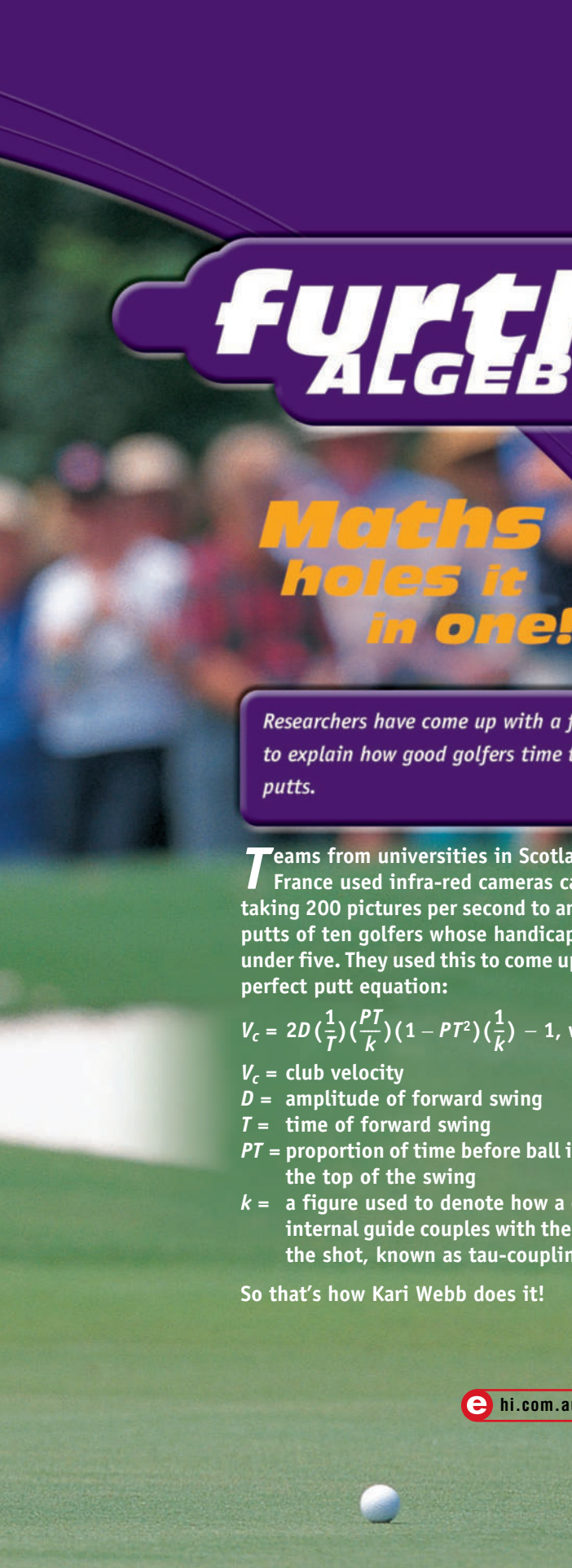
RETURN TO MAIN MENU

10 further ALGEBRA



Maths holes it in one!

Researchers have come up with a formula to explain how good golfers time their putts.

Teams from universities in Scotland and France used infra-red cameras capable of taking 200 pictures per second to analyse the putts of ten golfers whose handicaps were under five. They used this to come up with the perfect putt equation:

$V_c = 2D\left(\frac{1}{T}\right)\left(\frac{PT}{k}\right)(1 - PT^2)\left(\frac{1}{k}\right) - 1$, where

V_c = club velocity
D = amplitude of forward swing
T = time of forward swing
PT = proportion of time before ball is hit from the top of the swing
k = a figure used to denote how a golfer's internal guide couples with the timing of the shot, known as tau-coupling.

So that's how Kari Webb does it!

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outcomes

After completing this chapter you will be able to:

- simplify algebraic expressions
- substitute into algebraic expressions and formulae
- expand and factorise algebraic expressions
- locate points and coordinates on a number plane.

prepzone 10

Prepare for this chapter by attempting the following questions. If you have difficulty with a question, click on the Replay Worksheet icon on your *eMaths Zone* CD or ask your teacher for the Replay Worksheet.

Worksheet R10.1

1 (a) Work out which rule is being used for this table and write it as a formula using the pronumerals.

x	y
14	20
-56	-50
33	39
6	12
-7	-1
100	106

(b) Use the rule $y = 10x - 6$ to complete the table.

x	y
10	
-1	
5	
9	
-12	
20	

Worksheet R10.2

2 Substitute the values **(a)** $g = 2$ and **(b)** $g = -8$ into the formula $f = 10g - 9$.

Worksheet R10.3

3 Simplify:

(a) $6 \times 5 + 3$ **(b)** $6 \times (8 - 4) \div 3$ **(c)** $23 - 6 + (12 - 7) \times 2 + 1$

Worksheet R10.4

4 Write down the highest common factor (HCF) of each of the following.

(a) 8 and 12 **(b)** 35 and 77 **(c)** 6, 18 and 39

Worksheet R10.5

5 Fill in the missing number in each of the following:

(a) $3 + \_\_ = 10$ **(b)** $4 \times \_\_ = 40$ **(c)** $12 - \_\_ = 7$ **(d)** $12 \div \_\_ = 4$

Worksheet R10.6

6 Decode the following animal records by writing in order the letters contained in each grid square listed.

(a) The fastest living creature
E2 E4 A1 E4 B3 A1 D3 C2 E4
A3 A4 A2 C4 D2 C2

(b) The largest land carnivore (meat-eater)
E3 D2 D4 D3 A4 E3 B4 E4 A4 A1

	A	B	C	D	E
4	a	b	c	d	e
3	f	g	h	i	k
2	l	m	n	o	p
1	r	s	t	u	y

KEY WORDS

axes	**expression**	**origin**	**term**
Cartesian plane	**factorise**	**pronumeral**	***x*-axis**
coordinates	**graph**	**simplify**	***y*-axis**
distributive law	**like terms**	**solution**	
equation	**number plane**	**solve**	
expand	**ordered pair**	**substitution**	

10.1 Writing algebra

Algebraic abbreviations

In algebra we are always looking for shortcuts to make things easier. For example, we almost never use multiplication signs. It's not that it is *wrong* to use them, it's just that they are not necessary.

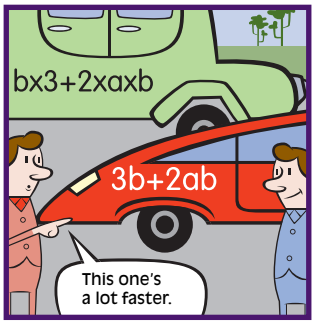
For example $7 \times y = 7y$

$4 \times a - 6 \times g = 4a - 6g$

Also we hardly ever use a division sign in algebra. Usually we write division as a fraction (which is really what the fraction means anyway).

For example $4 \div y = \frac{4}{y}$

$9 \times h \div 4 = \frac{9h}{4}$



dangerzone

$1 \times n$ is usually written as n, not $1n$. There is no need to write the 1.

Here are a few technical words you need to understand when working with algebra:

Terms: $5a$ $7q$ $9xy$ z abc 4

Terms may have one or more pronumerals, or may be just a number.

Expressions: $5a + 7q$ $5a + 7q - 12$ $9xy - z$

Expressions are made by adding or subtracting terms. An expression can consist of one or more algebraic terms and has no equals sign in it.

Equations: $p = 5a + 7q$ $j = 5a + 7q - 12$ $y = 7x + 3$

Equations have equal signs.

eTutorial

exercise 10.1 Writing algebra

Preparation: Prep Zone Q3

Core

1 Write these expressions without division and multiplication signs and without brackets.

Worksheet C10.1

Hint

(a) $4 \times a$ **(b)** $5 \times k$ **(c)** $p \times 2 \times q$

(d) $r \times s \times 7 \times t$ **(e)** $x \div 6$ **(f)** $h \div 9$

(g) $7 \div m$ **(h)** $5 \div n$ **(i)** $6 \times a \div 11$

(j) $15 \div (3 \times r)$ **(k)** $21 \div (12 \times v)$ **(l)** $4 \times s \div 19$

(m) $8 \div x - u \div 6$
(n) $h \div 5 + 4 \div i$
(o) $7 \div g + 6 \div c - 2 \times n$
(p) $5 \div w + 12 \div m + 7 \times f$
(q) $c \times u \div 5 + 9 \times y$
(r) $q \div (7 \times c) - g \times h \div 4$
(s) $v \times z \div 6 - 8 \div (f \times s)$
(t) $3 \div (t \times r) + 6 \times w \div (y \times z)$
(u) $4 \times h \times b \div (2 \times r)$
(v) $6 \times c \times a \div (5 \times e \times u)$
(w) $21 \times t \times s \div (6 \times f) + d \times b - 2 \div (7 \times f \times s)$
(x) $17 \times m \times n \div (h \times z) + 8 \times c \div r + 4 \times q \times f$

Hint

Worksheet C10.2

2 Answer TRUE or FALSE for each of these statements.

(a) $6y$ is a term
(b) $7y - 9$ is an equation
(c) $y = 7x$ is a term
(d) ab is a term
(e) $r = 5t - 9$ is an expression
(f) $cd + 4$ is an expression
(g) $w = s - 5b$ is an equation
(h) $6g$ is an equation
(i) $rs = sr$
(j) $7 - 6xzy = 7 - 6yxz$

Extension

3 Choose the correct answer.
Which expression matches up to the rule given in each case?

(a) Take a number and add another number to it.
A $6 + a$ **B** $u + v$ **C** $c + 9$ **D** $3 + 8x$

(b) Take a number and multiply it by another number.
A $a + b$ **B** $a - b$ **C** $4ab$ **D** ab

(c) Take a number and multiply it by six, then add another number to that answer.
A $6n + 6$ **B** $m + 6$ **C** $6t + h$ **D** $a + b + 6$

Hint

(d) Take a number and multiply it by three, then subtract another number from that answer.
A $3a - 1$ **B** $3n - y$ **C** $3m - 3$ **D** $r - 3 + a$

(e) Take a number and multiply it by two, then add another number to that answer, then subtract thirteen.
A $2f + 2d - 13$ **B** $2mn - 13$ **C** $2w + g - 13$ **D** $a + b - 13$

(f) Take a number and multiply it by eight, then subtract six, then add another number.
A $8i - 6j$ **B** $8a - 6 + b$ **C** $6(8 + t) - w$ **D** $8(a + b) - 6$

(g) Take a number and add it to another number, then multiply the answer by nine.
A $9x + y$ **B** $9(x + y)$ **C** $x + 9y$ **D** $9 + xy$

(h) Take a number and add it to another number, then subtract fifteen.
A $c + d - 15$ **B** $cd - 15$ **C** $15(c + d)$ **D** $c - d + 15$

(i) Take a number and multiply it by ten, then take another number and multiply it by four, then add the two answers together.
A $w + v + 10 + 4$ **B** $vw + 14$ **C** $14(v + w)$ **D** $10v + 4w$

(j) Take a number and multiply it by seven, then subtract another number, then add a third number.
A $p + 7 - z + g$ **B** $7p - zg$ **C** $7(p + z - g)$ **D** $7p - z + g$

(k) Add two numbers together, then multiply by twenty, then subtract another number from your answer.

A $20x + 20y - 20$ **B** $20(x + y) - z$

C $20(x + y - z)$ **D** $20(x + z) - 20$

(l) Subtract a number from another number, then multiply your answer by one hundred, then subtract a third number.

A $100 - x - y$ **B** $100 - x - y - z$

C $100x - y - z$ **D** $100(x - y) - z$

4 A rectangle has length a and breadth b.

(a) Write an expression for the perimeter of the rectangle. (There are three different ways to write this: with two terms, four terms and with brackets. Try each way.)

(b) Write an expression for the area of the rectangle.

5 Write two expressions, each with two terms.

eQuestions

Worksheet T10.1

10.2 Substitution

Sometimes we are told what the values of all the **pronumerals** in an expression are. In this case we can **substitute** the pronumerals with the numbers. It is important to make sure we put the multiplication sign back in after we replace the pronumeral.

worked example 1

Substitute $a = 8$, $b = 10$ and $c = 1$ into the following expressions and then simplify.

