1. Solve \( \frac{dy}{dt} = -3y + 3 - 2e^{-t} \), \( y(0) = 1/2 \).
2. The temperature $T$ of a cold drink placed in a 70-degree room satisfies a differential equation given by

$$\frac{dT}{dt} = 3(70 - T).$$

where $t$ is time. Suppose that at $t = 0$ the temperature of the cold drink is 30 degrees.

a. Find the temperature $T(t)$ at any time $t$.

b. When will the temperature of the cold drink reach 50 degrees?
3. Consider the differential equation \( x^2 y'' - xy' + y = 0 \) on \( x > 0 \).

a. Show that \( y_1 = x \) is a solution.

b. Show that \( y_2 = x \log(x) \) is a solution.

c. Show that \( y_1 \) and \( y_2 \) are a fundamental set of solutions for \( x > 0 \).
4. Find the general solution of each of the following. Be sure to check your roots carefully!

a. \(2y'' + 2y' + y = 0.\)

b. \(4y'' - 4y' + y = 0.\)

c. \(y'' - 2y' - 8y = 0.\)
5. Solve the initial value problem \( y'' + \frac{1}{9}y = 0 \), \( y(0) = 6 \), \( y'(0) = 5 \).
6. a. Give Euler’s formula.

b. Use it to express $e^{2-ix}$ in the form $a + ib$.

c. Give a formula for $\cos(x)$ in terms of $e^{ix}$ and $e^{-ix}$ and explain how it follows from Euler’s formula.