LE2
Reduced row echelon form

(a) For each of the following matrices, explain why it is not in reduced row echelon form.

$$A = \begin{bmatrix} 1 & 0 & -7 & 5 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 1 & -1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 0 & 2 & 0 \\ 0 & -7 & -21 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

(b) Show step-by-step why

$$\mathrm{RREF}\begin{bmatrix} 5 & 2 & 5 & 16 \\ 2 & 1 & 3 & 7 \\ -5 & -1 & 1 & -12 \\ 1 & 0 & -5 & -2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & -2 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

.

LE2
Reduced row echelon form

(a) For each of the following matrices, explain why it is not in reduced row echelon form.

$$A = \begin{bmatrix} 1 & 4 & 3 & 3 & -5 \\ 0 & 0 & 0 & 1 & -2 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 1 & 1 & 2 & -1 \\ 1 & 0 & 2 & -2 & -1 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \qquad C = \begin{bmatrix} 3 & 12 & 0 & -6 & 0 \\ 0 & 0 & 1 & 1 & -2 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(b) Show step-by-step why

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

.

LE2
Reduced row echelon form

(a) For each of the following matrices, explain why it is not in reduced row echelon form.

$$A = \begin{bmatrix} 1 & 0 & -3 & 3 \\ 5 & 1 & -15 & 12 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 1 & 2 & 2 \\ 1 & 0 & -2 & -3 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & -5 & 0 & 1 \\ 0 & 0 & 5 & 10 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

(b) Show step-by-step why

$$\text{RREF} \begin{bmatrix} -3 & 3 & -6 & -2 \\ 2 & -2 & 4 & 1 \\ -3 & 3 & -6 & -2 \\ -4 & 4 & -8 & -3 \end{bmatrix} = \begin{bmatrix} 1 & -1 & 2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

.

LE2
Reduced row echelon form

(a) For each of the following matrices, explain why it is not in reduced row echelon form.

$$A = \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 3 & 6 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & -1 \\ 3 & 0 & 1 & 7 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 0 & 0 & -2 \\ 0 & 0 & 1 & -2 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

(b) Show step-by-step why

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

.

LE2
Reduced row echelon form

(a) For each of the following matrices, explain why it is not in reduced row echelon form.

$$A = \begin{bmatrix} 1 & 6 & -14 \\ 0 & 1 & -2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 1 & -3 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 0 & -1 \\ 0 & 6 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

(b) Show step-by-step why

$$\mathrm{RREF} \begin{bmatrix} -1 & -2 & 4 \\ 1 & 4 & -10 \\ 2 & 5 & -11 \\ 1 & 1 & -1 \\ 0 & -3 & 9 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & -3 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

.

LE3
Counting Solutions for Linear Systems

Consider each of the following systems of linear equations or vector equations.

(a)

$$x_1 \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix} + x_2 \begin{bmatrix} 2 \\ 5 \\ 4 \end{bmatrix} + x_3 \begin{bmatrix} 4 \\ 9 \\ 12 \end{bmatrix} = \begin{bmatrix} -8 \\ -20 \\ -23 \end{bmatrix}$$

(b)

$$x_1 \begin{bmatrix} -2 \\ -3 \\ -5 \end{bmatrix} + x_2 \begin{bmatrix} 4 \\ 6 \\ 10 \end{bmatrix} + x_3 \begin{bmatrix} -1 \\ -2 \\ -5 \end{bmatrix} = \begin{bmatrix} -1 \\ -3 \\ -10 \end{bmatrix}$$

(c)

$$\begin{array}{rcrcrcr} -2\,x_1 & - & x_2 & + & x_3 & = & 9 \\ 3\,x_1 & + & x_2 & - & 4\,x_3 & = & -15 \\ -3\,x_1 & - & x_2 & + & 5\,x_3 & = & 16 \end{array}$$

- Explain how to find a simpler system or vector equation that has the same solution set for each.
- Explain whether each solution set has no solutions, one solution, or infinitely-many solutions. If the set is finite, describe it using set notation.

Version 7098

LE3 Counting Solutions for Linear Systems

Consider each of the following systems of linear equations or vector equations.

(a)

$$x_1 \begin{bmatrix} -1 \\ -2 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix} + x_3 \begin{bmatrix} -2 \\ -5 \\ 2 \end{bmatrix} = \begin{bmatrix} -7 \\ -14 \\ 1 \end{bmatrix}$$

(b)

$$\begin{array}{rcrcrcr} 5\,x_1 & & & - & 10\,x_3 & = & 16 \\ 3\,x_1 & + & x_2 & - & 6\,x_3 & = & 8 \\ -2\,x_1 & & & + & 4\,x_3 & = & -7 \end{array}$$

(c)

$$\begin{array}{rcrcrcr} -x_1 & + & 2\,x_2 & + & 4\,x_3 & = & 3 \\ 2\,x_1 & - & 5\,x_2 & - & 11\,x_3 & = & -7 \\ -3\,x_1 & + & 5\,x_2 & + & 9\,x_3 & = & 8 \end{array}$$

- Explain how to find a simpler system or vector equation that has the same solution set for each.
- Explain whether each solution set has no solutions, one solution, or infinitely-many solutions. If the set is finite, describe it using set notation.

LE3
Counting Solutions for Linear Systems

Consider each of the following systems of linear equations or vector equations.

(a)

$$x_1 \begin{bmatrix} -3 \\ 4 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} -4 \\ 5 \\ 1 \end{bmatrix} + x_3 \begin{bmatrix} -3 \\ 3 \\ 4 \end{bmatrix} = \begin{bmatrix} -3 \\ 4 \\ -1 \end{bmatrix}$$

(b)

$$x_1 \begin{bmatrix} 4 \\ 1 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 8 \\ 2 \\ 0 \end{bmatrix} + x_3 \begin{bmatrix} -5 \\ -1 \\ 4 \end{bmatrix} = \begin{bmatrix} -13 \\ -3 \\ 4 \end{bmatrix}$$

(c)

$$\begin{array}{rcrcrcr} x_1 & & & - & 2\,x_3 & = & -2 \\ -3\,x_1 & + & x_2 & + & 3\,x_3 & = & 9 \\ -2\,x_1 & + & 5\,x_2 & - & 11\,x_3 & = & 12 \end{array}$$

- Explain how to find a simpler system or vector equation that has the same solution set for each.
- Explain whether each solution set has no solutions, one solution, or infinitely-many solutions. If the set is finite, describe it using set notation.

Version 9916

LE3
Counting Solutions for Linear Systems

Consider each of the following systems of linear equations or vector equations.

(a)

$$x_1 \begin{bmatrix} 1 \\ -3 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} -3 \\ -5 \\ -5 \end{bmatrix} + x_3 \begin{bmatrix} 9 \\ 15 \\ 15 \end{bmatrix} = \begin{bmatrix} 11 \\ 5 \\ 16 \end{bmatrix}$$

(b)

$$\begin{array}{rcrcrcr} -3\,x_1 & + & 4\,x_2 & - & 4\,x_3 & = & -13 \\ & & x_2 & - & 3\,x_3 & = & -6 \\ -2\,x_1 & + & 3\,x_2 & - & 4\,x_3 & = & -11 \end{array}$$

(c)

$$x_1 \begin{bmatrix} 5 \\ -2 \\ -4 \end{bmatrix} + x_2 \begin{bmatrix} -5 \\ 2 \\ 4 \end{bmatrix} + x_3 \begin{bmatrix} 3 \\ -1 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ -1 \\ 7 \end{bmatrix}$$

- Explain how to find a simpler system or vector equation that has the same solution set for each.
- Explain whether each solution set has no solutions, one solution, or infinitely-many solutions. If the set is finite, describe it using set notation.

LE3
Counting Solutions for Linear Systems

Consider each of the following systems of linear equations or vector equations.

(a)

$$\begin{array}{rcrcrcr} -2\,x_1 & + & 5\,x_2 & - & 8\,x_3 & = & 7 \\ -x_1 & + & 2\,x_2 & - & 3\,x_3 & = & 1 \\ -2\,x_1 & + & 2\,x_2 & - & 2\,x_3 & = & 1 \end{array}$$

(b)

$$x_1 \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} + x_2 \begin{bmatrix} 3 \\ 1 \\ 3 \end{bmatrix} + x_3 \begin{bmatrix} -3 \\ -1 \\ -2 \end{bmatrix} = \begin{bmatrix} 5 \\ 1 \\ 5 \end{bmatrix}$$

(c)

$$\begin{array}{rcrcrcr} & - & x_2 & - & 2\,x_3 & = & -3 \\ x_1 & + & 3\,x_2 & + & 6\,x_3 & = & 11 \\ x_1 & - & 2\,x_2 & - & 4\,x_3 & = & -4 \end{array}$$

- Explain how to find a simpler system or vector equation that has the same solution set for each.
- Explain whether each solution set has no solutions, one solution, or infinitely-many solutions. If the set is finite, describe it using set notation.

LE4
Linear Systems with Infinitely-Many Solutions

Consider the following vector equation.

$$x_1 \begin{bmatrix} 1 \\ -2 \\ 0 \\ 2 \end{bmatrix} + x_2 \begin{bmatrix} 3 \\ -5 \\ -3 \\ 4 \end{bmatrix} + x_3 \begin{bmatrix} 4 \\ -7 \\ -3 \\ 6 \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ -3 \\ 0 \end{bmatrix}$$

(a) Explain how to find a simpler system or vector equation that has the same solution set.

