Get Ready

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Substituting Values Into Equations

When you are substituting values into equations, make sure you use the correct order of operations:
- brackets first
- multiply and divide in order from left to right
- add and subtract in order from left to right

Determine the value of y when substituting $x = 7$ into the following equation.

$y = 2(x - 3) + 5$
$y = 2(7 - 3) + 5$ Brackets.
$y = 2(4) + 5$ Multiply.
$y = 8 + 5$ Add.
$y = 13$

1. Determine the value of y in each equation when $d = 6$.

a) $y = (3d + 4) \div 2 + 8$

b) $y = (3 + d - 7) \times 4d + 5$

2. Calculate the surface area of a rectangular prism using the formula $SA = 2(bh + bl + hl)$, where $b = 5$ cm, $h = 11$cm, $l = 12$ cm.

Modelling and Solving One-Step Equations

To solve a problem, you sometimes need to translate words into equations. For example, "the sum of 4 and another number is 12" can be modelled by the equation $4 + x = 12$.
The equation can now be solved.

$x + 4 = 12$
$x + 4 - 4 = 12 - 4$ Subtract 4 from both sides of the equation.
$x = 8$

3. Model each situation with an algebraic equation.

a) seven more than a number, p, is twelve

b) three less than a number, x, is eleven

c) four times a number, s, is twenty-eight

d) when a number, k, is divided by six, the result is nine

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4. Develop and solve an algebraic equation for each question.

a) If Jim's height increased by 13 cm over the past year and he is now 152 cm, how tall was he a year ago?

b) Ayisha worked twice as long on a math project as Harpreet did. If Ayisha worked for 50 min on the project, how long did Harpreet work on it?

Solving Two-Step Equations

To solve a two-step problem of the form $ax + b = c$, you need to isolate the variable on one side of the equal sign. When undoing the operations performed on the variable, follow the reverse order of operations:

- Subtract and add in order from left to right.
- Multiply and divide in order from left to right.

Solve $6x + 7 = 25$

$6x + 7 - 7 = 25 - 7$ Subtract 7 from both sides of the equation.

$6x = 18$

$\frac{6x}{6} = \frac{18}{6}$ Divide both sides of the equation by 6.

$x = 3$

Check: Left Side $= 6x + 7$ Right Side $= 25$

$= 6(3) + 7$

$= 18 + 7$

$= 25$

Left Side = Right Side

The solution is correct.

5. For each equation, circle the first operation you undo and underline the second operation you undo.

a) $2n + 4 = 18$ **b)** $3x + 5 = 17$

c) $8y - 70 = 94$ **d)** $27 = 7q + 6$

6. Solve each equation. Check your solution.

a) $9 + 5j = 49$

b) $4t + 2 = 14$

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10.1 Modelling and Solving One-Step Equations: $ax = b, \frac{x}{a} = b$

***MathLinks 8*, pages 370–379**

Key Ideas Review

Match each method in column A with an example from column B.

A	B
1. Solve by inspection. _____ **2.** Model the equation using concrete materials, and then balance it. _____ **3.** Perform the opposite operation on both sides of the equal sign. _____ **4.** Check your solution by modelling or substitution. _____	**a)** $-3a = 12$ $\frac{-3a}{-3} = \frac{12}{-3}$ $a = -4$ **b)** Ask yourself, "What number results from dividing −12 by −3?" **c)** $-a = -1 -1 -1 -1$ $-a = -1 -1 -1 -1$ $-a = -1 -1 -1 -1$ **d)** Left Side = −3a = −3(−4) = 12; Right Side = 12 Left Side = Right Side

Practise and Apply

5. Write the equation modelled by the diagrams.

a) $r + r = +1 +1 +1 +1 +1 +1 +1 +1$

b) $-s - s - s = +1 +1 +1 +1 +1 +1 +1 +1 +1$

c) $\frac{x}{4} = +1 +1 +1 +1$

d) $-m - m - m - m = -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1$

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6. Solve by inspection.

a) $-7g = 56$ **b)** $-81 = 9p$

c) $\frac{-n}{5} = -6$ **d)** $-7 = \frac{b}{3}$

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

a) $-9 = 3t$

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

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

a) $14 = -7z$ **b)** $-8g = -64$

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

a) $5a = -25$

b) $-63 = -7k$

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

a) $\frac{x}{5} = -3$ **b)** $-9 = \frac{d}{-4}$

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

a) $72 = \frac{y}{-4}$ **b)** $-9 = -2y$

c) $-3 = \frac{y}{-6}$ **d)** $2y = 36$

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

b) Solve the equation. Verify your answer.

