Your Name

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Notes

Lesson 1.4 - Solving Systems of 3 Variable Equations

Graphing, Checking, and Substitution

Math Skill Objective:

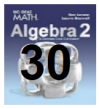
- Visualize solutions of systems of equations in 3 variables
- Check if an ordered triple is a solution to the system.
- Solve systems of equations with 3 variables algebraically using substitution

Life Lesson: As you get older, your problems become bigger and more complicated. You must use what you know and extend that knowledge to solve the new and bigger problems you are faced with. One way is to put something aside so that you can solve a simpler problem you are familiar with first, and then go back and solve the entire problem.

A linear equation in three variables, *x*, *y*, and *z* is an equation of the form $ax + by + cz = d$ where *a*, *b* and *c* are not all zero.

A solution of such a system is an ordered triple (*x*, *y*, *z*) whose coordinates make each equation true.

The graph of a linear equation in three variables is a plane in 3-dimensional space.



$0x + 0y + 0z = d$

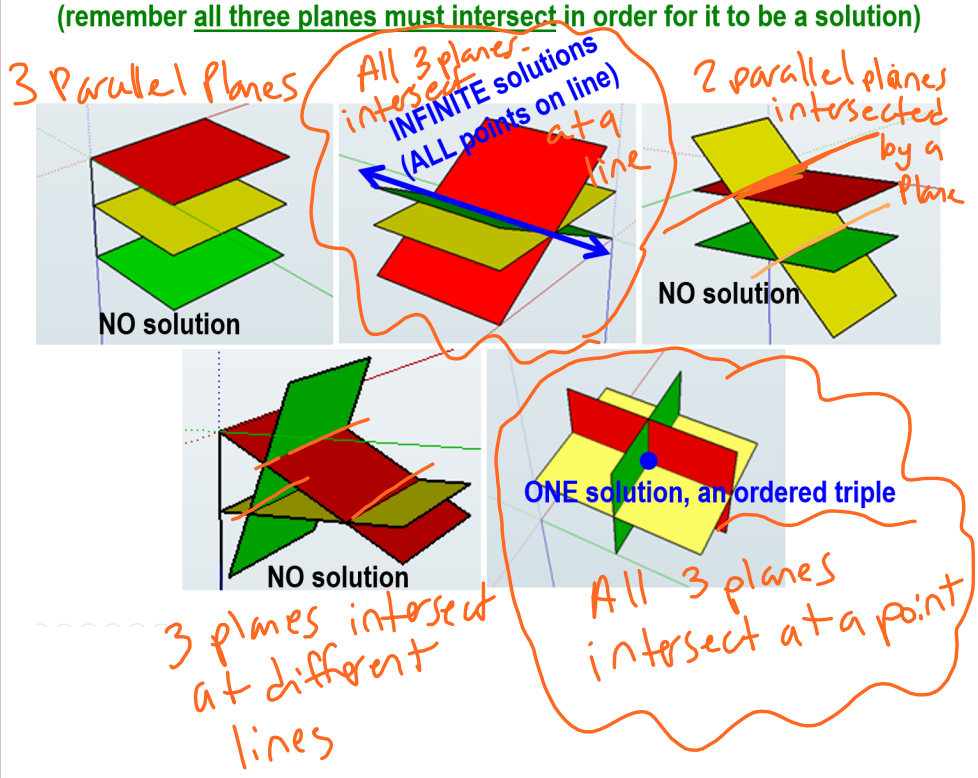
$0 = d$

3 Variable System

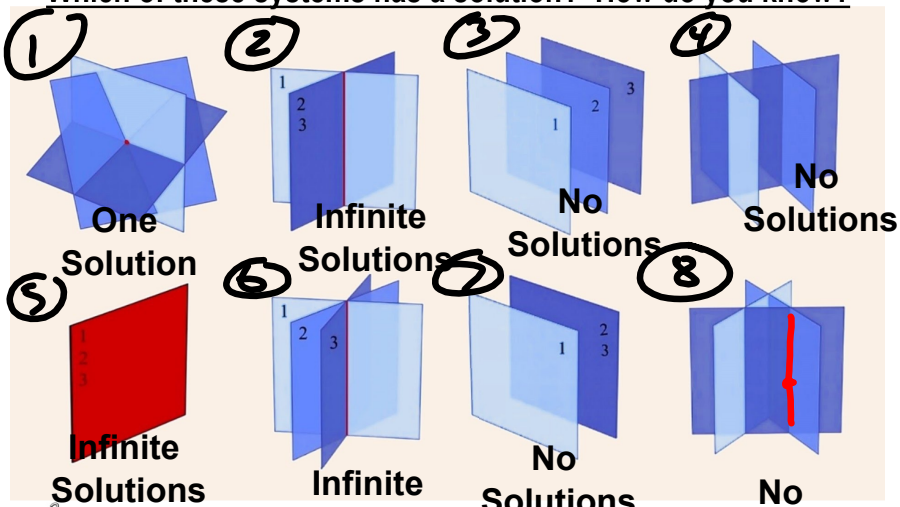
Types of Solutions

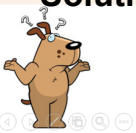
Ways Three Planes Can Intersect & Solution Implications

(remember all three planes must intersect in order for it to be a solution)



Which of these systems has a solution? How do you know?



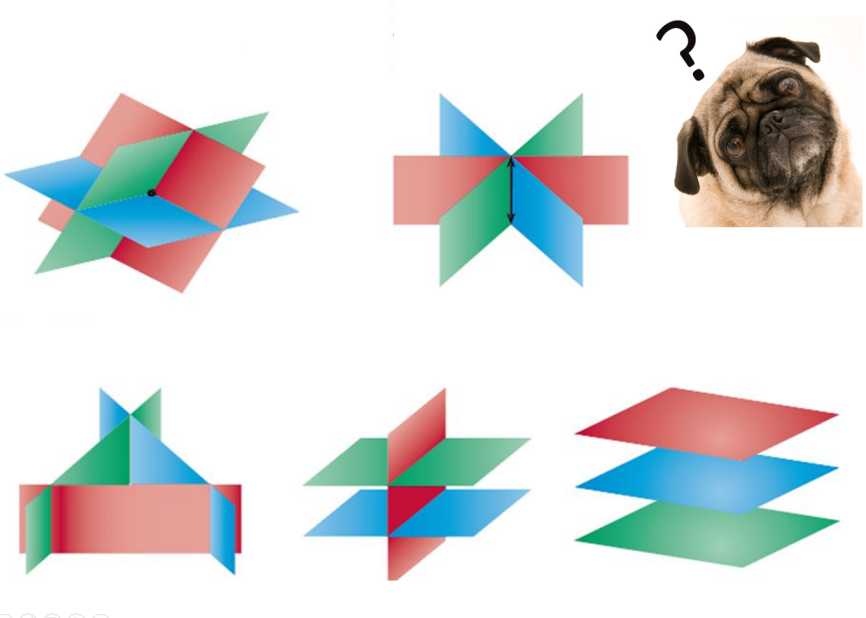