(a) $a + b - c$ **(b)** $\frac{3b}{5} - \frac{40}{a}$

Steps

(a) 1. Replace the pronumerals by the numbers.

2. Evaluate. (Remember to use the order of operations rule.)

(b) 1. Replace the pronumerals by the numbers. (Remember to put multiplication signs in where necessary.)

2. Evaluate. (Remember to use the order of operations rule.)

Solutions

(a) $a + b - c$

$= 8 + 10 - 1$

$= 17$

(b) $\frac{3b}{5} - \frac{40}{a}$

$= \frac{3 \times 10}{5} - \frac{40}{8}$

$= \frac{30}{5} - \frac{40}{8}$

$= 6 - 5$

$= 1$

Sometimes it's possible to do the addition and subtraction at the end in one step.

If there is a term next to a pair of brackets, it means multiply.

For example: $4(m-8)$ means $4 \times (m-8)$
$k(4+r)$ means $k \times (4+r)$
$5ab(a+6b)$ means $5 \times a \times b \times (a+6 \times b)$
$(h+7)j$ means $(h+7) \times j$

When substituting into expressions with brackets, work out the value *inside* the brackets first and leave the multiplication involving the brackets until last.

worked example 2

Substitute $a = 2$, $b = 1$ and $c = 5$ into $10c(5a - 2b)$, and then simplify.

Steps	Solution
1. Replace the pronumerals by the numbers.	$10c(5a-2b)$ $= 10 \times 5 \times (5 \times 2 - 2 \times 1)$
2. Evaluate. (Remember to use the order of operations rule.)	$= 10 \times 5 \times (10-2)$ $= 10 \times 5 \times 8$ $= 50 \times 8$ $= 400$

Substituting negative numbers

When substituting negative numbers, remember the rules about negatives and positives.

× or ÷

$(+) \times (+) = (+)$ $\quad$ $(+) \div (+) = (+)$
$(+) \times (-) = (-)$ $\quad$ $(+) \div (-) = (-)$
$(-) \times (+) = (-)$ $\quad$ $(-) \div (+) = (-)$
$(-) \times (-) = (+)$ $\quad$ $(-) \div (-) = (+)$

+ and −

$+ + = +$ $\quad$ and $\quad$ $- - = +$
$- + = -$ $\quad$ and $\quad$ $+ - = -$

Think of the number line. Remember that 'subtracting a negative number' is the same as 'adding a positive number'.

worked example 3

Substitute $a = -3$ and $b = -2$ into each of the following expressions, and then simplify.

(a) $2a - 4b$ **(b)** $7ab - \frac{4a}{b}$

Steps

(a) 1. Replace the pronumerals by the numbers.

2. Evaluate. (Remember to use the order of operations rule.)

(b) 1. Replace the pronumerals by the numbers.

2. Evaluate. (Remember to use the order of operations rule.)

Solutions

(a) $2a - 4b$
$= 2 \times -3 - 4 \times -2$
$= -6 - -8$
$= -6 + 8$
$= 2$

(b) $7ab - \frac{4a}{b}$
$= 7 \times -3 \times -2 - \frac{4 \times -3}{-2}$
$= -21 \times -2 - \frac{4 \times -3}{-2}$
$= 42 - \frac{4 \times -3}{-2}$
$= 42 - \frac{-12}{-2}$
$= 42 - 6$
$= 36$

exercise 10.2 Substitution

Preparation: Prep Zone Q1–3, Ex 10.1

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Core

1 Substitute $a = 3$ and $b = 6$ into each of the following expressions, and then simplify.

Hint

(a) $2a + 5b$ **(b)** $3a + 2b$ **(c)** $10b - 2a$
(d) $a + 2b$ **(e)** $6a + b$ **(f)** $5b - 5a$
(g) ab **(h)** $3ab$ **(i)** $10ab - a$

2 Substitute $x = 12$ and $y = 2$ into each of the following expressions, and then simplify.

Hint

(a) $\frac{x}{3} + 5y$ **(b)** $\frac{6}{y} + \frac{x}{2}$ **(c)** $\frac{24}{x} + \frac{24}{y}$
(d) $5y - \frac{x}{4}$ **(e)** $2x - 1 + \frac{18}{y}$ **(f)** $\frac{16}{y} - 7 + x$
(g) $\frac{x}{y}$ **(h)** $\frac{x}{y} + y$ **(i)** $\frac{xy}{8}$

3 Write down three numbers that when substituted into $5x + \frac{x}{3}$ give a whole number answer.

4 Answer TRUE or FALSE for each of these statements.

Worksheet C10.3

Hint

(a) If we substitute $a = 10$ into $\frac{a}{2}$ we get 20

(b) If we substitute $a = 5$ into $\frac{55}{a}$ we get 50

(c) If we substitute $b = 10$ into $7 + \frac{b}{10}$ we get 8

(d) If we substitute $x = 15$ and $y = 6$ into $\frac{x}{5} - \frac{18}{y}$ we get 0

(e) If we substitute $j = 5$ and $k = 6$ into $6j - \frac{k}{2} - 7$ we get 20

(f) If we substitute $m = 4$ and $n = 10$ into $\frac{n}{10} - 1 + 3m$ we get 1

5 Substitute $e = 1$, $f = 10$ and $g = 2$ into each of the following expressions, and then simplify.

Hint

(a) efg **(b)** $10efg$ **(c)** $\frac{f}{g} - e$

(d) $\frac{f}{e} + g$ **(e)** $\frac{3f}{5g} + 6e$ **(f)** $8e + \frac{4f}{10g}$

(g) $\frac{gf}{e} - 20e$ **(h)** $\frac{20}{e} - \frac{20}{f} - \frac{20}{g}$ **(i)** $\frac{10}{g} - \frac{10}{f} + \frac{10}{e}$

6 Substitute $x = 6$ and $y = 5$ into each of the following expressions, and then simplify.

Worksheet C10.4

(a) $4(x + y)$ **(b)** $2(x - y)$ **(c)** $x(y + 7)$

(d) $y(6 + x)$ **(e)** $4x(10 - y)$ **(f)** $2y(x + 14)$

(g) $8y(2x - 1)$ **(h)** $xy(15 + 3y)$ **(i)** $xy(8 + 2x)$

7 Substitute $x = 2$ and $y = 12$ into each of the following expressions, and then simplify.

(a) $\frac{10}{x}(y + 8)$ **(b)** $\frac{20}{x}(y - 2)$ **(c)** $(x + 8)\frac{y}{6}$

(d) $(x - 1)\frac{y}{4}$ **(e)** $\frac{y}{3}(y - x)$ **(f)** $\frac{6}{x}(x + y)$

(g) $(x + 18)(13 - y)$ **(h)** $(y + 3)(x + 3)$ **(i)** $(10y - 20)(x + 7)$

Extension

8 Substitute $x = -2$ and $y = -5$ into each of the following expressions, and then simplify.

eTester

Hint

(a) $10x + 5y$ **(b)** $y - 4x$ **(c)** $6x - 8y$

(d) $2x + 12y$ **(e)** $-2x + y$ **(f)** $-5y - 3 + x$

(g) $5x - y$ **(h)** $7y - 4 - 4x$ **(i)** $8 - 6y + 2x$

9 Use each of the following rules to complete the tables.

Worksheet C10.5

Hint

(a) $y = x - 4$

x	y
-5	-9
3	-1
2	
-7	
-9	
1	

(b) $y = x - 9$

x	y
7	-2
-1	-10
-5	
-9	
2	
6	

(c) $y = x - 7$

x	y
4	
-8	
-5	
1	
-3	
3	

(d) $y = -6x$

x	y
-3	
-2	
2	
-5	
-10	
1	

(e) $y = -9x$

x	y
5	
-8	
-5	
-2	
2	
11	

(f) $y = -2x$

x	y
-1	
6	
2	
-5	
-11	
0	

(g) $y = -4x + 3$

x	y
3	
-2	
-5	
-10	
2	
1	

(h) $y = -5x - 3$

x	y
2	
-1	
10	
-6	
6	
-3	

(i) $y = -10x - 7$

x	y
-5	
8	
-4	
0	
10	
-1	

(j) $y = 5 - x$

x	y
3	
10	
-9	
100	
-20	
5	

(k) $y = 2 + 3x$

x	y
0	
10	
-3	
-1	
50	
8	

(l) $y = -8 - 2x$

x	y
10	
-4	
0	
20	
5	
-8	

10 Substitute $d = -2$ and $e = 5$ into each of the following expressions, and then simplify.

Hint

Worksheet C10.6

Homework 10.1

Worksheet A10.2

Worksheet T10.2

Worksheet A10.1

(a) $-5de + 100$ **(b)** $-3de - 6$ **(c)** $8de + 6e$

(d) $\frac{10}{e}$ **(e)** $\frac{40}{d}$ **(f)** $\frac{-20}{e}$

(g) $\frac{12}{d} - \frac{30}{e}$ **(h)** $\frac{15}{e} - \frac{18}{d}$ **(i)** $\frac{6e}{10} - 3d$

10.3 Adding and subtracting pronumerals - like terms

For terms to be **like terms**, they have to contain *exactly* the same pronumerals. They can be in a different order, but they have to be the same pronumerals, to the same power. Like terms can also be numbers only.

For example,

$4x$ and $7x$ are like terms	$4x$ and $7y$ are *not* like terms
$5ab$ and $9ba$ are like terms	$5ab$ and $9b$ are *not* like terms
$8a^2$ and $3a^2$ are like terms	$8a^2$ and $3a$ are *not* like terms
8 and 17 are like terms	8 and $17s$ are *not* like terms

It may be possible to **simplify** an expression by adding or subtracting terms.

For example, $6c + 9c = 15c$
$8x - 3x = 5x$
$12y + 3y - 4y = 11y$
$16abc - 13abc = 3abc$

For example, $6c + 9s$ can't be simplified, so we leave it as it is
$14abc - 6ab$ can't be simplified

You can only add or subtract *like terms*.

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When you add or subtract like terms, the pronumeral part remains the same. For example, $5a + 2a = 7a$ not $7a^2$

worked example 4

Simplify:

(a) $6b + 2b$ **(b)** $3m^2 - 2p - 5m^2 + 8p$

Steps

(a) Add or subtract the like terms. Remember the pronumeral does not change.

Solutions

(a) $6b + 2b$
$= 8b$

(b) 1. Rearrange the expression so that the like terms are grouped together. Remember to keep the correct signs in front of each term.

2. Add or subtract the like terms. We can write this as $6p - 2m^2$ to avoid starting with a negative sign.

(b) $3m^2 - 2p - 5m^2 + 8p$
$= 3m^2 - 5m^2 - 2p + 8p$
$= -2m^2 + 6p$
$= 6p - 2m^2$

eTutorial

exercise 10.3 Adding and subtracting pronumerals – like terms

Preparation: Ex 10.1

Core

Worksheet C10.7

1 Answer TRUE or FALSE for each of these statements.

(a) $4w$ and $6w$ are like terms
(b) $7u$ and $7w$ are like terms
(c) $7t$ and $6i$ are like terms
(d) 3 and 5 are like terms
(e) $6d$ and $3de$ are like terms
(f) yx and $33xy$ are like terms
(g) $9xyz$ and $5xyz$ are like terms
(h) $6x$ and $52xyz$ are like terms
(i) $6xy$ and $8yx$ are like terms
(j) $2xyz$ and $4zyx$ are like terms

Hint

Remember, an expression can be simplified by adding or subtracting like terms.

