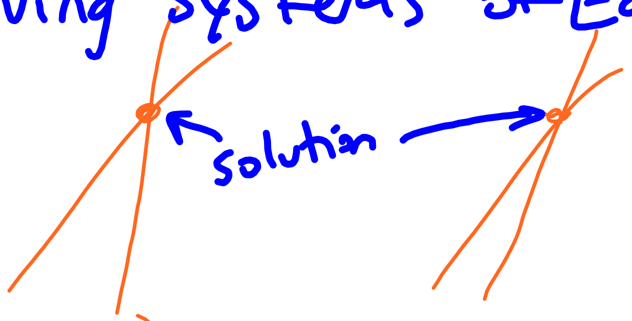
Solving Systems of Equations



① (0,1)   2 (1,2)

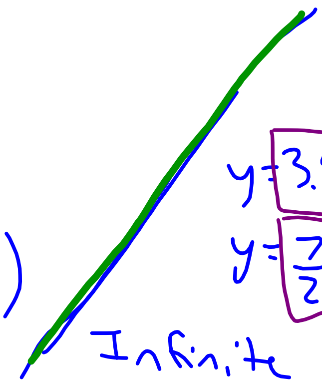
④

$y = \boxed{-\frac{5}{2}}x - 7$

$y = \boxed{-\frac{5}{2}}x - 1$

No solution

5)



$y = \boxed{3.5}x - 4$

$y = \boxed{\frac{7}{2}}x - 4$

Infinite solutions

⑥

Parallel?

$y = \boxed{5}x - 1$

$y = \boxed{6}x - 5$

No.

to find the solution/intersection point we need to solve the system algebraically...

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4-2 Practice Solving Systems of Equations by Substitution

Use substitution to solve each system of equations.

1. $\begin{cases} y = -x + 4 \\ y = 3x \end{cases}$

Step 2: Substitute

$y = 3x$

$(-x+4) = 3x$

Step 3: Distribute, Simplify, Solve

$-x + 4 = 3x$

$+x \quad +x$

$4 = 4x$

$\frac{4}{4} = \frac{4x}{4}$

$1 = x$

Step 4: Substitute into original

$y = 3x$

$y = 3(1)$

$y = 3$

Step 5: Write Coordinate

$\boxed{(1, 3)}$

2. $\begin{cases} y = 2x - 10 \\ 2y = x - 8 \end{cases}$

2: $2(2x-10) = x - 8$

$4x - 20 = x - 8$

3: $-x \quad -x$

$3x - 20 = -8$

$+20 \quad +20$

$\frac{3x}{3} = \frac{12}{3}$

$x = 4$

4: $y = 2(4) - 10$

$y = 8 - 10$

$y = -2$

5: $\boxed{(4, -2)}$

4. $\begin{cases} x = 2y - 6 \\ y = 3x - 7 \end{cases}$

Step 2: $y = 3(2y-6) - 7$

Step 3: $y = 6y - 18 - 7$

$y = 6y - 25$

$-6y \quad -6y$

$-5y = -25$

$\frac{-5y}{-5} = \frac{-25}{-5} \rightarrow y = 5$

Step 4:

