MPA International School

YEAR 8

MATHEMATICS

Reference Resources Booklet (1)

Name : ……………………………………..………

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2026-2027 Academic Year

YEAR 8

MATHEMATICS

Reference Resources Booklet (1)

Unit – 1

Unit – 2

Unit – 3

Unit – 4

Preface

At MPA International School, we are committed to nurturing learners who are not only knowledgeable but also capable of guiding their own learning journey. This booklet has been carefully prepared to support our students as a confident, curious, and independent learner by providing clear, structured notes that reinforce key concepts and offer guidance across all related topics.

Each section in this booklet connects directly to the topics of the textbook, offering:

- Clear explanations of key ideas
- Concept summaries for quick revision
- Supportive notes that encourage **self-study** and **personal reflection**

This resource is designed to help students' **review at their own pace**, explore topics more deeply, and strengthen what they've learned in class. Whether they're preparing for a quiz, completing homework, or simply curious to know more—this booklet is here to guide and support them. Most importantly, use it to grow as a **self-directed learner**—someone who learns with purpose, confidence, and curiosity.

This resource is not meant to replace active learning or classroom discussion but to empower students to revisit important content at their own pace—whether reviewing after a lesson, preparing for a quiz, or exploring further out of curiosity.

We hope this booklet empowers you to take ownership of your learning with purpose and pride.

Academic Team
MPA International School

Contents

UNIT (1) Number

1.1 Calculating with negative numbers

A **negative** number is **less than** zero. A negative number is written with a minus sign in front.
The four operations are addition (+), subtraction (–), multiplication (×), and division (÷). When adding and subtracting negative numbers, it may help to have a number line.

Addition and Subtraction

Example 1 Calculate -6 + 4. Find the starting number. **-6** Now, look at the sign immediately to the right of this number. This tells you whether to move right or left from your starting number; + tells you to go right, up the number line, and – tells you to move down, to the left. In this question, you will move right (up the number line). The second number tells you how many to move up or down, which, in this case will be 4. **-6 + 4 = -2**	**Example 2** Calculate -3 – 5. Find the starting number. **-3**. Look at the sign immediately to the right of this number: – This tells you to move down (left) along the number line. 5 tells you that this will be 5 places. **-3 – 5 = -8**
Example 3 Calculate -6 – -9. This question has two signs next to each other; when this happens, you can substitute the pair for a single function to simplify the calculation. **++ or – – are replaced by +.** **+ – or – + are replaced by –.** So, -6 – -9 becomes -6 + 9. Following the same steps as before gives you an answer of **3**.	**Example 4** Calculate -5 + -2. **+ – or – + are replaced by –.** -5 + -2 becomes -5 – 2. -5 – 2 = -7

Multiplication and Division

The methods for multiplying and dividing negative numbers are completely different from those for adding and subtracting.
Firstly, ignore any negative signs and complete the multiplication or division with positive numbers.
Once you have calculated the multiplication or division, take note of the signs in the question.
If they are **both negative** or **both positive**, your answer will be **positive**.
If there is **one of each**, your answer will be **negative**.

Example 1	Example 2
Calculate -7 × 3. Complete the multiplication with positive numbers. **7 × 3 = 21** Now, look at the signs. There is a **negative** sign with 7 and there doesn't appear to be anything with 3. (If there doesn't appear to be a sign with a number, the number is positive.) We have one of each so the answer will be negative. **-7 × 3 = -21**	Calculate -45 ÷ -9. Complete the division with positive numbers. 45 ÷ 9 = 5. Now, look at the signs. Both signs are **negative**, so the answer will be **positive**. **-45 ÷ -9 = 5**

1.2 Prime Factor Decomposition

What is prime?

- A prime number is **a whole number greater than 1** whose **only factors are 1 and itself**.
- A factor is a whole number that can be divided evenly into another number.
- The first few prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, and 29. Numbers that have more than two factors are called composite numbers.