2 Choose the correct answer.

Hint

(a) Which of these is a like term for $6y$?
A $6x$ **B** $14y$ **C** $6 + y$ **D** 6

(b) Which of these is a like term for mn?
A $9n$ **B** $8mp$ **C** mnp **D** $8nm$

(c) Which of these is a like term for $5xyz$?
A $22xy$ **B** $xy + z$ **C** $8yzy$ **D** $6zxy$

3 Write four like terms for $3xy$.

4 Answer TRUE or FALSE for each of these statements.
If we simplify:

Hint

(a) $4x + 3x$ we get $4x$
(b) $9x + 2x$ we get $11x$
(c) $8a - 3a$ we get $5a$
(d) $6a + 2a + 4a$ we get $8a$
(e) $24x - 3x - 5x$ we get $16x$
(f) $13j + 8j - 7$ we get $14j$
(g) $9h - 3h + 12$ we get $6h + 12$
(h) $7a + 6b$ we get $13ab$
(i) $7x - 5x + 2q + 6q$ we get $2x + 8q$
(j) $3x + 9 + 5x + 1$ we get $8x + 10$

5 Simplify these expressions if possible.

Hint

Worksheet C10.8

(a) $6a + 11a$
(b) $7v - 2v$
(c) $9d - 6d$
(d) $15f + 6f$
(e) $5v - 8v$
(f) $4v - 6v$
(g) $-7w + 17w$
(h) $-12d + 15d$
(i) $-15j + j$
(j) $-j - 9j$
(k) $5ty - 2ty$
(l) $7ghi - 4ghi$
(m) $3xy - 10yx$
(n) $pq + 5qp$
(o) $-4rs - 16sr$

(p) $6jk - kj$ **(q)** $17mn + 2nm$ **(r)** $12gh - 4hg$
(s) $-5klm + 2mlk$ **(t)** $-17pqr - 4rpq$ **(u)** $22bca - 27bac$

6 Simplify these expressions.

(a) $8t + 7t + 2d + 5d$ **(b)** $18f - 5f + 6g - 3g$
(c) $6y + 4y + 17q - 7q$ **(d)** $40w + 50w + 100v + 34v$
(e) $6a + 5b + 4a - 3b$ **(f)** $8g + 14v - 6g - 6v$
(g) $7d + 8d + 9 - 3d$ **(h)** $9f + 5 - 2f + 5f$
(i) $-6b - 8b + 10b$ **(j)** $-9b - 4b + 18b$
(k) $-3r + 6u + 10r - 9u$ **(l)** $6m - 9n - 13m - 2n$
(m) $4jk + 7mn - 3jk - 2mn$ **(n)** $2fg - 13pq + 7gf + 2qp$
(o) $-4de + 2kj + 7jk + 4ed$ **(p)** $5prq + pqr - 6qpr$
(q) $12jkl + 5klj - 7jkl$ **(r)** $uvw - 7uwv - 10vwu$
(s) $2xyz + 3zyx - 10xzy$ **(t)** $-5ghi - 2hig + 7ghi$
(u) $6def + 12fed - 20dfe$

Hint

Extension

Worksheet C10.9

7 Simplify these expressions.

Hint

(a) $24ab - 5ab + 7$ **(b)** $12 + 5df + 6df$
(c) $7f + 8fg - 4f - 6fg$ **(d)** $8ij + 14j - 2ij + 6j$
(e) $3hdw + 6hd + 7d - 4hd + 8 - 2d$ **(f)** $4x + 15 + 6x + 7xyz - 7 - 3xyz$
(g) $5x^2 - 6y - 13x^2 - 4y + 2$ **(h)** $7x^3 - y - 12x^3 - 5y + xy$
(i) $28ab + 40 + 30a - 10ab + 6 - 6a + 15b - 8ab$
(j) $9s + 40st + 5 + 100stc - 5s + 15 - 2s + 50stc$
(k) $-9b - 4b^3 + ab - b^3 + 8b - 6ab + 8b^3 + b$
(l) $6a^3 - 8a^2 - 4a - 7a^3 - 5a - 4a^3 + a^2 - 61$

eQuestions

10.4 Multiplying and dividing pronumerals

Multiplying

When multiplying terms, it often helps to simplify the expression if you first insert the missing multiplication signs and then rearrange the numbers and pronumerals.

Remember, it doesn't matter which way round you do the multiplication.

For example, $5 \times 2 = 2 \times 5$

$a \times b = b \times a$

worked example 5

Simplify $7a \times 3bc \times 2$

Steps	Solution
1. Insert the missing multiplication signs.	$7a \times 3bc \times 2$ $= 7 \times a \times 3 \times b \times c \times 2$
2. Rearrange so that the numbers are together at the start.	$= 7 \times 3 \times 2 \times a \times b \times c$
3. Multiply the numbers.	$= 42 \times a \times b \times c$
4. Take out the multiplication signs.	$= 42abc$

With a bit of practice, you won't have to do all these steps.

Dividing

When dividing pronumerals, it's easiest to think of the expression as a fraction. It is often possible to simplify the expression by cancelling.

Working with algebraic fractions is similar to working with normal fractions.

worked example 6

Simplify $8m \div 2m$

Steps	Solution
1. Write the division as a fraction.	$8m \div 2m$ $= \frac{8m}{2m}$
2. Reduce the numbers to their simplest fractional form.	$= \frac{\cancel{8}^{4}m}{\cancel{2}_{1}m}$
3. Cancel any pronumeral factors that appear in both the numerator and denominator.	$= \frac{4\cancel{m}^{1}}{\cancel{m}_{1}}$
4. Do the multiplication and division.	$= \frac{4}{1}$ $= 4$

worked example 7

Simplify $24ab \div -18b$

Steps	Solution
1. Write the division as a fraction.	$24ab \div -18b$ $= \frac{24ab}{-18b}$
2. Reduce the numbers to their simplest fractional form.	$= \frac{\cancel{24}^{4}ab}{\cancel{-18}_{3}b}$
3. Cancel any pronumeral factors that appear in both the numerator and denominator.	$= \frac{4a\cancel{b}^{1}}{-3\cancel{b}_{1}}$
4. Write the answer.	$= \frac{-4a}{3}$

Remember: $\frac{4}{-3} = \frac{-4}{3}$ Also: $\frac{-4}{-3} = \frac{4}{3}$

exercise 10.4 Multiplying and dividing pronumerals

Preparation: Ex 10.1

Core

1 Simplify:

(a) $5 \times 3a$ **(b)** $6 \times 2a$ **(c)** $8g \times 3$ Hint
(d) $9g \times 2$ **(e)** $7 \times 8z$ **(f)** $3z \times 12$
(g) $x \times 7y$ **(h)** $a \times 4b$ **(i)** $3x \times z$
(j) $11e \times 6f$ **(k)** $7e \times 8f$ **(l)** $3z \times 5u$
(m) $2 \times 4r \times 5t$ **(n)** $10 \times 3r \times 2t$ **(o)** $5 \times 3p \times 6q$
(p) $6gh \times k \times 3$ **(q)** $8gh \times 3 \times 2k$ **(r)** $6b \times 5eh \times 3$
(s) $2p \times 3q \times 5a$ **(t)** $4s \times 8r \times 10t$ **(u)** $5m \times 4n \times 4x$
(v) $4ghi \times 5 \times 3$ **(w)** $7 \times def \times 9$ **(x)** $3pqr \times 1 \times 9$

2 Simplify:

(a) $4 \times -5y$ **(b)** $-3 \times -7y$ **(c)** $-2a \times -8$ Hint
(d) $-x \times 3y$ **(e)** $-k \times -4w$ **(f)** $p \times -7q$
(g) $11a \times -4b$ **(h)** $-3r \times -6uq$ **(i)** $-7u \times 8rq$
(j) $-4j \times -2 \times 10k$ **(k)** $10j \times -2k \times 3$ **(l)** $-4x \times 3y \times -5$
(m) $-4q \times 5pr \times 6$ **(n)** $3s \times -2 \times -7tu$ **(o)** $-ab \times 3c \times -4$
(p) $4p \times 7q \times -10r$ **(q)** $2u \times -9w \times x$ **(r)** $-d \times -7e \times 8f$
(s) $7 \times -2def \times -2$ **(t)** $-xyz \times 8 \times -3$ **(u)** $-1 \times 12 \times -4stu$
(v) $3s \times 5 \times -4rt \times -2$ **(w)** $-2a \times 6bc \times -3 \times 2$ **(x)** $-3p \times r \times 10q \times -2$

3 Simplify:

Worksheet C10.10

Hint

(a) $\frac{14a}{7}$ **(b)** $\frac{12b}{3}$ **(c)** $20c \div 5$ **(d)** $40d \div 4$

(e) $\frac{5e}{e}$ **(f)** $17y \div y$ **(g)** $3x \div x$ **(h)** $\frac{9p}{p}$

(i) $12g \div 6g$ **(j)** $60h \div 10h$ **(k)** $\frac{8e}{2e}$ **(l)** $\frac{15f}{5f}$

(m) $\frac{25x}{35x}$ **(n)** $\frac{14x}{21x}$ **(o)** $30x \div 80x$ **(p)** $100x \div 700x$

(q) $x \div 7x$ **(r)** $20x \div 22x$ **(s)** $\frac{10x}{12x}$ **(t)** $\frac{x}{15x}$

4 Simplify:

Hint

(a) $\frac{15ab}{5}$ **(b)** $\frac{26ab}{13}$ **(c)** $18cd \div 9$ **(d)** $56cd \div 8$

(e) $30gh \div 6h$ **(f)** $45gh \div 5g$ **(g)** $\frac{24ef}{8e}$ **(h)** $\frac{77ef}{11f}$

(i) $\frac{5ab}{a}$ **(j)** $\frac{6ab}{ab}$ **(k)** $13cd \div cd$ **(l)** $\frac{16cd}{d}$

(m) $\frac{ef}{8e}$ **(n)** $\frac{28ef}{7ef}$ **(o)** $50gh \div 2gh$ **(p)** $gh \div 3g$

Extension

5 Simplify:

Hint

(a) $\frac{-6ab}{3b}$ **(b)** $\frac{-22ab}{11a}$ **(c)** $8cd \div -4c$ **(d)** $60cd \div -12d$

(e) $-50ab \div 30a$ **(f)** $12ab \div -8b$ **(g)** $\frac{-16ef}{-4ef}$ **(h)** $\frac{-36ij}{9i}$

(i) $\frac{18cd}{-12d}$ **(j)** $\frac{-42cd}{36c}$ **(k)** $21ef \div -28e$ **(l)** $80ef \div -90e$

(m) $-ij \div -6ij$ **(n)** $-11ij \div -ij$ **(o)** $\frac{-7gh}{-77h}$ **(p)** $\frac{-9gh}{-45h}$

6 Write down three possible terms that $24ab$ could be divided by to give an answer with no pronumerals in it.

7 Show that $\frac{6xy}{-2y} = -3x$ by substituting values for x and y.

10.5 Expanding brackets - the distributive law

Look at the pattern in the following pairs of statements.

(a) *Bracket form*
$10 \times (3 + 2)$
$= 10 \times 5$
$= 50$

Expanded form
$10 \times 3 + 10 \times 2$
$= 30 + 20$
$= 50$

(b) *Bracket form*
$2 \times (6 - 5)$
$= 2 \times 1$
$= 2$

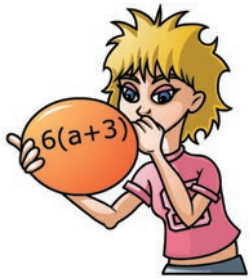
Expanded form
$2 \times 6 - 2 \times 5$
$= 12 - 10$
$= 2$

Notice that the bracket form and the expanded form give the same result.

That is, $10 \times (3 + 2) = 10 \times 3 + 10 \times 2$

And $2 \times (6 - 5) = 2 \times 6 - 2 \times 5$

This pattern is called the **distributive law**. The distributive law can also be used to **expand** expressions containing pronumerals.



Expanding the brackets

worked example 8

Use the distributive law to simplify each of the following.

(a) $10 \times (a + 2)$ **(b)** $11(v - w)$

Steps

(a) 1. Write in expanded form.
2. Simplify each term.

(b) 1. Write in expanded form.
2. Simplify each term.

