $Z = R$

$\therefore$ Power factor, $\cos\varphi = \frac{R}{Z} = 1$

---

# Question31

## In which of the following devices, the eddy current effect is not used? (NEET 2019)



**Options:**

A. electric heater

B. induction furnace

C. magnetic braking in train

D. electromagnet

**Answer: A**

## Solution:

**Solution:**
Electric heater works on the principle of Joule's heating effect.

---

# Question32

## A 800 turn coil of effective area $0.05 m^2$ is kept perpendicular to a magnetic field $5 \times 10^{-5}$ T. When the plane of the coil is rotated by $90^\circ$ around any of its coplanar axis in 0.1 s, the emf induced in the coil will be (NEET 2019)



**Options:**

A. 0.02V

B. 2V

C. 0.2V

D. $2 \times 10^{-3}$V

**Answer: A**

## Solution:

**Solution:**
Here $N = 800$, $A = 0.05 m^2$
$B = 5 \times 10^{-5} T$, $\Delta t = 0.1 s$
Induced emf, $\varepsilon = -\frac{\Delta \phi}{\Delta t} = -\frac{(\phi_f - \phi_i)}{\Delta t}$
$\phi_i = N(\vec{B} \cdot \vec{A}) = 800 \times 5 \times 10^{-5} \times 0.05 \times \cos 0°$
$= 2 \times 10^{-3} T\,m^2$
$\phi_f = 0$
$\therefore \varepsilon = \frac{-(0 - 2 \times 10^{-3})}{0.1} = 2 \times 10^{-2} V = 0.02 V$

------------------------------------------------------------------------------------------------

# Question33

## A circuit when connected to an AC source of 12V gives a current of 0.2A. The same circuit when connected to a DC source of 12V, gives a current of 0.4A. The circuit is (OD NEET 2019)



**Options:**

A. series LR

B. series RC

C. series LC

D. series LCR

**Answer: A**

## Solution:

**Solution:**
When circuit is connected to an ACsource of 12V, gives a current of 0.2A.
$\therefore$ Impedance, $Z = \frac{12}{0.2} = 60\Omega$
When the same circuit is connected to a DC source of 12V, gives a current of 0.4A.
$\therefore$ Resistance, $R = \frac{12}{0.4} = 30\Omega$
As, power factor, $\cos\phi = \frac{R}{Z} = \frac{30}{60} = \frac{1}{2} = \cos 60°$
$\Rightarrow \phi = 60°$, i.e., current lags behind the emf.
So, we can conclude that the circuit is a series LR.

------------------------------------------------------------------------------------------------

# Question34

**A cycle wheel of radius 0.5m is rotated with constant angular velocity of 10rad / s in a region of magnetic field of 0.1T which is perpendicular to the plane of the wheel. The EMF generated between its centre and the rim is,**
**(OD NEET 2019)**



**Options:**

A. 0.25V

B. 0.125V

C. 0.5V

D. zero

**Answer: B**

## Solution:

**Solution:**
Here, given, $B = 0.1T$ , $r = 0.5m$
$\omega = 10\,rad / s$
So, the emf generated between its centre and rim is, $\varepsilon = \frac{1}{2}B\omega r^2$
$= \frac{1}{2} \times 0.1 \times 10 \times (0.5)^2 = 0.125V$

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# Question35

**The magnetic potential energy stored in a certain inductor is 25mJ , when the current in the inductor is 60mA. This inductor is of inductance**
**(NEET 2018)**



**Options:**

A. 0.138H

B. 138.88H

C. 1.389H

D. 13.89H

**Answer: D**

## Solution:

Magnetic potential energy stored in an inductor is given by

$U = \frac{1}{2}LI^2 \Rightarrow 25 \times 10^{-3} = \frac{1}{2} \times L \times (60 \times 10^{-3})^2$

$L = \frac{25 \times 2 \times 10^6 \times 10^{-3}}{3600} = \frac{500}{36} = 13.89H$

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# Question36

## An inductor 20mH, a capacitor 100μF and a resistor 50Ω are connected in series across a source of emf, $V = 10 \sin 314 t$. The power loss in the circuit is (NEET 2018)



**Options:**

A. 0.79W

B. 0.43W

C. 2.74W

D. 1.13W

**Answer: A**

## Solution:

**Solution:**

Impedance Z in an ac circuit is $Z = \sqrt{R^2 + (X_C - X_L)^2}$; where $X_C =$ capacitivereactance and $X_L =$ inductive reactance.

Also $X_C = \frac{1}{\omega C}$ and $X_L = \omega L$

$\therefore Z = \sqrt{(50)^2 + \left(\frac{1}{314 \times 100 \times 10^{-6}} - 314 \times 20 \times 10^{-3}\right)^2}$

or $Z = 56\Omega$

The power loss in the circuit is $P_{av} = \left(\frac{V_{rms}}{Z}\right)^2 R$

$\therefore P_{av} = \left(\frac{10}{(\sqrt{2})56}\right)^2 \times 50 = 0.79W$

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# Question37

## A long solenoid of diameter 0.1 m has $2 \times 10^4$ turns per metre. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^2\Omega$, the total charge flowing through the coil during this time is (2017 NEET)

**Options:**

A. 16 μC

B. 32 μC

C. 16 πμC

D. 32 π μC

**Answer: B**

## Solution:

**Solution:**
Given $n = 2 \times 10^4$; $I = 4A$
Initially $I = 0A$
$\therefore B_i = 0$ or $\phi_i = 0$
Finally, the magnetic field at the centre of the solenoid is given as
$B_f = \mu_0 nI = 4\pi \times 10^{-7} \times 2 \times 10^4 \times 4 = 32\pi \times 10^{-3} T$

Final magnetic flux through the coil is given as
$\phi_f = N BA = 100 \times 32\pi \times 10^{-3} \times \pi \times (0.01)^2$

$\phi_f = 32\pi^2 \times 10^{-5} T m^2$
Induced charge, $q = \frac{|\Delta\phi|}{R} = \frac{|\phi_f - \phi_i|}{R} = \frac{32\pi^2 \times 10^{-5}}{10\pi^2}$
$= 32 \times 10^{-6} C = 32 \mu C$

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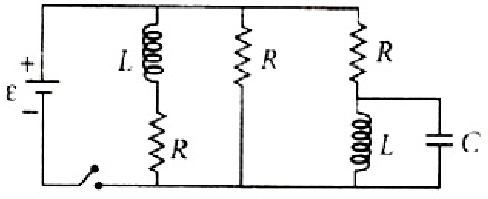
# Question38

## Figure shows a circuit that contains three identical resistors with resistance R = 9.0Ω each, two identical inductors with inductance L = 2.0 mH each, and an ideal battery with emf ε = 18V .The current i through the battery just after the switch closed is




## (2017 NEET)

**Options:**

A. 0.2 A

B. none of the above

C. 0 ampere

D. 2 mA

**Answer: B**

## Solution:

At time, t=0 i.e., when switch is closed, inductor in the circuit provides very high resistance (open circuit) while capacitor starts charging with maximum current (low resistance).
Equivalent circuit of the given circuit
Current drawn from battery,

$$i = \frac{\varepsilon}{\left(\frac{R}{2}\right)} = \frac{2\varepsilon}{R} = \frac{2 \times 18}{9} = 4A$$

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# Question39

## An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf V = 10sin340t. The power loss in A.C. circuit is
## (2016 NEET Phase-1)

©

**Options:**

A. 0.76 W

B. 0.89 W

C. 0.51 W

D. 0.67 W

**Answer: C**

## Solution:

Here, $L = 20mH = 20 \times 10^{-3}H$ .
$C = 50\mu F = 5010^{-6}F$
$R = 40\Omega$, $V = 10\sin 340t = V_0 \sin\omega t$
$\omega = 340 rad\ s^{-1}$, $V_0 = 10V$
$X_L = \omega L = 340 \times 20 \times 10^{-3} = 6.8\Omega$

$$X_C = \frac{1}{\omega C} = \frac{1}{340 \times 50 \times 10^{-6}} = \frac{10^4}{34 \times 5} = 58.82\Omega$$

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$
$$= \sqrt{(40)^2 + (58.82 - 6.8)^2}$$
$$= \sqrt{(40)^2 + (52.02)^2} = 65.62\Omega$$

The peak current in the circuit is

$$I_0 = \frac{V_0}{Z} = \frac{10}{65.62}A, \cos\phi = \frac{R}{Z} = \left(\frac{40}{65.62}\right)$$

Power loss in A.C. circuit

$$= V_{rms} I_{rms} \cos\phi = \frac{1}{2} V_0 I_0 \cos\phi$$
$$\frac{1}{2} \times 10 \times \frac{10}{65.62} \times \frac{40}{65.62} = 0.46W$$

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# Question40

**A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C**
**(2016 NEET Phase-I)**

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**Options:**

A. Current /(f) is in phase with voltage V(t).

B. Current /(f) leads voltage V(t) by 180°.

C. Current /(f), lags voltage V(t) by 90°

D. Over a full cycle the capacitor C does not consume any energy from the voltage source

**Answer: D**

## Solution:

**Solution:**
When an ideal capacitor is connected with an ac voltage source, current leads voltage by 90°. Since, energy stored in capacitor during charging is spent in maintaining charge on the capacitor during discharging. Hence over a full cycle the capacitor does not consume any energy from the voltage source.

