Ex: Compute the power as a function of time consumed by a battery-powered device that draws the following current from a 1.5 volt battery.

a) Compute the power as a function of time consumed by a battery-powered device that draws the following current from a 1.5 volt battery.

\[ i(t) = 1 \text{ mA} + 2\cos(2\pi t + 30^\circ) \text{ mA} \]

b) Find the energy consumed by the device described in (a) in the first minute. Note: Convert the 30° to radians before integrating.

Sol'n: a) Power is the product of voltage and current.

\[ p(t) = i(t) \cdot 1.5V = 1.5 \text{ mW} + 3\cos(2\pi t + 30^\circ) \text{ mW} \]

b) Energy is the integral of power with respect to time. The product of power and time is energy (or work). The units for energy are Joules.

\[ w(t = 60s) = \int_0^{60} p(t) dt = 90 \text{ mJ} + \frac{3\sin(2\pi t + 30^\circ)}{2\pi} \bigg|_0^{60} \text{ mJ} = 90 \text{ mJ} \]

Note: The integral of the \( \cos() \) term is zero since the \( \sin() \) function is evaluated at times where the total angles differ by an integer multiple of \( 2\pi \) and are, therefore, the same.