

Chapter 1 Algebra

Practice 1 Algebraic Expressions Involving Addition and Subtraction

- 1 There are k marbles in a box at first. Some marbles are then added.



Write an algebraic expression in each row below to represent the number of marbles.

	Number of marbles in the box
Number of marbles at first	k
Add 1 more marble	$k + 1$
Add 4 more marbles	$k + 4$
Add 10 more marbles	$k + 10$

- 2 A container has w buttons at first. Some buttons are then removed.

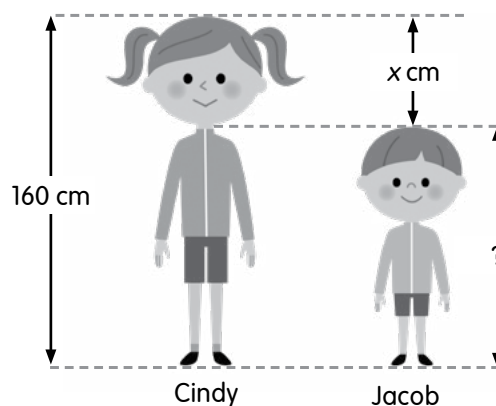


Write an algebraic expression in each row below to represent the number of buttons.

	Number of buttons in the container
Number of buttons at first	w
Remove 1 button	$w - 1$
Remove 3 buttons	$w - 3$
Remove 9 buttons	$w - 9$

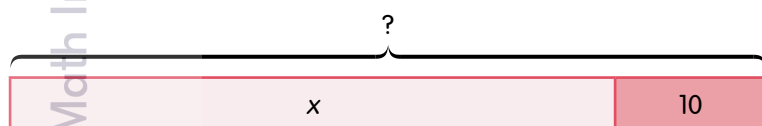
- 3 Write an algebraic expression to represent Jacob's height in terms of x .

Jacob's height is $(160 - x)$ cm.



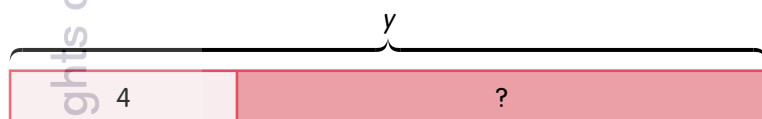
- 4 Write an algebraic expression for each of the following.

- (a) Raj has x stickers. Ali gives him 10 more stickers. How many stickers does Raj have now?



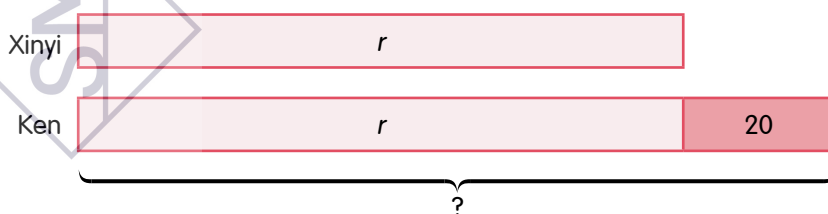
Raj has $(x + 10)$ stickers now.

- (b) A pail had y ℓ of water. Mr Lim used 4 ℓ of the water to wash his car. How much water was left in the pail?



$(y - 4)$ ℓ of water was left in the pail.

- (c) Xinyi has $\$r$. Ken has $\$20$ more than Xinyi. How much money does Ken have?



Ken has $\$ (r + 20)$.

- 5 Write an algebraic expression for each statement.

Statement	Algebraic Expression
(a) Add c to 35.	$35 + c$ or $c + 35$
(b) Subtract p from 18.	$18 - p$
(c) s more than 7.	$s + 7$ or $7 + s$
(d) k less than 30.	$30 - k$
(e) Sum of 12 and t .	$12 + t$ or $t + 12$

- 6 Sabrina is m years old.
She is 3 years older than Tina.

- (a) What is Tina's age in terms of m ?
(b) What is the total age of the two girls in terms of m ?

(a) Tina's age in terms of m is $m - 3$.

(b) $m + (m - 3) = 2m - 3$

The total age of the two girls is $2m - 3$.

