Year 8
Mathematics
Unit 8

Name: ____________________________

Class: ____________________________

Contents

1 Expanding Single Brackets

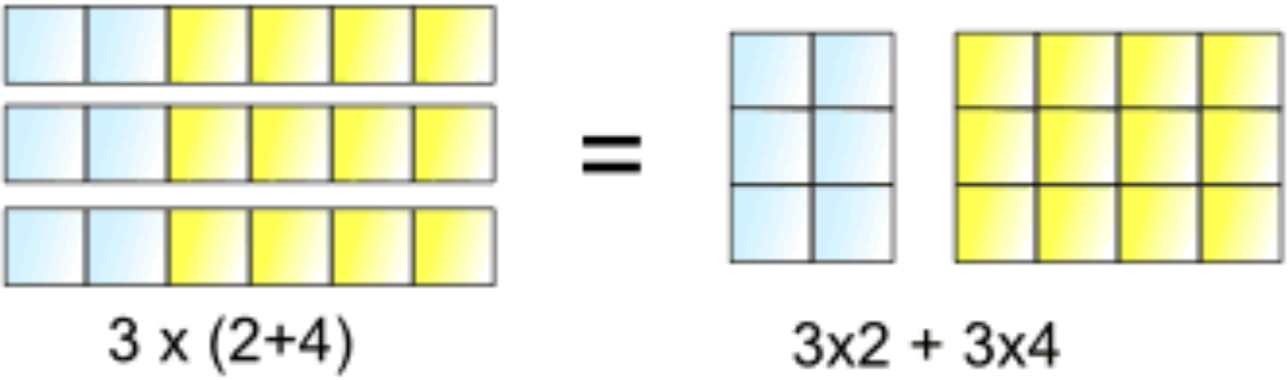
1.1 Distributive Law

In this section you will look at the distributive law.

The **distributive law** says that multiplying a number by a group of numbers added together is the same as doing each multiplication separately.

For example: $3 \times (2 + 4) = 3 \times 2 + 3 \times 4$

So the "3" can be "distributed" across the "$2 + 4$" into 3 times 2 and 3 times 4.



Worked Example	Your Turn
Use the distributive property to calculate: a) $7 \times (80 + 3)$ b) $(70 + 8) \times 3$	Use the distributive property to calculate: a) $3 \times (80 + 7)$ b) $(30 + 8) \times 7$

1.2 Expanding Single Brackets without Powers

In this section you will look at expanding single brackets without powers.

Worked Example	Your Turn
Expand: a) $2(x-3)$ b) $-2(x-3)$	Expand: a) $2(3-x)$ b) $-2(3-x)$

1.3 Expanding Single Brackets with Powers

In this section you will look at expanding single brackets with powers.

Worked Example	Your Turn
Expand: a) $2x(x-3)$ b) $-2x(x-3)$	Expand: a) $2x(3-x)$ b) $-2x(3-x)$

1.4 Expanding Single Brackets with Index Laws

In this section you will look at expanding single brackets with index laws.

Worked Example	Your Turn
Expand and simplify: a) $a^3bc(10b^2c^2 + 9a^2)$ b) $4a^5b^2(3a^4b^4 - 5b^2)$	Expand and simplify: a) $a^3b^5(3a^3b + 7ab^4c)$ b) $7x^5y^4(6x^2y + 5x^4y)$

1.5 Expanding and Simplifying Single Brackets

In this section you will look at expanding and simplifying single brackets.

Worked Example	Your Turn
Expand and simplify: a) $4 + 7(6x - 5)$ b) $8x + 6 + 8(5x + 9)$	Expand and simplify: a) $-5 + 2(4y - 1)$ b) $6z + 6 + 5(7z + 2)$

Worked Example	Your Turn
Expand and simplify: a) $2(x-1)+3(x-4)$ b) $2(x-1)-3(x-4)$	Expand and simplify: a) $2(x-1)+5(x-4)$ b) $2(x-1)-5(x-4)$

Worked Example	**Your Turn**
Expand and simplify: a) $2x(x-1)-3x(x-4)$ b) $2x(x-1)-3(x-4)$	Expand and simplify: a) $2x(x-1)-5x(x-4)$ b) $2x(x-1)-5(x-4)$

2 Factorising to a Single Bracket

Factorising to a Single Bracket

Factorising means:
To turn an expression into a **product** of factors.

Year 8 Factorisation

$$2x^2 + 4xz \xrightarrow{\text{Factorise}} 2x(x+2z)$$

Year 9 Factorisation

$$x^2 + 3x + 2 \xrightarrow{\text{Factorise}} (x+1)(x+2)$$

A Level Factorisation

$$2x^3 + 3x^2 - 11x - 6 \xrightarrow{\text{Factorise}} (2x+1)(x-2)(x+3)$$

Factorising is the **reverse of expanding**.
When you have a sum of terms, just **identify the common factor**.
i.e. Find the largest expression each of your terms is divisible by.

