Lesson 13-2

Example 1 Name Dimensions of Matrices
State the dimensions of each matrix. Then identify the position of the circled element in each matrix.

a. $\begin{bmatrix} \textcircled{-2} \\ 4 \\ 12 \end{bmatrix}$

This matrix has 3 rows and 1 column.
Therefore, it is a 3-by-1 matrix.
The circled element is in the first row and the first column.

b. $\begin{bmatrix} 4 & -3 & \textcircled{6} & 0 \\ 5 & 7 & 2 & -2 \end{bmatrix}$

This matrix has 2 rows and 4 columns.
Therefore, it is a 2-by-4 matrix.
The circled element is in the first row and the third column.

Example 2 Add Matrices

If $X = \begin{bmatrix} -21 & 11 \\ 15 & 23 \\ 54 & 41 \end{bmatrix}$, $Y = \begin{bmatrix} 13 & 31 & -13 \\ 18 & 14 & 0 \end{bmatrix}$, **and** $Z = \begin{bmatrix} 14 & 11 \\ -3 & 25 \\ 28 & 17 \end{bmatrix}$**, find each sum. If the sum does not exist, write *impossible*.**

a. ***X*** **+** ***Y***

$$X + Y = \begin{bmatrix} -21 & 11 \\ 15 & 23 \\ 54 & 41 \end{bmatrix} + \begin{bmatrix} 13 & 31 & -13 \\ 18 & 14 & 0 \end{bmatrix}$$ Substitution.

Since *X* is a 3-by-2 matrix and *Y* is a 2-by-3 matrix, the matrices do not have the same dimensions. Therefore, it is impossible to add these matrices.

b. ***X*** **+** ***Z***

$$X + Z = \begin{bmatrix} -21 & 11 \\ 15 & 23 \\ 54 & 41 \end{bmatrix} + \begin{bmatrix} 14 & 11 \\ -3 & 25 \\ 28 & 17 \end{bmatrix}$$ Substitution.

$$= \begin{bmatrix} -21+14 & 11+11 \\ 15+(-3) & 23+25 \\ 54+28 & 41+17 \end{bmatrix}$$ Definition of matrix addition.

$$= \begin{bmatrix} -7 & 22 \\ 12 & 48 \\ 82 & 58 \end{bmatrix}$$ Simplify.

Example 3 Subtract Matrices

If $L = \begin{bmatrix} 0 & -7 & 11 \\ 21 & 3 & 41 \\ 4 & 34 & 8 \end{bmatrix}$, $M = \begin{bmatrix} 7 & -6 & 9 \\ 19 & 5 & 22 \\ -3 & 4 & 13 \end{bmatrix}$, and $N = \begin{bmatrix} 14 & -3 \\ 12 & 11 \\ 6 & 17 \end{bmatrix}$, find each difference. If the difference does not exist, write *impossible*.

a. ***M* – *L***

$$M - L = \begin{bmatrix} 7 & -6 & 9 \\ 19 & 5 & 22 \\ -3 & 4 & 13 \end{bmatrix} - \begin{bmatrix} 0 & -7 & 11 \\ 21 & 3 & 41 \\ 4 & 34 & 8 \end{bmatrix}$$ Substitution

$$= \begin{bmatrix} 7-0 & -6-(-7) & 9-11 \\ 19-21 & 5-3 & 22-41 \\ -3-4 & 4-34 & 13-8 \end{bmatrix}$$ Definition of matrix subtraction

$$= \begin{bmatrix} 7 & 1 & -2 \\ -2 & 2 & -19 \\ -7 & -30 & 5 \end{bmatrix}$$ Simplify.

b. ***N* – *M***

$$N - M = \begin{bmatrix} 14 & -3 \\ 12 & 11 \\ 6 & 17 \end{bmatrix} - \begin{bmatrix} 7 & -6 & 9 \\ 19 & 5 & 22 \\ -3 & 4 & 13 \end{bmatrix}$$ Substitution

Since *N* is a 3-by-2 matrix and *M* is a 3-by-3 matrix, the matrices do not have the same dimensions. Therefore, it is impossible to subtract these matrices.

Example 4 Perform Scalar Multiplication

If $J = \begin{bmatrix} 4 & -10 \\ 14 & 17 \end{bmatrix}$, find –2*J*.

$$-2J = -2\begin{bmatrix} 4 & -10 \\ 14 & 17 \end{bmatrix}$$ Substitution.

$$= \begin{bmatrix} -2(4) & -2(-10) \\ -2(14) & -2(17) \end{bmatrix}$$ Definition of scalar multiplication

$$= \begin{bmatrix} -8 & 20 \\ -28 & -34 \end{bmatrix}$$ Simplify.