(b) Explain how to describe this solution set using set notation.

LE4
Linear Systems with Infinitely-Many Solutions

Consider the following system of linear equations.

$$\begin{array}{rcrcrcrcr} 5\,x_1 & + & 10\,x_2 & - & 3\,x_3 & - & 7\,x_4 & = & -8 \\ 3\,x_1 & + & 6\,x_2 & + & 4\,x_3 & - & 10\,x_4 & = & 1 \\ -2\,x_1 & - & 4\,x_2 & + & 2\,x_3 & + & 2\,x_4 & = & 4 \end{array}$$

(a) Explain how to find a simpler system or vector equation that has the same solution set.

(b) Explain how to describe this solution set using set notation.

LE4
Linear Systems with Infinitely-Many Solutions

Consider the following vector equation.

$$x_1 \begin{bmatrix} -3 \\ 0 \\ 1 \\ -2 \end{bmatrix} + x_2 \begin{bmatrix} -9 \\ 0 \\ 3 \\ -6 \end{bmatrix} + x_3 \begin{bmatrix} 3 \\ 1 \\ -1 \\ 3 \end{bmatrix} = \begin{bmatrix} 3 \\ 3 \\ -1 \\ 5 \end{bmatrix}$$

(a) Explain how to find a simpler system or vector equation that has the same solution set.

(b) Explain how to describe this solution set using set notation.

LE4
Linear Systems with Infinitely-Many Solutions

Consider the following vector equation.

$$x_1 \begin{bmatrix} 0 \\ -1 \\ 0 \\ -1 \end{bmatrix} + x_2 \begin{bmatrix} 1 \\ -4 \\ -5 \\ -1 \end{bmatrix} + x_3 \begin{bmatrix} -2 \\ 10 \\ 10 \\ 4 \end{bmatrix} = \begin{bmatrix} -1 \\ 7 \\ 5 \\ 4 \end{bmatrix}$$

(a) Explain how to find a simpler system or vector equation that has the same solution set.

(b) Explain how to describe this solution set using set notation.

LE4
Linear Systems with Infinitely-Many Solutions

Consider the following system of linear equations.

$$\begin{array}{ccccccccc} x_1 & - & 2\,x_2 & - & 2\,x_3 & + & 4\,x_4 & = & 4 \\ & & & & x_3 & - & 3\,x_4 & = & -1 \\ 4\,x_1 & - & 8\,x_2 & - & 3\,x_3 & + & x_4 & = & 11 \end{array}$$

(a) Explain how to find a simpler system or vector equation that has the same solution set.

(b) Explain how to describe this solution set using set notation.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\ y_1 + y_2 - 6)$$
$$c \odot (x, y) = (cx,\ cy)\,.$$

(a) Show that vector addition is associative, that is:

$$((x_1, y_1) \oplus (x_2, y_2)) \oplus (x_3, y_3) = (x_1, y_1) \oplus ((x_2, y_2) \oplus (x_3, y_3))\,.$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = \left(x_1 + x_2 + 6,\ \sqrt{y_1^2 + y_2^2}\right)$$

$$c \odot (x, y) = (cx,\ cy)\,.$$

(a) Show that vector addition is associative, that is:

$$((x_1, y_1) \oplus (x_2, y_2)) \oplus (x_3, y_3) = (x_1, y_1) \oplus ((x_2, y_2) \oplus (x_3, y_3))\,.$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\, y_1 + y_2)$$
$$c \odot (x, y) = (3\,cx,\, 5\,cy)\,.$$

(a) Show that scalar multiplication distributes over scalar addition, that is:

$$(c + d) \odot (x, y) = c \odot (x, y) \oplus d \odot (x, y).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2 + 1,\ y_1 + y_2)$$
$$c \odot (x, y) = (cx,\ y^c)\,.$$

(a) Show that vector addition is associative, that is:

$$((x_1, y_1) \oplus (x_2, y_2)) \oplus (x_3, y_3) = (x_1, y_1) \oplus ((x_2, y_2) \oplus (x_3, y_3))\,.$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\ y_1 + y_2)$$
$$c \odot (x, y) = (5\,cx,\ 3\,cy)\,.$$

(a) Show that scalar multiplication distributes over scalar addition, that is:

$$(c + d) \odot (x, y) = c \odot (x, y) \oplus d \odot (x, y).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 x_2,\, y_1 + 2\, y_2)$$
$$c \odot (x, y) = (cx,\, 0)\,.$$

(a) Show that there exists an additive identity element, that is:

$$\text{There exists } (w, z) \in V \text{ such that } (x, y) \oplus (w, z) = (x, y).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (2\,x_1 + 2\,x_2,\; 5\,y_1 + 5\,y_2)$$
$$c \odot (x, y) = (cx,\; cy)\,.$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

Version 6707

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\ y_1 + y_2)$$
$$c \odot (x, y) = (3\,cx,\ 2\,cy)\,.$$

(a) Show that scalar multiplication distributes over scalar addition, that is:

$$(c + d) \odot (x, y) = c \odot (x, y) \oplus d \odot (x, y).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\, y_1 + y_2)$$
$$c \odot (x, y) = \left(c^3 x,\, c^4 y\right).$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (3\,x_1 + 3\,x_2,\, 3\,y_1 + 3\,y_2)$$
$$c \odot (x, y) = (cx,\, cy)\,.$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\, y_1 + y_2 - 2)$$
$$c \odot (x, y) = (cx,\, cy)\,.$$

(a) Show that vector addition is associative, that is:

$$((x_1, y_1) \oplus (x_2, y_2)) \oplus (x_3, y_3) = (x_1, y_1) \oplus ((x_2, y_2) \oplus (x_3, y_3))\,.$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 x_2,\ y_1 y_2)$$
$$c \odot (x, y) = (x^c,\ y^c)\,.$$

(a) Show that there exists an additive identity element, that is:

There exists $(w, z) \in V$ such that $(x, y) \oplus (w, z) = (x, y)$.

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (2\,x_1 + x_2,\; y_1 + 3\,y_2)$$
$$c \odot (x, y) = (cx,\; cy)\,.$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (3\,x_1 + x_2,\, y_1 + 3\,y_2)$$
$$c \odot (x, y) = (cx,\, cy)\,.$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

VS1
Vector spaces

Let V be the set of all pairs (x, y) of real numbers together with the following operations:

$$(x_1, y_1) \oplus (x_2, y_2) = (x_1 + x_2,\, y_1 + y_2)$$
$$c \odot (x, y) = \left(c^2 x,\, c^4 y\right).$$

(a) Show that scalar multiplication distributes over vector addition, that is:

$$c \odot ((x_1, y_1) \oplus (x_2, y_2)) = c \odot (x_1, y_1) \oplus c \odot (x_2, y_2).$$