$x = 2(5) - 6$

$x = 10 - 6$

$x = 4$

Step 5: $\boxed{(4, 5)}$

5. $\begin{cases} 6x - 4y = 18 \quad (A) \\ -x - 6y = 7 \quad (B) \end{cases}$

Step 1: Solve for x

(B) $-x - 6y = 7$

$+x \quad +x$

$-6y = x + 7$

$-7 \quad -7$

$-6y - 7 = \boxed{x}$

2: (A) $6(-6y-7) - 4y = 18$

$-36y - 42 - 4y = 18$

$-40y - 42 = 18$

3: $+42 \quad +42$

$\frac{-40y}{-40} = \frac{60}{-40}$

$y = -1.5$

4: $x = -6y - 7$

$x = -6(-1.5) - 7$

5: $x = 9 - 7$

$x = 2$

$\boxed{(2, -1.5)}$

7. $\begin{cases} y = 3x + 8 \\ 2y = 6x + 16 \end{cases}$

$2(3x+8) = 6x + 16$

$6x + 16 = 6x + 16$

$-6x \quad -6x$

$16 = 16$

$0 = 0$

Infinite solutions

8. $\begin{cases} -4x + y = 5 \\ 12x - 3y = 9 \end{cases}$

$-4x + y = 5$

$+4x \quad +4x$

$y = 4x + 5$

$12x - 3(4x+5) = 9$

$12x - 12x - 15 = 9$

$-15 = 9$

False

No solution

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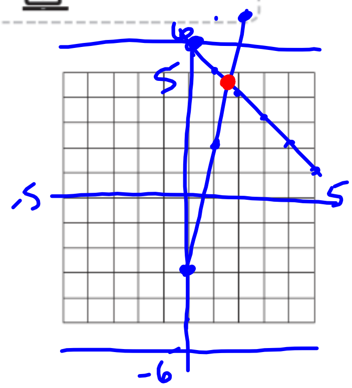
10. Solve the system $\begin{cases} x + y = 6 & A \\ 5x - \boxed{y} = 3 & B \end{cases}$
by graphing and by substitution. Compare the methods. Which method is more accurate? Explain.



Solve using Substitution

Step 1: Solve for y $x + y = 6$ A

$-x \quad -x$

Step 2 $\boxed{y} = -x + 6$ A

Step 3 B $5x - (-x + 6) = 3$

$5x + x - 6 = 3$

$6x - 6 = 3$

$+6 \quad +6$

$\frac{6x}{6} = \frac{9}{6}$

$x = 1.5$

Step 4 A $x + y = 6$

Step 5 $1.5 + y = 6$

$y = 4.5$

$(1.5, 4.5)$

Solve by graphing

Step 1: Solve BOTH equations for y

B $5x - y = 3$

$+y \quad +y$

Step 2: Label Axes, Determine scale, Graph lines

$5x = y + 3$

$-3 \quad -3$

Step 3: Find Intersection point

$(1.5, 4.5)$

$5x - 3 = y$

B $y = 5x - 3$

A $y = -x + 6$

11. A community theater sold a total of 400 full-price tickets for adults and children. The price was $8.00 per adult ticket and $5.00 per children's ticket. If the total revenue was $2,750, how many adult tickets and how many children's tickets were sold?

Determine Variables

x: # adult tickets **y:** # of children tickets **Solve System**

Write Equations:

A. $8\boxed{x} + 5y = 2750$

B. $x + y = 400 \rightarrow \boxed{x} = (400 - y)$

$8(400 - y) + 5y = 2750$

$3200 - 8y + 5y = 2750$

$3200 - 3y = 2750$

$-3200 \quad -3200$

$\frac{-3y}{-3} = \frac{-450}{-3}$

$y = 90$ child tickets sold

$x + y = 400$

$x + 90 = 400$

$-90 \quad -90$

$x = 310$ adult tickest sol ld

Introducing 3 Variable Linear Systems! Name:________________

NO Chocolate, Just Eggs!

Suzanne likes to try new recipes. The first time she tried one she needed to buy three ingredients. Eggs, milk, and chocolate. The second time she made a new recipe she had enough eggs but she still needed to buy milk and chocolate. The last time she tried a recipe she only had to buy the chocolate.

This system of linear equations is representative of her purchases:

$$\begin{cases} x + 3y + 4z = \$29 \\ 7y + 2z = \$34 \\ z = \$3 \end{cases}$$

"what does the variable represent"

$7y + 2(3) = 34$
$7y + 6 = 34$
$7y = 28$
$y = 4$

Define each variable:

x = price of eggs, y = price of milk, z = price of chocolate

What did the chocolate cost? $3

What did the milk cost? $4

How can you use the previous answers to find the cost of the eggs?

Substitute 3 for z and 4 for y into 1st equation & solve for x

What did the eggs cost?

