

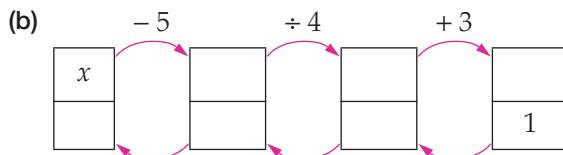
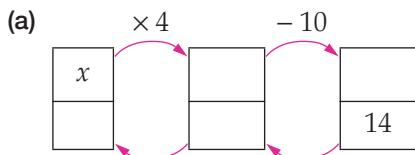
Half-time 7



- 1 Solve the equation $\frac{x}{12} = 7$ by inspection.

Ex. 7.2

- 2 The perimeter of a rectangular room is 18 m. If the length of the room is 5 m, what is the width? Form an equation and solve it with backtracking.
- 3 Copy and complete the following flowcharts. Write the equation and use the flowchart to find the solution for x .



- 4 Write a true number sentence that shows two consecutive numbers whose sum is 43.

Ex. 7.1

- 5 (a) James is 5 years older than his brother Tom who is 7 years old. If James is j years old:

- (i) write an equation to represent this situation with Tom's age on the RHS
(ii) solve the equation by inspection to find James' age.

- (b) Jude is 4 years younger than his sister Amanda who is 16 years old. If Jude is d years old:

- (i) write an equation to represent this situation with Amanda's age on the RHS
(ii) solve the equation by inspection to find Jude's age.

- 6 Use backtracking to solve each of the following equations.

Ex. 7.3

(a) $3x + 4 = 11$

(b) $\frac{x}{2} + 5 = -3$

(c) $3(x - 8) = 15$

- 7 Write the equation $5x + 3 = 23$ in words.

Ex. 7.2

- 8 The following number sentences are not true. Rewrite them by changing the coloured number so that you have a true number sentence.

Ex. 7.1

(a) $3 + 6 = 11$

(b) $4 \times 3 = 26 - 6$

(c) $4 + \frac{28}{4} = 18$

- 9 Kate has a piece of cardboard that is x centimetres wide. She joins a 50-centimetre piece of cardboard of the same length to it and then divides the width into 7 strips so she can paint each strip a different colour of the rainbow. Each strip is 10 cm wide. Use backtracking to find the width of the original piece of cardboard.

Ex. 7.3

- 10 State whether the following number sentences are true or false.

Ex. 7.1

(a) $6 - 4 = 4 - 6$

(b) $2(3 + 5) = 2 \times 3 + 2 \times 5$

(c) $(8 \times 9) \times 2 = 8 \times (9 \times 2)$

- 11 Pete is five years older than his brother Sam. The sum of their ages is 23. If Pete is p years old,

Ex. 7.3

- (a) write an expression to represent Sam's age

- (b) write an equation to represent this situation with 23 on the RHS of the equation

- (c) solve the equation using backtracking to find the ages of Pete and Sam.

7.4

Solving equations using the balance method

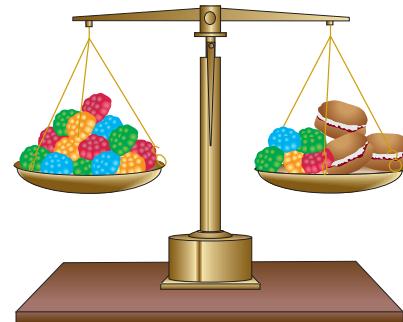
Scales can be used to measure the mass of an object if other masses are available for comparison. To balance the scales, the two sides of the scales must hold equal masses.

Worked Example 10

WE 10

This set of scales is balanced. The left-hand side has 14 lollies; and the right-hand side has three biscuits and five lollies.

- (a) If one lolly is taken from the right-hand side, the scales become unbalanced. Which of the sides is now heavier?
- (b) How can the scales be balanced without putting the lolly back?
- (c) Starting again, if all of the lollies are taken from the right-hand side, what should be done to the left-hand side to balance the scales?
- (d) How many lollies are equivalent to the three biscuits?
- (e) How many lollies are equivalent to one biscuit?



