Unit (1) Number and Place value

Numbers to 10,000,000: *Reading, Writing and Representing Numbers*

There are many useful tools to help structures, and they can be represented in different ways.

Numerals	***Words***
Numbers can be represented with digits.	They can also be written as words as shown below.
4,120,513	**four million, one hundred and twenty thousand, five hundred and thirteen**

Commas are used to help separate the sections of the number, making it easier to read.

Different ways of saying numbers to 10,000,000

Some numbers can be said in different ways.

For example:

500,000	=	*five hundred thousand*	=	*half a million*
250,000	=	*two hundred and fifty thousand*	=	*quarter of a million*

Visual Representations of Numbers-Place Value Charts

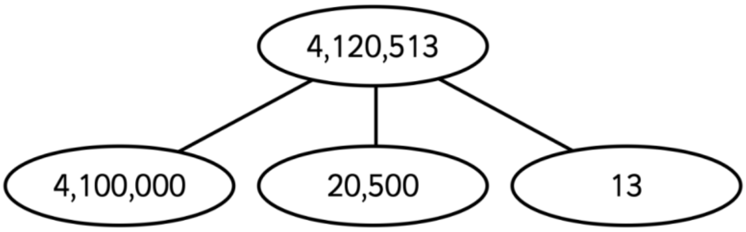
These charts start with the largest value digit on the left and end with the smallest value digit on the right. You can represent the number with counters or digits.

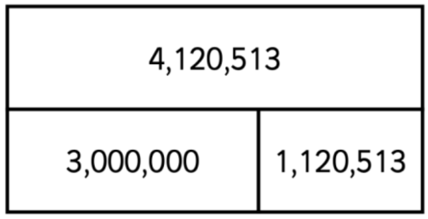
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones
●●●●	●	●●		●●●●●	●	●●●
4	**1**	**2**	**0**	**5**	**1**	**3**

Zeros must always be used as a placeholder when a column does not have a value.

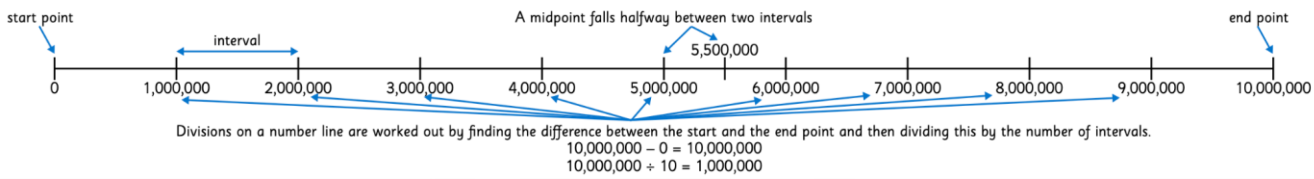
Part-whole and bar models

These models can separate numbers into parts so you can see the relationship between those parts and the whole number.





Number lines to 10,000,000



Powers of 10

A Gattegno Chart is a useful tool for seeing the relationship between multiplying and dividing numbers by 10, 100, and 1000.

1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000	8,000,000	9,000,000
100,000	200,000	300,000	400,000	500,000	600,000	700,000	800,000	900,000
10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000
1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
100	200	300	400	500	600	700	800	900
10	20	30	40	50	60	70	80	90
1	2	3	4	5	6	7	8	9

50,000 is 10 times the size of 5,000
500,000 is 100 times the size of 5,000
5,000,000 is 1,000 times the size of 5,000

500 is one-tenth of the size of 5,000
50 is one-hundredth of the size of 5,000
5 is one-thousandth of the size of 5,000

Moving up the chart

- Moving up the chart by 1 row means the number is 10 times the size
- Moving up the chart by 2 rows means the number is 100 times the size. (10 × 10 = 100)
- Moving up the chart by 3 rows means the number is 1000 times the size. (10 × 10 × 10 = 1000)

Moving down the chart

- Moving down the chart by 1 row means the number is one-tenth the size
- Moving down the chart by 2 rows means the number is one-hundredth the size.
- Moving down the chart by 3 rows means the number is one-thousandth of the size.

Compare and order any integers

You can compare integers by looking at the place value of each digit in a number, starting with the first digit. Integers can be equal to (=), greater than (>) or less than (<) another integer.

300,760 = 300,000 + 760

1,208,465 > 1,098,765

109,984 < 190,984

When you order numbers, you place them in an ***ascending*** sequence where the value of the numbers gets ***larger***, or a ***descending*** sequence where the value of the numbers gets ***smaller***.

Ascending: 309,087 509,879 9,054,873

Descending: 9,054,873 509,879 309,087

Rounding any integer

When rounding, you first need to identify which digit will tell you whether to round up or down.

- To round a number to the **nearest 10**, you should look at the ones digit.
- To round a number to the **nearest 100**, you should look at the tens digit.
- To round a number to the **nearest 1000**, you should look at the hundreds digit.
- To round a number to the **nearest 10,000**, you should look at the thousands digit.
- To round a number to the **nearest 100,000**, you should look at the ten-thousandths digit.
- To round a number to the **nearest 1,000,000**, you should look at the hundred-thousandth digit.

Number	Nearest 10	Nearest 100	Nearest 1,000
527,356	527,360	527,400	527,000

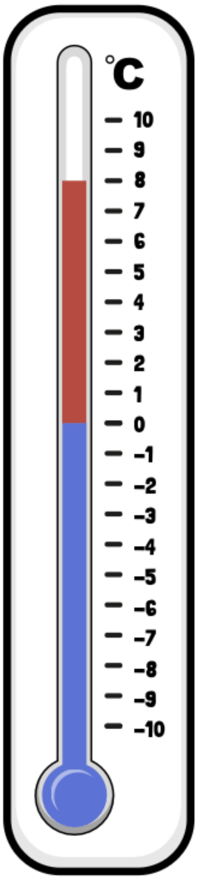
Number	Nearest 10,000	Nearest 100,000	Nearest 1,000,000
527,356	530,000	500,000	1,000,000

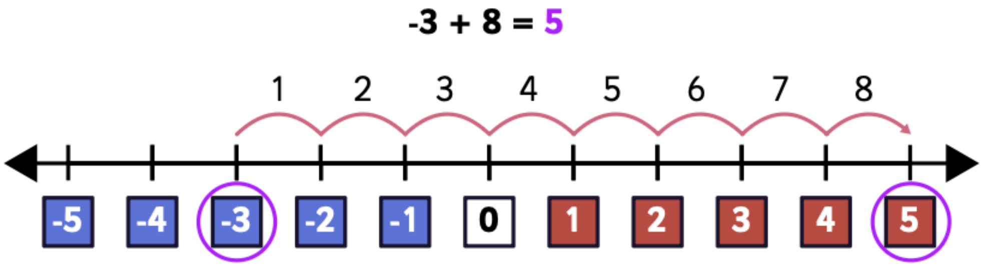
Negative numbers

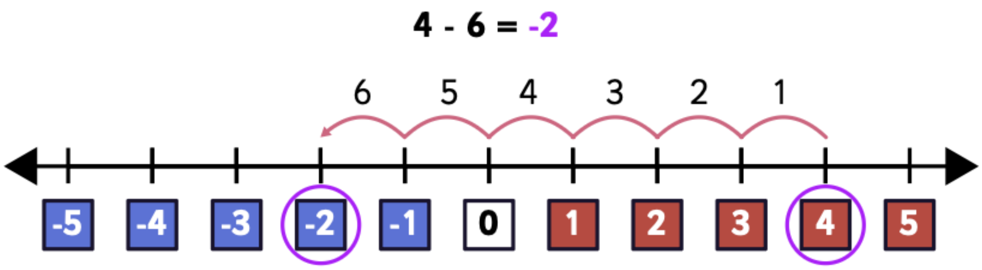
Number lines do not stop at zero. Numbers above zero are called positive numbers, and numbers below zero are called negative numbers.

Negative numbers are used in real life to show temperature, amounts of money in a bank account, and the depth of valleys below sea level.

Number lines are helpful when adding and subtracting negative numbers.







The temperature is 8°C.
If it drops by 10°C, the new temperature will be -2°C.

Unit (2 & 3) Four Operations

Addition

	4	5	8	6	4
+	2	3	4	9	7
	6	9	3	6	1
		1	1	1	

Starting with the ones, add each column in turn. Regroup tens, hundreds, thousands, ten thousands as required.

#Note: Integers are positive numbers, negative numbers, and zero. Integers do not have any added parts, such as decimals or fractions.

Subtraction

			6	12	1
	3	5	~~7~~	~~4~~	~~2~~
-		3	4	7	6
	3	2	2	6	6

Starting with the ones, subtract each column in turn. Exchange tens, hundreds, thousands, and/or ten thousands as required.

Common factors

Factors of 48

1	2	3	4	6	8	12	16	24	48

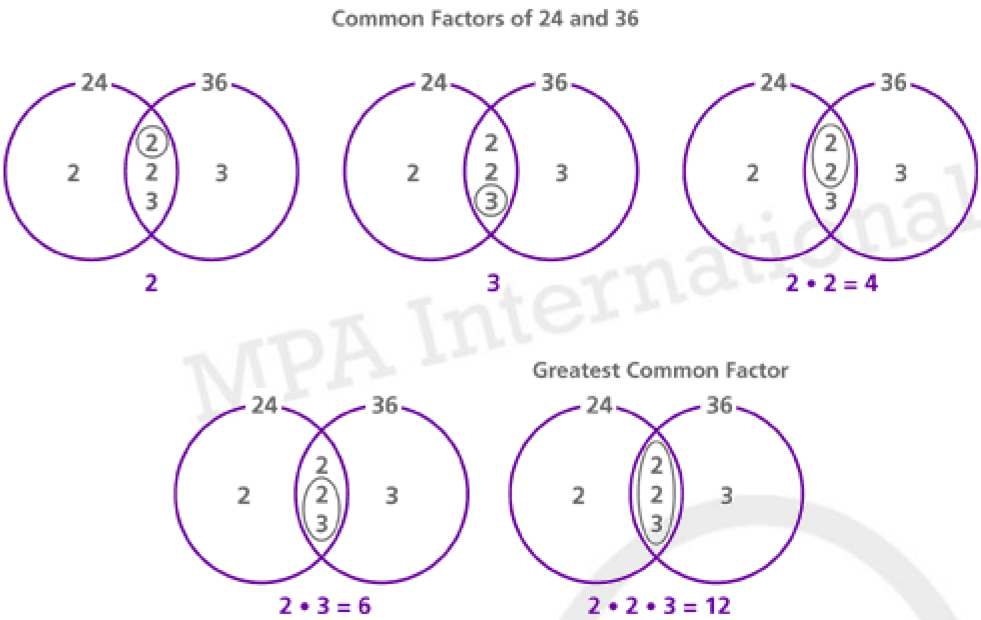
Factors of 30

1	2	3	5	6	10	15	30

Common factors of 48 and 30 are: 1, 2, 3, 6

Highest Common Factor (HCF) is: 6

Common factor using a Venn Diagram



Common multiples

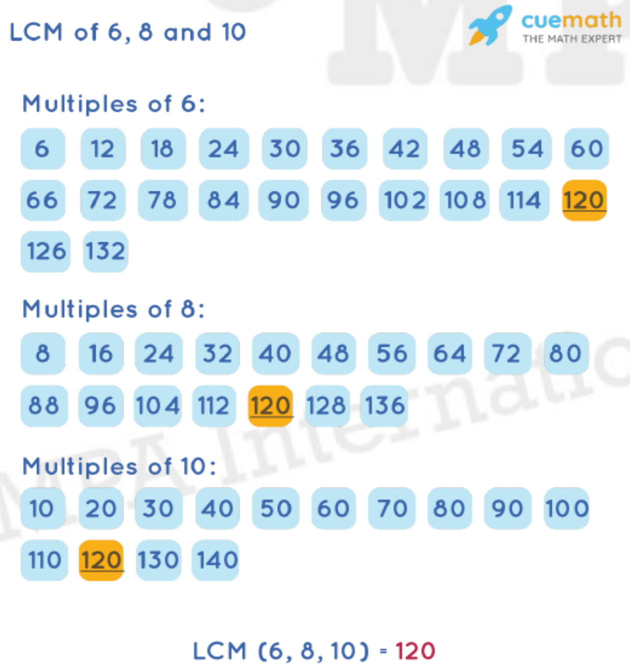
Multiples of 3

3	**…**	**18**	**21**	**24**	**…**	**39**	**42**

Multiples of 7

7	**14**	**21**	**28**	**35**	**42**

Common multiples of 3 and 7 are: 21 and 42
Lowest Common Multiple (LCM) is: 21



Rules of divisibility

DIVISIBILITY RULES	
Divisible by...	
2	last digit of a number is 0, 2, 4, 6, and 8
3	the sum of the digits is a multiple of 3
4	last two digits of a number are a multiple of 4
5	last digit of a number is 5 or 0
6	divisible by 2 and 3
9	the sum of the digits is a multiple of 9
10	last digit of a number is 0

Multiply up to 4 digits by a 2-digit number

1	~~3~~	~~2~~	
	1	5	4
x		2	6
	2	9	4
3	0	8	0
4	0	0	4
1	1		

Start with the ones.

$154 \times 6 = 924$
$154 \times 20 = 3080$
$3080 + 924 = 4004$

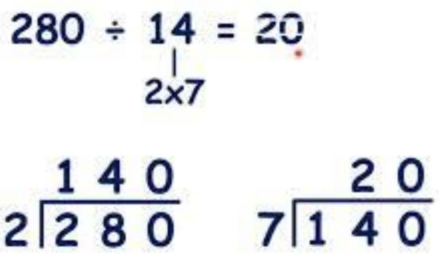
Short division

		4	4	0	5
12	5	[5] 2	[4] 8	6	[6] 0

Start from the left.

$5 \div 12 = 0$ r5
$52 \div 12 = 4$ r4
$48 \div 12 = 4$
$6 \div 12 = 0$ r6

Division using factors



Long division

			2	4	r	1	2
1	5	3	7	2			
	–	3	0	0			
			7	2			
	–		6	0			
			1	2			

$1 \times 15 = 15$

$2 \times 15 = 30$

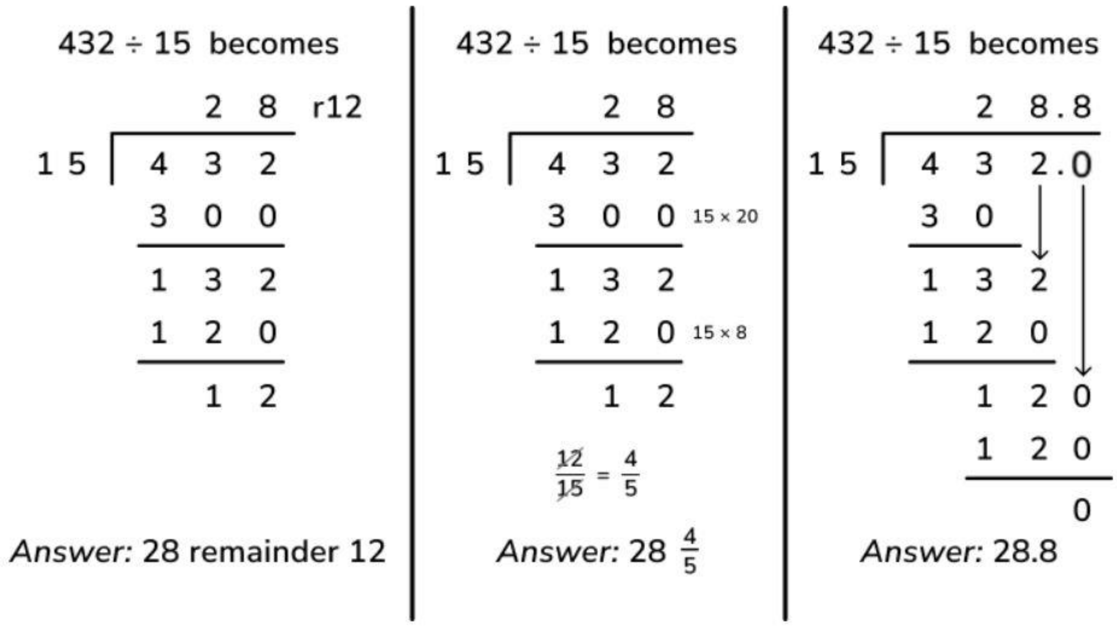
$3 \times 15 = 45$

$4 \times 15 = 60$

$5 \times 15 = 75$

$10 \times 15 = 150$

Interpret remainders, in fractions, or by rounding as appropriate for the context.



Order of Operations and Brackets

When there are different operations within a calculation, the order in which they are completed affects the answer. In mixed operation calculations, the calculations are not carried out from left to right.

B	**Brackets**	10 × (4 + 2) = 10 × 6 = 60
O	**Order**	5 + 2^2 = 5 + 4 = 9
D	**Division**	10 + 6 ÷ 2 = 10 + 3 = 13
M	**Multiplication**	10 - 4 × 2 = 10 - 8 = 2
A	**Addition**	10 × 4 + 7 = 40 + 7 = 47
S	**Subtraction**	10 ÷ 2 - 3 = 5 - 3 = 2

If there is no operation sign written, it means multiplication; e.g., 4 (2 + 1) means 4 × (2 + 1).

Primes to 100

A prime number has exactly two factors: 1 and itself.

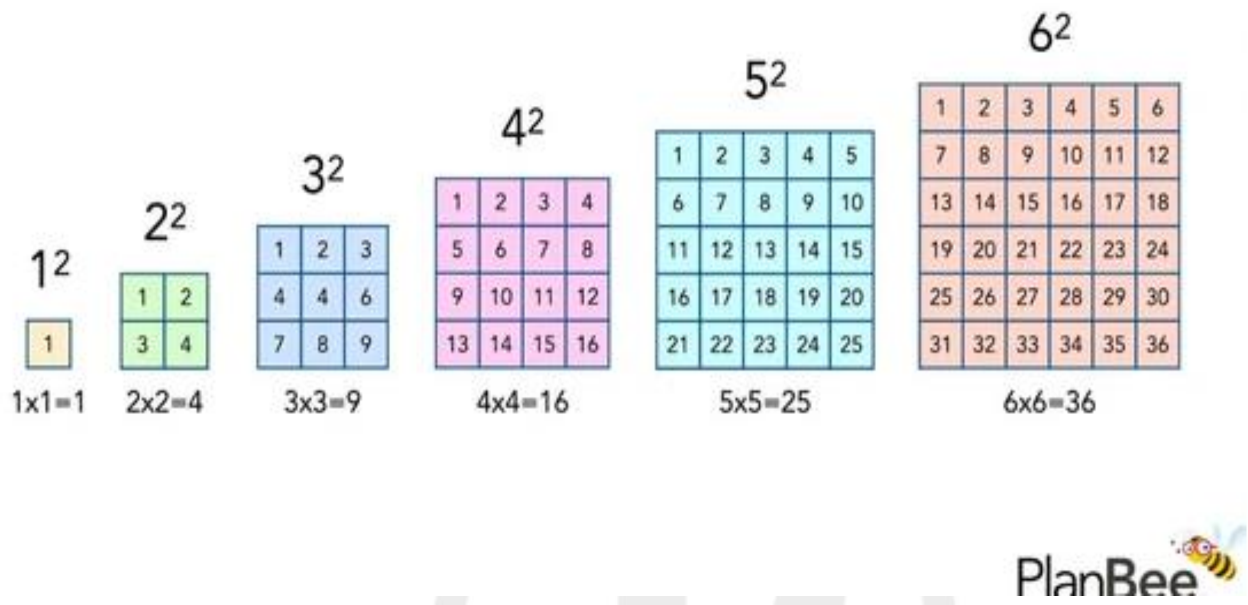
Prime Numbers

1	**2**	**3**	4	**5**	6	**7**	8	9	10
11	12	**13**	14	15	16	**17**	18	**19**	20
21	22	**23**	24	25	26	27	28	**29**	30
31	32	33	34	35	36	**37**	38	39	40
41	42	**43**	44	45	46	**47**	48	49	50
51	52	**53**	54	55	56	57	58	**59**	60
61	62	63	64	65	66	**67**	68	69	70
71	72	**73**	74	75	76	77	78	**79**	80
81	82	**83**	84	85	86	87	88	**89**	90
91	92	93	94	95	96	**97**	98	99	100

Squares and cubes

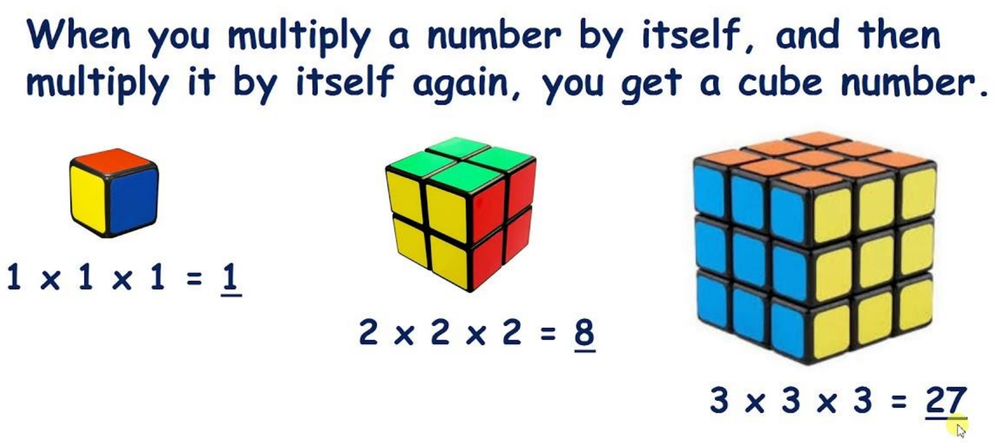
Square numbers

This is when we multiply the number by itself, the first 5 square numbers are shown below.



Cube numbers

This is when we multiply the number by itself three times; the first 3 square numbers are shown below.



Squares 1 to 20

cuemath THE MATH EXPERT

$1^2 = 1$	$11^2 = 121$
$2^2 = 4$	$12^2 = 144$
$3^2 = 9$	$13^2 = 169$
$4^2 = 16$	$14^2 = 196$
$5^2 = 25$	$15^2 = 225$
$6^2 = 36$	$16^2 = 256$
$7^2 = 49$	$17^2 = 289$
$8^2 = 64$	$18^2 = 324$
$9^2 = 81$	$19^2 = 361$
$10^2 = 100$	$20^2 = 400$

Cubes 1 to 20

cuemath THE MATH EXPERT

$1^3 = 1$	$11^3 = 1331$
$2^3 = 8$	$12^3 = 1728$
$3^3 = 27$	$13^3 = 2197$
$4^3 = 64$	$14^3 = 2744$
$5^3 = 125$	$15^3 = 3375$
$6^3 = 216$	$16^3 = 4096$
$7^3 = 343$	$17^3 = 4913$
$8^3 = 512$	$18^3 = 5832$
$9^3 = 729$	$19^3 = 6859$
$10^3 = 1000$	$20^3 = 8000$

Mental calculations

1. **Change the order of calculations**

   $50 \times 34 \times 2 = 50 \times 2 \times 34 = 100 \times 34 = 3400$

2. **Rounding**

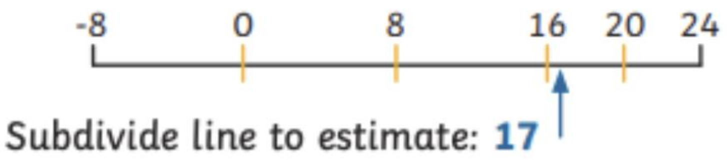
   £8.99 + £3.49 = £12.48

   Round to £9 + £3.50 = £12.50

   We've added 1p to each amount, so then subtract 2p.

   £12.50 - 2p = £12.48

3. **Estimate on a number line**



Reasons from known facts

Facts we know from one calculation can help us to answer another similar calculation without starting again.

$90 \div 10 = 9$ so $90 \div 20 = 4.5$ and $90 \div 5 = 18$

$16 \times 9 = 144$ so $1.6 \times 9 = 14.4$

$4352 \div 17 = 256$

so $256 \times 18 = 4352 + 256 = 4608$

$3786 + 2850 = 6636$

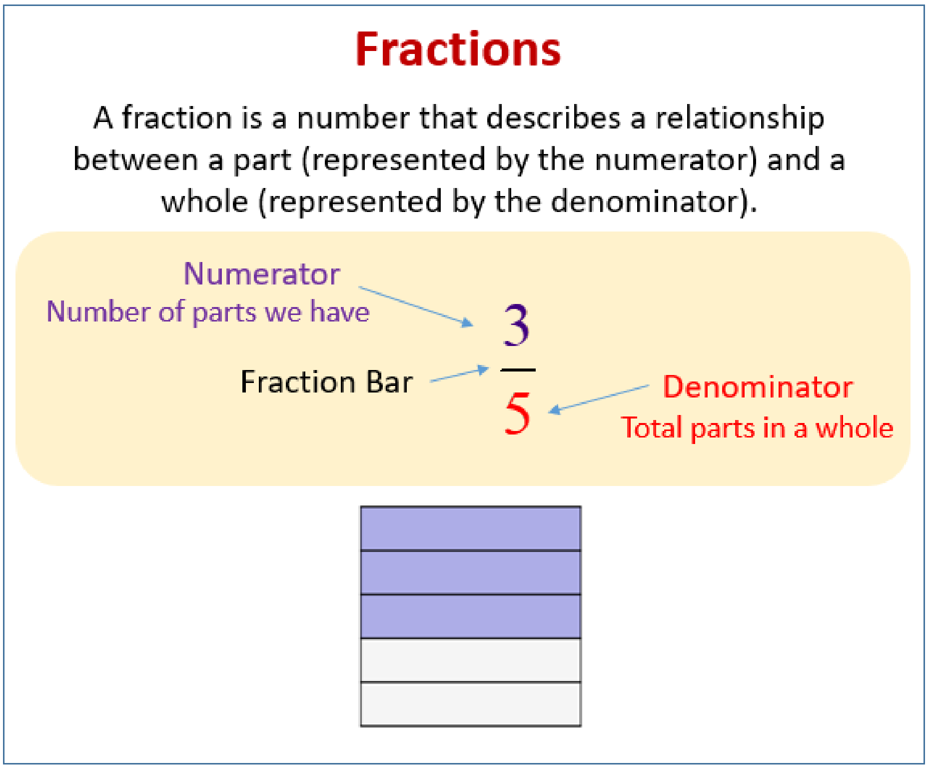
so $4786 + 2850 = 7636$

and $2786 + 3850 = 6636$

and $8636 - 3786 = 4850$

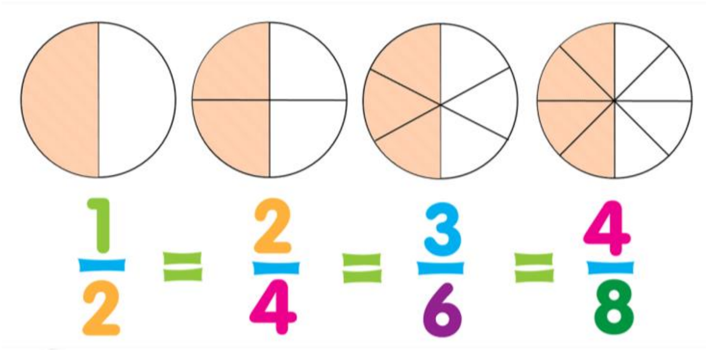
Unit (4 & 3) **Fractions**

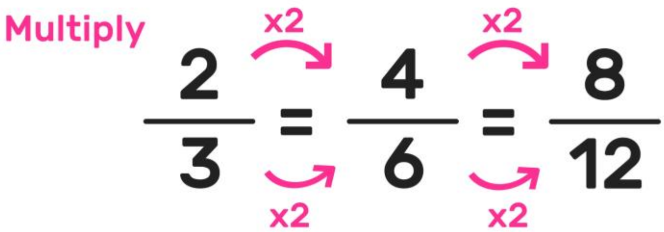
What is a fraction?



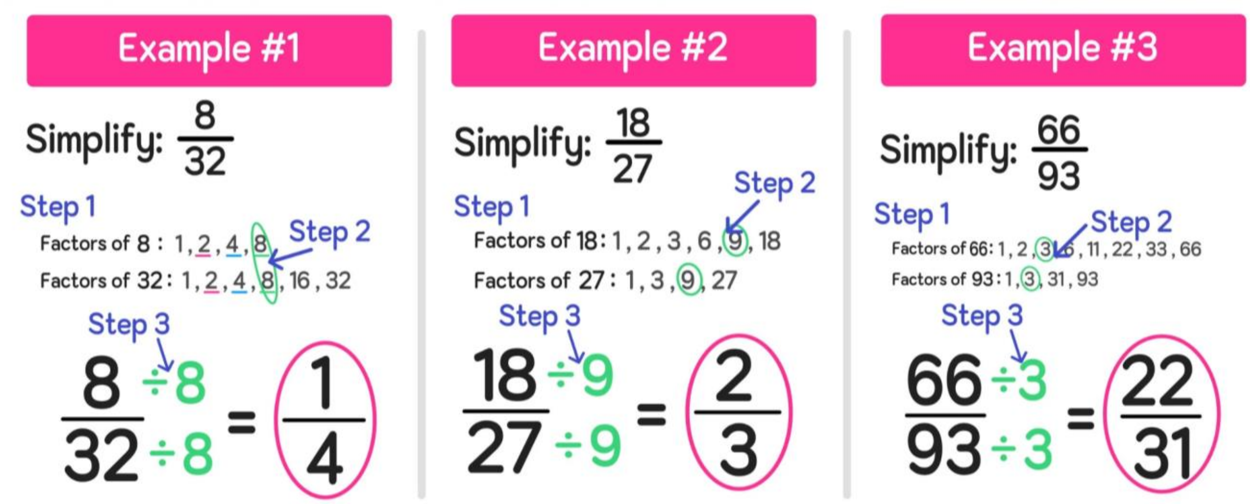
Equivalent fractions

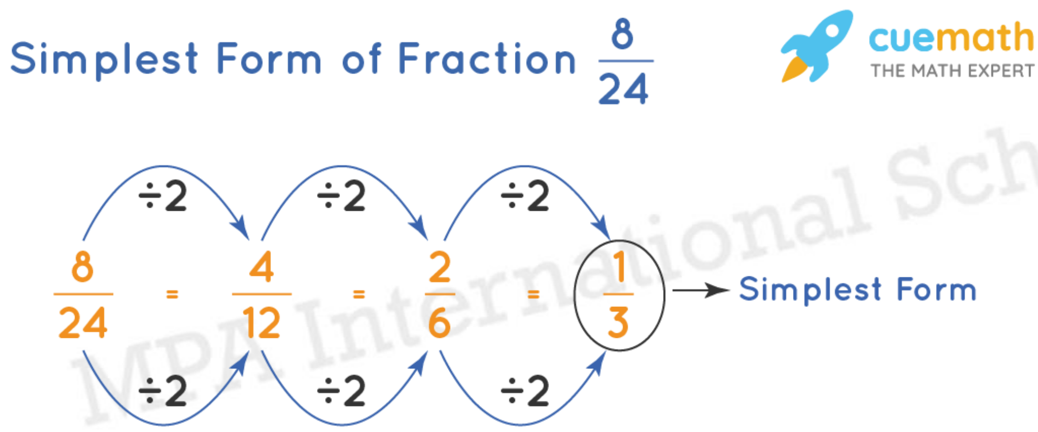
Equivalent fractions are fractions that name the **same amount**.





