THE METHOD OF SUBSTITUTION

1. Choose an equation and **isolate** one variable (* pick the easiest one!).
2. Substitute one equation into the other (Sub ❶ in ❷).
3. Solve the new equation for the other variable.
4. Substitute that result (x = #) into one of the original equations.
5. Check your solution in both original equations.

Example 1
Solve the linear system using the method of substitution.
❶ y = 2x + 4
❷ 3x + y = 9

Sub what represents y in equation ① into where you see "y" in equation ②

Step 1
① $y = \boxed{2x+4}$
② $3x + y = 9$ replace "y" with 2x+4

Step 2
$3x + 2x + 4 = 9$
$5x + 4 \ ^{-4} = 9 \ ^{-4}$
$\dfrac{5x}{5} = \dfrac{5}{5}$
$\boxed{x = 1}$

Step 3
Sub "1" for "x" in equation ①
① $y = 2x + 4$
$y = 2(1) + 4$
$\boxed{y = 6}$

∴ P.O.I = (1,6)

CHECK

y	2x+4
6	2(1)+4
	6

LS = RS ✓

3x + y	9
3(1)+6	9
9	9

LS = RS ✓

∴ The solution is (1,6)

Example 2
Solve the linear system using the method of substitution.
❶ 2y – 4x = 2
❷ Y = - x + 4

Sub ② into ①

① $2y - 4x = 2$
② $y = -x + 4$

$2(-x + 4) - 4x = 2$
$-2x + 8 - 4x = 2$
$8 - 6x \ ^{-8} = 2 \ ^{-8}$
$\dfrac{-6x}{-6} = \dfrac{-6}{-6}$
$\boxed{x = 1}$

Sub "1" for "x" in equation ②
$y = -(1) + 4$
$\boxed{y = 3}$

P.O.I (solution)
(1,3)

① Subbing
② Solving for "x"
③ Solving for "y"

CHECK (1,3)

2y-4x	2
2(3) - 4(1)	2
6-4	2
2	2

LS = RS

y	-x+4
3	-(1)+4
3	3

LS = RS

∴ (1,3) is the solution

Example 3

Solve the linear system using the method of substitution.

❶ $2x + y = 7$
❷ $x - y = -1$

1) Rearrange ② into $y = mx + b$

$x - y = -1$

$\dfrac{-y}{-1} = \dfrac{-x}{-1} - \dfrac{1}{-1}$

$\boxed{y = x + 1}$

① $2x + y = 7$
② $y = x + 1$

sub ② in ①

$2x + (x+1) = 7$

$3x + 1^{-1} = 7^{-1}$

$\dfrac{3x}{3} = \dfrac{6}{3}$

$\boxed{x = 2}$

sub "2" for "x" in equation ②

$y = x + 1$
$= 2 + 1$
$\boxed{y = 3}$

∴ POI is $(2, 3)$

CHECK $(2, 3)$

$2x + y$	7
$2(2) + 3$	7
$= 4 + 3$	7
$= 7$	7

$LS = RS$ ✓

$x - y$	-1
$2 - 3$	-1
-1	-1

$LS = RS$ ✓

∴ The solution is $(2, 3)$

Example 4

Solve the linear system using the method of substitution.

❶ $2x - y = 4$
❷ $4x + y = 9$

i) Rearrange ① into $y = mx + b$

$2x - y^{-2x} = 4^{-2x}$

$\dfrac{-y}{-1} = \dfrac{-2x}{-1} + \dfrac{4}{-1}$

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

① $y = 2x - 4$
② $4x + y = 9$

sub ① → ②

$4x + (2x - 4) = 9$

$6x - 4^{+4} = 9^{+4}$

$\dfrac{6x}{6} = \dfrac{13}{6}$

$\boxed{x = \dfrac{13}{6}}$

sub "$\dfrac{13}{6}$" for "x"