- 7** Write an algebraic expression for each of the following.
Siti saved \$25. Danny saved \$ r more than Siti.

(a) How much did Danny save?

Danny saved $\$(25 + r)$.

(b) How much did they save altogether?

$$\$(25 + 25 + r) = \$(50 + r)$$

They saved $\$(50 + r)$ altogether.

- 8** Mary has a red ribbon and a green ribbon. The red ribbon is y cm long.
The green ribbon is 10 cm shorter than the red ribbon.

(a) What is the length of the green ribbon in terms of y ?

$$y - 10$$

The green ribbon is $(y - 10)$ cm long.

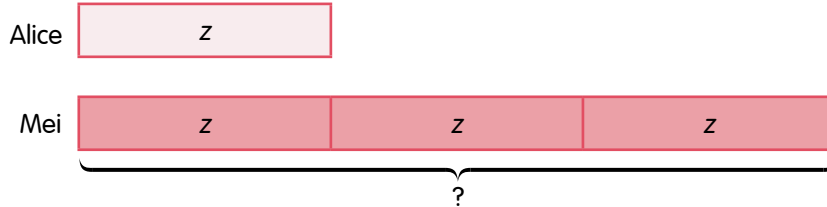
(b) What is the total length of the 2 ribbons in terms of y ?

$$y + y - 10 = 2y - 10$$

The total length of the 2 ribbons is $(2y - 10)$ cm.

Practice 2 Algebraic Expression Involving Multiplication and Division**1** Write an algebraic expression for each of the following.

- (a) Alice has z beads. Mei has 3 times as many beads as Alice.
How many beads does Mei have?

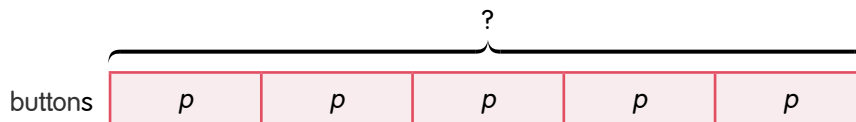


Mei has

$3z$

 beads.

- (b) Mrs Tay has 5 boxes of buttons. Each box has p buttons.
How many buttons does Mrs Tay have altogether?

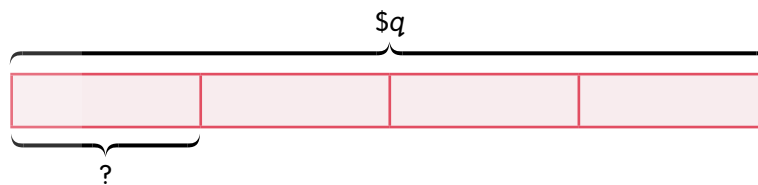


Mrs Tay has

$5p$

 buttons altogether.

- (c) A sum of $\$q$ is shared equally among 4 people.
How much does each person receive?



Each person receives \$

$\frac{q}{4}$

.

2 Write an algebraic expression for each statement.

Statement	Algebraic Expression
(a) Multiply 12 by y .	$12y$
(b) Divide x by 4.	$\frac{x}{4}$
(c) Product of r and 7.	$7r$
(d) Three times as many as z .	$3z$

3 n cookies were shared equally among Ben, Ravi and Faizal. Ben ate 9 of his cookies.

(a) How many cookies did Ben have at first?

Write an algebraic expression in terms of n .

$$n \div 3 = \frac{n}{3}$$

Ben had $\frac{n}{3}$ cookies at first.

(b) How many cookies did Ben have in the end?

Write an algebraic expression in terms of n .

Ben had $\left(\frac{n}{3} - 9\right)$ cookies in the end.

- 4 The mass of a papaya is z kg. A watermelon is 2 times as heavy as the papaya. A bunch of bananas is 3 kg lighter than the watermelon.

(a) What is the mass of the watermelon in terms of z ?

$$2 \times z \text{ kg} = 2z \text{ kg}$$

The mass of the watermelon is $2z$ kg.

(b) What is the mass of the bunch of bananas in terms of z ?

The mass of the bunch of bananas is $(2z - 3)$ kg.

- 5 Jane bought a table tennis bat for \$15. She bought 4 ping pong balls at \$ q each.

