Math 7 Unit 6 worksheet: Two-step equations (answer key)

ANSWERS AT A GLANCE

1. (a) $x = -5$ (b) $m = -3$ (c) $n = -6$ (d) $b = -4$ (e) $k = 13$ (f) $w = 32$
2. (a) $x = -12$ (b) $t = -8$ (c) $y = 8$ (d) $c = -6$ (e) $r = -1$
3. $21 + (-4)n = 49$, that is $21 - 4n = 49$, so the number is −7.
4. (a) negative, $x = -4$ (b) positive, $x = 6$ (c) negative, $x = -16$
5. (a) $-4x - 9 = -21$ (b) $-\frac{1}{2}x + 6 = 11$
6. 5 meters per minute

WORKED SOLUTIONS

1. Solve each equation. Check your answer in the original equation.

(a) $-7x + 4 = 39$ (b) $15 = 3 - 4m$ (c) $-2 = 16 + 3n$ (d) $9b + 20 = -16$ (e) $-8 - k = -21$ (f) $-10 = 6 - \frac{w}{2}$

ANSWER

(a) $x = -5$ (b) $m = -3$ (c) $n = -6$ (d) $b = -4$ (e) $k = 13$ (f) $w = 32$

SOLUTION

(a) Subtract 4: $-7x = 35$. Divide by −7: $x = -5$. Check: −7(−5) + 4 = 35 + 4 = 39.

(b) The coefficient is −4 and the constant is 3. Subtract 3: $12 = -4m$. Divide by −4: $m = -3$. Check: 3 − 4(−3) = 3 + 12 = 15.

(c) Subtract 16: $-18 = 3n$. Divide by 3: $n = -6$. Check: 16 + 3(−6) = 16 − 18 = −2.

(d) Subtract 20: $9b = -36$. Divide by 9: $b = -4$. Check: 9(−4) + 20 = −36 + 20 = −16.

(e) Here $-k$ has coefficient −1. Add 8: $-k = -13$. Divide by −1: $k = 13$. Check: −8 − 13 = −21.

(f) Subtract 6: $-16 = -\frac{w}{2}$. Multiply by −2: $w = 32$. Check: $6 - \frac{32}{2} = 6 - 16 = -10$.

2. Solve each equation. Clear the fractions or decimals first if you like. Check your answer.

(a) $-\frac{3}{4}x - 2 = 7$ (b) $\frac{2}{5} = 2 + \frac{t}{5}$ (c) $-0.6y + 1.8 = -3$ (d) $2.5 - 0.25c = 4$ (e) $\frac{3}{2}r + \frac{5}{6} = -\frac{2}{3}$

ANSWER

(a) $x = -12$ (b) $t = -8$ (c) $y = 8$ (d) $c = -6$ (e) $r = -1$

SOLUTION

(a) Add 2: $-\frac{3}{4}x = 9$. Multiply by the reciprocal $-\frac{4}{3}$: $x = -\frac{4}{3} \cdot 9 = -12$. Check: $-\frac{3}{4}(-12) - 2 = 9 - 2 = 7$.

(b) Subtract 2: $\frac{t}{5} = \frac{2}{5} - \frac{10}{5} = -\frac{8}{5}$. Multiply by 5: $t = -8$. Check: $2 + \frac{-8}{5} = \frac{10}{5} - \frac{8}{5} = \frac{2}{5}$.

(c) Multiply every term by 10: $-6y + 18 = -30$. Subtract 18: $-6y = -48$. Divide by −6: $y = 8$. Check: −0.6(8) + 1.8 = −4.8 + 1.8 = −3.

(d) Subtract 2.5: $-0.25c = 1.5$. Divide by −0.25: $c = -6$. Check: 2.5 − 0.25(−6) = 2.5 + 1.5 = 4.

(e) Multiply every term by 6: $9r + 5 = -4$. Subtract 5: $9r = -9$. Divide by 9: $r = -1$. Check: $\frac{3}{2}(-1) + \frac{5}{6} = -\frac{9}{6} + \frac{5}{6} = -\frac{4}{6} = -\frac{2}{3}$.