(b) Explain why V nonetheless is not a vector space.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 1 \\ -1 \\ -2 \\ -1 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 2 \\ 0 \\ 1 \\ -2 \end{bmatrix}$, $\begin{bmatrix} -5 \\ 1 \\ 0 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -14 \\ 2 \\ -2 \\ 14 \end{bmatrix}$.
- $\begin{bmatrix} 0 \\ -2 \\ -1 \\ -2 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 2 \\ 0 \\ 1 \\ -2 \end{bmatrix}$, $\begin{bmatrix} -5 \\ 1 \\ 0 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -14 \\ 2 \\ -2 \\ 14 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} -5 \\ 12 \\ 3 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ -2 \\ -1 \end{bmatrix}$, $\begin{bmatrix} 3 \\ -5 \\ 1 \end{bmatrix}$, $\begin{bmatrix} 7 \\ -11 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -2 \\ 3 \\ -2 \end{bmatrix}$.
- $\begin{bmatrix} -6 \\ 11 \\ 2 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ -2 \\ -1 \end{bmatrix}$, $\begin{bmatrix} 3 \\ -5 \\ 1 \end{bmatrix}$, $\begin{bmatrix} 7 \\ -11 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -2 \\ 3 \\ -2 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 14 \\ 7 \\ -10 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -3 \\ -1 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 5 \\ 4 \\ -4 \end{bmatrix}$, $\begin{bmatrix} -14 \\ -7 \\ 10 \end{bmatrix}$, and $\begin{bmatrix} 21 \\ 14 \\ -16 \end{bmatrix}$.
- $\begin{bmatrix} 13 \\ 8 \\ -11 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -3 \\ -1 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 5 \\ 4 \\ -4 \end{bmatrix}$, $\begin{bmatrix} -14 \\ -7 \\ 10 \end{bmatrix}$, and $\begin{bmatrix} 21 \\ 14 \\ -16 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\left[\begin{array}{c} -5 \\ -3 \\ 6 \\ -2 \end{array}\right]$ is a linear combination of the vectors $\left[\begin{array}{c} 1 \\ 0 \\ 0 \\ 1 \end{array}\right]$, $\left[\begin{array}{c} -3 \\ 0 \\ 0 \\ -3 \end{array}\right]$, and $\left[\begin{array}{c} 1 \\ 1 \\ -2 \\ 0 \end{array}\right]$.
- $\left[\begin{array}{c} -4 \\ -2 \\ 5 \\ -1 \end{array}\right]$ is a linear combination of the vectors $\left[\begin{array}{c} 1 \\ 0 \\ 0 \\ 1 \end{array}\right]$, $\left[\begin{array}{c} -3 \\ 0 \\ 0 \\ -3 \end{array}\right]$, and $\left[\begin{array}{c} 1 \\ 1 \\ -2 \\ 0 \end{array}\right]$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 7 \\ -3 \\ 5 \\ 3 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ -1 \\ 0 \end{bmatrix}$, $\begin{bmatrix} -3 \\ 1 \\ -1 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} 8 \\ -2 \\ 0 \\ 2 \end{bmatrix}$.
- $\begin{bmatrix} 8 \\ -4 \\ 6 \\ 2 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ -1 \\ 0 \end{bmatrix}$, $\begin{bmatrix} -3 \\ 1 \\ -1 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} 8 \\ -2 \\ 0 \\ 2 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 5 \\ 3 \\ -7 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$, $\begin{bmatrix} -2 \\ 0 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 0 \\ -2 \end{bmatrix}$, and $\begin{bmatrix} 2 \\ 1 \\ -3 \end{bmatrix}$.
- $\begin{bmatrix} 6 \\ 2 \\ -8 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$, $\begin{bmatrix} -2 \\ 0 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 0 \\ -2 \end{bmatrix}$, and $\begin{bmatrix} 2 \\ 1 \\ -3 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} -3 \\ -11 \\ -7 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 4 \\ 3 \end{bmatrix}$, $\begin{bmatrix} 3 \\ 12 \\ 9 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 8 \\ 6 \end{bmatrix}$, and $\begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$.
- $\begin{bmatrix} -4 \\ -12 \\ -8 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 4 \\ 3 \end{bmatrix}$, $\begin{bmatrix} 3 \\ 12 \\ 9 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 8 \\ 6 \end{bmatrix}$, and $\begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 9 \\ 13 \\ 16 \\ -2 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, $\begin{bmatrix} -2 \\ -4 \\ -5 \\ 1 \end{bmatrix}$, and $\begin{bmatrix} 4 \\ 6 \\ 5 \\ -1 \end{bmatrix}$.
- $\begin{bmatrix} 8 \\ 14 \\ 15 \\ -3 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, $\begin{bmatrix} -2 \\ -4 \\ -5 \\ 1 \end{bmatrix}$, and $\begin{bmatrix} 4 \\ 6 \\ 5 \\ -1 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 6 \\ 10 \\ -21 \\ 5 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 1 \\ -4 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 3 \\ -5 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} -4 \\ -7 \\ 7 \\ 7 \end{bmatrix}$.
- $\begin{bmatrix} 7 \\ 9 \\ -22 \\ 4 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 1 \\ -4 \\ 2 \end{bmatrix}$, $\begin{bmatrix} 2 \\ 3 \\ -5 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} -4 \\ -7 \\ 7 \\ 7 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 14 \\ 11 \\ 6 \\ 5 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 3 \\ 5 \\ 1 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 5 \\ -4 \\ 3 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -2 \\ 9 \\ -2 \\ -5 \end{bmatrix}$.
- $\begin{bmatrix} 15 \\ 12 \\ 5 \\ 4 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 3 \\ 5 \\ 1 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 5 \\ -4 \\ 3 \\ 5 \end{bmatrix}$, and $\begin{bmatrix} -2 \\ 9 \\ -2 \\ -5 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 9 \\ 1 \\ 0 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 0 \\ -2 \end{bmatrix}$, $\begin{bmatrix} 5 \\ 1 \\ 0 \end{bmatrix}$, and $\begin{bmatrix} -10 \\ -2 \\ 3 \end{bmatrix}$.
- $\begin{bmatrix} 10 \\ 2 \\ 1 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 0 \\ -2 \end{bmatrix}$, $\begin{bmatrix} 5 \\ 1 \\ 0 \end{bmatrix}$, and $\begin{bmatrix} -10 \\ -2 \\ 3 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 2 \\ 7 \\ 0 \\ 4 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -1 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, $\begin{bmatrix} 4 \\ 5 \\ -1 \\ 0 \end{bmatrix}$, and $\begin{bmatrix} 6 \\ 3 \\ -1 \\ -2 \end{bmatrix}$.
- $\begin{bmatrix} 1 \\ 8 \\ -1 \\ 3 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -1 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, $\begin{bmatrix} 4 \\ 5 \\ -1 \\ 0 \end{bmatrix}$, and $\begin{bmatrix} 6 \\ 3 \\ -1 \\ -2 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 1 \\ 0 \\ -3 \\ 5 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -2 \\ 1 \\ -1 \\ 3 \end{bmatrix}$, $\begin{bmatrix} 2 \\ -1 \\ 1 \\ -3 \end{bmatrix}$, and $\begin{bmatrix} -3 \\ 1 \\ 2 \\ -2 \end{bmatrix}$.
- $\begin{bmatrix} 0 \\ -1 \\ -4 \\ 4 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} -2 \\ 1 \\ -1 \\ 3 \end{bmatrix}$, $\begin{bmatrix} 2 \\ -1 \\ 1 \\ -3 \end{bmatrix}$, and $\begin{bmatrix} -3 \\ 1 \\ 2 \\ -2 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} -1 \\ -3 \\ 3 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 5 \\ 5 \end{bmatrix}$, $\begin{bmatrix} 1 \\ 5 \\ 5 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ 4 \end{bmatrix}$, and $\begin{bmatrix} 1 \\ 3 \\ -3 \end{bmatrix}$.
- $\begin{bmatrix} 0 \\ -4 \\ 2 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 5 \\ 5 \end{bmatrix}$, $\begin{bmatrix} 1 \\ 5 \\ 5 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ 4 \end{bmatrix}$, and $\begin{bmatrix} 1 \\ 3 \\ -3 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS2
Linear combinations

(a) Write a statement involving the solutions of a vector equation that's equivalent to each claim below.

- $\begin{bmatrix} 3 \\ -2 \\ 5 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$, $\begin{bmatrix} -1 \\ 1 \\ -2 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} -4 \\ 1 \\ -5 \end{bmatrix}$.
- $\begin{bmatrix} 2 \\ -3 \\ 4 \end{bmatrix}$ is a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$, $\begin{bmatrix} -1 \\ 1 \\ -2 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}$, and $\begin{bmatrix} -4 \\ 1 \\ -5 \end{bmatrix}$.

(b) Use these statements to determine if each vector is or is not a linear combination. If it is, give an example of such a linear combination.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -1 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ 1 \\ -4 \end{bmatrix}, \begin{bmatrix} -3 \\ -5 \\ 3 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \\ -11 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -1 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ 1 \\ -4 \end{bmatrix}, \begin{bmatrix} -3 \\ -5 \\ 3 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \\ -11 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -2 \\ 1 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 2 \\ 1 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -2 \\ 1 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 2 \\ 1 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 0 \\ -2 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 6 \\ 3 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} -2 \\ 2 \\ 0 \\ 2 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 0 \\ -2 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 6 \\ 3 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} -2 \\ 2 \\ 0 \\ 2 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -1 \\ 1 \\ 0 \\ 3 \end{bmatrix}, \begin{bmatrix} -4 \\ 3 \\ 2 \\ 5 \end{bmatrix}, \begin{bmatrix} 4 \\ -2 \\ -3 \\ 2 \end{bmatrix}, \begin{bmatrix} -11 \\ 7 \\ 7 \\ 5 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -1 \\ 1 \\ 0 \\ 3 \end{bmatrix}, \begin{bmatrix} -4 \\ 3 \\ 2 \\ 5 \end{bmatrix}, \begin{bmatrix} 4 \\ -2 \\ -3 \\ 2 \end{bmatrix}, \begin{bmatrix} -11 \\ 7 \\ 7 \\ 5 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ -3 \\ 1 \\ -3 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ -1 \\ 5 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ -3 \\ 1 \\ -3 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ -1 \\ 5 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 2 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} -2 \\ -5 \\ -2 \\ -1 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 2 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} -2 \\ -5 \\ -2 \\ -1 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 4 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 1 \\ -3 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \\ -1 \\ 3 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 4 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 1 \\ -3 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \\ -1 \\ 3 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -1 \\ -1 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} 3 \\ 3 \\ 0 \\ 6 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 4 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ -3 \\ -4 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -1 \\ -1 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} 3 \\ 3 \\ 0 \\ 6 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ 4 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ -3 \\ -4 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 0 \\ -4 \\ -4 \end{bmatrix}, \begin{bmatrix} 9 \\ 0 \\ 12 \\ 12 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 3 \\ 3 \end{bmatrix}, \begin{bmatrix} 4 \\ -2 \\ 2 \\ 2 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 0 \\ -4 \\ -4 \end{bmatrix}, \begin{bmatrix} 9 \\ 0 \\ 12 \\ 12 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 3 \\ 3 \end{bmatrix}, \begin{bmatrix} 4 \\ -2 \\ 2 \\ 2 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -1 \\ -1 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} -2 \\ -3 \\ -3 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ -1 \\ 0 \\ -5 \end{bmatrix}, \begin{bmatrix} -1 \\ -3 \\ -4 \\ 3 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -1 \\ -1 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} -2 \\ -3 \\ -3 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ -1 \\ 0 \\ -5 \end{bmatrix}, \begin{bmatrix} -1 \\ -3 \\ -4 \\ 3 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 2 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} -3 \\ 2 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} -2 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -1 \\ -3 \\ 2 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ 2 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} -3 \\ 2 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} -2 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -1 \\ -3 \\ 2 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -4 \\ -2 \\ -2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ 5 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} -1 \\ -3 \\ -3 \\ -1 \end{bmatrix}, \begin{bmatrix} -5 \\ -3 \\ 2 \\ -2 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -4 \\ -2 \\ -2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ 5 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} -1 \\ -3 \\ -3 \\ -1 \end{bmatrix}, \begin{bmatrix} -5 \\ -3 \\ 2 \\ -2 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 0 \\ 2 \\ -4 \\ 1 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ 4 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ 1 \\ -4 \\ 4 \end{bmatrix}, \begin{bmatrix} -8 \\ 0 \\ -4 \\ 7 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ 8 \\ -5 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 0 \\ 2 \\ -4 \\ 1 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ 4 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ 1 \\ -4 \\ 4 \end{bmatrix}, \begin{bmatrix} -8 \\ 0 \\ -4 \\ 7 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ 8 \\ -5 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 5 \\ -2 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 3 \\ 0 \\ -1 \\ 5 \end{bmatrix}, \begin{bmatrix} 9 \\ 1 \\ 7 \\ 2 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 5 \\ -2 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 3 \\ 0 \\ -1 \\ 5 \end{bmatrix}, \begin{bmatrix} 9 \\ 1 \\ 7 \\ 2 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS3
Spanning sets