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

a) Write an equation to represent this situation.

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

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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.

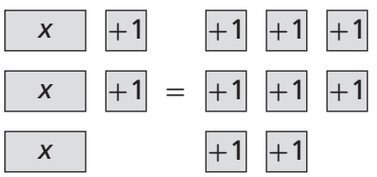
4. In the visuals used in this chapter, a white box or rectangle represents a (negative/positive) integer.

5. In the visuals used in this chapter, a grey box or rectangle represents a (negative/positive) integer.

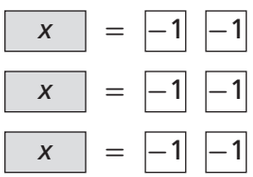
Practise and Apply

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

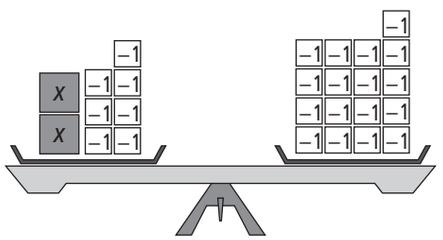
a)



b)



c)



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) $2x + 5 = 11$

b) $4p + 3 = 19$

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

d) $15 = -11d - 18$

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.

b) How many games did the Vampires win?

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

a) $4x + 6 = -20$ **b)** $-5 - 2x = -15$

c) $8x - 4 = 36$ **d)** $13x + 12 = 77$

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.

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

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

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

a) Write an equation to model this situation.

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

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

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10.3 Modelling and Solving Two-Step Equations: $\frac{x}{a} + b = c$

***MathLinks 8*, pages 388–393**

Key Ideas Review

Choose from the following terms to complete #1.

add	divide	isolate	reverse	substituting	value

1. a) To solve an equation, _____ the variable on one side of the equal sign.

b) When undoing the operations performed on the variable, follow the _____ order of operations.

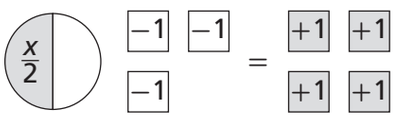
- subtract and/or _____
- multiply and/or _____

c) One method you can use to check your answer is _____ it back into the equation. Both sides should have the same _____.

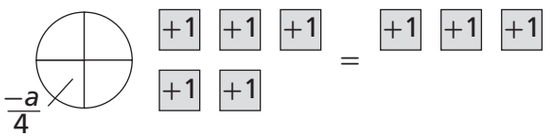
Practise and Apply

2. Solve the equation modelled by each diagram. Check your solution.

a)



b)



3. Draw a model for each equation, and then solve. Verify your answer.

a) $\frac{x}{-5} + 6 = 4$ **b)** $-5 + \frac{y}{3} = -3$

c) $2 = 14 + \frac{n}{3}$ **d)** $16 = 9 + \frac{c}{-7}$

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

a) $\frac{f}{6} + 2 = -4$ **b)** $\frac{r}{-3} - 6 = 7$

c) $12 = 7 + \frac{z}{-5}$ **d)** $\frac{k}{11} - 12 = 6$

5. Solve each equation.

a) $\frac{d}{-4} - 5 = -3$ **b)** $4 + \frac{n}{2} = 20$

c) $-6 = \frac{b}{-3} + 11$ **d)** $\frac{p}{13} - 2 = -3$

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

a) $-6 = \frac{h}{-4} - 3$ **b)** $5 = 11 - \frac{h}{2}$

c) $\frac{-h}{12} + 8 = 9$ **d)** $\frac{h}{3} - 1 = 3$

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.

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.

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

a) Write an equation to represent this situation.

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

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

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10.4 Modelling and Solving Two-Step Equations: $a(x + b) = c$

***MathLinks 8*, pages 394–399**

Key Ideas Review

For #1 to #4, unscramble the letters to form a word that correctly completes the statement.