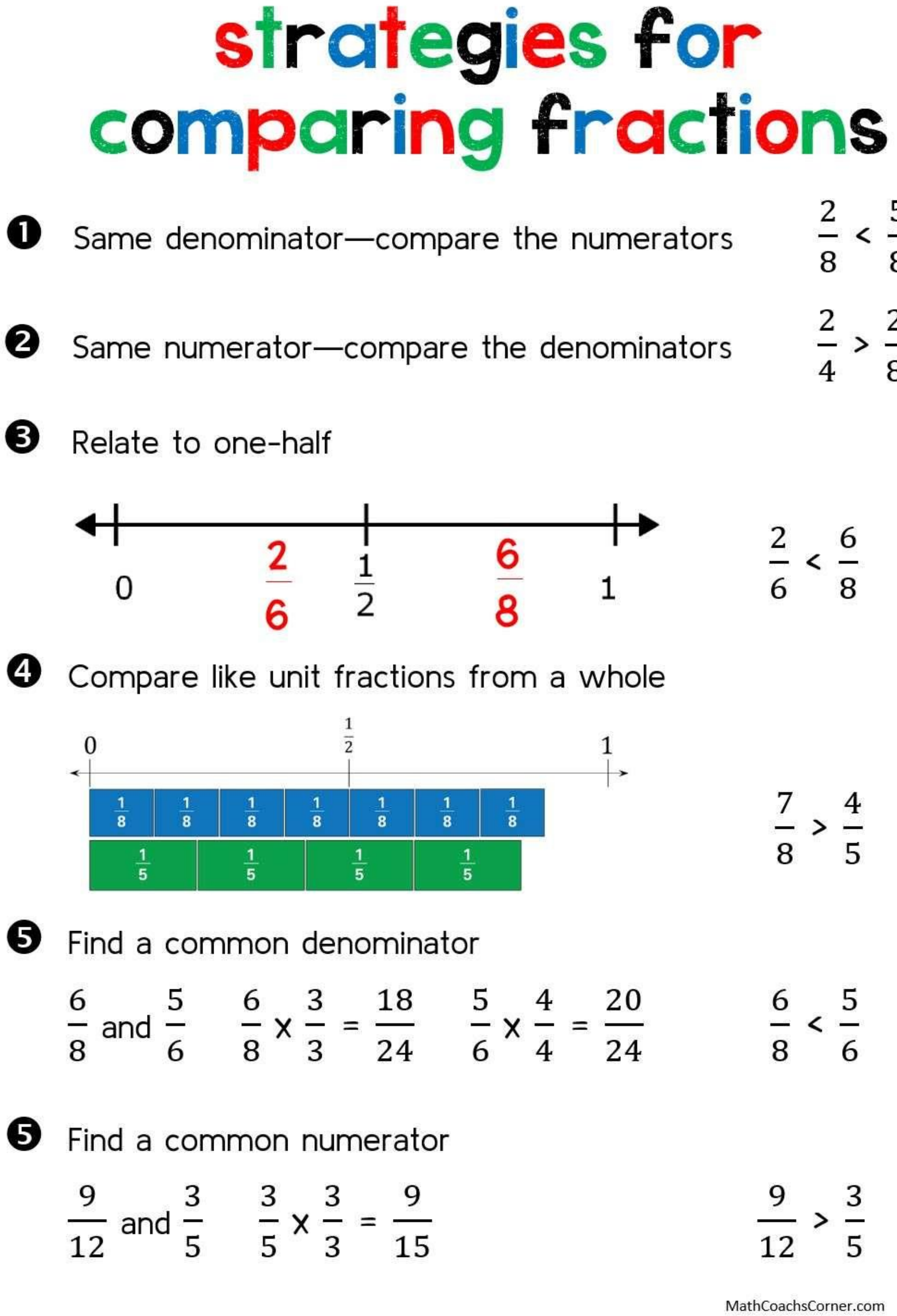
Simplifying fractions





Compare and order fractions

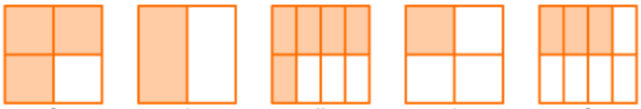
Comparing fractions



Ordering fractions

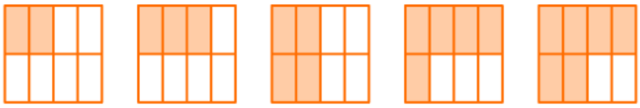
Ordering fractions is arranging a set of fractions from least to greatest (**ascending** order) or from greatest to least (**descending** order).

Example Write the fractions in ascending order.



$\frac{3}{4}$ $\frac{1}{2}$ $\frac{5}{8}$ $\frac{1}{4}$ $\frac{3}{8}$

Find a common denominator and use the size of the numerators to order the fractions.



$\frac{1\times 2}{4\times 2}=\frac{2}{8}$ $\frac{3}{8}$ $\frac{1\times 4}{2\times 4}=\frac{4}{8}$ $\frac{5}{8}$ $\frac{3\times 2}{4\times 2}=\frac{6}{8}$

Rule #1 - If all of the denominators are the same, the fraction with the greatest numerator has the greatest value.

Example:

$\frac{1}{7}$ $\frac{5}{7}$ $\frac{6}{7}$ $\frac{2}{7}$ $\frac{4}{7}$ →

greatest to least

$\frac{6}{7}$ $\frac{5}{7}$ $\frac{4}{7}$ $\frac{2}{7}$ $\frac{1}{7}$

least to greatest

$\frac{1}{7}$ $\frac{2}{7}$ $\frac{4}{7}$ $\frac{5}{7}$ $\frac{6}{7}$

Rule #2 - If all of the numerators are the same, the fraction with the smallest denominator has the greatest value.

Example:

$\frac{3}{5}$ $\frac{3}{4}$ $\frac{3}{7}$ $\frac{3}{9}$ $\frac{3}{6}$ →

greatest to least

$\frac{3}{4}$ $\frac{3}{5}$ $\frac{3}{6}$ $\frac{3}{7}$ $\frac{3}{9}$

least to greatest

$\frac{3}{9}$ $\frac{3}{7}$ $\frac{3}{6}$ $\frac{3}{5}$ $\frac{3}{4}$

Rule #3 - If all the numerators and denominators are different, find the LCD and change the fractions to show the same denominators. $\frac{1}{4}$ $\frac{3}{8}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{7}{8}$

**The LCD of 4, 8, 2, 4, 8 is 8

$\frac{1}{4}\to\frac{2}{8}$, $\frac{3}{8}\to\frac{3}{8}$, $\frac{1}{2}\to\frac{4}{8}$, $\frac{3}{4}\to\frac{6}{8}$, $\frac{7}{8}\to\frac{7}{8}$

greatest to least

$\frac{7}{8}$ $\frac{3}{4}$ $\frac{1}{2}$ $\frac{3}{8}$ $\frac{1}{4}$

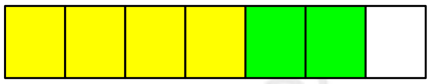
least to greatest

$\frac{1}{4}$ $\frac{3}{8}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{7}{8}$

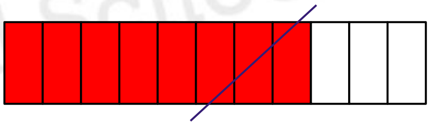
Add and subtract fractions

- ***Same Denominator***

$$\frac{4}{7} \quad + \quad \frac{2}{7} \quad = \quad \frac{6}{7}$$



$$\frac{8}{11} \quad - \quad \frac{3}{11} \quad = \quad \frac{5}{11}$$



- ***Different Denominators***

$$\frac{2}{7} + \frac{3}{5}$$

Multiples of 7: 7, 14, 21, 28, **35**
Multiples of 5: 5, 10, 15, 20, 25, 30, **35**

$$\frac{2}{7} = \frac{10}{35}, \frac{3}{5} = \frac{21}{35}$$

$$\frac{10}{35} + \frac{21}{35} = \frac{31}{35}$$

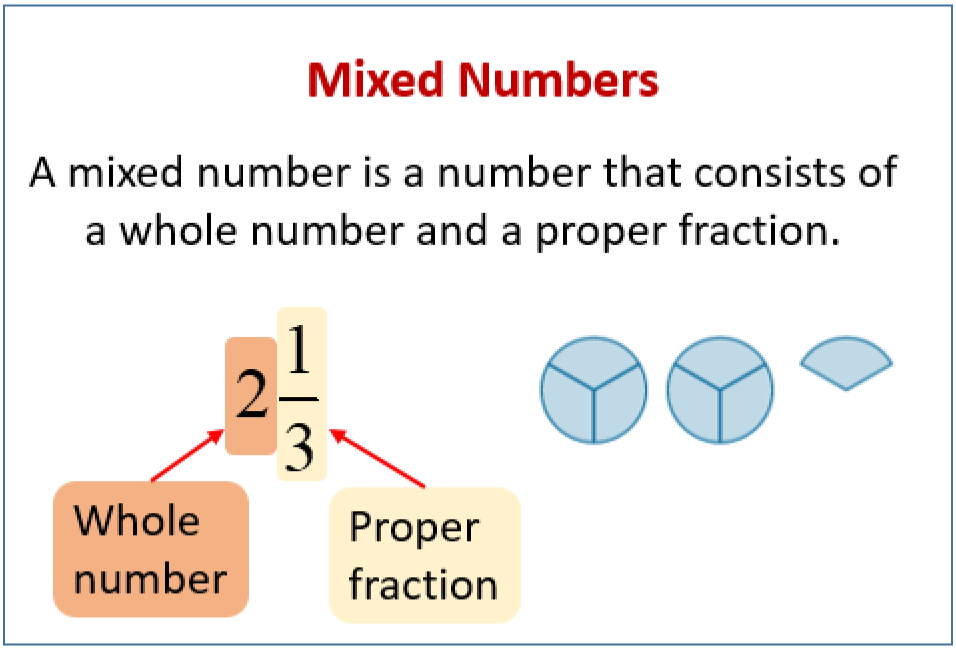
$$\frac{9}{10} - \frac{1}{4}$$

Multiples of 10: 10, **20**
Multiples of 4: 4, 8, 12, 16, **20**

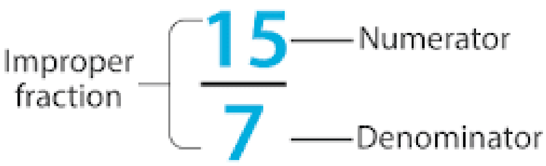
$$\frac{9}{10} = \frac{18}{20}, \frac{1}{4} = \frac{5}{20}$$

$$\frac{18}{20} - \frac{5}{20} = \frac{13}{20}$$

What are Mixed numbers?



How to convert improper fractions into mixed numbers?



Step 1: Divide the numerator with the denominator

$$15 \div 7 = 2 \text{ R } 1$$

Step : 2 Assemble the mixed fraction

$$\frac{15}{7} = 2\frac{1}{7}$$

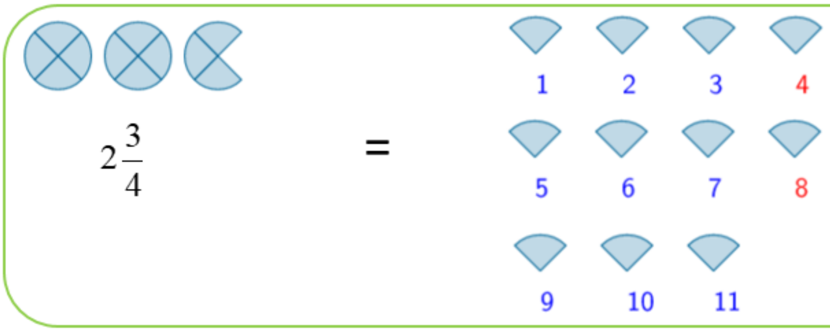
$$\frac{15}{7} = 2\frac{1}{7}$$ ← Mixed number

Mixed numbers into improper fractions

Mixed Number to Improper Fraction

$$2\frac{3}{4} = \frac{(4 \times 2) + 3}{4} = \frac{8+3}{4} = \frac{11}{4}$$

Mixed Number — Improper Fraction



$$2\frac{3}{4} = \frac{11}{4}$$

Add two mixed numbers

- ❖ Add or subtract the whole numbers and fractions separately

$2\frac{2}{5} + 1\frac{3}{10}$

Add the wholes: 2 + 1 = 3

Add the parts:

$\frac{2}{5} + \frac{3}{10} = \frac{4}{10} + \frac{3}{10} = \frac{7}{10}$

$3 + \frac{7}{10} = 3\frac{7}{10}$

$2\frac{1}{2} - 1\frac{1}{4}$

Subtract the wholes: 2 - 1 = 1

Subtract the parts:

$\frac{1}{2} - \frac{1}{4} = \frac{2}{4} - \frac{1}{4} = \frac{1}{4}$

$1 + \frac{1}{4} = 1\frac{1}{4}$

- ❖ Convert the mixed numbers to improper fractions

$2\frac{2}{5} + 1\frac{3}{10}$

$2\frac{2}{5} = \frac{12}{5}$ $\quad 1\frac{3}{10} = \frac{13}{10}$

$\frac{12}{5} + \frac{13}{10} = \frac{24}{10} + \frac{13}{10} = \frac{37}{10}$

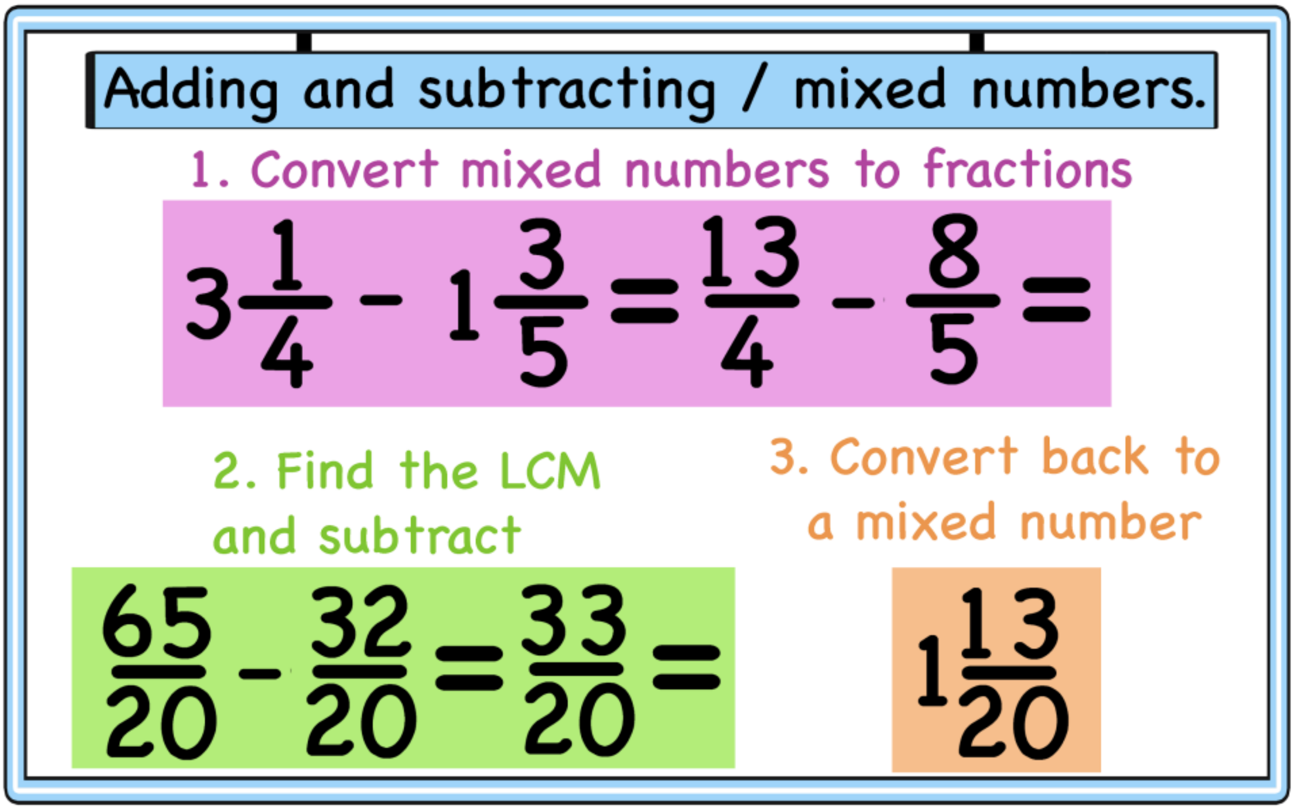
$\frac{37}{10} = 3\frac{7}{10}$

$2\frac{1}{2} - 1\frac{1}{4}$

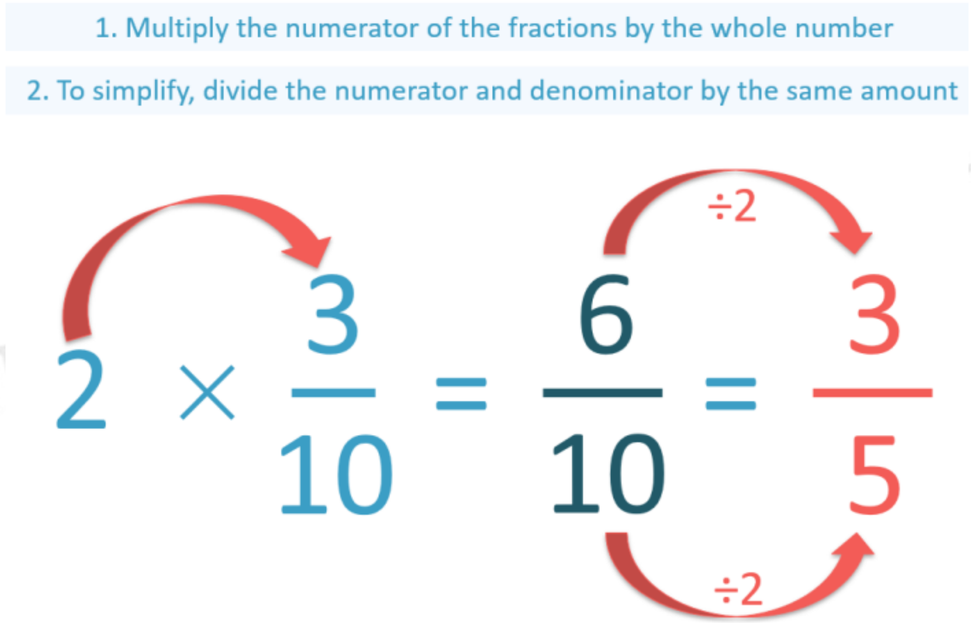
$2\frac{1}{2} = \frac{5}{2}$ $\quad 1\frac{1}{4} = \frac{5}{4}$

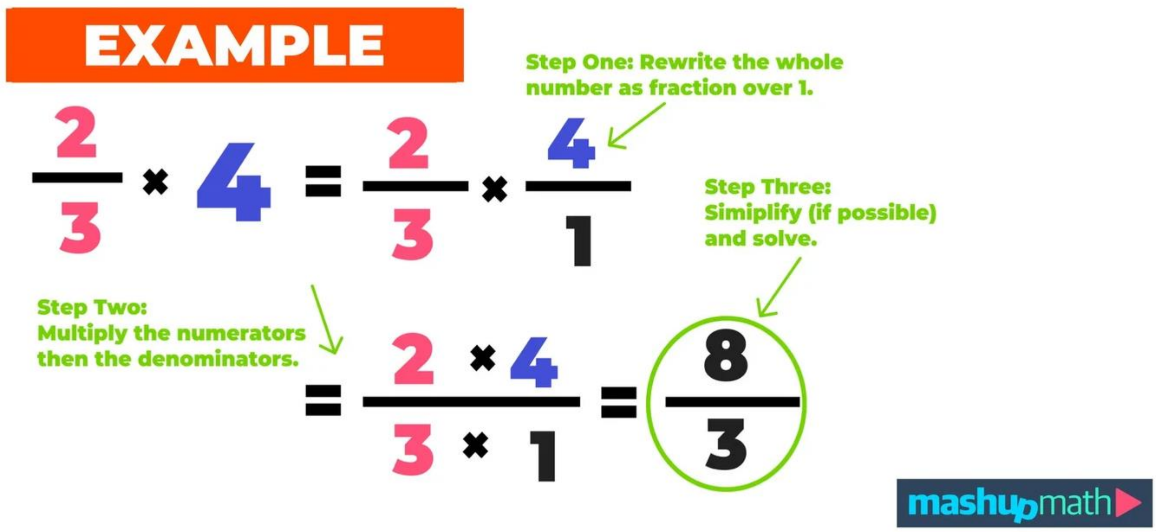
$\frac{5}{2} - \frac{5}{4} = \frac{10}{4} - \frac{5}{4} = \frac{5}{4}$

$\frac{5}{4} = 1\frac{1}{4}$

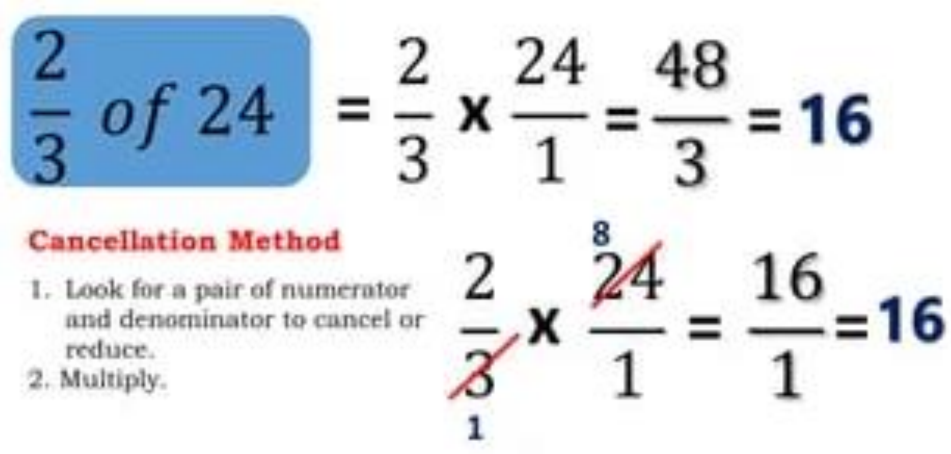


Multiply fractions by integers





Cancellation method



Multiply fractions by fractions

Multiply: $\frac{1}{3} \times \frac{3}{5}$

Step-1:

$$\frac{1 \times 3}{3 \times 5} = \frac{3}{15}$$

Step-2:

$$\frac{\cancel{3}\ ^{1}}{\cancel{15}\ 5} = \frac{1}{5}$$

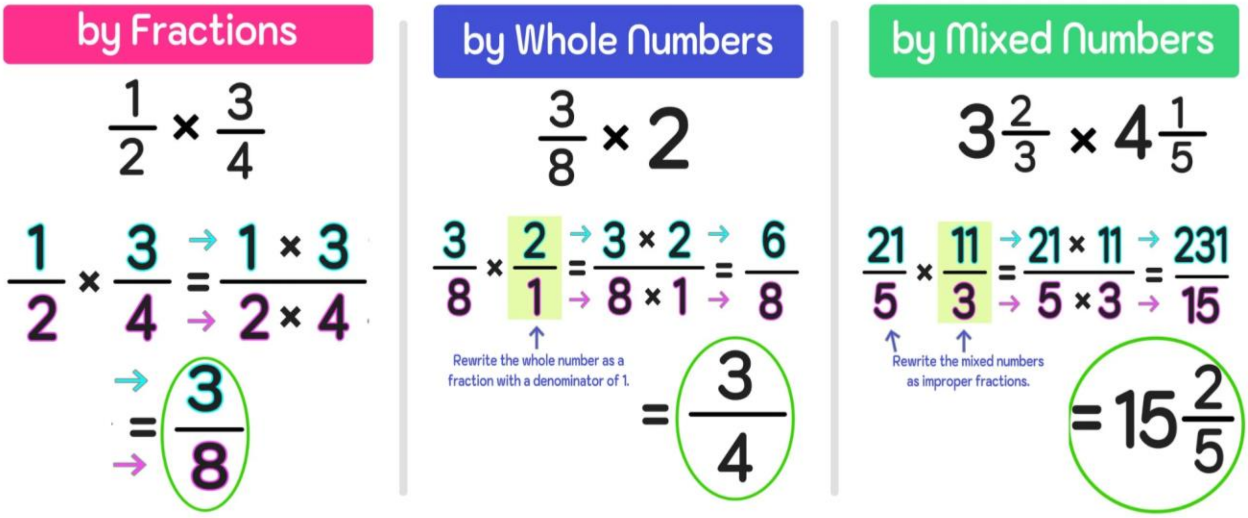
$$\therefore \frac{1}{3} \times \frac{3}{5} = \frac{1}{5}$$

fraction multiplying with cancelling

$$\frac{{}^{4}\cancel{8}}{{}_{1}\cancel{9}} \times \frac{\cancel{9}^{1}}{\cancel{10}_{5}}$$

$$\frac{{}^{2}\cancel{6}}{{}_{1}\cancel{7}} \times \frac{\cancel{14}^{2}}{\cancel{15}_{5}}$$

$$\frac{{}^{1}\cancel{5}}{{}_{1}\cancel{6}} \times \frac{\cancel{24}^{4}}{\cancel{25}_{5}}$$



Divide a fraction by an integer

Remember:

K Keep the first number the same.

F Flip the second number. (upside down)

C Convert division sign into multiplication sign.

Divide Whole Number by Fraction

$$5 \div \frac{2}{3}$$

$$= \frac{5}{1} \div \frac{2}{3}$$

Rewrite the whole number as a fraction with a denominator of 1.

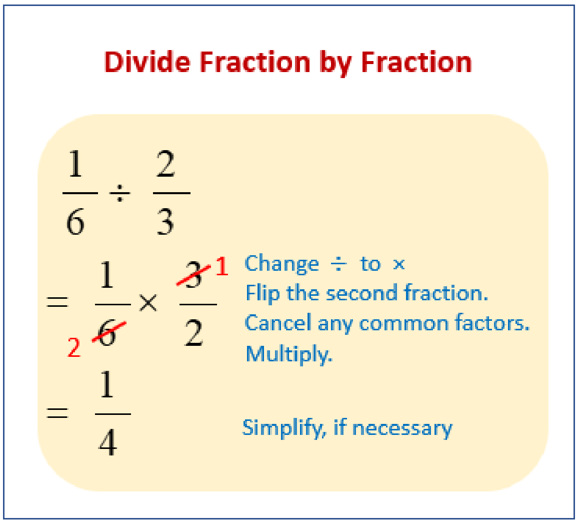
$$= \frac{5}{1} \times \frac{3}{2}$$

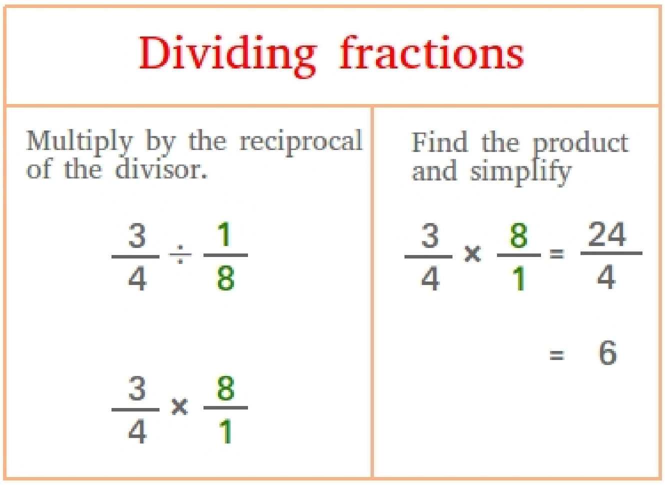
Change ÷ to ×
Flip the second fraction.
Cancel any common factors.
Multiply.