Solutions

(a) $10 \times (a + 2) = 10 \times a + 10 \times 2$
$= 10a + 20$

(b) $11(v - w) = 11 \times v - 11 \times w$
$= 11v - 11w$

eTutorial

exercise 10.5 Expanding brackets - the distributive law

Preparation: Ex 10.4

Interactive

Worksheet C10.11

Hint

Core

1 Copy and complete the following statements.

(a) $5 \times (1 + 4) = 5 \times 1 + 5 \times 4$
$= \_\_\_\_ = \_\_\_\_$

(b) $2 \times (6 - 5) = 2 \times 6 - 2 \times 5$
$= \_\_\_\_ = \_\_\_\_$

(c) $5 \times (1 + m) = 5 \times 1 + 5 \times m$
$= \_\_\_\_$

(d) $2 \times (h - 5) = \_\_\_\_$
$= \_\_\_\_$

2 Use the distributive law to simplify each of the following.

(a) $12(a+5)$ **(b)** $4(7+m)$ **(c)** $3(h-8)$ **(d)** $11(w-v)$
(e) $9(v-w)$ **(f)** $2(y+r)$ **(g)** $a(5+b)$ **(h)** $d(4+z)$
(i) $f(g-7)$ **(j)** $c(7-u)$ **(k)** $a(c+b)$ **(l)** $m(n-p)$

Animation

3 Expand the following expressions.

(a) $2(3a+4)$ **(b)** $3(10+5m)$ **(c)** $5(2b+7)$ **(d)** $3(6h-5)$
(e) $8(7w-2)$ **(f)** $9(3m-5)$ **(g)** $9(u-3v)$ **(h)** $7(4b+c)$
(i) $6(k-7m)$ **(j)** $b(2a+3)$ **(k)** $m(4-3n)$ **(l)** $p(2q-7)$
(m) $r(2p-s)$ **(n)** $a(3b+c)$ **(o)** $k(j+7m)$ **(p)** $3(2a+5b)$
(q) $5(4m-3n)$ **(r)** $9(2s+5t)$

Hint

Extension

4 Expand the following expressions.

(a) $4a(3+b)$ **(b)** $(n-7)2m$ **(c)** $2p(3-4q)$ **(d)** $7k(3+j)$
(e) $5a(4b+7)$ **(f)** $(2s-9)3m$ **(g)** $(p+4q)8r$ **(h)** $5c(6d-e)$
(i) $4h(g+7j)$ **(j)** $5x(2y+3z)$ **(k)** $(2e+11f)6c$ **(l)** $10k(3m-4n)$

Hint

5 Expand the following expressions.

(a) $-12(a+5)$ **(b)** $3(-6-x)$ **(c)** $-k(m-n)$ **(d)** $-2(a-b)$
(e) $-j(4+k)$ **(f)** $(-n-8)m$ **(g)** $(-3-q)2p$ **(h)** $-5j(9+m)$
(i) $-3p(7-r)$ **(j)** $-5(2k+3m)$ **(k)** $-6(3p-10r)$ **(l)** $8(-4d+3f)$

Hint

6 Kristy has a poor quality photocopy of an expression in expanded form. Kristy can only read $r(2s-\ \ ) =\ \ \ -qr^2$. Write three possibilities for the term missing from the brackets.

eQuestions

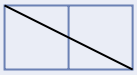
Worksheet A10.3

Working mathematically

investigation

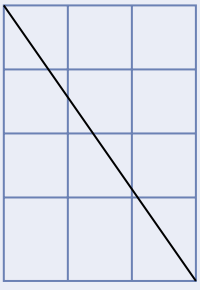
Crossed wires

The Supa Volta Power Company needs to lay underground power cables from one corner of rectangular blocks of properties to the other, like the ones shown below.



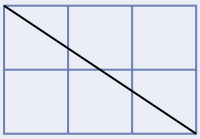
breadth
= 1 property

length = 2 properties
Number of properties crossed by cable = 2



breadth
= 4 properties

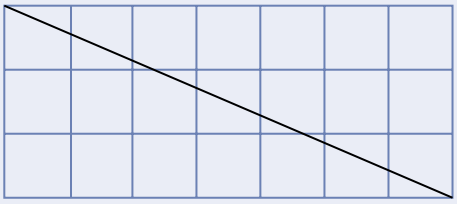
length = 3 properties
Number of properties crossed by cable = 6



breadth
= 2 properties

length = 3 properties

Number of properties crossed by cable = 4



They have to know how many properties the cable will cross, and they want to find a pattern.

Copy the table below and fill in values based on the previous diagrams. Use square grid paper to draw the other blocks of properties shown in this table and work out the numbers of properties.

Length	*Breadth*	*Properties*
2	1	2
1	2	
2	2	
3	2	4
3	4	6
7	3	

Use square grid paper to draw at least eight more blocks and cables, and add these results to the table.

Can you find the pattern?

10.6 Factorising

To **factorise** means to 'break down into smaller factors'.

For example, $15 = 5 \times 3$ (two factors)

$40 = 4 \times 10 = 2 \times 2 \times 5 \times 2$ (four factors)

Algebraic terms can also be broken down into factors.

For example, $5a = 5 \times a$ (two factors)

$4a^3b = 2 \times 2 \times a \times a \times a \times b$ (six factors)

Algebraic expressions can also be broken down into factors. Factorising an expression is the opposite of expanding it.

For example, Expanding $5(a + 7) = 5a + 35$

Factorising $5a + 35 = 5(a + 7)$

(Since $5(a + 7) = 5 \times (a + 7)$ there are two factors.)

dangerzone

1 is always a factor of any term and so a common factor of any algebraic expression. We don't usually write down 1 as a common factor.

worked example 9

Factorise the following expressions.

(a) $6m + 15$ **(b)** $12ab - 18b$

Steps

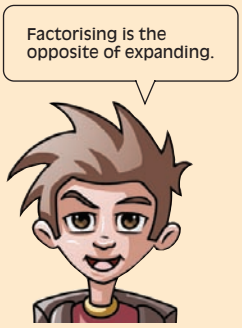
(a)
1. Break each term down into its factors.
2. Put the common factors outside the brackets.
3. Take out the multiplication signs.

(b)
1. Break each term down into its factors.
2. Put all the common factors outside the brackets.
3. Multiply the numbers and take out the multiplication signs.

Solutions

(a) $6m + 15$
$= 3 \times 2 \times m + 5 \times 3$
$= 3 \times (2 \times m + 5)$
$= 3(2m + 5)$

Check
$3(2m + 5)$
$= 3 \times 2m + 3 \times 5$
$= 6m + 15$ (Answer is correct)



(b) $12ab - 18b$
$= 3 \times 2 \times 2 \times a \times b - 3 \times 3 \times 2 \times b$
$= 3 \times 2 \times b \times (2 \times a - 3)$
$= 6b(2a - 3)$

Check
$6b(2a - 3)$
$= 6b \times 2a - 6b \times 3$
$= 12ab - 18b$ (Answer is correct)

eTutorial

eTutorial

It is possible to take fewer steps to factorise. To do this, you need to recognise that the number that comes out of the brackets is the highest common factor (HCF) of the two original terms.

For example,
HCF of 6 and 15 is 3
HCF of $12a$ and 18 is 6
HCF of ab and a is a
HCF of $6w$ and $20wz$ is $2w$
HCF of 12 and 18 is 6
HCF of $-12a$ and -18 is -6
HCF of $4v$ and $12v$ is $4v$

exercise 10.6 Factorising

Preparation: Prep Zone Q4, Exs 10.4 and 10.5

Core

1 Copy and complete the following statements.

(a) The HCF of $3e$ and 12 is ____
So $3e + 12 =$ ____ $(e + 4)$

(b) The HCF of $15f$ and 5 is ____
So $15f + 5 =$ ____ $(3f + 1)$

(c) The HCF of $12t$ and 10 is ____
So $12t + 10 =$ ____ $(6t + 5)$

(d) The HCF of 24 and $20y$ is ____
So $24 + 20y =$ ____ (____ + ____)

Hint

(e) The HCF of 18 and $12j$ is ____
So $18 - 12j =$ ____ (____ – ____)

(f) The HCF of $25fg$ and $5g$ is ____
So $25gf - 5g =$ ____ $(5f - 1)$

(g) The HCF of $14ts$ and $20t$ is ____
So $14ts + 20t =$ ____ $(7s + 10)$

2 Factorise the following expressions.

(a) $2h + 14$	**(b)** $3e + 15$	**(c)** $2d - 14$
(d) $5b - 20$	**(e)** $5m + 30$	**(f)** $9d - 18$
(g) $6f - 2$	**(h)** $8w + 2$	**(i)** $20j + 5$
(j) $24 - 14f$	**(k)** $16 - 12g$	**(l)** $28 + 21v$
(m) $12 - 66q$	**(n)** $33 - 55q$	**(o)** $100 + 60h$

Hint
Animation
Worksheet C10.12
eQuestions

3 Factorise the following expressions.

(a) $3hi + 6$	**(b)** $5vw + 15$	**(c)** $24 + 6ab$
(d) $7jk - 35$	**(e)** $36 - 9ab$	**(f)** $12mn - 60$
(g) $2d + de$	**(h)** $mn - 7n$	**(i)** $100x - xy$
(j) $5e - 7ef$	**(k)** $2pq + 5p$	**(l)** $7ab - 8a$
(m) $4e + 16g$	**(n)** $14k - 21m$	**(o)** $6r + 15s$

Hint

Extension

4 Factorise the following expressions.

(a) $13de + 26d$	**(b)** $7mn + 21n$	**(c)** $32r - 8rs$
(d) $6vw - 2w$	**(e)** $4c + 8cd$	**(f)** $3p - 12pq$
(g) $30z + 25zy$	**(h)** $77k - 66jk$	**(i)** $18ij - 14j$
(j) $22uv + 14u$	**(k)** $24ab + 16a$	**(l)** $24mp - 36m$

Hint
eQuestions
Homework 10.2

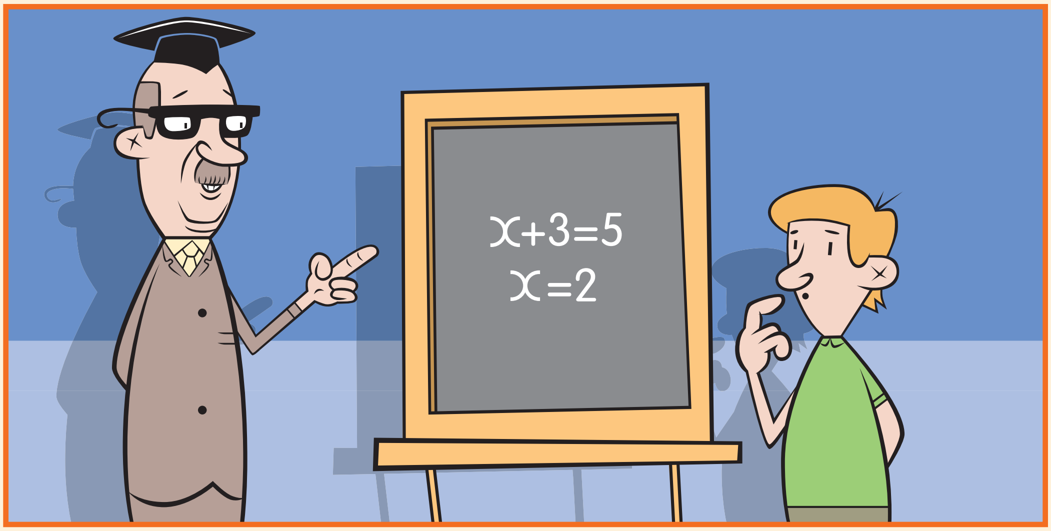
speedingzone

Do these in your head as quickly as you can and write down the answers.

Time target: 2 minutes

1 $\frac{1}{2}$ of $1\frac{1}{2}$
2 $2 \times 5 \times 6 \times 2$
3 $-54 + 100$
4 \$10.30 – \$2.50
5 20×22
6 $6.284 \div 2$
7 $12.86 + 0.6$
8 $\$5 \div 4$
9 $6^2 \times 4$
10 1 m subtract 28 cm (answer in cm)

laughzone



Answer the following, showing your working, then arrange the letters in the order shown by the number corresponding to each answer to find the cartoon caption.

Expand the following using the distributive law.

$12(a+b)$	**I**	$a(6-b)$	**Q**	$b(a-c)$	**Y**
$3(4a-b)$	**N**	$a(3+4b)$	**S**	$c(9b+2a)$	**D**
$3a(4-b)$	**F**	$2b(6+3a)$	**L**	$4c(2a+3b)$	**R**

Factorise the following.

