**19.** Consider the initial value problem

$$y' + \frac{1}{4}y = 3 + 2\cos(2t), \quad y(0) = 0.$$

**a.** Find the solution of this initial value problem and describe its behavior for large $t$.

**N b.** Determine the value of $t$ for which the solution first intersects the line $y = 12$.

**20.** Find the value of $y_0$ for which the solution of the initial value problem

$$y' - y = 1 + 3\sin t, \quad y(0) = y_0$$

remains finite as $t \to \infty$.

**21.** Consider the initial value problem

$$y' - \frac{3}{2}y = 3t + 2e^t, \quad y(0) = y_0.$$

Find the value of $y_0$ that separates solutions that grow positively as $t \to \infty$ from those that grow negatively. How does the solution that corresponds to this critical value of $y_0$ behave as $t \to \infty$?

**22.** Show that all solutions of $2y' + ty = 2$ [equation (41) of the text] approach a limit as $t \to \infty$, and find the limiting value.
*Hint:* Consider the general solution, equation (47). Show that the first