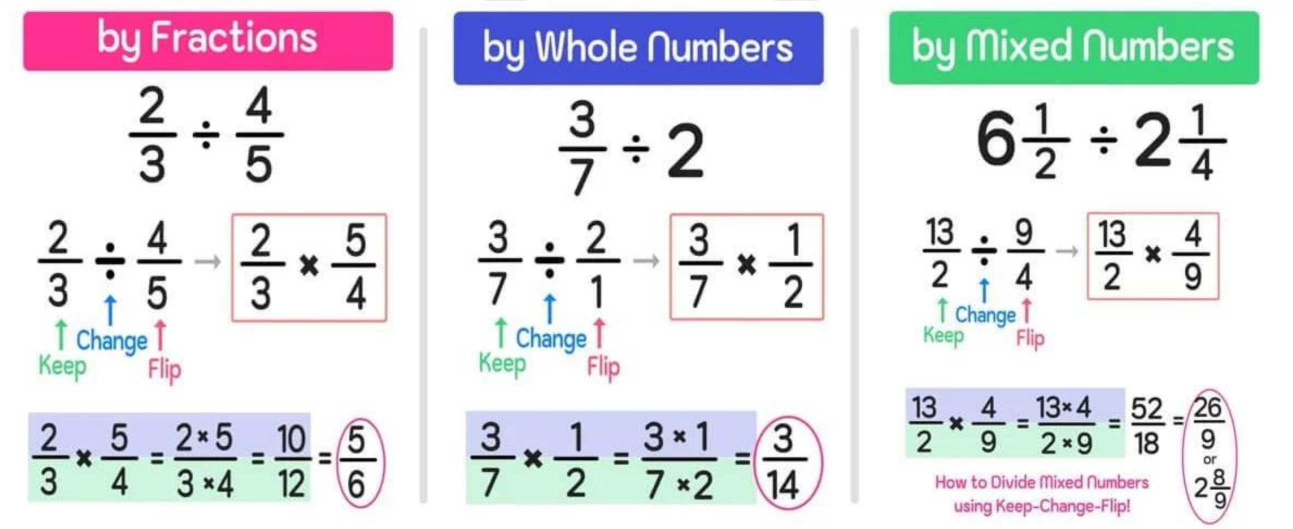
$$= \frac{15}{2} = 7\frac{1}{2}$$

Change to mixed number, if necessary

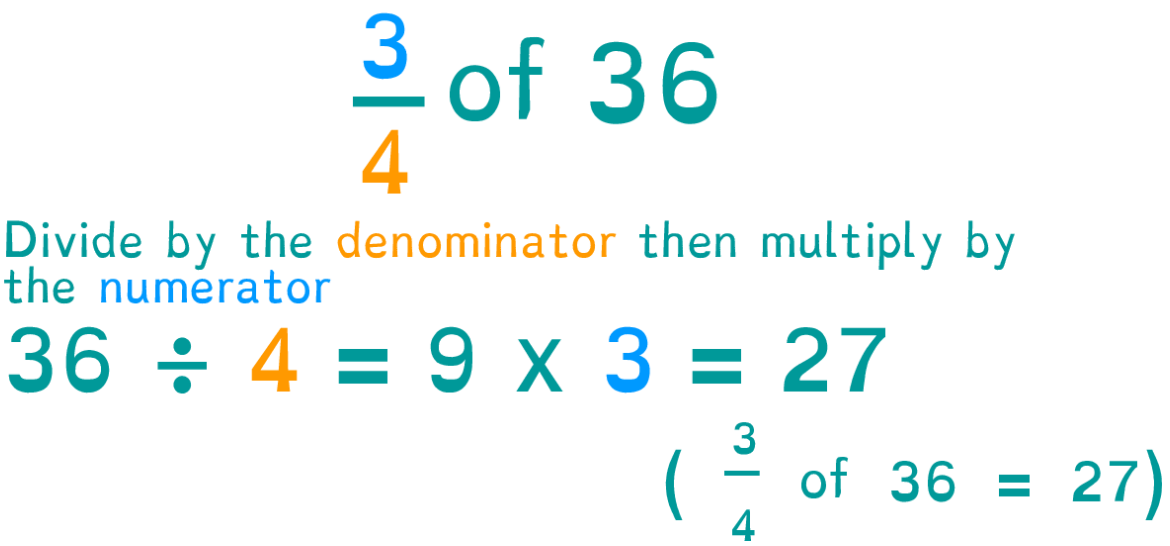
Divide a fraction by a fraction

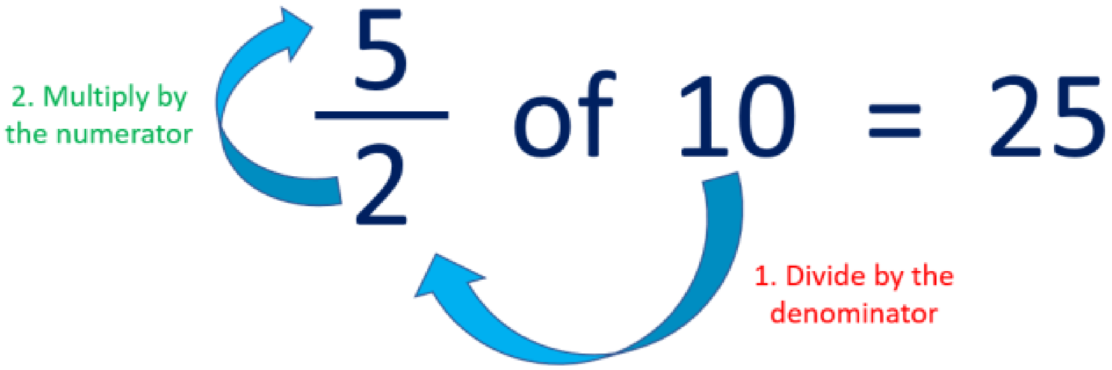






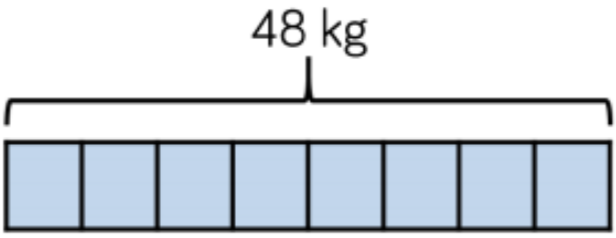
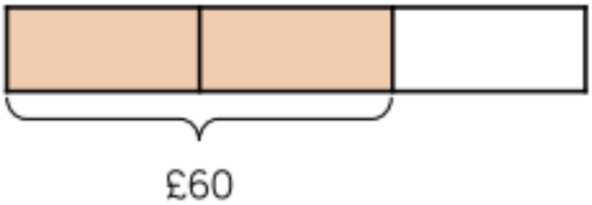
Fraction of an amount





$10 \div 2 = 5$

$5 \times 5 = 25$

Fraction of an amount	Find the whole
Find 5/8 of 48kg  1/8 of 48kg = 48 ÷ 8 = 6kg 5/8 = 6 x 5 = 30kg	**Jack has spent 2/3 of his money. He spent £60, how much money did he start with?**  2/3 = £60 so 1/3 = £30 £60 + £30 = £90 / £30 x 3 = £90

Unit (6) ***Measure - imperial and metric measures***

Measurement in the metric system

Mass: Measure how **heavy** something is.

Eg, My school bag weighs 3 kg.

Mass is measured in **grams** (**g**), **kilograms** (**kg**)

Length: Measure the **distance** between 2 points

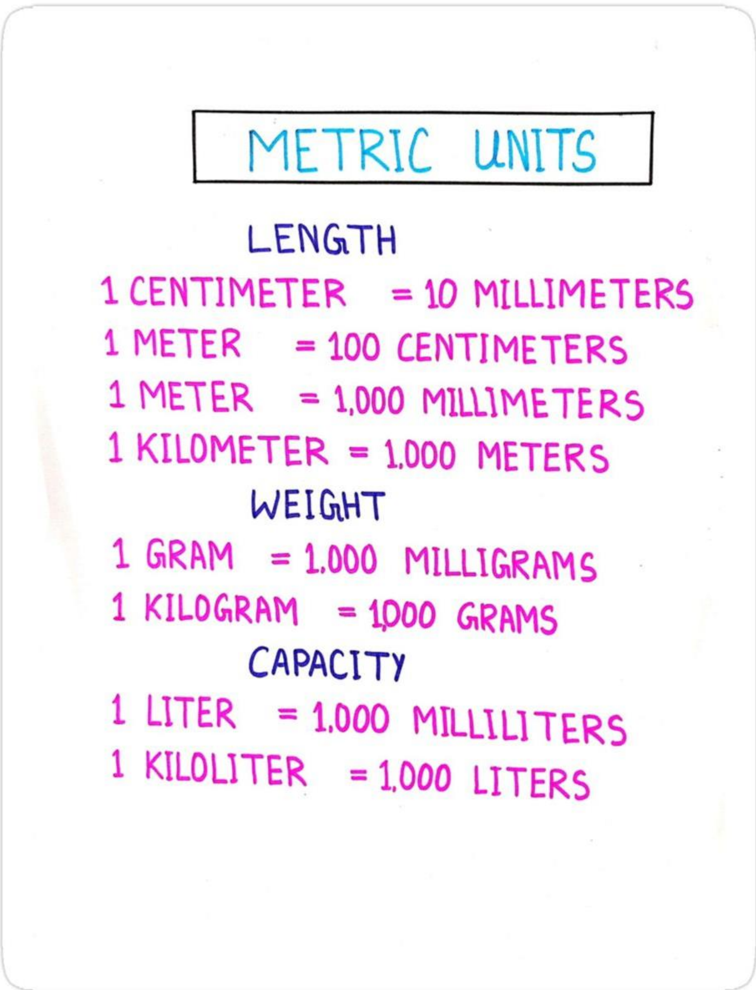
Eg, My pencil is 1 metre long.

Length is measured in **millimetres** (**mm**), **centimetres** (**cm**), **metres** (**m**), and **kilometres** (**km**).

Capacity: Measure the amount something can **contain**.

Eg, I drink 200 ml of milk every day.

Capacity is measured in **millilitres** (**ml**) and **litres** (**l**).



Convert metric measures

Length

1000 m = 1km

100 cm = 1m

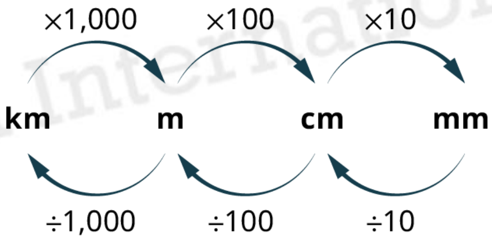
10mm = 1cm

$\frac{1}{2}$m = 0.5m = 50cm

$\frac{1}{4}$m = 0.25m = 25cm

$\frac{3}{4}$m = 0.75m = 75cm

$\frac{1}{10}$m = 0.01m = 10cm



Mass

1 tonne = 1000 kg

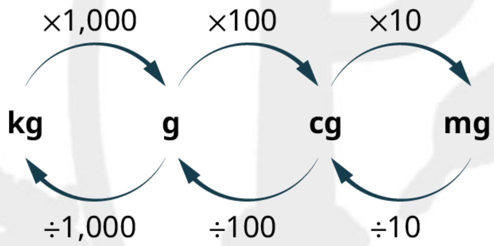
1000g = 1 kg

$\frac{1}{10}$ kg = 0.1 kg = 100g

$\frac{1}{4}$ kg = 0.25 kg = 250g

$\frac{1}{2}$ kg = 0.5 kg = 500g

$\frac{3}{4}$ kg = 0.75 kg = 750g



Capacity

1000 ml = 1l

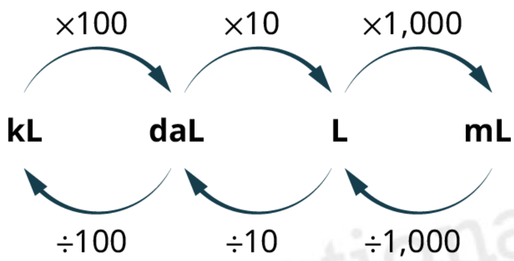
$\frac{1}{10}$l = 0.1l = 100ml

$\frac{1}{4}$l = 0.25l = 250ml

$\frac{1}{2}$l = 0.5l = 500ml

$\frac{3}{4}$l = 0.75l = 750ml

$\frac{1}{100}$l = 0.01l = 10ml



Miles and kilometres

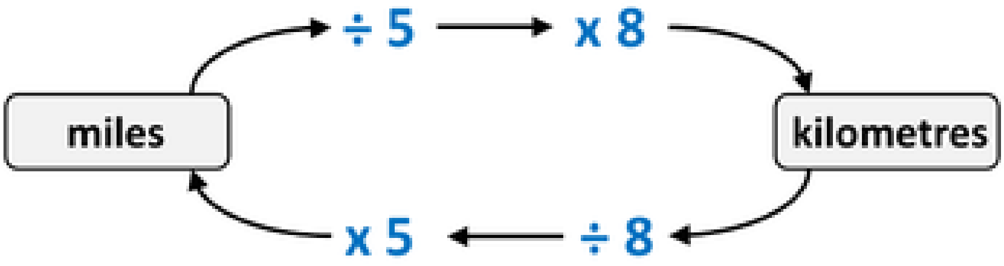
1 mile = 1.609 kilometres

This is made simpler using the following method of conversion

5 miles ≈ 8 kilometres

(the ≈ symbol means approximately)

How to convert between miles and kilometres



Examples

15 miles ≈ 24 kilometres
÷ 5 x 8

48 kilometres ≈ 30 miles
÷ 8 x 5

Trickier Examples!

With these you may need to use a formal method for division and/or multiplication

12 miles

12 ÷ 5 = 2.4

2.4 x 8 = **19.2 km**

15 km

15 ÷ 8 = 1.875

1.875 x 5 = **9.375 miles**

Convert metric and imperial measures

Metric	Imperial
Millimetres Centimetres Metres Kilometres Milligrams Grams Kilograms tonnes Millilitres Litres	Inch Yard Foot / feet Acre Ounce pounds Stone Pint gallon

	Metric	Imperial
Lenght 	Millimeter (mm) Centimeter (cm) Meter (m) Kilometer (km)	Inch (in) Foot (ft) Yard (yd) Mile (mi)
Weight 	Milligram (mg) Gram (g) Kilogram (kg) Metric Ton (t)	Ounce (oz) Pound (lb) Stone (st)
Volume 	Milliliter (ml) Liter (L)	Pint (pt) Quart (qt) Gallon (gal)

Length	Mass	Capacity
1 inch = 2.5cm 1 foot = 30cm 1 mile = 1.6km 5 miles = 8km	16 ounces = 1 pound 1 ounce = 25g 1 pound = 450g 2.2 pounds = 1kg	8 pints = 1 gallon 1 gallon = 4.5 litres 1 pint = 570ml

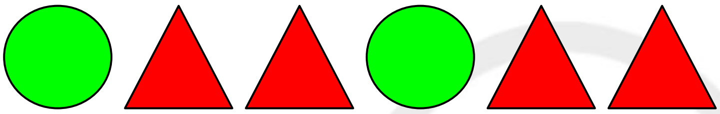
Unit (7) ***Ratio and proportion***

Key Vocabulary

❖ Ratio ❖ Proportion ❖ “For every …… there are…..” ❖ Part ❖ Whole	❖ Scale factor ❖ Enlargement ❖ Similar shapes ❖ Length ❖ Width ❖ perimeter

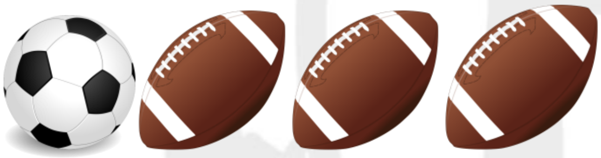
Ratio Language

- For every 1 circle, there are 2 triangles.

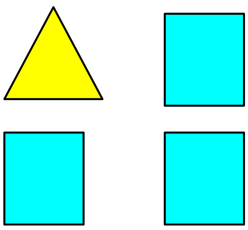


- For every 2 bananas, there are 3 apples.

- For every 1 football, there are 3 rugby balls.

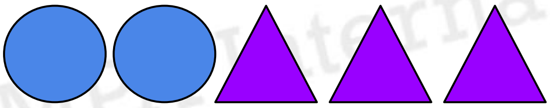


Ratios and Fractions

	For every 1 rugby ball, there are 2 footballs. Ratio of rugby balls to footballs 1 : 2 $\frac{1}{3}$ of the balls are rugballs.
	For every 1 triangle, there are 3 squares. Ratio of triangles to squares 1 : 3 $\frac{1}{4}$ of the shapes are triangles.

The Ratio Symbol

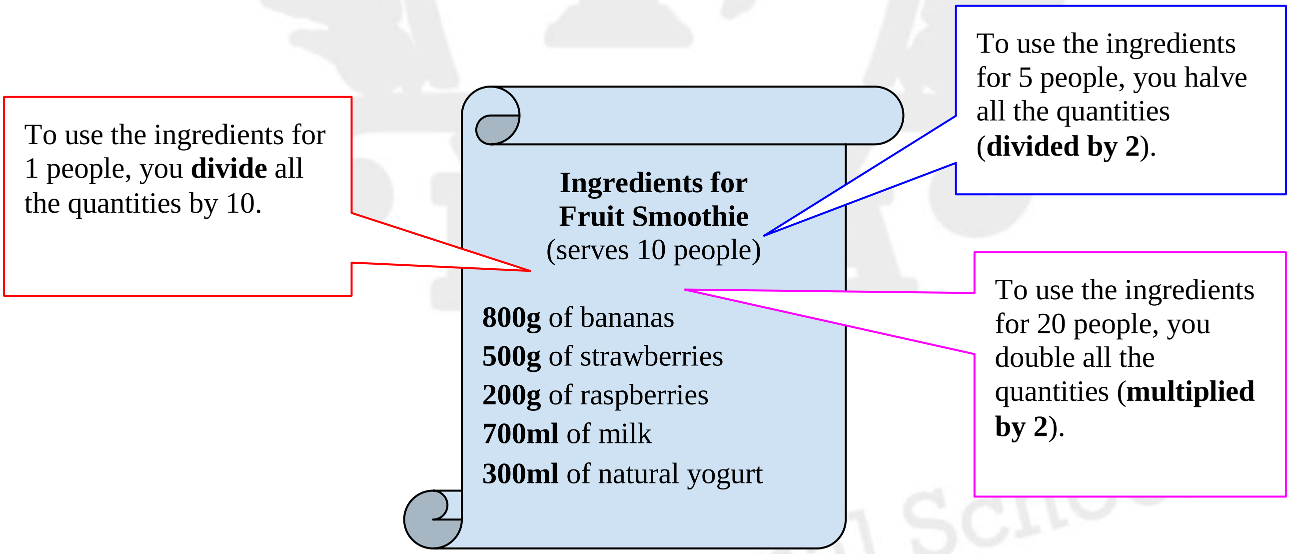
The ratio of footballs to rugby balls; 1 : 4
The ratio of rugby balls to footballs; 4 : 1



The ratio of circles to triangles; 2 : 3
The ratio of triangles to circles; 3 : 2

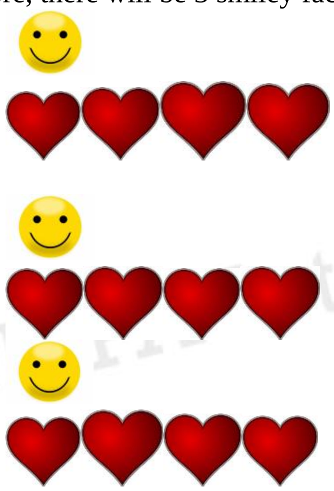
The ratio of apples to bananas; 1 : 2
The ratio of bananas to oranges; 2 : 3
The ratio of apples to bananas to oranges; 1 : 2 : 3
The ratio of oranges to bananas to apples; 3 : 2 : 1

Ratio and Proportion Problem-Solving



In a bag of 15 sweets, there is 1 smiley face sweet for every 4 love heart sweets.

Therefore, there will be 3 smiley face sweets and 12 love heart sweets in the bag.



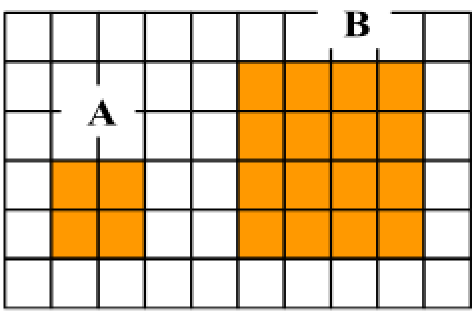
— 5

— 5

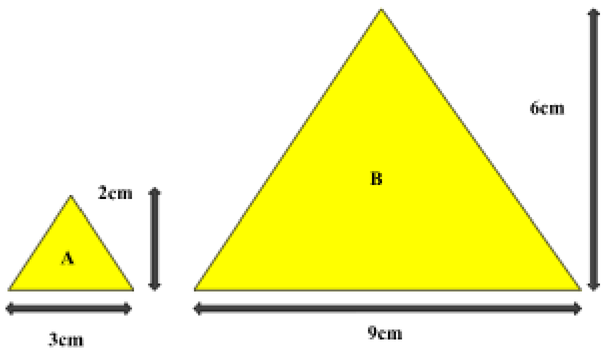
— 5

Scale Factor

- Shape A has been enlarged by a scale factor of 2 to make Shape B.
- Shape B is now two times as big as Shape A.



- Shape B has been enlarged from Shape A by a scale factor 3.
- Shape B is now three times as big as Shape A.



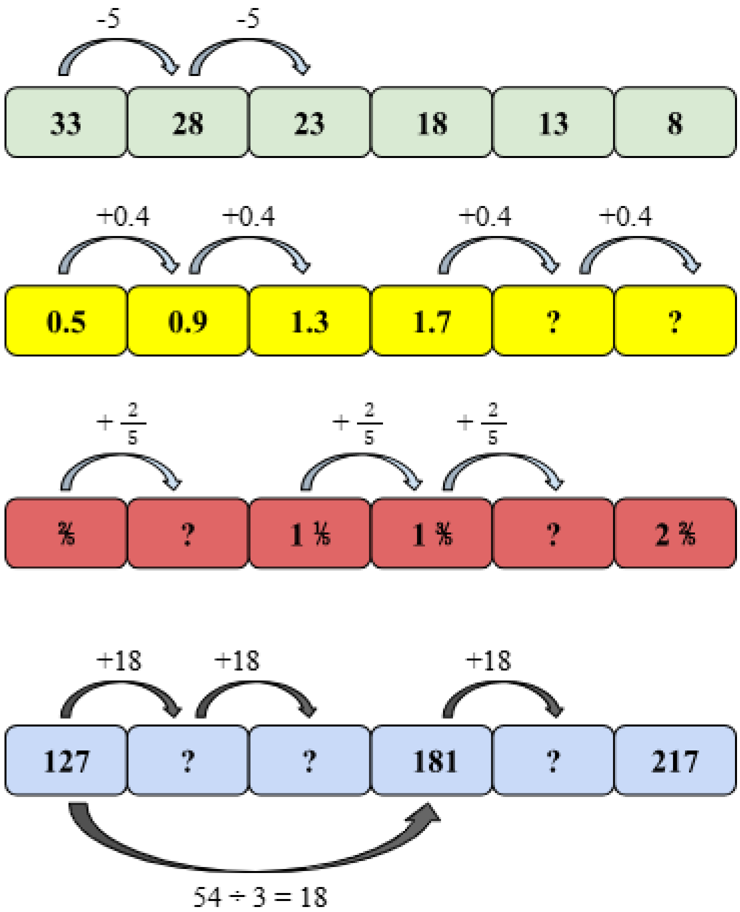
Unit (8) ***Algebra***

Key Vocabulary

❖ Term-to-term rule	❖ One-step equation
❖ Unknown	❖ Two-step equation
❖ Expression	❖ Substitution
❖ Equation	❖ Pairs of unknowns
❖ Formula	❖ Enumerate

Linear Number Sequence

- A linear number sequence is a sequence where each value **increases** or **decreases** by the **same amount** each time.
- Each number in a linear sequence is called a **term**.
- The constant change between each number is called the **term-to-term rule**.
- To identify the term-to-term rule, find the **difference** between two adjacent terms.
- When you know the term-to-term rule, you can use it to find the next number in the sequence.
- It can also be used to find missing numbers within a sequence.



Forming Expressions

An **expression** is a group of numbers, letters and operation symbols.

- Add 14 to a	$a + 14$
- Subtract 20 from b	$b - 20$
- Multiply c by 4	$4c$
- 12 more than d	$d + 12$
- Multiply e by 3 subtract 5	$3e - 5$
- Add 12 to f and then multiply by 2	$2(f - 12)$

$a + 14 = 20$

$b - 20 = 15$

$4c = 28$

$d + 12 = 30$

$3e - 5 = 10$

$2(f - 12) = 44$

An equation is a number statement with an equal sign (=). Expressions on either side of the equal sign are of equal value.

Formulas / Formulae

(The word formula has two possible plural forms, formulae and formulas.)

A formula is a special type of equation that shows the relationship between different substituted variables. Formulas are often used in geometry to find area and volume.

Area of triangle = (base × height) ÷ 2

Area of rectangle = length × width

(12.5 × hours worked) + 25 = cost of job

Equations with Pairs of Unknowns

In an equation with two unknown numbers, there may be several possible values for the unknowns that will balance the equation.

ab = 18

a	b
1	18
2	9
3	6
6	3
9	2
18	1

2a + b = 10

a	b
2	6
3	4
4	2
5	0

Enumerating Possibilities

Enumerating means making a complete list of answers to a problem.

- Use a system for finding the possibilities.
- Organise your findings in an ordered list or table.
- Have a way of deciding when all possibilities have been found.

There are four ice cream flavours.



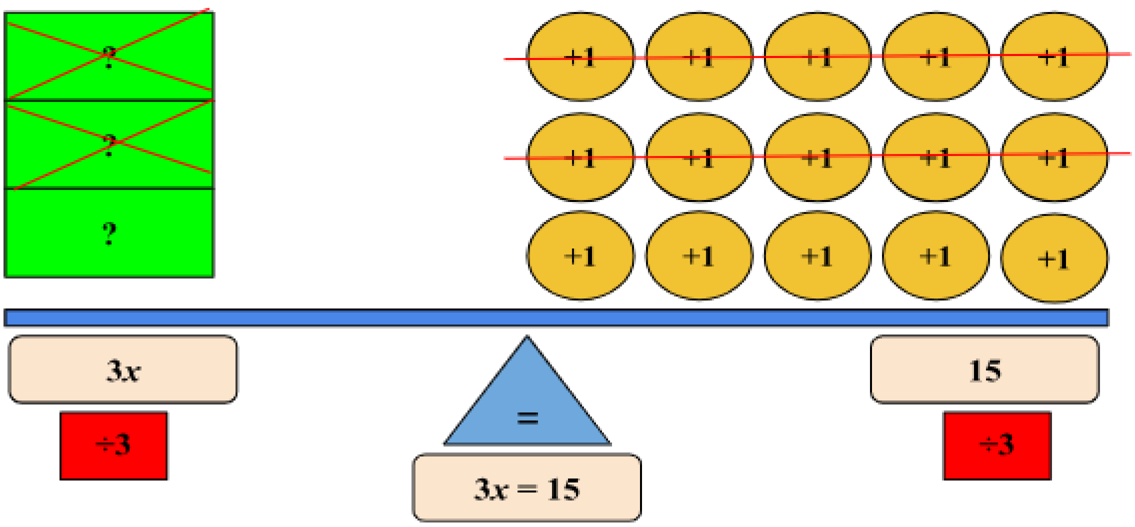

Two scoops of two different flavours give six possible combinations.

❖ Strawberry and green tea	❖ Green tea and chocolate
❖ Strawberry and chocolate	❖ Green tea and mint
❖ Strawberry and mint	❖ Chocolate and mint

Solving One-Step Equations

- In algebra, missing numbers in equations are represented by letters.
- Any letter can be used, but often the letter ***x*** is used.
- An algebraic ***x*** is written to look different from a normal letter x to avoid confusion.

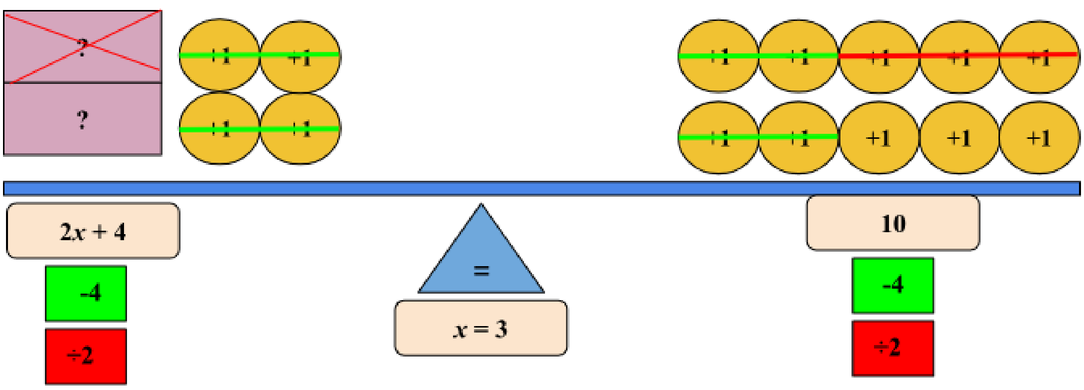
$3x = 15$



Solving Two-Step Equations

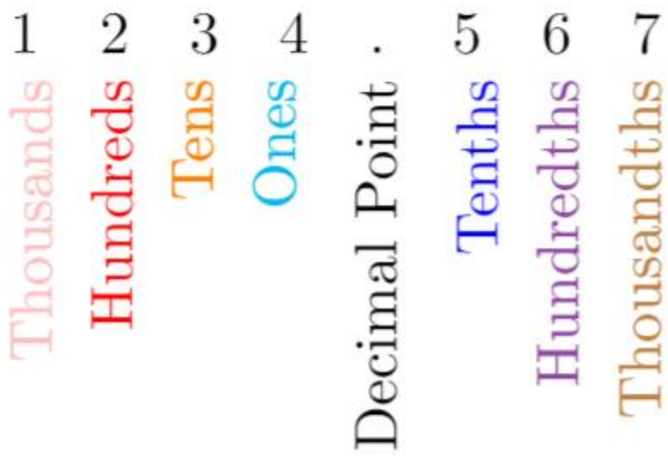
- The multiplication sign is not used in algebra to avoid confusing it with the algebraic ***x*** used to show a missing number.
- Inverse operations are used to isolate the letter on one side of the equation.