$2a-16$	**O**	$3+12b$	**U**	$8a+12$	**T**
$3ab+6$	**W**	$ab-6b$	**E**	$9a+6b$	**G**
$2ab-4a$	**A**	$4c+12ac$	**X**	$12ab+8b$	**H**

1 $4(2a+3)$ **2** $3a+4ab$ **3** $3(3a+2b)$ **4** $4c(1+3a)$ **5** $12b+6ab$
6 $3(1+4b)$ **7** $8ac+12cb$ **8** $2(a-8)$ **9** $4b(3a+2)$ **10** $12a-3b$
11 $12a+12b$ **12** $6a-ab$ **13** $3(ab+2)$ **14** $12a-3ab$ **15** $b(a-6)$
16 $ab-bc$ **17** $2a(b-2)$ **18** $9bc+2ac$

‘ 9 17 10 3 / 8 10 , / 16 15 2 1 15 7 18 17 16

16 8 6 / 2 17 11 18 / 4 / 13 17 2

15 12 6 17 5 / 1 8 / 14 8 6 7 ’

10.7 Introduction to linear equations

Remember in section 10.1 you learned that an equation has a left-hand side that is equal to a right-hand side. This is different to an expression because an expression has no equals sign (=).

For example, $4 + 8 = 12$ is an equation.

$3 \times 2 = 5 + 1$ is also an equation because both sides are equal to 6.

Sometimes equations contain pronumerals. Remember from Chapter 4 that pronumerals are letters that represent numbers.

For example, $a + 8 = 12$ is an equation.

To **solve** an equation means to find the value of the pronumeral that makes the equation true.

worked example 10

Solve the equation $b - 6 = 11$.

Steps	Solution
1. Write out the equation.	$b - 6 = 11$
2. Decide what number must go in place of the pronumeral to make the equation true.	$17 - 6 = 11$
3. Write down the value of the pronumeral.	$b = 17$

$b = 17$ is called the **solution** to the equation in Worked Example 10.

exercise 10.7 Introduction to linear equations

Preparation: Prep Zone Q1–3 and 5, Exs 10.1 and 10.2

Core

1 State TRUE or FALSE for each of the following equations.

(a) $12 + 23 = 35$
(b) $75 - 62 = 12$
(c) $8 \times 6 = 42$
(d) $5 \times 7 = 27 + 9$
(e) $24 + 27 = 26 \times 2$
(f) $4 \times 8 = 44 - 12$
(g) $22 - 37 = 5 \times -3$
(h) $6 \times -8 = -60 + 14$
(i) $9 \times -9 = 9 - 90$
(j) $6 \times 6 = 72 \div -2$
(k) $32 \div 8 = -400 \div -100$
(l) $120 \div -3 = -5 \times 9$

Hint

Worksheet C10.13

2 Copy and complete the following equations so that they are true.

Hint

(a) $-6 + 27 = \_\_$	**(b)** $103 + 28 = \_\_$	**(c)** $36 + 75 = \_\_$
(d) $223 - 82 = \_\_$	**(e)** $187 - 91 = \_\_$	**(f)** $-22 - 20 = \_\_$
(g) $3 \times 16 = \_\_$	**(h)** $38 \times 2 = \_\_$	**(i)** $8 \times 15 = \_\_$
(j) $96 \div 8 = \_\_$	**(k)** $125 \div 5 = \_\_$	**(l)** $180 \div 6 = \_\_$
(m) $\_\_ + 27 = 53$	**(n)** $93 + \_\_ = 102$	**(o)** $\_\_ + 97 = 117$
(p) $82 - \_\_ = 76$	**(q)** $\_\_ - 65 = -50$	**(r)** $90 - \_\_ = 73$
(s) $\_\_ \times 12 = 84$	**(t)** $30 \times \_\_ = 150$	**(u)** $\_\_ \times 25 = 150$
(v) $72 \div \_\_ = 12$	**(w)** $\_\_ \div -5 = -7$	**(x)** $360 \div \_\_ = 120$

3 Copy and complete the following equations so that they are true.

Hint

(a) $2 + 7 = 3 + \_\_$	**(b)** $11 - 5 = 5 + \_\_$	**(c)** $6 + 7 = 15 - \_\_$
(d) $3 \times 6 = \_\_ + 13$	**(e)** $7 \times 4 = 20 + \_\_$	**(f)** $5 \times 6 = \_\_ - 8$
(g) $2 \times \_\_ = 13 + 3$	**(h)** $\_\_ \times 7 = 25 - 4$	**(i)** $3 \times \_\_ = 35 - 20$
(j) $\_\_ \div 7 = 17 - 9$	**(k)** $44 \div \_\_ = 7 + 4$	**(l)** $\_\_ \div 6 = 18 - 11$
(m) $24 \div 2 = 3 \times \_\_$	**(n)** $5 \times 2 = \_\_ \div 7$	**(o)** $36 \div \_\_ = 3 \times 3$
(p) $18 \div 6 = \_\_ \div 9$	**(q)** $24 \div \_\_ = 66 \div 11$	**(r)** $40 \div 5 = 16 \div \_\_$

4 Solve each of the following equations.

Hint

(a) $a + 5 = 12$	**(b)** $k + 7 = 30$	**(c)** $r + 9 = 15$
(d) $12 + h = 22$	**(e)** $18 + m = 25$	**(f)** $7 + p = 29$
(g) $u - 12 = 5$	**(h)** $t - 30 = 8$	**(i)** $r - 15 = 20$
(j) $27 - f = 7$	**(k)** $19 - s = 3$	**(l)** $34 - v = 12$
(m) $h \times 5 = 60$	**(n)** $j \times 7 = 42$	**(o)** $y \times 9 = 36$
(p) $6t = 66$	**(q)** $8n = 48$	**(r)** $4k = 32$
(s) $c \div 8 = 7$	**(t)** $\frac{h}{9} = 5$	**(u)** $\frac{w}{7} = 4$
(v) $\frac{24}{q} = 3$	**(w)** $\frac{49}{p} = 7$	**(x)** $28 \div j = 4$

5 Write an equation for each of the following. Let the pronumeral x represent the number.

Worksheet C10.14

(a) A number plus three is equal to nineteen.
(b) A number added to six gives fifteen.
(c) A number subtracted from twenty is equal to five.
(d) Ten subtracted from a number gives twelve.
(e) A number multiplied by eight is equal to twenty-four.
(f) Six multiplied by a number gives eighteen.
(g) A number divided by five is equal to six.
(h) Thirty-two divided by a number gives four.

6 Find the solution ($x = ?$) to each of the equations you wrote for Question **5**. (First check that your answers to Question **5** are correct.)

7 Use substitution to check if the solution (in brackets) is correct. Write TRUE or FALSE.

Hint

(a) $p + 7 = 19$	$(p = 11)$	**(b)** $r + 9 = 34$	$(r = 25)$
(c) $12 + k = 25$	$(k = 13)$	**(d)** $21 + y = 29$	$(y = 9)$

(e) $t - 15 = 21$ $(t = 6)$
(f) $h - 12 = 40$ $(h = 38)$
(g) $29 - d = 12$ $(d = 17)$
(h) $32 - j = 11$ $(j = 43)$
(i) $7m = 35$ $(m = 5)$
(j) $2v = 8$ $(v = 16)$
(k) $c \div 8 = 2$ $(c = 4)$
(l) $u \div 5 = 3$ $(u = 15)$
(m) $36 \div z = 9$ $(z = 4)$
(n) $56 \div w = 8$ $(w = 7)$
(o) $3b + 3 = 18$ $(b = 5)$
(p) $4h + 3 = 11$ $(h = 3)$
(q) $2x - 1 = 9$ $(x = 4)$
(r) $6f - 3 = 21$ $(f = 3)$
(s) $k \div 6 + 5 = 6$ $(k = 6)$
(t) $g \div 4 + 3 = 7$ $(g = 8)$

Extension

8 Find the solution to each of the following equations, by inspection.

(a) $2w + 5 = 13$
(b) $18 = 5t + 3$
(c) $7f + 6 = 20$
(d) $13 = 6h - 5$
(e) $5r - 10 = 15$
(f) $9 = 8s - 7$
(g) $\frac{y}{7} + 6 = 10$
(h) $11 = \frac{q}{4} + 4$
(i) $\frac{p}{5} + 3 = 7$
(j) $0 = \frac{a}{6} - 7$
(k) $\frac{w}{3} - 4 = 5$
(l) $\frac{c}{7} - 4 = 1$
(m) $4x - 5 = (-21)$
(n) $2p + 4 = (-2)$
(o) $-17 = 5x + 3$
(p) $\frac{p}{3} + 6 = 4$
(q) $-4 = \frac{m}{5} + 6$
(r) $\frac{c}{6} - 5 = (-4)$

Hint

Worksheet C10.15
Worksheet A10.4
Worksheet T10.3
Worksheet T10.4

Working mathematically

problem solving

Diophantus

You may like to work in pairs to solve this.

Not much is known about Diophantus, the Greek mathematician who became known as the 'Father of Algebra'. Scholars believe he lived sometime between 100 and 400 AD. One of his admirers wrote the following riddle about Diophantus.

Diophantus' youth lasted one-sixth of his life. He grew a beard after half more. After another one-seventh of his life he married. Five years later he had a son. His son lived exactly half as long as his father and Diophantus died only four years later. All of this adds up to the years Diophantus lived.

Can you solve the riddle to find how long Diophantus lived?

Taxi driver: Louise Taunt

Company: Taxis Combined Services

Qualifications/Experience: taxi licence, two years experience

Related occupations: limousine driver, bus driver, truck driver, tour guide

I drive taxis for Taxis Combined, leasing my own cab and driving from about 5 a.m. to 9 p.m., six days a week. I like the independence and I like moving, and it helped me to save money to go overseas.

When I was at school, I didn't have a favourite part of mathematics; I didn't actually 'get' a lot of it. I only made sense of it when there was a practical application. I have found maths coming into my taxi driving all the time. I'm constantly calculating distances, and how long I think it'll take me to get from A to B and estimating what the fare will be. You really become an expert at reading the Sydways—very quickly.

These days, jobs are allocated electronically so it's not as much fun, but when the radio system was used, your mind was constantly buzzing with calculations. The radio operator would call out the jobs and within a couple of seconds you'd have to calculate whether you could get there inside 10 minutes and how much the fare would be (say, from Stanmore to Manly). Then you'd have to press your buzzer and yell out your call sign to be the first one to get the job. I used to love the 'beat the buzzer' aspect. All day long I would be half listening to the radio and calculating distances and fares, at the same time as listening to people's life stories.

The taxi driver's problem

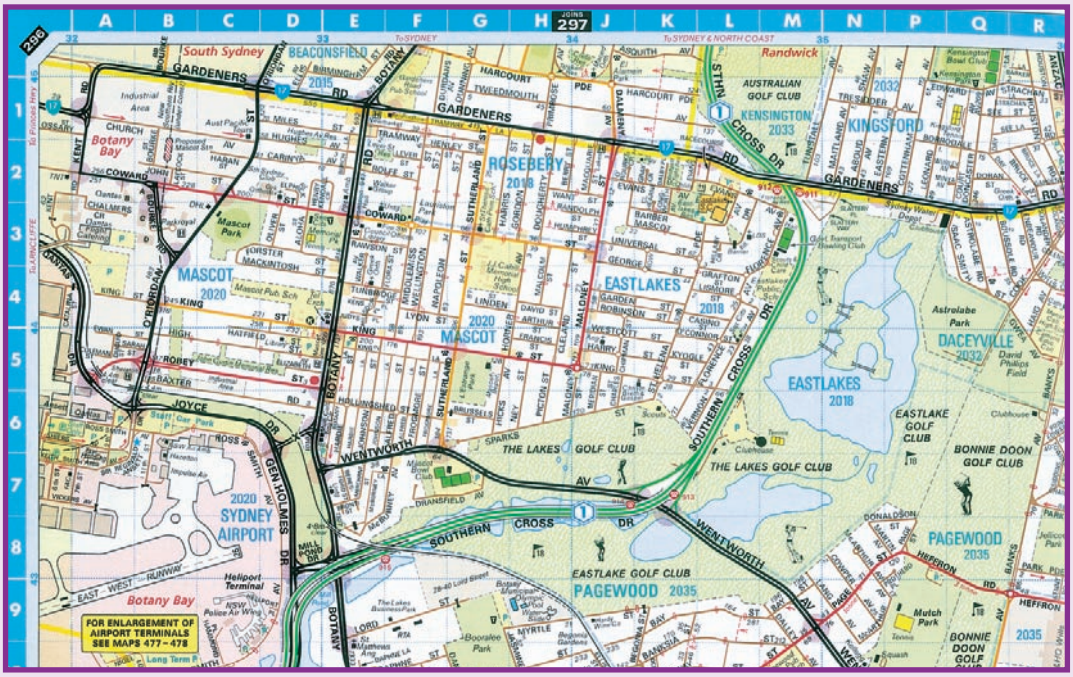
Louise is expected to know the major streets, highways and motorways of Sydney. However, she doesn't know the exact location of every street. Often she will ask the passenger for an approximate location and then take further directions when they get closer to the address. However, the passenger does not always know where they are going.