Thinking

- (a) Look at the diagram and decide which side is heavier after removing the lolly.
- (b) Balance the scales by doing the same to the other side.
- (c) Identify how many lollies were on the right-hand side at the start (5). Take the same amount from the left-hand side.
- (d) The beam is horizontal. Look at how many lollies are on the left-hand side (9).
- (e) The beam is balanced, so the biscuits on the right-hand side equal the lollies on the left-hand side.

Working

- (a) The left-hand side is now heavier.
- (b) Take a lolly from the left-hand side.
- (c) Take five lollies from the left-hand side.
- (d) Nine lollies = three biscuits.
- (e) Three biscuits = nine lollies.
One biscuit = three lollies.

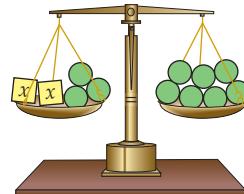
Equivalent equations

Equivalent equations are those that have the same solution. For example, $2x = 4$ is equivalent to $2x + 3 = 7$ as they both have a solution of $x = 2$. This can be checked by substituting $x = 2$ into both equations to show they are both true number sentences.

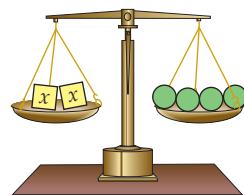
$$2x = 4 \quad 2x + 3 = 7$$

$$2 \times 2 = 4 \quad 2 \times 2 + 3 = 7$$

This situation can also be represented with balance scales. The 'equals' sign can be thought of as sitting in the middle of the two balanced sides. These scales represent $2x + 3 = 7$.



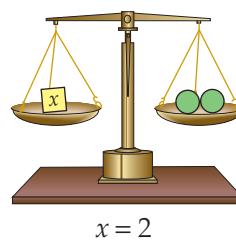
$$2x + 3 = 7$$



$$2x = 4$$

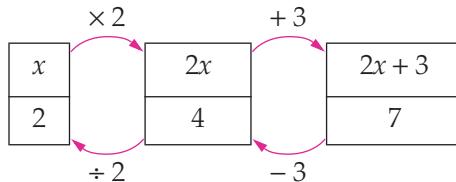
When 3 is taken off both sides, the scales are still balanced and now represent $2x = 4$.

Because the scales are still balanced we say that $2x + 3 = 7$ and $2x = 4$ are equivalent equations.



$$x = 2$$

As two identical unknown masses equal 4, then one mass equals 2. The scales represent $x = 2$.



All these equations are equivalent.
The simplest equivalent equation is $x = 2$, which is also the solution.

$$x = 2 \quad 2x = 4 \quad 2x + 3 = 7$$

We create equivalent equations by performing the same operation on both sides of the equation.

Worked Example 11

We11

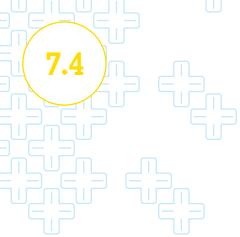
Form an equivalent equation to each of the following by performing the operation given in brackets to both sides of the equation.

(a) $x - 5 = 7$ (+ 6)

(b) $5x + 3 = 8$ (- 2)

(c) $\frac{x}{2} = 4$ ($\times 2$)

(d) $8x = 24$ ($\div 4$)



Thinking

Working

(a) 1 Write the equation. $x - 5 = 7$

2 Perform the same operation on both sides (add 6). $x - 5 + 6 = 7 + 6$

3 Simplify. $x + 1 = 13$

(b) 1 Write the equation. $5x + 3 = 8$

2 Perform the same operation on both sides (subtract 2). $5x + 3 - 2 = 8 - 2$

3 Simplify. $5x + 1 = 6$

(c) 1 Write the equation. $\frac{x}{2} = 4$

2 Perform the same operation on both sides (multiply by 2). $\frac{x}{2} \times 2 = 4 \times 2$

3 Simplify. $x = 8$

(d) 1 Write the equation. $8x = 24$

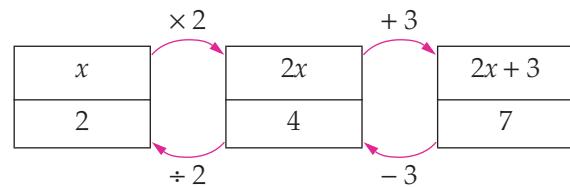
2 Perform the same operation on both sides (divide by 4). $\frac{8x}{4} = \frac{24}{4}$

3 Simplify. $2x = 6$

Solving equations using the balance method

By using a set of scales to represent our equation, we can now solve equations using the **balance method**. Up until now, we have used flowcharts to show us both the order and the operations we need to use to solve equations. With the balance method, we still need to use the same information, but now we show it in a different way.

