

1. Suggested textbook questions. Please practice enough of these until you can solve the ODEs quickly
 1. 2.2 Separable ODEs: 1-22
 2. 2.4 Linear ODEs: 1-26
 3. 2.6 Exact ODEs: 1-30
 4. 4.3 Homogeneous constant coefficient second-order ODEs: 1-36
 5. Inhomogeneous constant coefficient second-order ODEs (undetermined coefficients or variation of parameters): 4.5 1-8, 10-29; 4.6: 1-12
2. Consider the following initial value problem:

$$\begin{cases} y' = x + xy^2, \\ y(0) = 0. \end{cases}$$

- (a) Is the differential equation linear? Is it separable?
 - (b) Find the explicit solution to the initial value problem.
3. Consider the initial value problem: $ty' = y, \quad y(t_0) = y_0$.
 - (a) Show that if $t_0 = 0$ and $y_0 \neq 0$, there is no solution.
 - (b) Show that for all c , $y(t) := ct$ is a solution and so if $t_0 = 0$ and $y_0 = 0$, there is more than one solution.
4. Consider the initial value problem $y' = \cos(y) - \frac{1}{2}, \quad y(0) = y_0$.
 - (a) Find all possible equilibrium solutions and classify them as I) stable, or II) unstable.
 - (b) For what range of y_0 values will $\lim_{t \rightarrow \infty} y(t) = \pi/3$?
5. Consider the second-order equation

$$x'' + \mu x' + 4x = 0$$

For each value of $\mu > 0$, find a pair of linearly independent solutions.

6. Consider the second order system

$$x'' - 2x' + x = t.$$

Solve the initial value problem with $x(0) = x'(0) = 0$.