



1) Solve the following systems using Substitution :

a) $3x - 4y = 19$ ①
 $x + 4y = 1$ ②
 ② $x = -4y + 1$
 ① $3x - 4y = 19$
 $3(-4y + 1) - 4y = 19$
 $-12y + 3 - 4y = 19$
 $-16y + 3 = 19$ ③
 $-16y = 16$
 $y = -1$
 $x = -4(-1) + 1 = 4 + 1 = 5$

b) $3x + y = 3$
 $x = y - 1$
 $3(y - 1) + y = 3$
 $3y - 3 + y = 3$ ③
 $4y = 6$
 $y = \frac{6}{4} = \frac{3}{2}$
 $x = y - 1 = \frac{3}{2} - 1 = \frac{3 - 2}{2} = \frac{1}{2}$
 $x = 1.5 - 1 = 0.5$

If you are really stuck... Switch to decimals.

Elimination using Addition

Consider the system

$$\begin{array}{r} x - 2y = 5 \quad \text{①} \\ 2x + 2y = 7 \quad \text{②} \\ \hline 3x = 12 \\ \frac{3x}{3} = \frac{12}{3} \\ \boxed{x = 4} \end{array}$$

$(4, -\frac{1}{2})$

$$\begin{array}{r} \text{①} \quad x - 2y = 5 \\ 4 - 2y = 5 \\ -2y = 1 \\ \frac{-2y}{-2} = \frac{1}{-2} \\ \boxed{y = -\frac{1}{2}} \end{array}$$

Elimination using Addition

Consider the system

$$\begin{array}{r}
 x - 2y = 5 \\
 + 2x + 2y = 7 \\
 \hline
 \end{array}$$

^{touch}
 ← Lets add both equations
 ← to each other

Elimination using Addition

Consider the system

$$\begin{array}{r}
 x - 2y = 5 \\
 + 2x + 2y = 7 \\
 \hline
 3x \quad = 12
 \end{array}$$

← Lets add both equations
 ← to each other

solve for x

ANS: (4, y)

$$x = 4$$

Now solve for y (HOW???)

- sub the value of x into one of the equations and solve for y

$$\begin{array}{r}
 x - 2y = 5 \\
 4 - 2y = 5 \\
 - 2y = 1 \\
 y = \frac{-1}{2}
 \end{array}$$

intersection point (4, -0.5)

Elimination using Addition

Same process as before
You can choose to eliminate either x or y

$$x + 3y = 14$$

$$\begin{array}{r} \square \\ -x + 4y = 7 \end{array}$$

Who would you eliminate??

Elimination using Addition

$$\begin{array}{r} x + 3y = 14 \\ + \begin{array}{r} \square \\ -x \end{array} + 4y = 7 \end{array}$$

Add this time

Elimination using Addition

$$\begin{array}{r} x + 3y = 14 \\ -x + 4y = 7 \\ \hline 7y = 21 \end{array}$$

Add this time

$$y = 3$$

$(x, 3)$

solve for x

$$x + 3y = 14$$

$$x + 3(3) = 14$$

$$x + 9 = 14$$

$$x = 14 - 9$$

$$x = 5$$

Solve the system of equations

Example 1)

$$2x + y = 5$$

$$3x - y = 15$$

Example 2)

$$\begin{cases} 6y + x = 11 \\ 2y - x = 5 \end{cases}$$

Elimination Using Subtraction

$$\begin{array}{r}
 \begin{array}{l}
 \overset{-5}{\cancel{6x}} + 11y = -5 \quad \textcircled{1} \\
 \overset{-5}{\cancel{6x}} + 9y = -3 \quad \textcircled{2} \\
 \hline
 \end{array} \\
 \begin{array}{l}
 2y = -2 \\
 \frac{2y}{2} = \frac{-2}{2} \\
 \boxed{y = -1}
 \end{array} \\
 \begin{array}{l}
 \textcircled{1} \quad 6x + 11y = -5 \\
 \quad \quad 6x + 11(-1) = -5 \\
 \quad \quad 6x - 11 = -5 + 11 \\
 \quad \quad \frac{6x}{6} = \frac{6}{6} \\
 \quad \quad \boxed{x = 1}
 \end{array}
 \end{array}$$

