



UNDERSTAND

9. **Generalize** Suppose square matrices A and B have dimensions $n \times n$, where n is a positive integer greater than or equal to 2. What are the dimensions of their product $A \times B$
10. **Use Structure** If you wanted to find a product of the two matrices shown below, explain why it is necessary to write them in this order.

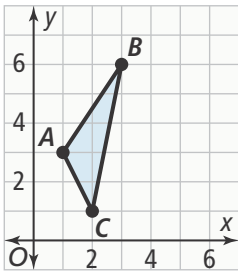
$$\begin{bmatrix} 10 & 15 & 12 \\ 7 & 11 & 20 \end{bmatrix} \begin{bmatrix} 50 \\ 14 \\ 38 \end{bmatrix}$$

11. **Error Analysis** Describe and correct the error a student made in multiplying matrix A by matrix B .

$$\begin{array}{cc} A & B \\ \begin{pmatrix} 6 & 2 \\ -3 & 5 \end{pmatrix} & \begin{pmatrix} -1 & 0 \\ 4 & -2 \end{pmatrix} \\ \begin{pmatrix} 6 & 2 \\ -3 & 5 \end{pmatrix} \begin{pmatrix} -1 & 0 \\ 4 & -2 \end{pmatrix} = \begin{pmatrix} -6 & 0 \\ -12 & -10 \end{pmatrix} \end{array}$$

X

12. **Higher Order Thinking** The triangle shown is transformed using two matrices, $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, in that order.



- What transformation occurs as a result of multiplication by matrix A ?
- What transformation occurs as a result of multiplication by matrix B ?

PRACTICE

13. A math teacher assigns final grades based on a weighted system. Matrix W represents the weights of each type of assignment, and matrix G represents the grades for two students, Jacob and Lucy. Use matrix multiplication to find matrix F that represents the final class grades for these two students. **SEE EXAMPLE 1**

$$W = \begin{array}{cc} \text{hw} & \text{tests} & \text{exam} \\ \begin{bmatrix} 0.20 & 0.50 & 0.30 \end{bmatrix} \end{array}$$

$$G = \begin{array}{cc} & \text{Jacob} & \text{Lucy} \\ \begin{array}{c} \text{hw} \\ \text{tests} \\ \text{exam} \end{array} & \begin{bmatrix} 95 & 85 \\ 80 & 90 \\ 75 & 85 \end{bmatrix} \end{array}$$

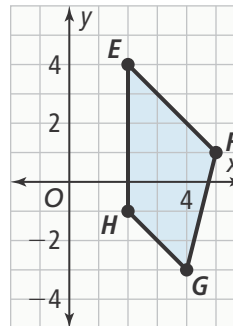
Determine whether each equation is true for the following matrices. **SEE EXAMPLE 2**

$$A = \begin{bmatrix} 1 & 2 \\ 0 & -2 \end{bmatrix}, B = \begin{bmatrix} -4 & 0 \\ -1 & 8 \end{bmatrix}, C = \begin{bmatrix} 5 & 1 \\ 7 & -2 \end{bmatrix}$$

14. $(A + B)C = AC + BC$
15. $A(BC) = (AB)C$
16. Find IQ , if
- $$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ and } Q = \begin{bmatrix} 1 & -3 & 2 \\ -4 & 5 & -6 \\ 9 & -7 & 8 \end{bmatrix}.$$

SEE EXAMPLE 3

17. Create matrix A to represent the coordinates of quadrilateral $EFGH$.

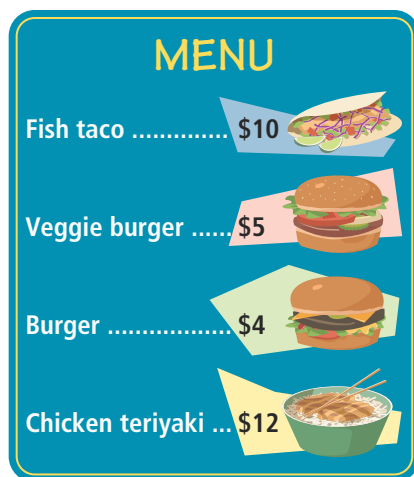


- Multiply matrix A by $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$
- Graph the quadrilateral represented by the resulting matrix, and describe the movement of the quadrilateral in the coordinate plane.

APPLY

18. **Reason** The following matrix represents the inventory of the three snack bars at a state park.

	fish taco	veggie burger	burger	chicken teriyaki
Snack Bar A	20	15	7	11
Snack Bar B	22	18	6	8
Snack Bar C	15	19	10	5



Use matrix multiplication to find the total value of the inventory for each snack bar.

19. **Model With Mathematics** Raul owns and operates two souvenir stands. At his baseball park stand, sweatshirts cost \$45 and T-shirts cost \$20. At his football stadium stand, sweatshirts cost \$50 and T-shirts cost \$15. Today Raul sold 20 sweatshirts and 25 T-shirts at each stand. Use matrix multiplication to find the total amount in daily sales at each souvenir stand.

20. **Reason** A drama teacher assigns final grades in her class based on the weighted system shown below. The matrix G represents the grades for Kiyo and his two friends, Rachel and Leo.

	Kiyo	Rachel	Leo
tests	90	83	78
$G = \text{proj}$	94	88	96
part	98	94	89

Drama Syllabus
 Tests 45%
 Projects 30%
 Participation 25%

- Write matrix W as a 1×3 matrix to represent the weighted grading system.
- Perform matrix multiplication to find the final grades for each of the three students.

ASSESSMENT PRACTICE

21. Find the product of the two matrices.

$$\begin{bmatrix} 1 & 0 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} -3 & 4 \\ 5 & 2 \end{bmatrix} = \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix}$$

22. **SAT/ACT** Select the undefined matrix product.

Ⓐ $\begin{bmatrix} 1 & 2 \\ 3 & 6 \end{bmatrix} \begin{bmatrix} 5 & 0 \\ 0 & 2 \end{bmatrix}$
 Ⓑ $\begin{bmatrix} 1 & 4 \\ 2 & -1 \end{bmatrix} \begin{bmatrix} 2 \\ 5 \end{bmatrix}$

Ⓒ $\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} 1 & 1 & -1 \\ -2 & 0 & -4 \end{bmatrix}$
 Ⓓ $\begin{bmatrix} 1 & -2 & -1 \\ -2 & 3 & 0 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}$

23. **Performance Task** Paula has a candle-making business. The candles come in four different types. The cost of making each type of candle is \$0.50, \$1, \$5, and \$7, in order of size. Paula's candle sales for her first three years of business are shown in the table below.

	Tea \$1	Floating \$2	Jar \$12	Pillar \$15
Year 1	20	15	40	30
Year 2	25	20	50	35
Year 3	15	20	60	45

Part A Write matrix C as a 4×1 matrix to represent the cost of making each type of candle, write matrix P as a 4×1 matrix to represent the selling price of each candle, and write matrix S as a 3×4 matrix to represent Paula's candle sales for the first three years.

Part B Use matrix subtraction to find a matrix, X , that represents the amount of profit that Paula makes per candle.

Part C Use matrix multiplication to find the product of matrices S and X . Explain what the elements of this product represent.