On my honor, as an Aggie, I have neither given nor received unauthorized aid on this work.

Name (print):

In all questions, no analytical work — no points.
1. Find the general solution of

\[ y' + 2ty = 2te^{-t^2}. \]
2. Find the general solution of

\[(x - 2y)dx + (y - 2x)dy = 0.\]
3. Find the solution of the initial value problem

\[ y'' + 9y = 18te^{3t}, \quad y(0) = 0, y'(0) = 3. \]
4. For the forced vibrating system described by

\[ u'' + u' + 2u = 2 \cos(2t), \]

find the steady state and determine its amplitude.
5. A mechanical oscillator described by the equation

\[ y'' + 2y' + 10y = F_{\text{ext}}(t), \]

is initially at rest with no external force. At time \( t = 1 \) the experimenter switches on a magnet that acts on the oscillator with constant force 10 (Newtons). Find the position \( y(t) \) of the oscillator at time \( t \) and sketch it on the interval \( 0 < t < 10 \).
6. Find eigenvalues (and eigenvectors, if needed) to sketch the phase portrait of the system

\[ x' = \begin{pmatrix} 5 & -1 \\ 3 & 1 \end{pmatrix} x. \]
7. Find eigenvalues (and eigenvectors, if needed) to sketch the phase portrait of the system

\[ x' = \begin{pmatrix} -1 & -4 \\ 1 & -1 \end{pmatrix} x. \]
8. Solve the initial value problem

\[ x' = \begin{pmatrix} 1 & 1 \\ 4 & -2 \end{pmatrix} x, \quad x(0) = \begin{pmatrix} 1 \\ 6 \end{pmatrix}. \]

Sketch the phase portrait of the above system.
9. **Bonus question +2 points (no partial credit):** Solve question 3 by a different method.