(a) How much did she pay for 4 ping pong balls in terms of q ?

$$4 \times q = 4q$$

She paid \$ $4q$ for the 4 ping pong balls.

(b) How much did she pay for the table tennis bat and the ping pong balls together in terms of q ?

$$15 + 4q$$

She paid \$ $(15 + 4q)$ for the table tennis bat and the ping pong balls altogether.

- 6 A fruit seller had $4a$ boxes of apples.
Each box had 20 apples.
He sold 13 boxes of apples.
Find the number of apples left in terms of a .

$$4a \times 20 = 80a$$

He had $80a$ apples at first.

$$80a - (13 \times 20) = 80a - 260$$

He had $(80a - 260)$ apples left.

- 7 Mary has $10h$ beads.
This is 3 times the number of beads Sally has.
Denise has twice the number of beads Sally has.
Find the number of beads Denise has in terms of h .

$$10h \div 3 = \frac{10h}{3}$$

Sally has $\frac{10h}{3}$ beads.

$$2 \times \frac{10h}{3} = \frac{20h}{3}$$

Denise has $\frac{20h}{3}$ beads.

Practice 3 Simplifying Algebraic Expressions

1 Simplify each algebraic expression.

(a) $7n + 3n = 10n$

(b) $12j + 10j = 22j$

(c) $11p - 5p = 6p$

(d) $12k - 11k = k$

(e) $10r + 12r + 4r = 26r$

(f) $20g - 6g - 8g = 6g$

(g) $2w + 4w - w = 5w$

(h) $6x - 2x + 5x = 9x$

(i) $y - 7 + 3y = 4y - 7$

(j) $24c + 9 - 10c = 14c + 9$

2 Simplify each algebraic expression.

(a) $2 + j + 7 + 7j$
 $= 9 + 8j$ or $8j + 9$

(b) $12q - 5q - 6 + 6q$
 $= 13q - 6$

(c) $4 + 15m + 6 - 4m$
 $= 10 + 11m$ or $11m + 10$

(d) $6u + 7u + 20 - 12u$
 $= u + 20$

(e) $16f - 3f - 8 - f$
 $= 12f - 8$

(f) $23v + 9 - 10v - 5$
 $= 13v + 4$

(g) $25s + 10 - 4s + 6s - 8$
 $= 27s + 2$ or $2 + 27s$

(h) $15 + 36v - 4v - 8v - 10$
 $= 5 + 24v$ or $24v + 5$

Practice 4 Evaluating Algebraic Expressions

- 1 Find the value of each algebraic expression for each value of z .

Algebraic expression	$z = 5$	$z = 7$
(a) $z + 10$	$5 + 10 = 15$	$7 + 10 = 17$
(b) $z - 5$	$5 - 5 = 0$	$7 - 5 = 2$
(c) $2z$	$2 \times 5 = 10$	$2 \times 7 = 14$
(d) $\frac{z}{5}$	$\frac{5}{5} = 1$	$\frac{7}{5} = 1\frac{2}{5}$

- 2 Find the value of each expression when $a = 4$.

$$\begin{aligned} \text{(a)} \quad 4a + 3 &= 4 \times 4 + 3 \\ &= 16 + 3 \\ &= 19 \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad 16 + 6a &= 16 + 6 \times 4 \\ &= 16 + 24 \\ &= 40 \end{aligned}$$

$$\begin{aligned} \text{(c)} \quad 5a - 7 &= 5 \times 4 - 7 \\ &= 20 - 7 \\ &= 13 \end{aligned}$$

$$\begin{aligned} \text{(d)} \quad 10a - 13 &= 10 \times 4 - 13 \\ &= 40 - 13 \\ &= 27 \end{aligned}$$

$$\begin{aligned} \text{(e)} \quad 2a \div 5 &= \frac{2a}{5} \\ &= \frac{2 \times 4}{5} \\ &= \frac{8}{5} \text{ or } 1\frac{3}{5} \end{aligned}$$

$$\begin{aligned} \text{(f)} \quad \frac{7a}{6} &= \frac{7 \times 4}{6} \\ &= \frac{28}{6} \\ &= \frac{14}{3} \text{ or } 4\frac{2}{3} \end{aligned}$$