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3. The sum of 21 and −4 times a number is 49. Write an equation and solve it to find the number.

ANSWER

$21 + (-4)n = 49$, that is $21 - 4n = 49$, so the number is −7.

SOLUTION

Let n be the number. Then −4 times the number is $-4n$, and the sum of 21 and that product is $21 + (-4n)$, which is $21 - 4n$:

$$21 - 4n = 49$$

The coefficient is −4 and the constant is 21. Subtract 21 from both sides: $-4n = 28$. Divide both sides by −4: $n = -7$.

Check: −4(−7) = 28, and 21 + (28) = 49.

4. For each equation, undo the constant term only. From the signs of what is left, say whether the solution is positive or negative, and why. Then finish solving.

(a) $-6x + 11 = 35$ (b) $20 - 3x = 2$ (c) $\frac{x}{4} + 9 = 5$

ANSWER

(a) negative, $x = -4$ (b) positive, $x = 6$ (c) negative, $x = -16$

SOLUTION

(a) Subtract 11: $-6x = 24$. A negative number times x gives a positive number, so x must be negative. Dividing by −6: $x = -4$.

(b) Subtract 20: $-3x = -18$. A negative number times x gives a negative number, so x must be positive. Dividing by −3: $x = 6$.

(c) Subtract 9: $\frac{x}{4} = -4$. A number divided by a positive number is negative only when the number is negative, so x is negative. Multiplying by 4: $x = -16$.

Checks: −6(−4) + 11 = 35; 20 − 3(6) = 2; $\frac{-16}{4} + 9 = 5$.

5. Each part gives the two moves that solve a two-step equation, in the order they are done, and the solution. Write the equation, in the form $px + q = r$.

(a) Add 9 to both sides, then divide both sides by −4. The solution is $x = 3$.

(b) Subtract 6 from both sides, then multiply both sides by −2. The solution is $x = -10$.

ANSWER

(a) $-4x - 9 = -21$ (b) $-\frac{1}{2}x + 6 = 11$

SOLUTION

The moves undo what was done to x, in reverse order, so the first thing done to x is undone last.

(a) Dividing by −4 undoes multiplying by −4, and adding 9 undoes subtracting 9. So x was multiplied by −4, and then 9 was subtracted: the left side is $-4x - 9$. With $x = 3$ it is −4(3) − 9 = −12 − 9 = −21, so the equation is $-4x - 9 = -21$. Check with the given moves: add 9 to get $-4x = -12$, divide by −4 to get $x = 3$.

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(b) Multiplying by −2 undoes multiplying by $-\frac{1}{2}$ (dividing by −2), and subtracting 6 undoes adding 6. So the left side is $-\frac{1}{2}x + 6$. With $x = -10$ it is 5 + 6 = 11, so the equation is $-\frac{1}{2}x + 6 = 11$ (also written $6 - \frac{x}{2} = 11$). Check with the given moves: subtract 6 to get $-\frac{1}{2}x = 5$, multiply by −2 to get $x = -10$.

6. A floor-cleaning robot rolls along a long, straight corridor. Positions are measured in meters from its charging dock: positive to the right of the dock, negative to the left. The robot starts at 11 m and rolls left at a steady speed. After 4 minutes it is at −9 m. Write an equation and solve it to find the robot's speed.

ANSWER

5 meters per minute

SOLUTION

Let v be the speed in meters per minute. Rolling left changes the position by $-v$ each minute, so after 4 minutes the position is $11 - 4v$:

$$11 - 4v = -9$$

Subtract 11 from both sides: $-4v = -20$. Divide both sides by −4: $v = 5$.

Check in the story: in 4 minutes at 5 m a minute the robot rolls 20 m to the left, and 11 − 20 = −9, so it ends 9 m left of the dock. The speed is 5 meters per minute.

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