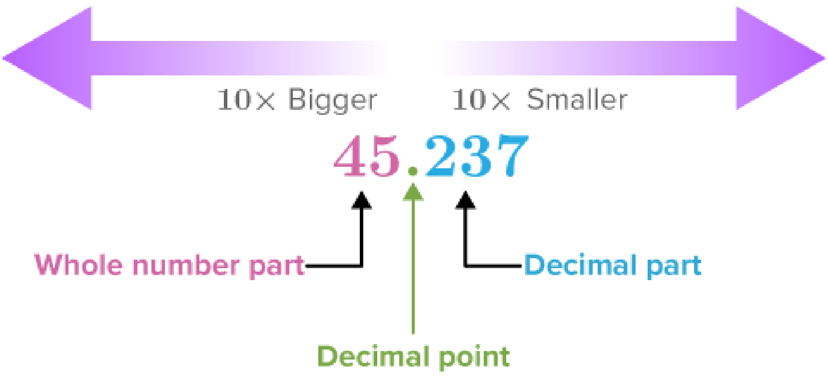
$2x + 4 = 10$

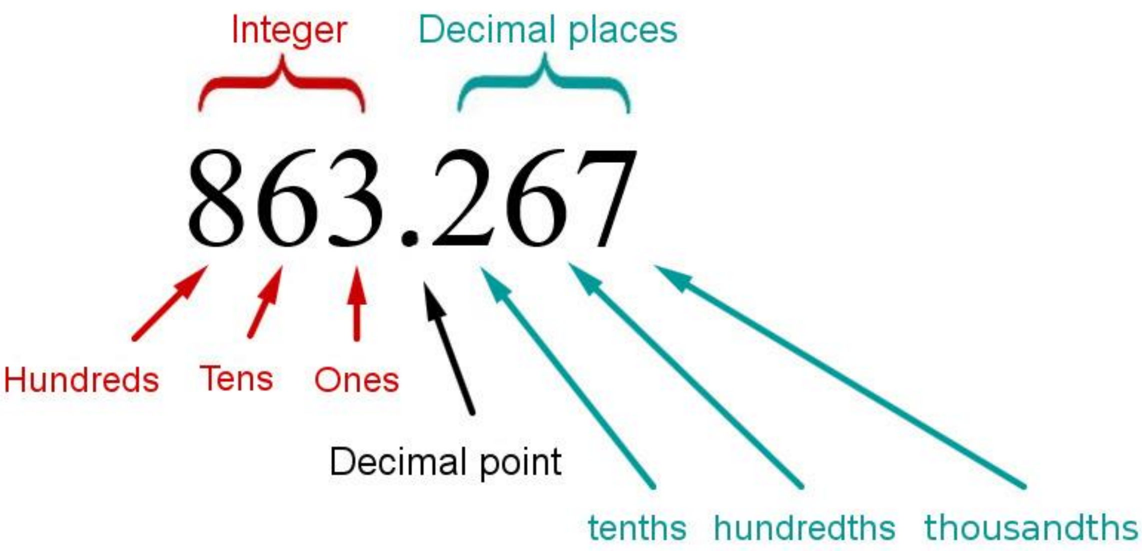


Unit (9) ***Decimals***

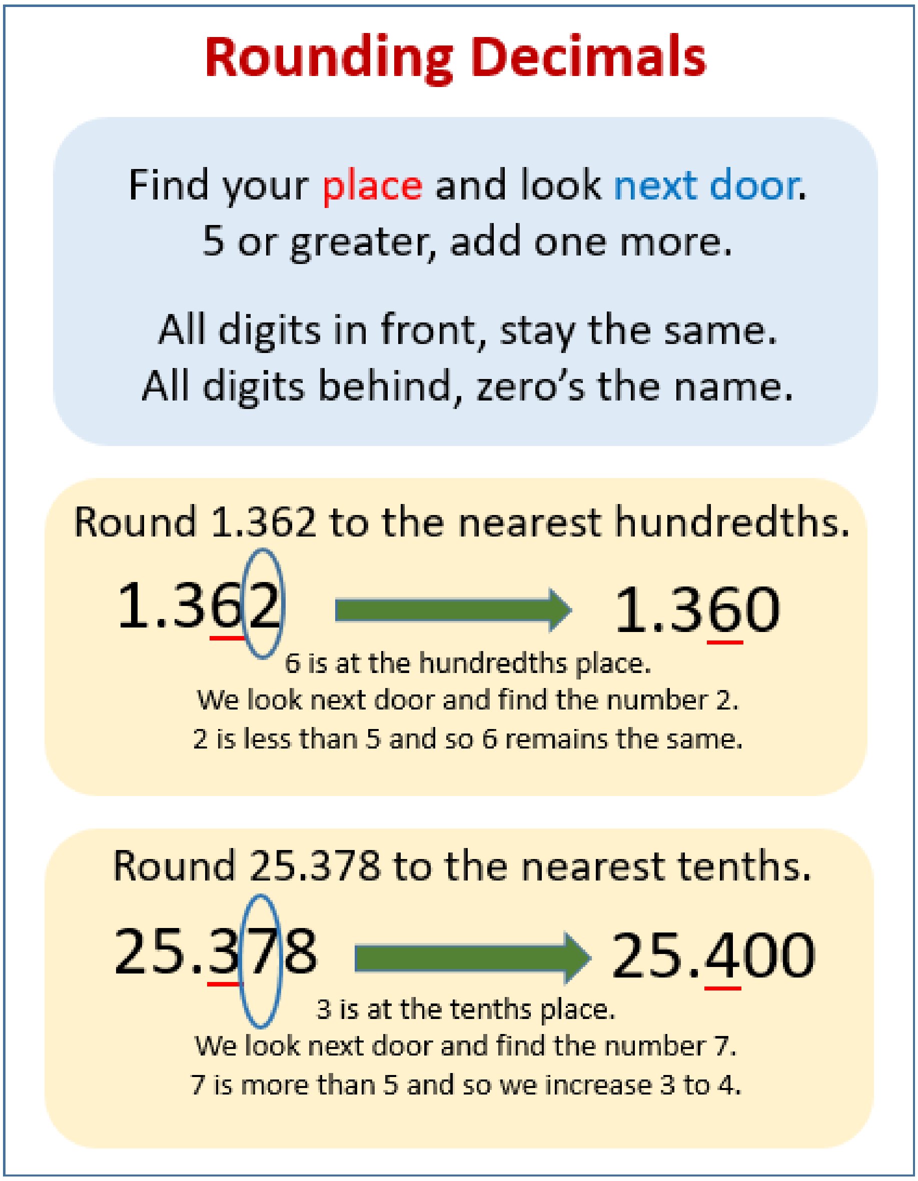
Decimal place value extends our understanding of place value to decimal numbers. Decimal place are the digits to the right of the decimal point. Place value helps us understand the value of each digit in a number.

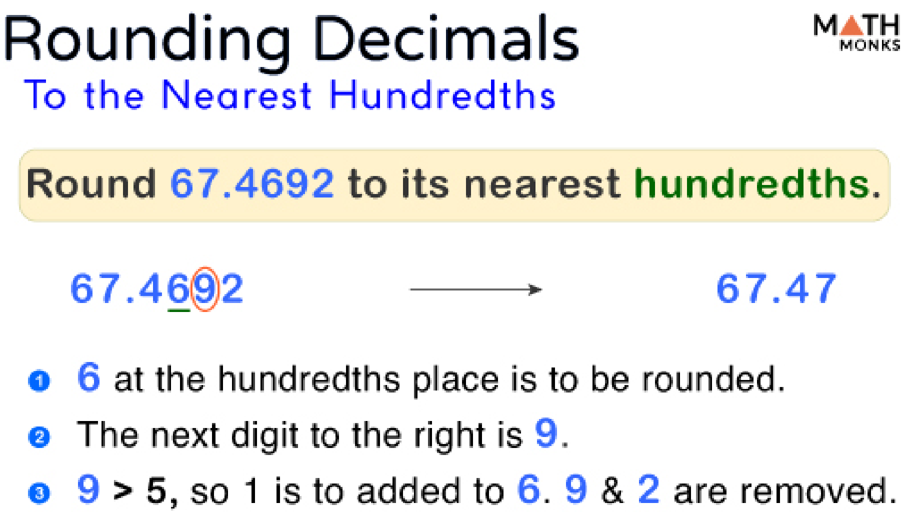




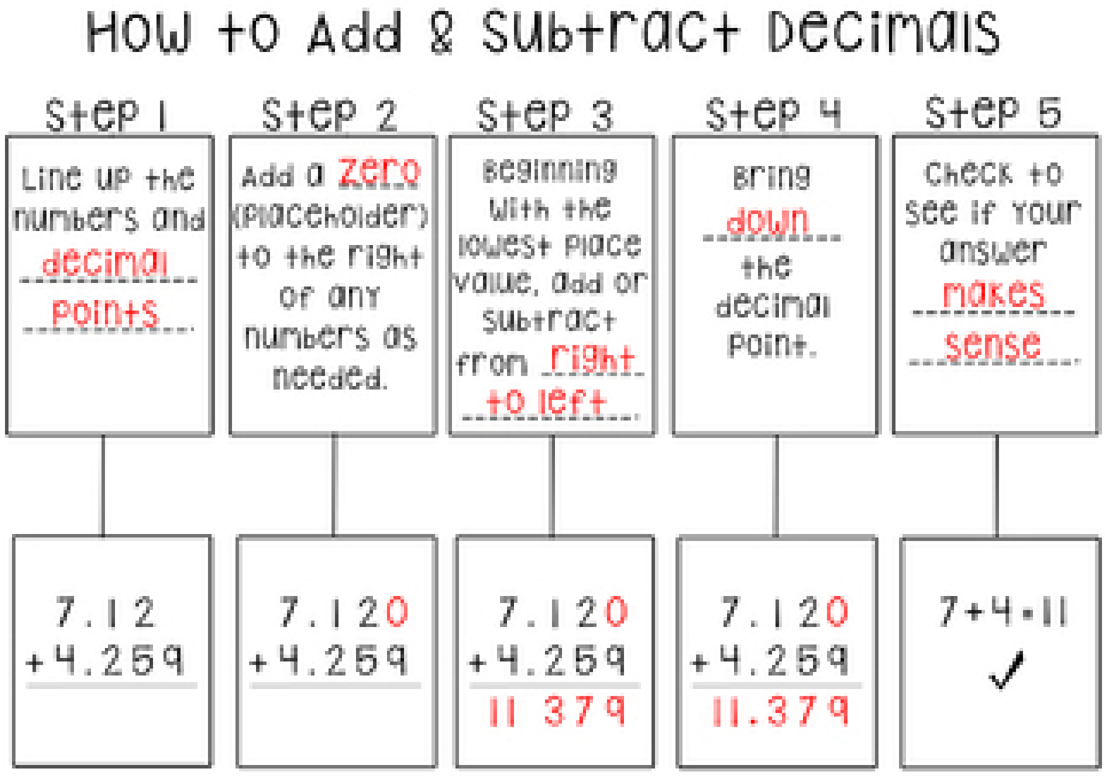


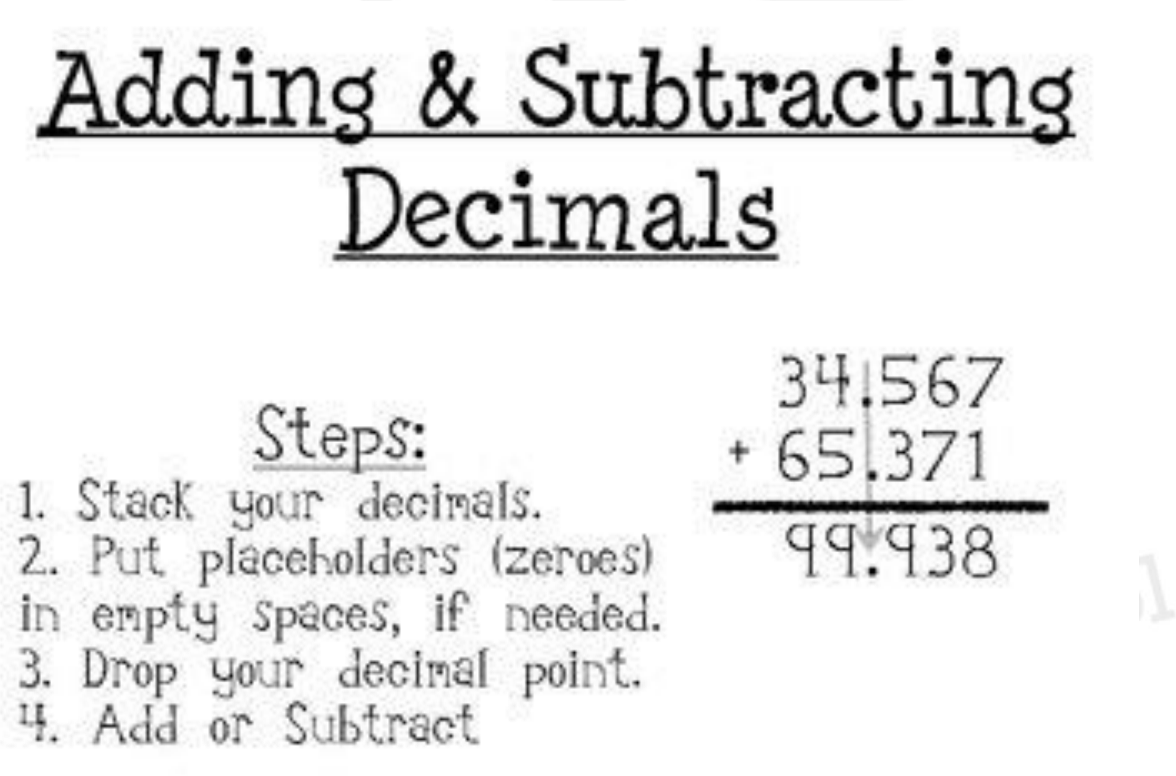
Rounding decimals





Add or subtract decimals

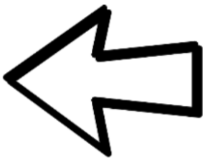




Multiply by 10, 100, and 1000

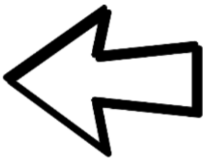
Multiplying by 10

When multiplying by 10, the number gets 10 times bigger. Move each digit 1 place to the left.



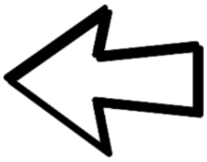
Multiplying by 100

When multiplying by 100, the number gets 100 times bigger. Move each digit 2 places to the left.



Multiplying by 1000

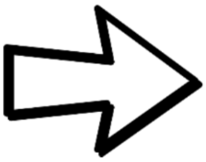
When multiplying by 1000, the number gets 1000 times bigger.
Move each digit 3 places to the left.



Divide by 10, 100, and 1000

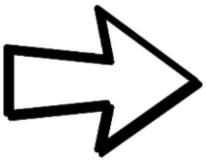
Dividing by 10

When dividing by 10, the number is getting 10 times smaller. Move each digit 1 place to the right.



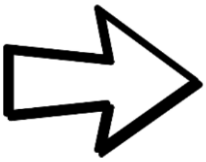
Dividing by 100

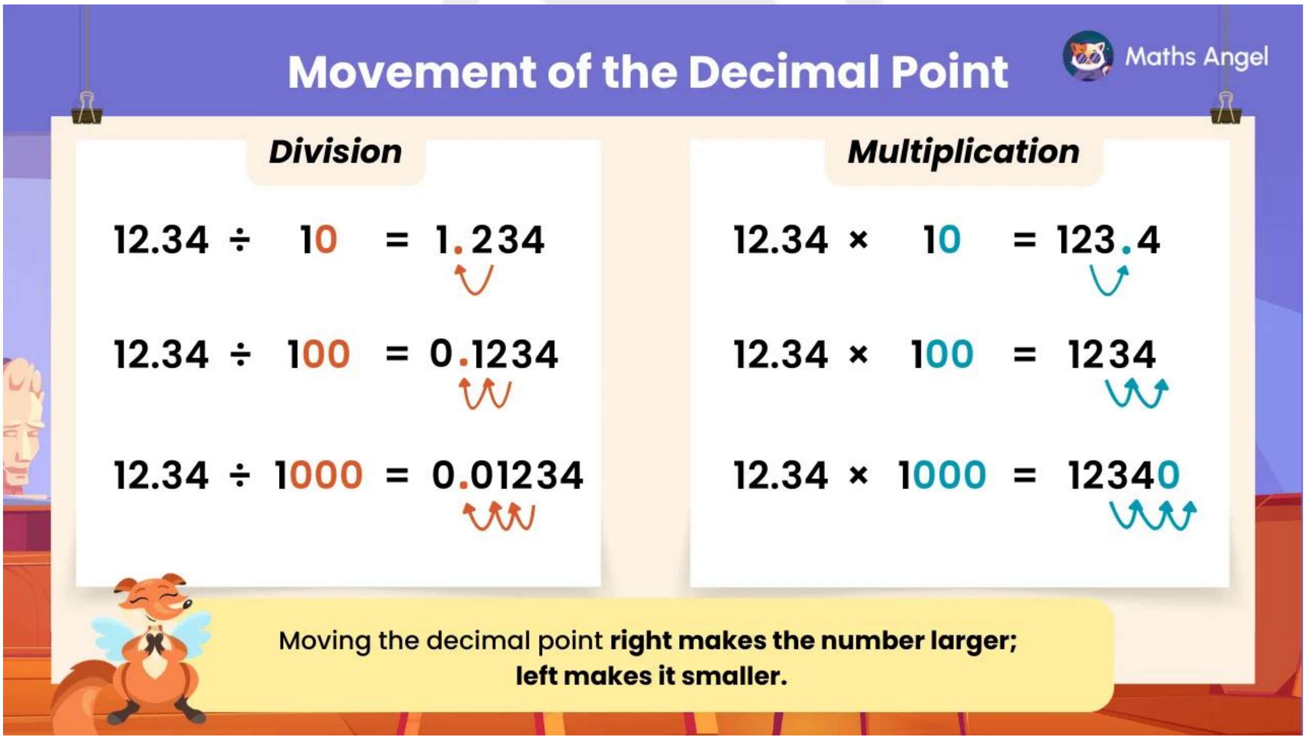
When dividing by 100, the number is getting 100 times smaller. Move each digit 2 places to the right.



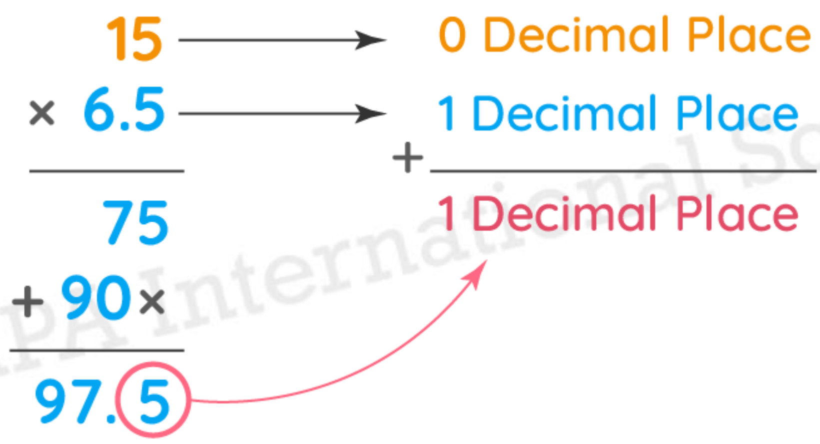
Dividing by 1000

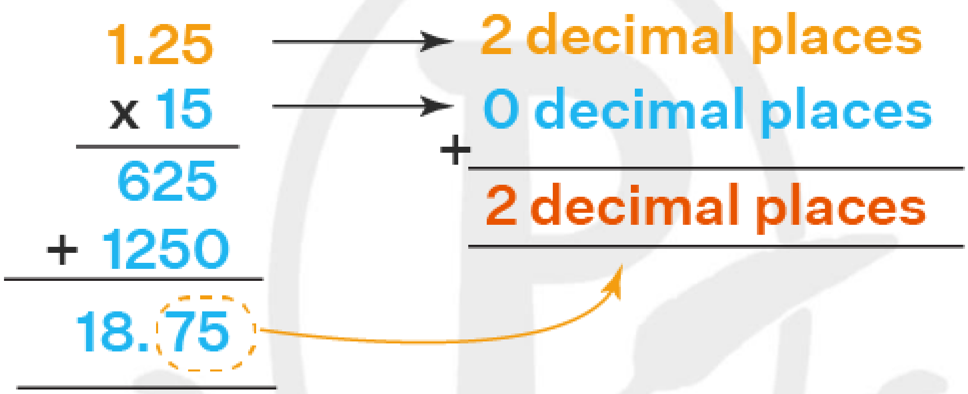
When dividing by 1000, the number is getting 1000 times smaller.
Move each digit 3 places to the right.

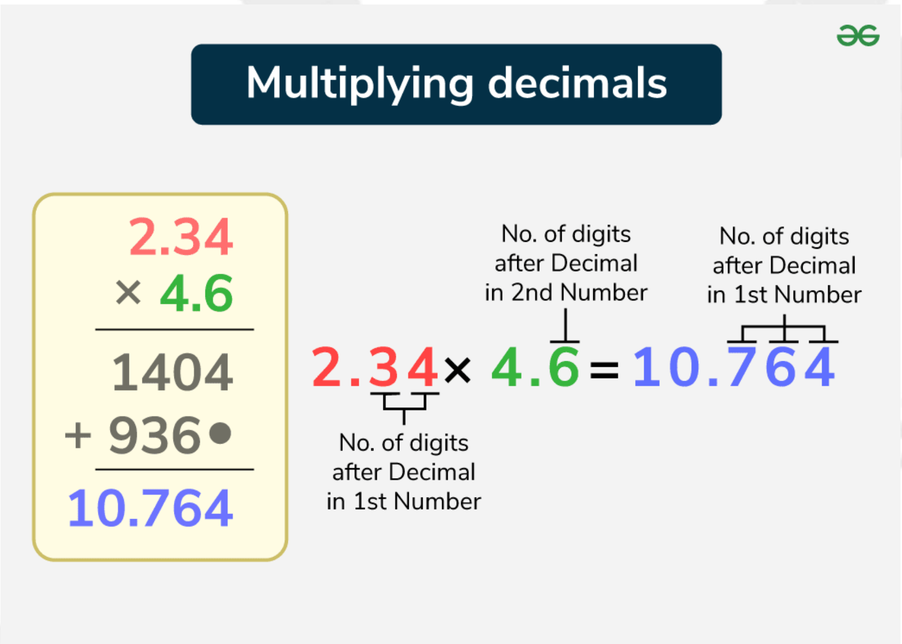




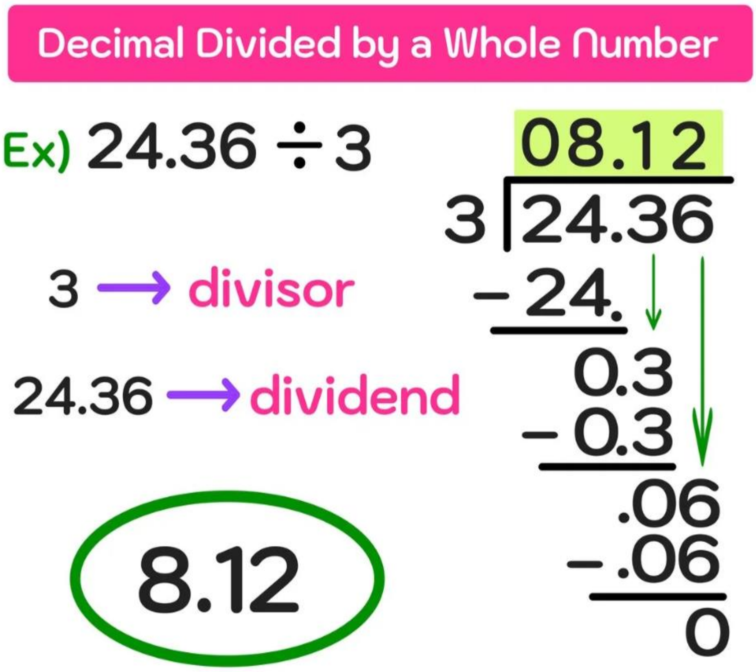
Multiply decimals by integers

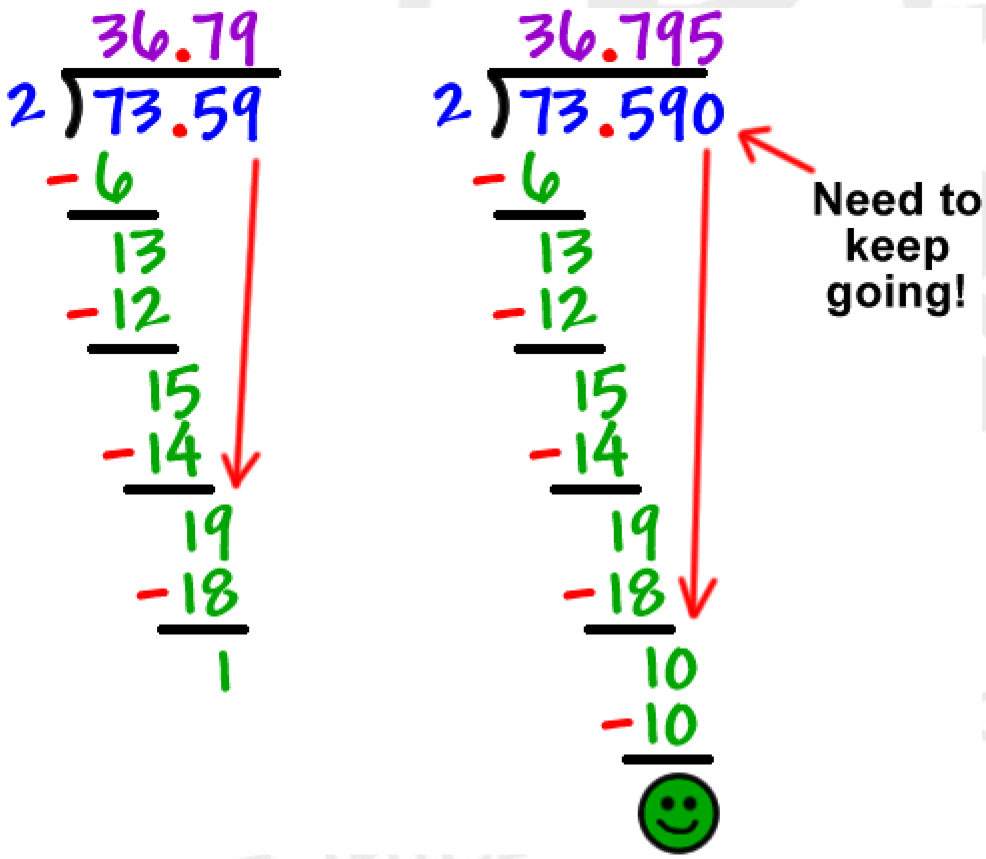






Divide decimals by integers





Fractions to decimals & Fractions as division

×5

$\frac{7}{20} = \frac{35}{100}$ or 0.35

×5

×2

$\frac{7}{50} = \frac{14}{100}$ or 0.14

×2

×4

$\frac{7}{25} = \frac{28}{100}$ or 0.28

×4

÷2

$\frac{8}{200} = \frac{4}{100}$ or 0.04

÷2

- When the denominator is not a factor or multiple of 100

$\frac{7}{8} = 7 \div 8$

	0 .	8	7	5
8	7 .	$^{7}0$	$^{6}0$	$^{4}0$

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9

$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$	$\frac{1}{10}$
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

$\frac{1}{10}$ $\frac{2}{10}$ $\frac{3}{10}$ $\frac{4}{10}$ $\frac{5}{10}$ $\frac{6}{10}$ $\frac{7}{10}$ $\frac{8}{10}$ $\frac{9}{10}$

Percent %

- a type of part-to-total ratio, where the total is 100.
- symbol: %
- "per 100"
- "out of 100"

20 %
20 per 100
20 out of 100

Fractions to Percentages

× 2

$\frac{15}{50} = \frac{30}{100} = 0.3 = 30\%$

× 2

÷ 2

$\frac{60}{200} = \frac{30}{100} = 0.3 = 30\%$

÷ 2

Converting **fractions to percentages** is representing the fraction as a percentage without changing its value.

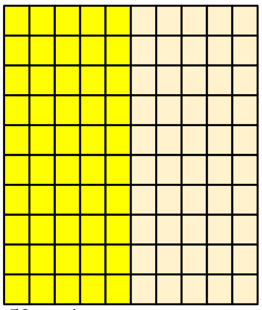
E.g.

