

Adding and Subtracting Matrices

Booklet Two

$$\begin{bmatrix} 3 & 8 \\ 4 & 6 \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 1 & -9 \end{bmatrix} = \begin{bmatrix} 7 & 8 \\ 5 & -3 \end{bmatrix}$$

Prepared by
Dr. Robert E. Mason IV
Mathematics Consultant

Adding and Subtracting Matrices

Objectives

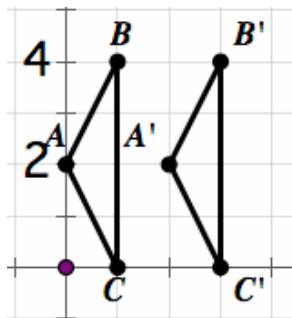
After studying this booklet, you should be able to:

- Add and subtract matrices

Check for Understanding

Study the lesson. Then complete the following in your toolbox-book.

1. **Explain** the conditions under which matrices can be added.
2. **Illustrate** the difference between a dilation and a translation.
3. **Write** the translation matrix for triangle ABC and its image triangle $A'B'C'$ shown below.



4. **Write** a convincing argument for the statement Matrix addition is commutative and associative. If the statement is not true, find a counterexample.

Guided Practice

$$5. \begin{bmatrix} 3 & 7 \\ -2 & 1 \end{bmatrix} - \begin{bmatrix} 2 & -3 \\ 5 & -4 \end{bmatrix}$$

$$6. \begin{bmatrix} 4 \\ 1 \\ -3 \end{bmatrix} + \begin{bmatrix} 6 \\ -5 \\ 8 \end{bmatrix}$$

$$7. 2 \begin{bmatrix} 3 & -1 \end{bmatrix} + 3 \begin{bmatrix} 5 & 0 \end{bmatrix}$$

EXERCISES - Practice

$$8. \begin{bmatrix} 3 & -9 \\ 4 & 2 \end{bmatrix} + \begin{bmatrix} -8 & -4 \\ 3 & 10 \end{bmatrix}$$

$$9. \begin{bmatrix} 5 & 8 & -4 \end{bmatrix} + \begin{bmatrix} -1 & 12 & 5 \end{bmatrix}$$

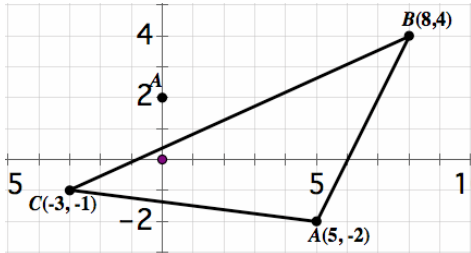
$$10. 4 \begin{bmatrix} 2 & 7 \\ -3 & 6 \end{bmatrix} + 5 \begin{bmatrix} -6 & -4 \\ 3 & 0 \end{bmatrix}$$

$$11. \frac{1}{2} \begin{bmatrix} 4 & 6 \\ 3 & 0 \end{bmatrix} - \frac{2}{3} \begin{bmatrix} 9 & 27 \\ 0 & 3 \end{bmatrix}$$

$$12. 5 \begin{bmatrix} 1 \\ -1 \\ -3 \end{bmatrix} - 6 \begin{bmatrix} -4 \\ 3 \\ 5 \end{bmatrix} - 2 \begin{bmatrix} -3 \\ 8 \\ -4 \end{bmatrix}$$

$$13. 2 \begin{bmatrix} -2 & 4 \\ 1 & -1 \\ 3 & 0 \end{bmatrix} - 3 \begin{bmatrix} 5 & 3 \\ -3 & 2 \\ 8 & -9 \end{bmatrix} + \begin{bmatrix} 0 & -5 \\ 9 & -3 \\ -2 & 7 \end{bmatrix}$$

14. Translate triangle ABC below so that A' is at (3,4).



- Graph triangle ABC and triangle A'B'C'.
- Write the coordinates of triangle A'B'C' in matrix form.

15. Quadrilateral BURT has vertices B(6, 1), U(3, 5), R(-1, 4), and T(-3, -5).

- What translation matrix would you need to use to translate BURT so that R' has coordinates (3, 2)?
- Use your translation matrix to find the coordinates of B', T', and U'.

16. Dilate and then translate triangle XYZ with vertices X(-6, 2), Y(-2, 8), and Z(4, -5) so that X' has coordinates (2, 2) and the perimeter of triangle X'Y'Z' is one-half the perimeter of triangle XYZ. State the coordinates of Y' and Z'.

17. **Solve** for the variables.

$$\begin{bmatrix} x \\ 7z \\ 2y \end{bmatrix} - \begin{bmatrix} 4z \\ -3y \\ 3x \end{bmatrix} - \begin{bmatrix} -2y \\ 2x \\ -5z \end{bmatrix} = \begin{bmatrix} -4 \\ 11 \\ 18 \end{bmatrix}$$

Applications and Problem Solving

18. *Geometry-* Find the coordinates of the vertices of quadrilateral MNOP that is a translation of quadrilateral XYZW whose vertices are X(5, -3), Y(2, 7), Z(-3, 3), and W(-5, 1), if M is located at the origin.

19. Business - The Famous Franklin Bakery keeps a log of each type of cookie sold in a spreadsheet at three of their branch stores so that they can monitor their purchases of supplies. Two days of sales are shown below.

| A | B | C | D | E | |
|---|----------|----------------|---------------|-------|---------|
| 1 | Friday | Chocolate chip | Peanut butter | Sugar | Cut-out |
| 2 | Store 1 | 120 | 97 | 64 | 75 |
| 3 | Store 2 | 80 | 59 | 36 | 60 |
| 4 | Store 3 | 72 | 84 | 29 | 48 |
| | | | | | |
| A | B | C | D | E | |
| 1 | Saturday | Chocolate chip | Peanut butter | Sugar | Cut-out |
| 2 | Store 1 | 112 | 87 | 56 | 74 |
| 3 | Store 2 | 84 | 65 | 39 | 70 |
| 4 | Store 3 | 88 | 98 | 43 | 60 |

- Write a matrix for each day's sales. Then find the sum of the two days' sales expressed as a matrix.
- Each cookie takes approximately one-fourth cup of flour. If there are four cups flour in one pound, how many pounds of flour were needed for the two days of baking?

20. Find $4 \begin{bmatrix} -7 & 5 & 11 \\ 2 & -4 & 9 \end{bmatrix}$.