Louise has to take a person visiting Sydney to an address near the airport. She doesn't know the way so she needs to use a road directory. The passenger wants to go to Middlemiss Street, Mascot. The first step is for Louise to look up the street name in the index at the back.

We can see that there are four Middlemiss streets listed, but only one is a street in Mascot. This shows us that the address we want is located on Map 317 in grid F4.

MIDDLE HEAD			
rd	Balmoral	38	M20
rd	Georges Heights	48	J1,L1
rd	Mosman	38	M20
rd	Mosman	47	G1
rd	Mosman	48	J1,L1
rd	Mosman	258	L20
rd	Mosman	278	G1,K2
MIDDLEHOPE			
st	Bonnyrigg Heights	289	J10
MIDDLEMISS			
st	Lavender Bay	46	J6
st	Lavender Bay	277	J6
st	Mascot	317	F4
st	Rosebery	317	F4
MIDDLETON *see also MIDELTON*			
av	Castle Hill	212	G17
cr	Bidwill	208	F20
pl	Picton	403	R12
rd	Chester Hill	272	G20
rd	Cromer	219	C18
rd	Dee Why	219	C18
rd	Leumeah	368	R6
rd	Leumeah	369	A5
st	Petersham	63	H10
st	Petersham	73	H11
st	Petersham	296	H11

To find the street Louise looks down column F until she gets into row 4. If you do this now you should be able to see Middlemiss Street. As with most streets it is actually located in more than one grid position.



Questions

1 In what other grid(s) does Middlemiss Street exist?

Louise is now in a position to plan the approach. She will be approaching Mascot from the north (further up the page), along Botany Road. One possible route would be to turn left at Gardeners Road, and then right into Middlemiss Street.

2 Often, right-hand turns are not allowed on busy streets. Suggest a route Louise could take to avoid the right-hand turn off Gardeners Road.

3 Describe the route you think Louise would take if she had come down Southern Cross Drive instead of Botany Road.

4 The Sydney Airport takes up a lot of space on this map. How can you tell what space is part of the airport?

5 What do you think the dotted lines, such as the one following Southern Cross Drive at the top of the page, indicate?

6 Find the Eastlakes Public School.

(a) List all of the grids that contain at least part of this school.

(b) How would Louise get to the school assuming the taxi is travelling down Middlemiss Street from the north? You want to go into Florence Avenue.

7 What is the location of J.J. Cahill Memorial High School?

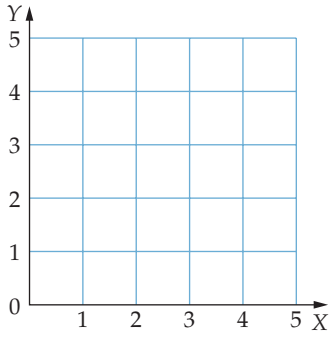
8 Describe what is located at each of the following grid references.

(a) G5 **(b)** A3 **(c)** H9 **(d)** Q1

10.8 The number plane

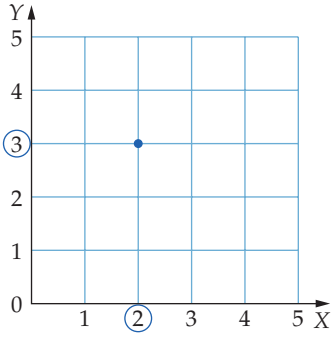
The grid system used most commonly in mathematics was invented by the French mathematician René Descartes in 1619, and can be used to locate single points on a grid exactly. Here's how Descartes' **number plane** works.

The number plane (which is also referred to as the **Cartesian plane**, in Descartes' honour) has a horizontal axis called the ***x*-axis**, and a vertical axis called the ***y*-axis**. Both **axes** (the plural of axis) are like number lines that increase in the direction of the arrows.



The position of any point on a number plane is described by two numbers or **coordinates**. The x-coordinate tells you how far along the x-axis a point is, while the y-coordinate tells you how far up the y-axis it is. The x- and y-coordinates are written together in brackets, with the x-coordinate always written first: (x, y)

For example, the coordinates of the point shown opposite are (2, 3).



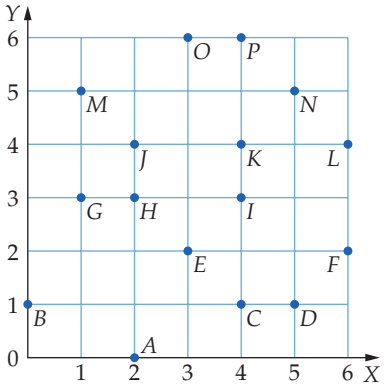
The process of drawing dots on a number plane is called plotting points, and a set of points on a number plane is called a **graph**.

exercise 10.8 The number plane

Preparation: Prep Zone Q6

Core

1 Write the coordinates of the following points from the number plane opposite.



(a) A **(b)** B
(c) C **(d)** D
(e) E **(f)** F
(g) G **(h)** H
(i) I **(j)** J
(k) K **(l)** L
(m) M **(n)** N
(o) O **(p)** P

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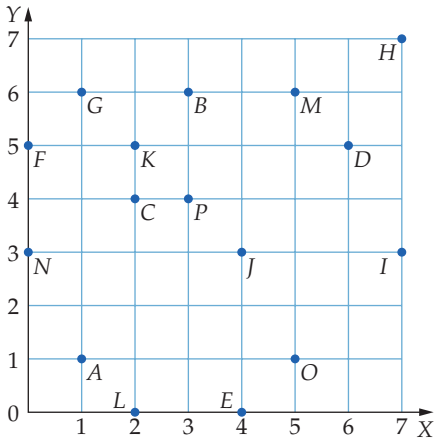
Worksheet C10.16
Hint

2 Write the capital letter used to label each of the following points from the number plane shown.

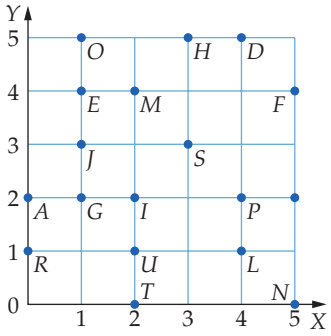
(a) (1, 1) **(b)** (7, 7)
(c) (3, 4) **(d)** (6, 5)
(e) (4, 3) **(f)** (5, 6)
(g) (0, 5) **(h)** (2, 4)
(i) (7, 3) **(j)** (3, 6)
(k) (1, 6) **(l)** (0, 3)
(m) (4, 0) **(n)** (2, 5)
(o) (5, 1) **(p)** (2, 0)



Hint

3 (a) Use the graph opposite to discover what Descartes' other occupation was by writing the letters that match the listed points in the order given.
(3, 3) (1, 5) (4, 1) (4, 5) (2, 2)
(1, 4) (0, 1)

(b) Use the code from the graph opposite to learn a word meaning 'one whose hobby is climbing the outside of tall buildings'.
(3, 3) (2, 0) (1, 4) (1, 2) (1, 5) (4, 2)
(3, 5) (2, 2) (4, 1) (2, 2) (3, 3) (2, 0)



4 Rule up a number plane on graph paper and number each axis up to 12 in steps of 1 cm. Plot the following points and join them in the order given to form a Maltese cross.
(3, 1) (6, 3) (9, 1) (7, 5) (11, 3) (9, 6) (11, 9) (7, 7) (9, 11) (6, 9) (3, 11) (5, 7) (1, 9) (3, 6) (1, 3) (5, 5) (3, 1)
You may wish to colour the completed graph.

Hint

5 Rule up a Cartesian plane with both axes numbered up to 9, and plot the following points in the order given. When you reach the word STOP, lift your pencil and start again from the next pair of coordinates (i.e. don't join coordinates separated by the word STOP). The resulting sketch may look like a small cube in the corner of a larger one, or a small cube outside a larger one, depending on how you see it.

Join (1, 1) (6, 1) (8, 3) (8, 8) (3, 8) (1, 6) (1, 1) (2, 2) (2, 4) (3, 5) (3, 8) STOP
Join (2, 2) (4, 2) (5, 3) (8, 3) STOP
Join (2, 4) (4, 4) (5, 5) STOP
Join (5, 3) (5, 5) (3, 5) STOP
Join (4, 2) (4, 4) STOP

6 The following sets of points may be joined in order to form aquatic creatures.

(a) Rule up the x-axis to 18 and the y-axis to 11.
(5, 6) (2, 6) (3, 5) (5, 4) (8, 4) (10, 2) (10, 4) (15, 5) (17, 4) (16, 6) (17, 8) (15, 7) (10, 8) (10, 10) (8, 8) (5, 8) (3, 7) (2, 6)
Draw an eye at (5, 7).

(b) Rule up the x-axis to 17 and the y-axis to 8.
(10, 1) (11, 1) (12, 2) (12, 3) (16, 3) (14, 4) (12, 6) (10, 7) (8, 7) (6, 6) (4, 4) (3, 4) (3, 5) (2, 5) (1, 4) (1, 3) (5, 3) (5, 2) (4, 1) (5, 1) (6, 2) (6, 3) (11, 3) (11, 2) (10, 1)
Draw an eye at (2, 4).

7 Draw your own design, using at least 12 pairs of coordinates. List the coordinates used.

Extension

8 Join the following points in order to draw a dinosaur. You'll need the x-axis to go to 52 and the y-axis to go to 22. An A4 page of $\frac{1}{2}$ cm grid with the x-axis along the long edge would be suitable.

Join (2, 6) (6, 7) (10, 9) (14, 12) (18, 16) (22, 19) (26, 20) (30, 20) (34, 19) (38, 17) (39, 16) (40, 18) (42, 20) (44, 21) (46, 20) (45, 18) (45, 16)(46, 14) (48, 15) (50, 16) (46, 12) STOP
Join (49, 15) (51, 16) (48, 13) (47, 11) (49, 10) (50, 11) (50, 10) (51, 8) (50, 6) (49, 5) (49, 6) (47, 7) STOP
Join (49, 6) (44, 7) (42, 8) (40, 10) (41, 11) STOP
Join (41, 9) (40, 8) (38, 7) (35, 7) STOP
Join (42, 12) (40, 13) (39, 14) (39, 16) STOP
Join (40, 8) (41, 5) (42, 3) (40, 3) (39, 4) (38, 6) (37, 7) STOP
Join (39, 10) (38, 9) (36, 8) (35, 7) (35, 5) (36, 3) (33, 3) (31, 7) (31, 9) (34, 12) (36, 13) STOP
Join (31, 7) (29, 6) (27, 6) (23, 8) (25, 4) (23, 4) (21, 8) (23, 12) (22, 14) STOP
Join (18, 14) (17, 12) (17, 10) (18, 8) (20, 4) (23, 4) STOP
Join (18, 8) (16, 7) (10, 6) (2, 6) STOP
Join (43, 13) (45, 13) (45, 11) STOP
Draw an eye at (44, 12).

9 Join the points below to sketch an Australian native animal. Your x-axis should go up to 30 and your y-axis should reach 36.

