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10.2 Modelling and Solving Two-Step Equations: $ax + b = c$

***MathLinks 8*, pages 380–387**

Key Ideas Review

Circle the correct response to complete each statement.

1. To solve an equation, (isolate/reverse) the variable on one side of the equal sign.
2. When undoing the operations performed on the variable, (reverse/follow) the order of operations.
3. Check your solution by (substitution/switching) or drawing a diagram.
4. In the visuals used in this chapter, a white box or rectangle represents a (negative/positive) integer.
5. In the visuals used in this chapter, a grey box or rectangle represents a (negative/positive) integer.

Practise and Apply

6. Write and solve each equation modelled below. Check your solution.

a) x $+1$ $+1$ $+1$ $+1$
x $+1$ $=$ $+1$ $+1$ $+1$
x $+1$ $+1$

$3x + 2 = 8$
$3x + 2 - 2 = 8 - 2$
$3x = 6$
$\frac{3x}{3} = \frac{6}{3}$
$x = 2$

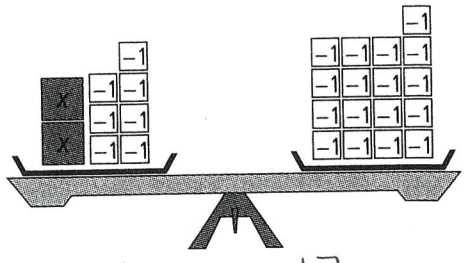
check
$3x + 2 = 8$
$3(2) + 2 = 8$
$6 + 2 = 8$
$8 = 8$ ✓

b) x $=$ -1 -1
x $=$ -1 -1
x $=$ -1 -1

$\frac{3x}{3} = \frac{-6}{3}$
$x = -2$

check
$3x = -6$
$3(-2) = -6$
$-6 = -6$ ✓

c)



$2x - 7 = -17$
$2x - 7 + 7 = -17 + 7$
$\frac{2x}{2} = \frac{-10}{2}$
$x = -5$

check
$2x - 7 = -17$
$2(-5) - 7 = -17$
$-10 - 7 = -17$
$-17 = -17$ ✓

7. Circle the first operation you should undo to solve each equation. Underline the second operation you should undo.

a) $5 + 3x = -7$ b) $4r - 6 = 14$

c) $13 = -6y - 11$ d) $-89 = 9t - 26$

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8. Solve the equation. Check your solution.

a) $2x + 5 = 11$

$2x+5-5=11-5$

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

$x=3$

check

$2x+5=11$

$2(3)+5=11$

$11=11$

b) $4p + 3 = 19$

$4p+3-3=19-3$

$\frac{4p}{4}=\frac{16}{4}$

$p=4$

check

$4p+3=19$

$4(4)+3=19$

$16+3=19$

$19=19$

c) $-25 = -6a - 43$

$-25+43=-6a-43+43$

$\frac{18}{-6}=\frac{-6a}{-6}$

$-3=a$

check

$-25=-6(-3)-43$

$-25=18-43$

$-25=-25$

d) $15 = -11d - 18$

$15+18=-11d-18+18$

$\frac{33}{-11}=\frac{-11d}{-11}$

$-3=d$

check

$15=-11(-3)-18$

$15=33-18$

$15=15$

9. The Hornets won 19 games. This is 5 less than 4 times the number of games the Vampires won.

a) Let v represent the Vampires' wins. What equation models this situation? Explain your thinking.

V = vampire
H = hornets

$19 = 4V - 5$

b) How many games did the Vampires win?

$19=4v-5$ (+5 to both sides)

$24=4v$

$\frac{24}{4}=\frac{4v}{4}$

$6=v$

10. Show whether $x = 5$ is the solution to each equation.

a) $4x + 6 = -20$

$4(5)+6=-20$

$20+6=-20$

$26=-20$ (no)

b) $-5 - 2x = -15$

$-5-2(5)=-15$

$-5-10=-15$

$-15=-15$ yes

c) $8x - 4 = 36$

$8(5)-4=36$

$40-4=36$

$36=36$ yes

d) $13x + 12 = 77$

$13(5)+12=77$

$65+12=77$

$77=77$ yes

11. The length of a square's side is 10 cm. This square's perimeter is 7 cm more than the perimeter of an equilateral triangle.

*Squares side length is 10cm so perimeter is 40cm

a) Let s represent the length of one side of the triangle. What equation models this situation?

$40 = 3s + 7$

△ equilateral (3 identical sides)

b) Solve the equation to find the length of the triangle's sides. Verify your answer.

$40=3s+7$

$40-7=3s+7-7$

$\frac{33}{3}=\frac{3s}{3}$

$s=11$cm

12. A chalet rents for $150 plus $72 per person for a weekend.

a) Write an equation to model this situation.

$C = 150 + 72p$

b) How much will it cost 16 people to rent the chalet for one night?

$C=150+72(16)$

$C=150+1152$

$C=\$1302$

cost is $1302

c) If the group budgets $1950 for the chalet rental, how many people can stay for the weekend?

