

SOLVING TWO-STEP EQUATIONS

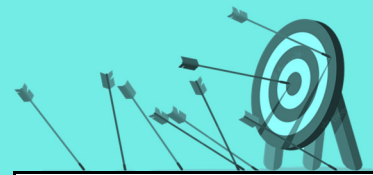


BIG IDEAS:

- Two-step equations can be solved using **inverse (opposite) operations**
- If we do something to one side of an equation, we **must do the same thing** to the other side of the equation
- Before isolating the variable, **collect like terms** on both sides of the equation

LEARNING GOALS AND SKILL DEVELOPMENT:

You know you have met the goals for this lesson when you can:



	LEARNING GOALS	ANCHOR QUESTIONS
EMERGING	Determine the operations, in the correct order, that would need to be applied to both sides of an equation to isolate a variable	1
	Solve two-step equations involving addition, subtraction or multiplication with positive and negative integers	4

SKILL BUILDING QUESTIONS			
1	2	3	4

	LEARNING GOALS	ANCHOR QUESTIONS
EVOLVING	Solve two-step equations that require collecting like terms on both sides of the equation and prove the solution is correct	8
	Solve real-world problems by writing and solving two-step equations and prove the solution is correct	9, 12
	Solve two-step equations involving decimal numbers and prove the solution is correct	10

SKILL BUILDING QUESTIONS			
5	6	7	8
9	10	12	13
14			

	LEARNING GOALS	ANCHOR QUESTIONS
EXTENDING	Solve two-step equations involving the addition or subtraction of polynomials	11
	Solve two-step equations involving square and square root terms	17, 18
	Write and solve two-step equations that make connections to other course topics, such as angle relationships	15

SKILL BUILDING QUESTIONS			
11	15	16	17
18	19		

BUILD YOUR SKILLS

1. State the operations, in order, that could be applied to both sides of the equation to solve for the unknown.

a) $2x+1=7$ b) $9t-5=22$ c) $-2x+10=30$ d) $-5=-3y-11$ e) $13+8x=37$

2. Solve each equation in question #1 (find the value of the variable) and check each answer.

3. Simplify the left and/or right sides of each equation to express it as an equivalent two-step equation. You do not need to solve the equation.

a) $2x+3+4=15$ b) $3y+2y+4=28$ c) $6x-10x-3=83-32$
d) $12a+2+8a-10=52$ e) $-10y-9+4y+3=-55+7$ f) $-4+(-2)=6-2x-(-8)$

4. Solve.

a) $5x+8=23$ b) $-6x-4=8$ c) $26=3y+5$ d) $-52=-2t+12$
e) $31+7m=143$ f) $50=8-6x$ g) $18p-(-22)=22$ h) $57=-x-22$

5. A number, x , is doubled and then increased by 10. The resulting value is 126.

- Write an equation that could be used to determine the value of x .
- Solve your equation to determine the value of x .

6. A number, n , is tripled and then decreased by 40. The resulting value is 146.

- Write an equation that could be used to determine the value of n .
- Solve your equation to determine the value of n .

7. If $6a-4=14$ and $22=-14-3b$, determine the value of $5a-2b$.

8. Find the root of each equation and check your answers.

a) $3x+5+8=46$ b) $4n+n-3=22$ c) $-4x+7x-4+12=-13-27$
d) $3x-4-9x+18=44$ e) $9-20=3x-8-4x$ f) $4p-2+(-7)+p=-12-(-13)$

9. An astronomy club charges a one-time registration fee of \$25 plus an annual fee of \$16. Emerson spent a total of \$201 in membership fees.

- Write an equation to model the numbers of years over which Emerson was a member of the club.
- Solve your equation to determine the number of years for which Emerson was a member of the club.



10. Solve.

a) $2.5x - 4.1 = 3.9$ b) $-8.6 - 3.2y = -29.4$ c) $13.6 - 18.3 = 15.6x - 4.7 + 20.8x$

11. Solve.

a) $(3x - 4) + (5x + 6) = 42$ b) $(9x + 3) - (7x + 7) = -84$ c) $26 = (4 - 3n) - (9n + 14)$

12. At a local pizzeria, a large pizza costs \$12 plus \$1.50 per topping.

- Write an equation to model the number of toppings that can be added to a large pizza if the customer has \$21 to spend.
- Solve your equation to determine the number of toppings that can be added to a large pizza if a total of \$21 will be spent.