$x + 3(4) + 4(3) = 29$

$x = \$5$

Let's eliminate the chocolate, because I **really** only like the eggs!

I have many recipes that include eggs, milk, and chocolate. I usually cook for large crowds, too! The system below shows my purchases for the last three "large crowd" cook-outs.

$$\begin{cases} \text{Purchase 1} & (12x + 5y + 3z = \$81.20)\cdot -1 \\ \text{Purchase 2} & 15x + 7y + 3z = \$101.05 \\ \text{Purchase 3} & (8x + 3y + 3z = \$56.90)\cdot -1 \end{cases}$$

Use purchase 1 & 2 to eliminate the chocolate:

$$\begin{array}{r} -12x - 5y - 3z = -81.20 \\ 15x + 7y + 3z = 101.05 \\ \hline -2\cdot(3x + 2y = 19.85) \end{array}$$

Use purchase 2 & 3 to eliminate the chocolate:

$$\begin{array}{r} 15x + 7y + 3z = 101.05 \\ + \; -8x - 3y - 3z = -56.90 \\ \hline 7x + 4y = 44.15 \end{array}$$

Put your two new equations together:
What do they represent?

the differences in total cost for eggs + milk

Well, now that you've eliminated the chocolate, I'M HAPPY! You can eliminate the next ingredient. Choose whichever one you wish to eliminate.

$$\begin{array}{r} -6x - 4y = -39.70 \\ + \; 7x + 4y = 44.15 \\ \hline x = 4.45 \end{array}$$

$$3(4.45) + 2y = 19.85$$
$$13.35 + 2y = 19.85$$
$$2y = 6.5$$
$$y = 3.25$$

So what was the cost of the item that you did not eliminate? \$4.45 for eggs

What was the item you eliminate and it's cost? \$3.25 for milk

How much \$\$\$ was the chocolate? \$3.85

$$8x + 3y + 3z = 56.40$$
$$8(4.45) + 3(3.25) + 3z = 56.9$$
$$35.6 + 9.75 + 3z = 56.9$$
$$3z = 11.55$$
$$z = \$3.85 \text{ for}$$

Use substitution to solve each system of equations.

1. $\begin{cases} y = 2x - 10 \\ 2y = x - 8 \end{cases}$

Step 2: Substitute

$2(2x-10) = x-8$

$4x - 20 = x - 8$

$+20 \quad +20$

$4x = x + 12$

$-x \quad -x$

$3x = 12$

$\frac{3x}{3} = \frac{12}{3}$

$x = 4$

Step 3: Distribute, Simplify, Solve

Step 4: Substitute into original

$y = 2(4) - 10$

$y = 8 - 10$

$y = -2$

Step 5: Write Coordinate

$(4, -2)$

Use elimination to solve each system of equations.

1. $\begin{cases} -3x + 6y = -30 \\ 3x + y = -12 \end{cases}$

$-3x + 6y = -30$

$+ \; 3x + y = -12$

$7y = -42$

$y = -6$

Step 2: Add equations together to eliminate a variable

$3x + (-6) = -12$

$3x = -6$

$x = -2$

Step 3: Solve for remaining variable

$(-2, -6)$

Step 4: Plug in to one of the original equations to solve for other variable

Step 5: Write Coordinate as (x,y)

Notes___Solving 3 x 3 System by Elimination Date_____ Name:________________________

Objective: Solve systems of equations of three variables using a variety of methods Section 1.4 BIM Algebra 2 Text p29-36

- Solving system of three variable equations through **elimination**

A. $x + 2y + 2z = 5$ **B.** $(3x + y - z = 4)2$ **C.** $(4x + y - z = 3)\cdot -1$	Solution Method • Step 1: Eliminate z from 2 of the equations • Step 2: Solve the resulting 2 x 2 linear system • Step 3: Use results of 2 x 2 system solve to find z