One Solution

Infinite Solutions

No Solutions

Which of these systems has a solution? How do you know?



One Solution

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Checking if an ordered triple is a solution

If an ordered triple works for all three equations when substituted in, then it is a solution to the system

Here is a *system of three linear equations* in three variables:

$$\begin{cases} x+2y-3z=-3 \\ 2x-5y+4z=13 \\ 5x+4y-z=5 \end{cases}$$

The ordered triple (2,-1,1) is a **solution** to this system since it is a solution to all three equations.

$$\begin{cases} 2+2(-1)-3(1)=2-2-3=-3 \checkmark \\ 2(2)-5(-1)+4(1)=4+5+4=13 \checkmark \\ 5(2)+4(-1)-1=10-4-1=5 \checkmark \end{cases}$$

Decide whether the given ordered triple is a solution of the system.

2. $(-1,-2,5)$

$$2x+y-5z=-29$$
$$6x+4y-z=-19$$
$$x+y+2z=7$$

$(-1,-2,5)$ is a solution

$2(-1)+(-2)-5(5)=-29$

$-2 \quad -2 \quad -25$

$-29 \quad = -29 \checkmark$

$6(-1)+4(-2)-(5)=-19$

$-19 \quad = -19 \checkmark$

$(-1)+(-2)+2(5)=7$

$7 \quad = 7 \checkmark$

Solving 3 Variable System by Substitution

1. Pick the equation you will solve for one variable for and do so.
2. Substitute that expression in for the variable into the two other equations which will create two new equations with the same two variables
3. Solve the new system of two variables using elimination or substitution (again).
4. Plug the two solutions for the variables you found back in to one of the original 3 variable equations to solve for the third variable.