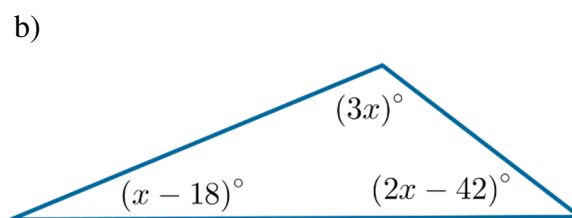
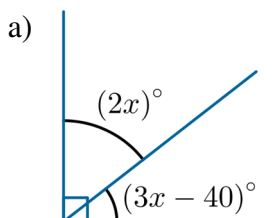
13. Solve. Express each answer as a fraction in lowest terms.

a) $3x - 7 = -5$ b) $12 - 4x = 10$ c) $37 = 10y - y + 43$ d) $7t - 19 + 8t = -9$

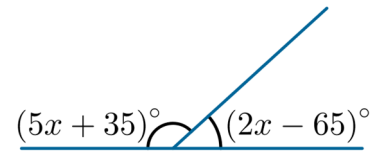
14. A helicopter starts at an altitude of 5500 feet and descends at a rate of 600 ft/min. Write and solve an equation to determine how long it takes for the helicopter to reach an altitude of 250 feet.



15. For each diagram, write an equation that can be used to determine the value of x and then use your equation to find the value of x .



16. Explain why there is no value of x that will satisfy the diagram on the right.



17. Solve.

a) $3\sqrt{x} = 12$ b) $-2\sqrt{y} = -10$ c) $\sqrt{h} - 12 = -3$ d) $5\sqrt{x} - 3 = 17$

18. Solve.

a) $x^2 - 3 = 6$ b) $8x^2 = 32$ c) $y^2 + 4 = -12$ d) $-3n^2 = -75$ e) $x^3 + 5 = -22$

19. Solve.

a) $8x + 6 - 3x - 5x = 17$ b) $-9y + 11y - 15 - 2y = -13 - 2$ c) $x - 4x + 5x = 9 - 3^2$

CHECK YOUR UNDERSTANDING

- a) subtract 1, divide by 2 b) add 5, divide by 9 c) subtract 10, divide by -2
d) add 11, divide by -3 e) subtract 13, divide by 8
- a) $x=3$ b) $t=3$ c) $x=-10$ d) $y=-2$ e) $x=3$
- a) $2x+7=15$ b) $5y+4=28$ c) $-4x-3=51$ d) $20a-8=52$ e) $-6y-6=-48$
f) $-6=-2x+14$
- a) $x=3$ b) $x=-2$ c) $y=7$ d) $t=32$ e) $m=16$ f) $x=-7$ g) $p=0$
h) $x=-79$
- a) $2x+10=126$ b) $x=58$
- a) $3n-40=146$ b) $n=62$
- 39
- a) $x=11$ b) $n=5$ c) $x=-16$ d) $x=-5$ e) $x=3$ f) $p=2$
- a) Answers may vary. For example, $25+16n=201$, where n represents the number of years for which Emerson was a member of the club.
b) 11 years
- a) $x=3.2$ b) $y=6.5$ c) $x=0$
- a) $x=5$ b) $x=-40$ c) $n=-3$
- a) Answers may vary. For example, $12+1.50n=21$, where n represents the number of toppings.
b) 6 toppings
- a) $x=\frac{2}{3}$ b) $x=\frac{1}{2}$ c) $y=-\frac{2}{3}$ d) $t=\frac{2}{3}$
- A possible equation is $5500-600t=250$, where t represents the number of minutes. The helicopter takes 8.75 minutes (8 minutes and 45 seconds) to reach an altitude of 250 feet.
- a) A possible equation is $2x+(3x-40)=90$; $x=26$
b) A possible equation is $3x+(x-18)+(2x-42)=180$; $x=40$

16. The two indicated angles must add to 180° since they form a straight line. Therefore, $(5x + 35) + (2x - 65) = 180$. Solving this equation gives $x = 30$. Substituting $x = 30$ in the original expressions for the two angles gives 185° and -5° . These values do not correspond to the given diagram, which indicates an obtuse angle (between 90° and 180°) and an acute angle (between 0° and 90°). Therefore, no value of x will satisfy the given diagram.
17. a) $x = 16$ b) $y = 25$ c) $h = 81$ d) $x = 16$
18. a) $x = 3$ or $x = -3$ b) $x = 2$ or $x = -2$ c) no real solution d) $x = 5$ or $x = -5$
e) $x = -3$
19. a) no solution b) infinitely many solutions c) $x = 0$