2.1 Highest Common Factor

In this section you will look at highest common factor of algebraic terms.

Worked Example	Your Turn
Find the highest common factor of: a) $3a$ and $5a$ b) 6 and $6a$ c) $3a$ and $6a$ d) $4ab^2$ and $6a^2$b	Find the highest common factor of: a) $2b$ and $3b$ b) 6 and $12b$ c) $6b$ and $12b^2$ d) $8a^2b$ and $12a^2b^2$

2.2 Factorising to a Single Bracket

In this section you will look at factorising to a single bracket.

Worked Example	Your Turn
a) Factorise $12x + 18$	a) Factorise $12x - 20$
b) Factorise $12x + 18y$	b) Factorise $12x - 20y$
c) Factorise $12x^2 + 18$	c) Factorise $12x^3 - 20$

Worked Example	Your Turn
a) Factorise $12x^2 + 18\mathrm{x}$	a) Factorise $12x^2 - 20x$
b) Factorise $12x^2 + 18xy$	b) Factorise $12x^2 - 20xy$
c) Factorise $12x^2y + 18xy$	c) Factorise $12x^2y - 20xy^2$

2.3 Factorising to a Single Bracket with Index Laws

In this section you will look at factorising to a single bracket with index laws.

Worked Example	Your Turn
Factorise: a) $x^4y^2 - x^3y^5$ b) $10x^7y^4 - 25x^3y^2$	Factorise: a) $x^2y^5 - xy^3$ b) $20e^5f^2 - 12e^2f$

2.4 Finish Factorising

In this section you will look at expressions which need to be fully factorised.

Worked Example	Your Turn
Finishing factorising: a) $4(10x + 50)$ b) $4(30x + 50)$	Finishing factorising: a) $4(5x + 15)$ b) $4(25x + 15)$

3 Solving Linear Equations

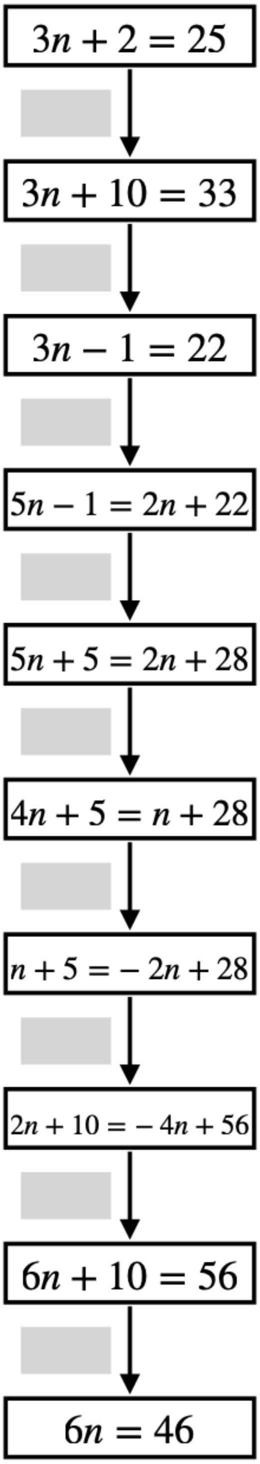
3.1 Terminology

In this section you will look at the terminology used in this topic.

- An **expression** is a collection of letters and numbers with no equals sign, for example $3x + 1$
- An **equation** contains an equals sign and an unknown letter to be solved, for example $3x + 1 = 10$
- A **formula** is a relationship between two or more letters, and it contains an equals sign, for example $A = bh$
- An **identity** is an equation that is always true, no matter what values are substituted, for example $2x + 3x = 5x$ (use $\equiv$)

Worked Example

For the following equations waterfall, indicate the step which has been carried out to both sides of the equation:



