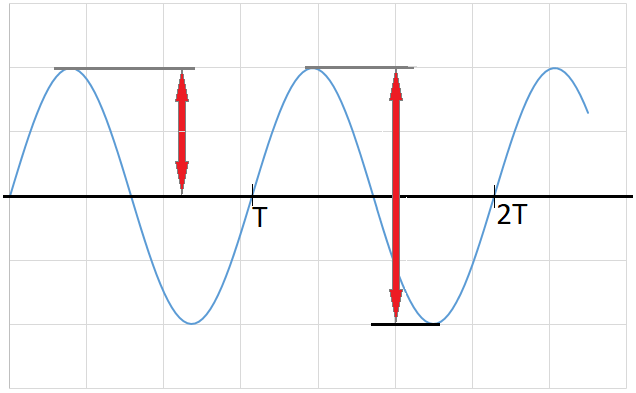
Physics II

Alternating currents



$V_{rms} = \frac{V_{peak}}{\sqrt{2}}$ rms value

$f = \frac{1}{T}$ frequency

$Z = \frac{V_{rms}}{I_{rms}}$ impedance

$Z_C = \frac{1}{2\pi fC}\angle -90^\circ$ impedance of a capacitor

$Z_L = 2\pi fL\angle 90^\circ$ impedance of an inductance

Problem 1.- An ac voltage, whose peak value is 125V is across a 120-Ω resistor. Find the rms voltage and the average power dissipated in the resistor.

Solution: If the peak value is 125 V, the rms value will be:

$$Vrms = \frac{125V}{\sqrt{2}} = \mathbf{88.4\ V}$$

To calculate the power, we use the formula $\frac{V^2}{R}$ with the understanding that we should use the rms value of the voltage.

$$Power = \frac{(88.4V)^2}{120\Omega} = \mathbf{65\ W}$$

Problem 2.- The specifications of an electronic instrument indicate it needs 120 V and consumes 300W of power. We understand that the voltage given is an rms quantity. If we can consider the instrument equivalent to a resistance, calculate the value of the resistance and the rms value of the current.

Solution: The values given in the specifications allow us to calculate the equivalent resistance and the current:

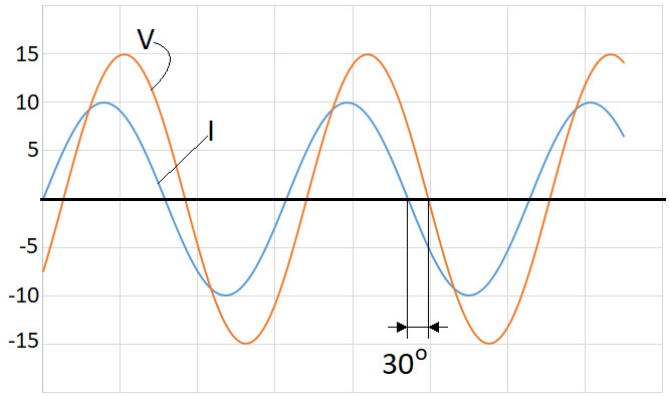
$$P = \frac{V^2_{rms}}{R}$$

$$\rightarrow R = \frac{V^2_{rms}}{P} = \frac{(120V)^2}{300W} = \mathbf{48\ \Omega}$$

$$P = V_{rms} I_{rms}$$

$$\rightarrow I_{rms} = \frac{P}{V_{rms}} = \frac{300W}{120V} = \mathbf{2.5\ A}$$

Problem 3.- The figure shows the voltage and current in an electric device. Determine the value of the impedance in magnitude and angle.



Solution: By observing the values in the graph we determine:

$$Z = 1.5\angle 30^\circ$$

Problem 4.- The plate in the back of a certain computer scanner indicates the unit consumes 0.34A off a 120 V line at 60 Hz. Determine

a) The peak current.
b) Peak to Peak current.
c) RMS current.
d) The current read by an ammeter connected to the device.
e) The amplitude of the current.
f) The average current.
g) The power if the phase is zero.