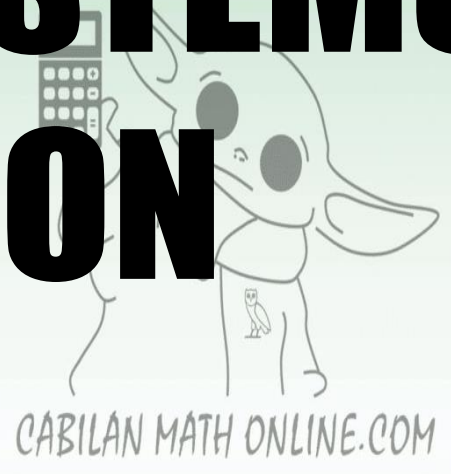
ST. JEAN DE BREBEUF

MATHEMATICS

CHAPTER 5.3

SOLVE LINEAR SYSTEMS BY ELIMINATION



CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

For each set of numbers, determine whether you **add** or **subtract** the two numbers to equal **zero.**

$3 \quad + \quad -3 = 0$

$7 \quad - \quad 7 = 0$

$-5 \quad - \quad -5 = 0$

$-10 \quad + \quad 10 = 0$

$3 + (-3)$

$= 3 - 3$

$= 0$

$-5 - (-5)$

$= -5 + 5$

$= 0$

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CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

KEY CONCEPTS

A system of linear equations can be solved *algebraically* using the **elimination** method.

To solve a linear system by *elimination*, the equations are added or subtracted to eliminate one variable.

When each term in an equation is **multiplied by a constant**, the resulting equation produces the same line when graphed.

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(a) Solve the following system of linear equations.

(1) $x + 1y = 1$

(2) $-\ x + 3y = -1$

$-2y = 2$

$1y - (+3y)$
$= 1y - 3y$
$= \mathbf{-2y}$

$1 - (-1)$
$= 1 + 1$
$= \mathbf{2}$

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(a) Solve the following system of linear equations.

(1) $x + y = 1$

(2) $-\ x + 3y = -1$

$-2y = 2$

$\frac{-2y}{-2} = \frac{2}{-2}$

$y = -1$

Substitute **y = – 1** into Equation **(1)**

$x + y = 1$

$x + (-1) = 1$

$x - 1 = 1$

$x = 1 + 1$

$x = \mathbf{2}$

The solution is **(2, – 1)**

* You would get the same answer if you substitute y = – 1 into Equation **(2)**

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(a) Solve the following system of linear equations.

(1) $x + y = 1$

(2) $x + 3y = -1$

Perform a check by substituting **(2, – 1)** into the original equations

x y

EQUATION (1)

LS = x + y

= 2 + (– 1)

= 2 – 1

= **1**

= RS

RS = 1

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(a) Solve the following system of linear equations.

(1) $x + y = 1$

(2) $x + 3y = -1$

Perform a check by substituting **(2, – 1)** into the original equations

x y

EQUATION (2)

LS = x + 3y

= 2 + 3(– 1)

= 2 – 3

= **– 1**

= RS

RS = – 1

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(b) Solve the following system of linear equations.

(1) $3x + y = 17$

(2) $- \; 1x + y = 9$

$2x = 8$

$3x - 1x = \mathbf{2x}$

$17 - 9 = \mathbf{8}$

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(b) Solve the following system of linear equations.

(1) $3x + y = 17$

(2) $-\quad x + y = 9$

$2x = 8$

$\frac{2x}{2} = \frac{8}{2}$

$x = 4$

Substitute **x = 4** into Equation **(2)**

$x + y = 9$

$4 + y = 9$

$y = 9 - 4$

$y = \mathbf{5}$

The solution is **(4, 5)**

* You would get the same answer if you substitute x = 4 into Equation **(1)**

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(b) Solve the following system of linear equations.

(1) $3x + y = 17$

(2) $x + y = 9$

Perform a check by substituting **(4, 5)** into the original equations **x y**

EQUATION (1)

LS = 3x + y RS = 17

= 3(4) + 5

= 12 + 5

= 17

= RS

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 1

Solving Linear Systems by Adding or Subtracting

(b) Solve the following system of linear equations.

(1) $3x + y = 17$

(2) $x + y = 9$

Perform a check by substituting **(4, 5)** into the original equations

x y

EQUATION (2)

LS = x + y

= 4 + 5

= **9**

= RS

RS = 9

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

a) Solve the following system of linear equations. Check your solution.

(1) **x 2** $x - 4y = -11$

(2) $2x + 7y = 8$

(1) $2x - 8y = -22$

(2) $2x + 7y = 8$

We need to multiply each term by **2** to get rid of *x*

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where both co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

a) Solve the following system of linear equations. Check your solution.

(1) $2x - 8y = -22$

(2) $-\ (2x + 7y = 8)$

$-15y = -30$

$-8y - (+7y)$
$= -8y - 7y$
$= \mathbf{-15y}$

$-22 - 8$
$= \mathbf{-30}$

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

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EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

a) Solve the following system of linear equations. Check your solution.

