SOLVING ONE-STEP EQUATIONS

BIG IDEAS:

- One-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:

EMERGING

LEARNING GOALS	ANCHOR QUESTIONS
Determine the operations that would need to be applied to both sides of an equation to isolate a variable	1, 2
Solve one-step equations involving addition, subtraction, multiplication or division with positive and negative integers and prove the solution is correct	2, 6a-f
Solve one-step equations that require collecting like terms on one side of the equation and prove the solution is correct	5abc, 8a-f

SKILL BUILDING QUESTIONS			
1	2	3	4
5abc	6	7	8a-f

EVOLVING

LEARNING GOALS	ANCHOR QUESTIONS
Solve one-step equations that require collecting like terms on both sides of the equation and prove the solution is correct	8g-k
Solve real-world problems by writing and solving one-step equations and prove the solution is correct	9
Solve one-step equations involving decimal numbers and prove the solution is correct	11

SKILL BUILDING QUESTIONS			
5d	8g-k	9	10
11	12		

EXTENDING

LEARNING GOALS	ANCHOR QUESTIONS
Solve real-world problems by writing and solving one-step equations that involve collecting like terms and prove the solution is correct	13, 14, 19
Solve one-step equations involving square and square root terms	20, 21

SKILL BUILDING QUESTIONS			
13	14	15	16
17	18	19	20
21			

BUILD YOUR SKILLS

1. State the operation that would be applied to both sides of the equation to solve for the unknown.

a) $x+5=12$ b) $y-4=5$ c) $10+x=14$ d) $t+(-2)=6$ e) $-8=x-6$

2. State the operation that would be applied to both sides of the equation to solve for the unknown.

a) $2x=16$ b) $3y=27$ c) $-5x=20$ d) $-9n=-45$ e) $32=8x$ f) $-10=-15k$

3. Solve (determine the value of the unknown).

a) $x+6=10$ b) $y-7=8$ c) $x-7=-7$ d) $5+m=-6$ e) $-9+t=-15$

4. Solve.

a) $2x=14$ b) $3x=18$ c) $5n=-20$ d) $-2p=10$ e) $-10x=-80$

5. Simplify each equation to an equivalent one-step equation. You do not need to solve the equation.

a) $2x=10+8$ b) $4y=-12+4$ c) $2x+3x=20$ d) $8x-5x=-15+3$

6. Solve.

a) $x+9=15$ b) $p-10=13$ c) $8x=24$ d) $6y=-30$

e) $-9=k+7$ f) $-4h=28$ g) $x+(-3)=9$ h) $-4x=-32$

i) $-8+x=-17$ j) $y-(-12)=-18$ k) $16=2x$ l) $-19=-12+c$

7. Match each equation on the left with its equivalent equation on the right.

a) $8x=-5+21$ i) $7x=-14$

b) $15x-7x=32$ ii) $8x=32$

c) $25-39=7x$ iii) $7x=-21$

d) $-21=15x-8x$ iv) $8x=16$

e) $5x+3x=-12-4$ v) $8x=-16$

8. Solve.

a) $3x = 14 + 19$ b) $9x - 4x = 20$ c) $24 - 38 = 7t$

d) $-5x + 3x = 18$ e) $52y - 51y = -3$ f) $3x - 7x = 0$

g) $9a = 60 - (-21)$ h) $6x - 4x = -25 + 13$ i) $10x - 15x = 43 + 32$

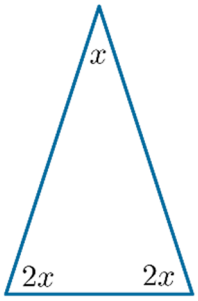
j) $16 + (-52) = -8b + 4b$ k) $14x - (-2x) = -25 - 23$

9. At a school coffee house event, a cookie costs \$0.95. Kirra spent a total of \$12.35 on cookies for her and her friends.

a) Write an equation to model the number of cookies that Kirra purchased.

b) Solve your equation to determine the number of cookies that Kirra bought.

10. A triangle has angles of x, $2x$ and $2x$, as shown on the right.



a) Create an equation that could be used to determine the value of x.

b) Solve your equation to find the value of x.

11. Solve.

a) $x - 2.5 = 3.7$ b) $5.4x = 37.8$ c) $-6.7y = -34.84$ d) $2.5m - 3.1m = -24.8 + 5.6$

12. After solving an equation, we can check our solution by comparing the left and right sides of the original equation with the solution value substituted for the variable. Consider the following example:

Solve $3x - x = -19 + 11$

Solution:

$$3x - x = -19 + 11$$
$$2x = -8$$
$$x = \frac{-8}{2}$$
$$x = -4$$

Check:

Left Side	Right Side
$3x - x$	$-19 + 11$
$= 3(-4) - (-4)$	$= -8$
$= -12 - (-4)$	
$= -8$	

$\therefore$ left side = right side

$\therefore$ the solution $x = -4$ is correct

Solve each of the following equations and check your answers.

a) $8x + 2x = 65 - 35$ b) $4x - 6x = -9 + (-15)$ c) $1.2 - 8.7 = 3x$

13. The rectangle shown on the right has a length that is three times its width. The width of the rectangle, in centimetres, is represented by the expression $2x$. The perimeter of the rectangle is 168 cm.

a) Create an equation that could be used to determine the value of x.

b) Solve your equation to find the value of x.

c) Determine the width and length of the rectangle.

