

Blaise Pascal

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7.1

Solving Systems of Equations by Multiplication/Addition

Solving systems of equations by the addition/elimination method works only if the x or y variables have coefficients that are opposite or can be made opposites by multiplying one of the equations by -1 .

To solve equations when the coefficients are not opposites or cannot be made opposites requires multiplying one or both of the equations by a factor or factors that make the coefficients opposite. In Example 1 below, multiplying the second equation by 2 makes the coefficients opposites.

Example 1 Solve the system: $3x - 4y = -37$ and $x + 2y = 1$.

A. $3x - 4y = -37$ Original system.

B. $x + 2y = 1$

B. $x + 2y = 1$ Multiply equation B by 2, changing $2y$ to $4y$.

$$2[x + 2y = 1]$$

$$2x + 4y = 2$$

A. $3x - 4y = -37$ Add the transformed equation B to equation A to eliminate the y terms.

B. (+) $2x + 4y = 2$

$$\begin{array}{r} 3x - 4y = -37 \\ 2x + 4y = 2 \\ \hline 5x = -35 \end{array}$$

$$\frac{5x}{5} = \frac{-35}{5}$$
 Solve the resulting equation for x .

$$x = -7$$

$-7 + 2y = 1$ Substitute the value of x into one of the original equations and solve it for y . (Equation B is used.)

$$\frac{2y}{2} = \frac{8}{2}$$

$$y = 4$$

$(-7, 4)$ Ordered-pair solution.

$3(-7) - 4(4) = -37$ Since equation B was used to find y , substitute the solution into equation A.

$$-21 - 16 = -37$$

$$-37 = -37$$

Math in History

Jacqueline Pascal, Blaise's sister, wanted to join a convent to become a nun but, out of respect to her father's opposition, she did not do so until after he died. As a nun, Jacqueline's dedicated prayer and her continued communication with Blaise had a great influence on his becoming a Christian.

When one of the coefficients is not a multiple of the other, both equations must be multiplied by the appropriate factors to achieve opposite coefficients.

Example 2 Solve the system: $2x - 3y = -11$ and $3x + 4y = 9$.

- A. $2x - 3y = -11$ Original system. Neither the x , nor the y coefficients are multiples of the other, so both equations must be multiplied to get opposite coefficients.
- B. $3x + 4y = 9$

- A. $4[2x - 3y = -11]$ Equation A multiplied by 4 to get a coefficient of -12 .
 $8x - 12y = -44$

- B. $3[3x + 4y = 9]$ Equation B multiplied by 3 to get a coefficient of 12.
 $9x + 12y = 27$

- A. $8x - 12y = -44$ The transformed equations added.

- B. $(+) \begin{array}{r} 9x + 12y = 27 \\ \hline 17x = -17 \end{array}$

- $x = -1$ Resulting equation solved for x .

- $2(-1) - 3y = -11$ Substitute the value of x into one of the original equations and solve it for y . (Equation A is used.)
 $-2 - 3y = -11$
 $-3y = -9$
 $y = 3$

- $(-1, 3)$ The solution to the system is the ordered-pair $(-1, 3)$.

Sometimes the coefficients of the terms in a system of equations are not opposites. When this happens, both sides of one of the equations must be multiplied by a negative factor.

Any of the methods taught in this course can be used to solve a system of equations. Each method will produce the same solution, but one may be simpler for a given situation. Proficiency in each method makes it easier to determine which method works best for a specific problem.

Example 3 on the next page shows solving a system of equations when both equations must be multiplied by appropriate factors.

Math in History

Etienne Pascal, Blaise Pascal's father, did not want him studying math until he was fifteen. However, Blaise studied on his own and at the age of twelve his father gave him Euclid's book, Elements of Geometry.

“ We understand nothing of the works of God unless we take it as a principle that He wishes to blind some and enlighten others. ”

Blaise Pascal

Example 3 Solve the system: $2x + 3y = -15$ and $5x + 2y = 1$.

A. $2x + 3y = -15$ Original system.

B. $5x + 2y = 1$

A. $5[2x + 3y = -15]$ Multiply equation A by 5 to get a coefficient of $10x$.
 B. $-2[5x + 2y = 1]$ Multiply equation B by -2 to get a coefficient of $-10x$.