Convert $\frac{3}{4}$ to a percentage $\quad \frac{3}{4} = \frac{3 \times 25}{4 \times 25} = \frac{75}{100} = \mathbf{75\%}$ So $\frac{3}{4} = \mathbf{75\%}$

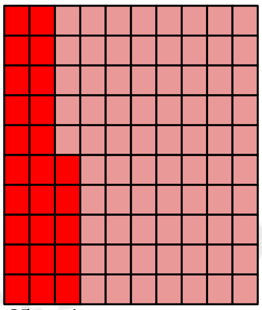
Convert $\frac{5}{8}$ to a percentage $\quad \frac{5}{8} = 5 \div 8 \Rightarrow$ $8 \overline{)5.000}$ = 0.625 So $\frac{5}{8} = \mathbf{0.625}$

0.625 x 100 = 62.5% So $\frac{5}{8} = \mathbf{62.5\%}$

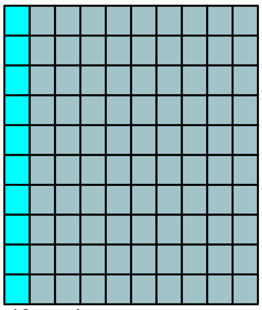
Equivalent Fractions, Decimals, and Percentages



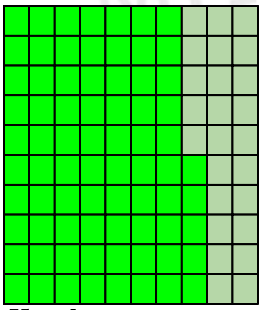
$\frac{50}{100} = \frac{1}{2} = 0.5 = 50\%$



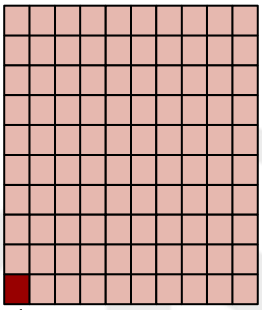
$\frac{25}{100} = \frac{1}{4} = 0.25 = 25\%$



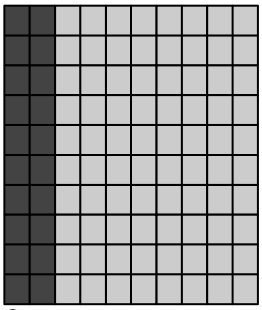
$\frac{10}{100} = \frac{1}{10} = 0.1 = 10\%$



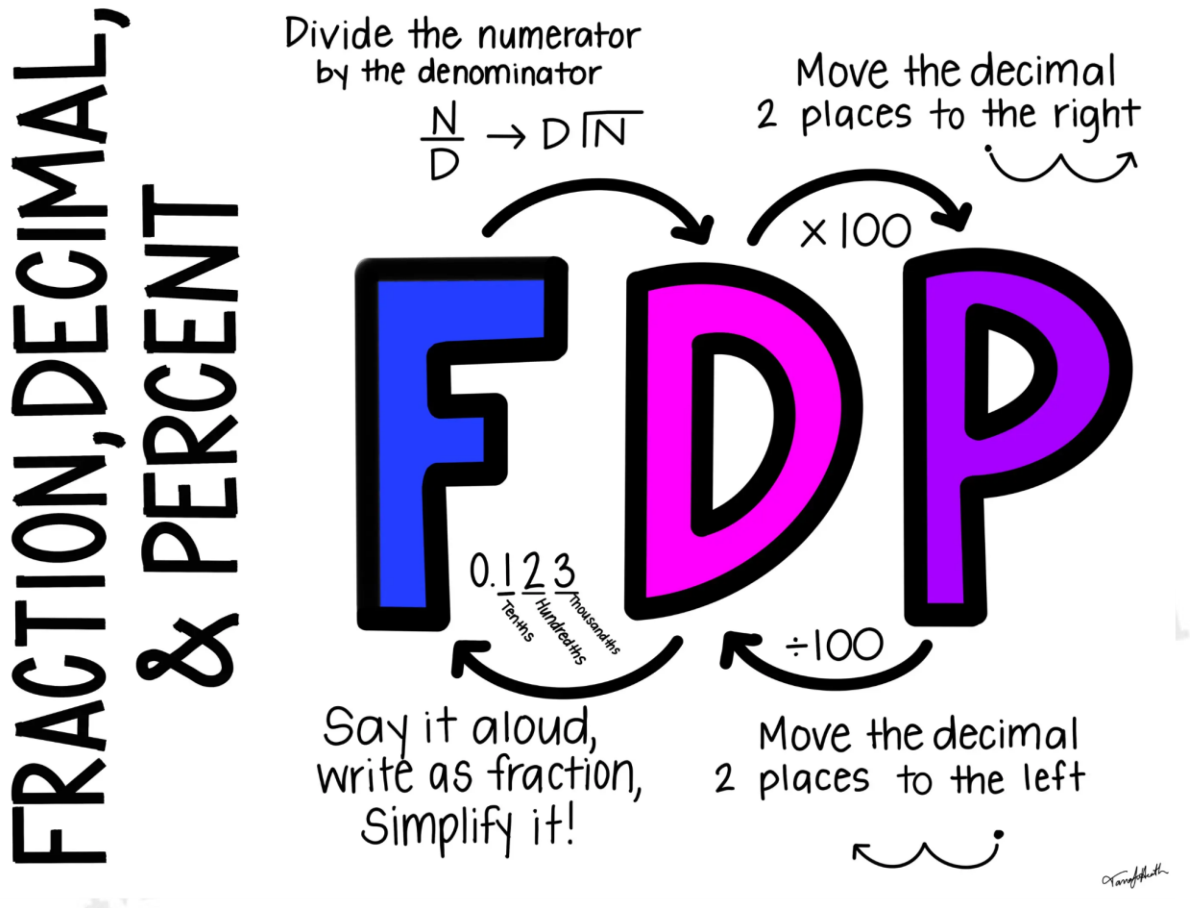
$\frac{75}{100} = \frac{3}{4} = 0.75 = 75\%$



$\frac{1}{100} = 0.01 = 1\%$

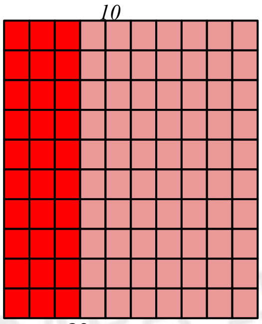


$\frac{20}{100} = \frac{2}{10} = 0.2 = 20\%$

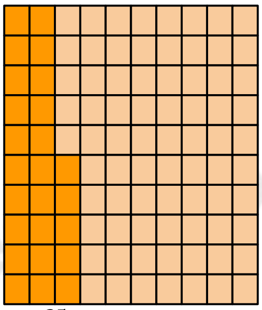


Ordering Fractions, Decimals, and Percentages

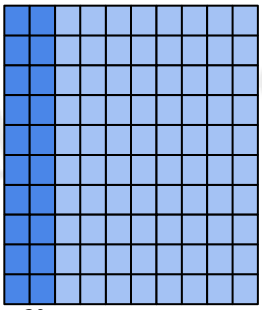
$\frac{3}{10}$ > 25% > 0.2



$\frac{30}{100}$ = 30%

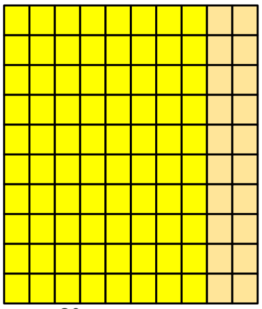


$\frac{25}{100}$ = 25%

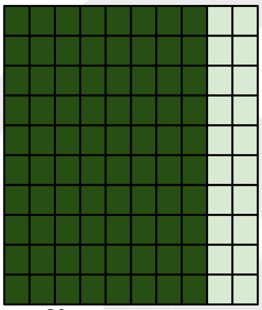


$\frac{20}{100}$ = 20%

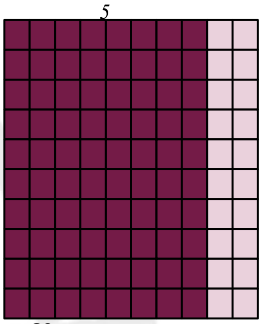
80% = 0.8 = $\frac{4}{5}$



$\frac{80}{100}$ = 80%



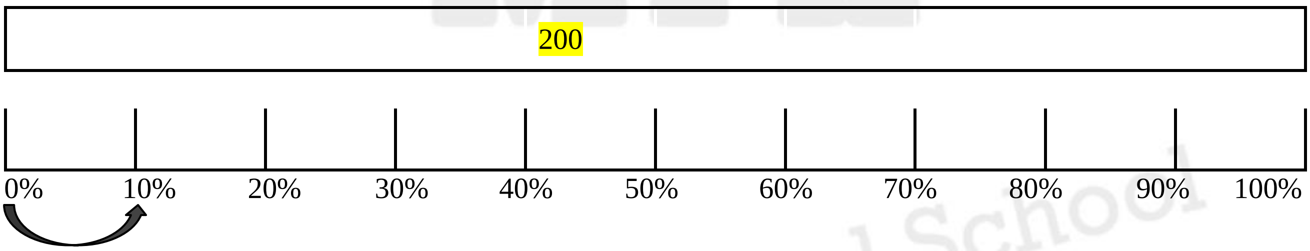
$\frac{80}{100}$ = 80%

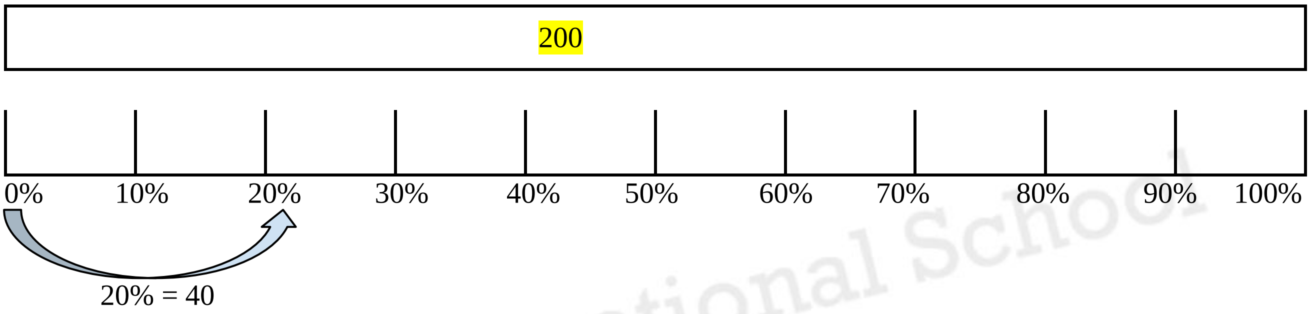


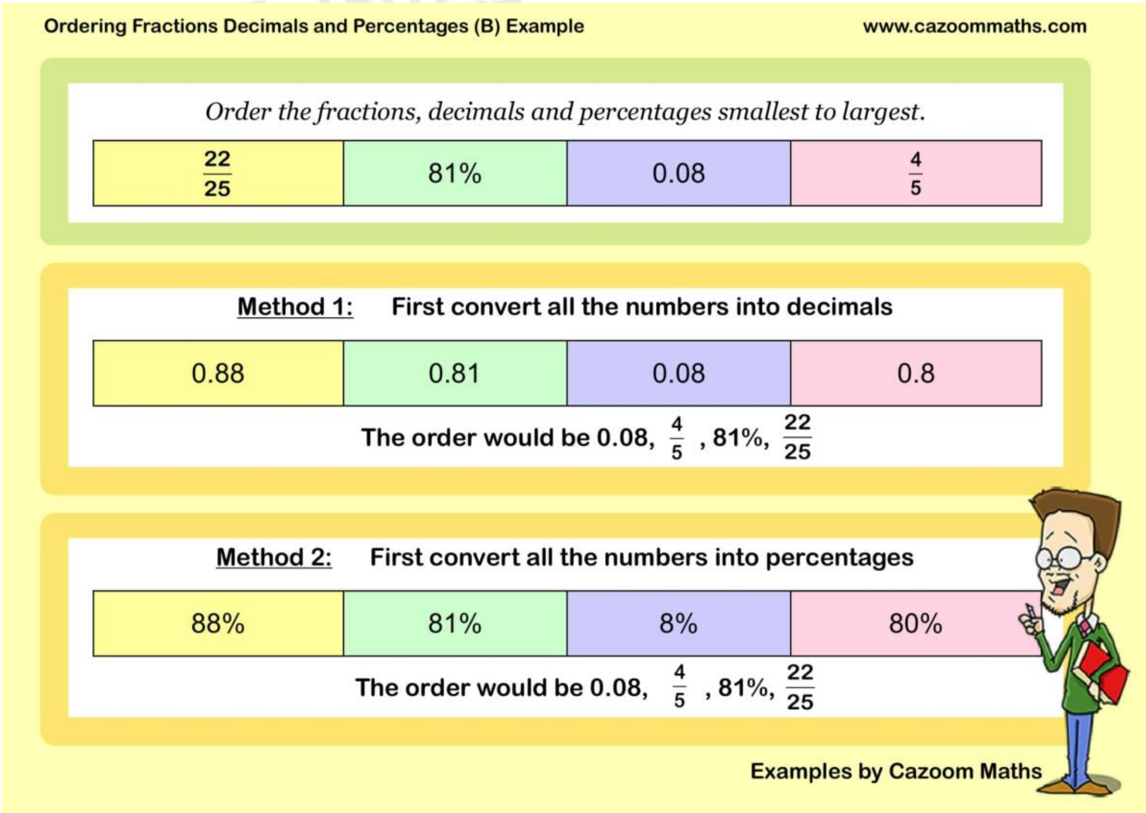
$\frac{80}{100}$ = 80%

Finding a Percentage of an Amount

50% = $\frac{1}{2}$ so we can divide by 2	**10% = $\frac{1}{10}$ so we can divide by 10**	**25% = $\frac{1}{4}$ so we can divide by 4**	**1% = $\frac{1}{100}$ so we can divide by 100**







Percentage of an amount

35% of 200 =?

10% of 200 → × 3 → 20 × 3 = 60

200 ÷ 10 = 20 → 30% = 60

÷ 2

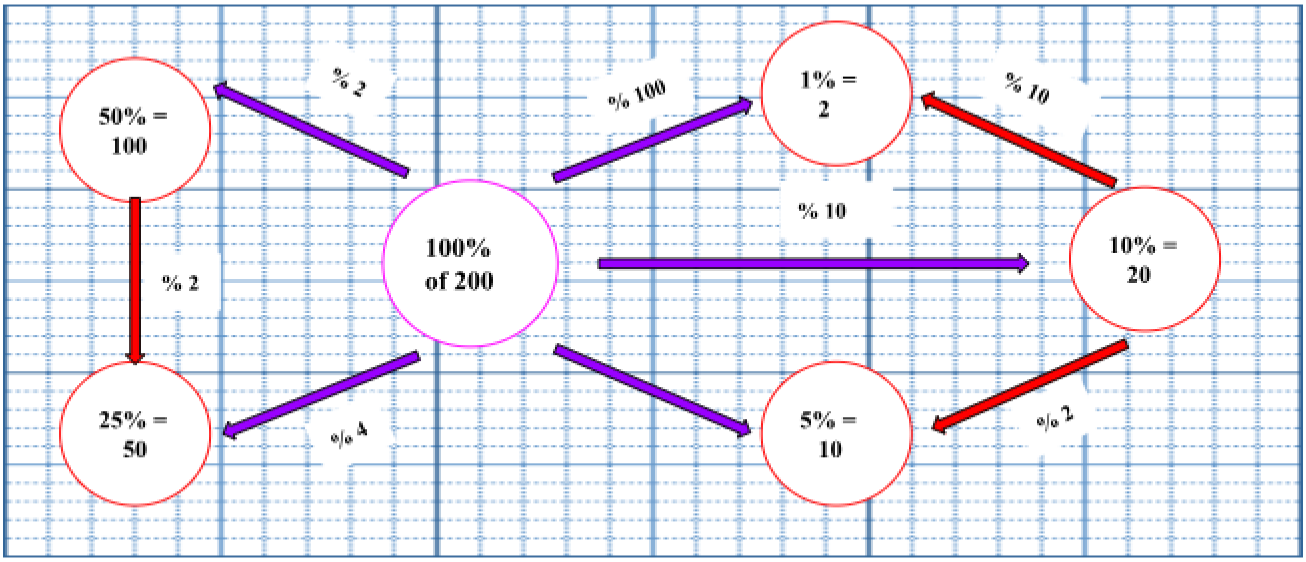
20 ÷ 2 = 10

5 % = 10

35% = 30% + 5%

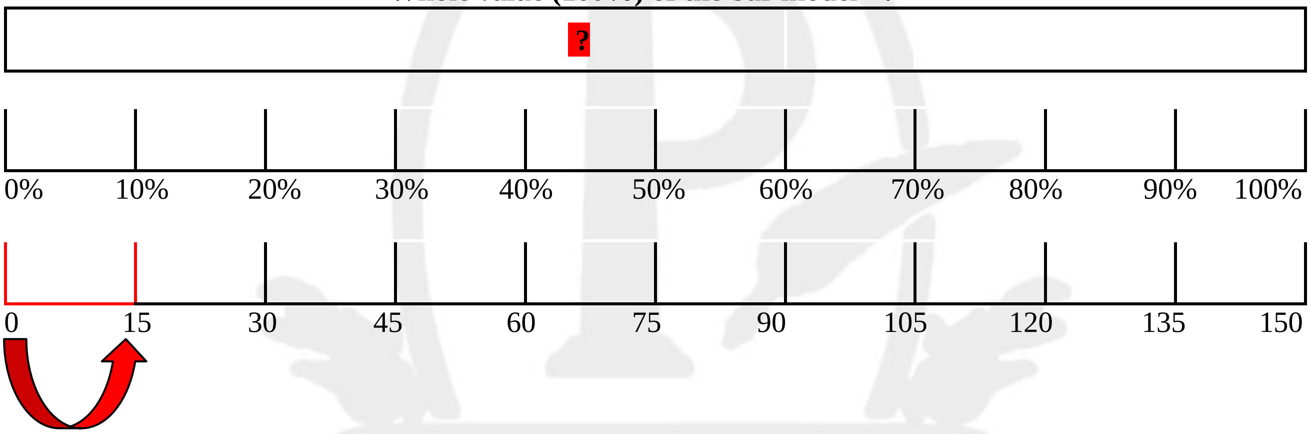
60 + 10 = 70

so 35% of 200 = **70**



Percentages - Missing Values

Whole value (100%) of the bar model =?



10% = 15

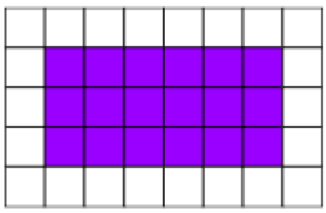
We know 10% = 15 10% × 10 = 100% (the whole) so 15 × 10 = 150

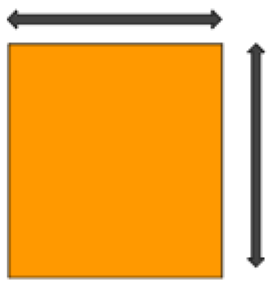
Unit (11) *Measure - perimeter, area and volume*

Key Vocabulary

• Perimeter • Area • Volume • Squared units (e.g., m^2) • Cubic units (e.g., cm^3) • Cube • Cuboid • Parallel lines • Perpendicular height	• Base length • Width • Length • Height • Rectangle • Rectilinear • Parallelogram • Trapezium • Rhombus

Area of Rectangles





Counting squares:
area = $18cm^2$

Useful formula:
6cm × 3cm
area = $18cm^2$

area = 8cm × 4cm = $18cm^2$

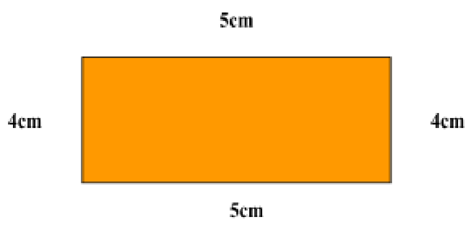
Area	=	**length**	×	**width**

Perimeter of Rectangles

Perimeter	=	**length**	+	**width**	+	**length**	+	**width**

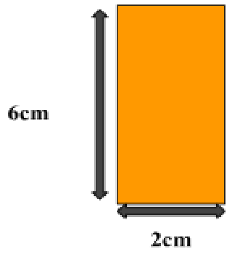
Or

Perimeter	=	**(length**	+	**width)**	×	**2**



Perimeter = 5 cm + 4 cm + 5 cm + 4 cm = 18 cm

Area = 5 cm × 4 cm = 20 cm²

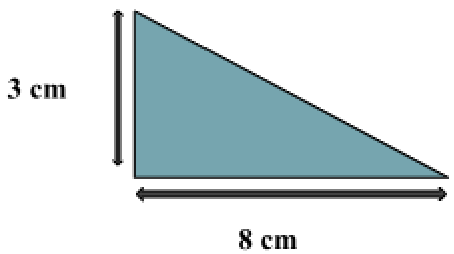


Perimeter = (6 cm + 2 cm) × 2 = 8 cm × 2 = 16 cm

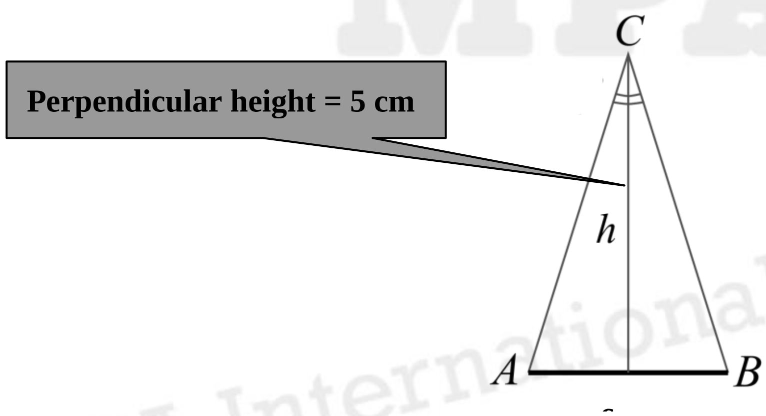
Area = 6 cm × 2 cm = 12 cm²

Area of Triangles

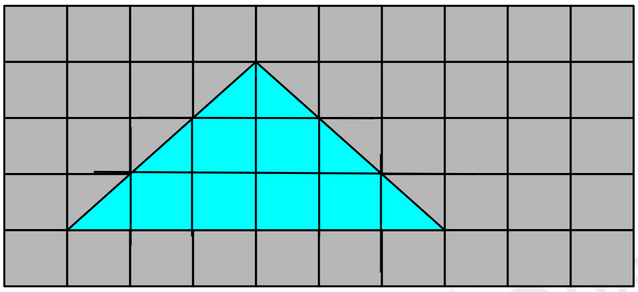
Area of triangle	=	$\frac{1}{2}$	×	**base length**	×	**perpendicular height**



$$\text{Area} = \frac{1}{2} \times 8\text{ cm} \times 3\text{ cm}$$
$$= \frac{1}{2} \times 24\text{ cm}^2$$
$$= 12\text{ cm}^2$$



Area of triangle = (6 cm × 5 cm) ÷ 2
= 30 cm² ÷ 2
= 15 cm²



Counting Squares:

6 whole squares	=	6cm²
6 half squares	=	3cm²
6cm² + 3cm²	=	9cm²
Area of triangle	=	9cm²

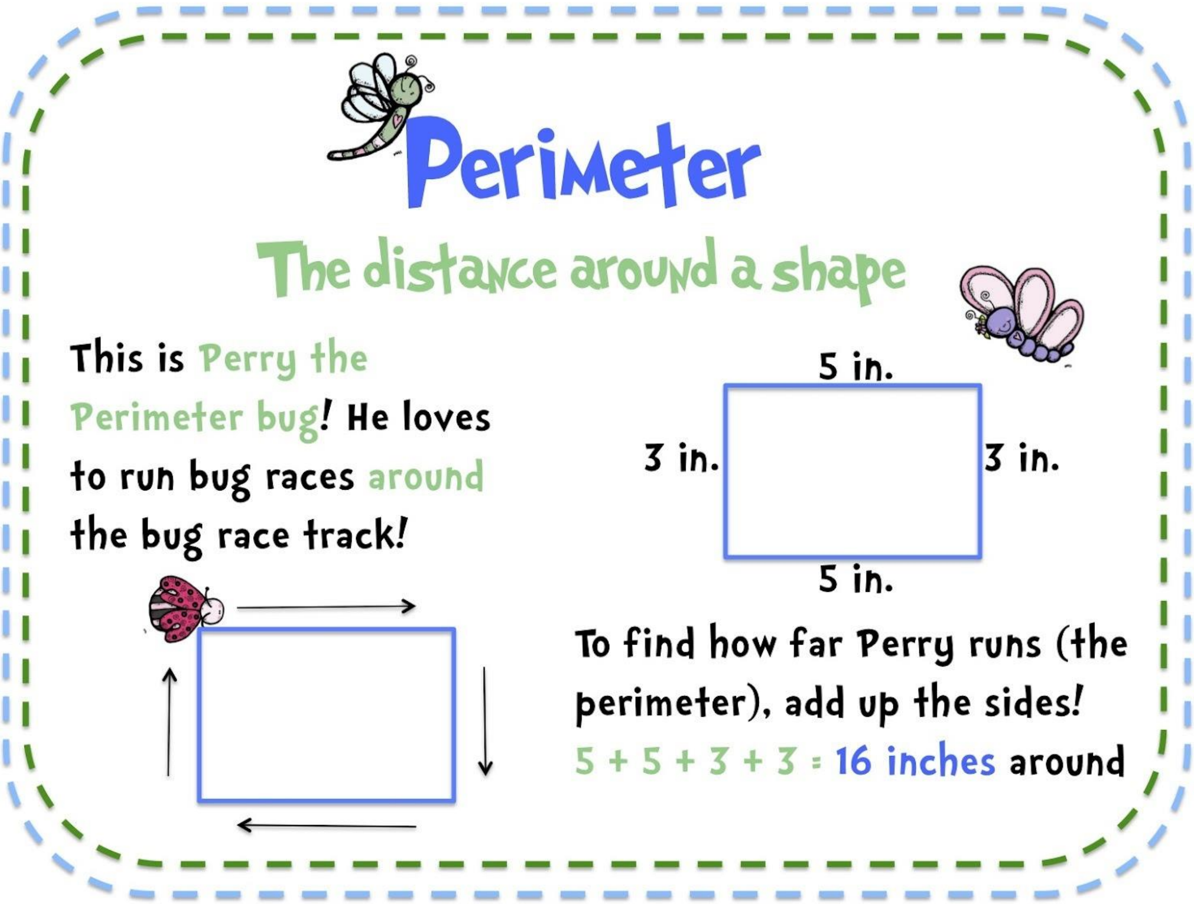
Using Formula:

Area = (6cm × 3cm) ÷ 2

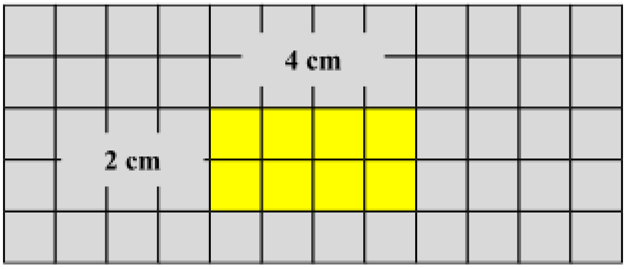
= 18cm² ÷ 2

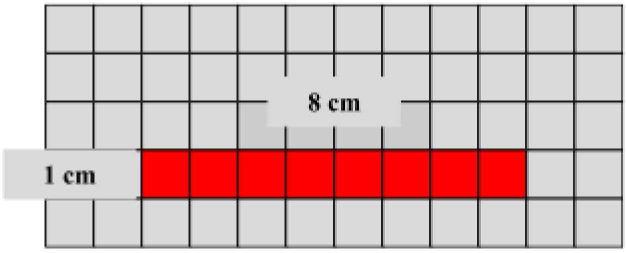
= 9cm²

Perimeter & Area



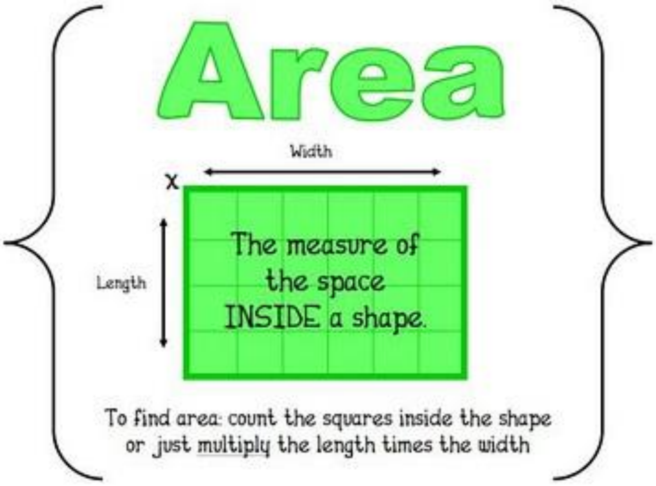
Shapes with the same area can have different perimeters.

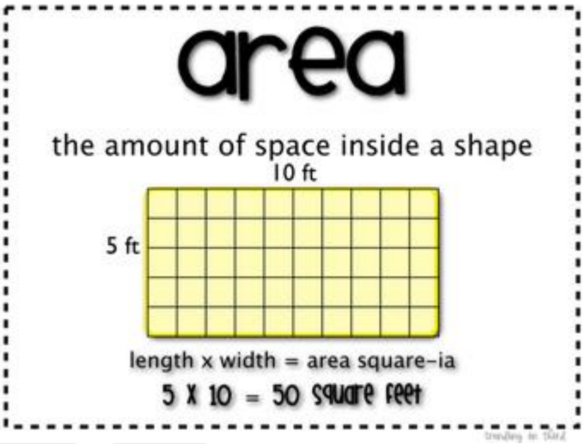




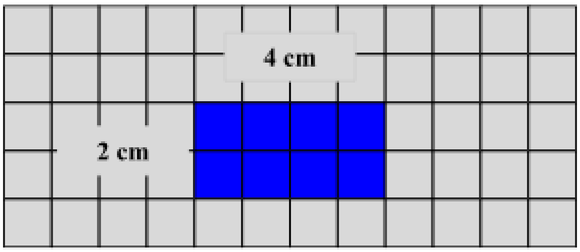
Area = 8 cm²	Perimeter = 12 cm	Area = 8 cm²	Perimeter = 18 cm

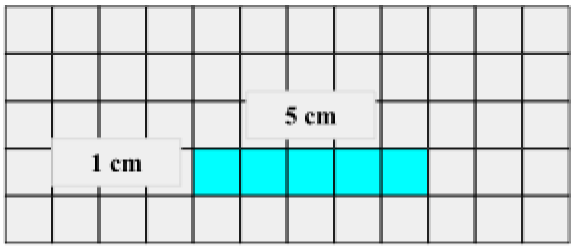
Area = 8 cm²	Perimeter = 12 cm	Area = 8 cm²	Perimeter = 18 cm





Shapes with the same perimeter can have different areas.