$$3n + 2 = 25$$

$$3n + 10 = 33$$

$$3n - 1 = 22$$

$$5n - 1 = 2n + 22$$

$$5n + 5 = 2n + 28$$

$$4n + 5 = n + 28$$

$$n + 5 = -2n + 28$$

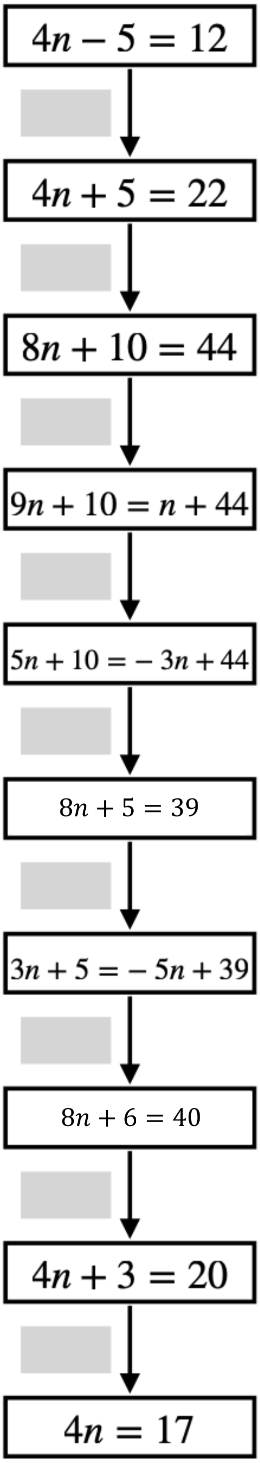
$$2n + 10 = -4n + 56$$

$$6n + 10 = 56$$

$$6n = 46$$

Your Turn

For the following equations waterfall, indicate the step which has been carried out to both sides of the equation:



$$4n - 5 = 12$$

$$4n + 5 = 22$$

$$8n + 10 = 44$$

$$9n + 10 = n + 44$$

$$5n + 10 = -3n + 44$$

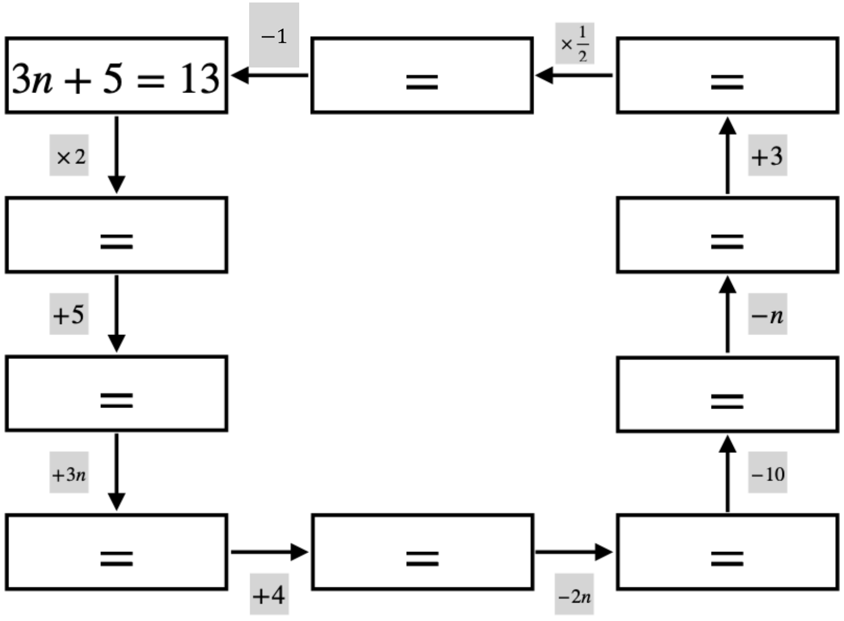
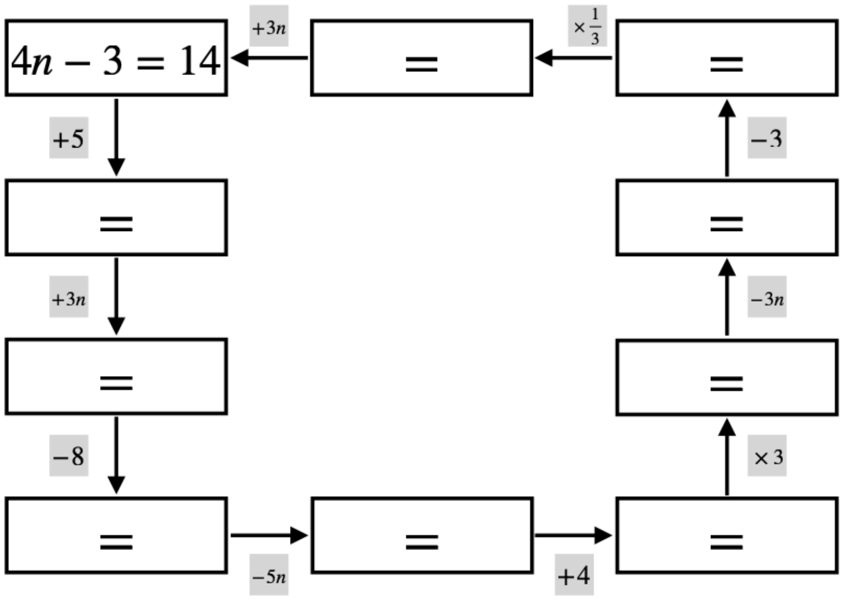
$$8n + 5 = 39$$

$$3n + 5 = -5n + 39$$

$$8n + 6 = 40$$

$$4n + 3 = 20$$

$$4n = 17$$

Worked Example	Your Turn
Complete the loop by carrying out the indicated steps to each side of the equations:  	Complete the loop by carrying out the indicated steps to each side of the equations: 

3.2 Forming Expressions

In this section you will look at forming expressions.