Consider $2x + 3 = 7$.



$$x = 2$$

$$2x = 4$$

$$2x + 3 = 7$$

Notice that the three boxes contain three equivalent equations. We have moved backwards through the flowchart and used inverse (opposite) operations ($-3, \div 2$) to solve the equation $2x + 3 = 7$. Let's now show the same steps using the balance method. The order of operations in the flowchart tells us how our equation was built. By moving backwards and performing the inverse operation, we will undo our equation to find the solution.

$$2x + 3 = 7$$

$$2x + 3 - 3 = 7 - 3 \quad (\text{subtracting } 3 \text{ from both sides})$$

$$2x = 4$$

$$\frac{2x}{2} = \frac{4}{2}$$

$$x = 2$$

(dividing both sides by 2)

Note that the three equivalent equations formed here $2x + 3 = 7, 2x = 4, x = 2$ are the same as the three equations formed from the boxes in the flowchart.

Worked Example 12

WE12

Solve the equation $3x - 7 = 11$ using the balance method. Check your solution by substitution.

Thinking

- 1 Write the equation. Identify the last operation to be performed on the LHS of it. This is the first operation to be undone. (-7)
- 2 Use the inverse operation ($+7$) on both sides of the equals sign and simplify your equation.
- 3 Identify the next operation to be undone and apply the inverse operation ($\div 3$). If one side of the equation is now the variable by itself, you have found the solution. Otherwise, continue the process until you do have the variable by itself.
- 4 Check the solution by substitution.

Working

$$3x - 7 = 11$$

$$\begin{aligned} 3x - 7 + 7 &= 11 + 7 \\ 3x &= 18 \end{aligned}$$

$$\begin{aligned} \frac{3x}{3} &= \frac{18}{3} \\ x &= 6 \end{aligned}$$

$$\begin{aligned} \text{Check: } \text{LHS} &= 3x - 7 \\ &= 3 \times 6 - 7 \\ &= 18 - 7 \\ &= 11 \\ &= \text{RHS} \end{aligned}$$

7.4 Solving equations using the balance method

Navigator

Q1, Q2 Column 1, Q3 Column 1,
Q4, Q5, Q6, Q10

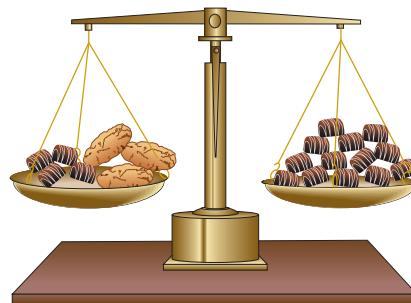
Q1, Q2 Column 2, Q3 Column 2,
Q4, Q6, Q7, Q8, Q9, Q10

Q1, Q2 Column 2, Q3 Column 3,
Q4, Q5, Q6, Q7, Q8, Q9, Q10

Answers
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Fluency

- 1 This set of scales is balanced. The left-hand side has 4 chocolates and 3 biscuits; and the right-hand side has 13 chocolates.
- (a) If one chocolate is taken from the left-hand side, the scales become unbalanced. Which of the sides is now heavier?
- (b) How can the scales be balanced without putting the chocolate back?
- (c) Starting again, if all of the chocolates are taken from the left-hand side, what should be done to the right-hand side to balance the scales?
- (d) How many chocolates are equivalent to the three biscuits?
- (e) How many chocolates are equivalent to one biscuit?



WE10

- 2 Form an equivalent equation to each of the following by performing the operation given in brackets to both sides of the equation.

(a) $x + 5 = 8 \quad (+3)$

(b) $x + 4 = 12 \quad (+5)$

(c) $x + 1 = 7 \quad (+6)$

(d) $2x + 2 = 10 \quad (-1)$

(e) $3x + 5 = 10 \quad (-5)$

(f) $6x + 8 = 14 \quad (-5)$

- 3 Solve each of the following equations using the balance method. Check your solutions by substitution.