1. To solve an equation, _____ (OITSLAE) the variable on one side of the equal sign.
2. When _____ (DIUONNG) the operations performed on the variable, use _____ (PTIOOPES) operations.
3. Solve equations in the form $a(x + b) = c$ by _____ (DDGIIINV) first, or by using the _____ (BDEIIISRTTUV) property.
4. Check your _____ (AENRSW) by substituting it back into the equation. Both _____ (EIDSS) should have the same value.

Practise and Apply

5. Solve the equation modelled by each diagram. Check your solution.

a) $x \quad -1 \quad -1 = +1 \quad +1 \quad +1 \quad +1$

$x \quad -1 \quad -1 = +1 \quad +1 \quad +1 \quad +1$

b) $+1 \quad +1 \quad +1 \quad x \quad -1 \quad -1 \quad -1 \quad -1$

$+1 \quad +1 \quad +1 = x \quad -1 \quad -1 \quad -1 \quad -1$

$+1 \quad +1 \quad +1 \quad x \quad -1 \quad -1 \quad -1 \quad -1$

c) $-x \quad +1 \quad +1 \quad -1$

$-x \quad +1 \quad +1 \quad -1$

$-x \quad +1 \quad +1 = -1$

$-x \quad +1 \quad +1 \quad -1$

d) $x \quad +1 \quad -1 \quad -1 \quad -1$

$x \quad +1 \quad -1 \quad -1 \quad -1$

$x \quad +1 = -1 \quad -1 \quad -1$

$x \quad +1 \quad -1 \quad -1 \quad -1$

$x \quad +1 \quad -1 \quad -1 \quad -1$

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6. Model and then solve each equation. Check your solution.

a) $4(t - 5) = 8$

b) $5(r + 7) = -55$

7. Solve each equation. Check your answer.

a) $-3(x - 8) = 12$

b) $600 = 4(s + 4)$

c) $2(x - 3) = 6$

8. Beth would like to put a 2-m wide grass border around a square garden that has a perimeter of 44 m.

a) What equation models this situation?

b) If she wants a fence around the outside of the grass border, what length of fencing will she have to buy?

9. Aaron is driving to his friend's place 180 km away. If he can average a speed that is 5 km/h more than his current speed and then triple that, he will arrive in two hours.

a) Using s for his current speed, what equation models this situation?

b) Determine Aaron's speed.

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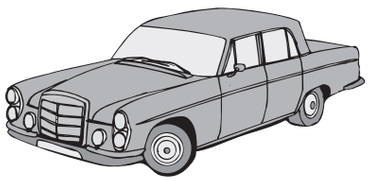
Link It Together

Many items depreciate or lose value over time. As a car gets older, its value automatically depreciates a certain amount each year. The relationship between a car's age and its value is linear. Several equations are used to calculate a car's depreciation.



1. Write an equation to represent each of the following depreciation methods. Identify your variables.

a) The depreciation is the number of years owned times 1000.

b) The depreciation is the age of the car times one tenth the cost of the car.

c) The depreciation is the cost of the car minus $2750 and then times one fiftieth the age of the car.

2. Calculate the depreciation of a $20 000 car after three years, using each of the equations in #1. Show your thinking.

3. Complete the table using the equation from #1b). Show your thinking.

Age of Car (Yr)	Value of Car ($)
0	30 000
1	
2	
5	
8	
10	

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Vocabulary Link

Use the clues to identify the key words from Chapter 10. Then, write them in the crossword puzzle blank.

Across

3. In $-84 = 12d$, _____ $12d$ by dividing both sides of the equation by 12.

7. In $5d + 4 = 39$, 5 is the _____ _____.

8. When solving an equation such as $6a - 4 = 26$, you need to use the _____ _____ to isolate the variable.

9. In the equation $\frac{m}{7} = 6$, m is the _____.

Down

1. In the equation $5w + 1 = t$, 1 is a _____.

2. $5(s + 2) = 5s + 10$ uses the _____ property.

4. A mathematical statement with two expressions that have the same value is called a(n) _____.

5. When graphed, a _____ equation such as $d = \frac{c}{2}$ results in points along a straight line.

6. When solving $6a = 72$, you need to _____ the variable.