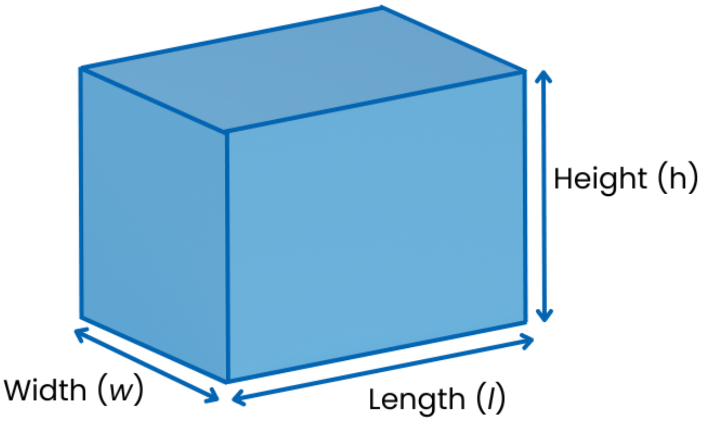


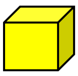


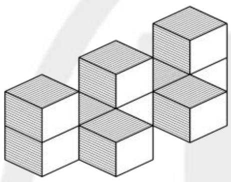
Area = 8 cm²	Perimeter = 12 cm	Area = 5 cm²	Perimeter = 12 cm

Definition:

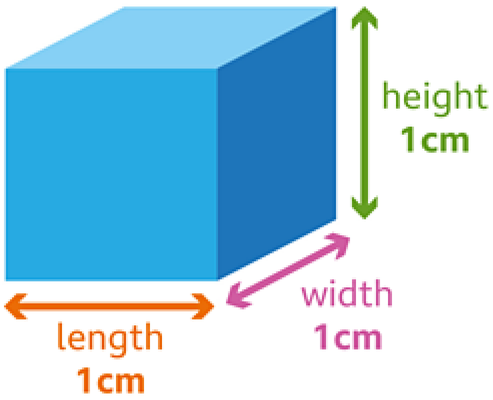
Volume is the amount of space an object occupies, measured in cubic units like cubic meters or liters.




= 1 cm^3


= 10 cm^3


= 27 cm^3



Volume = 1cm^3

Volume of a cuboid = ***Length*** × ***width*** × ***height***

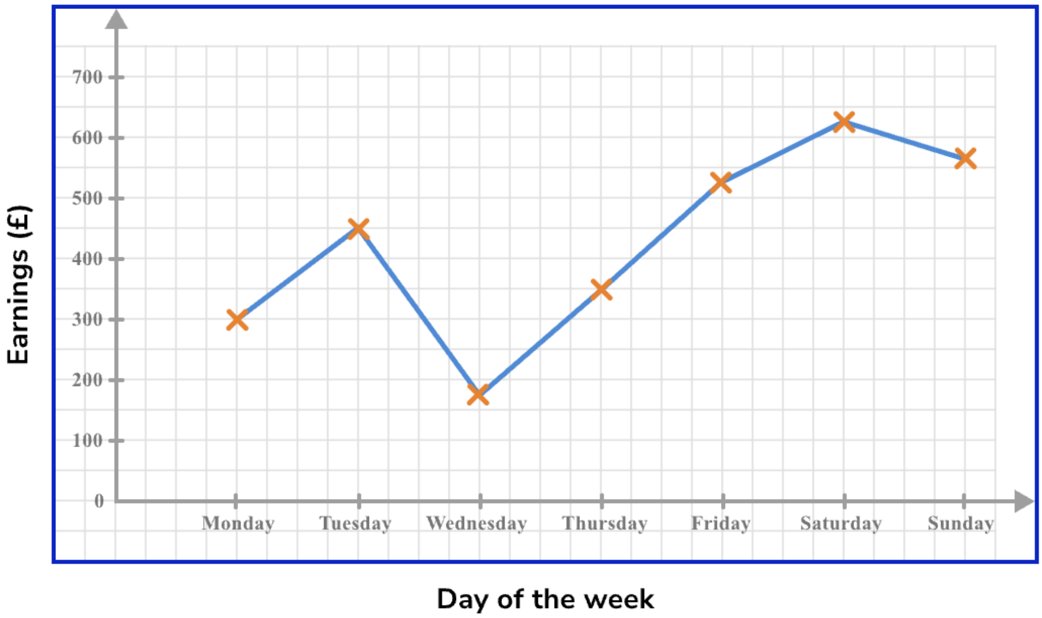
Unit (12) Statistics

What is a line graph?

A **line graph** is a way of displaying data to easily see a trend over time.

To draw a line graph, we need to **plot individual items** of data onto a set of axes and then connect each **consecutive data** point with a **line segment**.

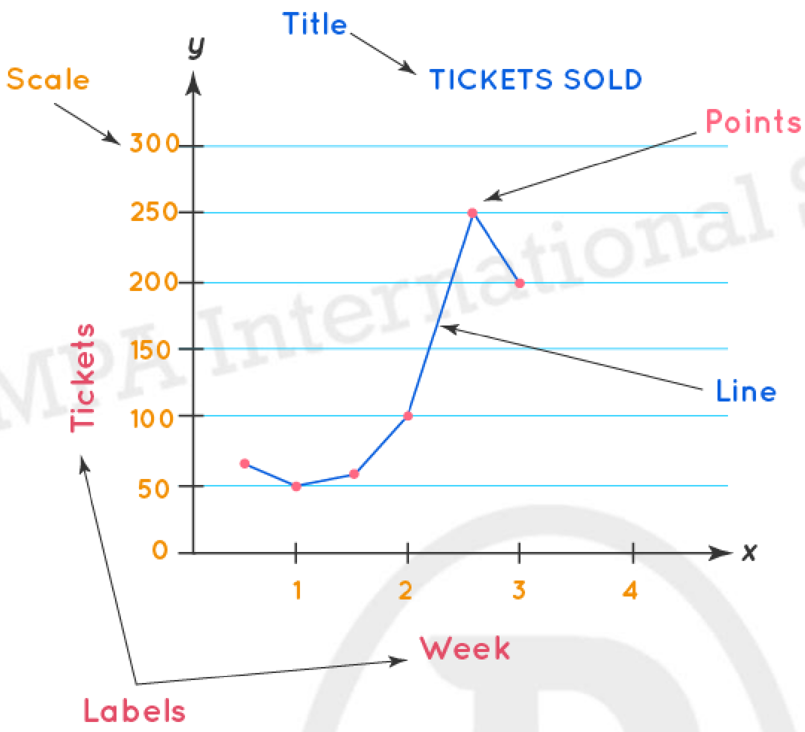
The x**-axis** or **horizontal axis** is labelled as time, and the y**-axis** or **vertical axis** is the variable that is being measured or tracked (ice cream sales, hours spent on homework, earnings, number of births etc).



How to draw a line graph

To draw a line graph:

- Label the axes and add an axis title.
- Plot each data point accurately.
- Connect each pair of consecutive points with a straight line.



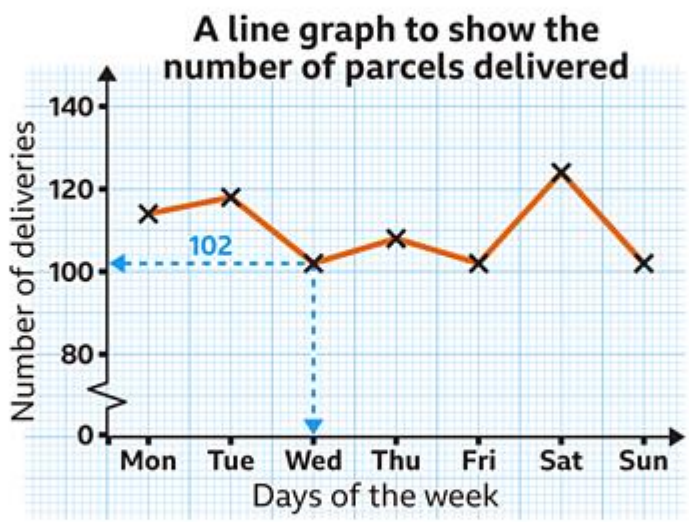
Title: Represents the title of the graph using a keyword. The line graph shown here talks about the tickets sold in 4 weeks.

Scale: Represents the total number of units in the horizontal x-axis & vertical y-axis. For example, the space between two lines in the y-axis represents 50 units.

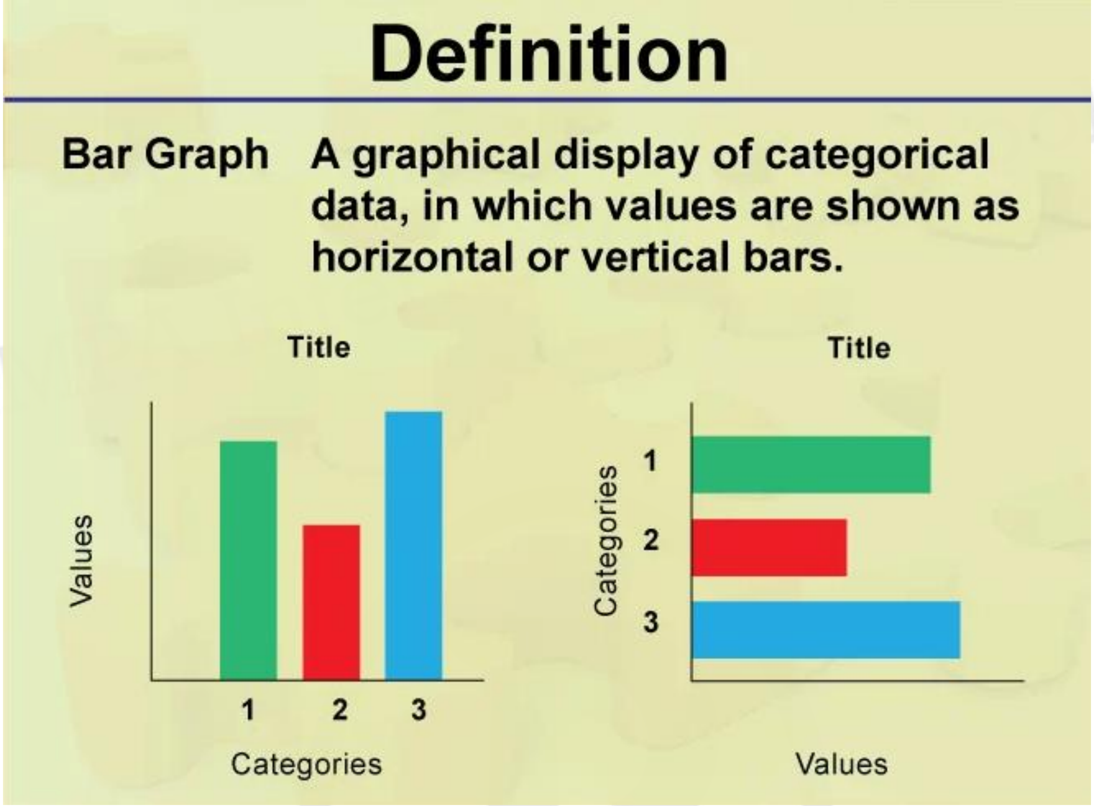
Points: Represents the amount of data for value along the x-axis. For example, in the first week, 50 tickets were sold.

Labels: Represents what kind of data is shown in the x-axis and y-axis. For example, in the line graphs, the x-axis represents the number of the weeks and the y-axis represents the number of tickets sold in that particular week.

Line: Line segments connecting two or more individual data points on the graph forms a line.

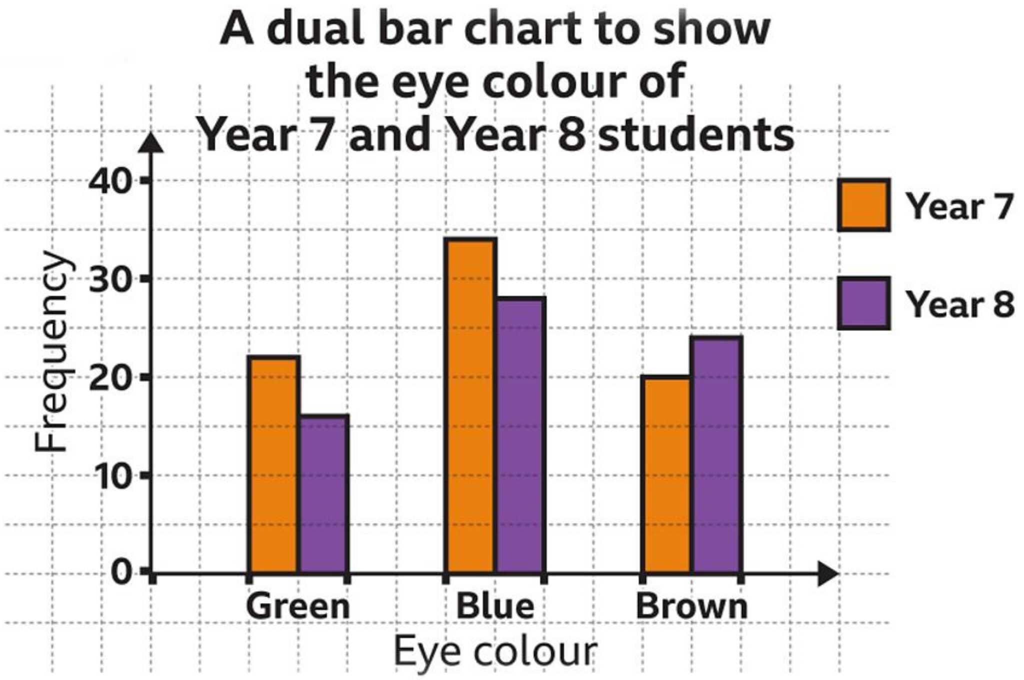


Advanced bar charts



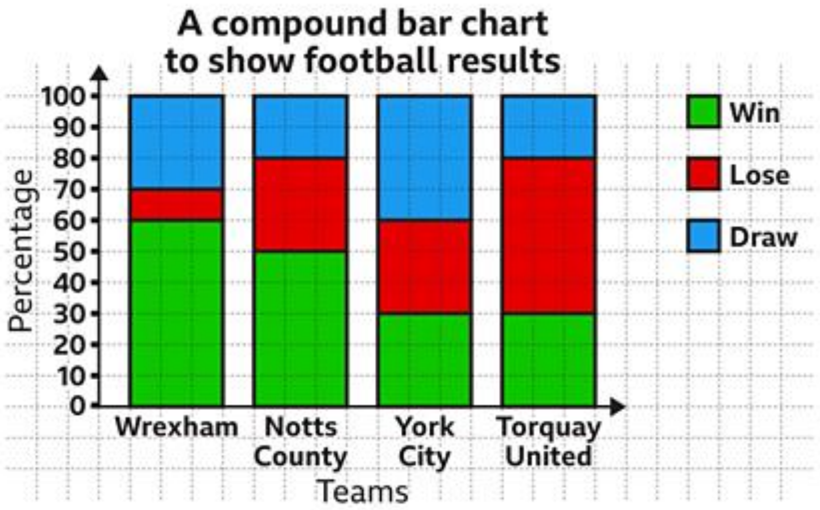
Dual bar chart

A dual bar chart (or double bar graph) is a data visualization tool that displays two related sets of data side-by-side for each category on the x-axis, allowing for direct comparison.



Compound bar chart

A compound bar chart (also known as a grouped, composite, or segmented bar chart) is a data visualization tool that displays two or more sets of data side-by-side or stacked within a single category.



Frequency Table

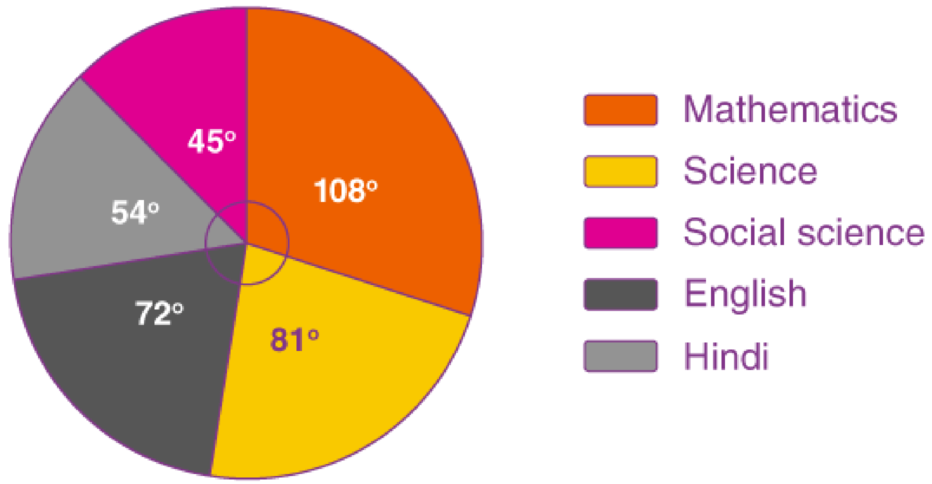
Eye colour	Tally	Frequency
brown	卌 |	6
blue	卌 |||	8
green	|||	3
grey	||||	4
hazel	卌	5

- Tally marks are used to help count things.
- Each vertical line represents one unit.
- The fifth tally mark goes down across the first four to make it easier to count.

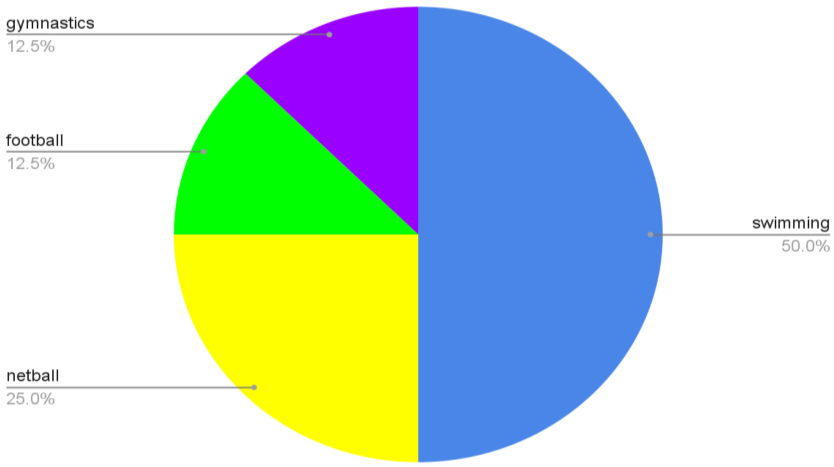
The frequency column is completed after all the data has been collected.

Pie chart

A pie chart is a circular statistical graphic divided into slices, where each slice represents a numerical proportion of a whole. All slices add up to 100% and 360 degrees. It is primarily used to display static categorical data, such as market share or demographic breakdowns.



A pie chart to show children's favourite sports



24 children were asked in total.

- Swimming $= \frac{1}{2}$ so $\frac{1}{2}$ of 24 = 12 children
- Netball $= \frac{1}{4}$ so $\frac{1}{4}$ of 24 = 6 children
- Football $= \frac{1}{8}$ so $\frac{1}{8}$ of 24 = 3 children
- Gymnastics $= \frac{1}{8}$ so $\frac{1}{8}$ of 24 = 3 children

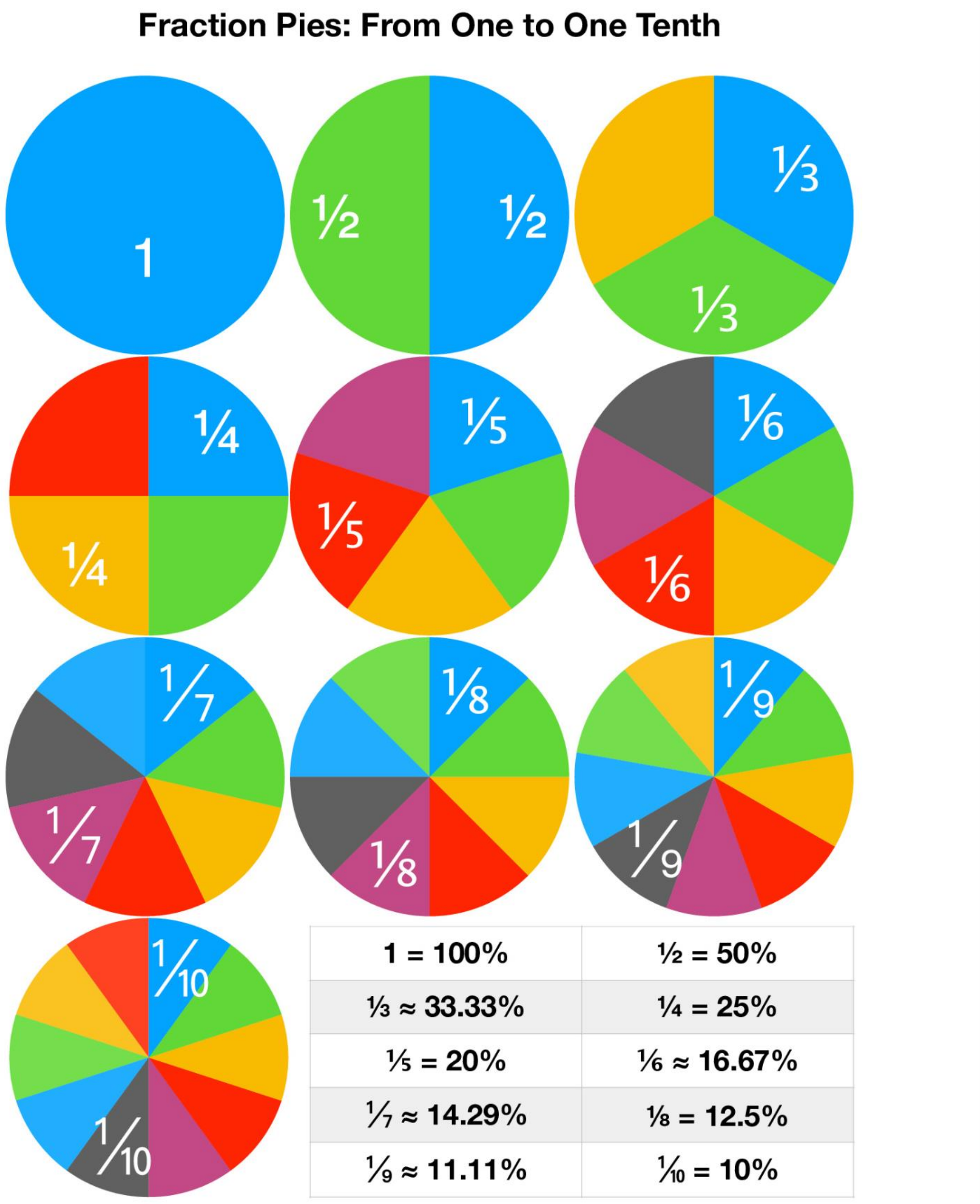
Read and interpret pie charts

To read and interpret a pie chart, you must look at the relative sizes of the slices (sectors) to understand how a total data set is divided into smaller categories. The entire circle represents the whole (100% of the data or a complete 360 degrees, while each individual slice represents a specific part of that whole.

Pie charts and fractions

Every pie chart is governed by three primary structural rules:

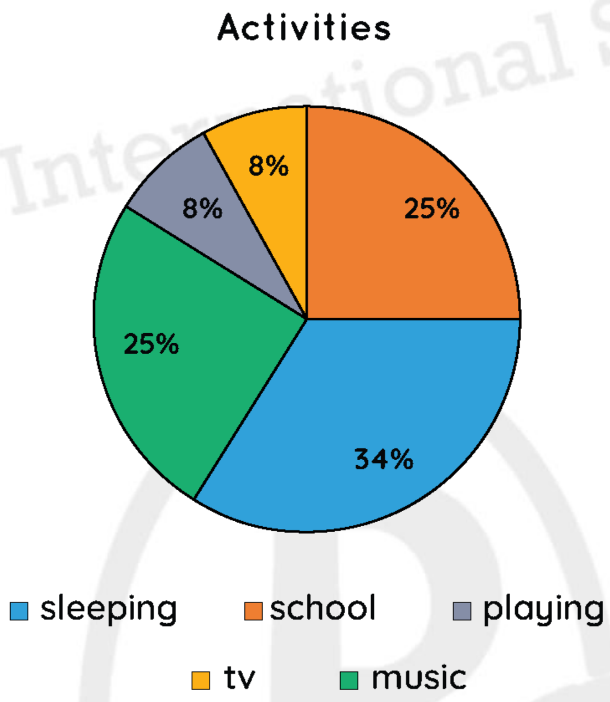
- The **Whole**: The entire circle represents 1 whole.
- **Total Degrees**: A full turn around the circle is exactly 360°.
- **Fraction Sum**: The individual fractions of all sectors must equal $\frac{1}{1}$.

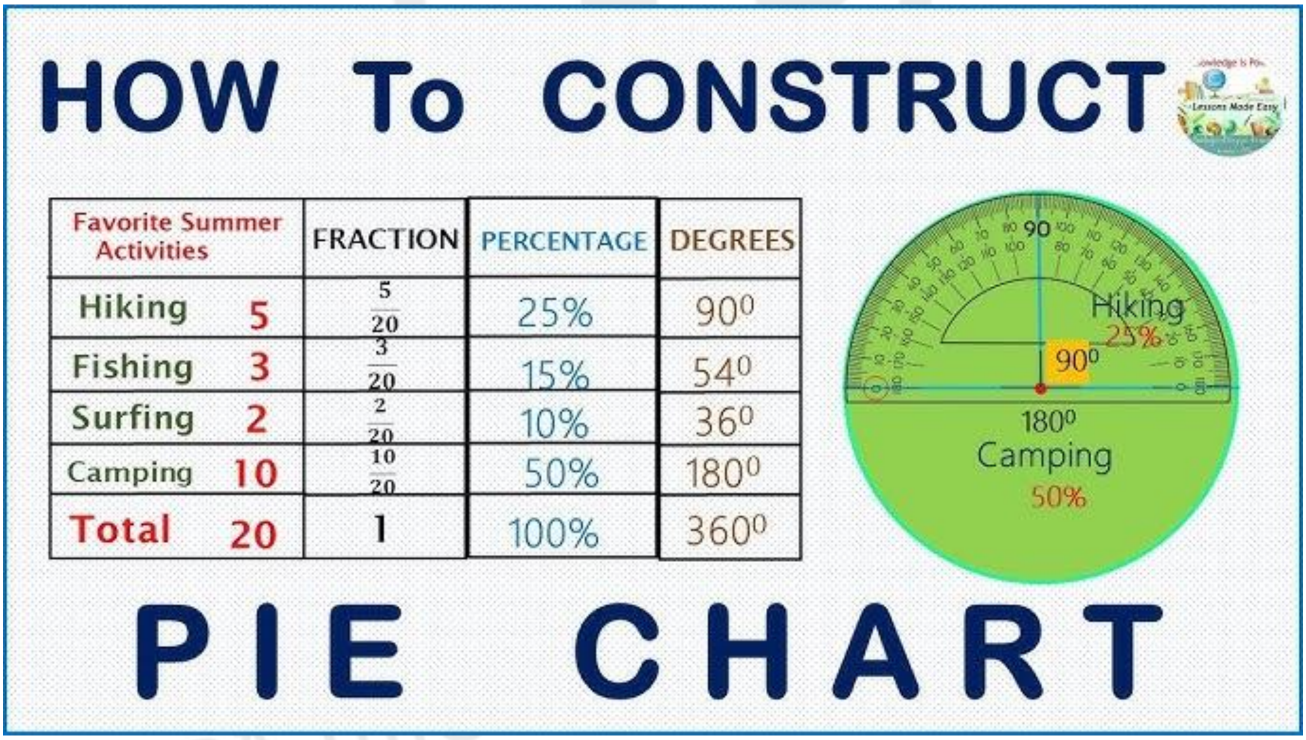


1 = 100%	½ = 50%
⅓ ≈ 33.33%	¼ = 25%
⅕ = 20%	⅙ ≈ 16.67%
1/7 ≈ 14.29%	⅛ = 12.5%
1/9 ≈ 11.11%	1/10 = 10%

Pie charts and percentages

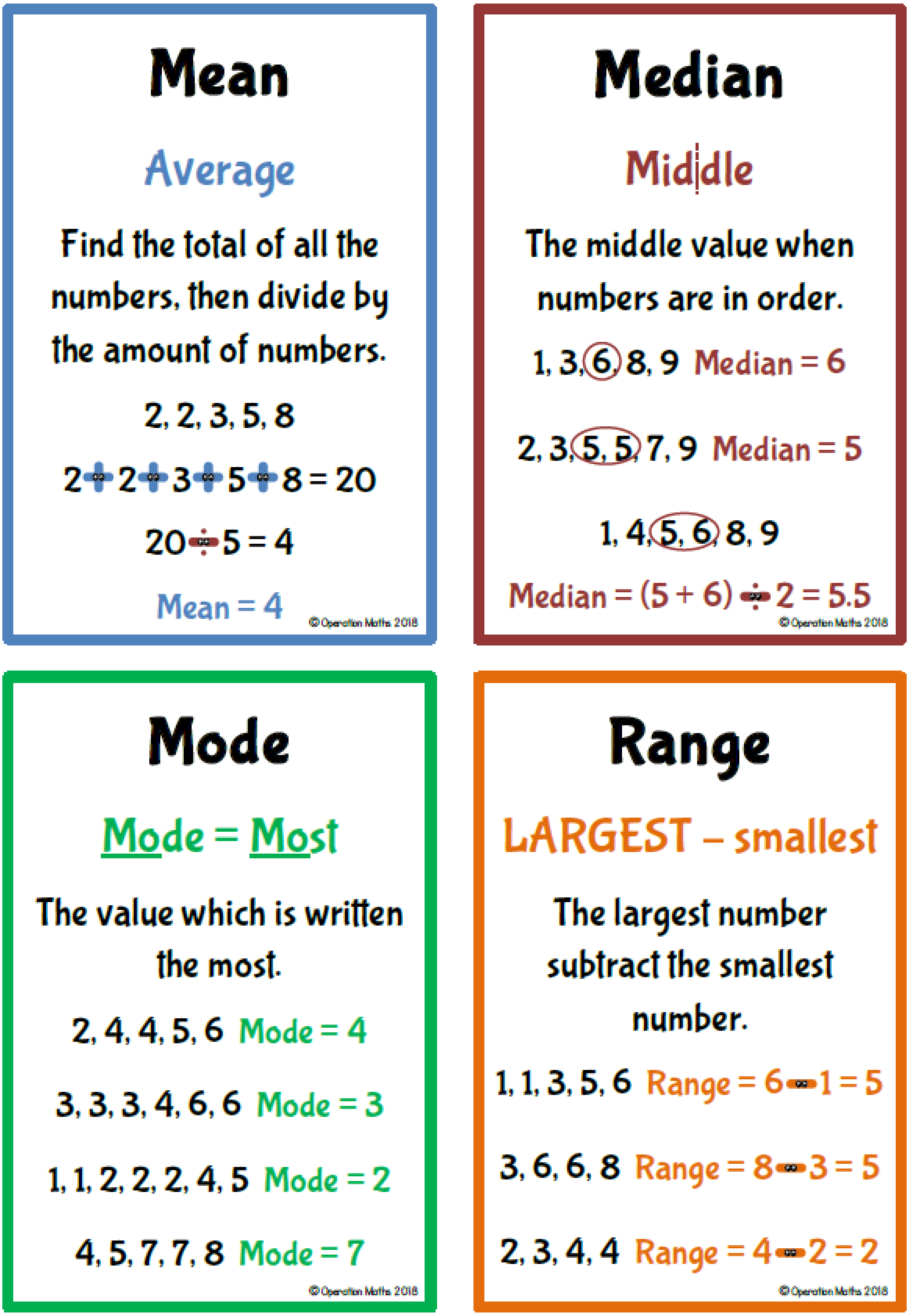
A pie chart is a circular graphic divided into slices (sectors) to illustrate numerical proportions, where the entire circle always represents 100% of the data and measures exactly 360 degrees. Each slice represents a specific category, and its size is directly proportional to the quantity or percentage it holds.





