

Instructions: Show all work. Answers without work required to obtain the solution will not receive full credit. Some questions may contain multiple parts: be sure to answer all of them. Give exact answers unless specifically asked to estimate.

1. Perform the indicated operation, given:

$$A = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}, B = \begin{bmatrix} -1 & 1 \\ 0 & 9 \end{bmatrix}, \vec{u} = \begin{bmatrix} 1 \\ 4 \end{bmatrix}, \vec{v} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

a. $2\vec{u} - 3\vec{v}$

$$2 \begin{bmatrix} 1 \\ 4 \end{bmatrix} - 3 \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 2 \\ 8 \end{bmatrix} - \begin{bmatrix} 6 \\ 9 \end{bmatrix} = \begin{bmatrix} 2-6 \\ 8-9 \end{bmatrix} = \begin{bmatrix} -4 \\ -1 \end{bmatrix}$$

b. $A + 2B$

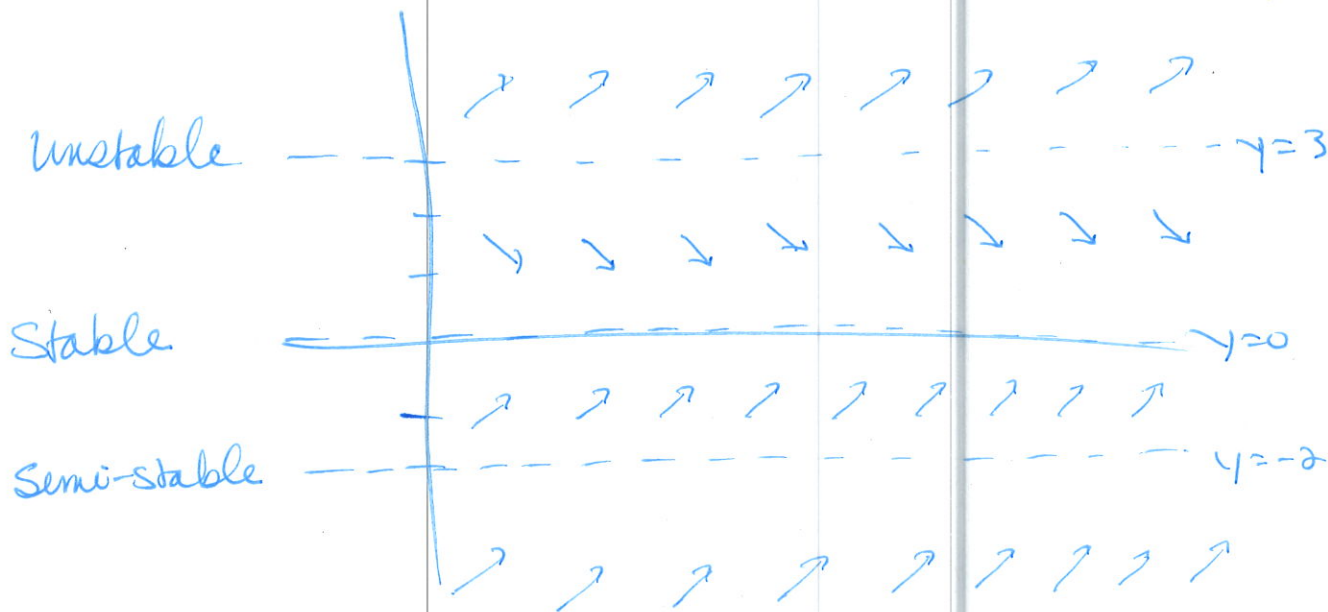
$$\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix} + 2 \begin{bmatrix} -1 & 1 \\ 0 & 9 \end{bmatrix} = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix} + \begin{bmatrix} -2 & 2 \\ 0 & 18 \end{bmatrix} = \begin{bmatrix} 1 & 3 \\ 1 & 20 \end{bmatrix}$$

c. $\vec{u} + i\vec{v}$

$$\begin{bmatrix} 1 \\ 4 \end{bmatrix} + i \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 1+2i \\ 4+3i \end{bmatrix}$$

2. Sketch the direction field for $y' = y(y+2)^2(y-3)$. Label all equilibria. Classify each as stable, unstable or semi-stable.

$$y=0 \quad y=-2 \quad y=3$$



$y < -2$
 $(-)(+)(-1) = +$
 $(-2, 0)$
 $(-)(+)(-) = +$
 $(0, 3)$
 $(+)(+)(-) = -$
 $y > 3$
 $(+)(+)(+) = +$