1. Consider the following system of linear equations

\[ 2x_1 + 2x_2 = 10 \]
\[ -x_1 + 3x_2 = 3 \]

(a) Verify that \( x_1 = 3 \) and \( x_2 = 2 \) is a solution to the above system of equations.

(b) Verify the above solution geometrically by plotting (on a plot similar to that shown below) the two lines and showing that their intersection is the point \((3, 2)\).

\( x_2 = -x_1 + 5 \)

\[ 2x_1 + 2x_2 = 10 \]
\[ 2(3) + 2(2) = 10 \]
\[ 6 + 4 = 10 \]
\[ 10 = 10 \checkmark \]

\[ -x_1 + 3x_2 = 3 \]
\[ -3 + 3(2) = 3 \]
\[ -3 + 6 = 3 \]
\[ 3 = 3 \checkmark \]
2. Consider the following system of linear equations

\[3x + 2y = 14\]
\[x + 2y = 6\]

(a) Solve for \(x\) and \(y\) (show your work).

(b) Verify your solution geometrically by plotting the two lines and their intersection.

\[\begin{align*}
(a) & \quad x + 2y = 6 \\
& \quad x = 6 - 2y \\
& \quad 3x + 2y = 14 \\
& \quad 3(6-2y) + 2y = 14 \\
& \quad 18 - 6y + 2y = 14 \\
& \quad 18 - 4y = 14 \\
& \quad -4y = -4 \\
& \quad y = 1 \\
& \quad x = 6 - 2y \\
& \quad x = 4
\end{align*}\]
3. Consider the following system of linear equations

\[ 4x - y = 2 \]
\[ x + 2y = 5 \]

(a) Solve for \( x \) and \( y \) (show your work).
(b) Verify your solution geometrically by plotting the two lines and their intersection.

\[ \begin{align*}
4x - y &= 2 \\
20 - 8y &= 2 \quad \text{(from } 4(5-2y) + y = 2) \\
-9y &= -18 \\
y &= 2 \\
x &= 5 - 2(2) \\
x &= 1
\end{align*} \]
4. Consider the following system of linear equations.

\[ 2x - y = 3 \]
\[ 2x + 2y = 6 \]

(a) Solve for \( x \) and \( y \) (show your work).

(b) Express the linear equations in vector-form as a sum of two scaled vectors.

(c) Draw the two vectors from the left-hand side of your solution to part (b).

(d) Draw the two vectors from the left-hand side of your solution to part (b) but this time scaled by your solution to part (a). Using the parallelogram construction, draw the sum of these scaled vectors to verify your solution.

\[
(a) = \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}
\]

\[
(b) = \begin{pmatrix} \frac{3}{2} \\ -2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 3 \\ 6 \end{pmatrix}
\]

(c) Shown in red

(d) Shown in blue
5. Consider the following vectors

\[ A = \begin{pmatrix} -1 \\ 2 \end{pmatrix} \quad B = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad C = \begin{pmatrix} 3 \\ 4 \end{pmatrix} \]

For each part below, compute the specified vector quantity, and draw the specified vector(s) and their specified linear combination.

(a) \[ A + B \quad \begin{pmatrix} -1 \\ 2 \end{pmatrix} + \begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} -1 + 2 \\ 2 + 3 \end{pmatrix} = \begin{pmatrix} 1 \\ 5 \end{pmatrix} \]

(b) \[ 2B \quad 2 \begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 2 \cdot 2 \\ 2 \cdot 3 \end{pmatrix} = \begin{pmatrix} 4 \\ 6 \end{pmatrix} \]

(c) \[ C - A \quad \begin{pmatrix} 3 \\ 4 \end{pmatrix} - \begin{pmatrix} -1 \\ 2 \end{pmatrix} = \begin{pmatrix} 3 + 1 \\ 4 - 2 \end{pmatrix} = \begin{pmatrix} 4 \\ 2 \end{pmatrix} \]

6. Given the matrices

\[ A = \begin{pmatrix} 3 \\ -5 \end{pmatrix} \quad B = \begin{pmatrix} -2 & 4 \\ 4 & 6 \end{pmatrix} \quad C = \begin{pmatrix} 1 & -2 \\ 3 & -1 \end{pmatrix} \quad D = \begin{pmatrix} 3 & 2 \\ -1 & 4 \\ 6 & -3 \end{pmatrix} \]

compute the following values (show your work). If the values are undefined, briefly explain why.

(a) \[ 3A \quad (\begin{pmatrix} 9 \\ -15 \end{pmatrix}) \]

(b) \[ \frac{1}{2}B \quad \begin{pmatrix} -1 & 2 \\ 2 & 3 \end{pmatrix} \]

(c) \[ B - C \quad \begin{pmatrix} -3 & 6 \\ 1 & 7 \end{pmatrix} \]

(d) \[ \text{UNDEFINED: MATRIX + VECTOR} \]

(e) \[ BA \]

(f) \[ AC \]

(g) \[ AD \]

(h) \[ DA \]

(i) \[ BD \]

(j) \[ DC \]

(c) \[ \text{UNDEFINED:} \quad (2 \times 2) \cdot (3 \times 2) \]

(i) \[ \begin{pmatrix} 9 & -8 \\ 11 & -2 \\ -3 & -9 \end{pmatrix} \]