14. At his summer job, Alan earns x dollars per hour. Rawan earns double Alan's hourly wage and Mikayla earns double Rawan's hourly wage. If all three students work one hour, their combined earnings equal \$99.75.

a) Create an equation that could be used to determine the value of x.

b) Solve your equation to find the value of x.

c) Determine each student's hourly wage.

15. Root of an Equation: A solution of an equation is commonly referred to as a **root** of the equation. Find the root of each of the following equations. Express each answer as a fraction in simplest (reduced) form.

a) $9x = 6$ b) $-3n = -1$ c) $26x - 12x = -7$ d) $-3 + 38 = 15y$ e) $-8x - 7x = 15 + 9$

16. Explain why the equation $0x = 5$ does not have a solution.

17. Explain why the equation $0x = 0$ has infinitely many solutions.

18. Solve.

a) $3x - 3x = 15 + 13$ b) $3x + 4x - 7x = 4 - 15$

c) $-8x - 2x + 10x = -3 + 15 - 12$ d) $8x + 9x - 10x = -90 + 120 - 30$

19. Sabrina has an identical number of quarters, dimes and nickels. In total, she has \$11.20.

a) Create an equation to model the number of coins that Sabrina has.

b) Solve your equation to determine how many of each coin she has.

20. Solve.

a) $\sqrt{x} = 2$ b) $\sqrt{y} = 3$ c) $\sqrt{c} = 10$ d) $\sqrt{x} = 1$ e) $\sqrt{t} = 0$

21. Solve.

a) $x^2 = 4$ b) $x^2 = 16$ c) $x^2 = -25$ d) $x^3 = 8$ e) $x^3 = -27$ f) $x^4 = 81$

ANSWERS

CHECK YOUR UNDERSTANDING

1. a) subtract 5 b) add 4 c) subtract 10 d) subtract -2 (or add 2) e) add 6

2. a) divide by 2 b) divide by 3 c) divide by -5 d) divide by -9 e) divide by 8
f) divide by -15

3. a) $x = 4$ b) $y = 15$ c) $x = 0$ d) $m = -11$ e) $t = -6$

4. a) $x = 7$ b) $x = 6$ c) $n = -4$ d) $p = -5$ e) $x = 8$

5. a) $2x = 18$ b) $4y = -8$ c) $5x = 20$ d) $3x = -12$

6. a) $x = 6$ b) $p = 23$ c) $x = 3$ d) $y = -5$ e) $k = -16$ f) $h = -7$ g) $x = 12$
h) $x = 8$ i) $x = -9$ j) $y = -30$ k) $x = 8$ l) $c = -7$

7. a) iv b) ii c) i d) iii e) v

8. a) $x = 11$ b) $x = 4$ c) $t = -2$ d) $x = -9$ e) $y = -3$ f) $x = 0$ g) $a = 9$
h) $x = -6$ i) $x = -15$ j) $b = 9$ k) $x = -3$

9. a) $0.95x = 12.35$, where x represents the number of cookies purchased b) 13 cookies

10. a) Answers may vary. For example, $x + 2x + 2x = 180°$ or $5x = 180°$ b) $x = 36°$

11. a) $x = 6.2$ b) $x = 7$ c) $y = 5.2$ d) $m = 32$

12. a) $x = 3$ (both sides equal 30) b) $x = 12$ (both sides equal -24)
c) $x = -2.5$ (both sides equal -7.5)

13. a) Answers may vary. For example, $2x + 6x + 2x + 6x = 168$ or $16x = 168$ or $2x + 6x = 84$ or $8x = 84$
b) 10.5 cm
c) width = 21 cm, length = 63 cm

14. a) Answers may vary. For example, $x + 2x + 4x = 99.75$ or $7x = 99.75$
b) $x = 14.25$
c) Alan earns \$14.25/h, Rawan earns \$28.50/h and Mikayla earns \$57.00/h.

15. a) $x = \frac{2}{3}$ b) $n = \frac{1}{3}$ c) $x = -\frac{1}{2}$ d) $y = \frac{7}{3}$ $\left(\text{or } 2\frac{1}{3}\right)$ e) $x = -\frac{8}{5}$ $\left(\text{or } -1\frac{3}{5}\right)$

16. $0x = 5$ means that 0 multiplied by x equals 5, which is impossible since the result of 0 multiplied by anything is 0. Therefore, the equation has no solutions.

17. $0x = 0$ means that 0 multiplied by x equals 0, which is true for any value of x. Therefore, the equation has infinitely many solutions.

18. a) no solution b) no solution c) infinitely many solutions d) $x = 0$

19. a) Answers may vary. For example, $0.25x + 0.10x + 0.05x = 11.20$ or $0.4x = 11.20$, where x represents the number of each coin.

b) 28 of each coin

20. a) $x = 4$ b) $y = 9$ c) $c = 100$ d) $x = 1$ e) $y = 0$

21. a) $x = 2$ or $x = -2$ b) $x = 4$ or $x = -4$ c) no real solution d) $x = 2$ e) $x = -3$

f) $x = 3$ or $x = -3$

ANSWERS