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# Question41

## A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3}$ Wb. The self-inductance of the solenoid is (2016 NEET Phase-I)

©

**Options:**

A. 2 H

B. 1 H

C. 4 H

D. 3 H

**Answer: B**

## Solution:

Here, $N = 1000$, $I = 4A$, $\phi_0 = 4 \times 10^{-3}$ Wb
Total flux linked with the solenoid $\phi = N\phi_0$
$= 1000 \times 4 \times 4 \times 10^{-3}$ Wb $= 4$ Wb
Since $\phi = LI$
∴ Self-inductance of solenoid,
$L = \frac{\phi}{I} = \frac{4\,Wb}{4A} = 1H$

# Question42

## Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication ? (2016 NEET Phase-II)



**Options:**

A. $R = 20\Omega$, $L = 1.5H$ , $C = 35\mu F$

B. $R = 25\Omega$, $L = 2.5H$ , $C = 45\mu F$

C. $R = 15\Omega$, $L = 3.5H$ , $C = 30\mu F$

D. $R = 25\Omega$, $L = 1.5H$ , $C = 45\mu F$

**Answer: C**

## Solution:

Quality factor of an L-C-R circuit is given by

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

$Q_1 = \frac{1}{20}\sqrt{\frac{1.5}{35 \times 10^{-6}}} = 50 \times \sqrt{\frac{3}{70}} = 10.35$

$Q_2 = \frac{1}{25} \times \sqrt{\frac{2.5}{45 \times 10^{-6}}} = 40 \times \sqrt{\frac{5}{90}} = 9.43$

$Q_3 = \frac{1}{15}\sqrt{\frac{3.5}{30 \times 10^{-6}}} = \frac{100}{15}\sqrt{\frac{35}{3}} = 22.77$

$Q_4 = \frac{1}{25} \times \sqrt{\frac{1.5}{45 \times 10^{-6}}} = \frac{40}{\sqrt{30}} = 7.30$

Clearly $Q_3$ is maximum of $Q_1$, $Q_2$, $Q_3$ and $Q_4$
Hence, option (c) should be selected for better tuning of an L-C-R circuit.

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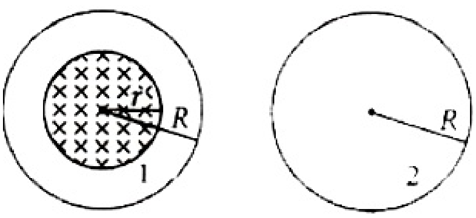
# Question43

## A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius R > r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure. Then the e.m.f. generated is



(2016 NEET Phase-II)

**Options:**

A. zero in loop 1 and zero in loop 2

B. $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\frac{d\vec{B}}{dt}\pi r^2$ in loop 2

C. $\frac{d\vec{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

D. $\frac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

**Answer: D**

## Solution:

**Solution:**
Emf generated in loop 1,
$\varepsilon_1 = -\frac{d\phi}{dt} = -\frac{d}{dt}\left(\vec{B}.\vec{A}\right) = -\frac{d}{dt}(BA) = -A \times \frac{dB}{dt}$

$\varepsilon_1 = -\left(\pi r^2 \frac{dB}{dt}\right)$

($\because A = \pi r^2$ because $\frac{dB}{dt}$ is restricted upto radius r).
Emf generated in loop 2,
$\varphi_2 = -\frac{d}{dt}(BA) = -\frac{d}{dt}(0 \times A) = 0$

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# Question44

## The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is (2016 NEET Phase-II)



**Options:**

A. 0.4

B. 0.5

C. 0.8

D. 1.0

**Answer: C**

## Solution:

Here, $V_R = 80V$, $V_C = 40V$, $V_L = 100V$

Power factor, $\cos\phi = \frac{R}{Z}$

$= \frac{V_R}{V} = \frac{V_R}{\sqrt{V_R^2 + (V_L - V_C)^2}}$

$= \frac{80}{\sqrt{(80)^2 + (100 - 40)^2}} = \frac{80}{100} = 0.8$

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# Question45

## A resistance 'P' draws power 'P' when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes 'Z' the power drawn will be (2015)

**Options:**

A. $P\left(\frac{R}{Z}\right)$

B. $P$

C. $P\left(\frac{R}{Z}\right)^2$

D. $P\sqrt{\frac{R}{Z}}$

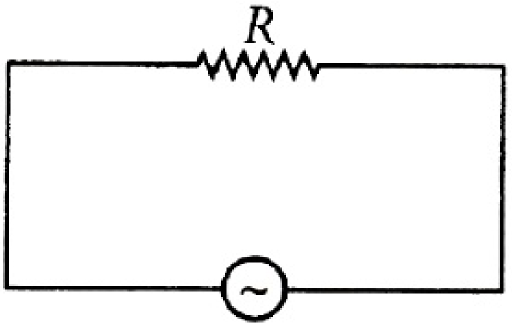
**Answer: C**

## Solution:

**Case I:** $P = V_{rms} I_{rms}$

$= V_{rms} \times \frac{V_{rms}}{R}$

$P = V_{rms}^2 \Rightarrow V_{rms}^2 = PR$........(i)



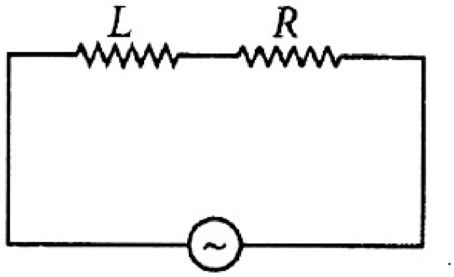

**Case II:** Power drawn in LR circuit

$P' = V_{rms} I_{rms} \cos\phi = V_{rms} \times \frac{V_{rms}}{Z} \times \frac{R}{Z}$

$= V_{rms}^2 \frac{R}{Z^2} = PR \times \frac{R}{Z^2}$

[Using eqn(i)]

$P' = P\frac{R^2}{Z^2}$

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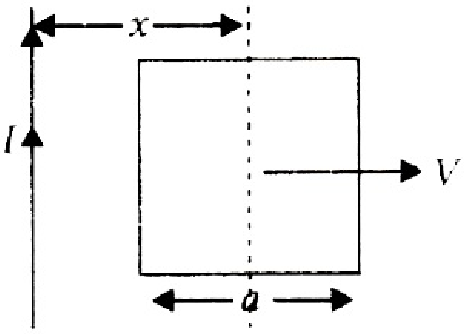
# Question46

**A conducting square frame of side ‘a ’ and a long straight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity ‘V’. The emf induced in the frame will be proportional to**




**(2015)**

**Options:**

A. $\frac{1}{(2x+a)^2}$

B. $\frac{1}{(2x-a)(2x+a)}$

C. $\frac{1}{x^2}$

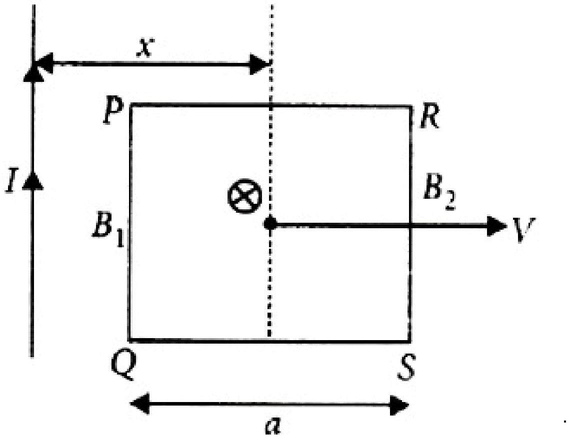
D. $\frac{1}{(2x-a)^2}$

**Answer: B**

## Solution:

Here, PQ = RS = PR =QS = a
Emf induced in the frame
$\varepsilon = B_1(PQ)V - B_2(RS)V$
$= \frac{\mu_0 I}{2\pi\left(x - \frac{a}{2}\right)} aV - \frac{\mu_0 I}{2\pi\left(x + \frac{a}{2}\right)} aV$
$= \frac{\mu_0 I}{2\pi}\left[\frac{1}{(2x-a)} - \frac{2}{(2x+a)}\right] aV$
$= \frac{\mu_0 I}{2\pi} \times 2\left[\frac{2a}{(2x-a)(2x+a)}\right]$

$\therefore \varepsilon \propto \frac{1}{(2x-a)(2x+a)}$

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# Question47

**A series R-C circuit is connected to an alternating voltage source. Consider two situations**
**(a) When capacitor is air filled.**
**(b) When capacitor is mica filled.**
**Current through resistor is i and voltage across capacitor is V then (2015)**

**Options:**

A. $i_a > i_b$

B. $V_a = V_b$

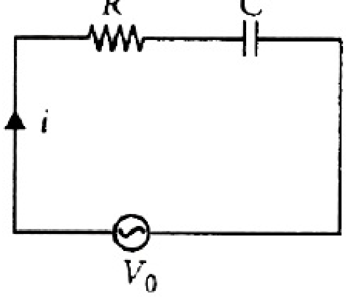
C. $V < V_b$

D. $V_a > V_b$

**Answer: D**

## Solution:

**Solution:**
Current through resistor, i = Current in the circuit




$$= \frac{V_0}{\sqrt{R^2 + X_C^2}} = \frac{V_0}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}}$$

Voltage across capacitor, $V = iX_C$

$$= \frac{V_0}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} \times \frac{1}{\omega C} = \frac{V_0}{\sqrt{R^2\omega^2C^2 + 1}}$$

As $C_a < C_b$
$\therefore i_a < i_b$ and $V_a > V_b$

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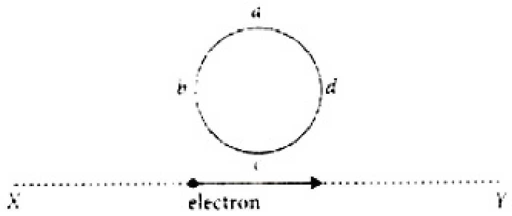
# Question48

## An electron moves on a straight line path X Y as shown. The abed is a coil adjacent to the path of electron. What will be the direction of current, if any, induced in the coil?