Forming Expressions

Form the following expressions starting from x:

$4x - 5$	
$5 - 4x$	
$\frac{x}{4} - 5$	
$\frac{x - 5}{4}$	
$4(x - 5)$	

3.3 One Side

In this section you will look at equations with the variable on one side.

To solve an equation means that we find the value of the variable(s).

Strategy: To get x on its own on one side of the equation, we gradually need to ‘claw away’ the things surrounding it.

Note: In algebra, we tend to give our answers as fractions rather than decimals (unless asked). And never recurring decimals. Don’t round also (unless asked).

Worked Example	Your Turn
Solve the following equations: a) $4x + 17 = 43$ b) $17 + 4x = 43$	Solve the following equations: a) $6x + 27 = 53$ b) $27 + 6x = 43$

Worked Example	Your Turn
Solve the following equations: a) $4x - 17 = 43$ b) $17 - 4x = 43$	Solve the following equations: a) $6x - 27 = 53$ b) $27 - 6x = 53$

Worked Example	Your Turn
Solve the following equations: a) $4(x+8)=50$ b) $4(2x+8)=50$	Solve the following equations: a) $6(x-8)=50$ b) $6(3x-8)=50$

Worked Example	**Your Turn**
Solve the following equations: a) $-4(2x+8)=50$ b) $-4(2x-8)=50$	Solve the following equations: a) $-6(3x+8)=50$ b) $-6(3x-8)=50$

Worked Example	Your Turn
Solve the following equations: a) $8(x+3)+3(2x+6)=84$ b) $8(x+3)-3(2x-6)=84$	Solve the following equations: a) $3(x-3)+4(2x-6)=110$ b) $3(x-3)-4(2x-6)=110$

3.4 Both Sides

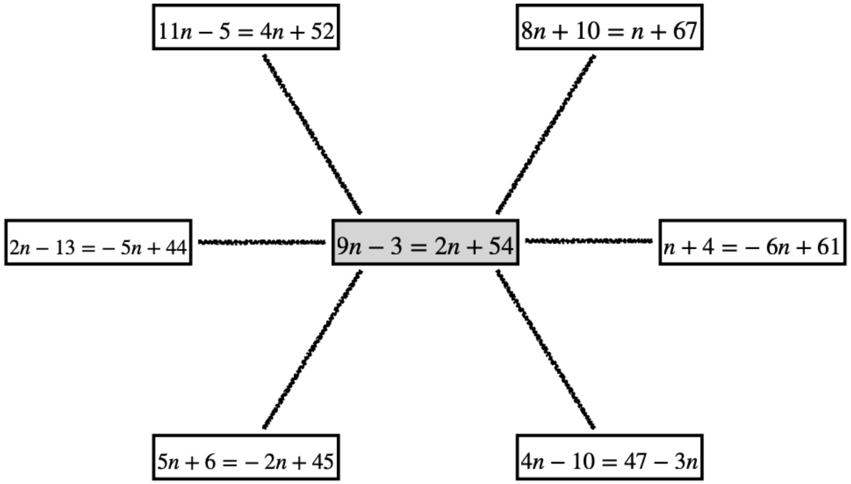
In this section you will look at equations with the variable on both sides.

- Collect the variable terms (i.e. the terms involving x) on one side of the equation, and the 'constants' (i.e. the individual numbers) on the other side.

- Collect the variable terms on the side of the equation where there's more of them (and move constant terms to other side).

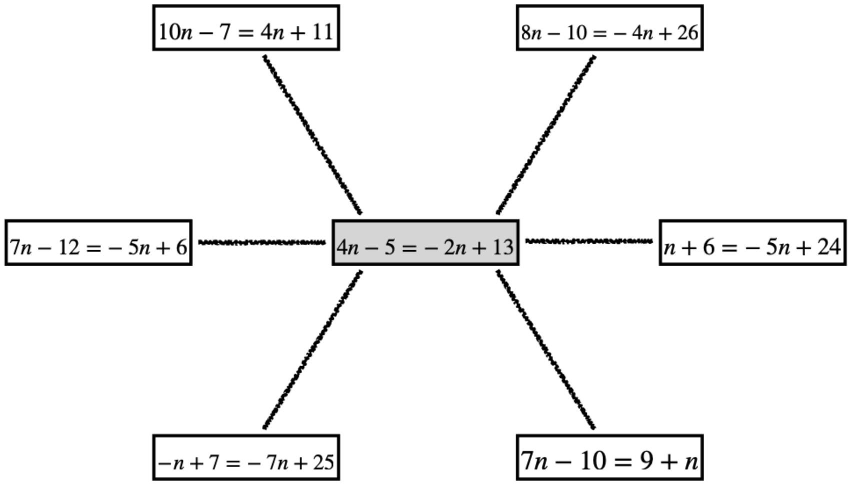
Worked Example

Identify which equation is **not** the same equation from this equation spider:



Your Turn

Identify which equation is **not** the same equation from this equation spider:



Balancing

- We eliminate the variable from the side with the smaller number of the variable.