Favorite Summer Activities		FRACTION	PERCENTAGE	DEGREES
Hiking	5	$\frac{5}{20}$	25%	90^0
Fishing	3	$\frac{3}{20}$	15%	54^0
Surfing	2	$\frac{2}{20}$	10%	36^0
Camping	10	$\frac{10}{20}$	50%	180^0
Total	20	1	100%	360^0

Introduction to mean

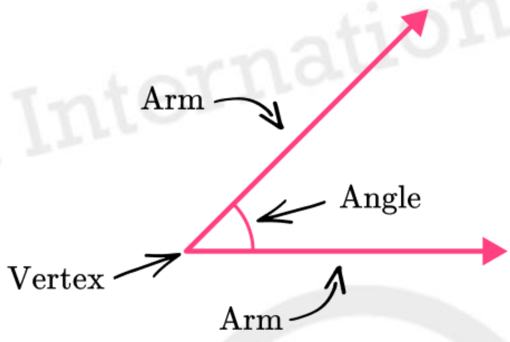


Unit (13) **Geometry - properties of shapes**

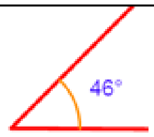
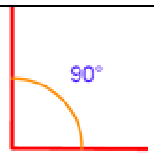
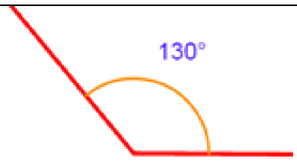
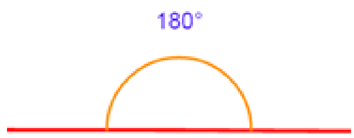
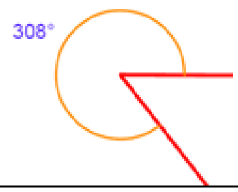
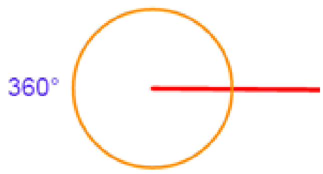
What is an angle?

An angle is the measure of turn between two lines that meet at a point.

Parts of an angle:



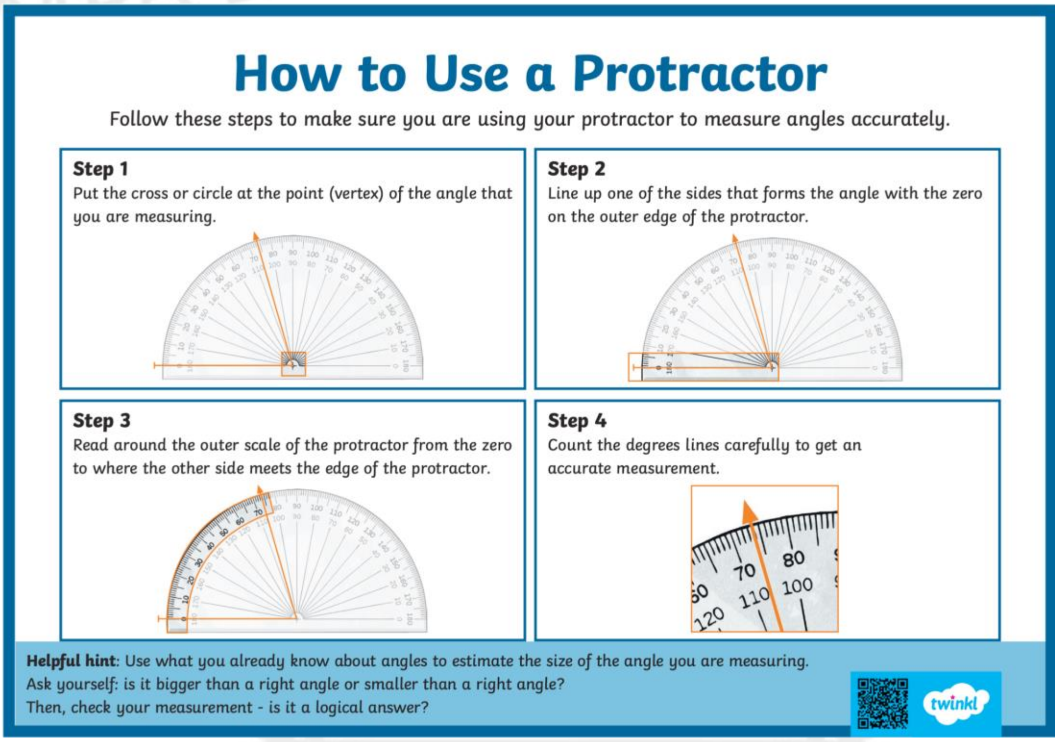
Types of angles

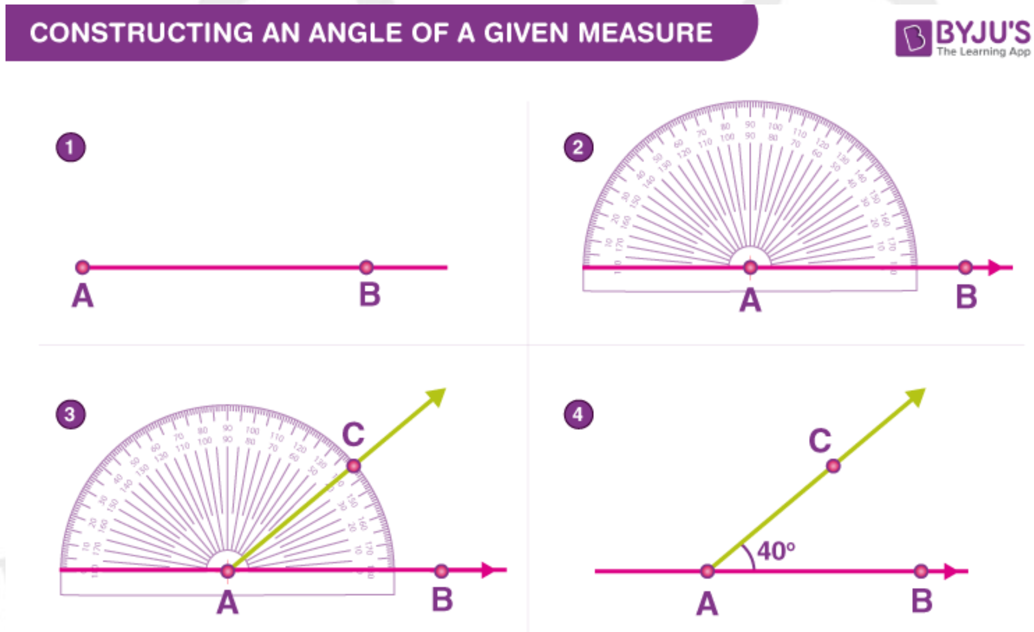
Type of Angle	Description	Example
Acute Angle	An angle that is less than 90°	
Right Angle	An angle that is exactly 90°	
Obtuse Angle	An angle that is greater than 90° and less than 180°	
Straight Angle	An angle that is exactly 180°	
Reflex Angle	An angle that is greater than 180° and less than 360°	
Full Angle	An angle that is exactly 360°	

How to Measure Angles with a Protractor

Follow these four absolute rules to ensure a perfect measurement every time:

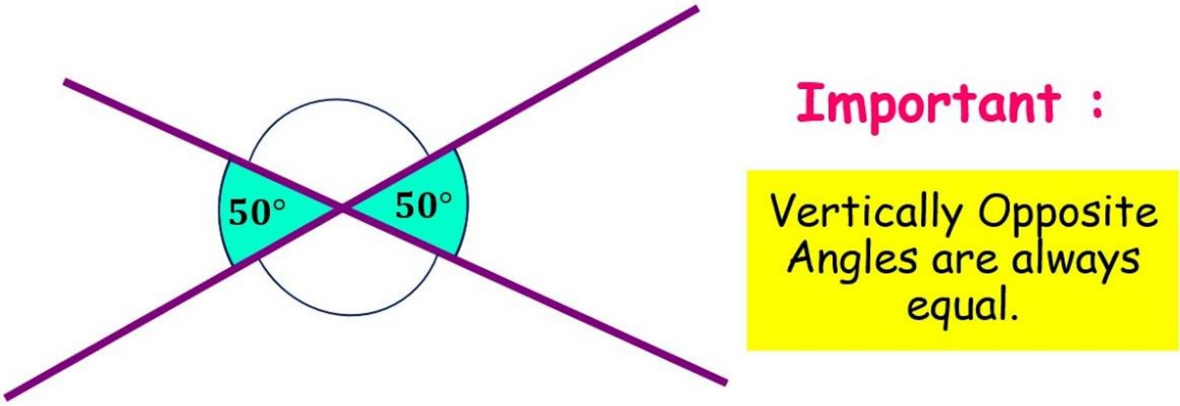
1. Center the Vertex: Place the exact crosshair (central midpoint) of your protractor directly over the angle's vertex.
2. Align the Baseline: Turn the protractor so its 0° baseline lies flat on top of one of the angle's arms.
3. Choose the Correct Scale: Find where that first arm points to 0. If the zero is on the inside scale, count up using the inside numbers. If it is on the outside scale, count up using the outside numbers.
4. Read the Second Arm: Follow the scale up from zero to where the second arm crosses the edge. Count the individual tick marks carefully for precise degrees.



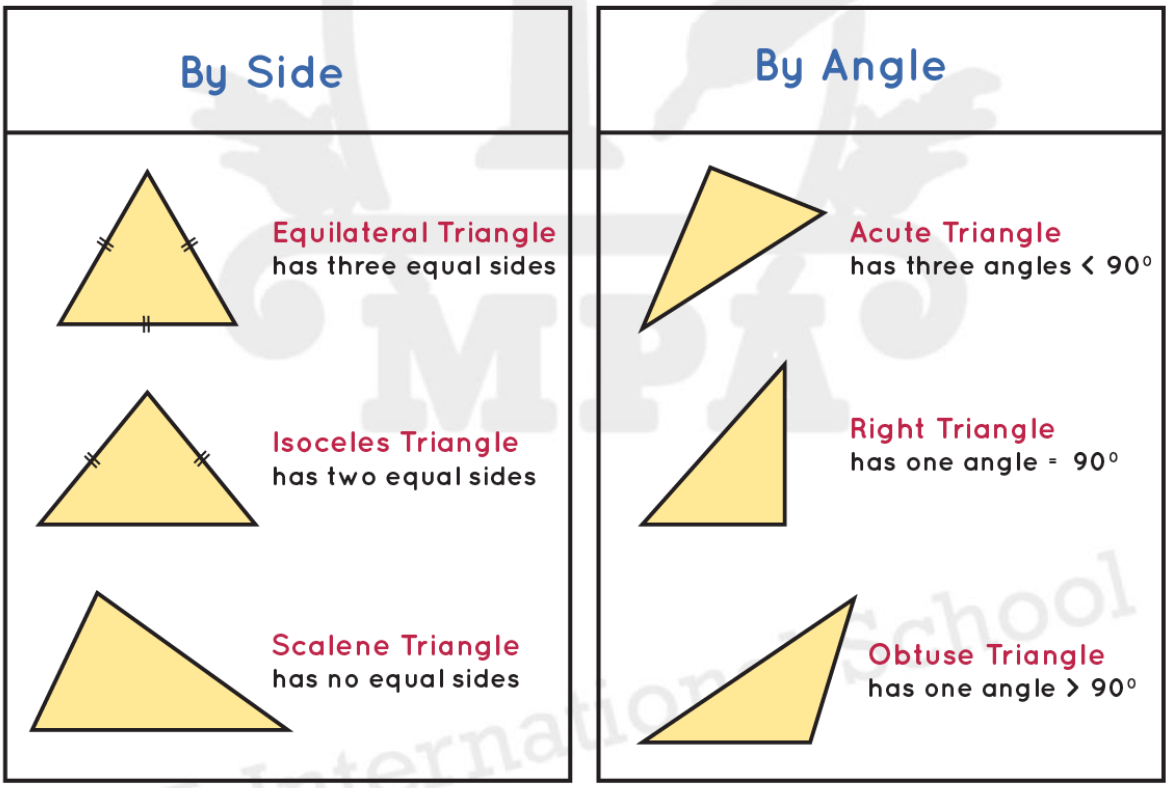


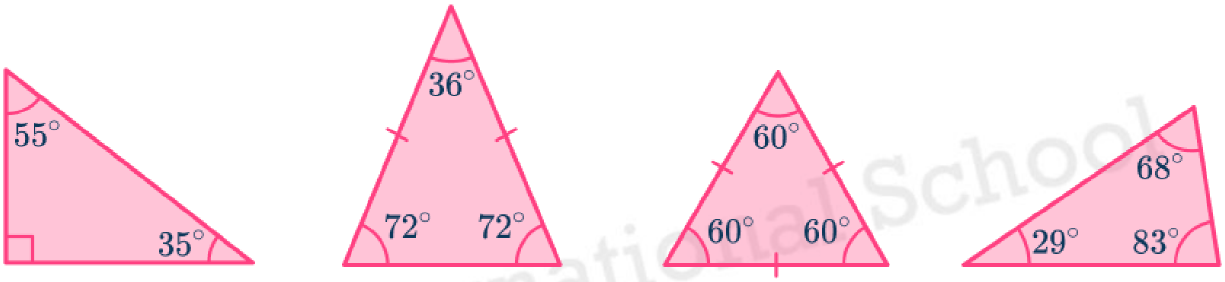
Vertically opposite angles

Vertically opposite angles are the pairs of angles that sit directly across from each other when two straight lines cross. In Year 6 geometry, the most important rule to remember is that vertically opposite angles are always equal to each other.



Angles in a triangle



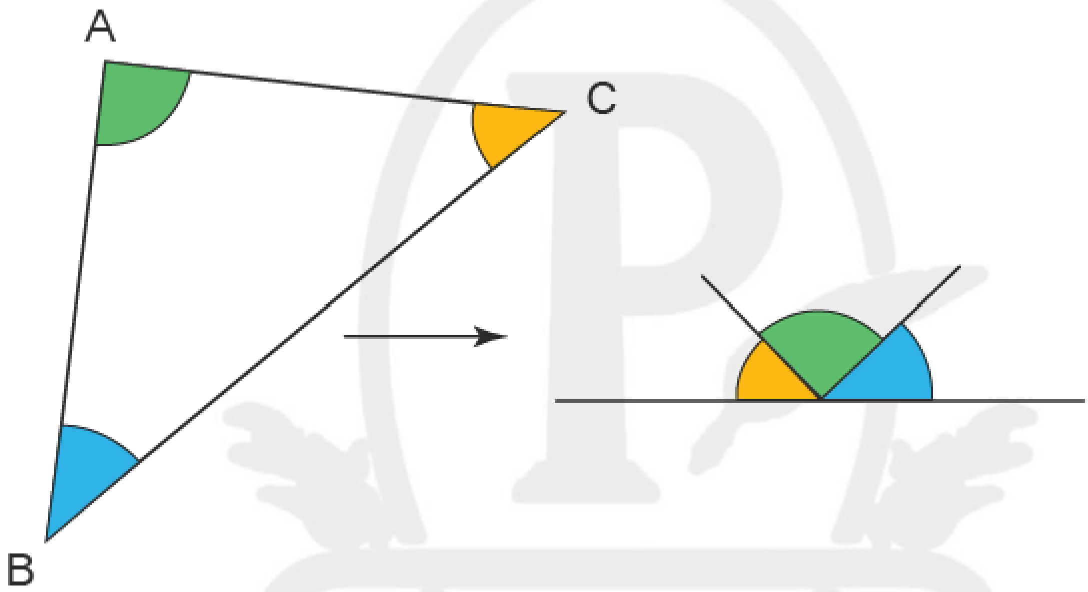


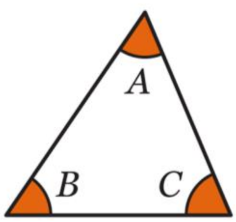
Right triangle
One right angle
$90 + 55 + 35 = 180^\circ$

Isosceles triangle
Two equal sides & angles
$72 + 72 + 36 = 180^\circ$

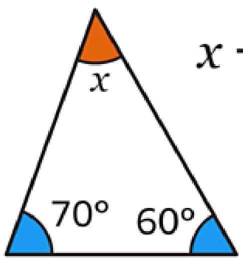
Equilateral triangle
Three equal sides & angles
$60 + 60 + 60 = 180^\circ$

Scalene triangle
All sides & angles different
$83 + 68 + 29 = 180^\circ$





$A + B + C = 180°$



$x + 70° + 60° = 180°$

$x + 130° = 180°$

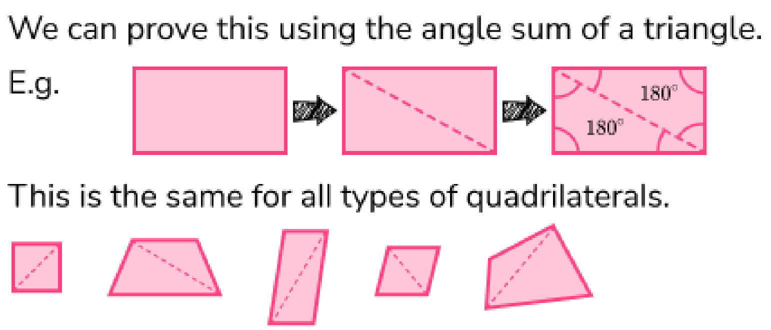
$-130° \quad -130°$

$x = 50°$

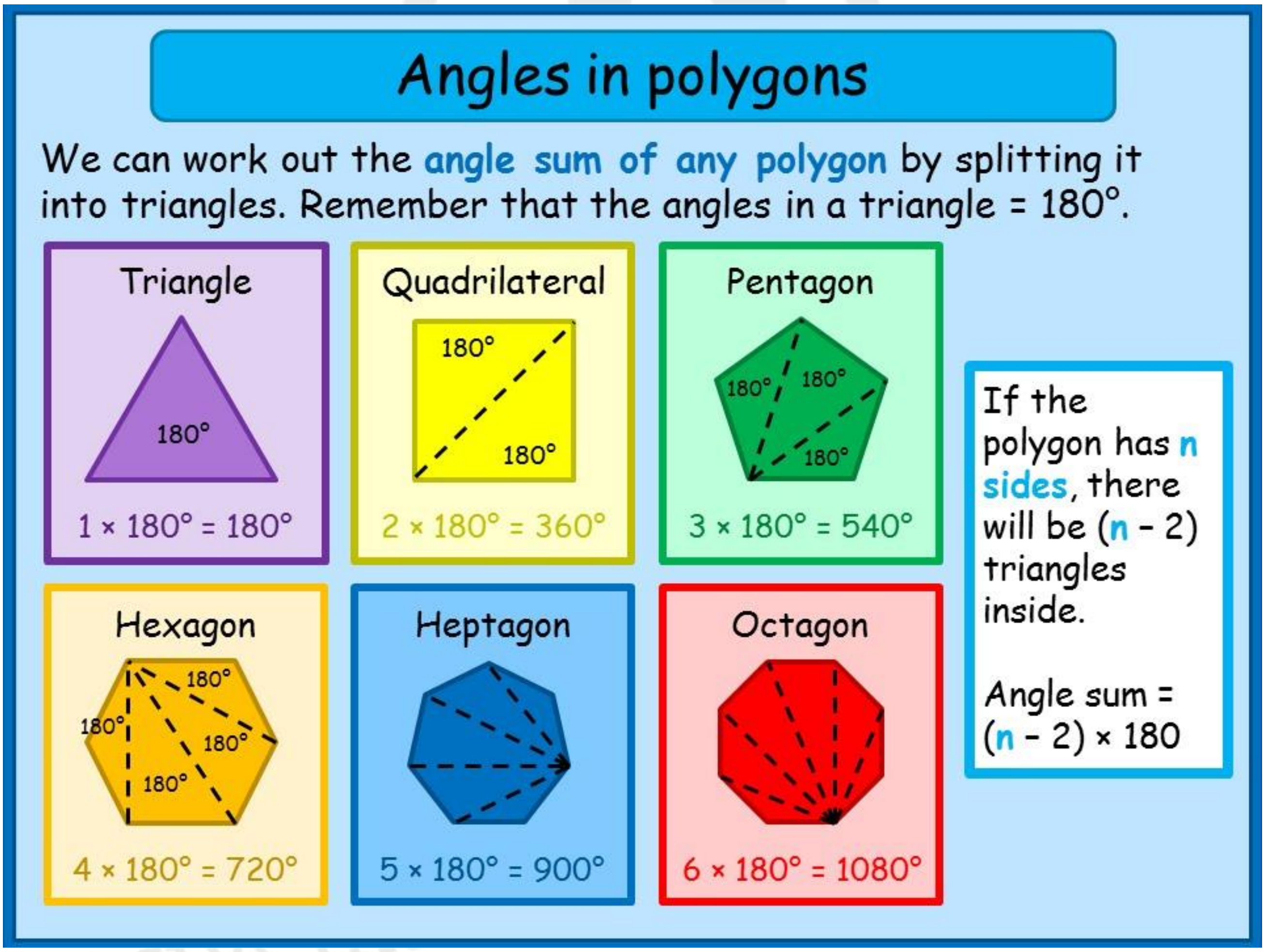
Angles in a quadrilateral

Angles in a quadrilateral are the four angles that occur at each vertex within a four-sided shape.

The sum of the four angles of any quadrilateral is 360°.

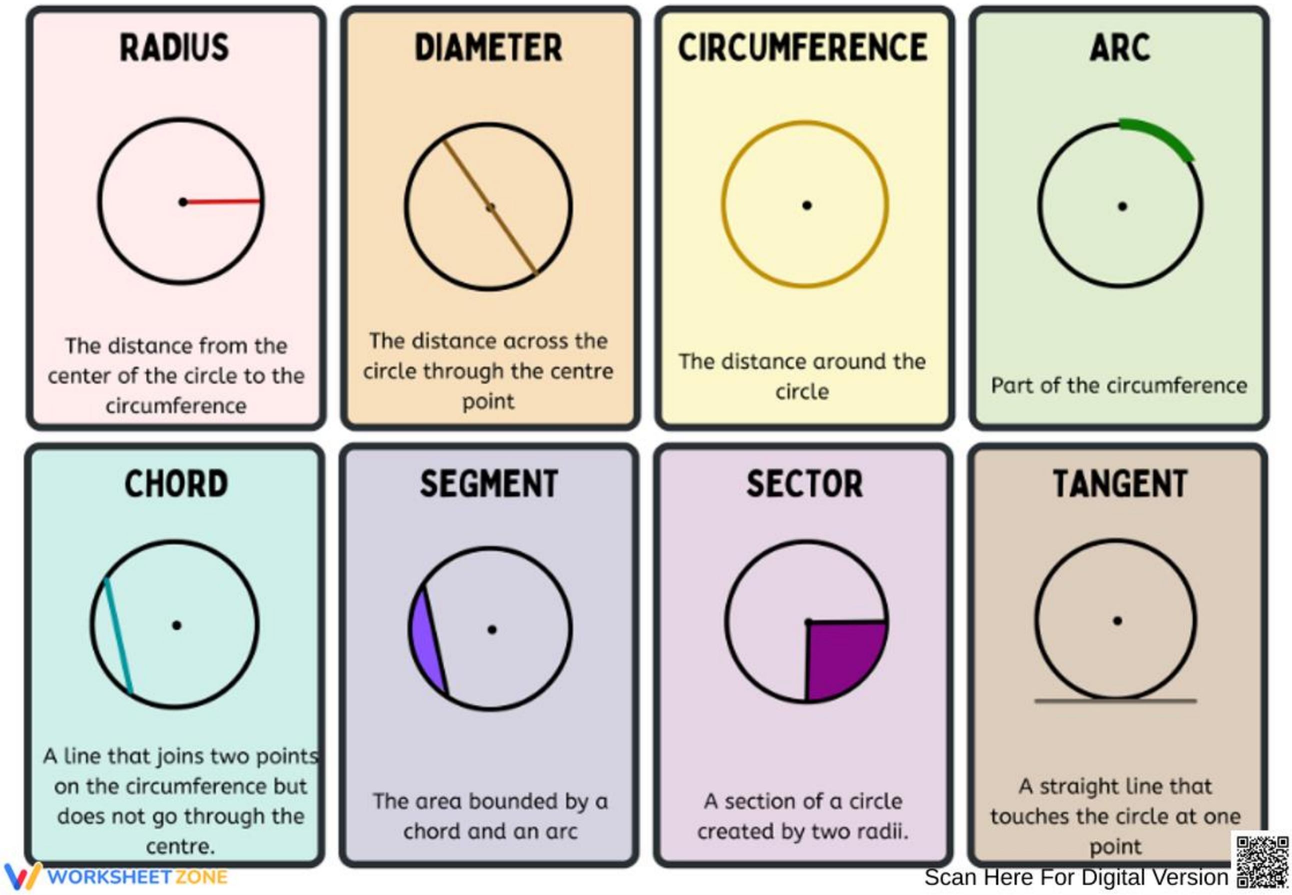


Angles in polygons



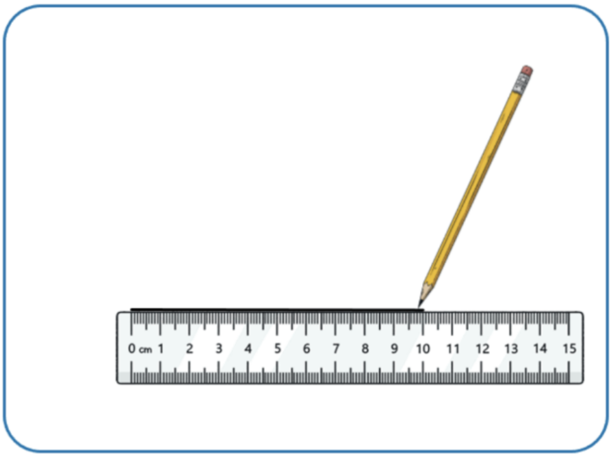
Circles

A circle is a closed two-dimensional figure in which the set of all the points in the plane is equidistant from a given point called the "*centre*".



<u>Side - Angle - Side (Two sides and one angle)</u>

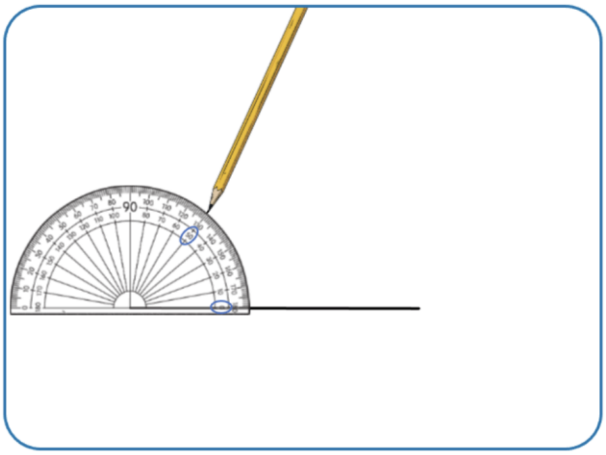
Step 1 Draw the Baseline



Use a ruler to measure and draw the first line.