Step 1: Show the work to eliminate **z** from equations _B_ and _C_ B $3x + y - z = 4$ C $+ -4x - y + z = -3$ $\frac{-x}{-1} = \frac{1}{-1}$ D $x = -1$	Step 1: Show work to eliminate **z** from equations _A_ and _B_ A $x + 2y + 2z = 5$ B $+ 6x + 2y - 2z = 8$ E $7x + 4y = 13$	Step 1.5: Write the system of two equations for new equations D and E D $x = -1$ E $7x + 4y = 13$

Step 2: Solve the system of two new equations D and E to find **x** and **y**: Choose elimination or substitution

Solve for _x_ $x = -1$	Solve for _y_ E $7(-1) + 4y = 13$ $-7 + 4y = 13$ $+7 \quad\quad +7$ $\frac{4y}{4} = \frac{20}{4}$ $y = 5$

Step 3: Use the values of **x** and **y** to find **z** through substitution in to one of the original three equations B $3x + y - z = 4$ $3(-1) + (5) - z = 4$ $-3 + 5 - z = 4$ $2 - z = 4 \rightarrow z = -2$ Answer: $\boxed{(-1, 5, -2)}$ x, y, z	Elimination Video Link https://www.youtube.com/watch?v=UcYbFN49uGc https://www.youtube.com/watch?v=CdpFu7t0dJ4 https://www.youtube.com/watch?v=a3S2NQJYI5oCheck your answer by plotting the equations and your point in GeoGebra 3D https://www.geogebra.org/3d?lang=en

Notes ___Solving 3 x 3 System by Substitution Date_____ Name:_________________________

Objective: Solve systems of equations of three variables using a variety of methods

Section 1.4 BIM Algebra 2 Text p29-36

- Solving system of three variable equations through **substitution**

A. $\boxed{y} = 2x - z - 15$
B. $4x + 5\boxed{y} + 2z = 10$
C. $-x - 4\boxed{y} + 3z = -20$

Solution Method **substitution**

- Step 1: substitute the expression in for y into the 2 other equations to eliminate y
- Step 2: Solve the resulting 2 x 2 linear system
- Step 3: Use results of 2 x 2 system solve to find y

Step 1: Show the work to substitute the expression in replacing **y** which will eliminate **y** from equation B

B $4x + 5(2x - z - 15) + 2z = 10$

$4x + 10x - 5z - 75 + 2z = 10$

$14x - 3z - 75 = 10$

$+75 \quad +75$

D $14x - 3z = 85$

Step 1: Show the work to substitute the expression in replacing **y** which will eliminate **y** from equation C

C $-x - 4(2x - z - 15) + 3z = -20$

$-x - 8x + 4z + 60 + 3z = -20$

$-9x + 7z + 60 = -20$

$-60 \quad -60$

E $-9x + 7z = -80$

Step 1.5: Write the system of two equations for new equations D and E

D $(14x - 3z = 85) \cdot 7$

D $98x - 21z = 595$

E $(-9x + 7z = -80)3$

E $-27x + 21z = -240$

Step 2: Solve the system of two new equations A and B to find **x** and **z**: Choose elimination or substitution

E $-27x + 21z = -240$

D $+\ 98x - 21z = 595$

$71x = 355$

$\frac{71x}{71} = \frac{355}{71}$

$x = 5$

E $-9x + 7z = -80$

$-9(5) + 7z = -80$

$-45 + 7z = -80$

$\frac{7z}{7} = \frac{-35}{7}$

$z = -5$

Step 3: Use the values of **x** and **z** to find **y** through substitution in to one of the original three equations

A $y = 2x - z - 15$

$y = 2(5) - (-5) - 15$

$y = 10 + 5 - 15 = 0$

Answer: $\boxed{(5, 0, -5)}$

x y z

Substitution Video Link
https://www.youtube.com/watch?v=a3S2NQJYI5o
https://www.youtube.com/watch?v=YriMMWbndn0
https://www.youtube.com/watch?v=cS_Sk-UaBg4
Check your answer by plotting the equations and your point in GeoGebra 3D
https://www.geogebra.org/3d?lang=en