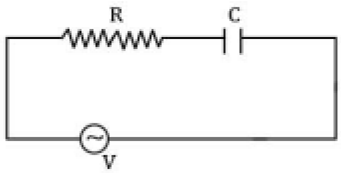
1. A $20 \text{ V}, \ 50 \text{ Hz}$ AC source is connected across a resistor of resistance $R$ and a capacitor of capacitance $C$ as shown in the figure. The voltage across the resistor is $12 \text{ V}$. The voltage across the capacitor is

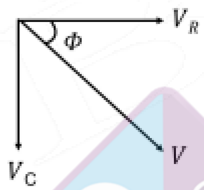



A. $18 \text{ V}$

B. $16 \text{ V}$

C. $10 \text{ V}$

D. $12 \text{ V}$




For an AC RC circuit,

$V^2 = V_R^2 + V_C^2$

$\Rightarrow 20^2 = 12^2 + V_C^2$

$\Rightarrow V_C = 16 \text{ V}$

Hence, option $(B)$ is the correct answer.

2. An AC circuit consists of a $220\ \Omega$ resistance and $0.7\ \mathrm{H}$ choke. Find the average power absorbed from $220\ \mathrm{V}$ and $50\ \mathrm{Hz}$ source connected in this circuit if the resistance and choke are joined in parallel.

A. $110\ \mathrm{W}$

B. $220\ \mathrm{W}$ ✔

C. $310\ \mathrm{W}$

D. $410\ \mathrm{W}$

When the resistance and choke are in parallel, the entire power is absorbed in resistance, as the choke having small resistance absorbs negligible power.

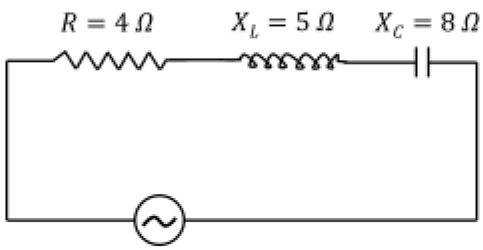
So, the average power,

$$P_{\text{avg}} = \mathcal{E}_{\text{rms}} i_{\text{rms}} \cos\phi = \mathcal{E}_{\text{rms}} \times \frac{\mathcal{E}_{\text{rms}}}{R} \times \cos 0^\circ = \frac{\mathcal{E}_{\text{rms}}^2}{R}$$

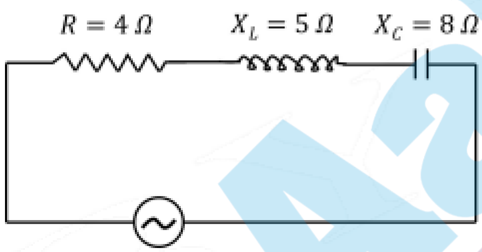
$$\Rightarrow P_{\text{avg}} = \frac{220^2}{220} = 220\ \mathrm{W}$$

Hence, option $(B)$ is the correct answer.

3. For the given AC RLC circuit, at a particular frequency of the AC source, the current -




- ✔ **A.** Lead the voltage by $\tan^{-1}(3/4)$
- ✖ **B.** Lead the voltage by $\tan^{-1}(5/8)$
- ✖ **C.** Lag the voltage by $\tan^{-1}(3/4)$
- ✖ **D.** Lag the voltage by $\tan^{-1}(5/8)$




Suppose, the AC source voltage is given by,

$V = V_m \sin(\omega t)$

Then, the AC in the circuit is,

$I = I_m \sin(\omega t + \phi)$

So,

$$\tan\phi = \frac{X_C - X_L}{R} = \frac{8-5}{4} = \frac{3}{4}$$

$\Rightarrow \phi = \tan^{-1}(3/4)$

Hence, option $(A)$ is the correct answer.

4. Average power dissipated in a series AC RLC circuit connected to a source whose voltage is given by, $\mathcal{E} = \mathcal{E}_0 \sin(\omega t)$, if $X_L = X_C$ is -

$R$ is the resistance of the resistor.

A. $\dfrac{(\mathcal{E}_0)^2}{R}$

B. $\dfrac{(\mathcal{E}_0)^2}{2R}$

C. $\dfrac{2(\mathcal{E}_0)^2}{R}$

D. $\dfrac{3(\mathcal{E}_0)^2}{R}$

Average power dissipated in a series AC RLC circuit,

$$P = \mathcal{E}_{\text{rms}} i_{\text{rms}} \cos\phi$$

$$\Rightarrow P = \mathcal{E}_{\text{rms}} \left(\frac{\mathcal{E}_{\text{rms}}}{Z}\right)\left(\frac{R}{Z}\right) = \frac{(\mathcal{E}_{\text{rms}})^2 R}{Z^2}$$

$$\Rightarrow P = \frac{(\mathcal{E}_0)^2 R}{2Z^2} = \frac{(\mathcal{E}_0)^2 R}{2(R^2 + (X_C - X_L)^2)}$$

$$\Rightarrow P = \frac{(\mathcal{E}_0)^2 R}{2R^2} = \frac{(\mathcal{E}_0)^2}{2R} \quad [\text{Given } X_L = X_C]$$

Hence, option $(B)$ is the correct answer.

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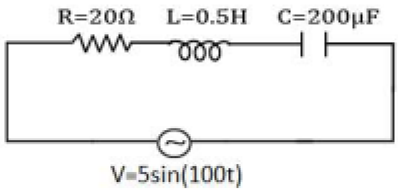
5.Consider the following AC RLC circuit. The maximum voltage drop across the inductor is -

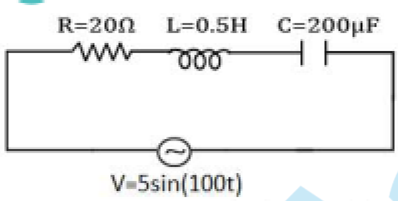



A. $17.5 \text{ V}$

B. $15.5 \text{ V}$

C. $12.5 \text{ V}$

D. $19.5 \text{ V}$




Here,

$$X_L = \omega L = 100 \times 0.5 = 50\ \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{100 \times 200 \times 10^{-6}} = 50\ \Omega$$

The impedance is,

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

$$\Rightarrow Z = \sqrt{20^2 + (50 - 50)^2} = 20\ \Omega$$

Now,

$$I_0 = \frac{V_0}{Z} = \frac{5}{20} = \frac{1}{4} \text{A}$$

So, the maximum voltage drop across the inductor is,

$$V_{L_0} = I_0 X_L = \frac{1}{4} \times 50 = 12.5 \text{ V}$$

Hence, option $(C)$ is the correct answer.