(a) $3x + 5 = 8$

(b) $5x + 1 = 21$

(c) $7x + 3 = 17$

(d) $2x + 1 = 11$

(e) $2x + 5 = 19$

(f) $2x - 10 = 8$

(g) $3x - 4 = 20$

(h) $5x - 1 = 4$

(i) $6x - 2 = 16$

(j) $4x - 3 = 17$

(k) $2x - 3 = 7$

(l) $4x - 1 = 31$

(m) $\frac{2x}{3} = 8$

(n) $\frac{2x}{7} = 2$

(o) $\frac{5x}{2} = 20$

(p) $\frac{x+5}{3} = 5$

(q) $\frac{x+1}{3} = 7$

(r) $\frac{x+4}{5} = 3$

(s) $2(x-5) = 14$

(t) $3(x+2) = 24$

(u) $7(x-2) = 35$

Inverse operations need to be applied in the correct order to find a solution.

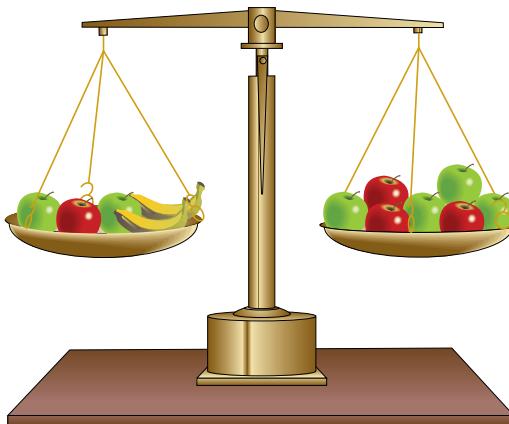


Understanding

- 4 This set of scales is balanced with 3 apples and 2 bananas on the left-hand side and 7 apples on the right-hand side.

If 4 apples are taken from the right-hand side, the scale can be balanced by:

- A taking 4 apples from the left-hand side
- B taking 3 apples and 1 banana from the left-hand side
- C taking 2 apples and 2 bananas from the left-hand side
- D taking 2 bananas from the left-hand side.



- 5 Trixie's father weighs twice as much as Trixie plus 12 kilograms. If her father weighs 104 kg:

- (a) write an equation representing the situation using t to represent Trixie's weight
- (b) solve the equation to find out Trixie's weight.

- 6 Naram has shot a number of 3-point goals as well as 18 other points in a game of basketball. If he shot a total of 30 points in the game:

- (a) write this as an equation with p representing the number of 3-point goals shot by Naram
- (b) solve your equation to find the number of 3-point goals that he shot.



Reasoning

- 7 Fatima drives to and from work each day for the five-day working week, and drives an additional 85 kilometres on the weekend. She drives a total of 425 kilometres every week in her car. How far is it from her home to her workplace?
- 8 George has to take 5 litres of water with him on a boat trip. He has one 1.25 L container and three other containers of equal capacity. Together, the four containers will hold 5 litres. What is the capacity of the other containers?

Open-ended

- 9 Write down three different equations that are equivalent to $5x + 4 = 14$.
- 10 Vejay was given the equation $\frac{2x+3}{7} = 3$ to solve and presented the following solution.

$$\frac{2x+3}{7} = 3$$

$$\frac{2x+3}{7} - 3 = 3 - 3$$

$$\frac{2x}{7} = 0$$

$$\frac{2x}{7} \times 7 = 0 \times 7$$

$$2x = 0$$

$$\frac{2x}{2} = \frac{0}{2}$$

$$x = 0$$



(a) Explain to Vejay why his working out is incorrect.

(b) Show Vejay the process he should have used.

(c) How could Vejay avoid making the same mistake next time he's solving equations?

Outside the Square Problem solving

Paper mountain

Imagine a very, very large sheet of paper, 0.1 mm thick.

If you fold it in half, it is 0.2 mm thick.

How thick will it be if you fold it in half again?

Imagine the paper can be folded an unlimited number of times.

