Alternating Current- L1

1. An alternating current is given by the equation, $i = 3\sqrt{2}\sin(100\pi t + \pi/4)$ and an alternating voltage is given by the equation, $\mathcal{E} = 220\sqrt{2}\sin(100\pi t + \pi/2)$. Calculate the phase difference between them.

   ✔ **A.** $\pi/4$

   ✘ **B.** $\pi/3$

   ✘ **C.** $\pi/2$

   ✘ **D.** $\pi/6$

   Given:

   Current, $i = 3\sqrt{2}\sin(100\pi t + \pi/4) \Rightarrow \phi_1 = 100\pi t + \pi/4$
   Voltage, $\mathcal{E} = 220\sqrt{2}\sin(100\pi t + \pi/2) \Rightarrow \phi_2 = 100\pi t + \pi/2$

   Therefore, phase difference,

   $\Delta\phi = \phi_2 - \phi_1 = 100\pi t + \pi/2 - (100\pi t + \pi/4) = \pi/4$

2. If an alternating voltage is given by the equation, $\mathcal{E} = 20\sin(100\pi t)$ V, then calculate its value at time, $t = \frac{1}{600}$ s.

   ✘ **A.** 5 V

   ✘ **B.** 8 V

   ✔ **C.** 10 V

   ✘ **D.** 12 V

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Given:

Voltage, $\mathcal{E} = 20\sin(100\pi t)$ V

At $t = 1/600$ s

$\mathcal{E} = 20\sin(100\pi \times 1/600)$ V

$\Rightarrow \mathcal{E} = 10$ V

Note:

Angle in the above equations is in radian.

3. If phase difference between voltage $(\mathcal{E})$ and current (i) is $\frac{\pi}{4}$ and frequency, $f = 50$ Hz. Calculate the time difference.

- ✗ **A.** 1.5 ms
- ✓ **B.** 2.5 ms
- ✗ **C.** 3.5 ms
- ✗ **D.** 4.5 ms

The time difference,

$$\Delta t = \frac{T}{2\pi} \times \Delta\phi$$

$$\Rightarrow \Delta t = \frac{1}{2\pi f} \times \Delta\phi$$

$$\Rightarrow \Delta t = \frac{1}{2\pi \times 50} \times \frac{\pi}{4} = 2.5 \times 10^{-3} \text{ s} = 2.5 \text{ ms}$$

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4. A generator produces time varying voltage given by $\mathcal{E} = 240 \sin 120t$, where t is in second. The average value of voltage for the half cycle is -

- A. $123\ \text{V}$
- B. $133\ \text{V}$
- C. $143\ \text{V}$
- D. $153\ \text{V}$

Given:

$\mathcal{E} = 240 \sin 120t$

So, $\mathcal{E}_0 = 240\ \text{V}$

We know that the average value of voltage of an AC source for a half cycle is given by,

$$\mathcal{E}_{avg} = \frac{2\mathcal{E}_0}{\pi}$$

4. $$\Rightarrow \mathcal{E}_{avg} = \frac{2 \times 240}{\pi} = 153\ \text{V}$$

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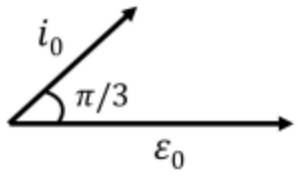
5.The phasor diagram for a component connected with AC supply is shown below. Select the incorrect statement.

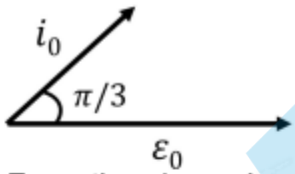


A. Current is leading the voltage.

B. The phase difference between the current and voltage is $\frac{\pi}{3}$.

C. The component in the circuit is a pure resistor.

D. The peak magnitude of current is less than the peak magnitude of voltage.



From the given phasor diagram, we can conclude that -

(i) Current is leading the voltage

(ii) The phase difference between the current and voltage is $\frac{\pi}{3}$.

(iii) The peak magnitude of current is less than the peak magnitude of voltage.

But for the pure resistive circuit connected with AC supply, current and voltage remain in the same phase.

Therefore, the component in the circuit is not a pure resistor.

Hence, option (C) is the correct answer.

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