8. Use exactly the same steps as in Example 1.5 from the lecture to find all solutions of the ODE $y' + 4y + 2 = 0$. Also, give the solution y of this ODE that satisfies $y(1) = 2$. Finally, let t_0 and y_0 be arbitrary real numbers and find the solution y of the ODE that satisfies $y(t_0) = y_0$.
9. Consider the linear first order equation with constant coefficients $y' = ry + k$.
   (a) Recall from Theorem 1.6 what the general solution is.
   (b) Find all constant solutions.
   (c) Find the solution with $y(0) = 2$.
   (d) For a given point (t_0, y_0), find the solution that goes through this point.
   (e) Characterize all increasing solutions. Characterize all decreasing solutions.
   (f) Determine the behavior of the solutions as $t \to \infty$.
10. Find the solutions of the following initial value problems:
   (a) $y' = 5y - 1$, $y(0) = 2$;
   (b) $y' = -y + 4$, $y(1) = -1$;
   (c) $5y' = 2y - 3$, $y(-2) = 3$;
   (d) $3y' - 2y = 1$, $y(-1) = 0$;
   (e) $-2y' + 2y - 4 = 0$, $y(5) = 10$.
11. Consider a certain product on the market. Let a demand function $D(t)$ and a supply function $S(t)$ for this product be given. Also, let the function $P(t)$ describe the market price of the product (as a function of the time t). We assume that S and D depend linearly on the market price P: $D(t) = \alpha + aP(t)$, $S(t) = \beta + bP(t)$.
   (a) According to the model, should we assume $a < 0$ or $a > 0$?
   (b) According to the model, should we assume $b < 0$ or $b > 0$?
   (c) Now we assume that P is changing proportionally to the difference $D - S$, with constant of proportionality γ. According to the model, should we assume $\gamma < 0$ or $\gamma > 0$?
   (d) Derive a differential equation for P and solve it.
   (e) Calculate the so-called equilibrium price of the product, i.e., determine $\lim_{t\to\infty} P(t)$.
12. 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) $y' + 2ty = 2te^{-t^2}$, $y(2) = 0$.