

PHYSICS • CLASS 12

CHAPTER 7

Alternating Current

NCERT SOLUTIONS



RMS VALUES AND AC RESISTOR – EXERCISES 7.1 – 7.2

Q. 7.1 A $100\ \Omega$ resistor is connected to a 220 V, 50 Hz AC supply.

- (a) Find rms current.
- (b) Find net power consumed over a full cycle.

Answer:

In a pure resistor, the current and voltage are in phase. The average power consumed over a full cycle can be calculated using rms values.

(a) Rms current:

$$I_{rms} = \frac{V_{rms}}{R} = \frac{220}{100} = 2.20\text{ A}$$

(b) Net power consumed over a full cycle:

$$\begin{aligned} P_{av} &= V_{rms} I_{rms} = I_{rms}^2 R \\ &= (2.20)^2 (100) = 484\text{ W} \end{aligned}$$

Q. 7.2 (a) The peak supply voltage is 300 V.
Find the rms voltage.

(b) The rms circuit current is 10 A. Find the peak current.

Answer:

For a sinusoidal AC, the rms value is related to the peak value by $V_{rms} = \frac{V_{peak}}{\sqrt{2}}$ (and similarly for current).

(a) Rms voltage:

$$V_{rms} = \frac{V_{peak}}{\sqrt{2}} = \frac{300}{\sqrt{2}} = 212\text{ V}$$

(b) Peak current:

$$I_{peak} = \sqrt{2} I_{rms} = \sqrt{2} \times 10 = 14.1\text{ A}$$

CURRENT THROUGH AN INDUCTOR — EXERCISE 7.3

Q. A 44 mH inductor is connected to a 220 V, 50 Hz ac supply. Find the RMS current.

Answer: A pure inductor resists changing current through its inductive reactance $X_L = 2\pi fL$. The 220 V supply value is rms. The current lags the voltage by 90° for an ideal inductor.

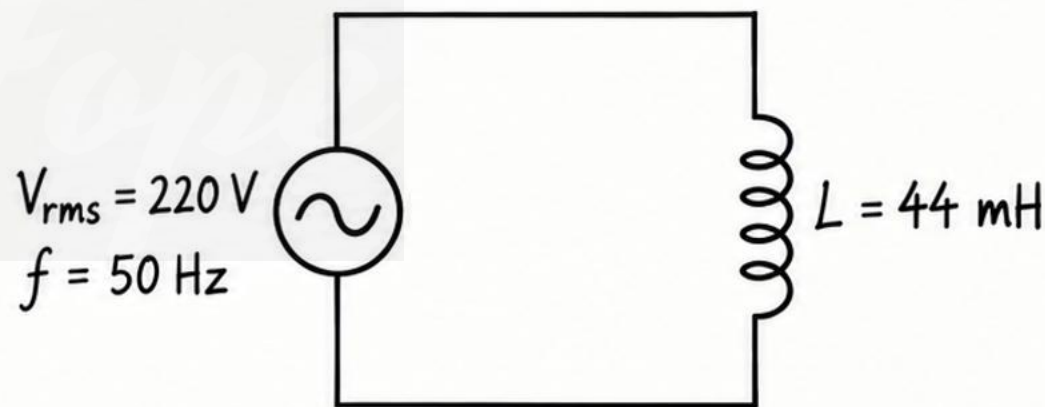
$$L = 44 \text{ mH} = 0.044 \text{ H}$$

$$f = 50 \text{ Hz}$$

$$V_{\text{rms}} = 220 \text{ V}$$

$$X_L = 2\pi fL = 2\pi(50)(0.044) = 13.82 \, \Omega$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{X_L} = \frac{220}{13.82} = 15.9 \text{ A}$$



CURRENT THROUGH A CAPACITOR – EXERCISE 7.4

Q. A $60 \mu\text{F}$ capacitor is connected to a 110 V , 60 Hz ac supply. Find the RMS current.

Answer: A pure capacitor has capacitive reactance $X_C = \frac{1}{2\pi fC}$.

The 110 V supply value is rms.

$$C = 60 \mu\text{F} = 60 \times 10^{-6} \text{ F}$$

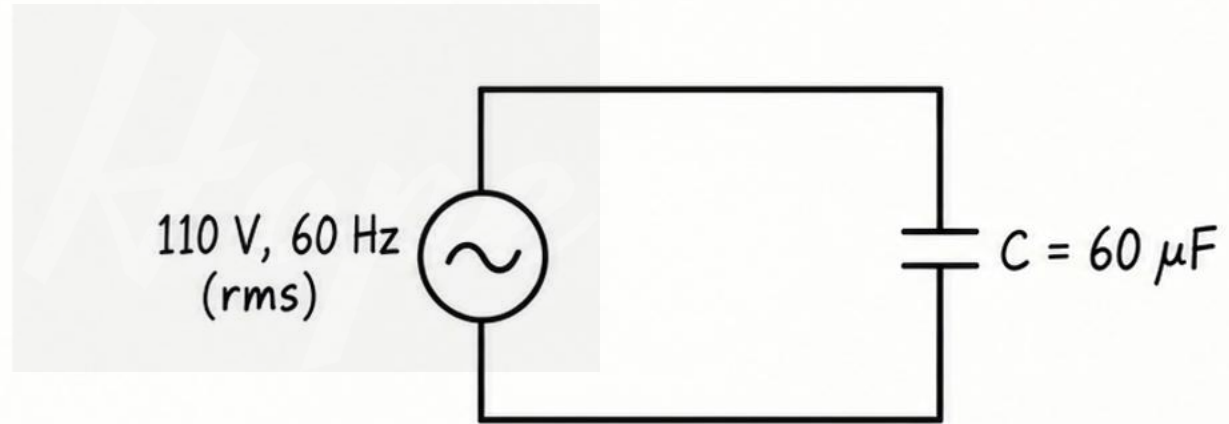
$$f = 60 \text{ Hz}$$

$$V_{\text{rms}} = 110 \text{ V}$$

$$X_C = \frac{1}{2\pi(60)(60 \times 10^{-6})} = 44.2 \Omega$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{X_C} = \frac{110}{44.2} = 2.49 \text{ A}$$

The current leads the voltage by 90° for an ideal capacitor.



POWER IN IDEAL L AND C – EXERCISE 7.5

Q. For the inductor in Exercise 7.3 and capacitor in Exercise 7.4, find the NET POWER absorbed by EACH circuit over one full AC cycle. Explain.

Answer: A pure inductor stores magnetic energy; a pure capacitor stores electric energy. Both return the energy to the source. Current and voltage differ in phase by 90° , so average real power is zero.

$$P_{av} = V_{rms} I_{rms} \cos \phi.$$

INDUCTOR (L):

For a pure inductor, current lags voltage by 90° .

$$\phi = +90^\circ$$

$$\cos \phi = 0$$

$$P_{av,L} = V_{rms} I_{rms} \cos \phi = 0 \text{ W.}$$

CAPACITOR (C):

For a pure capacitor, current leads voltage by 90° .

$$\phi = -90^\circ$$

$$\cos \phi = 0$$

$$P_{av,C} = V_{rms} I_{rms} \cos \phi = 0 \text{ W.}$$

BOTH ABSORB 0 W ON AVERAGE OVER A FULL CYCLE.

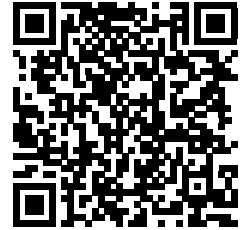


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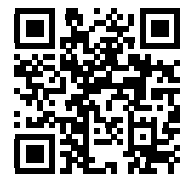


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