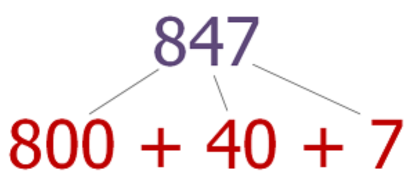
What are the factors?

To factor a number is **to express it as a product of (other) whole numbers**, called its factors.

For example, we can factor 12 as 3 × 4, or as 2 × 6, or as 2 × 2 × 3. So 2, 3, 4, and 6 are all factors of 12.

What is decomposition?

Decomposing a number means bre**aking a whole number into two smaller parts**.
To decompose the number 5, you can break it into smaller parts of 4 and 1, or 3 and 2.
Decompose a number. Decomposing a number means taking a whole number and breaking it into two smaller
parts.



Prime factor decomposition

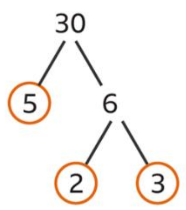
Prime factor decomposition of a number means writing it as a product of prime factors.

- To factorise a number, divide it by the first possible prime number.
- Take the resulting quotient below the number.
- If it is possible, continue dividing this quotient successively by the same prime number.
- When you cannot divide by this prime number, divide it by the next possible prime number.
- And so forth until the final quotient is 1.
- Finally, write this number as a product of powers of prime factors.
-

Factor tree

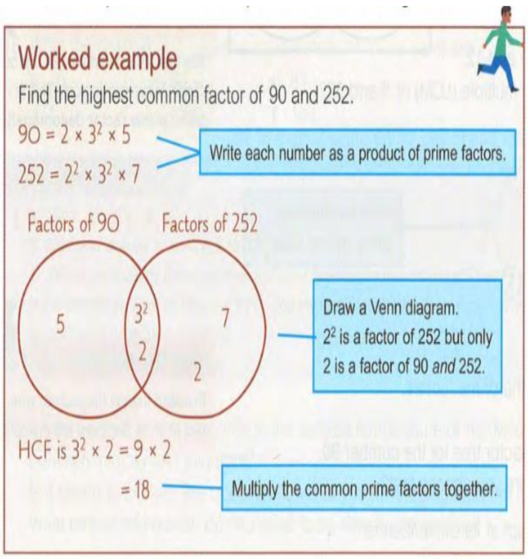
A special diagram where we find the factors of a number, then the factors of those numbers, etc, until we can't factor any more.

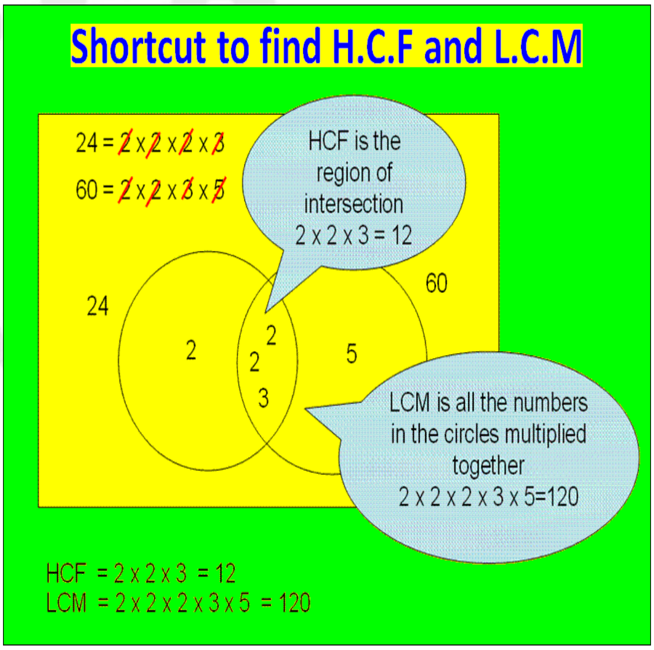
The ends are all the prime factors of the original number.