- We eliminate the variable by applying the inverse to both sides.

Which side do you eliminate the variable from?
How would you balance both sides?

- $3x + 4 = 2x + 6$

- $2x + 4 = 3x + 6$

- $2x - 4 = 3x - 6$

- $4 - 2x = 3x - 6$

- $4 - 2x = 6 - 3x$

Worked Example	Your Turn
Solve the following equations: a) $5x + 7 = 2x + 31$ b) $2x - 23 = 7 - x$	Solve the following equations: a) $5x + 7 = 3x + 23$ b) $2x - 23 = 12 - 3x$

Worked Example	**Your Turn**
Solve the following equations: a) $3(x+2)=2(x+3)$ b) $3(x+5)-7=2(x+2)$	Solve the following equations: a) $9(x-3)=4(x+7)$ b) $7(x+6)-7=4(x+2)$

Worked Example	Your Turn
Solve the following equation: $3(2w-1)-4=4(w+2)+1$	Solve the following equation: $2(2p-2)-4=2(p+3)-3$

3.5 Fractions

In this section you will look at equations with fractions.

Worked Example	Your Turn
Solve the following equations: a) $\frac{x}{3} + 12 = 49$ b) $\frac{x+12}{3} = 49$	Solve the following equations: a) $\frac{x}{6} - 12 = 49$ b) $\frac{x-12}{6} = 49$

Worked Example	Your Turn
Solve the following equations: a) $\frac{2x}{3}+12=49$ b) $\frac{2x+12}{3}=49$	Solve the following equations: a) $\frac{5x}{6}-12=49$ b) $\frac{5x-12}{6}=49$

Worked Example	Your Turn
Solve the following equation: a) $\frac{3}{x} + 2 = 6$ b) $\frac{3}{x+2} = 6$	Solve the following equation: a) $\frac{15}{x} - 2 = 6$ b) $\frac{15}{x-2} = 6$

Worked Example	Your Turn
Solve the following equation: $\frac{3x+6}{2}=x+3$	Solve the following equation: $\frac{9x-27}{4}=x+7$

Worked Example	Your Turn
Solve the following equation: $\frac{3x+6}{x+3} = 2$	Solve the following equation: $\frac{7x-21}{x+7} = 2$

3.6 Cross Multiplication

In this section you will look at equations which can be solved using cross multiplication.

You can cross multiply to solve equations which are in the form:

$$\frac{a}{b} = \frac{c}{d}$$

Are the following equations ready to be cross multiplied?

- $\frac{2x}{3} = \frac{5}{9}$
- $\frac{2x}{3} + 1 = \frac{5}{9}$
- $\frac{2x}{3} + 1 = 5$
- $\frac{2x+1}{3} = 5$
- $\frac{3}{2x+1} = \frac{5}{x}$

Worked Example	Your Turn
Solve the following equations: a) $\frac{x}{5}=\frac{3}{2}$ b) $\frac{x+1}{5}=\frac{3}{2}$	Solve the following equations: a) $\frac{2x}{5}=\frac{3}{2}$ b) $\frac{2x+1}{5}=\frac{3}{2}$

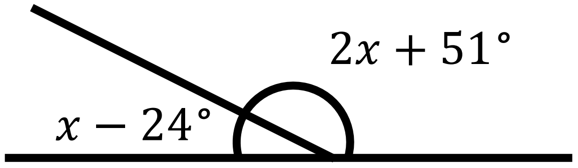
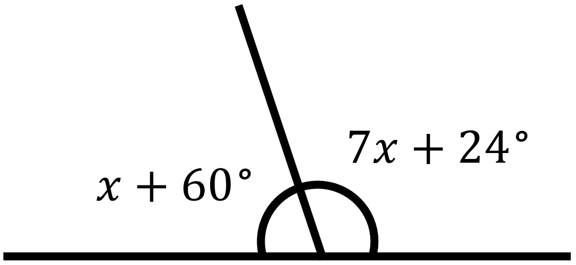
Worked Example	Your Turn
Solve the following equations: a) $\frac{3x-4}{5}=\frac{x+4}{3}$ b) $\frac{4}{2-3x}=\frac{5}{6-2x}$	Solve the following equations: a) $\frac{x+4}{7}=\frac{x-4}{3}$ b) $\frac{4}{2+3x}=\frac{5}{6+2x}$