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 3 \\ 0 \\ 6 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} -5 \\ -1 \\ 1 \\ -5 \end{bmatrix} \right\}$ **spans** $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 3 \\ 0 \\ 6 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} -5 \\ -1 \\ 1 \\ -5 \end{bmatrix} \right\}$ does **not** span $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \\ w \end{array} \right] \middle| \, 6\,x^3 y + 3\,wz = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \\ w \end{array} \right] \middle| \, 6\,x + 7\,y + 2\,z = 4\,w \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^4$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array} \right] \middle| \, 3\,y = 6\,x - 5\,z \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array} \right] \middle| \, x^3 + 4\,y + 2\,z = 0 \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

Version 8814

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, 3\,x = 3\,y \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, x^2 + y = 0 \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

Version 8186

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| 6\,xy^2 = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| 5\,x = 2\,y \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

Version 7981

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, x^2 + 2\,y + 5\,z = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, 3\,x + 2\,y = 5\,z \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array}\right] \middle| \, x + y = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array}\right] \middle| \, x^2 = 7\,y \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \\ w \end{array}\right] \middle|\, y^3 + 2\,x = 3\,z \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \\ w \end{array}\right] \middle|\, w + 6\,y = 6\,x - 4\,z \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^4$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, x^3 + 4\,y = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, 2\,x + 2\,y = 0 \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, 3\,x + 2\,y = 2\,z \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, 6\,x = z^3 + 3\,y \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, 6\,x = 7\,y + 4\,z \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, y^2 + 2\,x = 4\,z \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

Version 1217

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, x^2 + y + 4\,z = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle|\, 2\,y = 6\,x - 5\,z \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \begin{bmatrix} x \\ y \end{bmatrix} \middle| \, 7\,x + 6\,y = 0 \right\} \qquad W = \left\{ \begin{bmatrix} x \\ y \end{bmatrix} \middle| \, x^2 = 2\,y \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, 2\,x + 2\,y = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, x^3 = 3\,y \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, x^3 = y \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \end{array} \right] \middle| \, x + 5\,y = 0 \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^2$ and one is not.

Version 6101

VS4
Subspaces

Consider the following two sets of Euclidean vectors:

$$U = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle| x^2 + y + 2\,z = 0 \right\} \qquad W = \left\{ \left[\begin{array}{c} x \\ y \\ z \end{array}\right] \middle| 7\,y = 6\,x - 3\,z \right\}$$

Explain why one of these sets is a subspace of $\mathbb{R}^3$ and one is not.

Version 4928

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ -1 \\ 4 \end{bmatrix}, \begin{bmatrix} 2 \\ 2 \\ -1 \\ 3 \end{bmatrix}, \begin{bmatrix} -3 \\ -2 \\ 2 \\ -4 \end{bmatrix}, \begin{bmatrix} -3 \\ -3 \\ 4 \\ 4 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ -1 \\ 4 \end{bmatrix}, \begin{bmatrix} 2 \\ 2 \\ -1 \\ 3 \end{bmatrix}, \begin{bmatrix} -3 \\ -2 \\ 2 \\ -4 \end{bmatrix}, \begin{bmatrix} -3 \\ -3 \\ 4 \\ 4 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 0 \\ -1 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ -3 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ -2 \\ 4 \\ -2 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 0 \\ -2 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} 0 \\ -1 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ -3 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ -2 \\ 4 \\ -2 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 0 \\ -2 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{\begin{bmatrix}4\\-3\\0\\3\end{bmatrix}, \begin{bmatrix}-1\\1\\1\\0\end{bmatrix}, \begin{bmatrix}1\\-2\\-4\\2\end{bmatrix}\right\}$ is linearly **independent**.
- The set of vectors $\left\{\begin{bmatrix}4\\-3\\0\\3\end{bmatrix}, \begin{bmatrix}-1\\1\\1\\0\end{bmatrix}, \begin{bmatrix}1\\-2\\-4\\2\end{bmatrix}\right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

Version 1424

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -4 \\ 5 \\ -2 \\ 5 \end{bmatrix}, \begin{bmatrix} 13 \\ -16 \\ 7 \\ -15 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -4 \\ 5 \\ -2 \\ 5 \end{bmatrix}, \begin{bmatrix} 13 \\ -16 \\ 7 \\ -15 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

Version 5275

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -3 \\ 2 \\ -2 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -4 \\ 2 \\ -1 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} -3 \\ -3 \\ 2 \\ -2 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -4 \\ 2 \\ -1 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 4 \\ 4 \\ 2 \end{bmatrix}, \begin{bmatrix} -5 \\ 0 \\ 5 \\ 4 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 4 \\ 4 \\ 2 \end{bmatrix}, \begin{bmatrix} -5 \\ 0 \\ 5 \\ 4 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{\begin{bmatrix}-2\\-1\\1\\0\end{bmatrix},\begin{bmatrix}-1\\5\\-1\\1\end{bmatrix},\begin{bmatrix}-3\\-7\\3\\-1\end{bmatrix}\right\}$ is linearly **independent**.
- The set of vectors $\left\{\begin{bmatrix}-2\\-1\\1\\0\end{bmatrix},\begin{bmatrix}-1\\5\\-1\\1\end{bmatrix},\begin{bmatrix}-3\\-7\\3\\-1\end{bmatrix}\right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 2 \\ -2 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ -2 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ -1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 3 \\ -3 \\ 0 \end{bmatrix} \right\}$ is linearly **independent**.
- The set of vectors $\left\{ \begin{bmatrix} 2 \\ -2 \\ 2 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ -2 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ -1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 3 \\ -3 \\ 0 \end{bmatrix} \right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{\begin{bmatrix}1\\4\\0\\2\end{bmatrix}, \begin{bmatrix}-2\\-3\\1\\-2\end{bmatrix}, \begin{bmatrix}3\\1\\-2\\2\end{bmatrix}, \begin{bmatrix}4\\3\\-2\\5\end{bmatrix}\right\}$ is linearly **independent**.
- The set of vectors $\left\{\begin{bmatrix}1\\4\\0\\2\end{bmatrix}, \begin{bmatrix}-2\\-3\\1\\-2\end{bmatrix}, \begin{bmatrix}3\\1\\-2\\2\end{bmatrix}, \begin{bmatrix}4\\3\\-2\\5\end{bmatrix}\right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS5
Linear independence

(a) Write a statement involving a vector equation that's equivalent to each claim below.

- The set of vectors $\left\{\begin{bmatrix} 2 \\ 1 \\ 1 \\ -3 \end{bmatrix}, \begin{bmatrix} -3 \\ 2 \\ -4 \\ -3 \end{bmatrix}, \begin{bmatrix} 7 \\ 0 \\ 6 \\ -3 \end{bmatrix}\right\}$ is linearly **independent**.
- The set of vectors $\left\{\begin{bmatrix} 2 \\ 1 \\ 1 \\ -3 \end{bmatrix}, \begin{bmatrix} -3 \\ 2 \\ -4 \\ -3 \end{bmatrix}, \begin{bmatrix} 7 \\ 0 \\ 6 \\ -3 \end{bmatrix}\right\}$ is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 1 \\ 2 \end{bmatrix}, \begin{bmatrix} -3 \\ 4 \\ 0 \\ 4 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \\ -1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 1 \\ 2 \end{bmatrix}, \begin{bmatrix} -3 \\ 4 \\ 0 \\ 4 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -2 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -2 \\ 1 \end{bmatrix}, \begin{bmatrix} 6 \\ 0 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 4 \\ -1 \\ 3 \\ -3 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -2 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -2 \\ 1 \end{bmatrix}, \begin{bmatrix} 6 \\ 0 \\ 0 \\ -3 \end{bmatrix}, \begin{bmatrix} 4 \\ -1 \\ 3 \\ -3 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ 1 \\ 4 \\ 4 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 0 \\ -2 \end{bmatrix}, \begin{bmatrix} -2 \\ 0 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ 1 \\ 4 \\ 4 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} -4 \\ 5 \\ 0 \\ 5 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 5 \\ 1 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} -4 \\ 5 \\ 0 \\ 5 \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 5 \\ 1 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 5 \\ -2 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} 5 \\ -2 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ -1 \\ -2 \end{bmatrix}, \begin{bmatrix} -6 \\ 1 \\ 5 \\ 0 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 5 \\ -2 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} 5 \\ -2 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ -1 \\ -2 \end{bmatrix}, \begin{bmatrix} -6 \\ 1 \\ 5 \\ 0 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} -2 \\ 2 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ 4 \\ 4 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} -2 \\ 2 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ 4 \\ 4 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -3 \\ -5 \\ -5 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 5 \\ 3 \end{bmatrix}, \begin{bmatrix} -2 \\ 9 \\ 25 \\ 19 \end{bmatrix}, \begin{bmatrix} 3 \\ -12 \\ -30 \\ -24 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ -3 \\ -5 \\ -5 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 5 \\ 3 \end{bmatrix}, \begin{bmatrix} -2 \\ 9 \\ 25 \\ 19 \end{bmatrix}, \begin{bmatrix} 3 \\ -12 \\ -30 \\ -24 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ -3 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 2 \\ 5 \end{bmatrix}, \begin{bmatrix} -2 \\ 1 \\ 11 \\ -1 \end{bmatrix}, \begin{bmatrix} -4 \\ -2 \\ 2 \\ -14 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ -3 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 2 \\ 5 \end{bmatrix}, \begin{bmatrix} -2 \\ 1 \\ 11 \\ -1 \end{bmatrix}, \begin{bmatrix} -4 \\ -2 \\ 2 \\ -14 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ -1 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ 5 \\ -4 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ 3 \\ 1 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 1 \\ 0 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ -1 \\ 2 \end{bmatrix}, \begin{bmatrix} -4 \\ -3 \\ 5 \\ -4 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ 3 \\ 1 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS6
Basis identification