How many folds would be needed to create a paper stack that is taller than Mt Everest? (Mt Everest is 8848 m high.)



Strategy options

- Act it out.
- Look for a pattern.

Maths 4 Real

Dance Party dilemma

Have you ever wondered what is involved in organising a fund-raising event such as a dance party? There would need to be a venue booked, tickets printed, advertising material created and drinks provided, as well as a range of other things.

Believe it or not, a lot of the costs to be considered can be expressed as an equation. Many costs are variables that can change as the number of people attending the party changes. There are also fixed costs to consider, which remain the same no matter how many people attend. Once you have created an equation that represents all of the costs, it becomes possible to calculate how much you should charge each person to enter the event. This would then determine whether you make a profit or a loss.

- 1 The table below represents the total costs associated with running a dance party. It shows that it would cost \$50 to organise the party even if no people attend. Why might this be? Explain.

Number of people, n	0	10	20	30	40	50
Total cost (\$), C	50	150	250	350	450	550

- 2 (a) What happens to the cost every time you increase the number of people attending the dance party by 10?

- (b) Use your answer to (a) to determine the increase in cost for one extra person.

- 3 Using the table in Question 1, what equation could you use to calculate the costs of running the dance party? Use C to represent cost and n to represent the number of people attending the dance party.

$$C = \underline{\quad} \times n + \underline{\quad}$$

- 4 Use the equation that you found in Question 3 to calculate the costs of the dance party for the following number of people attending.

- (a) 25 (b) 36 (c) 83

- 5 Suppose the following table represents the money charged to attend the dance party. As the organiser of the party, this is your income. What equation could you use to represent this? Use I for income and n for the number of people attending.

Number of people, n	0	10	20	30	40	50
Income (\$), I	0	120	240	360	480	600



- 6** Use the formula that you found in Question 5 to calculate the income from the dance party for the following number of people attending.

- (a) 32
(b) 53
(c) 95

If your income is bigger than your costs you will make a profit. However, if your costs are greater than your income, you will make a loss.



- 7** Use your equations from Questions 3 and 5 to complete the following table showing all the costs and income associated with this dance party. Make sure that you also calculate the profit or loss (the difference between the cost and the incomes). Place a negative sign in front of a number to show a loss.

Number of people, n	0	15	35	45	63	100
Cost (\$), C	50	200	400	500		
Income (\$), I	0	180	420			
Profit/loss (\$), P	-50	-20	20			

- 8** The profit or loss made at the party is found by subtracting the cost from the income. Using P to represent the profit or loss, write a formula that shows this.
- 9** What is the smallest number of people you would need to attend the dance party in order to make a profit? Show how you worked this out.

Research

Investigate the costs of organising a dance party for 40 of your friends. You need to find the following.

- cost of a suitable venue
- catering costs
- music costs
- cleaning costs

Present a report that outlines a number of different options for each of the above costs. Which is your preferred option and why? What are the benefits of hiring a venue compared to having a party at home?

Technology Exploration Excel



Equipment required: 1 brain, 1 computer with an Excel spreadsheet



Versions of this Exploration are available for other technologies in Pearson Reader.

Algebra using a spreadsheet

Did you know that your computer or calculator can do algebra? A spreadsheet program, such as Excel, uses formulas to do a lot of repetitive substitution. Spreadsheets on a CAS calculator work exactly the same way.

There are many ways to solve algebraic equations. You have been learning some algebraic methods. In this exploration, we are going to use a spreadsheet to find the solution to algebraic equations through a numerical process.

- 1 Select an Excel spreadsheet or a spreadsheet from a CAS menu and enter x as a heading in cell A1.
 - (a) To enter x -values from 0 to 6 in column A start at cell A2. Enter 0 and 1, and highlight these two cells. With the cursor on the little black cross on the bottom right-hand corner of cell A3, drag down to A8 or enter =A2+1 into cell A3 and drag this formula down to cell A8.
 - (b) Enter the expression $3x - 5$ as a heading in cell B1.
 - (c) Enter the formula $=3 \times A2 - 5$ into cell B2. This will calculate the value for $3x - 5$ when $x = 0$. The x -value in cell A2 is 0.

