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24. Write the corresponding system of equations.

$$x^2 + 1 = 5$$

$$5 - y = x$$

$$x + y = 5$$

$$y - 4 = 3$$

Solve the fourth equation for y .

$$y - 4 = 3$$

$$y - 4 + 4 = 3 + 4$$

$$y = 7$$

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Substitute 7 for y in the second equation and solve for x .

$$5 - y = x$$

$$5 - 7 = x$$

$$-2 = x$$

A possible solution is $(-2, 7)$. Check whether this solution satisfies the first and third equations.

Substitute -2 for x in the first equation.

$$x^2 + 1 = 5$$

$$(-2)^2 + 1 = 5$$

$$4 + 1 = 4 \text{ true}$$

Substitute -2 for x and 7 for y in the third equation.

$$x + y = 5$$

$$-2 + 7 = 5$$

$$5 = 5 \text{ true}$$

The solution is $(-2, 7)$.

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

$$\begin{bmatrix} 10 \\ -4 \\ 5 \end{bmatrix}$$

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15. Impossible; the matrices have different dimensions.

18. $5[0 \ -1 \ 7 \ 2] + 3[5 \ -8 \ 10 \ -4]$

$$= [5(0) \ 5(-1) \ 5(7) \ 5(2)] + [3(5) \ 3(-8) \ 3(10) \ 3(-4)]$$

$$= [0 \ -5 \ 35 \ 10] + [15 \ -24 \ 30 \ -12]$$

$$= [0 + 15 \ -5 + (-24) \ 35 + 30 \ 10 + (-12)]$$

$$= [15 \ -29 \ 65 \ -2]$$

23. $5 \begin{bmatrix} \frac{1}{2} & 0 & 1 \\ 2 & \frac{1}{3} & -1 \end{bmatrix} + 4 \begin{bmatrix} -2 & \frac{3}{4} & 1 \\ \frac{1}{6} & 0 & \frac{5}{8} \end{bmatrix}$

$$= \begin{bmatrix} 5\left(\frac{1}{2}\right) & 5(0) & 5(1) \\ 5(2) & 5\left(\frac{1}{3}\right) & 5(-1) \end{bmatrix} + \begin{bmatrix} 4(-2) & 4\left(\frac{3}{4}\right) & 4(1) \\ 4\left(\frac{1}{6}\right) & 4(0) & 4\left(\frac{5}{8}\right) \end{bmatrix}$$

$$= \begin{bmatrix} \frac{5}{2} & 0 & 5 \\ 10 & \frac{5}{3} & -5 \end{bmatrix} + \begin{bmatrix} -8 & 3 & 4 \\ \frac{2}{3} & 0 & \frac{5}{2} \end{bmatrix}$$

$$= \begin{bmatrix} \frac{5}{2} + (-8) & 0 + 3 & 5 + 4 \\ 10 + \frac{2}{3} & \frac{5}{3} + 0 & -5 + \frac{5}{2} \end{bmatrix}$$

$$= \begin{bmatrix} -5\frac{1}{2} & 3 & 9 \\ 10\frac{2}{3} & 1\frac{2}{3} & -2\frac{1}{2} \end{bmatrix}$$

28. Yes; $c(AB) = A(cB)$ for the given matrices.

$$\begin{aligned} c(AB) &= 3 \left(\begin{bmatrix} 1 & -2 \\ 4 & 3 \end{bmatrix} \cdot \begin{bmatrix} -5 & 2 \\ 4 & 3 \end{bmatrix} \right) \\ &= 3 \begin{bmatrix} -13 & -4 \\ -8 & 17 \end{bmatrix} \\ &= \begin{bmatrix} -39 & -12 \\ -24 & 51 \end{bmatrix} \end{aligned}$$

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$$\begin{aligned} A(cB) &= \left(\begin{bmatrix} 1 & -2 \\ 4 & 3 \end{bmatrix} \cdot 3 \begin{bmatrix} -5 & 2 \\ 4 & 3 \end{bmatrix} \right) \\ &= \begin{bmatrix} 1 & -2 \\ 4 & 3 \end{bmatrix} \begin{bmatrix} -15 & 6 \\ 12 & 9 \end{bmatrix} \\ &= \begin{bmatrix} -39 & -12 \\ -24 & 51 \end{bmatrix} \end{aligned}$$

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25. Let $(a, b), (c, d)$, and (e, f) represent the original vertices J, K , and L .

