Solving Systems of Equations by the Addition Method (also called Elimination)

Goal: Add the two equations in the system so that one of the variables is eliminated. (Eq. in same form)

Ex. $(-5x) + 5x = 0$

$2x + (-2x) = 0$

} coeff. of variable must be opposites

Only allowable operations:

Multiply one or both equations by a non-zero number to get the equations in the form in which one of the variables has opposites as coefficients.

Ex. $2x + y = 6$

$3x - y = 4$ Add

$5x = 10$

$\frac{5x}{5} = \frac{10}{5}$

$x = 2$

Solve for y: $2(2) + y = 6$

$4 + y = 6$

$y = 2$

Solution: $(2, 2)$ ✓

Ex $2y = -3x$

$-3x - y = 3$

③ Sol.: $(-2, 3)$ ✓

① Rewrite

$$\begin{array}{r} 3x + 2y = 0 \\ -3x - y = 3 \\ \hline y = 3 \end{array}$$

② Solve for x:

$$\begin{aligned} 2(3) &= -3x \\ \frac{6}{-3} &= \frac{-3x}{-3} \\ -2 &= x \end{aligned}$$

Ex $2[2x - y = 12]$

$3x + 2y = -3$

Eliminate y

$-1, 2$

$\Rightarrow 2$

$2, -2$

$\frac{-2}{-1} = 2$

Add

$4x - 2y = 24$

$3x + 2y = -3$

$7x = 21$

$x = 3$

Solve for y:

$3(3) + 2y = -3$

$9 + 2y = -3$

$2y = -12$

$y = -6$

Solution $(3, -6)$ ✓

Ex $5(3x + 3y = 33)$

$-3(5x - 2y = 27)$

Eliminate x

$3 \cdot 5 \rightarrow 15$

$15, -15$

$\frac{15}{3} = 5$

$\frac{-15}{5} = -3$

Add $15x + 15y = 165$

$-15x + 6y = -81$

$21y = 84$

$\frac{21y}{21} = \frac{84}{21}$

$y = 4$

Solve for x: $3x + 3(4) = 33$

$3x + 12 = 33$

$3x = 21$

$x = 7$

Solution: $(7, 4)$

Ex $-2[-x+3y=4]$

$-2x+6y=8$

Elim. y

$3, 6 \to 6$

$6, (-6)$

$\frac{-6}{3} = -2$

$2x-6y=-8$

$-2x+6y=8$

$0=0$ True

$\Rightarrow$ same line

$\Rightarrow$ infinitely many sol

$\Rightarrow \{(x,y) \mid -x+3y=4\}$

Ex $-2[5x-2y=3]$

$10x-4y=5$

Elim. x

$5, 10 \to 10$

$10, -10$

$\frac{-10}{5} = -2$

$-10x+4y=-6$

Add $10x-4y=5$

$0=-1$ False

$\Rightarrow$ parallel lines

$\Rightarrow$ no solution