	B2	f _x	=3*A2-5
1	x	3x-5	
2	0	-5	
3	1		
4	2		
5	3		
6	4		
7	5		
8	6		

The formula must be changed in each row to use the x -value in column A in that row. The formula will now calculate a new value for $3x - 5$.

- (d) Copy this formula down to cell B8 by dragging the little black cross on the bottom right-hand corner of cell B2. This will change the formula to refer to the correct x -value.

- 2 Use your spreadsheet to find the solution to:

- (a) $3x - 5 = 4$
- (b) $3x - 5 = 13$
- (c) $3x - 5 = -2$

Highlight these solutions using any fill colour you want. Select the cell that contains your solution. Then, use the fill colour icon to select a colour from the font group on the Home tab.



In Excel, a formula always starts with an = sign and * represents a multiplication sign.



- 3 (a) In column C, enter the expression $-2x + 5$ as a heading in C1.

- (b) Enter the formula required to calculate a value for the expression $-2x + 5$ when $x = 0$ into cell C2.
- (c) Copy this formula down to C8.

- 4 Use your spreadsheet to find the solution to:

- (a) $-2x + 5 = 5$
- (b) $-2x + 5 = -3$
- (c) $-2x + 5 = -5$

Highlight these solutions with a different fill colour.

You will need to use a single quotation before the negative sign so that the formula is read as text

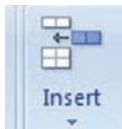


- 5 Use your spreadsheet to find the solution to $3x - 5 = -2x + 5$.

Highlight this solution using another fill colour.



- 6 We now want to solve $4x - 6 = 30$, so enter $4x - 6$ as a heading in D1 and $=4*A2-6$ as a formula in D2.
- Fill down to D8. You can see that none of the values = 30, so the solution is not in the 0 to 6 values for x .
 - We need to extend our values for x , so extend your x -values to $x = 10$.
 - Now, we can find a solution to $4x - 6 = 30$. Write down the solution and, once again, highlight the solution.
- 7 Sometimes, our solution might be less than 0, so we will need to insert values smaller than 0 in column A. Insert as many rows as you may want above row 2 and copy the formulas up instead of down.



Left click on row 2, then use 'insert sheet rows' in the 'insert' drop-down menu under the cells group on the Home tab.

Now, find the solution to:

(a) $3x - 5 = -11$ (b) $-2x + 5 = 11$

Highlight with the same fill colours you chose for these expressions previously.

- 8 Solutions to equations are not always integers. Suppose we are trying to find the solution to $4x - 6 = 25$. We can see that when $x = 7$, $4x - 6 = 22$ and when $x = 8$, $4x - 6 = 26$, but there is no solution for $4x - 6 = 25$. Because 25 is between 22 and 26, the solution will be between 7 and 8. Insert a row between $x = 7$ and $x = 8$ and enter 7.5. This gives us $4x - 6 = 24$. We now know that the solution is between 7.5 and 8.

- We can overwrite the 7.5 with 7.7. This gives us $4x - 6 = 24.8$.
- Overwriting the 7.7 with 7.75, we now get $4x - 6 = 25$.

Highlight this solution.

	A	B
1	x	$4x - 6$
2	-5	-26
3	-4	-22
4	-3	-18
5	-2	-14
6	-1	-10
7	0	-6
8	1	-2
9	1	-1
10	2	2
11	3	6
12	4	10
13	5	14
14	6	18
15	7	22
16	7.75	25
17	8	26
18	9	30
19	10	34

- 9 Insert new formulas in your spreadsheet to find the solutions to:

- $5x + 6 = 22$
- $8x + 1 = 4$
- $10x + 3.3 = 140$

Highlight each of these solutions.

Taking it further

- 10 Try to find the solution to $3x - 4 = 7$. It may look like the solution to this equation is 3.6, but $3 \times 3.6 - 4 = 6.8$, not 7. So, what has gone wrong?



Use the 'increase decimal places' icon found in the number groups on the Home tab to show four decimal places in column A and the column you have used for the expression $3x - 4$ (do not include the heading row). This gets us closer to a solution, but it is still not an exact solution. $x = 3.6666$ gives 6.9998. Do you think you would ever find an exact solution to this question with a spreadsheet? Explain your answer.

