1. Consider the following differential equation:

\[ y' = y(1 - y) \]

(a) (3 points) What are its equilibrium solutions?

**Solution:** The equilibrium solutions occur when \( y(1 - y) = 0 \), i.e., at \( y = 0 \) and \( y = 1 \).

(b) (3 points) Classify the equilibrium solutions as stable or unstable. (A picture is ok as long as you explain it.)

**Solution:** For \( y \) slightly smaller than 0, we have \( y(1 - y) < 0 \) and for \( 0 < y < 1 \), we have \( y(1 - y) > 0 \), so 0 is unstable. (In fact, both sides of 0 tend to move away from it.)

For \( 0 < y < 1 \), we have \( y(1 - y) > 0 \) and for \( y > 1 \), we have \( y(1 - y) < 0 \), so \( y = 1 \) is stable.

2. (4 points) Consider the following differential equation:

\[ y'' + y' - 2y = 0. \]

What is its general solution?

**Solution:** The characteristic equation is \( r^2 + r - 2 = 0 \), which factors as \((r + 2)(r - 1)\), so the two exponents are \(-2\) and \(1\). The general solution is thus

\[ c_1 e^{-2t} + c_2 e^t. \]