A. $10x + 15y = -75$

B. $(+) \begin{array}{r} -10x - 4y = -2 \\ \hline 11y = -77 \end{array}$ Add the transformed equation B to equation A to eliminate the x terms.

$11y = -77$ Solve the resulting equation for y .
 $y = -7$

A. $2x + 3(-7) = -15$ Substitute the value of y into one of the original equations and solve it for x . (Equation A is used.)
 $2x - 21 = -15$

$2x = 6$

$x = 3$

$(3, -7)$ The solution to the system is the ordered pair $(3, -7)$.

Today's Lesson

Solve the systems of equations by using the multiplication/addition method.

1. $\begin{cases} 3x - y = 29 \\ 4x - 5y = 46 \end{cases}$

2. $\begin{cases} 3x - 8y = 65 \\ 2x - y = 13 \end{cases}$

3. $\begin{cases} 2x + 3y = 23 \\ 4x - 5y = 35 \end{cases}$

$$4. \begin{cases} 2x - 3y = 19 \\ 5x + 7y = -25 \end{cases}$$

$$5. \begin{cases} 2x - 3y = 3 \\ 5x + 4y = 42 \end{cases}$$

$$6. \begin{cases} 2x + 7y = 79 \\ 3x - 4y = -41 \end{cases}$$

REVIEW

Multiply the rational expressions. Write your answers in lowest terms. 6.14

$$7. (2 - x) \cdot \frac{2 + x}{x - 2}$$

$$8. \frac{9 - 4x^2}{2xy + 3y} \cdot \frac{4y}{3}$$

$$9. \frac{x + 1}{5x} \cdot \frac{1 - x}{x - 1}$$

Simplify. 5.3

$$10. \sqrt[3]{25} \cdot \sqrt[3]{5}$$

$$11. \sqrt[3]{4} \cdot \sqrt[3]{2}$$

$$12. 10\sqrt{5} \cdot 2\sqrt{3}$$

Subtract the polynomials. 3.12

$$13. (6x^2 + 2 - 5x) - (x^2 - 2x - 1)$$

$$14. (2x^2 - 7y^2 + 6) - (-7y^2 + 2x^2 + 7)$$

Simplify the expressions. 6.12

$$15. -\{ -[-(-60)] \}$$

$$16. -(4x^2 + x^2y^2) - (3y^2 - 12)$$

$$17. \frac{-4(2x - 4)}{2(4 - 2x)}$$

Factor the GCF out of the polynomials. If there is no GCF, write *no GCF*. 3.13

$$18. 18x^3y^2 + 12xy^3 + 6xy^2$$

$$19. 14x^4y + 6xy^2 - 10x^2y$$

Lesson 7.1

20. $18x^3z - 15xyz + 5y$

21. $12m^2n^3 + 6m^2n + 15mn^2$

Multiply the polynomials. 4.12

22. $(3x + 2)(4x - 2y - 5)$

23. $(2x - 3y)(-x + 4y + 3)$

Solve the equations for the specified variable. 4.1

24. $5y + 5 = x$ for y

25. $q = mcT$ for m

26. $5x - 4y = 20$ for y

Solve the inequalities. 5.7

27. $x - 6 \leq 9x$

28. $\frac{x}{3} + 1 < -2$

29. $-6x + 5 > -8 - 7x$

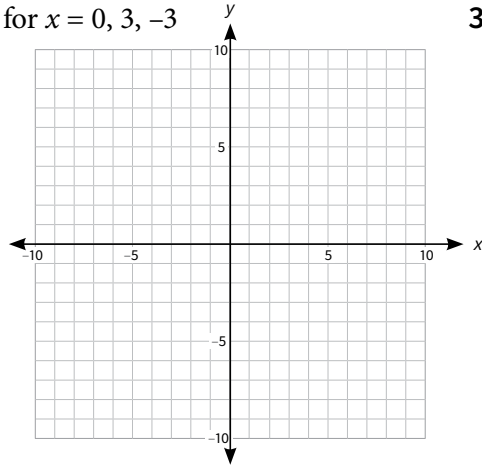
Solve the systems of equations by using substitution. 6.4