(a) Write a statement involving spanning and independence properties that's equivalent to each claim below.

- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ 1 \\ -2 \end{bmatrix}, \begin{bmatrix} -5 \\ -2 \\ -3 \\ 5 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 4 \\ -5 \end{bmatrix}, \begin{bmatrix} 5 \\ 3 \\ -1 \\ -1 \end{bmatrix} \right\}$ is a **basis** of $\mathbb{R}^4$.
- The set of vectors $\left\{ \begin{bmatrix} 2 \\ 1 \\ 1 \\ -2 \end{bmatrix}, \begin{bmatrix} -5 \\ -2 \\ -3 \\ 5 \end{bmatrix}, \begin{bmatrix} 4 \\ 1 \\ 4 \\ -5 \end{bmatrix}, \begin{bmatrix} 5 \\ 3 \\ -1 \\ -1 \end{bmatrix} \right\}$ is **not** a basis of $\mathbb{R}^4$.

(b) Explain how to determine which of these statements is true.

VS7
Basis of a subspace

Consider the following subspace W of $\mathbb{R}^4$:

$$W = \operatorname{span}\left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \\ -1 \end{bmatrix}, \begin{bmatrix} 5 \\ 1 \\ -4 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 0 \\ -2 \end{bmatrix} \right\}.$$

(a) Explain how to find a basis of W.

(b) Explain how to find the dimension of W.

VS7
Basis of a subspace

Consider the following subspace W of $\mathbb{R}^4$:

$$W = \operatorname{span}\left\{ \begin{bmatrix} 1 \\ 2 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 3 \\ 6 \\ 6 \\ 3 \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} -3 \\ -5 \\ -5 \\ -5 \end{bmatrix}, \begin{bmatrix} -7 \\ -12 \\ -12 \\ -11 \end{bmatrix} \right\}.$$

(a) Explain how to find a basis of W.

(b) Explain how to find the dimension of W.

VS7
Basis of a subspace

Consider the following subspace W of $\mathbb{R}^4$:

$$W = \operatorname{span}\left\{ \begin{bmatrix} 1 \\ -1 \\ -1 \\ -1 \end{bmatrix}, \begin{bmatrix} 4 \\ -3 \\ -4 \\ -5 \end{bmatrix}, \begin{bmatrix} -15 \\ 12 \\ 15 \\ 18 \end{bmatrix} \right\}.$$

(a) Explain how to find a basis of W.

(b) Explain how to find the dimension of W.

VS7
Basis of a subspace

Consider the following subspace W of $\mathbb{R}^4$:

$$W = \operatorname{span}\left\{ \begin{bmatrix} 1 \\ 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -2 \\ -1 \\ -2 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ -1 \\ -3 \\ -4 \end{bmatrix}, \begin{bmatrix} 9 \\ 4 \\ 7 \\ -2 \end{bmatrix} \right\}.$$

(a) Explain how to find a basis of W.

(b) Explain how to find the dimension of W.

VS7
Basis of a subspace

Consider the following subspace W of $\mathbb{R}^4$:

$$W = \operatorname{span} \left\{ \begin{bmatrix} 1 \\ 1 \\ -1 \\ 0 \end{bmatrix}, \begin{bmatrix} 3 \\ 4 \\ -5 \\ 3 \end{bmatrix}, \begin{bmatrix} -5 \\ -7 \\ 9 \\ -6 \end{bmatrix}, \begin{bmatrix} 7 \\ 10 \\ -13 \\ 9 \end{bmatrix} \right\}.$$

(a) Explain how to find a basis of W.

(b) Explain how to find the dimension of W.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 1 & 3 \\ -2 & 3 \end{bmatrix}, \begin{bmatrix} 1 & 4 \\ -1 & 5 \end{bmatrix}, \begin{bmatrix} 1 & 3 \\ -1 & 4 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ -1 & 2 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices is linearly **independent**.
- The set of matrices is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} -2 & -2 \\ -3 & 0 \end{bmatrix}, \begin{bmatrix} 2 & 3 \\ 3 & -3 \end{bmatrix}, \begin{bmatrix} -3 & -1 \\ -5 & -5 \end{bmatrix}, \begin{bmatrix} -12 & -11 \\ -19 & -1 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices is linearly **independent**.
- The set of matrices is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}, \begin{bmatrix} -3 & -3 \\ -6 & 0 \end{bmatrix}, \begin{bmatrix} -3 & -2 \\ -4 & -3 \end{bmatrix}, \begin{bmatrix} -1 & 1 \\ 3 & -2 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices is linearly **independent**.
- The set of matrices is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{1, -x^2 + x - 5, x^2 - 2, x^3 + 3\,x^2 - 4\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials is linearly **independent**.
- The set of polynomials is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{\begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} -1 & -2 \\ -1 & 0 \end{bmatrix}, \begin{bmatrix} -2 & -3 \\ -1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 3 \\ -1 & -2 \end{bmatrix}\right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices is linearly **independent**.
- The set of matrices is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 0 & 1 \\ 3 & 1 \end{bmatrix}, \begin{bmatrix} -1 & 2 \\ 1 & 2 \end{bmatrix}, \begin{bmatrix} -2 & 4 \\ 3 & 5 \end{bmatrix}, \begin{bmatrix} -1 & -1 \\ -5 & 3 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $M_{2,2}$
- The set of matrices does **not** span $M_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{\begin{bmatrix} -1 & 0 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 2 & 0 \\ -3 & 1 \end{bmatrix}, \begin{bmatrix} 1 & -5 \\ -3 & 3 \end{bmatrix}, \begin{bmatrix} -3 & 4 \\ 6 & -4 \end{bmatrix}\right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $\mathrm{M}_{2,2}$
- The set of matrices does **not** span $\mathrm{M}_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 1 & 3 \\ 5 & 5 \end{bmatrix}, \begin{bmatrix} -2 & -6 \\ -10 & -10 \end{bmatrix}, \begin{bmatrix} -1 & -2 \\ -4 & -5 \end{bmatrix}, \begin{bmatrix} -1 & 1 \\ 0 & -3 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $M_{2,2}$
- The set of matrices does **not** span $M_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{x^3 - 2\,x^2 - x + 1, -2\,x^3 + 4\,x^2 + 2\,x - 2, -x^3 + 3\,x^2 + 2\,x - 1, -4\,x^3 - 4\,x^2 - 5\,x, 4\,x^3 + 2\,x^2 + 3\,x\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials **spans** $\mathcal{P}_3$
- The set of polynomials does **not** span $\mathcal{P}_3$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{x^3 - x^2 - x - 1, 2\,x^3 - x^2 - 3, x^3 - x^2 - 4\,x, x^3 - x^2 + 4\,x - 3, -x^3 - x^2 + 12\,x - 3\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials **spans** $\mathcal{P}_3$
- The set of polynomials does **not** span $\mathcal{P}_3$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 1 & 2 \\ 1 & -3 \end{bmatrix}, \begin{bmatrix} 2 & 4 \\ 2 & -6 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 4 & -2 \end{bmatrix}, \begin{bmatrix} 0 & 5 \\ -5 & 1 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $\mathrm{M}_{2,2}$
- The set of matrices does **not** span $\mathrm{M}_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{-3\,x^{3} - 2\,x^{2} + 3\,x - 2, x^{3} + x^{2} + x - 1, -4\,x^{3} - 5\,x^{2} - x + 2\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials is linearly **independent**.
- The set of polynomials is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 2 & 0 \\ 2 & -1 \end{bmatrix}, \begin{bmatrix} -6 & 0 \\ -6 & 3 \end{bmatrix}, \begin{bmatrix} 3 & 1 \\ 2 & -3 \end{bmatrix}, \begin{bmatrix} 2 & -3 \\ 1 & 1 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $M_{2,2}$
- The set of matrices does **not** span $M_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{\begin{bmatrix} 1 & 2 \\ 0 & 4 \end{bmatrix}, \begin{bmatrix} -2 & 3 \\ 3 & 3 \end{bmatrix}, \begin{bmatrix} 2 & -1 \\ -2 & 0 \end{bmatrix}, \begin{bmatrix} -4 & -2 \\ 2 & -5 \end{bmatrix}\right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $M_{2,2}$
- The set of matrices does **not** span $M_{2,2}$

(b) Explain how to determine which of these statements is true.

