1. (15 points) Consider the differential equation \( x \frac{dx}{dt} = -t^2 \).
   a. Is this differential equation linear? Explain!
   b. Find the solution for which \( x(0) = -5 \).

2. (5 points) Show that the functions \( t^3 \) and \( t^4 \) are solutions of \( t^2 x'' - 6tx' + 12x = 0 \).

3. (5 points, no partial credit) Find all solutions of \( (tD^2 - D)x = 0 \) that are of the form \( t^a \).

4. (5 points, no partial credit) Evaluate 
   \[
   \det \begin{pmatrix}
   0 & 1 & 6 & 9 & 1 \\
   0 & 0 & 2 & 7 & 0 \\
   0 & 0 & 0 & 3 & 8 \\
   0 & 0 & 0 & 0 & 4 \\
   5 & 0 & 0 & 0 & 0 
   \end{pmatrix}.
   \]

5. (10 points) A savings account pays 3% interest per year, compounded continuously. In addition, the income from another investment is credited to the account continuously, at the rate of $700 per year. Set up a differential equation to model this account.

6. (5 points, no partial credit) Find the general solution of \( (D - 1)^2(D + 1)x = 0 \).

7. (7 points, no partial credit) Find the general solution of \( 3(D^2 + D + 2)^2x = 0 \).

8. (8 points, no partial credit) Make a simplified guess for a particular solution of 
   \[ (D - 1)(D^2 + 1)^3(D + 2)x = t^2 e^t + e^{-t} \sin 3t + t. \]
   Do not evaluate the constants.

9. (15 points) Find (and simplify where possible) the general solution of \( x'' - 2x' + x = e^t/t^2 \).
   (Check all your intermediate answers carefully; no credit for work based on wrong prior steps.)

10. (10 points)
    a. Compute the Wronskian of \( h_1(t) = te^t \) and \( h_2(t) = t^2 e^t \) at \( t = 1 \).
    b. Are these 2 functions linearly independent?

11. (10 points) Are the functions \( t^5, |t|^5 \) linearly independent on \( (-\infty, \infty) \)? Justify your conclusion.

12. (5 points) Suppose \( f(t) \) is continuous. Solve the initial-value problem \( x' + f(t)x = 0, \quad x(1) = 0 \).
    (Hint: Think before applying standard techniques.)