Careful you are subtraction all of the second
(switch all signs on the second equation)

May want to change signs and add

Elimination Using Subtraction

$$\begin{array}{r}
 \textcircled{6x} + 11y = -5 \\
 -(\textcircled{6x} + 9y = -3) \\
 \hline
 \end{array}$$

Careful you are subtraction all of the second
(switch all signs on t second equation)

Elimination Using Subtraction

Careful you are subtraction all of the second
(switch all signs on the second equation)

$$\begin{array}{r} 6x + 11y = -5 \\ -6x - 9y = +3 \\ \hline 2y = -2 \end{array}$$

$$y = -1$$

solve for x

$$\begin{aligned} 6x + 11y &= -5 \\ 6x + 11(-1) &= -5 \\ 6x - 11 &= -5 \\ 6x &= -5 + 11 \\ 6x &= 6 \\ x &= 1 \end{aligned}$$

Intersection (1, -1)

Use subtraction to eliminate

a)
$$\begin{array}{r} 7x + 7y = 0 \\ 7x - y = 24 \end{array}$$

b)
$$\begin{array}{r} 7x + 6y = -10 \\ 9x + 6y = -30 \end{array}$$

Math 10 (Numbers Relations & Functions)

Name _____

Elimination

Date _____

Solve each system by elimination.

$$\begin{array}{l} 1) \ 2x + 8y = 8 \\ \quad -3x - 8y = -4 \end{array}$$

$$\begin{array}{l} 2) \ -x + 4y = 7 \\ \quad x + 4y = 25 \end{array}$$

$$\begin{array}{l} 3) \ -9x + 8y = 15 \\ \quad -9x + 6y = 27 \end{array}$$

$$\begin{array}{l} 4) \ -x - 5y = -3 \\ \quad -x + 3y = 13 \end{array}$$

$$\begin{array}{l} 5) \ -5x + 2y = 9 \\ \quad 6x - 2y = -8 \end{array}$$

$$\begin{array}{l} 6) \ 5x + 5y = 30 \\ \quad 5x + 2y = 12 \end{array}$$

$$\begin{array}{l} 7) \ -10x + 8y = -28 \\ \quad 9x + 4y = 14 \end{array}$$

$$\begin{array}{l} 8) \ -6x + y = -15 \\ \quad -12x - 3y = -15 \end{array}$$

$$\begin{array}{l} 9) \ -5x + 10y = -10 \\ \quad -7x - 5y = -14 \end{array}$$

$$\begin{array}{l} 10) \ -5x + 10y = 5 \\ \quad 10x - 4y = 6 \end{array}$$

$$\begin{array}{l} 11) \ 7x - 2y = 24 \\ \quad 3x + 9y = 30 \end{array}$$

$$\begin{array}{l} 12) \ -3x - 2y = 2 \\ \quad -5x - 3y = 6 \end{array}$$

$$\begin{array}{l} 13) \ 3x - 6y = 30 \\ \quad -10x - 9y = -13 \end{array}$$

$$\begin{array}{l} 14) \ 7x - 10y = 0 \\ \quad -9x - 4y = 0 \end{array}$$

$$\begin{array}{l} 15) \ -10x + 7y = 12 \\ \quad -3x + 6y = -12 \end{array}$$

$$\begin{array}{l} 16) \ -3x + 4y = 2 \\ \quad -5x + 3y = 29 \end{array}$$

$$\begin{array}{l} 17) \ -10x - 6y = -14 \\ \quad 8x + 5y = 11 \end{array}$$

$$\begin{array}{l} 18) \ -3x - 2y = 8 \\ \quad -8x - 7y = 18 \end{array}$$

$$\begin{array}{l} 1) \ 2x + 8y = 8 \\ \quad -3x - 8y = -4 \\ \quad \quad (-4, 2) \end{array}$$