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VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix}, \begin{bmatrix} 3 & 1 \\ -4 & 1 \end{bmatrix}, \begin{bmatrix} -2 & -1 \\ 2 & -1 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices is linearly **independent**.
- The set of matrices is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{x^3+3\,x^2+5\,x-1, x^2+x, x^3+2\,x^2+3\,x-1, x^3+6\,x^2+10\,x-1, 3\,x^3+5\,x^2+5\,x-4\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials **spans** $\mathcal{P}_3$
- The set of polynomials does **not** span $\mathcal{P}_3$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{-2\,x^3+2\,x^2+2\,x-1, 3\,x^3+3\,x^2-x+2, -3\,x^3+2\,x^2+5\,x\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials is linearly **independent**.
- The set of polynomials is linearly **dependent**.

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{\begin{bmatrix} 1 & 0 \\ -1 & 2 \end{bmatrix}, \begin{bmatrix} -3 & 0 \\ 3 & -6 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix}, \begin{bmatrix} -2 & -2 \\ -1 & -3 \end{bmatrix}, \begin{bmatrix} 7 & 2 \\ -5 & 10 \end{bmatrix}\right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $\mathrm{M}_{2,2}$
- The set of matrices does **not** span $\mathrm{M}_{2,2}$

(b) Explain how to determine which of these statements is true.

VS8 Polynomial and matrix spaces

(a) Given the set

$$\left\{-x^3 + x^2 + 1, x^3 + x - 1, 3\,x^3 - 2\,x^2 + x - 3, -4\,x^3 + 2\,x^2 - 2\,x + 4, 2\,x^3 - 4\,x^2 - 3\,x - 2\right\}$$

write a statement involving a polynomial equation that's equivalent to each claim below.

- The set of polynomials **spans** $\mathcal{P}_3$
- The set of polynomials does **not** span $\mathcal{P}_3$

(b) Explain how to determine which of these statements is true.

VS8
Polynomial and matrix spaces

(a) Given the set

$$\left\{ \begin{bmatrix} 0 & 0 \\ -1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 1 & -3 \end{bmatrix}, \begin{bmatrix} -1 & 1 \\ -2 & 3 \end{bmatrix}, \begin{bmatrix} -1 & 2 \\ 4 & -4 \end{bmatrix} \right\}$$

write a statement involving a matrix equation that's equivalent to each claim below.

- The set of matrices **spans** $M_{2,2}$
- The set of matrices does **not** span $M_{2,2}$

(b) Explain how to determine which of these statements is true.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcrcl} -x_1 & - & x_2 & + & x_3 & + & 3\,x_4 & - & 4\,x_5 & = & 0 \\ -x_1 & - & x_2 & + & x_3 & - & 4\,x_4 & + & 10\,x_5 & = & 0 \\ x_1 & + & x_2 & - & x_3 & + & x_4 & - & 4\,x_5 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcrcr} x_1 & + & x_2 & + & x_3 & - & x_4 & - & 4\,x_5 & = & 0 \\ & & & & x_3 & - & 2\,x_4 & - & x_5 & = & 0 \\ 2\,x_1 & + & 2\,x_2 & + & 3\,x_3 & - & 4\,x_4 & - & 9\,x_5 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcr} & - & 4\,x_2 & + & 4\,x_3 & = & 0 \\ & & x_2 & - & x_3 & = & 0 \\ x_1 & - & x_2 & + & 3\,x_3 & = & 0 \\ x_1 & - & 5\,x_2 & + & 7\,x_3 & = & 0 \\ & - & x_2 & + & x_3 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcrcr} & - & x_2 & + & 3\,x_3 & + & 11\,x_4 & - & 2\,x_5 & = & 0 \\ x_1 & & & - & 5\,x_3 & - & 14\,x_4 & + & 5\,x_5 & = & 0 \\ 3\,x_1 & - & 4\,x_2 & - & 2\,x_3 & + & 5\,x_4 & + & 6\,x_5 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcrcr} -x_1 & - & x_2 & & & + & 3\,x_4 & + & 2\,x_5 & = & 0 \\ 2\,x_1 & + & 2\,x_2 & - & x_3 & - & 4\,x_4 & + & x_5 & = & 0 \\ x_1 & + & x_2 & - & x_3 & - & x_4 & + & 4\,x_5 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcr} x_1 & & & + & x_3 & = & 0 \\ 5\,x_1 & + & x_2 & + & 5\,x_3 & = & 0 \\ 4\,x_1 & & & + & 4\,x_3 & = & 0 \\ -4\,x_1 & + & 3\,x_2 & - & 4\,x_3 & = & 0 \\ -5\,x_1 & - & 3\,x_2 & - & 5\,x_3 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcrcr}
-2\,x_1 & + & 6\,x_2 & & & - & 2\,x_4 & + & 2\,x_5 & = & 0 \\
-5\,x_1 & + & 15\,x_2 & + & x_3 & - & 3\,x_4 & + & 8\,x_5 & = & 0 \\
x_1 & - & 3\,x_2 & & & + & x_4 & - & x_5 & = & 0
\end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcrcr} x_1 & - & x_2 & - & 4\,x_3 & + & 6\,x_4 & = & 0 \\ -x_1 & + & x_2 & + & 5\,x_3 & - & 8\,x_4 & = & 0 \\ & & & & & & 0 & = & 0 \\ 2\,x_1 & - & 2\,x_2 & - & 5\,x_3 & + & 6\,x_4 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcl}
-2\,x_1 & + & 2\,x_2 & + & 4\,x_3 & = & 0 \\
 & & x_2 & + & 3\,x_3 & = & 0 \\
 & & x_2 & + & 3\,x_3 & = & 0 \\
-x_1 & + & 5\,x_2 & + & 14\,x_3 & = & 0 \\
3\,x_1 & - & 5\,x_2 & - & 12\,x_3 & = & 0
\end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

VS9
Homogeneous systems

Consider the following homogeneous system of equations.

$$\begin{array}{rcrcrcr} 2\,x_1 & - & 2\,x_2 & + & 8\,x_3 & = & 0 \\ 3\,x_1 & + & x_2 & & & = & 0 \\ -x_1 & + & 2\,x_2 & - & 7\,x_3 & = & 0 \\ -3\,x_1 & + & 3\,x_2 & - & 12\,x_3 & = & 0 \\ 2\,x_1 & - & 5\,x_2 & + & 17\,x_3 & = & 0 \end{array}$$

(a) Find the solution space of this system.

(b) Find a basis of the solution space.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = 3\,h\left(x^2\right) + 4\,h'\left(x\right) \quad \text{and} \quad T(h(x)) = 2\,h\left(x\right)^2 - h\left(-3\right)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = 3\,h\,(x) + 2\,h'\,(x) \quad \text{and} \quad T(h(x)) = -x^2 - 5\,h'\,(4)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = -5\,g\,(x) - 2\,g'\,(x) \quad \text{and} \quad T(g(x)) = 4\,x - 2\,g\,(5)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = -f(x)^2 + 4\,f(x) \quad \text{and} \quad T(f(x)) = -f(x) + 5\,f'(4)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = g'(-3) + 4\,g'(x) \quad \text{and} \quad T(g(x)) = -3\,g(x)\,g'(x) + 5\,g(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = 4\,g\,(x)^3 + 5\,g\left(x^2\right) \quad \text{and} \quad T(g(x)) = 4\,x^2 g\,(x) - g'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = 4\,x^3 f\,(x) + 3\,f'\,(2) \quad \text{and} \quad T(f(x)) = -4\,f\,(x)\,f'\,(x) + 5\,f'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = 4\, f\,(x)^2 - f\,(-4) \quad \text{and} \quad T(f(x)) = -5\, f'\,(-4) - f'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -h\,(x)\,h'\,(x) - 5\,h'\,(-3) \quad \text{and} \quad T(h(x)) = -3\,h\,(5) + h'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = -2\,xg\,(x) - 5\,g\,(-1) \quad \text{and} \quad T(g(x)) = 4\,g\,(x)^3 - g'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = 2\,f\,(x)\,f'\,(x) + 2\,f\,(x) \quad \text{and} \quad T(f(x)) = 3\,x^3 f\,(x) + 2\,f'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

Version 2596

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -2\,x^2 h\,(x) - h'\,(-4) \quad \text{and} \quad T(h(x)) = 3\,h\,(x)\,h'\,(x) + 2\,h\,(1)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -2\,h\left(x^3\right) + 2\,h'(4) \quad \text{and} \quad T(h(x)) = -3\,h'(x) + 2$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = -2\, f\,(x)^2 + 3\, f\,(-1) \quad \text{and} \quad T(f(x)) = -4\, f'\,(-4) + 5\, f'\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = -3\, g\left(x^3\right) + 4 \quad \text{and} \quad T(g(x)) = -4\, x^2 g\left(x\right) - 5\, g'\left(x\right)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(f(x)) = -4\,x^3 f\,(x) + 5\,x^2 \quad \text{and} \quad T(f(x)) = 5\,f\,(1) - f\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -h\,(x)\,h'\,(x) + 2\,h'\,(-4) \quad \text{and} \quad T(h(x)) = -4\,h\left(x^3\right) + 4\,h\,(x)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -h\,(x)\,h'\,(x) - 4\,h'\,(x) \quad \text{and} \quad T(h(x)) = -5\,x^2 h\,(x) - h\,(4)$$

Explain why one these maps is a linear transformation and why the other map is not.