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} a & c & e \\ b & d & f \end{bmatrix} = \begin{bmatrix} -3 & -2 & 1 \\ -5 & 7 & 4 \end{bmatrix}$$

$$\begin{bmatrix} -b & -d & -f \\ a & c & e \end{bmatrix} = \begin{bmatrix} -3 & -2 & 1 \\ -5 & 7 & 4 \end{bmatrix}$$

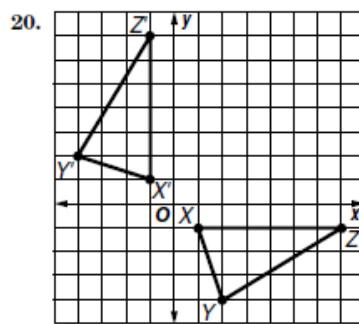
Thus, $b = 3, d = 2, f = -1, a = -5, c = 7$, and $e = 4$. The coordinates are $J(-5, 3), K(7, 2)$, and $L(4, -1)$.

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

19. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \cdot \begin{bmatrix} 1 & 2 & 7 \\ -1 & -4 & -1 \end{bmatrix} = \begin{bmatrix} -1 & -4 & -1 \\ 1 & 2 & 7 \end{bmatrix}$

The coordinates are $X'(-1, 1), Y'(-4, 2)$, and $Z'(-1, 7)$.



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$$\begin{aligned}
 31. \left| \begin{array}{ccc} 1 & 5 & -4 \\ -7 & 3 & 2 \\ 6 & 3 & -1 \end{array} \right| &= 1 \left| \begin{array}{cc} 3 & 2 \\ 3 & -1 \end{array} \right| - 5 \left| \begin{array}{cc} -7 & 2 \\ 6 & -1 \end{array} \right| + (-4) \left| \begin{array}{cc} -7 & 3 \\ 6 & 3 \end{array} \right| \\
 &= 1(-3 - 6) - 5(7 - 12) - 4(-21 - 18) \\
 &= 1(-9) - 5(-5) - 4(-39) \\
 &= -9 + 25 + 156 \\
 &= 172
 \end{aligned}$$

$$\begin{aligned}
 39. \det \begin{bmatrix} 2 & x \\ 5 & -3 \end{bmatrix} &= 24 \\
 2(-3) - x(5) &= 24 \\
 -6 - 5x &= 24 \\
 -5x &= 30 \\
 x &= -6
 \end{aligned}$$

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$$\begin{aligned}
 22. r = \left| \begin{array}{cc} 5 & 2 \\ -3 & \frac{1}{2} \\ \frac{1}{3} & 5 \\ 2 & -\frac{1}{2} \\ \frac{1}{3} & \frac{1}{2} \end{array} \right| & s = \left| \begin{array}{cc} \frac{1}{3} & 5 \\ \frac{2}{3} & -3 \\ \frac{1}{3} & 2 \\ \frac{2}{3} & 5 \\ \frac{1}{3} & -\frac{1}{2} \end{array} \right| \\
 &= \frac{5\left(\frac{-1}{2}\right) - 2(-3)}{\frac{1}{3}\left(\frac{-1}{2}\right) - \frac{2}{5}\left(\frac{1}{3}\right)} \\
 &= \frac{-\frac{5}{2} + 6}{-\frac{1}{6} - \frac{2}{15}} \\
 &= \frac{10}{-\frac{13}{30}} \\
 &= 30 \\
 &= 10
 \end{aligned}$$

The solution is (3, 10).

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$$\begin{aligned}
 28. r = \left| \begin{array}{ccc} -1 & -2 & -5 \\ 5 & 2 & -2 \\ -1 & 1 & 1 \end{array} \right| & s = \left| \begin{array}{ccc} 1 & -1 & -5 \\ 1 & 5 & -2 \\ 4 & -1 & 1 \end{array} \right| & t = \left| \begin{array}{ccc} 1 & -2 & -1 \\ 1 & 2 & 5 \\ 4 & 1 & -1 \end{array} \right| \\
 &= \frac{-33}{57} & = \frac{117}{57} & = \frac{-42}{57} \\
 &= -\frac{11}{19} & = \frac{39}{19} & = -\frac{14}{19}
 \end{aligned}$$

The solution is $\left(-\frac{11}{19}, \frac{39}{19}, -\frac{14}{19}\right)$.