Finding HCF using a Venn Diagram

- **Write the numbers as a product of their prime factors**
- **Find the common factors.**
- **Put the common factors into the *overlapping area* of the Venn diagram.**
- **And the numbers must be in their respective areas/circles.**
- **For HCF, *multiply* all the numbers *within the overlapping area*.**





1.3 Using Indices

Simplifying Expressions with Indices

Many expressions can be simplified by collecting like terms. Two terms are “like” if they have the same variable and the same power. For example, x^3 and $3x^3$ are like terms, but $4x^3$ and $4x^2$ are not, as one is to the power of 3 and the other is to the power of 2.

When multiplying or dividing expressions with indices, we consider the multiplication represented by the power. Coefficients should be considered separately, as should each different variable.

The Addition Law for Indices

If two terms have the same base, we can simplify the product of the terms by adding the powers. This can be generalised with the identity:

$$a^m \times a^n \equiv a^{m+n}$$

When the terms have coefficients, these should be considered separately and can be simplified by finding their product. Similarly, each different base should be considered individually.

The Subtraction Law for Indices

If two terms have the same base, we can simplify the division of the terms by subtracting the powers. This can be generalised with the identity:

$$\frac{a^m}{a^n} \equiv a^{m-n}$$

When the terms have coefficients, these should be considered separately and can be simplified by finding common factors. Similarly, each different base should be considered individually.

The Product Law for Indices

If an expression with an index is raised to a power, we can simplify the terms by multiplying the powers.
This can be generalised with the identity:

$$(a^m)^n \equiv a^{mn}$$

When the terms have coefficients, these should be considered separately and can be simplified by raising the coefficient to the power. Similarly, each different base should be considered individually.

1.4 Priority of Operations

When we evaluate expressions, we use one set of rules so that everyone arrives at the same correct answer. The rules used for simplifying numerical expressions are called **order of operations**. These rules are based on doing the most powerful operations first (exponents), then the less powerful ones (multiplication and division, going from left to right), and finally, the least powerful ones last (addition and subtraction, going from left to right). Grouping symbols, like parentheses, tell us to evaluate whatever is inside them before moving on. You can remember the order of operations with the acronym **PEMDAS** or **BIDMAS**.

Expressions with Only Addition, Subtraction, Multiplication, and Division

- Multiplication and division are evaluated **first**, **from left to right.**
- Addition and subtraction are always evaluated **last**, **from left to right**.

Expressions with Four Operations and Exponents

- Exponents are more **powerful** than multiplication or division.
- If exponents are present in an expression, they are evaluated **before** any multiplication or division.

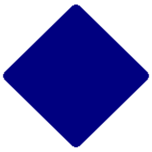
UNIT (4) 2D SHAPES AND 3D SOLIDS

4.1 Area of triangles, Parallelograms and Trapezia

Quadrilateral

A ***QUADRILATERAL*** is a polygon with four sides (***Quadri*** means ***four*** and ***Lateral*** means ***sides***).

Here are some "famous" quadrilaterals, and how they are related.

NAME	EXAMPLE	CHARACTERISTICS
Parallelogram		Opposite sides are parallel and equal in length.
Rectangle		A parallelogram where all four sides form right angles.
Rhombus		A parallelogram where all sides are equal in length.
Square		A parallelogram where all sides are equal in length and all sides form right angles.
Trapezoid		Has exactly two parallel sides, which are called $base_1$ and $base_2$. Sides do **NOT** have to be equal in length.

The **AREA** is the size of a surface or the amount of space inside a two-dimensional object.

Area is written in "*units squared*" or *units*^{2}.

AREA OF PARALLELOGRAM

To calculate the AREA of a PARALLELOGRAM, multiply the base length by the perpendicular height. (This formula applies to rectangles, rhombuses, and squares, too.)