Ex 1: $x + 2y + 3z = 225$

$x + y + z = 115$

$y = 4x$

step 1

step 2 $x + 2(4x) + 3z = 225$ $x + (4x) + z = 115$

$x + 8x + 3z = 225$ $-3(5x + z = 115)$

$9x + 3z = 225$ two new equations w/ same two variables

step 3 $-15x - 3z = -345$ Choose your method Substitution or Elimination?

$-6x = -120$

$\frac{-6x}{-6} = \frac{-120}{-6}$

$x = 20$

$5x + z = 115$

$5(20) + z = 115$

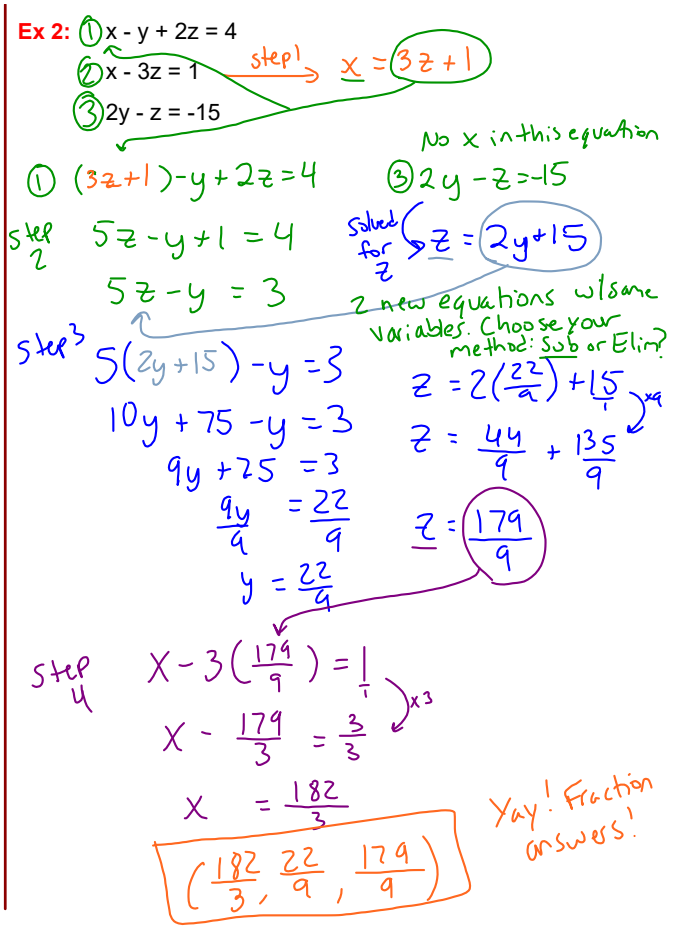
$100 + z = 115$

$z = 15$

$y = 4(20)$

$y = 80$

$(20, 80, 15)$



Homework:

1.4 Part 1 p.34 #1,23-26

And

1.4 Part 2 below

To be a system solution, an ordered triple must satisfy ALL three equations

Decide whether the given ordered triple is a solution of the system.

1. $(0, 0, 3)$

$3x + 4y + z = 3$

$-2x + 7y + 2z = 6$

$-10x + 12y - z = -3$

2. $(-1, -2, 5)$

$2x + y - 5z = -29$

$6x + 4y - z = -19$

$x + y + 2z = 7$

3. $(0, 0, 0)$

$x + y + z = 0$

$2x + 3y - z = 0$

$3x + y - 4z = 1$

4. $(-1, -3, -2)$

$x - 5y + 6z = 2$

$3x - y + 8z = -16$

$4x + 2y - 7y = 4$

5. $(5, 7, 1)$

$x + y + z = 13$

$2x - 7y + 5z = -34$

$3x + y + 4z = 25$

6. $(-4, 8, -9)$

$x + 2y - 3z = 39$

$2x + y - 7z = -63$

$3x + y + z = -13$

1,2,4 are

3,5,6 are not