3.7 Forming and Solving Equations

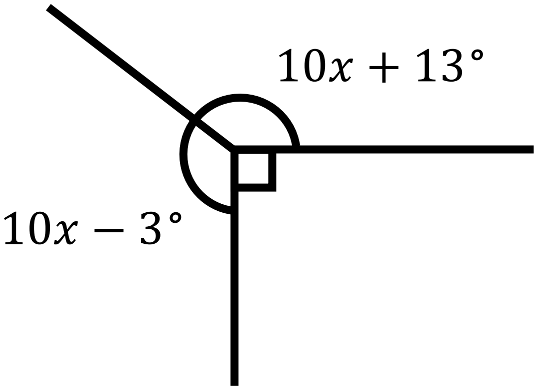
In this section you will look at forming and solving equations.

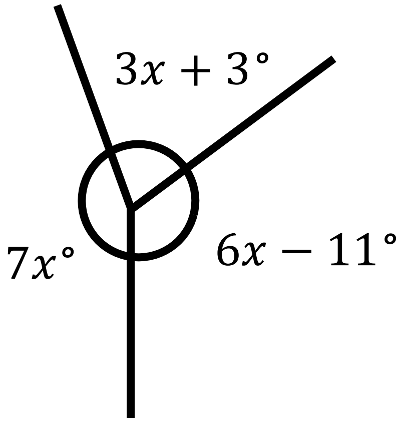
Worked Example	Your Turn
I think of a number. I multiply the number by 6 then subtract 3. The result is 15. What was my original number?	I think of a number. I multiply the number by 4 then subtract 5. The result is 27. What was my original number?

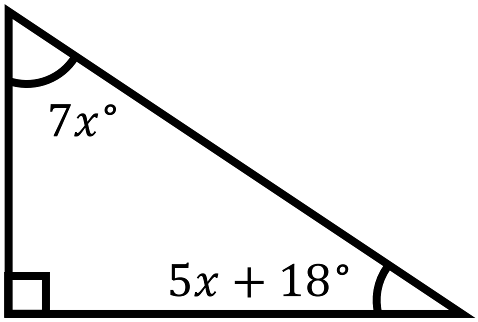
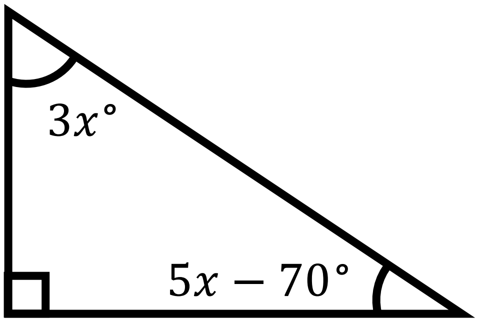
Worked Example	Your Turn
A is x years old. B is 3 years older than A. C is twice as old as A. The sum of the ages of A, B and C is 51. What are their ages?	A is x years old. B is 3 years younger than A. C is three times as old as A. The sum of the ages of A, B and C is 57. What are their ages?