## (2015)

**Options:**

A. The current will reverse its direction as the electron goes past the coil

B. No current induced

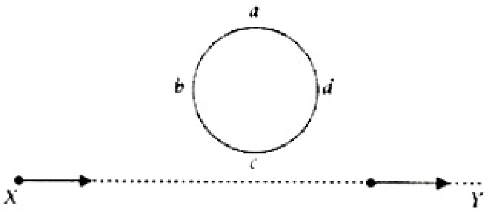
C. abed

D. adcb

**Answer: A**

## Solution:

**Solution:**




When the electron moves from X to Y, the flux linked with the coil abcd (which is into the page) will first increase and then decrease as the electron passes by. So the induced current in the coil will be first anticlockwise and will reverse its direction (i.e. will become clockwise) as the electron goes past the coil.

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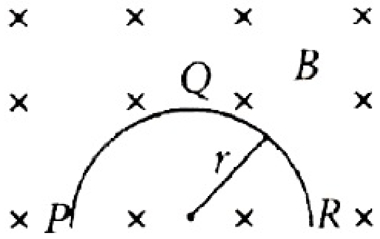
# Question49

## A thin semicircular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B, as shown in the figure. The potential difference developed across the ring when its speed is v, is




**(2014)**

**Options:**

A. zero

B. $\frac{Bv\pi r^2}{2}$ and P is at higher potential

C. πrBv and R is at higher potential

D. 2rBv and R is at higher potential

**Answer: D**

## Solution:

**Solution:**
Motional emf induced in the semicircular ring PQR is equivalent to the motional emf induced in the imaginary conductor PR.
$\varepsilon_{PQR} = \varepsilon_{PR} = Bvl = Bv(2r)$
(I = PR = 2r)

Therefore, potential difference developed across the ring is 2rBv with R is at higher potential.

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# Question50

## A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are (2014)



**Options:**

A. 300 V, 15 A

B. 450 V,15 A

C. 450 V, 13.5 A

D. 600 V, 15 A

**Answer: B**

## Solution:

Here, Efficiency of the transformer, $\eta = 90\%$
Input power, $P_{in} = 3kW = 3 \times 10^3 W = 3000W$
Voltage across the primary coil, $V_P = 200V$
Current in the secondary coil, $I_s = 6A$
AS $P_{in} = I_p V_p$
∴ Current in the primary coil,

$$I_p = \frac{P_{in}}{V_p} = \frac{3000W}{200V} V = 15A$$

Efficiency of the transformer,

$$\eta = \frac{P_{out}}{P_{in}} = \frac{V_s I_s}{V_p I_p}$$

$$\therefore \frac{90}{100} = \frac{6V_s}{3000} \text{ or } V_s = \frac{90 \times 3000}{100 \times 6} = 450V$$

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# Question51

## A wire loop is rotated in a magnetic field. The frequency of change of direction of the induced e.m.f. is
## (2013 NEET)



**Options:**

A. four times per revolution

B. six times per revolution

C. once per revolution

D. twice per revolution

**Answer: D**

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# Question52

## A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when
## (2013 NEET)

**Options:**

A. a capacitance of reactance $X_C = X_L$ is included in the same circuit.

B. an iron rod is inserted in the coil.

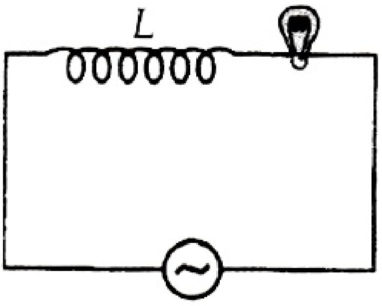
C. frequency of the A C source is decreased.

D. number of turns in the coil is reduced.

**Answer: B**

## Solution:

The situation is as shown in the figure.




As the iron rod is inserted, the magnetic field inside the coil magnetizes the iron increasing the magnetic field inside it. Hence, the inductance of the coil increases. Consequently, the inductive reactance of the coil increases. As a result, a larger fraction of the applied AC voltage appears across the inductor, leaving less voltage across the bulb. Therefore, the brightness of the light bulb decreases.

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# Question53

## In an electrical circuit, R, L, C and ac voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\frac{\pi}{3}$. If instead, C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$. The power factor of the circuit is (2012)



**Options:**

A. $\frac{1}{2}$

B. $\frac{1}{\sqrt{2}}$

C. 1

D. $\frac{\sqrt{3}}{2}$

**Answer: C**

## Solution:

**Solution:**
When L is removed, the phase difference between the voltage and current is
$\tan\phi_1 = \frac{X_C}{R}, \tan\frac{\pi}{3} = \frac{X_C}{R}$ or $X_C = R\tan 60°$ or $X_C = \sqrt{3}R$
When C is removed, the phase difference between the voltage and current is
$\tan\phi_2 = \frac{X_L}{R}$

$\tan\frac{\pi}{3} = \frac{X_L}{R}$ or $X_L = R\tan 60° = \sqrt{3}R$

As $X_L = X_C$. the series LCR circuit is in resonance.

Impedance of the circuit,

$Z = \sqrt{R^2 + (X_L - X_C)^2} = R$

$(\because X_L = X_C)$

Power factor, $\cos\phi = \frac{R}{Z} = \frac{R}{R} = 1$

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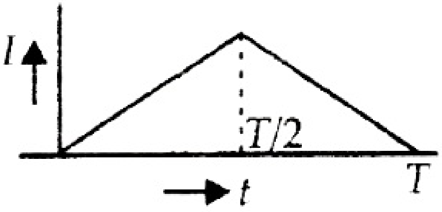
# Question54

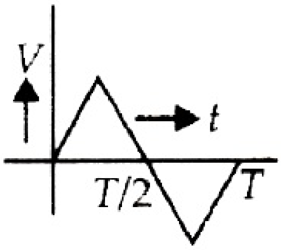
## The current (I ) in the inductance is varying with time according to the plot shown in figure.



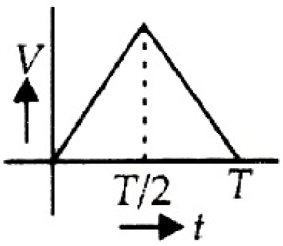

## Which one of the following is the correct variation of voltage with time in the coil?
## (2012)

**Options:**

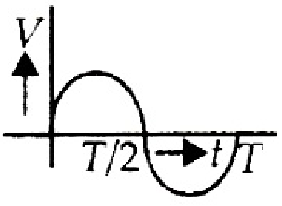
A.



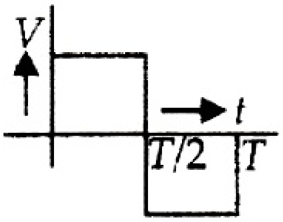

B.




C.




D.