$$\begin{array}{l} 2) \ -x + 4y = 7 \\ \quad x + 4y = 25 \\ \quad \quad (9, 4) \end{array}$$

$$\begin{aligned} 3) \quad & -9x + 8y = 15 \\ & -9x + 6y = 27 \\ & \quad \quad (-7, -6) \end{aligned}$$

$$\begin{aligned} 4) \quad & -x - 5y = -3 \\ & -x + 3y = 13 \\ & \quad \quad (-7, 2) \end{aligned}$$

$$\begin{aligned} 5) \quad & -5x + 2y = 9 \\ & 6x - 2y = -8 \\ & \quad \quad (1, 7) \end{aligned}$$

$$\begin{aligned} 6) \quad & 5x + 5y = 30 \\ & 5x + 2y = 12 \\ & \quad \quad (0, 6) \end{aligned}$$

$$\begin{aligned} 7) \quad & -10x + 8y = -28 \\ & 9x + 4y = 14 \\ & \quad (2, -1) \end{aligned}$$

$$\begin{aligned} 8) \quad & -6x + y = -15 \\ & -12x - 3y = -15 \\ & \quad (2, -3) \end{aligned}$$

$$\begin{aligned} 9) \quad & -5x + 10y = -10 \\ & -7x - 5y = -14 \\ & \quad (2, 0) \end{aligned}$$

$$\begin{aligned} 10) \quad & -5x + 10y = 5 \\ & 10x - 4y = 6 \\ & \quad (1, 1) \end{aligned}$$

$$\begin{aligned} 11) \quad & 7x - 2y = 24 \\ & 3x + 9y = 30 \\ & (4, 2) \end{aligned}$$

$$\begin{aligned} 12) \quad & -3x - 2y = 2 \\ & -5x - 3y = 6 \\ & (-6, 8) \end{aligned}$$

$$\begin{aligned} 13) \quad & 3x - 6y = 30 \\ & -10x - 9y = -13 \\ & (4, -3) \end{aligned}$$

$$\begin{aligned} 14) \quad & 7x - 10y = 0 \\ & -9x - 4y = 0 \\ & (0, 0) \end{aligned}$$

$$\begin{aligned} 15) \quad & -10x + 7y = 12 \\ & -3x + 6y = -12 \\ & \quad \quad (-4, -4) \end{aligned}$$

$$\begin{aligned} 16) \quad & -3x + 4y = 2 \\ & -5x + 3y = 29 \\ & \quad \quad (-10, -7) \end{aligned}$$

$$\begin{aligned} 17) \quad & -10x - 6y = -14 \\ & 8x + 5y = 11 \\ & \quad \quad (2, -1) \end{aligned}$$

$$\begin{aligned} 18) \quad & -3x - 2y = 8 \\ & -8x - 7y = 18 \\ & \quad \quad (-4, 2) \end{aligned}$$

Homework:

Math 10B

Name _____

System of Equations: Elimination (Add & Sub)

Date _____

Solve each system by elimination.

1) $8x - 8y = 0$
 $-5x + 8y = -3$

2) $6x - 4y = 6$
 $-8x + 4y = 0$

3) $-3x + 8y = -15$
 $9x - 8y = -3$

4) $x + 3y = 18$
 $3x - 3y = -6$

5) $-x + 5y = -28$
 $x + 3y = -28$

6) $-5x + 3y = 10$
 $5x - 5y = 10$

7) $-4x + 5y = 25$
 $-4x + 6y = 22$

8) $-3x + 5y = 12$
 $-5x + 5y = 0$

11) $5x - y = 19$
 $-9x - y = -9$

12) $-2x + y = 0$
 $-6x + y = 20$

13) $10x = 18 + 8y$
 $-8y = -5x - 27$

14) $8y + 13 = 3x$
 $-8y = 9x + 25$

15) $4 + x = -2y$
 $16 + 8y - x = 0$

16) $-12 + 8x = 6y$
 $-5y - 10 = 4x$

Homework:

Math 10B

Name _____

System of Equations: Elimination (Add & Sub)

Date _____

Solve each system by elimination.