(1) $2x - 8y = -22$

(2) $-\ 2x + 7y = 8$

$$-15y = -30$$

$$\frac{-15y}{-15} = \frac{-30}{-15}$$

$$y = \mathbf{2}$$

Substitute **y = 2** into Equation **(2)**

$2x + 7y = 8$

$2x + 7(2) = 8$

$2x + 14 = 8$

$2x = 8 - 14$

$2x = -6$

$$\frac{2x}{2} = \frac{-6}{2}$$

$$x = -3$$

The solution is **(– 3, 2)**

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

a) Solve the following system of linear equations. Check your solution.

(1) $x - 4y = -11$

(2) $2x + 7y = 8$

The solution is **(– 3, 2)**

Perform a check by substituting **(– 3, 2)** into the original equations **x y**

EQUATION (1)

LS = x – 4y RS = – 11

= – 3 – 4(2)

= – 3 – 8

= – 11

= RS

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

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EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

a) Solve the following system of linear equations. Check your solution.

(1) $x - 4y = -11$

(2) $2x + 7y = 8$

The solution is **(– 3, 2)**

Perform a check by substituting **(– 3, 2)** into the original equations **x y**

EQUATION (2)

LS = $2x + 7y$ RS = 8

$= 2(-3) + 7(2)$

$= -6 + 14$

$= \mathbf{8}$

= RS

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

b) Solve the following system of linear equations. Check your solution.

(1) $-2x - 4y = -12$

(2) $5x + y = 21$ **x 4**

(1) $-2x - 4y = -12$

(2) $20x + 4y = 84$

We need to multiply each term by **4** to get rid of *y*

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where both co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

b) Solve the following system of linear equations. Check your solution.

(1) $-2x - 4y = -12$

(2) $+ \; 20x + 4y = 84$

$18x = 72$

$-2x + 20x = \mathbf{18x}$

$-12 + 84 = \mathbf{72}$

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

b) Solve the following system of linear equations. Check your solution.

(1) $-2x - 4y = -12$

(2) $+\ 20x + 4y = 84$

$18x = 72$

$\frac{18x}{18} = \frac{72}{18}$

$x = \mathbf{4}$

Substitute **x = 4** into Equation **(1)**

$-2x - 4y = -12$

$-2(4) - 4y = -12$

$-8 - 4y = -12$

$-4y = -12 + 8$

$\frac{-4y}{-4} = \frac{-4}{-4}$

$y = \mathbf{1}$

The solution is **(4, 1)**

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

b) Solve the following system of linear equations. Check your solution.

(1) $-2x - 4y = -12$

(2) $5x + y = 21$

The solution is **(4, 1)**

Perform a check by substituting **(4, 1)** into the original equations **x y**

EQUATION (1)

LS $= -2x - 4y$

$= -2(4) - 4(1)$

$= -8 - 4$

$= \mathbf{-12}$

$= RS$

RS $= -12$

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 2

Solving Linear Systems by Multiplying with a Constant

b) Solve the following system of linear equations. Check your solution.

(1) $-2x - 4y = -12$

(2) $5x + y = 21$

The solution is **(4, 1)**

Perform a check by substituting **(4, 1)** into the original equations **x y**

EQUATION (2)

LS = 5x + y

= 5(4) + 1

= 20 + 1

= **21**

= RS

RS = 21

STEPS:

1. Choose a variable to eliminate

→ Choose a variable where <u>both</u> co-efficients are the same

2. If necessary, **multiply** the equations by a factor to make the co-efficients the same

3. **Add** or **subtract** the equations to eliminate the variable

4. Solve for the remaining variable

5. Substitute this variable into **(1)** or **(2)** to solve for the other

6. State the solution

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 3

Cody was at the music store and purchased a total of **13** CDs and DVD.

Cody spent **$5** for each CD and **$10** for each DVD for a total of **$110**.

How many of each did Cody buy?

(a) Using **c** to represent the # of CDs and **d** to represent the number of DVDs, write the two equations which describe this situation

Total # of CDs: **(1)** $c + d = 13$

Total cost: **(2)** $5c + 10d = 110$

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 3

Total # of CDs: **(1) x 5** $c + d = 13$

We need to multiply each term by **5** to get rid of *c*

Total cost: **(2)** $5c + 10d = 110$

(b) Using the equations above, solve the linear system to determine how many of each Cody bought.

$$\begin{array}{rl} (1) & 5c + 5d = 65 \\ (2) & - \quad 5c + 10d = 110 \\ \hline & -5d = -45 \end{array}$$

$5d - (+10d)$
$5d - 10d$
$= \mathbf{-5d}$

$65 - 110$
$= \mathbf{-45}$

CHAPTER 5.3 SOLVE LINEAR SYSTEMS BY ELIMINATION

EXAMPLE 3

Total # of CDs: **(1) x 5** $c + d = 13$

We need to multiply each term by **5** to get rid of *c*

Total cost: **(2)** $5c + 10d = 110$

(b) Using the equations above, solve the linear system to determine how many of each Cody bought.

(1) $5c + 5d = 65$

(2) $-\ 5c + 10d = 110$

$-5d = -45$

$-5 \quad -5$

$d = \mathbf{9}$

Substitute **d = 9** into original Equation **(1)** to solve for **c**

$c + d = 13$

$c + 9 = 13$

$c = 13 - 9$

$c = \mathbf{4}$

Cody bought **4 compact discs** and **9 DVDs**

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HOMEWORK:

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(Day 1) #1ace, 2ace, 3ac, 4ac

(Day 2) #6, 9