3 Simplify each expression. Find its value when $d = 8$.

$$\begin{aligned}\text{(a)} \quad 2d + 4d + 9 &= 6d + 9 \\ &= 6 \times 8 + 9 \\ &= 48 + 9 \\ &= 57\end{aligned}$$

$$\begin{aligned}\text{(b)} \quad 12 + 3d + 6d &= 12 + 9d \\ &= 12 + 9 \times 8 \\ &= 12 + 72 \\ &= 84\end{aligned}$$

$$\begin{aligned}\text{(c)} \quad 10d + 7 - 2d &= 10d - 2d + 7 \\ &= 8d + 7 \\ &= 8 \times 8 + 7 \\ &= 64 + 7 \\ &= 71\end{aligned}$$

$$\begin{aligned}\text{(d)} \quad 9d - 14 - 5d &= 9d - 5d - 14 \\ &= 4d - 14 \\ &= 4 \times 8 - 14 \\ &= 32 - 14 \\ &= 18\end{aligned}$$

4 Find the value of each expression when $b = 10$.

$$\begin{aligned}\text{(a)} \quad \frac{b+6}{2} &= \frac{10+6}{2} \\ &= \frac{16}{2} \\ &= 8\end{aligned}$$

$$\begin{aligned}\text{(b)} \quad \frac{4b-10}{5} &= \frac{4 \times 10 - 10}{5} \\ &= \frac{40 - 10}{5} \\ &= \frac{30}{5} \\ &= 6\end{aligned}$$

$$\begin{aligned}\text{(c)} \quad \frac{50-3b}{7} &= \frac{50-3 \times 10}{7} \\ &= \frac{50-30}{7} \\ &= \frac{20}{7} \text{ or } 2\frac{6}{7}\end{aligned}$$

$$\begin{aligned}\text{(d)} \quad \frac{7+4+2b}{3} &= \frac{7+4+2 \times 10}{3} \\ &= \frac{11+20}{3} \\ &= \frac{31}{3} \\ &= 10\frac{1}{3}\end{aligned}$$

- 5 The mass of each packet of sugar was m kg.

Mrs Tan had $5m$ kg of sugar.

She then bought another 3 packets of sugar.

(a) How much sugar did Mrs Tan have altogether in terms of m ?

(b) If $m = 2$, find the mass of sugar Mrs Tan had altogether.

(a) $5m + 3m = 8m$

Mrs Tan had $8m$ kg of sugar altogether.

(b) If $m = 2$,

$$8m = 8 \times 2$$

$$= 16$$

Mrs Tan had 16 kg of sugar altogether.

- 6 Devi bought h boxes of cupcakes at \$9 per box.

She paid with a \$50 note.

(a) How much change did Devi receive in terms of h ?

(b) If $h = 5$, what was the amount of change she received?

(a) $9 \times h = 9h$

$$50 - 9h$$

The amount of change Devi received was $\$(50 - 9h)$.

(b) If $h = 5$,

$$50 - 9h = 50 - 9 \times 5$$

$$= 50 - 45$$

$$= 5$$

The amount of change she received was \$5.

- 7 A handbag cost \$ k . A wallet cost \$3 more than the handbag.
David bought 3 such handbags and a wallet.

- (a) Find the total cost of the 3 handbags and the wallet in terms of k .
(b) If $k = 3$, find the total cost that David paid.

(a) $3 \times k = 3k$

The cost of 3 handbags was \$ $3k$.

$$3k + k + 3 = 4k + 3$$

The total cost of the 3 handbags and the wallet was \$ $(4k + 3)$.

- (b) If $k = 3$,

$$\begin{aligned} 4k + 3 &= 4 \times 3 + 3 \\ &= 12 + 3 \\ &= 15 \end{aligned}$$

The total cost that David paid was \$15.

- 8 Mrs Lim baked 100 cookies.
She gave w cookies to her neighbour and divided the remaining cookies equally into 4 boxes.

- (a) What was the number of cookies in each box in terms of w ?
(b) How many cookies were there in each box if $w = 40$?