① $y = 2x - 4$

$= 2 \cdot \left(\dfrac{13}{6}\right) - 4$

$= \dfrac{13}{3} - \dfrac{4 \cdot 3}{1 \cdot 3}$

$= \dfrac{13}{3} - \dfrac{12}{3}$

$= \dfrac{13 - 12}{3}$

$\boxed{y = \dfrac{1}{3}}$

∴ POI is $\left(\dfrac{13}{6}, \dfrac{1}{3}\right)$

CHECK $\left(\dfrac{13}{6}, \dfrac{1}{3}\right)$

y	$2x - 4$
$\dfrac{1}{3}$	$2\left(\dfrac{13}{6}\right) - 4$
	$\dfrac{13}{3} - 4$
	$\dfrac{1}{3}$

$LS = RS$ ✓

$4x + y$	9
$4\left(\dfrac{13}{6}\right) + \dfrac{1}{3}$	9
$\dfrac{26}{3} + \dfrac{1}{3}$	
$\dfrac{27}{3}$	
9	9

$LS = RS$ ✓

∴ The solution is $\left(\dfrac{13}{6}, \dfrac{1}{3}\right)$

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PRACTICE

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1. ① $y = 2x + 1$
   ② $y = -3x - 11$

$2x + 1 \overset{+3x}{=} -3x - 11 \overset{+3x}{}$

$5x + 1^{-1} = -11^{-1}$

$\dfrac{5x}{5} = \dfrac{-12}{5}$

$\boxed{x = \dfrac{-12}{5}}$

$y = 2x + 1$

$= 2\left(\dfrac{-12}{5}\right) + 1$

$= \dfrac{-24}{5} + \dfrac{1 \cdot 5}{1 \cdot 5}$

$= \dfrac{-24 + 5}{5}$

$\boxed{y = \dfrac{-19}{5}}$

$\therefore \left(\dfrac{-12}{5}, \dfrac{-19}{5}\right)$

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2. ① $y = 5x - 2$
   ① $6x + 3y = 36$

① → ②

$6x + 3(5x - 2) = 36$

$6x + 15x - 6 = 36$

$21x - 6^{+6} = 36^{+6}$

$\dfrac{21x}{21} = \dfrac{42}{21}$

$\boxed{x = 2}$

$y = 5x - 2$

$= 5(2) - 2$

$= 10 - 2$

$\boxed{y = 8}$

$\therefore$ POI is $(2, 8)$

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3. ① $2x + y = 3$
   ② $-3x + y = -7$

Rearrange ① into $y = mx + b$

① $y = -2x + 3$

② $-3x + y = -7$

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

$-3x - 2x + 3 = -7$

$-5x + 3^{-3} = -7^{-3}$

$\dfrac{-5x}{-5} = \dfrac{-10}{-5}$

$\boxed{x = 2}$

$y = -2x + 3$

$y = -2(2) + 3$

$y = -4 + 3$

$\boxed{y = -1}$

$\therefore$ POI is $(2, -1)$

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4. $2x + y = -1 \rightarrow y = -2x - 1$
   $x - 13y = 13$

$x - 13(-2x - 1) = 13$

$x + 26x + 13 = 13$

$27x + 13^{-13} = 13^{-13}$

$\dfrac{27x}{27} = \dfrac{0}{27}$

$\boxed{x = 0}$

$y = -2(0) - 1$

$\boxed{y = -1}$

$\therefore$ POI is $(0, -1)$

Need to rearrange for x = and substitute x first instead of y.

5. $2x + 5y = -18 \rightarrow 2x + 5y = -18$
   $x + 2y = -6 \rightarrow x = -2y - 6$

$2(-2y - 6) + 5y = -18$

$-4y - 12 + 5y = -18$

$-12 + y \overset{+12}{=} -18^{+12}$

$\boxed{y = -6}$

$x = -2(-6) - 6$

$= 12 - 6$

$\boxed{x = 6}$

$\therefore$ POI is $(6, -6)$

ANSWERS: 1. (-12/5, -19/5), 2. (2, 8), 3. (2, -1), 4. (0, -1), 5. (6, -6)