1) $8x - 8y = 0$
 $-5x + 8y = -3$

2) $6x - 4y = 6$
 $-8x + 4y = 0$

$(-3, -6)$ add

3) $-3x + 8y = -15$
 $9x - 8y = -3$

4) $x + 3y = 18$
 $3x - 3y = -6$

$(3, 5)$ add

5) $-x + 5y = -28$
 $x + 3y = -28$

6) $-5x + 3y = 10$
 $5x - 5y = 10$

$(-8, -10)$ add

7) $-4x + 5y = 25$
 $-4x + 6y = 22$

8) $-3x + 5y = 12$
 $-5x + 5y = 0$

$(6, 6)$ sub

9) $-4x - 7y = -15$
 $-4x - 9y = -17$

10) $-5x - 3y = 7$
 $-2x - 3y = -8$

$(-5, 6)$ sub

11) $5x - y = 19$
 $-9x - y = -9$

12) $-2x + y = 0$
 $-6x + y = 20$

$(-5, -10)$ sub

13) $10x = 18 + 8y$
 $-8y = -5x - 27$

14) $8y + 13 = 3x$
 $-8y = 9x + 25$

$(-1, -2)$ sub

~~15) $4 + x = -2y$
 $16 + 8y - x = 0$~~

~~16) $-12 + 8x = 6y$
 $-5y - 10 = 4x$~~

~~$(0, -2)$~~

$$\begin{array}{r} 2) \quad 6x - 4y = 6 \quad \textcircled{1} \\ + \quad -8x + 4y = 0 \quad \textcircled{2} \\ \hline \end{array}$$

$$-2x + 0 = 6$$

$$-2x = 6$$

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

$$\boxed{x = -3}$$

$$6x - 4y = 6$$

$$6(-3) - 4y = 6$$

$$-18 - 4y = 6$$

$$-4y = 6 + 18$$

$$-4y = 24$$

$$y = \frac{24}{-4}$$

$$\boxed{y = -6}$$

$$\begin{array}{r} 2) \quad 6x - 4y = 6 \quad \textcircled{1} \\ + \quad -8x + 4y = 0 \quad \textcircled{2} \\ \hline \end{array}$$

$$-2x + 0 = 6$$

$$-2x = 6$$

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

$$\boxed{x = -3}$$

$$6x - 4y = 6$$

$$6(-3) - 4y = 6$$

$$-18 - 4y = 6$$

$$-4y = 6 + 18$$

$$-4y = 24$$

$$y = \frac{24}{-4}$$

$$\boxed{y = -6}$$

$$8) -3x + 5y = 12 \quad \textcircled{1}$$

$$-(-5x + 5y = 0) \quad \textcircled{2}$$

$$\underline{(-3x + 5y) + 0 = 12 - 0}$$

$$2x = 12$$

$$x = \frac{12}{2}$$

$$\boxed{x = 6}$$

$$-3x + 5y = 12$$

$$-3(6) + 5y = 12$$

$$-18 + 5y = 12$$

$$5y = 12 + 18$$

$$5y = 30$$

$$\boxed{y = 6}$$

$$8) -3x + 5y = 12$$

$$\underline{-(-5x + 5y = 0)}$$

$$8) -3x + 5y = 12$$

$$+ 5x - 5y = 0$$

$$\underline{2x = 12}$$

$$\boxed{x = 6}$$

$$10) \begin{array}{r} -5x - 3y = 7 \\ -(-2x - 3y = -8) \\ \hline \end{array}$$

$$(-5x + 2x) - 3y + 3y = 7 + 8$$

$$-3x = 15$$

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

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

$$-5x - 3y = 7$$

$$-5(-5) - 3y = 7$$

$$25 - 3y = 7$$

$$-3y = 7 - 25$$

$$-3y = -18$$

$$y = \frac{-18}{-3}$$

$$\boxed{y = +6}$$

Elimination using Multiplication

Consider the system

$$\begin{array}{l} \boxed{x + 2y = 6} \text{ ①} \\ 3x + 3y = -6 \text{ ②} \end{array}$$

How are they related?

