537.

Problem 39.23 (RHK)

An electric motor connected to a 120-V, 60-Hz *power outlet does mechanical work at the rate of* 0.10 hp (1 hp = 746 W). *If it draws an rms current of* 650 mA, *we have to find the resistance in terms of power transfer. We have to answer whether this resistance would be the same as the resistance of the coils as measured with an ohm-meter with the motor disconnected from the power outlet.*

Solution:

An electric motor connected to a 120-V, 60-Hz power outlet does mechanical work at the rate of 0.10 hp (1 hp = 746 W). If it draws an rms current of 650 mA, we have to find the resistance in terms of power transfer.

In an *AC* circuit the power dissipation, *P*, is related to the rms current, i_{rms}, and the resistance, *R*, as

$P = i_{rms}^2 R$.

In our problem

$P = 0.10 \times 746 \text{ W} = 74.6 \text{ W},$

and

$i_{rms} = 0.65 \text{ A}.$

Therefore, the resistance of the motor is

$$R = \frac{74.6}{(0.65)^2} \ \Omega = 176.5 \ \Omega.$$

Yes, this would also be the resistance as measured by an ohm-meter with the motor disconnected from the outlet. In an *AC* circuit the impedance depends on the frequency of the mains and the values of circuit elements *L* and *C* and the *R*, and the i_{rms} is $\frac{E_{rms}}{Z}$ and not $\frac{E_{rms}}{R}$, but the power dissipation is in the resistive load *R* only.