- (a) Mrs Lim had $(100 - w)$ cookies left after giving w cookies to her neighbour.

$$(100 - w) \div 4 = \frac{100 - w}{4}$$

The number of cookies in each box was $\frac{100 - w}{4}$.

- (b) If $w = 40$,

$$\begin{aligned} \frac{100 - w}{4} &= \frac{100 - 40}{4} \\ &= \frac{60}{4} \\ &= 15 \end{aligned}$$

There were 15 cookies in each box.

- 9 At a fruit stall, each papaya cost \$ k . A watermelon cost \$2 more than the papaya. Mr Teng bought 3 such papayas and a watermelon.

(a) Find the total cost of the fruits in terms of k .

(b) If $k = 3$, find the total amount Mr Teng paid for the fruits.

(a) $3 \times k = 3k$

$$3k + k + 2 = 4k + 2$$

The total cost of the fruits was $\$(4k + 2)$.

(b) If $k = 3$,

$$4k + 2 = 4 \times 3 + 2$$

$$= 12 + 2$$

$$= 14$$

Mr Teng paid \$14 in all.

- 10 John is p years old now. He is 4 years younger than his brother.

(a) How old will his brother be in 5 years' time in terms of p ?

(b) If $p = 10$, how old will his brother be in 5 years' time?

(a) John's brother is $(p + 4)$ years old now.

$$p + 4 + 5 = p + 9$$

In 5 years' time, John's brother will be $(p + 9)$ years old.

(b) If $p = 10$,

$$p + 9 = 10 + 9$$

$$= 19$$

John's brother will be 19 years old in 5 years' time.



- 11** Mr Smith spent \$ v on a tie and twice as much on a shirt.
He also bought a belt for \$30.

- (a)** Express the total amount Mr Smith spent in terms of v .
(b) If $v = 25$, how much did Mr Smith spend altogether?

(a) $v + 2v + 30 = 3v + 30$

Mr Smith spent a total of $\$(3v + 30)$.

(b) If $v = 25$,
$$\begin{aligned} 3v + 30 &= (3 \times 25) + 30 \\ &= 75 + 30 \\ &= 105 \end{aligned}$$

Mr Smith spent \$105 altogether.

- 12** A child's ticket for a pet fair costs \$ b .
An adult's ticket for the same fair costs $\$(b + 6)$.
A family of 2 adults and 2 children wants to attend the pet fair.

- (a)** How much must the family pay in terms of b ?
(b) If $b = 3$, how much did the family pay in all?

(a)
$$\begin{aligned} \$b + \$b + \$(b + 6) + \$(b + 6) &= \$2b + \$b + \$6 + \$b + \$6 \\ &= \$(4b + 12) \end{aligned}$$

The family must pay $\$(4b + 12)$ in all.

(b) If $b = 3$,
$$\begin{aligned} \$(4b + 12) &= \$(4 \times 3 + 12) \\ &= \$24 \end{aligned}$$

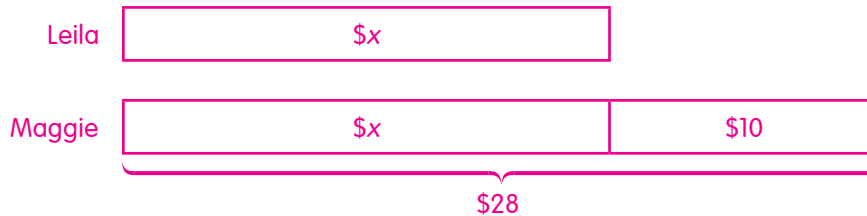
The family paid \$24 in all.

Practice 5 Solving Algebraic Equations

- 1 Leila had \$ x . Maggie had \$10 more than Leila.

(a) How much did Maggie have in terms of x ?

(b) If Maggie had \$28, how much money did Leila have?



(a) $x + 10$

Maggie had $\$(x + 10)$.

(b) $x + 10 = 28$
 $x = 28 - 10$
 $= 18$

Leila had \$18.

- 2 Alice has y bracelets. Bernice has 4 times as many bracelets as Alice.

