Q1 - 2024 (01 Feb Shift 1)

A parallel plate capacitor has a capacitance $C = 200pF$. It is connected to 230 V ac supply with an angular frequency $300rad/s$. The rms value of conduction current in the circuit and displacement current in the capacitor respectively are :

(1) $1.38\mu A$ and $1.38\mu A$

(2) $14.3\mu A$ and $143\mu A$

(3) $13.8\mu A$ and $138\mu A$

(4) $13.8\mu A$ and $13.8\mu A$

Q2 - 2024 (01 Feb Shift 1)

In series LCR circuit, the capacitance is changed from C to 4C. To keep the resonance frequency unchanged, the new inductance should be :

(1) reduced by $\frac{1}{4}$ L

(2) increased by 2 L

(3) reduced by $\frac{3}{4}$ L

(4) increased to 4 L

Q3 - 2024 (01 Feb Shift 2)

A transformer has an efficiency of 80% and works at 10 V and 4 kW. If the secondary voltage is 240 V, then the current in the secondary coil is :

(1) 1.59 A

(2) 13.33 A

(3) 1.33 A

(4) 15.1 A

Q4 - 2024 (27 Jan Shift 2)

Primary side of a transformer is connected to $230\ \mathrm{V}, 50\ \mathrm{Hz}$ supply. Turns ratio of primary to secondary winding is $10:1$. Load resistance connected to secondary side is 46Ω. The power consumed in it is :

(1) 12.5 W

(2) 10.0 W

(3) 11.5 W

(4) 12.0 W

Q5 - 2024 (27 Jan Shift 2)

A series LCR circuit with $\mathrm{L}=\frac{100}{\pi}\mathrm{mH}, \mathrm{C}=\frac{10^{-3}}{\pi}\mathrm{F}$ and $\mathrm{R}=10\Omega$, is connected across an ac source of $220\ \mathrm{V}, 50\ \mathrm{Hz}$ supply. The power factor of the circuit would be _____

Q6 - 2024 (29 Jan Shift 2)

In an a.c. circuit, voltage and current are given by : $\mathrm{V}=100\sin(100\mathrm{t})\mathrm{V}$ and $I=100\sin\left(100t+\frac{\pi}{3}\right)\mathrm{mA}$ respectively.

The average power dissipated in one cycle is :

(1) 5 W

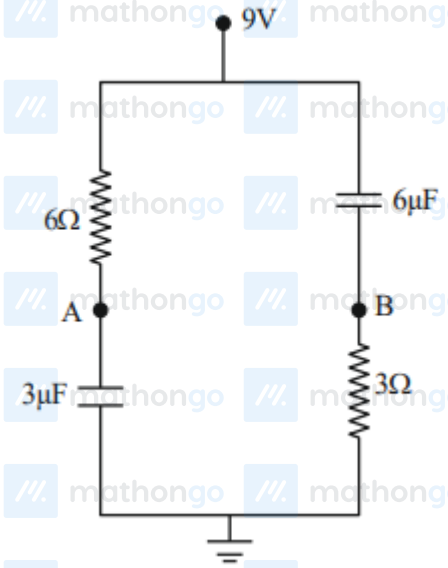
(2) 10 W

(3) 2.5 W

(4) 25 W

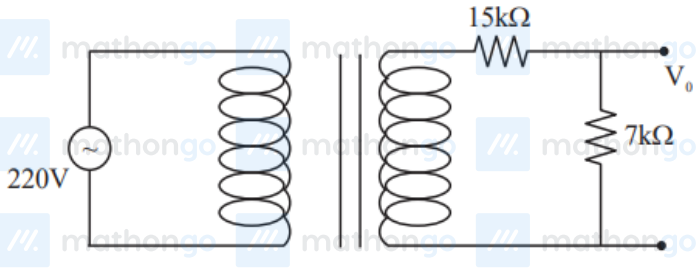
Q7 - 2024 (29 Jan Shift 2)

In the given figure, the charge stored in $6\mu\mathrm{F}$ capacitor, when points A and B are joined by a connecting wire is _____ $\mu\mathrm{C}$.



Q8 - 2024 (30 Jan Shift 1)

Primary coil of a transformer is connected to 220 V ac. Primary and secondary turns of the transforms are 100 and 10 respectively. Secondary coil of transformer is connected to two series resistance shown in shown in figure. The output voltage (V_0) is :



(1) 7 V

(2) 15 V

(3) 44 V

(4) 22 V

Q9 - 2024 (30 Jan Shift 1)

A series L,R circuit connected with an ac source $E = (25 \sin 1000t)V$ has a power factor of $\frac{1}{\sqrt{2}}$. If the source of emf is changed to $E = (20 \sin 2000\ t)$ V, the new power factor of the circuit will be:

(1) $\frac{1}{\sqrt{2}}$

(2) $\frac{1}{\sqrt{3}}$

(3) $\frac{1}{\sqrt{5}}$

(4) $\frac{1}{\sqrt{7}}$

Q10 - 2024 (30 Jan Shift 2)

An alternating voltage $V(t) = 220 \sin 100\pi t$ volt is applied to a purely resistive load of 50Ω. The time taken for the current to rise from half of the peak value to the peak value is:

(1) 5 ms

(2) 3.3 ms

(3) 7.2 ms

(4) 2.2 ms

Q11 - 2024 (30 Jan Shift 2)

A power transmission line feeds input power at 2.3 kV to a step down transformer with its primary winding having 3000 turns. The output power is delivered at 230 V by the transformer. The current in the primary of the transformer is 5 A and its efficiency is 90%. The winding of transformer is made of copper. The output current of transformer is_____ A.

