

# Systems of Linear Equations

## Systems of Linear Equations

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### Questions:

- 1) For the following augmented matrix, perform the indicated elementary

row operations:  $\left[ \begin{array}{cc|c} 3 & -2 & 1 \\ 2 & 0 & -1 \end{array} \right]$

- a.  $2R_1 \rightarrow R_1$                       b.  $R_1 \leftrightarrow R_2$                       c.  $R_2 + R_1 \rightarrow R_2$                       d.  $R_2 + 2R_1 \rightarrow R_2$
- 2) For the following augmented matrix perform the indicated elementary

row operations:  $\left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 3 & 1 & 2 & -4 \end{array} \right]$

- a.  $2R_3 \rightarrow R_3$                       b.  $R_1 \leftrightarrow R_3$                       c.  $R_3 - R_1 \rightarrow R_3$                       d.  $R_2 - 2R_1 \rightarrow R_2$
- 3) For the following augmented matrix perform the indicated elementary

row operations:  $\left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right]$

- a.  $\frac{1}{2}R_3 \rightarrow R_3$                       b.  $R_2 \leftrightarrow R_3$
- c.  $R_2 - 4R_1 \rightarrow R_2$                       d.  $R_3 + 2R_1 \rightarrow R_3$

## Calculus 1

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For the following systems of equations, convert the system into an augmented matrix and use the augmented matrix techniques to determine the solution to the system or to determine if the system is inconsistent:

$$4) \begin{cases} 2x + 7y = 13 \\ 2x + 5y = 11 \end{cases}$$

$$5) \begin{cases} 2x + 3y = 7 \\ 4x - 5y = 3 \end{cases}$$

$$6) \begin{cases} 2x + 3y = 8 \\ 5x - 4y = -3 \end{cases}$$

$$7) \begin{cases} 4x + 8y = 20 \\ 3x + 6y = 15 \end{cases}$$

$$8) \begin{cases} -6x + 3y = 15 \\ 10x - 5y = -25 \end{cases}$$

$$9) \begin{cases} 8x - 4y = 10 \\ -6x + 3y = 1 \end{cases}$$

$$10) \begin{cases} x + 2y + 3z = -11 \\ 2x + 3y - z = -5 \\ 3x + y - z = 2 \end{cases}$$

$$11) \begin{cases} 2x - y - 3z = 5 \\ 3x - 2y + 2z = 5 \\ 10x - 6y - 2z = 32 \end{cases}$$

$$12) \begin{cases} x + 2y + 3z = 3 \\ 4x + 6y + 16z = 8 \\ 3x + 2y + 17z = 1 \end{cases}$$

$$13) \begin{cases} x + 3y = 2 \\ 2x + y = -1 \\ x - y = -2 \end{cases}$$

$$14) \begin{cases} 4x - 7y = 0 \\ 8x - 14y = 2 \\ -16x + 28y = 0 \end{cases}$$

$$15) \begin{cases} 3x - 2y = 1 \\ -9x + 6y = -3 \\ 6x - 4y = 2 \end{cases}$$

$$16) \begin{cases} x + 2y + 2z = 2 \\ 3x - 2y - z = 5 \\ 2x - 5y + 3z = -4 \\ 2x + 8y + 12z = 0 \end{cases}$$

Answer Key:

1)

a.  $\left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 2 & 0 & -1 & -1 \end{array} \right] \xrightarrow{2R_1 \rightarrow R_1} \left[ \begin{array}{ccc|c} 6 & -4 & 2 & 2 \\ 2 & 0 & -1 & -1 \end{array} \right]$

b.  $\left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 2 & 0 & -1 & -1 \end{array} \right] \xrightarrow{R_1 \leftrightarrow R_2} \left[ \begin{array}{ccc|c} 2 & 0 & -1 & -1 \\ 3 & -2 & 1 & 1 \end{array} \right]$

c.  $\left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 2 & 0 & -1 & -1 \end{array} \right] \xrightarrow{R_2 + R_1 \rightarrow R_2} \left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 5 & -2 & 0 & 0 \end{array} \right]$

d.  $\left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 2 & 0 & -1 & -1 \end{array} \right] \xrightarrow{R_2 + 2R_1 \rightarrow R_2} \left[ \begin{array}{ccc|c} 3 & -2 & 1 & 1 \\ 8 & -4 & 1 & 1 \end{array} \right]$

2) a.  $\left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 3 & 1 & 2 & -4 \end{array} \right] \xrightarrow{2R_3 \rightarrow R_3} \left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 6 & 2 & 4 & -8 \end{array} \right]$

b.  $\left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 3 & 1 & 2 & -4 \end{array} \right] \xrightarrow{R_1 \leftrightarrow R_3} \left[ \begin{array}{ccc|c} 3 & 1 & 2 & -4 \\ 4 & 0 & -1 & 2 \\ 1 & -2 & 0 & 3 \end{array} \right]$

c.  $\left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 3 & 1 & 2 & -4 \end{array} \right] \xrightarrow{R_3 - R_1 \rightarrow R_3} \left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 2 & 3 & 2 & -7 \end{array} \right]$

d.  $\left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 4 & 0 & -1 & 2 \\ 3 & 1 & 2 & -4 \end{array} \right] \xrightarrow{R_2 - 2R_1 \rightarrow R_2} \left[ \begin{array}{ccc|c} 1 & -2 & 0 & 3 \\ 2 & 4 & -1 & -4 \\ 3 & 1 & 2 & -4 \end{array} \right]$

3) a.  $\left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right] \xrightarrow{\frac{1}{2}R_3 \rightarrow R_3} \left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -0.5 & 1 & 1 & -0.5 \end{array} \right]$

b.  $\left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right] \xrightarrow{R_2 \leftrightarrow R_3} \left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -1 & 2 & 2 & -1 \\ -2 & 0 & -1 & 2 \end{array} \right]$

c.  $\left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right] \xrightarrow{R_2 - 4R_1 \rightarrow R_2} \left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -6 & -8 & -17 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right]$

d.  $\left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ -1 & 2 & 2 & -1 \end{array} \right] \xrightarrow{R_3 + 2R_1 \rightarrow R_3} \left[ \begin{array}{ccc|c} 1 & 2 & 4 & 0 \\ -2 & 0 & -1 & 2 \\ 1 & 6 & 10 & -1 \end{array} \right]$

- 4)  $(3,1)$
- 5)  $(2,1)$
- 6)  $(1,2)$
- 7)  $(5-2t, t)$   $\infty$  solutions.
- 8)  $(-2.5+0.5t, t)$   $\infty$  solutions.
- 9) No solution.
- 10)  $(1, -3, -2)$
- 11) No solution.
- 12)  $\infty$  solutions.
- 13)  $(-1,1)$
- 14) No solution.
- 15)  $\infty$  solutions.
- 16)  $(2,1,-1)$