(1) Find the particular solution to the following 2nd order linear homogeneous ODEs.
   (a) \( y'' - y' - 2y = 0 \), \( y(0) = -1 \), \( y'(0) = 2 \)
   (b) \( y'' - 4y' - 5y = 0 \), \( y(1) = -1 \), \( y'(1) = -1 \)
   (c) \( y'' + 25y = 3 \), \( y(0) = 1 \), \( y'(0) = -1 \)
   (d) \( y'' - 2y' + 17y = 0 \), \( y(0) = -2 \), \( y'(0) = 3 \)

(2) Find the general solution to the following 2nd order linear inhomogeneous ODEs, by solving
   the associated homogeneous equation, and then finding a constant (particular) solution.
   (a) \( y'' + y' - 12y = 24 \)
   (a) \( y'' = -4y + 3 \)

(3) As we’ve seen, to solve ODE of the form
   \[ y'' + py' + qy = 0, \quad p \text{ and } q \text{ constants} \]
   we assume that the solution has the form \( e^{rt} \), and then we plug this back into the ODE to
   get the characteristic equation: \( r^2 + pr + q = 0 \). Given that this equation has a double root
   \( r = r_1 \) (i.e., the roots are \( r_1 = r_2 \)), show by direct substitution that \( y = te^{rt} \) is a solution
   of the ODE, and then write down the general solution. [Hint: If there’s a double-root,
   then it must be \(-\frac{p}{2}\). Why?]

(4) Suppose that \( z(t) = x(t) + iy(t) \) is a solution of
   \[ z'' + pz' + qz = Ae^{i\omega t}. \]
   Substitute \( z(t) \) into this equation above. Then compare (equate) the real and imaginary
   parts of each side to prove two facts:
   \[ x'' + px' + qx = A \cos \omega t \]
   \[ y'' + py' + qy = A \sin \omega t. \]
   Write a sentence or two summarizing the significance of this result.

(5) Solve the following initial value problems using the method of undetermined coefficients.
   (a) \( y'' + 3y' + 2y = -3e^{-4t}, \quad y(0) = 1, \quad y'(0) = 0 \)
   (b) \( y'' + 2y' + 2y = 2 \cos 2t, \quad y(0) = -2, \quad y'(0) = 0 \)
   (c) \( y'' + 4y' + 4y = 4 - t, \quad y(0) = -1, \quad y'(0) = 0 \)
   (d) \( y'' - 2y' + y = t^3, \quad y(0) = 1, \quad y'(0) = 0 \)