Join (24, 7) (22, 10) (20, 12) (16, 11) (14, 7) (13, 4) (10, 5) (11, 4) (9, 4) (11, 3) (9, 2) (13, 1) (14, 1) (16, 2) (18, 4) (19, 5) (20, 8) STOP
Join (21, 15) (19, 14) (16, 14) (13, 16) (12, 17) (8, 19) (7, 20) (7, 22) (8, 24) (9, 22) (11, 23) (10, 21) (13, 21) (17, 20) STOP
Join (20, 28) (19, 29) (18, 29) (17, 27) (18, 26) (19, 26) (20, 28) STOP
Join (16, 26) (18, 25) (20, 25) STOP
Join (9, 0) (7, 8) (7, 15) (8, 19) STOP
Join (8, 24) (7, 33) STOP

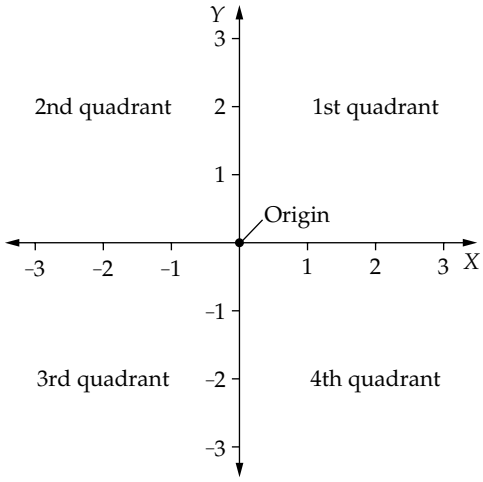
Join (12, 21) (11, 29) STOP
Join (7, 11) (6, 13) (5, 16) (2, 21) STOP
Join (3, 22) (7, 15) STOP
Join (16, 2) (20, 1) (25, 3) (28, 8) (27, 14) (23, 22) (23, 24) (24, 26) (26, 28) (27, 31) (26, 32) (24, 32) (22, 31) (21, 32) (19, 33) (16, 33) (14, 35)(12, 35) (11, 33) (12, 31) (13, 31) (13, 27) (14, 24) (13, 21) STOP
Join (12, 17) (12, 10) (14, 7) STOP
Join (20, 1) (20, 0) STOP
Draw eyes at (16, 29) and (21, 28).

Worksheet A10.5

10.9 Extending the number plane

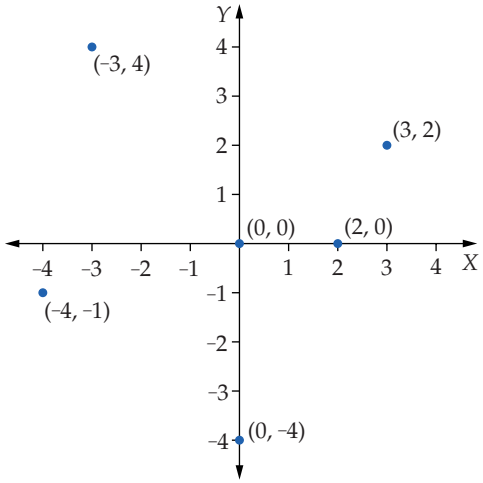
You can extend the x- and y-axes so they divide the number plane into four quadrants and intersect at a point called the **origin**.

The x-coordinate describes how far right (+) or left (–) a point is from the origin, and the y-coordinate describes how far up (+) or down (–) a point is from the origin.



Some points and their coordinates are shown on the number plane opposite.

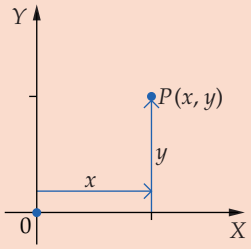
The origin has the coordinate pair (0, 0).



dangerzone

Remember, the *x*-coordinate is always written first. This is why a pair of *x*- and *y*-coordinates is also called an ordered pair. The order is important.

The position of a point, P, on the Cartesian plane is described by the coordinates (x, y).
The point, P, is x units horizontally and y units vertically from the origin.



eTutorial

exercise 10.9 Extending the number plane

Preparation: Prep Zone Q6, Ex 10.8

Core

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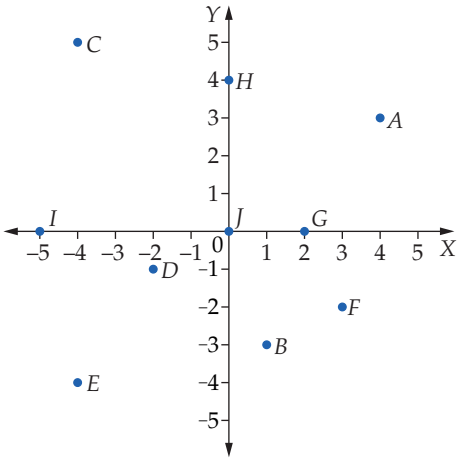
Hint

1 Write the coordinates of each of the points A to J shown on the number plane opposite.

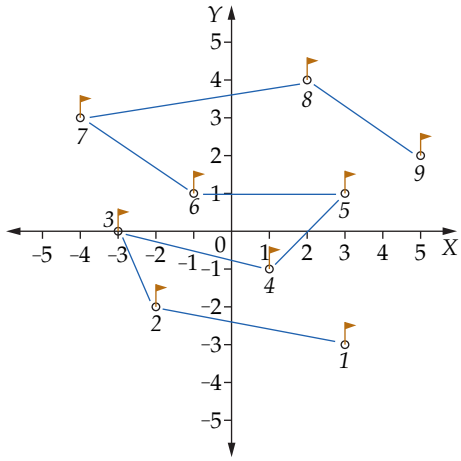


2 Use the number plane shown in Question **1** to answer the following.

(a) Write the letter of each point or points in:
- **(i)** the first quadrant
- **(ii)** the second quadrant
- **(iii)** the third quadrant
- **(iv)** the fourth quadrant.

(b) List any points which lie on:
- **(i)** the x-axis
- **(ii)** the y-axis
- **(iii)** both the x- and y-axes.

3 A nine-hole golf course has been shown on the number plane opposite. Write in order the ordered pairs of the nine holes.



4 Choose the correct answer.

Worksheet C10.17

Hint

(a) A point is 1 unit right and 4 units up from the origin of a Cartesian plane. The coordinates of the point are:
A (4, 1) **B** (-4, 1) **C** (1, 4) **D** (-1, 4)

(b) A point is 5 units left and 2 units up from the origin of a number plane. The coordinates of the point are:
A (-5, 2) **B** (2, -5) **C** (5, -2) **D** (-2, 5)

(c) A point is 4 units down and 3 units left of the origin of a Cartesian plane. The coordinates of the point are:
A (-4, -3) **B** (4, 3) **C** (-3, 4) **D** (-3, -4)

(d) A point is 2 units down and 7 units right of the origin of a number plane. The coordinates of the point are:
A (-2, 7) **B** (7, -2) **C** (2, -7) **D** (7, 2)

5 Choose the correct answer.

(a) The origin has the coordinates:
A (1, 0) **B** (0, 1) **C** (1, 1) **D** (0, 0)

Hint

(b) One ordered pair which lies on the x-axis is:
A (0, 4) **B** (1, 1) **C** (1, 0) **D** (0, 1)

(c) One ordered pair which lies on the y-axis is:
A (3, 0) **B** (3, 3) **C** (0, -3) **D** (-3, -3)

(d) The coordinates of one point which does not lie on either of the axes are:
A (2, 3) **B** (2, 0) **C** (0, 3) **D** (0, 2)

6 Rule a set of axes to form a Cartesian plane on a piece of grid or graph paper. Allow for a scale from -9 to 9 on the x-axis and -4 to 4 along the y-axis. Plot the following points and join them in the order given to form a picture. You may like to colour your picture when complete.

Hint

(-4, -1) (-5, -1) (-5, 0) (-9, 1) (-6, 3) (-1, 2) (-4, -1) (-4, -2) (-1, -4) (0, -3) (-1, 2) (0, 3) (1, 2) (6, 3) (9, 1) (5, 0) (5, -1) (4, -1) (1, 2) (0, -3) (1, -4) (4, -2) (4, -1) STOP

Now join (3, 4) to (0.5, 2.5) and join (-3, 4) to (-0.5, 2.5).

Extension

7 Rule a set of axes to form a Cartesian plane on a piece of grid or graph paper. Allow for a scale from -8 to 9 along the x-axis and -11 to 11 along the y-axis. Join each of the following sets of points in the order given. When you reach the word STOP, lift your pencil and start again from the next pair of coordinates.

Join (3, 0) (3, 5) (2, 5) (2, 4) (1, 4) (1, 5) (0, 5) (0, 4) (-1, 4) (-1, 5) (-2, 5) (-2, 4) (-3, 4) (-3, 5) (-4, 5) (-4, -9) (3, -9) (3, 0) (4, 0) (4, -1) (5, -1) (5, 0) (6, 0) (6, -1) (7, -1) (7, 0) (8, 0) (8, -9) (3, -9) STOP

Join (5, 0) (5, 7) ($6\frac{1}{2}$, 10) ($6\frac{1}{2}$, 11) (9, 10) ($6\frac{1}{2}$, 10) (8, 7) (8, 0) STOP

Join (-7, -2) (-7, -9) (-4, -9) (-4, 3) (-5, 3) (-5, 2) (-6, 2) (-6, 3) (-7, 3) (-7, 6) ($-7\frac{1}{2}$, 8) (-8, 6) (-8, -1) (-7, -2) (-7, 3) STOP

Join (-2, -6) (-1, -5) (0, -5) (1, -6) (-2, -6) (-2, -9) (-3, -11) (2, -11) (1, -9) (1, -6) STOP

Join (3, 5) (3, 7) ($3\frac{1}{2}$, 9) (4, 7) (4, 4) (3, 1) STOP
Join (-4, 5) (-4, 9) (-2, 8) (-4, 8) STOP
Join (6, -5) (7, -5) (7, -2) (6, -2) (6, -5) STOP
Join (6, 6) (7, 6) (7, 3) (6, 3) (6, 6) STOP
Join (2, -1) (2, 2) (1, 2) (1, -1) (2, -1) STOP
Join (-3, -1) (-2, -1) (-2, -4) (-3, -4) (-3, -1) STOP
Join (-6, -3) (-5, -3) (-5, 1) (-6, 1) (-6, -3) STOP
Join (3, 7) to (4, 7).
Join (5, 7) to (8, 7).
Join (-8, 6) to (-7, 6).
Join (-1, -5) to (-1, -7).
Join (0, -5) to (0, -7)

8 The location of points on a plane surface is related to a number of real-life situations, for example finding a location on a street map.

(a) Where else are point locations used?

(b) In what different ways are points recorded? (In this exercise points were recorded as coordinate pairs, e.g. (2, 3).)

eQuestions
Homework 10.3

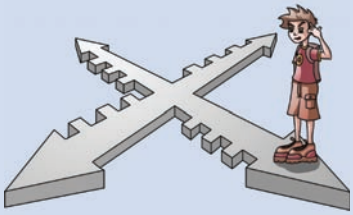
Working mathematically

problem solving

What points are we?

To get to me from the point (5, 8) you need to move a total of seven horizontal and vertical spaces. My coordinates are both positive whole numbers. The sum of my coordinates is 8. What point am I?

I am in the third quadrant. To get to my position from the origin takes five horizontal and vertical steps in total. The product of my coordinates is 4 and I am further from the origin horizontally than vertically. What point am I?



Use each clue to narrow down the possibilities.

languagezone

Summary

Copy and complete the following summary of this chapter using the words and phrases from the list. A word or phrase may be used more than once.

1 Terms with the same p_____ parts are called _____ _____.

2 We can _____ an equation to find the _____.

3 We use the _____ _____ to expand an expression in brackets.

4 To _____ an expression we need to take out the highest common factor.

5 Adding like terms is one way to s_____ an e_____.

6 In a number plane the _____ is where the two _____ meet.

7 The coordinates of a point on a number plane can be called an _____ _____.

Questions

1 Explain the difference between an equation and an expression.

2 Which of the following operations can't be performed on unlike terms?
multiplication addition subtraction division.

3 Write the non-mathematical meanings of 'term' and 'expression'.

4 Explain why the following expansions are incorrect:
$2(x - 7) = 2x - 7$ $-5(a + 3) = -5a + 15$

5 The origin is a starting point. Find two other words that begin with 'origin' and give their meanings.

6 Make at least 12 words of three or more letters from the letters in the following grid. All words must include the middle letter. Can you find the word that uses all nine letters?