Q12 - 2024 (31 Jan Shift 2)

An AC voltage $V = 20 \sin 200\pi t$ is applied to a series LCR circuit which drives a current $I = 10 \sin\left(200\pi t + \frac{\pi}{3}\right)$. The average power dissipated is:

(1) 21.6 W

(2) 200 W

(3) 173.2 W

(4) 50 W

Answer Key

Q1 (4)	**Q2** (3)	**Q3** (2)	**Q4** (3)
Q5 (1)	**Q6** (3)	**Q7** (36)	**Q8** (1)
Q9 (3)	**Q10** (2)	**Q11** (45)	**Q12** (4)

Q1

$I = \frac{V}{X_C} = 230 \times 300 \times 200 \times 10^{-12} = 13.8\mu A$

Q2

$\omega' = \omega$

$$\frac{1}{\sqrt{L'C'}} = \frac{1}{\sqrt{LC}}$$

$$\therefore L'C' = LC$$

$$L'(4C) = LC$$

$$L' = \frac{L}{4}$$

$\because$ Inductance must be decreased by $\frac{3\,L}{4}$

Q3

$$\text{Efficiency} = \frac{E_s I_s}{E_p I_p}$$

$$0.8 = \frac{240 I_s}{4000}$$

$$I_S = \frac{3200}{240} = 13.33 \text{ A}$$

Q4

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

$$\frac{230}{V_2} = \frac{10}{1}$$

$$V_2 = 23 \text{ V}$$

$$\text{Power consumed} = \frac{V_2^2}{R}$$

$$= \frac{23 \times 23}{46} = 11.5 \text{ W}$$

Q5

$$X_c = \frac{1}{\omega C} = \frac{\pi}{2\pi \times 50 \times 10^{-3}} = 10\Omega$$

$$X_L = \omega L = 2\pi \times 50 \times \frac{100}{\pi} \times 10^{-3}$$

$$= 10\Omega$$

$\because X_C = X_L$, Hence, circuit is in resonance

$$\therefore \text{ power factor } = \frac{R}{Z} = \frac{R}{R} = 1$$

Q6

$$P_{avg} = V_{mms} I_{ms} \cos(\Delta\phi)$$

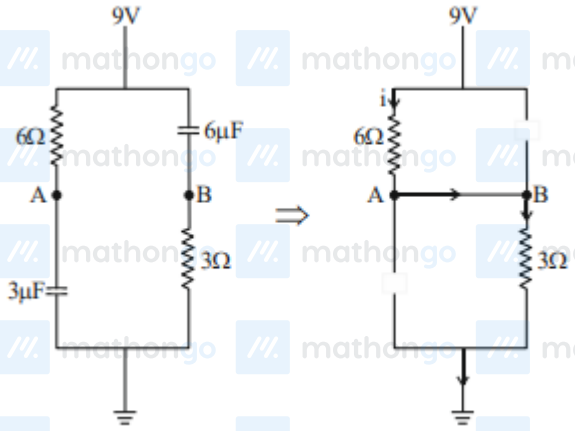
$$= \frac{100}{\sqrt{2}} \times \frac{100 \times 10^{-3}}{\sqrt{2}} \times \cos\left(\frac{\pi}{3}\right)$$

$$= \frac{10^4}{2} \times \frac{1}{2} \times 10^{-3}$$

$$= \frac{10}{4} = 2.5 \text{ W}$$

Q7

At steady state, capacitor behaves as an open circuit and current flows in circuit as shown in the diagram.



$$R_{eq} = 9\Omega$$

$$i = \frac{9 \text{ V}}{9\Omega} = 1 \text{ A}$$

$$\Delta V_{6\Omega} = 1 \times 6 = 6 \text{ V}$$

$$V_A = 3 \text{ V}$$

So, potential difference across $6\mu F$ is 6 V.

Hence

$$Q = C\Delta V$$
$$= 6 \times 6 \times 10^{-6}\text{C}$$
$$= 36\mu\text{C}$$

Q8

$$\frac{\varepsilon_1}{\varepsilon_2} = \frac{N_1}{N_2} = \frac{100}{10} \Rightarrow \varepsilon_2 = 22\text{ V}$$

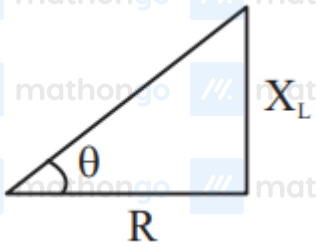
$$I = \frac{22}{22 \times 10^3} = 1\text{ mA}, V_0 = 7\text{ V}$$

Q9

$$\text{E} = 25\sin(1000\text{t})$$

$$\cos\theta = \frac{1}{\sqrt{2}}$$

LR circuit



Initially $\frac{R}{\omega_1 L} = \frac{1}{\tan\theta} = \frac{1}{\tan 45^\circ} = 1$

$$X_L = \omega_1 L$$

$$\omega_2 = 2\omega_1, \text{ given}$$

$$\tan\theta' = \frac{\omega_2 L}{R} = \frac{2\omega_1 L}{R}$$

$$\tan\theta' = 2$$

$$\cos\theta' = \frac{1}{\sqrt{5}}$$

Q10

Rising half to peak

$$\text{t} = \text{T}/6$$

$$\text{t} = \frac{2\pi}{6\omega} = \frac{\pi}{3\omega} = \frac{\pi}{300\pi} = \frac{1}{300} = 3.33\text{ ms}$$

Q11

$P_i = 2300 \times 5 \text{ watt}$

$P_0 = 2300 \times 5 \times 0.9 = 230 \times I_2$

$I_2 = 45A$

Q12

$< \mathrm{P} \rangle = \mathrm{IV} \cos \phi$

$= \frac{20}{\sqrt{2}} \times \frac{10}{\sqrt{2}} \times \cos 60^\circ$

$= 50 \text{ W}$