- 11 Give an example of another equation that will have the same problem.
- 12 'Spreadsheets are very useful for solving equations, but are not as good as algebraic solutions found by hand.' Do you agree with this statement? Give reasons to support your argument.

7.5

Solving problems with equations

Equations can be very useful in solving everyday problems. So far, you have practised solving equations presented to you. Now you will be forming your own equation from information supplied in a worded question. Solving this equation will help you find the unknown value asked for in the question. There may be more than one way to write the equation and solve it.

Worked Example 13

WE 13

Phil has 70 cents. He buys a pear and has 25 cents left. If x represents the cost of a pear (in cents), form an equation and solve it to find the cost of the pear.

Thinking

- 1 Define a variable to represent the unknown quantity.
- 2 Form an equation using the information given.
- 3 Identify the first operation to undo and then use the inverse operation on both sides of the equals sign.
- 4 Check the solution.
- 5 State the solution in words.

Working

Let x be the cost of a pear.

$$\begin{aligned}x + 25 &= 70 \\x + 25 - 25 &= 70 - 25 \\x &= 45 \\LHS &= 45 + 25 \\&= 70 \\&= RHS\end{aligned}$$

The pear costs 45 cents.

Worked Example 14

WE 14

Erica has bought two movie tickets and one bucket of popcorn for a total of \$21. If the popcorn costs \$5, how much does one movie ticket cost? Using t as the cost of a movie ticket, form an equation and solve it to find the value of t . (Assume both tickets are the same price.)



Thinking

- 1 Define a variable to represent the unknown quantity.
- 2 Form an equation using the information given.
- 3 Identify the first operation to undo and then use the inverse operation on both sides of the equals sign.
- 4 Identify the second operation to undo and then use the inverse operation on both sides of the equals sign.

5 Check the solution.

6 State the solution in words.

Working

Let t represent the cost in dollars of one movie ticket.

$$2t + 5 = 21$$

$$2t + 5 - 5 = 21 - 5$$

$$2t = 16$$

$$\frac{2t}{2} = \frac{16}{2}$$

$$t = 8$$

$$\begin{aligned} \text{LHS} &= 2t + 5 \\ &= 2 \times 8 + 5 \\ &= 16 + 5 \\ &= 21 \\ &= \text{RHS} \end{aligned}$$

One movie ticket costs \$8.

7.5 Solving problems with equations

Navigator

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q9,
Q11, Q13

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,
Q9, Q11, Q13

Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8,
Q10, Q12, Q13, Q14

**Answers
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Fluency

- 1 (a) Carmen has 95 cents. She buys an ice-cream and has 20 cents left. If x represents the cost of the ice-cream (in cents), form an equation and solve it to find the cost of the ice-cream.
WE13
- (b) Matthew can run 100 m in 12.8 seconds. In the school sports, Tony ran 1.5 seconds faster. If t represents Tony's time, form an equation and solve it to find Tony's time.
- 2 (a) Tran bought two sushi rolls and a juice for a total of \$8. If the juice costs \$1.60, how much does one sushi roll cost? Using d as the cost of a sushi roll, form an equation and solve it to find the value of d . (Assume both sushi rolls are the same price.)
WE14
- (b) Asif bought three DVDs and a CD for \$59. If the CD costs \$21.50, how much does one DVD cost? Using v as the cost of a DVD, form an equation and solve it to find the value of v . (Assume all DVDs are the same price.)
- 3 A bus has the capacity to seat 45 passengers. Eighteen passengers have boarded the bus and taken seats.
 - (a) If n represents the number of seats still available, the equation which can be formed is:
 A $n - 18 = 45$ B $n + 45 = 18$ C $18n = 45$ D $n + 18 = 45$
 - (b) Solve the equation formed in part (a) to find the number of seats still available on the bus.

- 4 A roll of fabric is divided evenly between six people. Each person receives 2.5 m of fabric.

(a) If t represents the total length of fabric in the roll (in m), the equation that can be formed is:

A $t = 6 + 2.5$

B $t + 2.5 = 6$

C $\frac{t}{6} = 2.5$

D $2.5t = 6$

(b) Solve the equation formed in part (a) to find the total length of the roll of fabric.