T	E	R
S	A	I
A	C	N

7 Unjumble these words:
IQTAEONU STOIFCARE NTUOOSLI

Key words

axes
Cartesian plane
coordinates
distributive law
equation
expand
expression
factorise
graph
like terms
number plane
ordered pair
origin
pronumeral
simplify
solution
solve
substitution
term
***x*-axis**
***y*-axis**

e Worksheet L10.1

e Worksheet L10.2

chapter 10 REVIEW

FAQs

Is $3m + 7$ the same as $3(m + 7)$?
No. The first expression means we multiply the m by 3 first, then add 7. The second expression means we add 7 to the m first then multiply by 3.

How can we check the answer to an equation?
The best way is to substitute the answer back into the original equation and see if it is correct. This is especially important in real-life problems where an answer you get may be correct algebraically but may not make sense in the real world, for example getting a negative measurement.

Does $\frac{ab}{6a}$ simplify to give $6b$?
No, $\frac{ab}{6a} = \frac{b}{6}$. If a factor is left on the bottom of a fraction, it must remain on the bottom of the fraction.

Does it matter how far apart the numbers are on the x-axis and y-axis?
The scale can be whatever you decide you want it to be as long as it is consistent all the way along the x-axis and consistent all the way along the y-axis. The x-axis and the y-axis don't always need to have the same scale, but it's a good idea if the numbers are similar.

Core

1 Substitute $a = 4$ and $b = 5$ into the following expressions and then simplify. **10.2**

(a) $3a + 2b$ **(b)** $2ab - 12$ **(c)** $\frac{8b}{a} + 2b$ **(d)** $\frac{10}{b} + \frac{ab}{10}$

2 Substitute $a = 2$ and $b = 3$ into the following expressions and then simplify. **10.2**

(a) $3a(b + 17)$ **(b)** $\frac{12}{b}(a + b)$ **(c)** $a(2b + 4)(5a + 10)$

3 Substitute $a = -2$ and $b = -3$ into the following expressions and then simplify. **10.2**

(a) $-2a + b - 5$ **(b)** $ab - 4 - \frac{6b}{2}$ **(c)** $\frac{15}{b} - \frac{6}{a}$

4 Simplify if possible: **10.3**

(a) $12a - 7a$ **(b)** $6a + 12b - 7a + 11b$ **(c)** $2a^2 - 4a$

5 Simplify: **10.4**

(a) $15a \times 2b$ **(b)** $6ab \times c \times 11$ **(c)** $-2a \times -7 \times b$

6 Simplify: 10.4

(a) $24a \div 20a$ **(b)** $\frac{25ab}{5a}$ **(c)** $-4ab \div -44a$

7 Expand: 10.5

(a) $7(2 + a)$ **(b)** $a(2b + 6)$ **(c)** $2x(3y - 7)$

8 Factorise: 10.6

(a) $3a - 15$ **(b)** $4a + 16ab$ **(c)** $20ab + 16b$

9 Copy and complete the following equations so that they are true. 10.7

(a) $8 \times \_\_ = 32$ **(b)** $3 + \_\_ = 12 - 5$ **(c)** $3 + 6 = \_\_ \div 4$

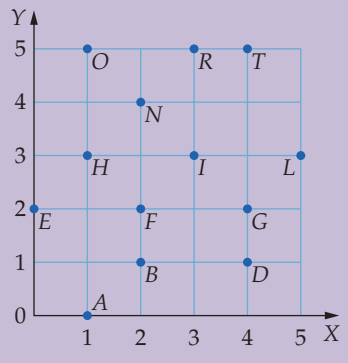
10 Solve each of the following equations. 10.7

(a) $b + 8 = 15$ **(b)** $18 - m = 11$ **(c)** $6x = 42$

11 Use substitution to check if the solution in the brackets is correct. Write TRUE or FALSE. 10.7

(a) $7p = 56 \quad (p = 7)$ **(b)** $t - 6 = 15 \quad (t = 21)$ **(c)** $2x + 3 = 11 \quad (x = 8)$

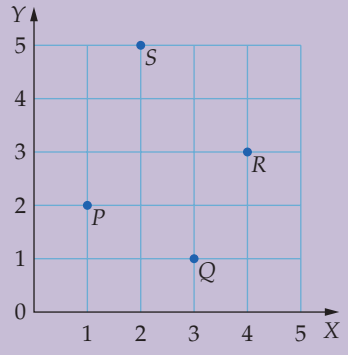
12 Use the graph to discover the inventors of the following. 10.8



(a) The mercury thermometer
(4, 2) (1, 0) (2, 1) (3, 5) (3, 3)
(0, 2) (5, 3)
(2, 2) (1, 0) (1, 3) (3, 5) (0, 2)
(2, 4) (1, 3) (0, 2) (3, 3) (4, 5)

(b) Dynamite
(1, 0) (5, 3) (2, 2) (3, 5) (0, 2) (4, 1)
(2, 4) (1, 5) (2, 1) (0, 2) (5, 3)

13 Give the coordinates of the following points from the graph. 10.8

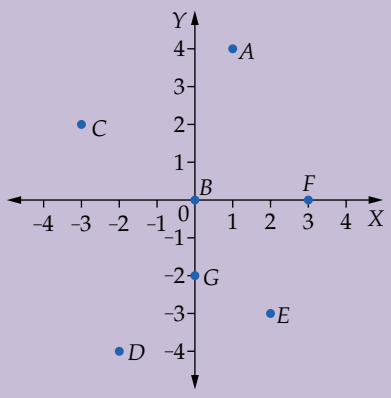


(a) P
(b) Q
(c) R
(d) S

14 **(a)** Write the coordinates of each of the points A–G shown on the number plane. 10.9

(b) Give the letter of the point at the origin.

(c) Give the letter of the point which lies in the third quadrant.



Extension

15 Suppose there are m jellybeans in a packet. Melissa, Hoa and Roderigo have bought some packets of jellybeans. The following tells us how many jellybeans each has in their packets at certain times. 10.1

Time	*Melissa*	*Hoa*	*Roderigo*
12.30	m	$2m$	m
12.31	$m - 2$	m	$2m$
12.32	$m - 4$	$3m$	0
12.33	$m - 6$	0	0
12.34	$m - 8$	0	0
12.35	$m - 14$	0	0

Write a paragraph about what happened during the five minutes.

16 The Education Department uses a formula to decide how many teachers to have at each secondary school. One of the formulae used in the past is 10.2

$$T = 8.8 + N + 0.06P$$

where T = the number of teachers allocated to the school

N = the special needs component (based on such things as number of students with non-English-speaking background)

P = the number of pupils in the school

The final T value is found by rounding *down* to the nearest whole number.

For example, if a school has 644 students and it has a special needs component of 1.5, then

$$T = 8.8 + 1.5 + 0.06 \times 644$$
$$= 48.94$$
$$T = 48 \quad \text{(rounded } down\text{)}$$

The school would be allocated 48 teachers.

(a) How many teachers would be allocated to a school of 500 pupils with a special needs component of 1.2?

(b) How many teachers would be allocated to a school of 1000 pupils with a special needs component of 0.2?

(c) Burnside Secondary College has 873 pupils and has a special needs component of 3.7. How many teachers would the school have allocated to it?

(d) Suppose the formula was changed to $T = 5 + \frac{P}{16.5}$ and the special needs component was eliminated. Again, any decimal answer at the end is rounded *down*. How many fewer teachers would Burnside Secondary College have allocated to it?

(e) Find out how many students your school has, and see how many teachers it should have according to the formula in part **(d)**. Does it actually have this many?

17 Solve the following equations. **10.7**

(a) $4x + 1 = 9$ **(b)** $-11 = 2p - 5$ **(c)** $6m + 2 = -10$

(d) $10 = \frac{p}{4} + 7$ **(e)** $\frac{k}{7} - 7 = -2$ **(f)** $\frac{m}{3} + 6 = 1$

18 Form a picture by joining the following points in order on a number plane with the x-axis ranging from 0 to 8 and the y-axis from 0 to 13. **10.8**

(2, 2) ($3\frac{1}{2}$, 2) ($3\frac{1}{2}$, 4) (0, 3) (3, 7) (1, 6) (3, 10) (2, 9) (4, 13) (6, 9) (5, 10) (7, 6) (5, 7) (8, 3) ($4\frac{1}{2}$, 4) ($4\frac{1}{2}$, 2) (6, 2) (5, 0) (3, 0) (2, 2)

19 Rule up a page of $\frac{1}{2}$ cm grid paper from -15 to 15 on both axes, and plot on it the following sets of points, joining them in the order shown to draw a macropod. **10.9**

Join (5, 0) ($6\frac{1}{2}$, -3) (5, -8) (5, -10) (6, -11) (9, $-11\frac{1}{2}$) (10, $-11\frac{1}{2}$) (11, -12) (4, -12) (3, -11) (4, -9) (4, -7) (2, -9) (-1, -11) (-13, -12) (-4, -10) (-1, -9) (0, -8) ($\frac{1}{2}$, -6) (0, -3) (1, 0) (4, 5) (5, 9) (5, $11\frac{1}{2}$) STOP

Join (6, 11) ($4\frac{1}{2}$, 12) (4, 13) (5, 13) (6, 12) STOP

Join (5, 13) (6, 13) (7, 12) (9, 11) ($10\frac{1}{2}$, 10) (10, 9) (8, 9) ($7\frac{1}{2}$, 8) (9, 5) (9, 3) (10, 0) ($9\frac{1}{2}$, -2) (9, $-2\frac{1}{2}$) (9, 0) ($8\frac{1}{2}$, $1\frac{1}{2}$) (8, 5) STOP

Join (7, 5) (8, 1) ($8\frac{1}{2}$, -1) ($8\frac{1}{2}$, -3) ($7\frac{1}{2}$, $-3\frac{1}{2}$) ($7\frac{1}{2}$, -2) (7, 0) (5, 3) STOP

Join ($7\frac{1}{2}$, -2) (6, -7) (6, -9) ($6\frac{1}{2}$, -10) (9, -10) (11, $-10\frac{1}{2}$) (6, -11) STOP

Join ($8\frac{1}{2}$, -1) (9, 0) STOP

Draw an eye at (8, $10\frac{1}{2}$).

REPLAY

1 Simplify: 1.6
(a) $3 \times (2 + 9)$ **(b)** $3 \times 6 - 12 \div 4$ **(c)** $(37 + 12) \div 7 - 6$

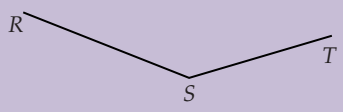
2 Calculate: 2.5
(a) $127 - 227$ **(b)** $-18 - 90$ **(c)** $-47 + 249$

3 List the first five multiples of each of the following numbers. 3.1
(a) 7 **(b)** 10 **(c)** 25

4 List each of the following numbers as a product of its prime factors. It may help to use a factor tree. 3.5
(a) 9 **(b)** 24 **(c)** 60

5 Copy and complete the following number patterns. 4.1
(a) 2, 3, 5, 8, 12, __, __, __ **(b)** 1, 3, 7, 15, __, __, __
(c) 5, 15, 105, 1005, __, __, __

6 Measure the size of the reflex angle $\angle RST$. 5.1, 5.4



7 Choose the correct answer. 5.7
Vertically opposite angles:
A add to 90° **B** add to 180° **C** add to 360° **D** are equal

8 Calculate: 6.4, 6.5
(a) $2.7 + 3.09$ **(b)** $5.6 - 2.1$ **(c)** $11.05 - 9.629$

9 Calculate: 6.11
(a) $2.4 \div 0.8$ **(b)** $5.2 \div 0.04$ **(c)** $0.006 \div 0.5$

10 Copy and complete the following area conversions. 7.5
(a) $150\ m^2 =$ _____ ha **(b)** $0.009\ cm^2 =$ _____ mm^2
(c) $80\,000\ cm^2 =$ _____ m^2

11 The sizes of two opposite angles in a kite are 112° and 70°. What is the size of each of the remaining angles? 8.4

12 Evaluate: 9.6
(a) $\frac{1}{3}$ of \$72 **(b)** $\frac{3}{5}$ of $6\frac{1}{4}$ hours **(c)** $\frac{4}{9}$ of 81 L

Assignment 10