$1950=150+72p$

$1950-150=150-150+72p$

$\frac{1800}{72}=\frac{72p}{72}$

$p=25$

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4. What are the first and second operations you should perform to solve each equation?

a) $\frac{f}{6} + 2 = -4$

① -2

② times 6

b) $\frac{r}{-3} - 6 = 7$

① +6

② times -3

c) $12 = 7 + \frac{z}{-5}$

① -7

② x -5

d) $\frac{k}{11} - 12 = 6$

① +12

② x 11

5. Solve each equation.

a) $\frac{d}{-4} - 5 = -3$ (+5, +5)

$\frac{d}{-4} = 2$ (x -4, x -4)

$d = -8$

b) $4 + \frac{n}{2} = 20$ (-4, -4)

$\frac{n}{2} = 16$ (x 2, x 2)

$n = 32$

c) $-6 = \frac{b}{-3} + 11$

d) $\frac{p}{13} - 2 = -3$

6. Show whether $h = 12$ is the solution to each equation.

a) $-6 = \frac{h}{-4} - 3$

yes $-6 = \frac{12}{-4} - 3$

$-6 = -3 - 3$

$-6 = -6$

b) $5 = 11 - \frac{h}{2}$

$5 = 11 - \frac{12}{2}$

$5 = 11 - 6$

$5 = 5$ yes

c) $\frac{-h}{12} + 8 = 9$

$\frac{-12}{12} + 8 = 9$

$-1 + 8 = 9$

$7 = 9$ no

d) $\frac{h}{3} - 1 = 3$

$\frac{12}{3} - 1 = 3$

$4 - 1 = 3$ yes

$3 = 3$

7. Rick saved $400 to buy a pair of skis. On Rick's birthday, his brother Jon gave him one eighth of his savings. Including the gift, Rick then had $475. Let j represents Jon's total savings. Write and solve an equation to determine Jon's savings before he gave Rick the gift.

g = gift

J = Jon's savings

$475 = g + 400$

$475 - 400 = g + 400 - 400$

$75 = g$

$J = 8g$ → $J = 8(75)$

$J = 600$

8. In the following formula, f is the speed that a peregrine falcon can dive in km/h, and c is the speed of a cheetah in km/h: $\frac{f}{5} + 30 = c$. If the top speed of a cheetah is 100 km/h, how fast can a peregrine falcon dive? Show your thinking.

$\frac{f}{5} + 30 = C$

$\frac{f}{5} + 30 = 100$ (-30, -30)

$5 \times \frac{f}{5} = 70 \times 5$

$f = 350$ km/hr

9. The discounted price of an airplane ticket is one third of the regular price, plus $137 in taxes and airport fees.

r = regular price

a) Write an equation to represent this situation.

$C = \frac{1}{3}r + 137$

b) If the discount ticket to Paris costs $349, what is the regular price?

$349 - 137 = \frac{1}{3}r + 137 - 137$

$3 \times 212 = \frac{1}{3}r \times 3$

$\$636 = r$

c) If the regular ticket price to Vancouver is $699, what will a discount ticket cost?

$C = \frac{1}{3}r + 137$

$C = \frac{1}{3}(699) + 137$

$C = \frac{699}{3} + 137$

$C = 233 + 137$

$C = 370$ $

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6. Solve by inspection.

a) $\frac{-7g}{-7} = \frac{56}{-7}$ $g = -8$

b) $\frac{-81}{9} = \frac{9p}{9}$ $p = -9$

c) $\frac{-n}{5} = -6$ $5x$ $\frac{-n}{5} = -6 \times 5$ $-n = -30$ so $n = 30$

d) $-7 = \frac{b}{3}$ $3x$ $-21 = b$ $\times 3$

7. Use models to solve each equation. Show your thinking.

a) $\frac{-9}{3} = \frac{3t}{3}$

$t = -3$

b) $4x$ $\frac{b}{4} = -2 \times 4$

$b = -8$

8. By what number would you divide both sides of the equation to solve it?

a) $\frac{14}{-7} = \frac{-7z}{-7}$ $z = -2$

b) $\frac{-8g}{-8} = \frac{-64}{-8}$

9. Solve each equation using the opposite operation. Check your answer.

a) $\frac{5a}{5} = \frac{-25}{5}$

$a = -5$

$5(-5) = -25$

$-25 = -25$

b) $\frac{-63}{-7} = \frac{-7k}{-7}$

$9 = k$

$-63 = -7(9)$

$-63 = -63$

10. By what number would you multiply both sides of the equation to solve it?

a) $\frac{x}{5} = -3$ (mult by 5)

b) $-9 = \frac{d}{-4}$ (mult by -4)

11. Show whether $y = 18$ is the solution to each equation.

a) $-4x$ $72 = \frac{y}{-4}$ $\times -4$

$y = 288$

b) $\frac{-9}{-2} = \frac{-2y}{-2}$

$y = 4.5$

c) $x-6$ $-3 = \frac{y}{-6}$ $\times -6$

$18 = y$

d) $\frac{2y}{2} = \frac{36}{2}$

$y = 18$

12. The cost of an adult ticket for a concert is three times the cost of a child's ticket. If an adult ticket costs $48 what is the cost for a child's ticket?

A - adult ticket

C = child ticket

a) Write an equation to represent this problem. What does your variable represent?

$A = 3C$

b) Solve the equation. Verify your answer.

$\frac{48}{3} = \frac{3C}{3}$

$\$16$ = child ticket

13. An LED light bulb lasts 50 times longer than an incandescent light bulb.

LED = L

Incandescent = I

$L = 50I$

a) Write an equation to represent this situation.

$L = 50I$

b) If an incandescent light bulb lasts 1000 hours, how long does an LED light bulb last? Show your thinking.

$L = 50(1000)$

$L = 50\,000$ hours