



**Question 1.** Find the general solution to:

$$x'' - 2x' + 2x = 0.$$



**Question 2.** Solve the following IVP

$$x'' + 2x' + 2x = 0, \quad x(\pi/4) = 2, \quad x'(\pi/4) = -2.$$



**Question 3.** Find the general solution to the following ODE:

$$x'' - 2x' + x = 0.$$



**Question 4.** Solve the following IVP

$$9x'' - 12x' + 4x = 0, \quad x(0) = 2, \quad x'(0) = -1.$$



**Question 5.** Given that  $x_1(t) = t^2$  is a solution to:

$$t^2x'' - 4tx' + 6x = 0,$$

find a second linearly independent solution (and show that it is linearly independent).



**Question 6.** Find the general solution to:

$$x'' - 2x' - 3x = 3e^{2t}.$$



**Question 7.** Find the general solution to:

$$x'' + x' - 6x = 12e^{2t}.$$



**Question 8.** Find the general solution to (use variation of parameters):

$$x'' - 5x' + 6x = 2e^t.$$





**Question 9.** Find the general solution to:

$$x' + 3x = t + e^{-2t}.$$



**Question 10.** Find the general solution to:

$$tx' + (t + 1)x = t.$$



**Question 11.** Find the general solution to:

$$x' = \frac{t^2}{x}.$$



**Question 12.** A tank contains 100 gallons of water and 50 oz of salt. Water containing salt at a concentration of  $\frac{1}{4}(1 + \frac{1}{2} \sin t)$  oz per gallons flows into the tank at a rate of 2 gallons per minute and out at a rate of 1 gallon per minute. Find an IVP that models this situation.



**Question 13.** Consider the ODE  $y' = (y - 1)^2(y - 2)$ . Sketch some solution curves as we have done previously. Determine the equilibrium solutions and their stability.



**Question 14.** Solve the following IVP:

$$(9x^2 + y - 1) - (4y - x)y' = 0, y(1) = 0.$$