Version 6386

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(g(x)) = g\left(x\right)^2 + 4\,g\left(-4\right) \quad \text{and} \quad T(g(x)) = -2\,g\left(x^2\right) + g'\left(x\right)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT1
Linear maps

Consider the following maps of polynomials $S : \mathcal{P} \to \mathcal{P}$ and $T : \mathcal{P} \to \mathcal{P}$ defined by

$$S(h(x)) = -5\,h\left(x\right)^2 + h\left(x\right) \quad \text{and} \quad T(h(x)) = 3\,h'\left(3\right) - 5\,h'\left(x\right)$$

Explain why one these maps is a linear transformation and why the other map is not.

AT2
Standard matrices

(a) Find the standard matrix for the linear transformation $S : \mathbb{R}^4 \to \mathbb{R}^3$ given by

$$S\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 - 3\,x_2 - 7\,x_3 + 4\,x_4 \\ x_2 + 2\,x_3 - x_4 \\ -3\,x_2 - 5\,x_3 + 3\,x_4 \end{bmatrix}.$$

(b) Let $T : \mathbb{R}^2 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix

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

Compute $T\left(\begin{bmatrix} 3 \\ 1 \end{bmatrix}\right)$.

AT2
Standard matrices

(a) Find the standard matrix for the linear transformation $S : \mathbb{R}^4 \to \mathbb{R}^2$ given by

$$S\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} -x + 2\,y - 5\,z - 2\,w \\ x - 3\,y + 6\,z + 4\,w \end{bmatrix}.$$

(b) Let $T : \mathbb{R}^2 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix

$$\begin{bmatrix} 1 & -3 \\ 2 & 7 \\ 0 & -3 \\ 2 & 6 \end{bmatrix}.$$

Compute $T\left(\begin{bmatrix} 2 \\ 8 \end{bmatrix}\right)$.

AT2
Standard matrices

(a) Find the standard matrix for the linear transformation $S : \mathbb{R}^4 \to \mathbb{R}^1$ given by

$$S\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} x + 2\,w \end{bmatrix}.$$

(b) Let $T : \mathbb{R}^3 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix

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

Compute $T\left(\begin{bmatrix} -1 \\ -7 \\ -7 \end{bmatrix}\right)$.

AT2
Standard matrices

(a) Find the standard matrix for the linear transformation $S : \mathbb{R}^4 \to \mathbb{R}^3$ given by

$$S\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} x - y - 8\,z \\ y + 5\,z + w \\ x + y + 3\,z + 2\,w \end{bmatrix}.$$

(b) Let $T : \mathbb{R}^2 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix

$$\begin{bmatrix} 3 & -5 \\ -3 & 7 \\ 2 & -3 \\ 1 & -6 \end{bmatrix}.$$

Compute $T\left(\begin{bmatrix} 4 \\ -2 \end{bmatrix}\right)$.

AT2
Standard matrices

(a) Find the standard matrix for the linear transformation $S : \mathbb{R}^3 \to \mathbb{R}^2$ given by

$$S\left(\begin{bmatrix} x \\ y \\ z \end{bmatrix}\right) = \begin{bmatrix} -x + 3\,z \\ x - y - 3\,z \end{bmatrix}.$$

(b) Let $T : \mathbb{R}^2 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix

$$\begin{bmatrix} 1 & 4 \\ 0 & 1 \\ -3 & -7 \\ -1 & -5 \end{bmatrix}.$$

Compute $T\left(\begin{bmatrix} -7 \\ -7 \end{bmatrix}\right)$.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 + 3\,x_2 - x_3 - x_4 \\ -2\,x_1 - 6\,x_2 + 3\,x_3 + 5\,x_4 \\ 3\,x_1 + 9\,x_2 - 5\,x_3 - 9\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} 4\,x_1 + 8\,x_2 + 5\,x_3 + 11\,x_4 \\ -x_1 - 2\,x_2 - x_3 - 2\,x_4 \\ 3\,x_1 + 6\,x_2 + 2\,x_3 + 3\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 - 3\,x_2 + 2\,x_3 - 12\,x_4 \\ x_2 + x_3 \\ -2\,x_1 + 4\,x_2 - 5\,x_3 + 21\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} 2\,x_1 + x_2 + 4\,x_3 - 5\,x_4 \\ 3\,x_1 + 4\,x_2 - 5\,x_3 + 28\,x_4 \\ -x_1 - 4\,x_3 + 9\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} -2\,x + 2\,y + 3\,z - w \\ z - 4\,w \\ -3\,x + 3\,y + 4\,z \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 - x_2 + 3\,x_3 - x_4 \\ 4\,x_1 - 3\,x_2 + 11\,x_3 - 5\,x_4 \\ -x_1 - x_2 - x_3 + 3\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

Version 8018

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} -x_1 - x_2 - 3\,x_3 - 7\,x_4 \\ -x_1 - x_2 - 4\,x_3 - 9\,x_4 \\ x_1 + x_2 + 3\,x_3 + 7\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} x - 5\,y - 16\,z + 9\,w \\ y + 3\,z - 2\,w \\ -x + 3\,y + 10\,z - 5\,w \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} -x_1 + x_2 - 3\,x_3 + 4\,x_4 \\ x_1 - 2\,x_2 + 5\,x_3 - 5\,x_4 \\ -3\,x_2 + 6\,x_3 - 3\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 - x_2 + 4\,x_3 + 4\,x_4 \\ x_2 - 2\,x_3 - 4\,x_4 \\ 2\,x_1 + 2\,x_2 + x_3 - 7\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

Version 2974

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 + x_2 - 2\,x_3 + 5\,x_4 \\ x_2 - 3\,x_3 + 6\,x_4 \\ 2\,x_2 - 5\,x_3 + 9\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} x + 2\,y - 4\,z + 7\,w \\ z - w \\ -z + w \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\left[\begin{array}{c} x \\ y \\ z \\ w \end{array}\right]\right) = \left[\begin{array}{c} x + y + 3\,z + w \\ z + w \\ -z - w \end{array}\right].$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}\right) = \begin{bmatrix} x_1 + 3\,x_2 \\ x_2 - x_3 + x_4 \\ -5\,x_2 + 5\,x_3 - 5\,x_4 \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT3
Image and kernel

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by

$$T\left(\begin{bmatrix} x \\ y \\ z \\ w \end{bmatrix}\right) = \begin{bmatrix} x + 3\,y - 2\,z - 4\,w \\ 4\,x + 5\,y - 8\,z - 2\,w \\ y - 2\,w \end{bmatrix}.$$

(a) Explain how to find the image of T and the kernel of T.

(b) Explain how to find a basis of the image of T and a basis of the kernel of T.

(c) Explain how to find the rank and nullity of T, and why the rank-nullity theorem holds for T.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^4 \to \mathbb{R}^3$ be the linear transformation given by the standard matrix $\begin{bmatrix} -5 & -2 & -5 & -4 \\ -4 & -3 & 4 & 17 \\ 2 & 1 & 1 & -1 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

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AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^3 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & -1 & 2 \\ 5 & -4 & 5 \\ 1 & -1 & 3 \\ 2 & -1 & 2 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^5 \to \mathbb{R}^4$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & -2 & 4 & 1 & 3 \\ 0 & 1 & -3 & -2 & 3 \\ 1 & 0 & -2 & -2 & 6 \\ 1 & -3 & 7 & -2 & 15 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^4 \to \mathbb{R}^5$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & -3 & -4 & 4 \\ -1 & 3 & -3 & 4 \\ -1 & 3 & -1 & 5 \\ 0 & 0 & -4 & 4 \\ 0 & 0 & -3 & -5 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^3 \to \mathbb{R}^5$ be the linear transformation given by the standard matrix $\begin{bmatrix} 0 & 3 & -5 \\ -3 & -2 & 3 \\ 0 & 1 & -2 \\ 1 & -2 & 3 \\ -5 & -2 & 5 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^3 \to \mathbb{R}^3$ be the linear transformation given by the standard matrix $\begin{bmatrix} 0 & 1 & 1 \\ -1 & 1 & 4 \\ 0 & 3 & 4 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^5 \to \mathbb{R}^3$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & 1 & 1 & 2 & 8 \\ -2 & -1 & 0 & 1 & -1 \\ 4 & 3 & 2 & 4 & 20 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^5 \to \mathbb{R}^3$ be the linear transformation given by the standard matrix $\begin{bmatrix} -2 & 0 & -3 & 13 & 6 \\ 2 & 1 & -3 & 5 & 5 \\ 3 & 0 & 4 & -18 & -8 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^3 \to \mathbb{R}^3$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & 1 & -3 \\ 0 & 1 & -3 \\ 1 & 1 & -2 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

AT4
Injectivity and surjectivity

Let $T : \mathbb{R}^4 \to \mathbb{R}^5$ be the linear transformation given by the standard matrix $\begin{bmatrix} 1 & 2 & 1 & -3 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 2 & 5 \\ -3 & -6 & -5 & 0 \\ 0 & 0 & -3 & -1 \end{bmatrix}$.

