

Precalculus · Matrices and Matrix Operations · Worksheet Answer Key

Common Core N-VM.C.6, N-VM.C.7, N-VM.C.8, N-VM.C.9, N-VM.C.10 · mathovore.fr

This precalculus matrices worksheet answer key solves all 23 problems of the matrices and matrix operations worksheet step by step.

Full worked solutions for all 23 problems follow, with each matrix drawn and every row-by-column sum shown. Check your own entries against the drawn results, and verify any inverse by multiplying it back to the identity.

Precalculus Common Core: N-VM.C.6 · N-VM.C.7 · N-VM.C.8 · N-VM.C.9 · N-VM.C.10

Precalculus Matrices Worksheet Answer Key: problems 1-5

Problem 1: Dimensions and entries

G has 3 rows and 4 columns, so its dimensions are 3×4 .

- a. Row 2, column 3: -3
- b. Row 3, column 4: -2
- c. The entry 7 is in **row 1, column 3**.

Problem 2: Organize data in a matrix

The matrix has 3 rows and 2 columns, so it is 3×2 .

	Fri	Sat
Cookies	24	36
Brownies	18	27
Muffins	30	21

Bake sale data as a 3×2 matrix.

Muffins are row 3: $30 + 21 =$ **51 muffins**.

Problem 3: Add matrices

Add matching entries: $3 + (-1) = 2$, $-2 + 4 = 2$, $5 + 2 = 7$, $0 + 6 = 6$.

$$A + B = \begin{bmatrix} 2 & 2 \\ 7 & 6 \end{bmatrix}$$

The sum $A + B$.

Problem 4: Subtract matrices

Subtract matching entries: row 1 is $7-4=3$, $2-(-1)=3$, $-3-2=-5$; row 2 is $0-3=-3$, $5-5=0$, $1-(-6)=7$.

$$C - D = \begin{bmatrix} 3 & 3 & -5 \\ -3 & 0 & 7 \end{bmatrix}$$

The difference $C - D$.

Problem 5: Scalar multiples

Multiply every entry by the scalar.

$$3A = \begin{bmatrix} 9 & -6 \\ 15 & 0 \end{bmatrix} - 2B = \begin{bmatrix} 2 & -8 \\ -4 & -12 \end{bmatrix}$$

The scalar multiples $3A$ and $-2B$.

Precalculus Matrices Worksheet Answer Key: problems 6-10

Problem 6: Combine operations

First $2A$ has entries 6, -4 , 10, 0. Then $3B$ has entries -3 , 12, 6, 18. Subtract entry by entry: $6-(-3)=9$, $-4-12=-16$, $10-6=4$, $0-18=-18$.

$$2A - 3B = \begin{bmatrix} 9 & -16 \\ 4 & -18 \end{bmatrix}$$

The result $2A - 3B$.

Problem 7: Solve for unknowns

Equal matrices have equal entries. Top left: $x+3=7$, so $x=4$. Top right: $2+y=5$, so $y=3$.

Check with the bottom row: $5+x=9$ and $y+1=4$. Both hold, so $x=4$ **and** $y=3$.

Problem 8: Is the product defined?

- a. Columns of $A = 3 =$ rows of B : **defined**, 2×4
- b. Columns of $A = 2$ but rows of $B = 3$: **not defined**
- c. Inner numbers match (3 and 3): **defined**, 1×1
- d. Inner numbers match (1 and 1): **defined**, 3×3

Problem 9: Multiply 2×2 matrices

- $c_{11} = 1 \cdot 4 + 3 \cdot (-2) = -2$
- $c_{12} = 1 \cdot 0 + 3 \cdot 5 = 15$
- $c_{21} = 2 \cdot 4 + (-1) \cdot (-2) = 10$
- $c_{22} = 2 \cdot 0 + (-1) \cdot 5 = -5$

$$PQ = \begin{bmatrix} -2 & 15 \\ 10 & -5 \end{bmatrix}$$

The product PQ.

Problem 10: Multiply a 2×3 by a 3×2

R is 2×3 and S is 3×2 , so RS is 2×2 .

