## Part I Problems

**Problem 1:** Give the general solution to the DE system $\mathbf{x}' = \begin{bmatrix} -2 & 1 \\ -1 & -4 \end{bmatrix} \mathbf{x}$ and also give its phase-plane picture (i.e its direction field graph together with a few typical solution curves).

**Problem 2:** For each of the following linear systems, carry out the graphing program laid out in this session, that is:

(i) find the eigenvalues of the associated matrix and from this determine the geometric type of the critical point at the origin, and its stability;

(ii) if the eigenvalues are real, find the associated eigenvectors and sketch the corresponding trajectories, showing the direction of motion for increasing $t$; then draw some nearby trajectories;

(iii) if the eigenvalues are complex, obtain the direction of motion and the approximate shape of the spiral by sketching in a few vectors from the vector field defined by the system.

a) $x' = 2x - 3y, y' = x - 2y$

b) $x' = 2x, y' = 3x + y$

c) $x' = -2x - 2y, y' = -x - 3y$

d) $x' = x - 2y, y' = x + y$

e) $x' = x + y, y' = -2x - y$