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$$\begin{aligned} 12. A \cdot B &= \begin{bmatrix} 6 & 2 \\ 5 & 2 \end{bmatrix} \cdot \begin{bmatrix} 2 & 1 \\ -\frac{5}{2} & -3 \end{bmatrix} \\ &= \begin{bmatrix} 6-5 & 6-6 \\ 5-5 & 5-6 \end{bmatrix} \\ &= \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \end{aligned}$$

No; the matrices are not inverses, since $A \cdot B \neq I$.

27. Find the determinant.

$$\begin{vmatrix} -2 & 0 \\ 5 & 6 \end{vmatrix} = -12 - 0 \text{ or } -12$$

Since the determinant is not equal to 0, the inverse exists.

$$\begin{aligned} \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix} &= \frac{1}{-2(6)-0(5)} \begin{bmatrix} 6 & 0 \\ -5 & -2 \end{bmatrix} \\ &= -\frac{1}{12} \begin{bmatrix} 6 & 0 \\ -5 & -2 \end{bmatrix} \text{ or } \begin{bmatrix} -\frac{1}{2} & 0 \\ \frac{5}{12} & \frac{1}{6} \end{bmatrix} \end{aligned}$$

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30. Write the matrix equation for the system.

$$\begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 6 \end{bmatrix}$$

Find the inverse of the coefficient matrix.

$$\begin{aligned} A^{-1} &= \frac{1}{2-6} \begin{bmatrix} 2 & -2 \\ -3 & 1 \end{bmatrix} \\ &= -\frac{1}{4} \begin{bmatrix} 2 & -2 \\ -3 & 1 \end{bmatrix} \end{aligned}$$

Multiply both sides of the matrix equation by A^{-1} .

$$\begin{aligned} -\frac{1}{4} \begin{bmatrix} 2 & -2 \\ -3 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} &= -\frac{1}{4} \begin{bmatrix} 2 & -2 \\ -3 & 1 \end{bmatrix} \cdot \begin{bmatrix} 8 \\ 6 \end{bmatrix} \\ \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} &= -\frac{1}{4} \begin{bmatrix} 4 \\ -18 \end{bmatrix} \\ \begin{bmatrix} x \\ y \end{bmatrix} &= \begin{bmatrix} -1 \\ \frac{9}{2} \end{bmatrix} \end{aligned}$$

The solution is $(-1, \frac{9}{2})$.

31. Write the matrix equation for the system.

$$\begin{bmatrix} 4 & -3 \\ 2 & 9 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \end{bmatrix}$$

Find the inverse of the coefficient matrix.

$$\begin{aligned} A^{-1} &= \frac{1}{36 - (-6)} \begin{bmatrix} 9 & 3 \\ -2 & 4 \end{bmatrix} \\ &= \frac{1}{42} \begin{bmatrix} 9 & 3 \\ -2 & 4 \end{bmatrix} \end{aligned}$$

Multiply both sides of the matrix equation by A^{-1} .

$$\begin{aligned} \frac{1}{42} \begin{bmatrix} 9 & 3 \\ -2 & 4 \end{bmatrix} \cdot \begin{bmatrix} 4 & -3 \\ 2 & 9 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} &= \frac{1}{42} \begin{bmatrix} 9 & 3 \\ -2 & 4 \end{bmatrix} \cdot \begin{bmatrix} 5 \\ 6 \end{bmatrix} \\ \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \end{bmatrix} &= \frac{1}{42} \begin{bmatrix} 63 \\ 14 \end{bmatrix} \\ \begin{bmatrix} x \\ y \end{bmatrix} &= \begin{bmatrix} \frac{3}{2} \\ \frac{1}{3} \end{bmatrix} \end{aligned}$$

The solution is $(\frac{3}{2}, \frac{1}{3})$.