(a) How many bracelets does Bernice have in terms of y ?

(b) If Bernice has 12 bracelets, how many bracelets does Alice have?



(a) $4 \times y = 4y$

Bernice has $4y$ bracelets.

(b) $4y = 12$
 $y = 12 \div 4$
 $= 3$

Alice has 3 bracelets.

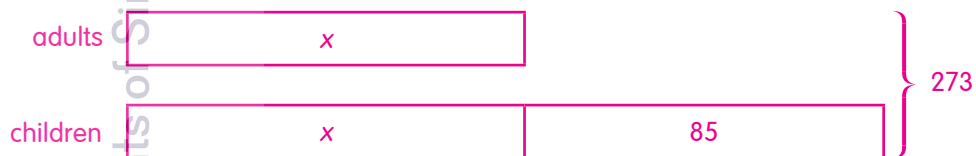
- 3 Mike had g stickers.
Nathan had $5g$ stickers.
They had 48 stickers altogether.
How many stickers did Mike have?



$$\begin{aligned}
 g + 5g &= 6g \\
 6g &= 48 \\
 g &= 48 \div 6 \\
 &= 8
 \end{aligned}$$

Mike had 8 stickers.

- 4 There are 273 people at the cinema.
There are 85 more children than adults.
How many children are there at the cinema?
Solve this problem using algebra by letting x be the number of adults.



$$\begin{aligned}
 2x &= 273 - 85 \\
 &= 188 \\
 x &= 188 \div 2 \\
 &= 94
 \end{aligned}$$

$$94 + 85 = 179$$

There are 179 children at the cinema.

- 5 A rope is 95 cm long.
It is cut into 3 pieces and their lengths are $3r$ cm, $(r + 10)$ cm and r cm.
What is the length of the shortest rope?



$3r$ cm



$(r + 10)$ cm



r cm

$$3r + r + 10 + r = 5r + 10$$

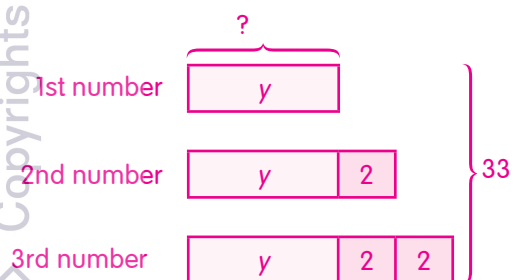
$$5r + 10 = 95$$

$$\begin{aligned} 5r &= 95 - 10 \\ &= 85 \end{aligned}$$

$$\begin{aligned} r &= 85 \div 5 \\ &= 17 \end{aligned}$$

The length of the shortest rope is 17 cm.

- 6 The sum of 3 numbers is 33.
The second number is 2 more than the first number.
The third number is 2 more than the second number.
What is the smallest number?

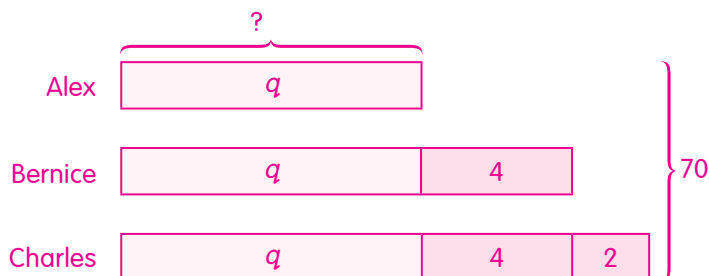


$$\begin{aligned} 3y &= 33 - 6 \\ &= 27 \end{aligned}$$

$$\begin{aligned} y &= 27 \div 3 \\ &= 9 \end{aligned}$$

The smallest number is 9.

