Chapter 3.2 Solve Systems of 7 Equations & 2 Variables!

\[ x - y = 4 \]
\[ 2x + y = 5 \]

**Goal:** Find an \((x, y)\) pair that satisfies both equations

\[ x = 3, y = -1 \]

**Check Answer**

1. \[ 3 - (-1) = 4 \Rightarrow 3 + 1 = 4 \]
2. \[ 2(3) + (-1) = 5 \Rightarrow 6 + (-1) = 5 \]

2 Methods To Find The Answer

1) Substitution To Use This Method When It Is Easy!

To isolate a variable (when have 1 or -1 coefficient)

**A. Step 1** - Isolate a variable (pick any equation that has the 1 or -1 coeff.)

1. Pick 1st Eq. I will isolate \(x\)

\[ x = 4 + y \]
\[ x = 3 \]

**B. Step 2** - Take this expression for the variable isolated and substitute into other eq.

\[ 2(y + 4) + y = 5 \Rightarrow 2y + 8 + y = 5 \]
\[ 3y = 5 - 8 \]
\[ 3y = -3 \Rightarrow y = -1 \]

Second Substitution Example:

Use the Substitution Method

\[ 2x + 3y = -15 \]
\[ 2x + y = -9 \]

Isolate \(y\)

\[ y = -2x - 9 \]

Sub. INTO Eq. for \(y\)

\[ 2x + 3(-2x - 9) = -15 \]
\[ 2x - 6x - 27 = -15 \]
\[ -4x = 12 \]
\[ x = -3 \]

Sub. INTO \(y\) isolated

\[ y = 2(-3) - 9 \]
\[ y = -6 - 9 \]
\[ y = -3 \]

Answer:

\[ (3, -3) \]
3.2 continued

Method #2: Elimination

We try to make coefficients add opposite.

\((-5, -1, 2, -2)\)

So that they are cancel when we add them together.

Multiply any eq by any number allowed to add any two eq.

\((-2) \cdot (2x + 2y = -8)\)

\[x - y = 4 \implies -2x + 2y = -8\]

\[2x + y = 5 \implies 2x + y = 5\]

\[\frac{3x}{3} = \frac{9}{3} \implies \frac{x = 3}{3} \implies \frac{3y}{3} = \frac{-3}{3} \implies y = -1\]

\[2x + 3y = -15 \implies -2x - 3y = +15\]

\[2x + y = -9 \implies 2x + y = -9\]

\[-2y = 6 \implies y = -3\]

\[2x + 3y = -15 \implies 2x + y = -9 \times 3 \implies -6x - 3y = +27\]

\[2x + y = -9 \implies -4x = 12 \implies x = -3\]

\[-4 \implies y = -3\]

Answer (-3, -3)

Note: Elimination doesn't work well with fractions. However, if many Eds,

As an answer.
System of 3 equations with 3 variables $(x, y, z)$

$2 \times 3 \times 3$ systems

1. Choose any two and eliminate a variable.

2. Pick another pair (not the same pair from the first problem) and eliminate the same variable as in step 1.

3. You now have two equations in two variables. So solve your two equation/two variable system like in 3.2 back substitution the two variable solution into one of the original 3 variable equations to get the final variable value.

1) $x - y + z = 2$ \quad $x, y, z$

2) $2x + y - z = 4$ \quad $(2, 1, 1)$

3) $2x - 3y + z = 2$

Add $^1$ to $^2$ because the $z$ is opposite already.

$1) \quad x - y + z = 2$

$2) \quad 2x + y - z = 4$

$3) \quad 2x - 3y + z = 2$

Add $^2$ to $^1$ \quad $2x + x + y - 2y + z = 8 - 6 = 2y$ \quad Sub $x = 2, y = 1$

$4) \quad x - 2y = 6$

$5) \quad 4(2) - 2y = 6$ \quad $8 - 2y = 6$
# 3.4 - CONTINUED 09-02-08

#17 (Bad Arrangement of Terms) If terms end up on the opposite side, just move it onto the opposite side and change sign. Example:

New 1) \(a + b + 2c = 7\)

New 2) \(a + 2b + c = 8\)

New 3) \(2a + b + c = 9\)

Check for 1's or single variables first.

\[
\begin{align*}
1. & \quad a + b + 2c = 7 \
2. & \quad a + 2b + c = 8 \
3. & \quad 2a + b + c = 9
\end{align*}
\]

*Pick a New Set,

Next, eliminate the same variable

1. \(a + b + 2c = 7 \quad \rightarrow \quad a + b + 2c = 7\)

2. \(a + 2b + c = 8 \quad \rightarrow \quad -2a - 4b - 2c = -16\)

3. \(2a + b + c = 9 \quad \rightarrow \quad -a - 3b = -9\)

\(\text{New Eliminate} \quad \text{Change}(a)\)

\(\text{New Eliminate} \quad \text{Substitute}\)

\(-a - 3b = -9 \quad \Rightarrow \quad \frac{a + 3b = 9}{4b = 8}\)

\(b = 2\)

\(-a - 3b = 9 \quad \Rightarrow \quad \frac{a + 3(2) = 9}{\text{Choose any one:}}\)

\(\frac{a + 6 = 9}{5 + 2c = 7}\)

\(\frac{a = 3}{2c = 7 - 5}\)

Final Answer: \(\left[ \frac{a}{b}, \frac{b}{c}, \frac{c}{1} \right]\)
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IN CLASS WORK

1. 3.2 P245
   #18) Solve by Substitution
   \[2x - y = -21\]
   \[4x + 5y = 7\]

2. 3.2 P245
   #25) Solve by Elimination
   \[5x + 2y = 11\]
   \[7x + 6y = 9\]

3. 3.4 P273
   #16) Solve by Elimination
   \[x + y + z = 4\]
   \[x - y + z = 2\]
   \[x - y - 2z = -1\]