# MthSc 208: Differential Equations (Fall 2011) In-class Worksheet 4b: Systems of differential equations (real eigenvalues) 

NAME:

Consider the system of differential equations: $\begin{cases}x_{1}^{\prime}=-2 x_{1}+x_{2}-12, & x_{1}(0)=5 \\ x_{2}^{\prime}=4 x_{1}+x_{2}-18, & x_{2}(0)=20\end{cases}$

1. Write this in matrix form, $\mathbf{x}^{\prime}=\mathbf{A x}+\mathbf{b}$, and find the steady-state solution, $\mathbf{x}_{s s}$.
2. Make a change of variables to transform the system into a homogeneous system.
3. Solve the homogeneous system. (Recall from Worksheet 6 that the eigenvalues of $\mathbf{A}$ are $\lambda_{1}=-3$, $\lambda_{2}=2$, with eigenvectors $\mathbf{v}_{1}=(-1,1)$ and $\mathbf{v}_{2}=(1,4)$.)
4. Solve the solution to the original system of differential equations, by writing $\mathbf{x}=\mathbf{x}_{h}+\mathbf{x}_{s s}$.
5. Sketch the phases portrait of the homogeneous system, and the inhomogeneous system. Also sketch the particular solutions satisfying the given initial conditions.