This can be either of the two sides but we have drawn the 10cm line.

Step 2 Mark the Angle

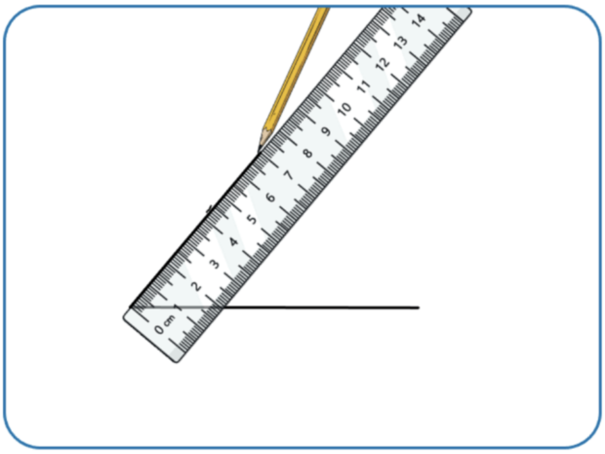


Line up your protractor on one end of the line.

Measure upwards from 0 to the angle you're drawing, in this case, 50°.

Use a pencil to mark this point then remove the protractor.

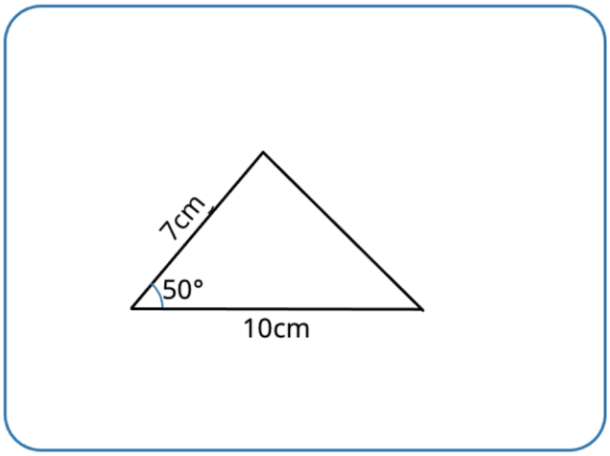
Step 3 Measure the Second Line



Line up your ruler so 0cm is at the base line and it passes through your pencil mark.

Carefully measure and draw the second side; this is a 7cm line.

Step 4 Drawing the Final Side

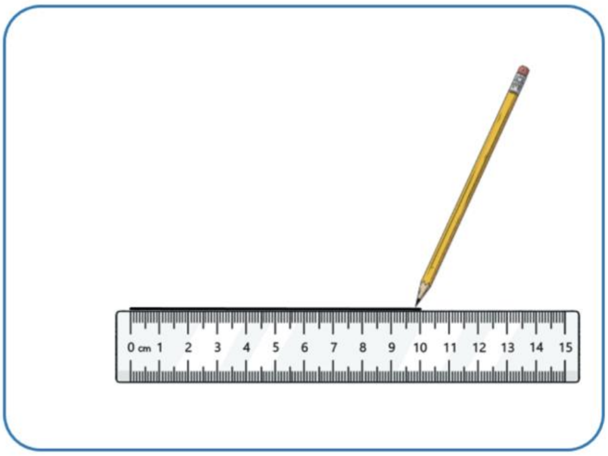


Line your ruler up with the ends of each of the sides you've drawn and join them up.

Finally, label the two sides and the angle.

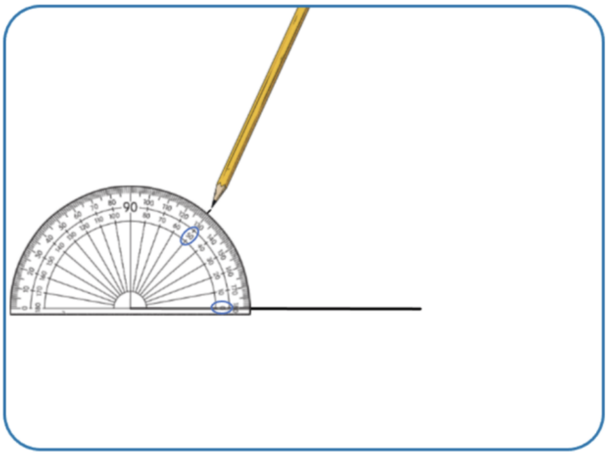
Angle - Side - Angle (Two angles and one side)

Step 1 Draw the First Side



Use a ruler to measure and draw the side you're given - in this case a 10cm line.

Step 2 Mark the First Angle

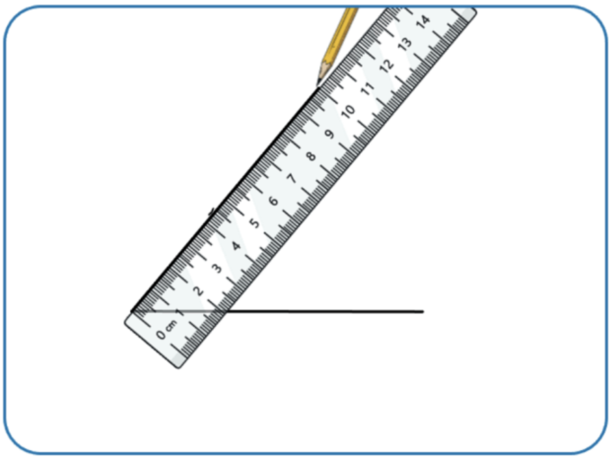


Line up your protractor on one end of the line.

Measure upwards from 0 to the angle you're drawing, in this case, 50°.

Use a pencil to mark this point then remove the protractor.

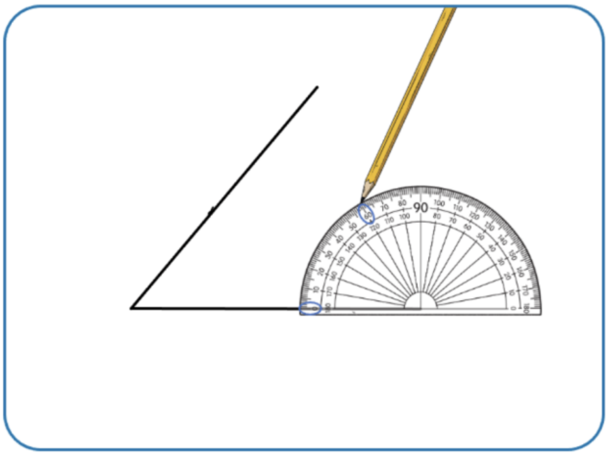
Step 3 Draw the Second Side



Line your ruler up so 0cm is at the base line and it passes through your pencil mark.

Draw the second side; you don't know the length so make it quite long. You can always erase some or add to it if you need.

Step 4 Mark the Second Angle

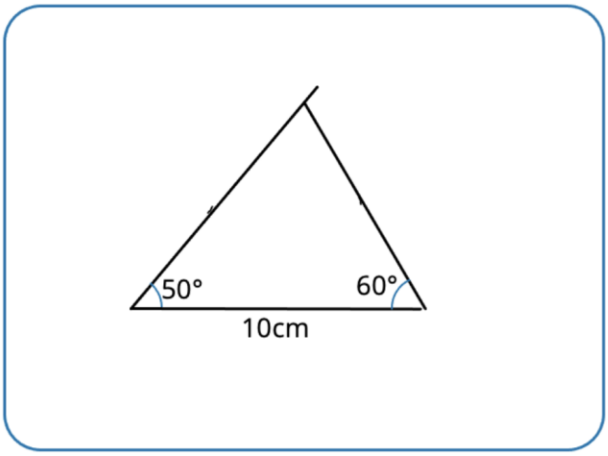


Line up your protractor on the other end of the base line.

Measure upwards from 0 to the angle you're drawing, in this case, 60°.

Use a pencil to mark this point then remove the protractor.

Step 5 Draw the Final Side

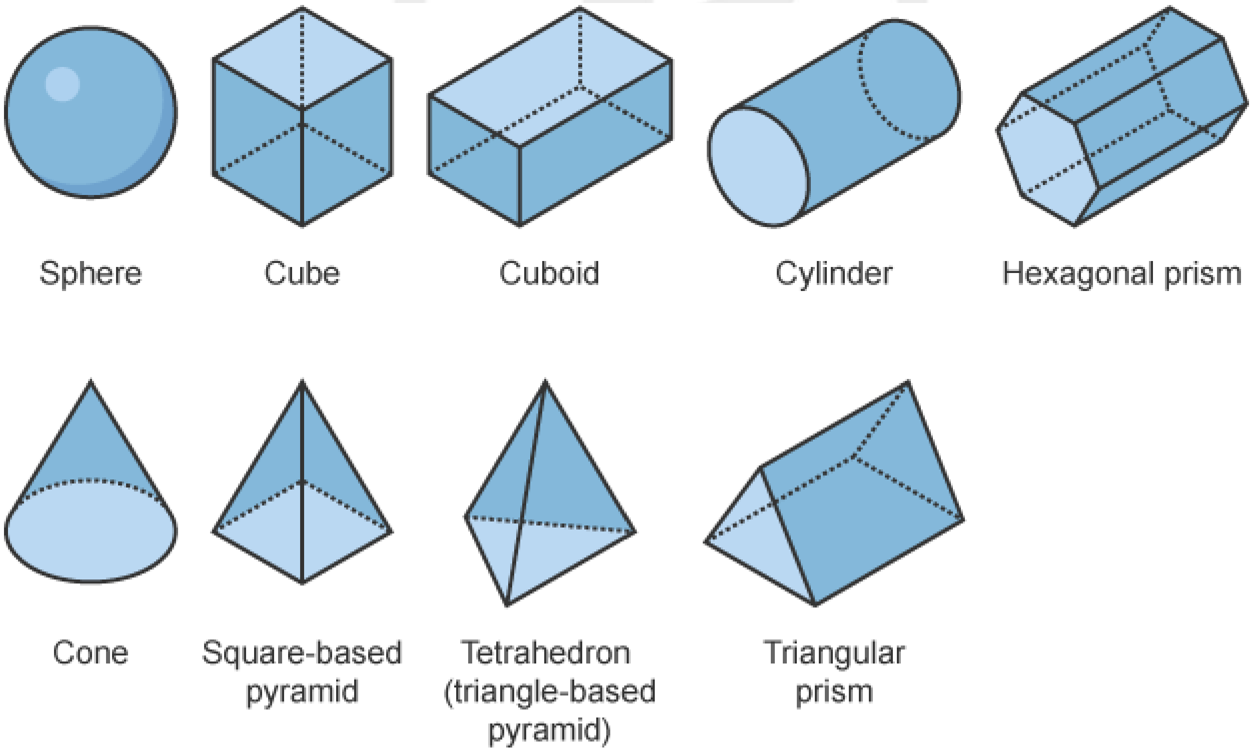


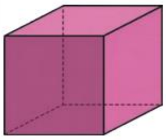
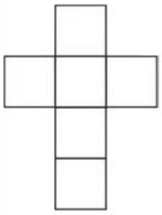
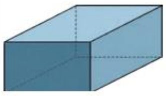
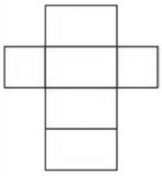
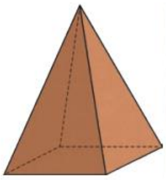
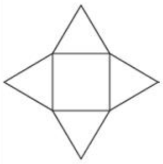
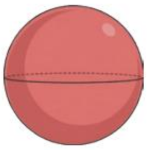
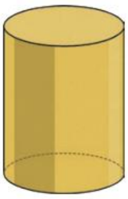
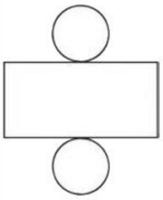
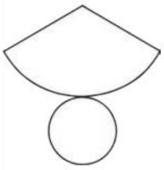
Line your ruler up at the end of the base line so it passes through your pencil mark.

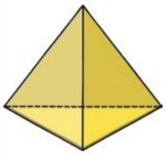
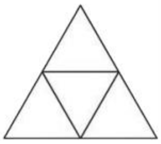
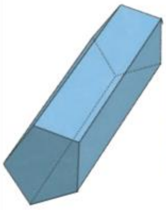
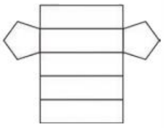
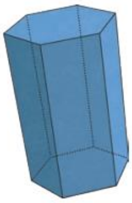
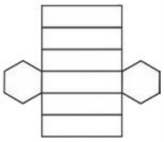
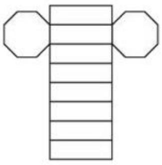
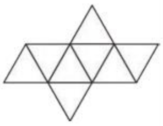
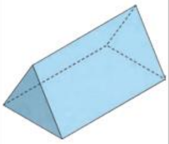
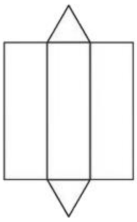
Draw the final side; it should be long enough to meet the second side.

Label the two angles and the side.

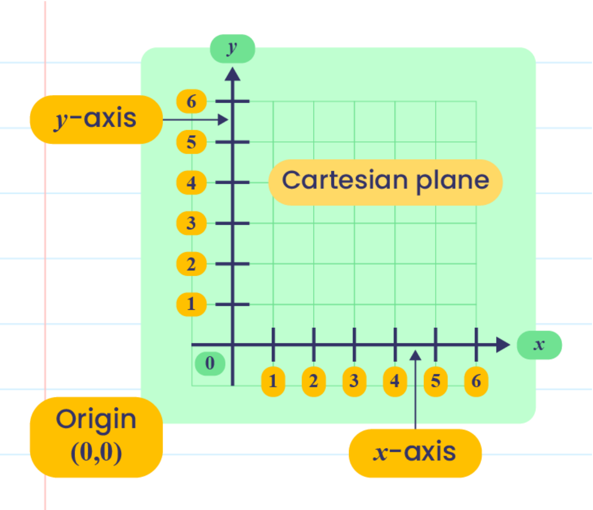
Nets of 3D shapes

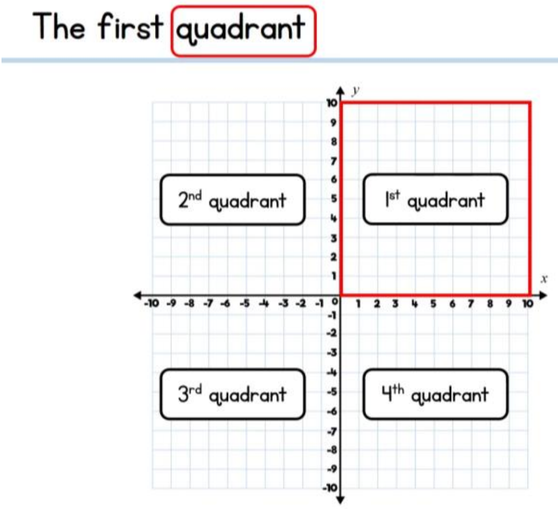


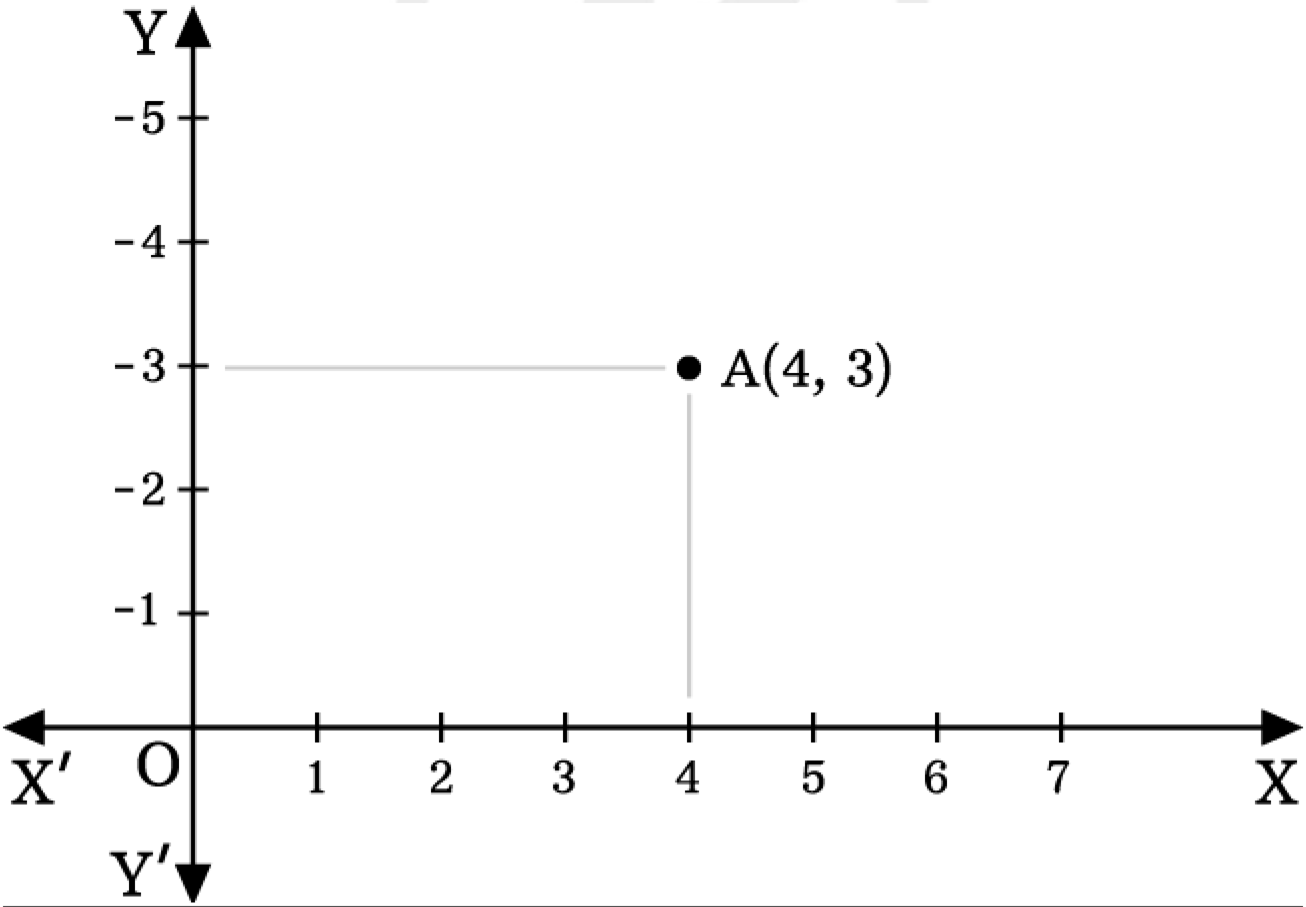
Name	Diagram	In Real Life	Corners (vertices)	Faces	Edges	Net
cube			8	6	12	
cuboid			8	6	12	
square-based pyramid			5	5	8	
sphere			0	1	0	There is no net for a sphere because there are no flat surfaces.
cylinder			0	3	2	
cone			1	2	1	

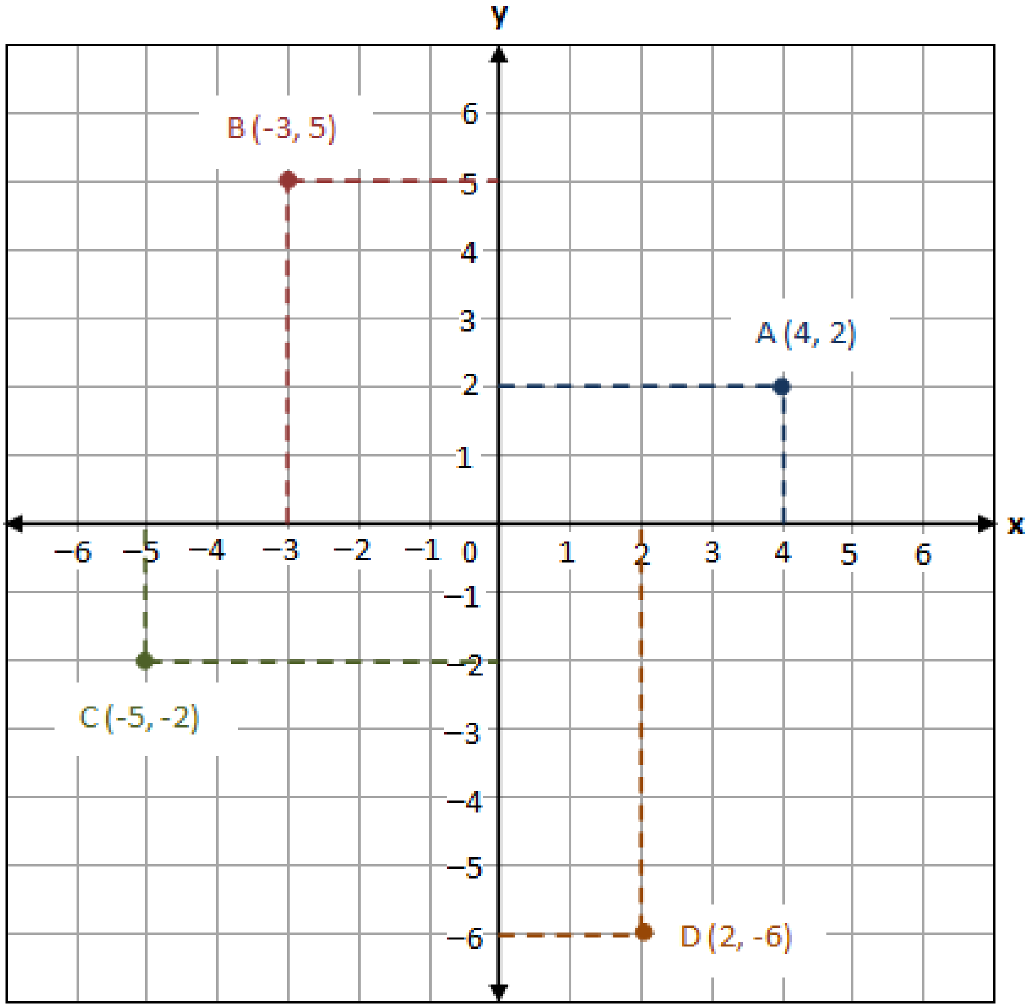
Name	Diagram	In Real Life	Corners (vertices)	Faces	Edges	Net
tetrahedron		 Tada Images - Shutterstock.com	4	4	6	
pentagonal prism			10	7	15	
hexagonal prism			12	8	18	
octagonal prism			16	10	24	
octahedron			6	8	12	
triangular prism			6	5	9	

<u>The first quadrant</u>



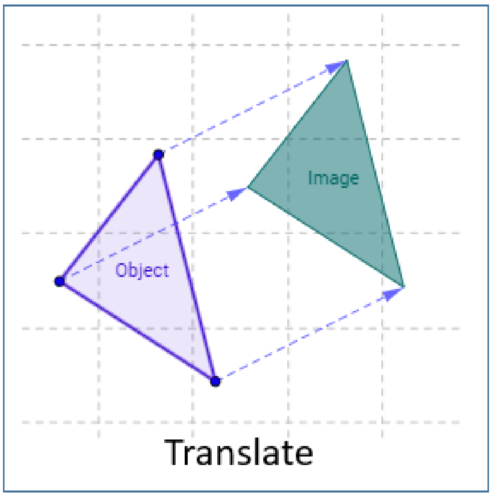


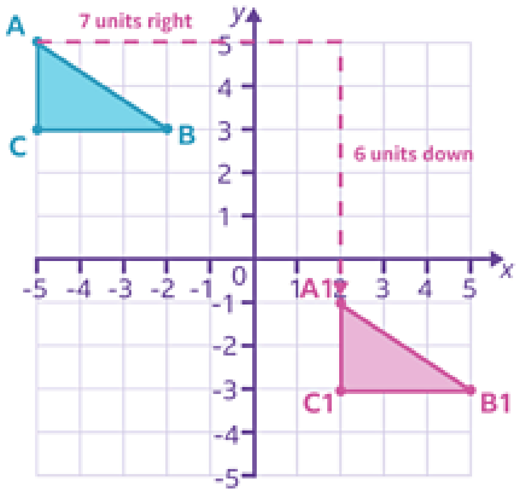




Translations

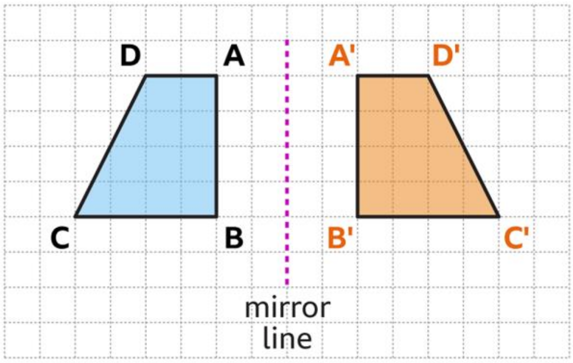
Translation means sliding a shape on a coordinate grid to a new position without turning, flipping, or resizing it. Every point on the shape moves the same distance in the same direction (e.g. 3 squares right, 2 squares down).

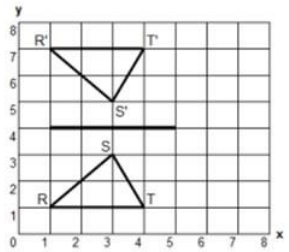




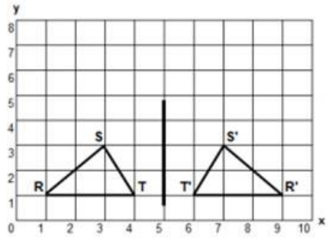
Reflections

Reflection is a type of transformation that flips a shape in a mirror line (also called a line of reflection) so that each point is the same distance from the mirror line as its reflected point.

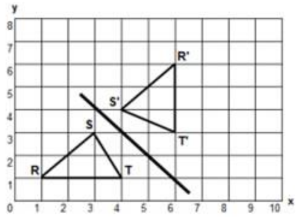




Horizontal mirror line

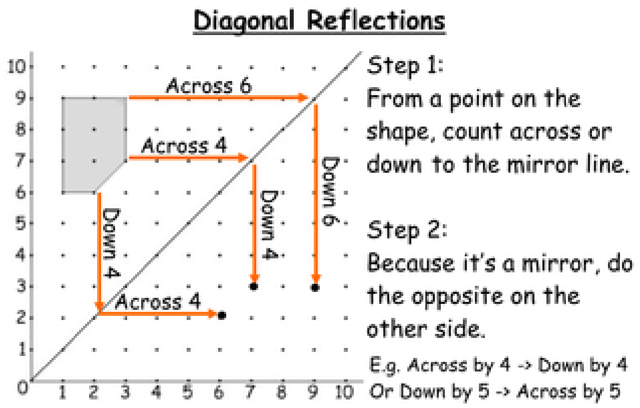


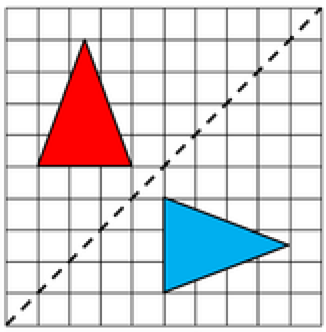
Vertical mirror line

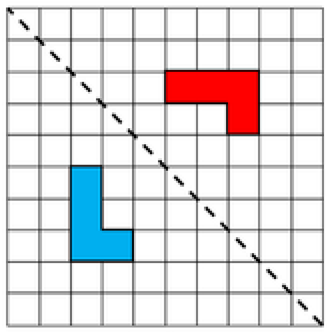


Diagonal mirror line

Facts for the diagonal mirror line

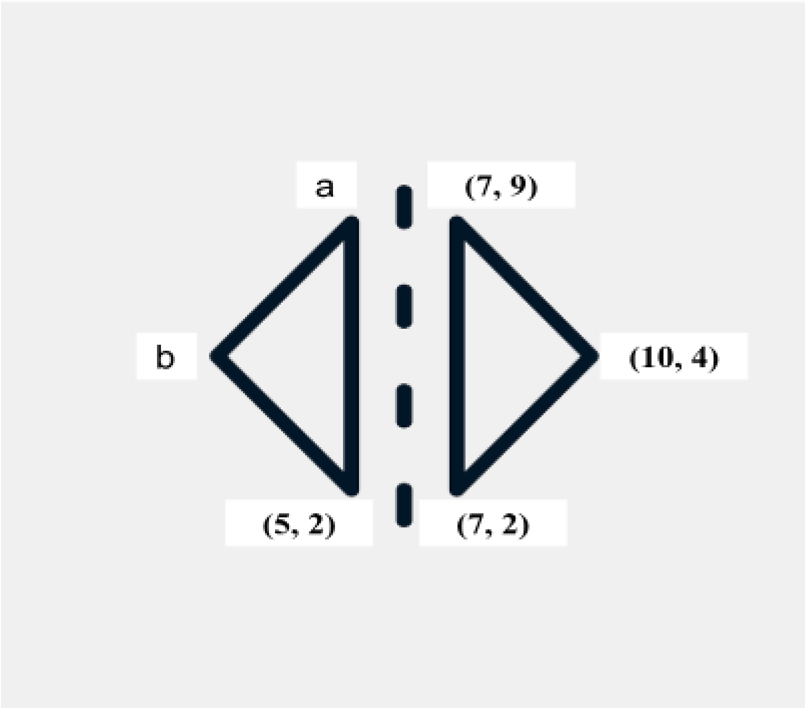






Missing Coordinates

- Shapes can be shown on unmarked grids.



- Point a is in the same position along the x-axis as (5, 2) and in the same position on the y-axis (7, 9).

  Point a (5, 9)

- Point b is in the same position on the y-axis as (10, 4). Both triangles will have the same width. The width of the right-angled triangle is 3. This means that the width of the left-hand triangle is also 3.

  Point b (2, 4)