**Answer: D**

## Solution:

**Solution:**

$V = -L\frac{dI}{dt}$

$V \propto$ slope of $I - t$ graph

----------------------------------------------------------------------------------------------------

# Question55

**The instantaneous values of alternating current and voltages in a circuit are given as**

**$i = \frac{1}{\sqrt{2}}\sin(100\pi t)$ ampere**

**$e = \frac{1}{\sqrt{2}}\sin\left(100\pi t + \frac{\pi}{3}\right)$ Volt**

**The average power in watts consumed in the circuit is**
**(2012 Mains)**



**Options:**

A. $\frac{1}{4}$

B. $\frac{\sqrt{3}}{4}$

C. $\frac{1}{2}$

D. $\frac{1}{8}$

**Answer: D**

## Solution:

Given: $i = \frac{1}{\sqrt{2}}\sin(100\pi t)$ ampere

Compare it with $i = i_0\sin(\omega t)$, we get

$i_0 = \frac{1}{\sqrt{2}}A$

Given: $e = \frac{1}{\sqrt{2}}\sin\left(100\pi t + \frac{\pi}{3}\right)$ volt

Compare it with $e = e_0\sin(\omega t + \phi)$, we get

$e_0 = \frac{1}{\sqrt{2}}V$ , $\phi = \frac{\pi}{3}$

$$\therefore i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{\frac{1}{\sqrt{2}}}{\sqrt{2}}A = \frac{1}{2}A e_{rms} = \frac{e_0}{\sqrt{2}} = \frac{\frac{1}{\sqrt{2}}}{\sqrt{2}}V = \frac{1}{2}V$$

Average power consumed in the circuit,

$P = i_{rms}e_{rms}\cos\phi$

$$= \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\cos\frac{\pi}{3} = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{8}W$$

----------------------------------------------------------------------------------------------------

# Question56

## The primary of a transformer when connected to a dc battery of 10 volt draws a current of 1mA. The number of turns of the primary and secondary windings are 50 and 100 respectively. The voltage in the secondary and the current drawn by the circuit in the secondary are respectively (KN NEET 2013)



**Options:**

A. 20V and 2.0mA

B. 10V and 0.5mA

C. Zero volt and therefore no current

D. 20V and 0.5mA

**Answer: C**

## Solution:

Transformer cannot work on dc.

$\therefore V_s = 0$ and $I_s = 0$

----------------------------------------------------------------------------------------------------

# Question57

## A current of 2.5 A flows through a coil of inductance 5H . The magnetic flux linked with the coil is (KN NEET 2013)



**Options:**

A. 0.5Wb

B. 12.5Wb

C. zero

D. $2 Wb$

**Answer: B**

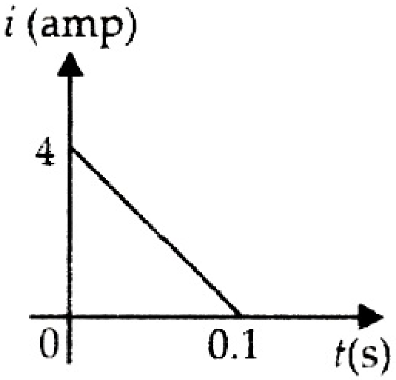
## Solution:

Here, $I = 2.5$ A, $L = 5$ H
Magnetic flux linked with the coil is
$\phi_B = LI = (5 H)(2.5 A) = 12.5 Wb$

---

# Question58

**In a coil of resistance 10 Ω, the induced current developed by changing magnetic flux through it, is shown in figure as a function of time. The magnitude of change in flux through the coil in weber is**




**(2012 Mains)**

**Options:**

A. 8

B. 2

C. 6

D. 4

**Answer: B**

## Solution:

q = Area under i-t graph
$= \frac{1}{2} \times 4 \times 0.1 = 0.2C$
As $q = \frac{\Delta\phi}{R}$
$\therefore \Delta\phi = qR = (0.2C)(10\Omega) = 2$ weber

---

# Question59

**An ac voltage is applied to a resistance R and an inductor!, in series. If R and the inductive reactance are both equal to 3Ω, the phase difference between the applied voltage and the current in the circuit is (2011)**

©

**Options:**

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{2}$

D. zero

**Answer: B**

## Solution:

Here, $R = 3\Omega$
Inductive reactance, $X_L = 3\Omega$
The phase difference between the applied voltage and the current in the circuit is
$\tan\phi = \frac{X_L}{R} = \frac{3\Omega}{3\Omega} = 1$
$\phi = \tan^{-1}$ or $\phi = \frac{\pi}{4}$

----------------------------------------------------------------------------------------------------

# Question60

**In an ac circuit, an alternating voltage $e = 200\sqrt{2}\sin 100t$ volts is connected to a capacitor of capacity 1μF . The r.m.s. value of the current in the circuit is**
**(2011)**

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**Options:**

A. 10 mA

B. 100 mA

C. 200 mA

D. 20 mA

**Answer: D**

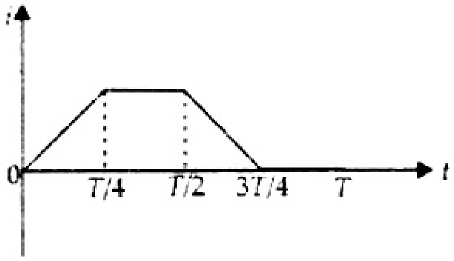
## Solution:

The given equation of alternating voltage is
$e = 200\sqrt{2}\sin 100t$.......(i)
The standard equation of alternating voltage is
$e = e_0 \sin\omega t$.........(ii)
Comparing (i) and (ii), we get
$e_0 = 200\sqrt{2}\text{V}$, $\omega = 100\text{rad s}^{-1}$
The capacitive reactance is
$$X_C = \frac{1}{\omega C} = \frac{1}{100 \times 1 \times 10^{-6}}\Omega$$
The r.m.s. value of the current in the circuit is
$$i_{r.m.s} = \frac{v_{r.m.s}}{X_C} = \frac{\frac{e_0}{\sqrt{2}}}{\frac{1}{\omega C}} = \frac{\left(200\frac{\sqrt{2}}{\sqrt{2}}\right)}{\left(\frac{1}{100} \times 10^{-6}\right)}$$
$$= 200 \times 100 \times 10^{-6}\text{A} = 2 \times 10^{-2}\text{A} = 20\text{mA}$$

----------------------------------------------------------------------------------------------------

# Question61

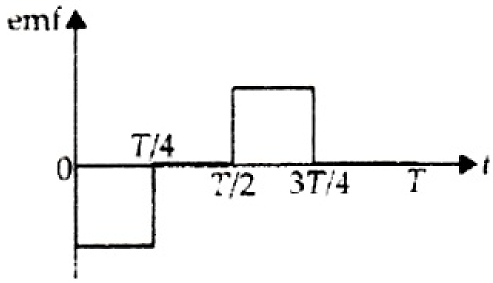
## The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be



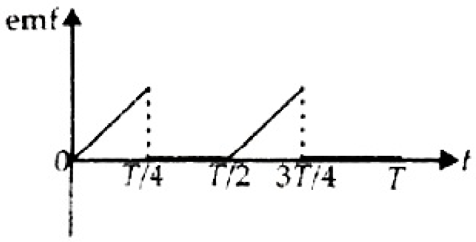

## (2011)

**Options:**

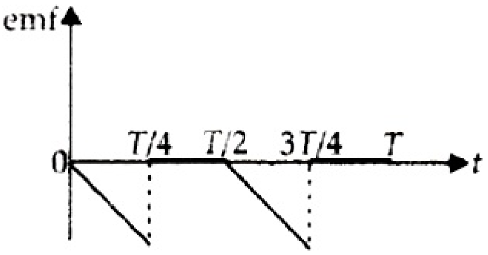
A.



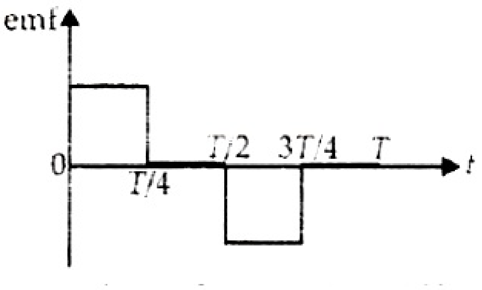

B.




C.




D.




**Answer: A**

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# Question62

## The rms value of potential difference V shown in the figure is


## (2011 Mains)

**Options:**

A. $\frac{V_0}{\sqrt{3}}$

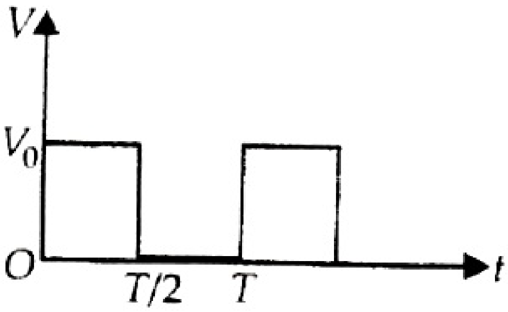
B. $V_0$

C. $\frac{V_0}{\sqrt{2}}$

D. $\frac{V_0}{2}$

**Answer: C**

## Solution:




$V + V_0$ for $0 \le t \le \frac{T}{2}$

$V = 0$ for $\frac{T}{2} \le t \le T$

$$V_{rms} = \left[ \frac{\int_0^T V^2 dt}{\int_0^T dt} \right] = \left[ \frac{\int_0^{\frac{T}{2}} V_0{}^2 dt + \int_{\frac{T}{2}}^{T} (0) dt}{\int_0^T dt} \right]$$

$$= \left[ V_0{}^2 [t]_0^{\frac{T}{2}} \right]^{\frac{1}{2}} = \left[ \frac{V_0{}^2}{T} \left( \frac{T}{2} \right) \right]^{\frac{1}{2}} = \left[ \frac{V_0{}^2}{2} \right]^{\frac{1}{2}}$$

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

----------------------------------------------------------------------------------------------------