Worked Example	Your Turn
Find x 	Find x 

Worked Example	Your Turn
Find x	Find x

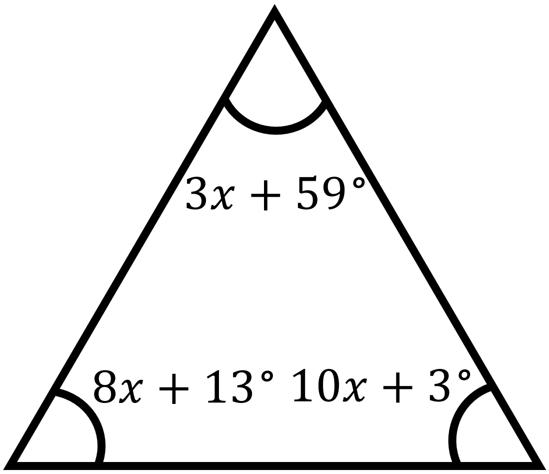




Worked Example	Your Turn
Find x  	Find x 

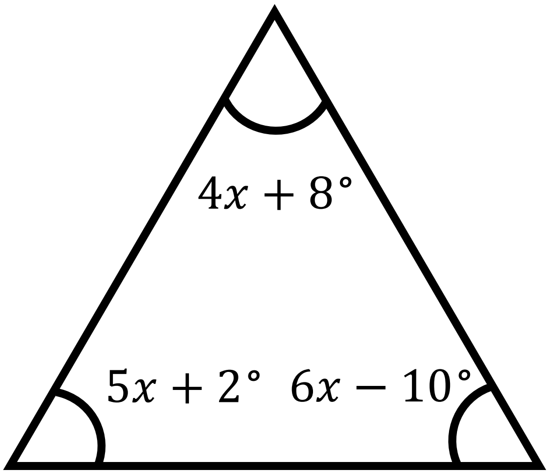
Worked Example

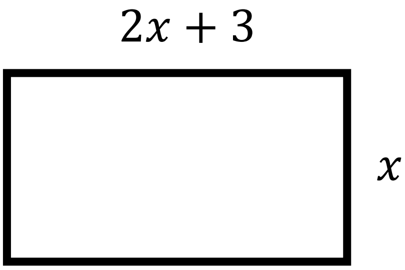
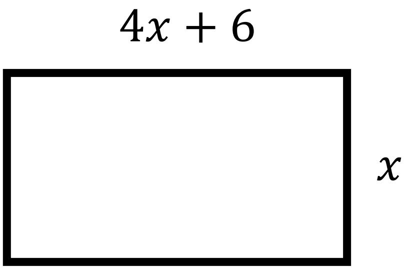
Find x

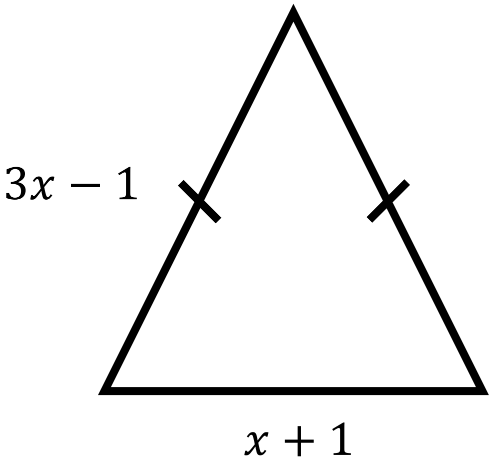
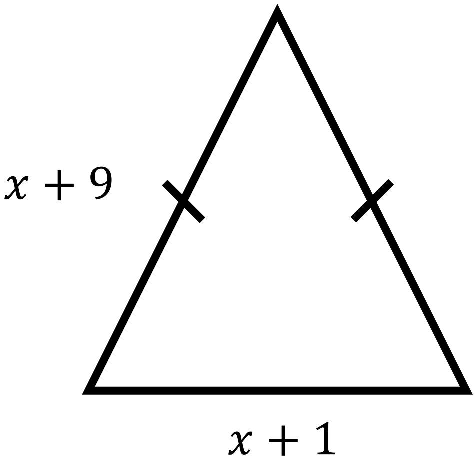


Your Turn

Find x

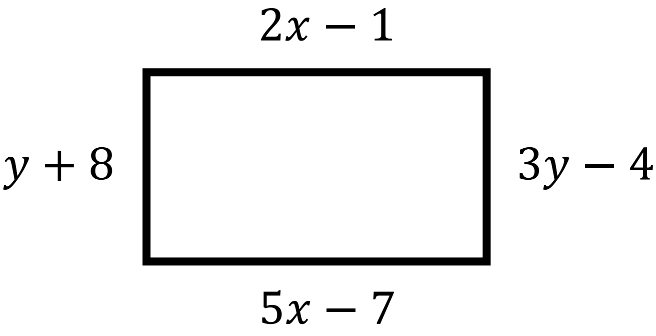


Worked Example	Your Turn
The perimeter of the rectangle is equal to 72 square units. Find x. 	The perimeter of the rectangle is equal to 72 square units. Find x. 

Worked Example	Your Turn
The perimeter of the isosceles triangle is equal to 34 square units. Find x.  	The perimeter of the isosceles triangle is equal to 34 square units. Find x. 