- $c_{11} = 1 \cdot 2 + 0 \cdot 0 + 2 \cdot 4 = 10$
- $c_{12} = 1 \cdot 1 + 0 \cdot (-2) + 2 \cdot 3 = 7$
- $c_{21} = (-1) \cdot 2 + 3 \cdot 0 + 1 \cdot 4 = 2$
- $c_{22} = (-1) \cdot 1 + 3 \cdot (-2) + 1 \cdot 3 = -4$

$$RS = \begin{bmatrix} 10 & 7 \\ 2 & -4 \end{bmatrix}$$

The product RS.

Precalculus Matrices Worksheet Answer Key: problems 11-15

Problem 11: Matrix times a column

The result is 2×1 . Row 1: $2 \cdot 5 + (-1) \cdot 2 = 8$. Row 2: $3 \cdot 5 + 4 \cdot 2 = 23$.

$$\begin{bmatrix} 8 \\ 23 \end{bmatrix}$$

The product, a 2×1 column.

Problem 12: Compare AB and BA

$$AB: c_{11}=1\cdot3+2\cdot1=5, c_{12}=1\cdot0+2\cdot1=2, c_{21}=0\cdot3+1\cdot1=1, c_{22}=0\cdot0+1\cdot1=1.$$

$$BA: d_{11}=3\cdot1+0\cdot0=3, d_{12}=3\cdot2+0\cdot1=6, d_{21}=1\cdot1+1\cdot0=1, d_{22}=1\cdot2+1\cdot1=3.$$

$$AB = \begin{bmatrix} 5 & 2 \\ 1 & 1 \end{bmatrix} \quad BA = \begin{bmatrix} 3 & 6 \\ 1 & 3 \end{bmatrix}$$

The two products.

The matrices differ, so $AB \neq BA$.

Problem 13: Identity and zero matrices

- Multiplying by the identity changes nothing: $AI = A$, the matrix with rows 4, -3 and 2, 7.
- Adding the zero matrix changes nothing: $A + O = A$.
- Every row-by-column sum is 0: $AO = O$, the 2×2 zero matrix.
- $-A$ has entries $-4, 3, -2, -7$, so the sum is O .

Problem 14: Check the distributive property

Left side: $B+C$ has rows 3, 0 and $-1, 3$. Then $A(B+C)$:

- $c_{11}=1\cdot3+2\cdot(-1)=1$
- $c_{12}=1\cdot0+2\cdot3=6$
- $c_{21}=3\cdot3+0\cdot(-1)=9$
- $c_{22}=3\cdot0+0\cdot3=0$

Right side: AB has rows 2, 1 and 6, -3 ; AC has rows $-1, 5$ and 3, 3. Adding gives rows 1, 6 and 9, 0.

$$A(B+C) = \begin{bmatrix} 1 & 6 \\ 9 & 0 \end{bmatrix} \quad AB+AC = \begin{bmatrix} 1 & 6 \\ 9 & 0 \end{bmatrix}$$

Both sides agree.

The two sides are equal, so $A(B+C) = AB+AC$.

Problem 15: Multiply 3×3 matrices

Each entry is a row of X times a column of Y . Row 1 of the product: $1\cdot2+0\cdot1+2\cdot0=2$,

$1 \cdot 1 + 0 \cdot 0 + 2 \cdot 2 = 5$, $1 \cdot 0 + 0 \cdot 1 + 2 \cdot 1 = 2$. Row 2: 1, -2, 0. Row 3: 7, 3, 1.

$$XY = \begin{bmatrix} 2 & 5 & 2 \\ 1 & -2 & 0 \\ 7 & 3 & 1 \end{bmatrix}$$

The product XY .

Precalculus Matrices Worksheet Answer Key: problems 16-20

Problem 16: Find determinants

- a. $3 \cdot 4 - 5 \cdot 2 = 12 - 10 = \mathbf{2}$
- b. $(-2)(-3) - 6 \cdot 1 = 6 - 6 = \mathbf{0}$
- c. $0 \cdot 7 - 4 \cdot (-3) = 0 + 12 = \mathbf{12}$
- d. $5 \cdot 3 - (-1) \cdot 2 = 15 + 2 = \mathbf{17}$

Problem 17: Find k for a singular matrix

- a. $\det = 3k - 12$. Set $3k - 12 = 0$: $k = 4$.
- b. $\det = k^2 - 16$. Set $k^2 - 16 = 0$: $k = 4$ **or** $k = -4$.