# Question63

**A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be**
**(2011 Mains)**



**Options:**

A. 2.0 A

B. 4.0 A

C. 8.0 A

D. $\frac{20}{\sqrt{13}}$A

**Answer: B**

## Solution:

Here Resistance.R = 30Ω
Inductive reactance,$X_L$ = 20Ω at 50 Hz
$\because X_L = 2\pi\upsilon L$

$\therefore \frac{X_L}{X'_L} = \frac{\upsilon'}{\upsilon}$

$X' + L = \frac{\upsilon'}{\upsilon} \times X_L = \left(\frac{100}{50}\right) \times 20\Omega = 40\Omega$

Impedance, $Z = \sqrt{R^2 + (X'_L)^2}$

$= \sqrt{(30)^2 + (40)^2} = 50\Omega$

Current in the coil, $I = \frac{V}{Z} = \frac{200V}{50\Omega} = 4A$

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# Question64

**A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop.The radius of the loop is made to shrink at a constant rate of 1 mm s '1. The induced emf when the radius is 2 cm, is**
**(2010)**



**Options:**

A. 2π μV

B. π μV

C. $\frac{\pi}{2}$μV

D. 2 μV

**Answer: B**

## Solution:

Here, Magnetic field, B = 0.025 T
Radius of the loop, $r = 2cm = 2 \times 10^{-2}m$
Constant rate at which radius of the loop shrinks,
$\frac{dr}{dt} = 1 \times 10^{-3}ms^{-1}$
Magnetic flux linked with the loop is
$\phi = BA\cos\theta = B(\pi r^2)\cos 0° = B\pi r^2$
The magnitude of the induced emf is
$|\varepsilon| = \frac{d\phi}{dt} = \frac{d}{dt}(B\pi r^2)\frac{dr}{dt}$
$= 0.025 \times \pi \times 2 \times 2 \times 10^{-2} \times 1 \times 10^{-3}$
$= \pi \times 10^{-6}V = \pi\mu V$

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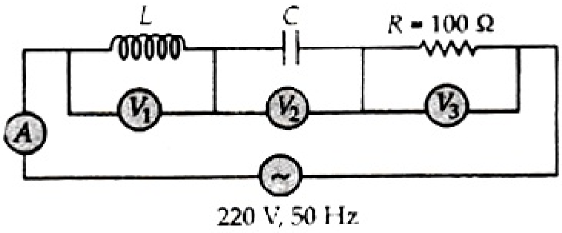
# Question65

**In the given circuit, the reading of voltmeter $V_1$ and $V_2$ are 300 volts each. The reading of the voltmeter $V_3$ and ammeter A are respectively**
**(2010)**




**Options:**

A. 150 V,2.2 A

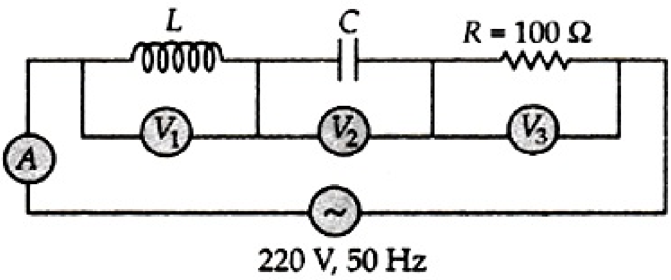
B. 220 V,2.2 A

C. 220 V,2.0 A

D. 100 V,2.0 A

**Answer: B**

## Solution:




As $V_L = V_C = 300V$ ,therefore the given series LCR circuit is in resonance.
$\therefore V_R = V = 220V$
$Z = R = 100\Omega$
Current, $I = \frac{V}{Z} = \frac{220V}{100}\Omega = 2.2A$
Hence, the reading of the voltmeter $V_3$ is 220 V and the reading of ammeter A is 2.2 A

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# Question66

## A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn b the primary windings of the transformer is (2010)



**Options:**

A. 3.6 ampere

B. 2.8 ampere

C. 2.5 ampere

D. 5.0 ampere

**Answer: D**

## Solution:

Here, Input voltage, $V_p = 20V$
Output voltage, $V_s = 440V$
Input current, $I_p = ?$
Output current, $I_s = 2A$
Efficiency of the transformer,η = 80%
Efficiency of the transformer,$\eta = \frac{\text{output power}}{\text{Input power}}$

$$\eta = \frac{V_s I_s}{V_p I_P}$$

or

$$= 5AI_p = \frac{V_s I_s}{\eta V_p} = \frac{(440V)(2A)}{\left(\frac{80}{100}\right)(220V)} = \frac{(440V)(2A)(100)}{(80)(220V)}$$

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# Question67

**A condenser of capacity C is charged to a potential difference of $V_1$. The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor when the potential difference across the condenser reduces to $V_2$ is**
**(2010 Mains)**



**Options:**

A. $\left(\frac{C(V_1 - V_2)^2}{L}\right)^{\frac{1}{2}}$

B. $\frac{C(V_1^2 - V_2^2)}{L}$

C. $\frac{C(V_1^2 + V_2^2)}{L}$

D. $\left(\frac{C(V_1^2 - V_2^2)}{L}\right)^{\frac{1}{2}}$

**Answer: D**

## Solution:

In case of oscillatory discharge of a capacitor through an inductor, charge at instant t is given by
$q = q_0 \cos\omega t$
Where, $\omega = \frac{1}{\sqrt{LC}}$

$$\therefore \cos\omega t = \frac{q}{q_0} = \frac{CV_2}{CV_1} = \frac{V_2}{V_1} \quad (\because q = CV) \text{..........(i)}$$

Current through the inductor

$I = \frac{dq}{dt}(q_0\cos\omega t) = -q_0\omega\sin\omega t$

$|I| = CV_1\frac{1}{\sqrt{LC}}[1-\cos^2\omega t]^{\frac{1}{2}}$

$= V_1\sqrt{\frac{C}{L}}\left[1-\left(\frac{V_2}{V_1}\right)^2\right]^{\frac{1}{2}} = \left[\frac{C(V_1^{\ 2}-V_2^{\ 2})}{L}\right]^{\frac{1}{2}}$

(Using (i))

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# Question68

## A rectangular, a square, a circular and an elliptical loop, all in the (x-y) plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{V} = v\hat{i}$. The magnetic field is directed along the negative z-axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for (2009)



**Options:**

A. the circular and the elliptical loops

B. only the elliptical loop

C. any of the four loops

D. the rectangular, circular and elliptical loops

**Answer: A**

## Solution:

**Solution:**
Once a rectangular loop or a square loop is being drawn out of the field, the rate of cutting the lines of field will be a constant for a square and rectangle, but not for circular or elliptical areas.

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# Question69

## Power dissipated in an LCR series circuit connected to an A.C. source of emf ε is (2009)



**Options:**

A. $\frac{\varepsilon^2\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)}}{R}$

B. $\frac{\varepsilon^2\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}{R}$

C. $\frac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}$

D. $\frac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$

**Answer: D**

## Solution:

Average power, $P = E_{rms} I_{rms} \cos\phi$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$, $\cos\phi = \frac{R}{Z}$

But $I_{rms} = \frac{E_{rms}}{Z}$ $\therefore P = E_{rms}{}^2 \cdot \frac{R}{Z^2}$

$\therefore P = E_{rms}{}^2 \frac{R}{[R^2 + (X_L - X_C)^2]}$

$= \frac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$

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# Question70

## A conducting circular loop is placed in a uniform magnetic field 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s. The induced emf in the loop when the radius is 2 cm is (2009)



**Options:**

A. 4.8π μV

B. 0.8π μV

C. 1.6π μV

D. 3.2π μV

**Answer: D**

## Solution:

$\phi = BA\cos\theta = B(\pi r^2)\cos 0° = B\pi r^2$

$|\varepsilon| = \frac{d\phi}{dt} = B\pi(2r)\frac{dr}{dt}$

$= 0.04 \times \pi \times (2 \times 2 \times 10^{-2}) \times 2 \times 10^{-3} = 3.2\pi \times 10^{-6} V = 3.2\pi \mu V$

# Question71

**A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is $4 \times 10^{-3}$Wb.The self-inductance of the solenoid is (2008)**



**Options:**

A. 1.0 henry

B. 4.0 henry

C. 2.5 henry

D. 2.0 henry

**Answer: A**

## Solution:

Here , N = 500, I = 2A, L = ?
Total flux, $\phi = 4 \times 10^{-3} \times 500$, $\phi = LI$
or $L = \frac{\phi}{I} = \frac{4 \times 10^{-3} \times 500}{2} = 10° = 1H$

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# Question72

**In an a.c. circuit, the e.m.f (ε) and the current (i) at any instant are given respectively by**
**$\varepsilon = E_0 \sin\omega t$, $i = I_0 \sin(\omega t - \phi)$**
**The average power in the circuit over one cycle of a.c. is (2008)**



**Options:**

A. $\frac{E_0 I_0}{2}\cos\phi$

B. $E_0 I_0$

C. $\frac{E_0 I_0}{2}$

D. $\frac{E_0 I_0}{2}\sin\phi$

**Answer: A**

## Solution:

Average power = $\frac{E_0 I_0}{2}\cos\phi$

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# Question73

**A circular disc of radius 0.2 meter is placed in a uniform magnetic field of induction $\frac{1}{\pi}\left(\frac{Wb}{m^2}\right)$ in such a way that its axis makes an angle of 60° with $\vec{B}$. The magnetic flux linked with the disc is**
**(2008)**

