Chapter 24 Solutions - Problems 1, 3, 4, 7, 11

1. Figure P24.3 displays a voltage *v(t)* versus time *t* curve. Its formula is given by Eq. (24.1):
   $v(t) = v_0 \sin(2\pi f t)$

   a. The maximum voltage can be read off from this curve:
   $V_{max} = v_0 =$ 25 volts

   b. The rms voltage is $V_{max} = \dfrac{v_0}{\sqrt{2}}$ = 17.7 volts (see Sec 24.2)

   c. The period $T = 1 / f$ can be read from the graph: $T = 0.1$ s

   d. The frequency $f = 1 / T = 10$ *Hz*.

3. The current is described by $i = 2 \cos(40\,t) = i_0 \cos(2\pi f t)$
   Comparing the last two expressions used immediately we see:

   a. peak current $i_0 = 2$ *A*

   b. effective current $I = \dfrac{i_0}{\sqrt{2}} = 1.41 A$

   c. rms current = effective current = 1.41 *A*

   d. $40 = 2\pi f$, thus $f \cong 6.37$ *Hz*

4. From the results of Problem 1, we can write:

   $v(t) = 25 \sin(20\,\pi\,t)$

7. The current $i(t) = 5 \sin(20\,t)$ flows through a resistor of $R = 15\ \Omega$. The power lost is given by:

   $$P = IV = I^2\ R = \left(\frac{25}{2}\right)(15)\ W$$

   or $$P = 187.5\ W$$

11. This problem refers to the situation in Fig. 24.5. The capcitance $C = 2\mu F$, the resistance is $R = 5 \times 10^6 \Omega$, and the *DC* voltage of the battery is $V = 12\ V$.

   a. The initial current $i(0) = V / R = 2.4 \times 10^{-6}\ A$

   b. The time constant $\tau = RC = 10\ s$

   c. The final charge $q\ (t = \infty) = CV = 2.4 \times 10^{-5} C$

   d. $q(t = RC) = 0.63\ CV = 1.51 \times 10^{-5} C$

   e. $i(t = RC) = 0.37\ i(0) = 8.9 \times 10^{-7} A$