Math 20D.
Midterm Exam 2
February 22, 2010

Turn off and put away your cell phone.
No calculators or any other electronic devices are allowed during this exam.
You may use one page of notes, but no books or other assistance during this exam.
Read each question carefully, and answer each question completely.
Show all of your work; no credit will be given for unsupported answers.
Write your solutions clearly and legibly; no credit will be given for illegible solutions.
If any question is not clear, ask for clarification.

<table>
<thead>
<tr>
<th>#</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Σ</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>
1. (10 points)

(a) Solve the initial value problem

$$\mathbf{x}' = \begin{pmatrix} 4 & 3 \\ -2 & -3 \end{pmatrix} \mathbf{x}$$

$$\mathbf{x}(0) = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

(b) Describe the long term behavior of the solution in the phase plane as $t \to \infty$. 
2. (8 points) Find the real-valued general solution of

\[ x' = \begin{pmatrix} 0 & 2 \\ -2 & 0 \end{pmatrix} x. \]
3. (10 points) Consider the nonhomogeneous differential equation

\[ y'' - 5y' + 4y = 3e^{4t} \]

(a) Find the general solution \( y_0(t) \) to the corresponding homogeneous differential equation.

(b) Use undetermined coefficients to find a particular solution \( Y(t) \) to the original nonhomogeneous differential equation.

(c) Write the general solution \( y(t) \) to the original nonhomogeneous differential equation.