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**Options:**

A. 0.08 Wb

B. 0.01 Wb

C. 0.02 Wb

D. 0.06 Wb

**Answer: C**

## Solution:

$B = \frac{1}{\pi}\left(\frac{Wb}{m^2}\right)$
Area of the disc normal to B is $\pi R^2 \cos 60°$
Flux = B x Area normal
$\therefore$ Flux $= \frac{1}{2} \times 0.04 = 0.02 Wb$

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# Question74

**The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux $\phi$ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where $\phi$ is in webers, t is time in seconds and $\phi_0$ is a constant, the output voltage across the secondary coil is**
**(2007)**

©

**Options:**

A. 120 volts

B. 220 volts

C. 30 volts

D. 90 volts

**Answer: A**

## Solution:

Given : No. of turns across primary $N_p = 50$
Number of turns across secondary $N_s = 1500$
Magnetic flux linked with primary, $\phi = \phi_0 + 4t$
∴ Voltage across the primary,

$$V_p = \frac{d\phi}{dt} = \frac{d}{dt}(\phi_0 + 4t) = 4\,\text{volt}$$

Also, $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

$$\therefore V_s = \left(\frac{1500}{50}\right) \times 4 = 120\text{ V}$$

---------------------------------------------------------------------------------------------------

# Question75

**A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 amp, the efficiency of the transformer is approximately**
**(2007)**



**Options:**

A. 50%

B. 90%

C. 10%

D. 30%.

**Answer: B**

## Solution:

Given : Output power $P = 100\text{ W}$
Voltage across primary $V_p = 220\text{ V}$
Current in the primary $I_p = 0.5\text{ A}$
Efficiency of a transformer

$$\eta = \frac{\text{output power}}{\text{input power}} \times 100$$

$$= \frac{P}{V_p I_p} \times 100 = \frac{100}{220 \times 0.5} \times 100 = 90\%$$

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# Question76

**What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\mu F$ and $\omega = 1000\ s^{-1}$?**
**(2007)**

©

**Options:**

A. 1 mH

B. cannot be calculated unless R is known

C. 10 mH

D. 100 mH .

**Answer: D**

## Solution:

**Solution:**
In series LCR, current is maximum atresonance.
$\therefore$ Resonant frequency $\omega = \frac{1}{\sqrt{LC}}$
$\therefore \omega^2 = \frac{1}{LC}$ or $, L = \frac{1}{\omega^2 C}$
Given $\omega = 1000 s^{-1}$ and $C = 10\mu F$
$\therefore L = \frac{1}{1000 \times 1000 \times 10 \times 10^{-6}} = 0.1\ H = 100\ mH$

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# Question77

**A coil of inductive reactance 31Ω has a resistance of 8Ω. It is placed in series with a condenser of capacitative reactance 25Ω. The combination is connected to ana.c. source of 110 V . The power factor of the circuit is**
**(2006)**

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**Options:**

A. 0.33

B. 0.56

C. 0.64

D. 0.80

**Answer: D**

## Solution:

$\because X_L = 31\Omega, X_C = 25\Omega, R = 8\Omega$
Impedance of series LCR is
$Z = \sqrt{(R^2) + (X_L - X_C)^2}$
$= \sqrt{(8)^2 + (31-25)^2} = \sqrt{64+36} = 10\Omega$
Power factor, $\cos\phi = \frac{R}{Z} = \frac{8}{10} = 0.8$

---

# Question78

## Two coils of self inductance 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is (2006)



**Options:**

A. 16 mH

B. 10 mH

C. 6 mH

D. 4 mH

**Answer: D**

## Solution:

Mutual inductance between coils is
$M = K\sqrt{L_1 L_2}$
or, $M = 1\sqrt{2 \times 10^{-3} \times 8 \times 10^{-3}}$ $(\because K = 1)$
$= 4 \times 10^{-3} = 4 \text{mH}$

---

# Question79

## The core of a transformer is laminated because (2006)



**Options:**

A. ratio of voltage in primary and secondary may be increased

B. energy losses due to eddy currents may be minimised

C. the weight of the transformer may be reduced

D. rusting of the core may be prevented.

**Answer: B**

## Solution:

**Solution:**
The core of a transformer is laminated to minimise the energy losses due to eddy currents.

---

# Question80

## A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f . If L is doubled and C is changed to 4C, the frequency will be (2006)

©

**Options:**

A. $\frac{f}{2}$

B. $\frac{f}{4}$

C. 8f

D. $\frac{f}{2\sqrt{2}}$

**Answer: D**

## Solution:

**Solution:**
Frequency of L coscillation $= \frac{1}{2\pi\sqrt{LC}}$

or, $\frac{f_1}{f_2} = \left(\frac{L_2C_2}{L_1C_1}\right)^{1/2} = \left(\frac{2L \times 4C}{L \times C}\right)^{\frac{1}{2}} = (8)^{1/2}$

$\therefore \frac{f_1}{f_2} = 2\sqrt{2} \Rightarrow f_2 = \frac{f_1}{2\sqrt{2}}$ or, $f_2 = \frac{f}{2\sqrt{2}}$

---

# Question81

## In a circuit L, C and R are connected in series with an alternating voltage source of frequency f . The current leads the voltage by 45°. The value of C is (2005)

©

**Options:**

A. $\frac{1}{\pi f(2\pi f L - R)}$

B. $\frac{1}{2\pi f(2\pi f L - R)}$

C. $\frac{1}{\pi f(2\pi f L + R)}$

D. $\frac{1}{2\pi f(2\pi f L + R)}$

**Answer: D**

## Solution:

**Solution:**

$:\tan\phi = \frac{X_C - X_L}{R}$

$\tan\left(\frac{\pi}{4}\right) = \frac{\frac{1}{\omega C} - \omega L}{R}$

$R = \frac{1}{\omega C} - \omega L$

$(R + 2\pi f L) = \frac{1}{2\pi f C}$ or $C = \frac{1}{2\pi f(R + 2\pi f L)}$

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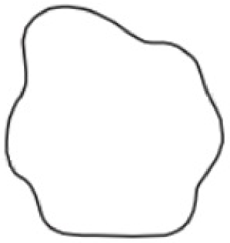
# Question82

## As a result of change in the magnetic flux linked to the closed loop as shown in the figure, an e.m.f. V volt is induced in the loop. The work done (joule) in takinga charge Q coulomb once along the loop is (2005)



**Options:**

A. QV

B. 2QV

C. $\frac{QV}{2}$

D. zero.

**Answer: A**

## Solution:

Work done due to a charge W = QV

---

# Question83

## A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is (2004)

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**Options:**

A. 5 seconds

B. $\frac{1}{5}$ seconds

C. 40 seconds

D. 20 seconds.

**Answer: A**

## Solution:

**Solution:**

Time constant of LR circuit is $\tau = \frac{L}{R}$.

$\therefore$ t = 5 sec

---

# Question84

## The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time $\Delta t$. Then the total quantity of electric charge Q that passes any point in the circuit during the time $\Delta t$ is represented by (2004)

©

**Options:**

A. $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$

B. $Q = \frac{\Delta\phi}{R}$

C. $Q = \frac{\Delta\phi}{\Delta t}$

D. $Q = R \cdot \frac{\Delta\phi}{\Delta t}$

**Answer: B**

## Solution:

Induced emf is given by $V = \frac{\Delta\phi}{\Delta t}$

$\Rightarrow$ current(i) $= \frac{Q}{\Delta t} = \frac{\Delta\phi}{\Delta t} \times \frac{1}{R}$

[where Q is total charge in time $\Delta t$ ]

$\Rightarrow Q = \frac{\Delta\phi}{R}$

----------------------------------------------------------------------------------------------------

# Question85

## For a series LCR circuit the power loss aresonance is (2002)



**Options:**

A. $\frac{V^2}{\left[\omega L - \frac{1}{\omega C}\right]}$

B. $I^2 L\omega$

C. $I^2 R$

D. $\frac{V^2}{C\omega}$.

**Answer: C**

## Solution:

The impedance $Z$ of a series LCR circuit is given by, $Z = \sqrt{R^2 + (X_L - X_C)^2}$

where $X_L = \omega L$ and $X_C = \frac{1}{\omega C}$, $\omega$ is angular frequency.

At resonance, $X_L = X_C$, hence $Z = R$.

$\therefore V_R = V$ (supply voltage)

$\therefore$ R.M.S. current, $I = \frac{V_R}{R} = \frac{V}{R}$

$\therefore$ Power loss $= I^2 R = \frac{V^2}{R}$

----------------------------------------------------------------------------------------------------

# Question86

## For a coil having $L = 2$ mH, current flow through it is $I = t^2 e^{-t}$ then, the time at which emf becomes zero (2001)

**Options:**

A. 2 sec

B. 1 sec

C. 4 sec

D. 3 sec.

**Answer: A**

## Solution:

$I = t^2 e^{-t}$

$|\varepsilon| = L\frac{dI}{dt}$ here emf is zero when $\frac{dI}{dt} = 0$

$\frac{dI}{dt} = 2te^{-t} - t^2 e^{-t} = 0;\ 2te^{-t} = t^2 e^{-t}$

i.e., $te^{-t}(t-2) = 0 \Rightarrow t \neq \infty$ and $t \neq 0$

$\therefore t = 2$ sec.