- 7 Alex is q years old.
His sister is 4 years older than he is.
His brother is 2 years older than his sister.
The sum of their ages is 70. Find Alex's age.



$$\begin{aligned} 3q &= 70 - 4 - 4 - 2 \\ &= 70 - 10 \\ &= 60 \end{aligned}$$

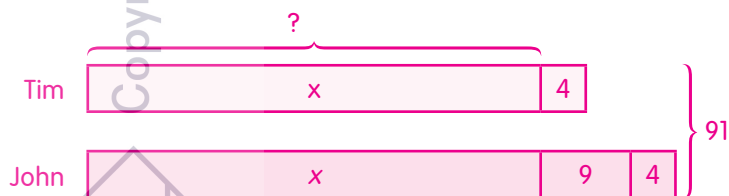
$$\begin{aligned} q &= 60 \div 3 \\ &= 20 \end{aligned}$$

Alex is 20 years old.

- 8 Tim is x years old now.
John is 9 years older than Tim.
In 4 years' time, the sum of their ages will be 91.
How old is Tim now?

John is $(x + 9)$ years old now.

In 4 years' time,



$$\begin{aligned} 2x &= 91 - 4 - 9 - 4 \\ &= 91 - 17 \\ &= 74 \end{aligned}$$

$$\begin{aligned} x &= 74 \div 2 \\ &= 37 \end{aligned}$$

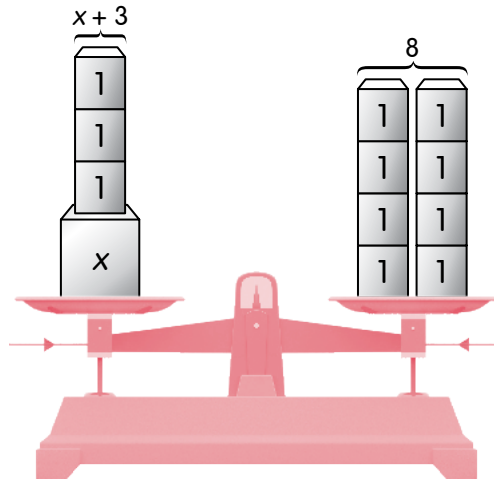
Tim is 37 years old now.

Performance Task



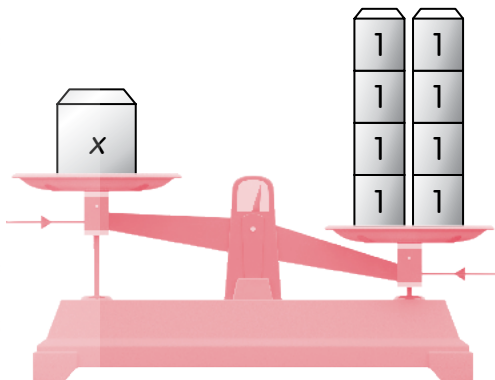
Activity: Using the concept of balance to solve an equation.

The balance in the diagram shows the equation $x + 3 = 8$.

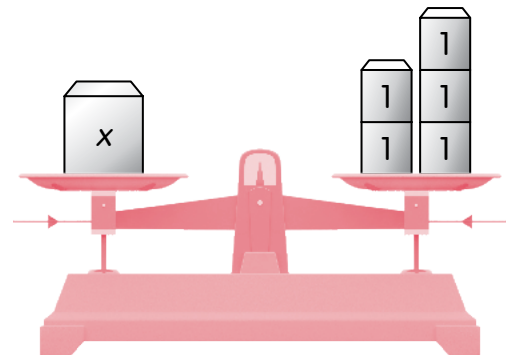


With the aid of the diagrams below, find the value of x in 2 steps.

Step 1



Step 2



(a) In Step 1, we remove units from the left-hand side of the balance.

(b) In Step 2, we remove units from the right-hand side of the balance.

(c) Find the value of x .

$$x + 3 - \text{3} = 8 - \text{3}$$

$$x = \text{5}$$

Problem Solving

Mr Goh is 3 times as old as his son.

His son is w years old.

In 8 years' time, the sum of their ages will be 68.

How old will his son be in 8 years' time?

Mr Goh is $3w$ years old now.

In 8 years' time,



$$\begin{aligned} 4w &= 68 - 8 - 8 \\ &= 68 - 16 \\ &= 52 \end{aligned}$$

$$\begin{aligned} w &= 52 \div 4 \\ &= 13 \end{aligned}$$

$$13 + 8 = 21$$

Mr Goh's son will be 21 years old in 8 years' time.