Instructions. Answer each of the questions on your own paper. Be sure to show your work so that partial credit can be adequately assessed. *Credit will not be given for answers (even correct ones) without supporting work.* Put your name on each page of your paper.

1. **[8 Points]** Determine if each of the following first order differential equations is separable (**Yes** or **No**), and/or linear (**Yes** or **No**). Do **not** solve the equations.

Equation	Separable	Linear
$y' + y = t^2$		
$y' + y^2 = t^2$		
$y' + y^2 t = 0$		
$y' + t^2 y = t^2$		

2. **[12 Points]** Let $A = \begin{bmatrix} 2 & 1 & -1 \\ 3 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}$. Compute each of the following matrices, if it exists.

   (a) AB (b) BA (c) A^2 (d) B^2

3. **[16 Points]** Find all solutions to the linear system

$$\begin{array}{rcrcrcrcl} x_1 & + & 2x_2 & + & x_3 & + & 3x_4 & = & 1 \\ x_1 & + & 2x_2 & + & 2x_3 & + & 5x_4 & = & 0 \\ -x_1 & - & 2x_2 & - & 3x_3 & - & 7x_4 & = & 1 \end{array}$$

4. **[16 Points]** Let $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 2 & 1 \\ 1 & 0 & 2 \end{bmatrix}$.

   (a) Compute $\det A$.

   (b) Compute the inverse of A.

5. **[16 Points]** Solve the initial value problem: $y' + 5y = 30e^{-5t} + 30e^{5t}, \quad y(0) = -5.$

6. **[16 Points]** Solve the initial value problem: $y' = y^2(t+2), \quad y(0) = 1.$

7. **[16 Points]** Solve the initial value problem: $y' + \dfrac{2}{t}y = t^4, \quad y(1) = \dfrac{22}{7}.$