-----------------------------------------------------------------------------------------------------

# Question87

**A capacitor of capacity C has reactance X. If capacitance and frequency become double then reactance will be**
**(2001)**



**Options:**

A. 4X

B. $\frac{X}{2}$

C. $\frac{X}{4}$

D. 2X.

**Answer: C**

## Solution:

$X = \frac{1}{C\omega}\ \ X' = \frac{1}{4C\omega}$

$\therefore X' = \frac{X}{4}$

-----------------------------------------------------------------------------------------------------

# Question88

**The value of quality factor is**
**(2000)**

**Options:**

A. $\frac{\omega L}{R}$

B. $\frac{1}{\omega RC}$

C. $\sqrt{LC}$

D. $\frac{L}{R}$.

**Answer: B**

## Solution:

Quality factor $Q = \frac{\omega L}{R}$

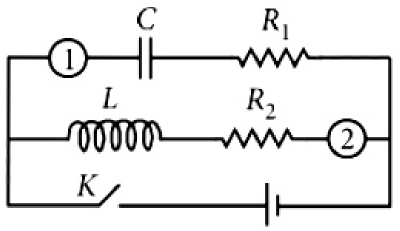
since $\omega^2 = \frac{1}{LC}$

$\therefore$ Quality factor $Q = \frac{1}{\omega RC}$

------------------------------------------------------------------------------------------------

# Question89

**In the circuit given in figure, 1 and are ammeters. Just after key K is pressed to complete the circuit, the reading will be**
**(1999)**




**Options:**

A. zero in 1, maximum in 2

B. maximum in both 1 and 2

C. zero in both 1 and 2

D. maximum in 1, zero in 2.

**Answer: D**

## Solution:

At t = 0
(i) capacitor offers negligible resistance.
(ii) inductor offers large resistance to current flow.

-----------------------------------------------------------------------------------------------

# Question90

**A step-up transformer operates on a 230 V line and supplies a load of 2 ampere. The ratio of the primary and secondary windings is 1 : 25. The current in the primary is**
**(1998)**



**Options:**

A. 15 A

B. 50 A

C. 25 A

D. 12.5 A

**Answer: B**

## Solution:

$$\frac{E_P}{E_S} = \frac{N_P}{N_S} = \frac{1}{25}; E_S = 5750 \text{ V}$$
$$I_S = 2 \text{ amp}, P_S = 2 \times 5750$$
$$I_P = \frac{P_P}{V_P} = \frac{P_S}{V_P} = \frac{2 \times 5750}{230} = 50\text{A}$$

-----------------------------------------------------------------------------------------------

# Question91

**Two coils have a mutual inductance 0.005 H. The current changes in the first coil according to equation $I = I_0 \sin \omega t$ where $I_0 = 10$ A and $\omega = 100\pi$ rad / sec. Themaximum value of e.m.f. in the second coilis**
**(1998)**



**Options:**

A. π

B. 5π

C. 2π

D. 4π.

**Answer: B**

## Solution:

As, $|\varepsilon| = M\frac{dI}{dt}$

$= M\frac{d}{dt}(I_0 \sin \omega t) = M I_0 \omega \cos \omega t$

$\therefore \varepsilon_{max} = 0.005 \times 10 \times 100\pi \times 1 = 5\pi$

------------------------------------------------------------------------------------------------

# Question92

**The primary winding of a transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an A.C. supply of $20V$, $50Hz$. The secondary will have an output of (1997)**



**Options:**

A. $2V$, $50Hz$

B. $2V$, $5Hz$

C. $200V$, $50Hz$

D. $200V$, $500Hz$.

**Answer: C**

## Solution:

**Solution:**
Turns on primary winding $= 500$; Turns on secondary winding $= 5000$; Primary winding voltage $(E_p) = 20V$ and frequency $= 50\ Hz$.

$\frac{N_s}{N_p} = \frac{E_s}{E_p}$ or $\frac{5000}{500} = \frac{E_s/}{20}$

or $E_s = \frac{5000 \times 20}{500} = 200V$

and frequency remains the same. Therefore secondary winding will have an output of $200V$, $50\ Hz$

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# Question93

**In an a.c. circuit with phase voltage $V$ and current $I$, the power dissipated is (1997)**



**Options:**

A. $V \ . I$

B. depends on phase angle between $V$ and $I$

C. $\frac{1}{2} \times V \ . I$

D. $\frac{1}{\sqrt{2}} \times V \ . I$

**Answer: B**

## Solution:

**Solution:**
The dissipation of power in an a.c. circuit is $(P) = V \times I \times \cos\theta$. Therefore current flowing in the circuit depends upon the phase angle between voltage $(V)$ and current $(I)$ of the a.c. circuit.

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# Question94

## A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet is (1996)



**Options:**

A. more than g

B. equal to g

C. less than g

D. either(a) or (c).

**Answer: C**

## Solution:

**Solution:**
When the magnet is dropped through the ring, an induced current is developed into the ring in the direction opposing the motion of magnet (Lenz's law). Therefore this induced current decreases the acceleration of barmagnet.

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# Question95

## In an A.C. circuit, the current flowing is $I = 5\sin\left(100t - \frac{\pi}{2}\right)$ ampere and the potential difference is $V = 200\sin(100t)$ volts. The power consumption is equal to (1995)

**Options:**

A. 20 W

B. 0 W

C. 1000 W

D. 40 W .

**Answer: B**

## Solution:

**Solution:**

Current $(I) = 5\sin\left(100t - \frac{\pi}{2}\right)$ and voltage $(V) = 200\sin(100t)$. Comparing the given equation, with the standard equation, we find that phase between current and voltage is

$\phi = \frac{\pi}{2} = 90°$

Power consumption $P = I_{rms}V_{rms}\cos\phi$

$= I_{rms}V_{rms}\cos 90° = 0$

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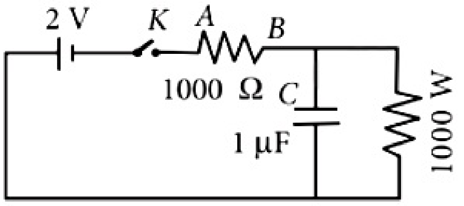
# Question96

## When the key K is pressed at time t = 0, then which of the following statement about the current I in the resistor AB of the given circuit is true? (1995)




**Options:**

A. I oscillates between 1 mA and 2 mA

B. at t = 0, I = 2 mA and with time it goes to 1 mA

C. I = 1 mA at all

D. I = 2 mA at all t

**Answer: B**

## Solution:

Initially, the current will pass through the capacitor (and not through the resistance which is parallel to the capacitor). So effective resistance in the circuit is $R_{AB}$. Therefore the current in the resistor is 2 mA. After some time, the capacitor will become fully charged and will be in its steady state. Now no current will pass through the capacitor and the effective

resistance of the circuit will be
(1000 + 1000) = 2000Ω
Therefore current in the resistor
$= \frac{V}{R} = \frac{2}{2000} = 1 \times 10^{-3}\text{ A} = 1\text{ mA}$

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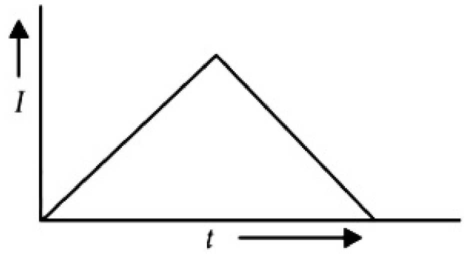
# Question97

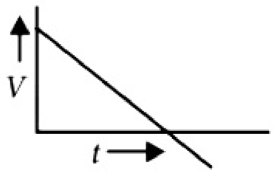
## The current I in an A.C. circuit with inductance coil varies with time according to the graph given below.



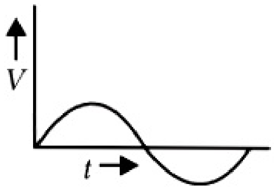

## Which one of the following graphs gives the variation of voltage with time?
## (1994)

**Options:**

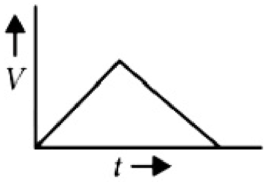
A.



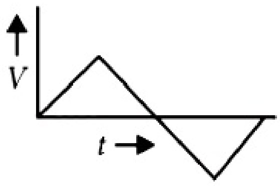

B.




C.




D.




**Answer: A**

## Solution:

In an A.C. circuit with inductance coil, the voltage $V$ leads the current $I$ by a phase difference of $90°$. Or the current $I$ lags behind the voltage $V$ by a phase difference of $90°$. Thus the voltage goes on decreasing with the increase in time as shown in the graph (a).