30.
$$\begin{cases} 4x - y = -20 \\ 2x + y = 2 \end{cases}$$

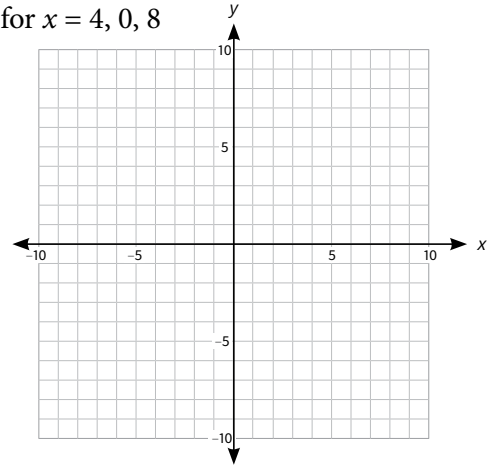
31.
$$\begin{cases} 2x - y = -33 \\ x - 3y = -24 \end{cases}$$

Graph each equation using the given value(s) for x . 4.9

32. $4x - 2y = -8$ for $x = 0, 3, -3$

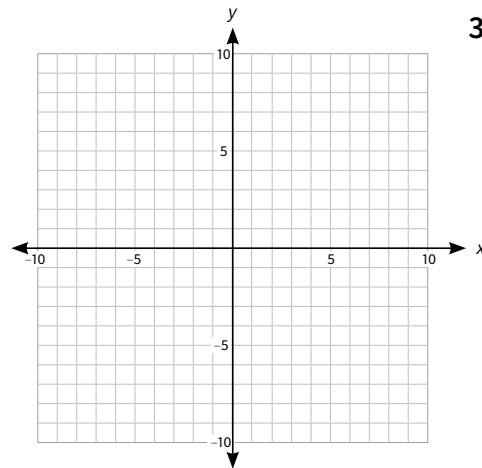


33. $\frac{1}{2}x + 2y = 6$ for $x = 4, 0, 8$

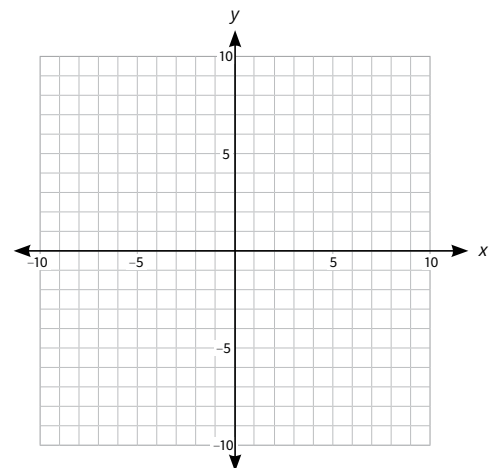


Graph the equations using slope-intercept form. 5.4

34. $y = -\frac{7}{3}x - 1$



35. $4x + 7y = 7$



Lesson 7.1

Use the five steps to set up and solve the equations.

36. Larry's Quik-Lube offers two types of oil changes—standard lube for \$24.95 and a deluxe lube for \$29.95. One day he serviced 38 cars. He knew his total receipts were \$1,033.10, but he failed to record how many of each type he had done. Calculate how many of each type of oil change he sold. 5.8
37. Marcus began filling his 5,000-gallon swimming pool with his household hose at a rate of 7 gallons per minute. Ninety minutes later his neighbor came home and added his hose with a capacity of 6 gallons per minute. If Marcus began filling the pool at 9:00 a.m., when would the pool be filled? Round to the nearest minute. 5.13

Today's Lesson

Solve the systems of equations by using the multiplication/addition method.

38.
$$\begin{cases} 2x + 5y = -190 \\ 5x - 2y = -40 \end{cases}$$

39.
$$\begin{cases} 2x + 3y = -24 \\ 6x + 7y = -52 \end{cases}$$

Extra Practice

Solve the systems of equations by using the multiplication/addition method.

40.
$$\begin{cases} 18x - 12y = 78 \\ 36x - 48y = 132 \end{cases}$$

41.
$$\begin{cases} 6x + 3y = 21 \\ 18x - 6y = 18 \end{cases}$$