12. Draw a direction field, guess the behavior of the solutions as time approaches infinity, find all solutions, and verify their behavior as $t \to \infty$:
    (a) $y' + 3y = t + e^{-2t}$;
    (b) $y' + y = te^{-t} + 1$.
13. Suppose p and g are continuous on some interval I. Let $t_0 \in I$ and y_0 be a real number. Show that the initial value problem $y' + p(t)y = g(t)$, $y(t_0) = y_0$ has exactly one solution, and give a formula for this solution.
14. Solve the following initial value problems:
    (a) $y' - y = 2te^{2t}$, $y(0) = 1$;
    (b) $y' + 2y = te^{-2t}$, $y(1) = 0$;
    (c) $ty' + 2y = t^2 - t + 1$, $y(1) = \frac{1}{2}$, $t > 0$;
    (d) $y' = \cot(t)y + \sin(2t)$, $y(\frac{\pi}{2}) = 0$;
    (e) $y' + \frac{2}{t}y = \frac{\cos(t)}{t^2}$, $y(\pi) = 0$, $t > 0$;
    (f) $y' - 2y = e^{2t}$, $y(0) = 2$;
    (g) $ty' + 3y = t^2$, $y(1) = 0$;
    (h) $y' = -t^2 y$, $y(0) = 1$;
    (i) $y' + 2ty = 2te^{-t^2}$, $y(2) = 0$.
15. A tank has ten gallons of water in which two pounds of salt has been dissolved. Brine with 1.5 pound of salt per gallon enters at three gallons per minute, and the well-stirred mixture is drained out at a rate of four gallons per minute. Find the amount of salt in the tank at any time.
16. Assume $y : (0, \infty) \to (0, \infty)$ is continuous with $\int_1^x \frac{y(t)}{t} \mathrm{d}t = y(x) - \frac{x^2+1}{2}$ for all $x > 0$. Find y.
17. Work on problems 37–41 on page 33. These problems deal with Bernoulli equations.