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# Question98

## A straight line conductor of length 0.4 m is moved with a speed of $7 \mathrm{~m/s}$ perpendicular to a magnetic field of intensity $0.9 \mathrm{~Wb/m^2}$. The induced e.m.f. across the conductor is (1995)

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**Options:**

A. $5.04 \mathrm{~V}$

B. $25.2 \mathrm{~V}$

C. $1.26 \mathrm{~V}$

D. $2.52 \mathrm{~V}$.

**Answer: D**

## Solution:

Length of conductor $(l) = 0.4 \mathrm{~m}$;
Speed $= 7 \mathrm{~m/s}$
andmagnetic field $(B) = 0.9 \mathrm{~Wb/m^2}$
Induced e.m.f. $(\varepsilon) = Blv = 0.9 \times 0.4 \times 7 = 2.52 \mathrm{~V}$

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# Question99

## In an A.C. circuit, $I_{rms}$ and $I_0$ are related as (1994)

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**Options:**

A. $I_{rms} = \pi I_0$

B. $I_{rms} = \sqrt{2} I_0$

C. $I_{rms} = \frac{I_0}{\pi}$

D. $I_{rms} = \frac{I_0}{\sqrt{2}}$

**Answer: D**

## Solution:

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

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# Question100

## An series L − C − R circuit is connected to a source of A.C. current. At resonance, the phase difference between the applied voltage and the current in the circuit, is (1994)



**Options:**

A. π

B. zero

C. $\frac{\pi}{4}$

D. $\frac{\pi}{2}$.

**Answer: B**

## Solution:

**Solution:**
For resonance condition, the impedance will be minimum and the current will be maximum. This is only possible when $X_L = X_C$

Therefore $\tan\theta = \frac{X_L + X_C}{R} = 0$ or $\theta = 0$

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# Question101

## Two cables of copper are of equal lengths. One of them has a single wire of area of cross-section A, while other has 10 wires of cross-sectional area $\frac{A}{10}$ each. Give their suitability for transporting A.C. and D.C. (1994)



**Options:**

A. only multiple strands for A.C., either for D.C.

B. only multiple strands for A.C., only single strand for D.C.

C. only single strand for D.C., either forA.C.

D. only single strand for A.C., either forD.C.

**Answer: A**

## Solution:

**Solution:**
The major portion of the A.C. flows on the surface of the wire. So where a thick wire is required, a number of thin wires are joined together to give an equivalent effect of a thick wire. Therefore multiple strands are suitable for transporting A.C. Similarly multiple strands can also be used for D.C.

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# Question102

## If $N$ is the number of turns in a coil, the value of self inductance varies as
## (1993)



**Options:**

A. $N^0$

B. $N$

C. $N^2$

D. $N^{-2}$

**Answer: C**

## Solution:

$L = \frac{N\phi}{i}; \phi = BA; B = \mu_0 ni = \frac{\mu_0 N i}{l}$

$L = \frac{\mu_0 N^2}{l} A = \mu_0 n^2 Al$

where $n$ is the number of turns/unit length $L \propto N^2$

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# Question103

## What is the self-inductance of a coil which produces $5\ V$ when the current changes from 3 ampere to 2 ampere in one millisecond?
## (1993)

**Options:**

A. 5000 henry

B. 5 milli-henry

C. 50 henry

D. 5 henry

**Answer: B**

## Solution:

$\varepsilon = -L\frac{di}{dt}$

$L = \frac{-\varepsilon}{\frac{di}{dt}} = \frac{-5 \times 10^{-3}}{(2-3)}H = 5\ mH$

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# Question104

## The time constant of C − R circuit is (1992)



**Options:**

A. $\frac{1}{CR}$

B. $\frac{C}{R}$

C. CR

D. $\frac{R}{C}$

**Answer: C**

## Solution:

**Solution:**
The time constant for resonancecircuit, $\tau = CR$
Growth of charge in a circuit containing capacitance and resistance is given by the formula,
$q = q_0(1 - e^{-t/CR})$
CR is known as time constant in this formula.

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# Question105

## The total charge, induced in a conducting loop when it is moved in magnetic field depends on

**(1992)**



**Options:**

A. the rate of change of magnetic flux

B. initial magnetic flux only

C. the total change in magnetic flux

D. final magnetic flux only

**Answer: C**

## Solution:

$q = \int i d t = \frac{1}{R} \int \varepsilon d t = \left(\frac{-d \phi}{d t}\right) \frac{1}{R} \int d t = \frac{1}{R} \int d \phi$

Hence total charge induced in the conducting loop depend upon the total change in magnetic flux.
As the emf or iR depends on rate of change of ϕ, charge induced depends on change of flux.

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# Question106

## A rectangular coil of 20 turns and area of cross-section 25 sq. cm has a resistance of 100Ω. If a magnetic field which is perpendicular to the plane of coil changes at a rate of 1000 tesla per second, the current in the coil is (1992)



**Options:**

A. 1 A

B. 50 A

C. 0.5 A

D. 5 A

**Answer: C**

## Solution:

$i = \frac{\varepsilon}{R} = \frac{\frac{N A d B}{d t}}{R}$

$= \frac{20 \times (25 \times 10^{-4}) \times 1000}{100} = 0.5 \text{ A}$

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# Question107

## Faraday's laws are consequence of conservation of (1991)

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**Options:**

A. energy

B. energy and magnetic field

C. charge

D. magnetic field

**Answer: A**

## Solution:

**Solution:**
According to Faraday's laws, it is the conservation of energy.

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# Question108

## If the number of turns per unit length of a coil of solenoid is doubled, the self-inductance of the solenoid will (1991)

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**Options:**

A. remain unchanged

B. be halved

C. be doubled

D. become four times

**Answer: D**

## Solution:

Self inductance of a solenoid $= \mu_0 n^2 A l$
where $n$ is the number of turns/length.
So self induction $\propto n^2$
So inductance becomes 4 times when $n$ is doubled.

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# Question109

**A 100 millihenry coil carries a current of1A. Energy stored in its magnetic field is**
**(1991)**



**Options:**

A. 0.5 J

B. 1 A

C. 0.05 J

D. 0.1 J

**Answer: C**

## Solution:

$$E = \frac{1}{2}Li^2 = \frac{1}{2}(100 \times 10^{-3}) \times 1^2 = 0.05J$$

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# Question110

**A magnetic field of $2 \times 10^{-2}$ T acts at right angles to a coil of area $100\ cm^2$, with 50 turns. The average e.m.f. induced in the coil is 0.1 V, when it is removed from the field in t sec. The value of t is**
**(1991)**



**Options:**

A. 10 s

B. 0.1 s

C. 0.01 s

D. 1 s

**Answer: B**

## Solution:

$$\varepsilon = \frac{-(\phi_2 - \phi_1)}{t} = \frac{-(0 - N\,BA)}{t} = \frac{N\,BA}{t}$$

$$t = \frac{N\,BA}{\varepsilon} = \frac{50 \times 2 \times 10^{-2} \times 10^{-2}}{0.1} = 0.1s$$

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# Question111

## The current in self inductance L = 40 mH is to be increased uniformly from 1 amp to 11 amp in 4 milliseconds. The e.m.f. induced in inductor during process is
## (1990)



**Options:**

A. 100 volt

B. 0.4 volt

C. 4.0 volt

D. 440 volt

**Answer: A**

## Solution:

$|\varepsilon| = L\frac{di}{dt}$
Given that, $L = 40 \times 10^{-3}$ H ,
$di = 11\ A - 1\ A = 10\ A$
and $dt = 4 \times 10^{-3}$ s
$\therefore |\varepsilon| = 40 \times 10^{-3} \times \left( \frac{10}{4 \times 10^{-3}} \right) = 100\ V$

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# Question112

## An inductor may store energy in
## (1990)



**Options:**

A. its electric field

B. its coils

C. its magnetic field

D. both in electric and magnetic fields

**Answer: C**

# Question113

## In a region of magnetic induction $B = 10^{-2}$ tesla, a circular coil of radius 30 cm and resistance $\pi^2$ ohm is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil. If the coil rotates at 200 rpm the amplitude of the alternating current induced in the coil is (1988)

**Options:**

A. $4\pi^2$ mA

B. 30 mA

C. 6 mA

D. 200 mA

**Answer: C**

## Solution:

$I_0 = \frac{E_0}{R} = N\frac{BA\omega}{R}$

Given, $N = 1$, $B = 10^{-2}$ T

$A = \pi(0.3)^2 m^2$, $R = \pi^2$

$f = \left(\frac{200}{60}\right)$ and $\omega = 2\pi\left(\frac{200}{60}\right)$

Substituting these values and solving, we get

$I_0 = 6 \times 10^{-3} A = 6$ mA

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# Question114

## Eddy currents are produced when (1988)

**Options:**

A. a metal is kept in varying magnetic field

B. a metal is kept in steady magnetic field

C. a circular coil is placed in a magnetic field

D. through a circular coil, current is passed

**Answer: A**

## Solution:

Eddy currents are produced when a metal is kept in a varying magnetic field.

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