(a) Explain why T is or is not injective.

(b) Explain why T is or is not surjective.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

$$A = \begin{bmatrix} 1 & -2 & 0 & 2 \\ 2 & -3 & 2 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 3 \\ -2 & 5 \\ -1 & 5 \\ 0 & 2 \end{bmatrix} \quad C = \begin{bmatrix} -3 & -1 \\ 1 & -2 \\ -2 & 1 \end{bmatrix}$$

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

$$A = \begin{bmatrix} 1 & 1 & 1 & -3 \\ 0 & 1 & 2 & -2 \end{bmatrix} \quad B = \begin{bmatrix} 1 & -3 & 2 & 3 \\ 0 & 1 & 0 & -3 \\ 0 & -1 & 1 & 0 \end{bmatrix} \quad C = \begin{bmatrix} 0 & -1 & 0 \\ 1 & 5 & 3 \end{bmatrix}$$

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

$$A = \begin{bmatrix} -2 & 1 & 2 & 0 \\ 1 & -1 & -2 & -2 \\ 0 & 0 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} -2 & -3 \\ -1 & -2 \\ 1 & 3 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 \\ -3 & -2 \\ -4 & 0 \\ -4 & -1 \end{bmatrix}$$

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

$$A = \begin{bmatrix} 1 & 2 & -1 & -1 \\ 0 & 0 & 1 & -2 \end{bmatrix} \quad B = \begin{bmatrix} 1 & -1 & 2 & 4 \\ 1 & 0 & -2 & 1 \\ 1 & 0 & -1 & 2 \end{bmatrix} \quad C = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX1
Multiplying matrices

Of the following three matrices, only two may be multiplied.

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

Explain which two can be multiplied and why. Then show how to find their product.

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix P that may be used to perform the row operation $R_2 + 2R_1 \to R_2$.

(b) Give a 4×4 matrix C that may be used to perform the row operation $-5R_2 \to R_2$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_2 + 2R_1 \to R_2$ and then $-5R_2 \to R_2$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix C that may be used to perform the row operation $R_4 + 3R_1 \to R_4$.

(b) Give a 4×4 matrix N that may be used to perform the row operation $R_3 \leftrightarrow R_4$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_4+3R_1 \to R_4$ and then $R_3 \leftrightarrow R_4$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix Q that may be used to perform the row operation $3R_4 \to R_4$.

(b) Give a 4×4 matrix C that may be used to perform the row operation $R_4 \leftrightarrow R_3$.

(c) Use matrix multiplication to describe the matrix obtained by applying $3R_4 \to R_4$ and then $R_4 \leftrightarrow R_3$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix M that may be used to perform the row operation $R_1 + 3R_3 \to R_1$.

(b) Give a 4×4 matrix Q that may be used to perform the row operation $3R_1 \to R_1$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_1 + 3R_3 \to R_1$ and then $3R_1 \to R_1$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix B that may be used to perform the row operation $R_1 + 2R_4 \to R_1$.

(b) Give a 4×4 matrix N that may be used to perform the row operation $R_3 \leftrightarrow R_1$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_3 \leftrightarrow R_1$ and then $R_1+2R_4 \to R_1$ to A (note the order).

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MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix C that may be used to perform the row operation $R_3 \leftrightarrow R_4$.

(b) Give a 4×4 matrix M that may be used to perform the row operation $R_4 + 2R_1 \to R_4$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_3 \leftrightarrow R_4$ and then $R_4+2R_1 \to R_4$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix Q that may be used to perform the row operation $R_4 - 2R_3 \to R_4$.

(b) Give a 4×4 matrix M that may be used to perform the row operation $R_1 \leftrightarrow R_4$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_4 - 2R_3 \to R_4$ and then $R_1 \leftrightarrow R_4$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix Q that may be used to perform the row operation $R_4 \leftrightarrow R_1$.

(b) Give a 4×4 matrix M that may be used to perform the row operation $R_1 - 2R_3 \to R_1$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_4 \leftrightarrow R_1$ and then $R_1 - 2R_3 \to R_1$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix N that may be used to perform the row operation $R_1 - 2R_3 \to R_1$.

(b) Give a 4×4 matrix B that may be used to perform the row operation $R_4 \leftrightarrow R_1$.

(c) Use matrix multiplication to describe the matrix obtained by applying $R_4 \leftrightarrow R_1$ and then $R_1 - 2R_3 \to R_1$ to A (note the order).

MX2
Row operations as matrix multiplication

Let A be a 4×4 matrix.

(a) Give a 4×4 matrix C that may be used to perform the row operation $R_1 \leftrightarrow R_3$.

(b) Give a 4×4 matrix B that may be used to perform the row operation $-3R_1 \to R_1$.

(c) Use matrix multiplication to describe the matrix obtained by applying $-3R_1 \to R_1$ and then $R_1 \leftrightarrow R_3$ to A (note the order).

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$M = \begin{bmatrix} 2 & -4 & 3 & -13 \\ 1 & -2 & 5 & -17 \\ -1 & 2 & 1 & -1 \\ 1 & -2 & 2 & -8 \end{bmatrix} \qquad Q = \begin{bmatrix} -2 & 2 & -1 & 0 \\ 0 & 1 & 1 & 3 \\ 0 & -3 & -2 & -4 \\ -1 & 0 & -1 & -1 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$C = \begin{bmatrix} 1 & -1 & 4 & -4 \\ 1 & 2 & 2 & 3 \\ 0 & -1 & 1 & -2 \\ 0 & 0 & -1 & 0 \end{bmatrix} \qquad M = \begin{bmatrix} -2 & -6 & 1 & -1 \\ 2 & 6 & 5 & -17 \\ -3 & -9 & -1 & 6 \\ 3 & 9 & 1 & -6 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

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

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

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

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

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

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$L = \begin{bmatrix} 3 & -2 & 3 & -2 \\ -2 & 1 & 0 & 5 \\ 1 & -1 & 2 & 1 \\ -1 & 2 & -3 & -1 \end{bmatrix} \qquad P = \begin{bmatrix} 1 & 0 & 2 & 3 \\ -2 & 1 & -5 & -2 \\ 0 & -1 & 1 & -3 \\ 1 & -1 & 3 & 3 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$D = \begin{bmatrix} 3 & -2 & -3 & -2 \\ 3 & -2 & -2 & 2 \\ 3 & -4 & -3 & -3 \\ 2 & -1 & -2 & -1 \end{bmatrix} \qquad L = \begin{bmatrix} 1 & -1 & 3 & 7 \\ 2 & -1 & 2 & 5 \\ 0 & 1 & -3 & -7 \\ 0 & -1 & 1 & 3 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$M = \begin{bmatrix} -3 & -3 & 9 & -2 \\ 3 & 3 & -9 & 1 \\ 1 & 1 & -3 & 2 \\ 2 & 2 & -6 & 1 \end{bmatrix} \qquad N = \begin{bmatrix} 1 & -1 & -1 & 5 \\ 0 & 1 & -3 & -4 \\ -1 & 1 & 2 & -4 \\ 1 & -1 & -5 & 2 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$M = \begin{bmatrix} -2 & 3 & -1 & -3 \\ -3 & 4 & -3 & -4 \\ 0 & -2 & -5 & 3 \\ 1 & -2 & -2 & 2 \end{bmatrix} \qquad L = \begin{bmatrix} 5 & 15 & -5 & -5 \\ -5 & -15 & -4 & 23 \\ -4 & -12 & -1 & 14 \\ -2 & -6 & 3 & 0 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

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

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$M = \begin{bmatrix} 1 & -3 & 3 & 0 \\ 1 & -3 & 3 & -1 \\ 0 & 0 & 0 & 1 \\ -1 & 3 & -3 & 4 \end{bmatrix} \qquad Q = \begin{bmatrix} 1 & 2 & 2 & -3 \\ -1 & -1 & -1 & 4 \\ 1 & -2 & -1 & -2 \\ 0 & 2 & 2 & 3 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$B = \begin{bmatrix} -1 & 1 & -5 & -11 \\ 1 & -1 & 4 & 9 \\ 1 & -1 & 1 & 3 \\ -1 & 1 & -3 & -7 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & -1 & 1 & -5 \\ 0 & 1 & 0 & 5 \\ 1 & -1 & 2 & -3 \\ -1 & 1 & -2 & 4 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$N = \begin{bmatrix} 4 & -2 & 1 & -6 \\ 0 & 1 & 2 & 6 \\ 3 & -2 & 0 & -7 \\ -4 & 1 & 1 & 8 \end{bmatrix} \qquad C = \begin{bmatrix} 0 & 1 & -1 & -3 \\ -2 & -1 & -4 & -3 \\ -1 & 0 & -2 & -2 \\ 0 & 0 & -2 & -3 \end{bmatrix}$$

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

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

MX3
The inverse of a matrix

Explain why each of the following matrices is or is not invertible by disussing its corresponding linear transformation. If the matrix is invertible, explain how to find its inverse.

$$D = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -2 \\ 1 & 1 & 1 & 1 \\ 1 & 2 & 0 & -3 \end{bmatrix} \qquad M = \begin{bmatrix} -1 & -2 & 0 & 1 \\ 1 & 2 & 4 & -5 \\ -2 & -4 & -3 & 5 \\ -3 & -6 & -4 & 7 \end{bmatrix}$$