What could we do to equation 1 to make the "x" equal?

$$\begin{array}{l} \text{①} \times 3 \\ 3(x + 2y = 6) \\ 3x + 6y = 18 \text{ ①} \\ - 3x + 3y = -6 \text{ ②} \\ \hline 3y = 24 \\ \frac{3y}{3} = \frac{24}{3} \\ \boxed{y = 8} \end{array}$$

answer

$$18 - 6$$

$$\text{① } x + 2y = 6$$

$$x + 2(8) = 6$$

$$x + 16 = 6 - 16$$

$$\boxed{x = -10}$$

Elimination using Multiplication

Consider the system

$$\begin{array}{l} x + 2y = 6 \\ 3x + 3y = -6 \end{array}$$

How are they related?

What could we do to equation 1 to make the "x" equal?

multiply equation 1 by 3



Elimination using Multiplication

Consider the system

$$\begin{array}{l} 3x + 6y = 18 \\ 3x + 3y = -6 \end{array}$$

Now subtract the equations



Elimination using Multiplication

Consider the system

$$3x + 6y = 18$$

$$\underline{-3x - 3y = +6}$$

Now subtract the equations

Answer



Elimination using Multiplication

Consider the system

$$3x + 6y = 18$$

$$\underline{-3x - 3y = +6}$$

$$3y = 24$$

$$y = 8$$

Now subtract the equations

Sub into equation 1 (original) or the above

$$x + 2y = 6$$

$$x + 2(8) = 6$$

$$x + 16 = 6$$

$$x = 6 - 16$$

$$x = -10$$

$$(-10, 6)$$

You Try

1)

$$x + 2y = 5$$

$$2x + 6y = 12$$

ANS:

2)

$$x + 2y = 4$$

$$x - 4y = 16$$

ANS:

Warm-Up:

Solve the following system of equations:

$$\frac{x}{2} + \frac{y}{3} = 1 \quad \textcircled{1}$$

$$\frac{x}{4} - \frac{2y}{3} = -1 \quad \textcircled{2}$$

$$\begin{aligned} \textcircled{1} \times 6 \\ 6\left(\frac{x}{2} + \frac{y}{3} = 1\right) \\ \frac{6x}{2} + \frac{6y}{3} = 6 \\ 3x + 2y = 6 \quad \textcircled{1} \\ - \quad 3x - 8y = -12 \quad \textcircled{2} \end{aligned}$$

$$\begin{aligned} \textcircled{2} \times 12 \\ 12\left(\frac{x}{4} - \frac{2y}{3} = -1\right) \\ \frac{12x}{4} - \frac{24y}{3} = -12 \\ 3x - 8y = -12 \quad \textcircled{2} \end{aligned}$$

$$\begin{aligned} 10y &= 18 \\ \frac{10y}{10} &= \frac{18}{10} \\ y &= \frac{18}{10} = \frac{9}{5} \end{aligned}$$

$$\begin{aligned} \textcircled{1} \quad 3x + 2y &= 6 \\ 3x + 2\left(\frac{9}{5}\right) &= 6 \\ 3x + \frac{18}{5} &= 6 \end{aligned}$$

$$3x = \frac{6 \cdot 5}{5} - \frac{18}{5}$$

$$3x = \frac{30 - 18}{5}$$

$$\frac{3x}{3} = \frac{12}{5 \cdot 3}$$

$$x = \frac{12}{15}$$