3RD METHOD TO SOLVE SYSTEMS

# 7.3 Solve Linear Systems by Adding or Subtracting

**Goal** • Solve linear systems using elimination. (also called linear Combination)

*Your Notes*

① EQUATIONS MUST BE IN STANDARD FORM

$AX + BY = C$

A, B, C are integers

② 3 FLAVORS
- ADDITION
- SUBTRACTION
- MULTIPLICATION

**SOLVING A LINEAR SYSTEM USING THE ELIMINATION METHOD**

Step 1 ADD the equations to ELIMINATE one variable.

Step 2 Solve the resulting equation for the other variable.

Step 3 Substitute in either original equation to FIND THE VALUE OF THE OTHER VARIABLE

STEP 4 : CHECK (X, Y) IN BOTH ORIGINAL EQUATIONS

**Example 1** *Use addition to eliminate a variable*

Solve the linear system: $x + 5y = 9$ Equation 1

$4x - 5y = -14$ Equation 2

NOTICE! 1 variable (Y) has opposite coefficients

**Solution**

1. ADD the equations to eliminate one variable. (Y is eliminated)

$$x + 5y = 9$$
$$4x - 5y = -14$$
$$5x = -5 \quad (X = -1)$$

2. Solve for X

3. Substitute $X = -1$ in either equation

$X + 5Y = 9$ ← PICK AN EQUATION.

$-1 + 5Y = 9$ Substitute $X = -1$

$+1 \quad +1$

$5Y = 10$ Solve for Y

$Y = 2$

The solution is (−1, 2).

Make sure to check your solution by substituting it into each of the original equations.

4. CHECK IN THE ORIGINAL EQ'S

C: $-1 + 5(2) = 9$

$9 = 9$ ✓

C: $4(-1) - 5(2) = -14$

$-4 - 10 = -14$

$-14 = -14$ ✓

(AKA MULTIPLY BY -1)

**Example 2** *Use subtraction to eliminate a variable*

Solve the linear system: $3x - 4y = 2$ Equation 1
$3x + 2y = 26$ Equation 2

NOTICE: 1 variable has the same COEF

**Solution**

1. MULTIPLE 1 EQUATION BY -1 to eliminate one variable. $-1(3x + 2y = 26)$ → $-3x - 2y = -26$

$3x - 4y = 2$

$-6y = -24$

2. Solve for y →

$y = 4$

3. Substitute 4 for y in either equation and SOLVE FOR THE OTHER VARIABLE (x)

Solve for x → $3x + 2(4) = 26$

$3x + 8 = 26$

$-8 \quad -8$

$3x = 18$

$x = 6$

The solution is (6, 4).

4. CHECK: C: $3(6) - 4(4) = 2$

$2 = 2$ ✓

C: $3(6) + 2(4) = 26$

$26 = 26$ ✓

**Checkpoint** Solve the linear system.

1. $-8x + 3y = 12$
$8x - 9y = 12$

$-6y = 24$

$y = -4$

FIND x:

$8x - 9(-4) = 12$

$8x + 36 = 12$

$-36 \quad -36$

$8x = -24$

$x = -3$

C: $-8(-3) + 3(-4) = 12$

$12 = 12$ ✓

C: $8(-3) + -9(-4) = 12$

$-24 + 36 = 12$

$12 = 12$ ✓

NOTICE x has opposite COEF

ADDITION METHOD

2. $x + 6y = 13$ →
$(-2x + 6y = -8)$ $\times -1$ →

$x + 6y = 13$

$2x - 6y = 8$

$3x = 24$

$x = 7$

Notice y has same COEF

MULT 1 EQ by -1

FIND y

$7 + 6y = 13$

$-7 \quad -7$

$6y = 6$

$y = 1$

C: $7 + 6(1) = 13$

$13 = 13$ ✓

C: $-2(7) + 6(1) = -8$

$-8 = -8$ ✓

**Example 3** *Arrange like terms*

Solve the linear system: $6x + 7y = 16$ Equation 1

$y = 6x - 32$ Equation 2

NOT STD FORM

**Solution**

1. Rewrite Equation 2 so that the like terms are arranged in columns. PUT IN STANDARD FORM

$6x + 7y = 16$

$y = 6x - 32$ → $-6x + y = -32$

$6x + 7y = 16$

$-6x + y = -32$ (+)

2. ADD the equations.

$8y = -16$

$\frac{8y}{8} = \frac{-16}{8}$

$y = -2$

3. Solve for OTHER VARIABLE (x)

$6x + 7(-2) = 16$

$6x - 14 = 16$

$+14 \quad +14$

$\frac{6x}{6} = \frac{30}{6}$

$x = 5$

The solution is (5, −2).

4. CHECK: C: $6(5) + 7(-2) = 16$

$30 - 14 = 16$

$+14 \quad +14$

$30 = 30$ ✓

C: $-2 = 6(5) - 32$

$-2 = -2$ ✓

**Checkpoint** Solve the linear system.

3. $4x - 5y = 5$ → $4x - 5y = 5$

$5y = x + 10$ → $-x + 5y = 10$ (+)

$-x \quad -x$

$3x = 15$

$x = 5$

FIND Y

$4(5) - 5y = 5$

$-20 \quad -20$

$\frac{-5y}{-5} = \frac{-15}{-5}$

$y = 3$

C: $4(5) - 5(3) = 5$

$5 = 5$ ✓

C: $5(3) = 5 + 10$

$15 = 15$ ✓

4. $7y = 4 - 2x$ → $2x + 7y = 4$

$2x + y = -8$ → $-1(2x + y = -8)$

$2x + 7y = 4$

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

$6y = 12$

$y = 2$

FIND X:

$7(2) = 4 - 2x$

$-4 \quad -4$

$\frac{10}{-2} = \frac{-2x}{-2}$

$x = -5$

C: $7(2) = 4 - 2(-5)$

$14 = 14$ ✓

C: $2(-5) + 2 = -8$

$-8 = -8$ ✓

# When to use ELIMINATION Method

(EQUATIONS MUST BE IN STANDARD FORM)
$Ax+By=C$

**1** **Addition**: USE when 1 of the variables has opposite COEFFICIENTS. EX:

$$2x + 2y = 10$$
$$3x - 2y = 40$$

**2** **Subtraction**: Use when 1 of the variables has the same coefficient

EX]
$$5x + 2y = 10$$
$$5x + 5y = 50$$

← multiply 1 EQUATION BY -1; Then FOLLOW Addition method.

**3** **MULTIPLICATION**: Use when you cannot use Addition or Subtraction Methods

$$2x + 4y = 10$$
$$-6x - 6y = -12$$

Goal is to eliminate 1 variable by multiplying 1 or BOTH EQUATIONS TO GET OPPOSITE COEF'S FOR 1 OF THE VARIABLES