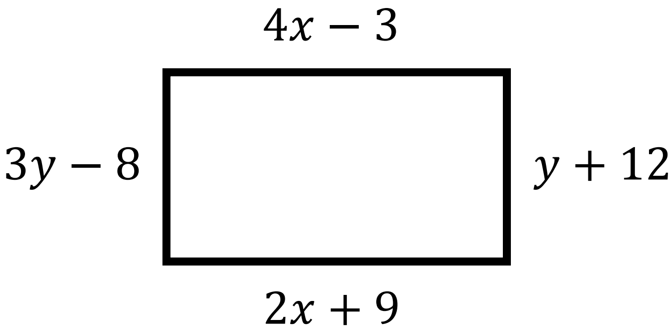
Worked Example

Find x and y

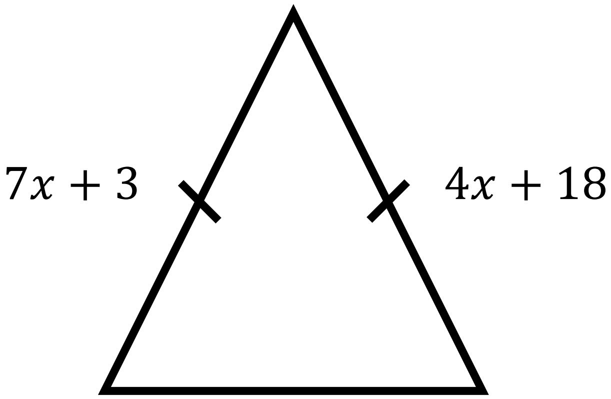


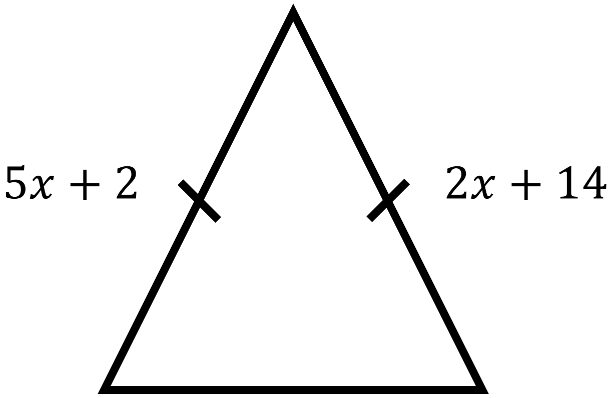
Your Turn

Find x and y

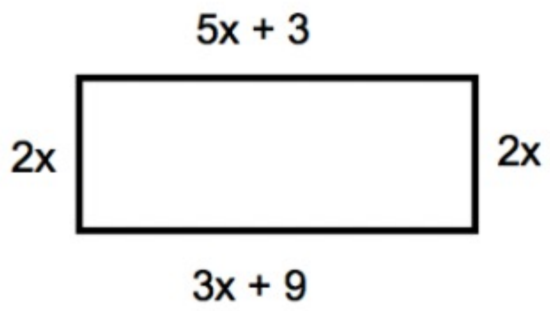


Worked Example	Your Turn
Find x	Find x





Fluency Practice



The diagram shows a rectangle. The sides are measured in centimetres.

(a) Explain why $5x + 3 = 3x + 9$

....

....

(1)

(b) Solve $5x + 3 = 3x + 9$

x =.....................cm

(2)

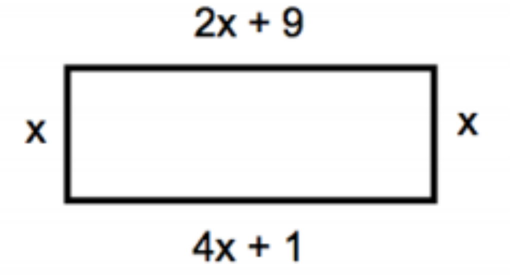
(c) Calculate the perimeter of the rectangle.

.....................cm

(2)

Fluency Practice

A rectangle is shown below.



(a) Explain why $4x + 1 = 2x + 9$

....

....

(1)

(b) Find the size of x.

$x =$ ....cm

(2)

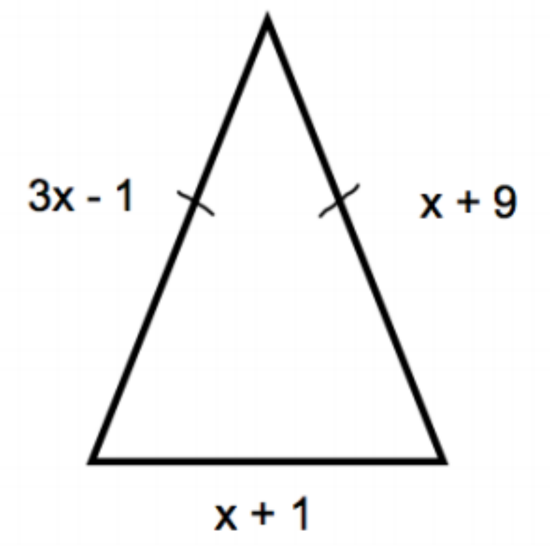
(c) Work out the area of the rectangle.

......................cm²

(2)

Fluency Practice

Shown below is an isosceles triangle. Each side is measured in centimetres.



(a) Explain why 3x - 1 = x + 9

....

....

(1)

(b) Solve the equation above.

x = ...cm

(2)

(c) Calculate the perimeter of the triangle.

......................cm

(2)

Worked Example	Your Turn
Is 100 in the sequence $16, 20, 24, 28, 32, \ldots ?$	Is 100 in the sequence $26, 30, 34, 38, 42, \ldots ?$

Worked Example	Your Turn
Is -100 in the sequence $42, 38, 34, 30, 26$ …?	Is -100 in the sequence $32, 28, 24, 20, 16,$ …?