Problem 18: Find a 2×2 inverse

- a. $\det = 3 \cdot 2 - 1 \cdot 5 = 1$. Swap 3 and 2, negate 1 and 5, and multiply by $\frac{1}{1}$: the inverse has rows 2, -1 and -5, 3.
- b. $\det = 4 \cdot 2 - 2 \cdot 3 = 2$. The swapped matrix has rows 2, -2 and -3, 4. Multiply by $\frac{1}{2}$: rows 1, -1 and $-\frac{3}{2}$, 2.

$$(a) A^{-1} = \begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix} \quad (b) B^{-1} = \begin{bmatrix} 1 & -1 \\ -\frac{3}{2} & 2 \end{bmatrix}$$

The two inverses.

Problem 19: Verify an inverse

$$AB: c_{11} = 3 \cdot 2 + 1 \cdot (-5) = 1, c_{12} = 3 \cdot (-1) + 1 \cdot 3 = 0, c_{21} = 5 \cdot 2 + 2 \cdot (-5) = 0, c_{22} = 5 \cdot (-1) + 2 \cdot 3 = 1.$$

$$BA: d_{11} = 2 \cdot 3 + (-1) \cdot 5 = 1, d_{12} = 2 \cdot 1 + (-1) \cdot 2 = 0, d_{21} = (-5) \cdot 3 + 3 \cdot 5 = 0, d_{22} = (-5) \cdot 1 + 3 \cdot 2 = 1.$$

$$AB = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad BA = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Both products are the identity matrix.

Since $AB = BA = I$, $B = A^{-1}$.

Problem 20: School store revenue

S is 2×3 and P is 3×1 , so SP is 2×1 .

- Monday: $12(0.50) + 8(0.75) + 5(2.25) = 6 + 6 + 11.25 = 23.25$
- Tuesday: $15(0.50) + 6(0.75) + 9(2.25) = 7.5 + 4.5 + 20.25 = 32.25$

$$SP = \begin{matrix} \text{Mon} \\ \text{Tue} \end{matrix} \begin{bmatrix} 23.25 \\ 32.25 \end{bmatrix}$$

Revenue in dollars

Revenue by day.

Revenue was **\\$23.25 on Monday** and **\\$32.25 on Tuesday**.

Precalculus Matrices Worksheet Answer Key: problems 21-23

Problem 21: Farmers market inventory

Add matching entries, then multiply by 2. For example, Saturday apples: $40 + 10 = 50$, and doubled $2 \cdot 50 = 100$.

$$A + B = \begin{bmatrix} 50 & 40 & 35 \\ 55 & 30 & 60 \end{bmatrix} \quad 2(A+B) = \begin{bmatrix} 100 & 80 & 70 \\ 110 & 60 & 120 \end{bmatrix}$$

Totals now and doubled totals.

Problem 22: Encode and decode a message

Coded: row 1 is $2 \cdot 7 + 1 \cdot 12 = 26$ and row 2 is $3 \cdot 7 + 2 \cdot 12 = 45$.

$$KX = \begin{bmatrix} 26 \\ 45 \end{bmatrix}$$

The coded column.

$\det K = 2 \cdot 2 - 1 \cdot 3 = 1$, so K^{-1} has rows 2, -1 and -3, 2. Decode: $2 \cdot 26 + (-1) \cdot 45 = 7$ and $(-3) \cdot 26 + 2 \cdot 45 = 12$. The original message is (7,12).

Problem 23: Does the matrix have an inverse?

$\det N = 6 \cdot 6 - 9 \cdot 4 = 36 - 36 = 0$. A 2×2 matrix has an inverse only when its determinant is not zero, so **Noah is wrong: N has no inverse**. Positive entries do not guarantee a nonzero determinant.

How to use this precalculus matrices worksheet answer key

Read this precalculus matrices worksheet answer key after trying each problem yourself, and redo any problem you missed.