Understanding

- 5 The length of a rectangular vegetable garden is 4 m. The perimeter of wire fencing needed to enclose this garden is 13 m.

(a) If w represents the width (in m) of the vegetable garden, the equation that can be formed is:

A $w + 4 = 13$

B $w + 8 = 13$

C $2w - 8 = 13$

D $2w + 8 = 13$

(b) Solve the equation formed in part (a) to find the width of the vegetable garden.

- 6 Lucas bought a salad sandwich and a container of milk for his lunch.

(a) If the salad sandwich cost $\$x$ and the milk cost $\$1.50$, write an expression for the total cost of his lunch.

(b) Form an equation and solve it to find the cost of the salad sandwich if Lucas spent $\$5.70$ on his lunch.

- 7 (a) If x represents the length (in cm) of a square floor tile, write an expression for its perimeter.

(b) Form an equation and solve it to find the length of the floor tile if its perimeter is 84 cm.



- 8 A restaurant has several tables that seat four people, but only three tables that seat two people.
- If x represents the number of four-person tables available, write an expression for the total number of people that can be seated at the restaurant.
 - A Saturday night booking for 62 people has been made. Six of these people are to be seated at the three two-person tables. Form an equation and solve it to find how many four-person tables will be needed.
- 9 At a particular rollerskating rink, it costs \$5 to hire skates and \$3 for each hour spent on the rink. If it costs Natalie \$14, form an equation and solve it to find how many hours she spent rollerskating. Let h represent the number of hours spent rollerskating.



- 10 The tallest man in recorded history was Robert Wadlow (1918–1940). At age 22, his height was 54 cm less than twice his height at age 5. If his height at age 22 was 272 cm, form an equation and solve it to find his height at age 5.
- 11 A company called Tool Time hires out electrical tools, charging a non-refundable deposit of \$15 for each item plus an amount per day according to the type of tool.



Tool	Hire charge per day
Electric drill	\$8
Electric sander	\$13
Electric circular saw	\$24
Electric jackhammer	\$35
Concrete mixer	\$48

Let d = the number of days the tools are hired, then form an equation and solve it to answer each of the following.

- If Allie hires an electric drill from Tool Time and pays \$63, for how many days did she hire it?
- If Serena hires a concrete mixer from Tool Time and pays \$111, for how many days did she hire it?
- Kosta hires an electric sander and an electric saw from Tool Time. For how many days did he hire the tools if he paid \$178?



Reasoning

- 12 The local council has hired a concreting firm to pave some footpaths. Each footpath is to be one metre wide. A wooden frame is needed before the concrete is poured. This frame is made up of one-metre lengths of wood.

The frames for some different lengths of footpath are shown in the diagrams below.



2 m long footpath



3 m long footpath



4 m long footpath

- How many pieces of wood are needed to construct the frame of a footpath of length:
 - 2 metres
 - 3 metres
 - 4 metres?
- Write an expression for the number of pieces of wood needed to construct the frame for a footpath of length x metres.
- Form an equation and solve it to find how many pieces of wood are needed to construct the frame for a footpath of length:
 - 6 metres
 - 10 metres
 - 13 metres.
- The concreting workers have only 36 pieces of wood. By using your equation and solving it, find the length of the longest footpath that could be poured at the one time.

Open-ended

- 13 Gary the gardener is keen to do some landscaping on a Saturday and has allowed for 7 hours work. It costs \$30 per hour for him to hire a jackhammer and \$22 per hour to hire a mulcher. He has budgeted to spend no more than \$180. Keeping in mind that he can only use one piece of equipment at a time, what are three options for using the equipment and what would each option cost him?
- 14 A man is 5 times the age of his son. Given that the sum of their ages is no greater than 70, what are their possible ages? Assume that the answers are whole numbers.

Outside the Square Problem solving

Algebraic puzzles

- Four numbers are added together and the result is 255. One of the numbers is the square of one of the others. The largest number is double the square number, and the fourth number is 55. Find the numbers.
- If a screw and a washer balance with a bolt, a screw balances with a washer and a nut, and two bolts balance with three nuts, find out how many washers will balance with a screw.



Strategy options

- Guess and check.
- Break problem into manageable parts.