A = base length × perpendicular height

Area of parallelogram, $A = bh$

AREA OF TRIANGLE

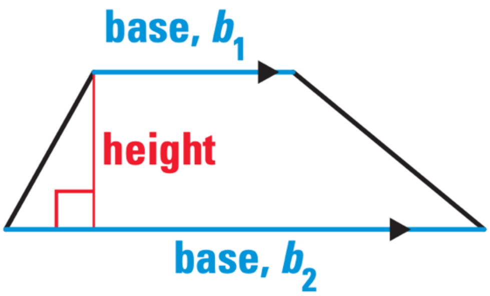
When we split the parallelogram diagonally into 2 equal parts, it gives us *2 identical triangles*.

Area of the triangle = half of the Area of the parallelogram

Area of the triangle = $12 \times bh$

Area of triangle, A = 12 bh

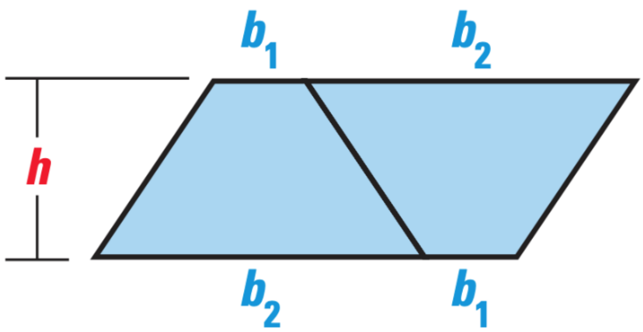
AREA OF TRAPEZOID / TRAPEZIUM



The parallel sides of a trapezoid are called the bases of the trapezoid, with lengths denoted by $\mathbf{b_1}$ and $\mathbf{b_2}$.

The shortest distance between the bases is the **height of the trapezoid**.

Suppose that two congruent trapezoids with bases $\mathbf{b_1}$ and $\mathbf{b_2}$ and height **h** are arranged to form a parallelogram as shown.



The area of the parallelogram is $h(b_1 + b_2)$. Because the two trapezoids are congruent, the area of one of the trapezoid is half the area of a parallelogram.

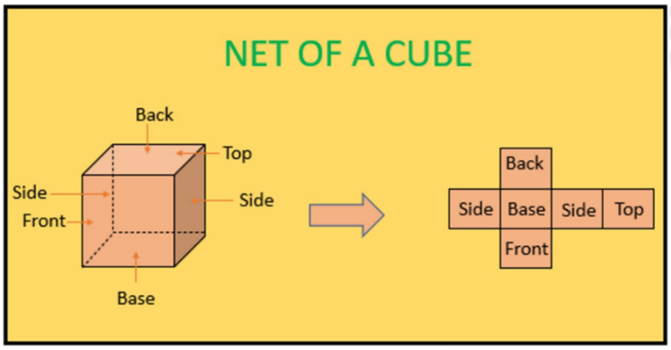
4.3 Properties of 3D solids

Nets of Solid Shapes:

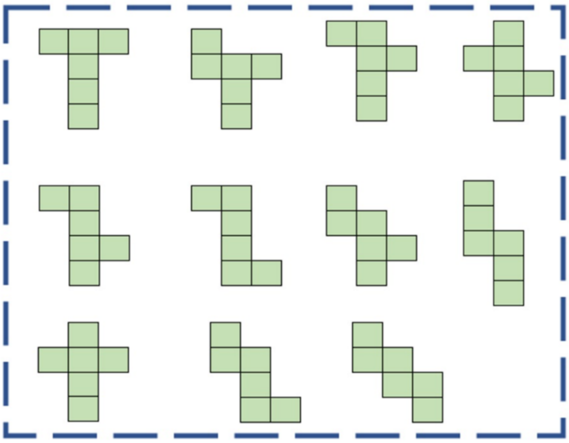
- A three-dimensional shape can be made by folding 2D shapes.
- When a three-dimensional solid is unfolded, a two-dimensional shape is obtained.
- Those 2D solids which are used to make a 3D shape are called.

Cube Nets:

- A cube has 6 faces.
- Each face of the cube is a square. Therefore, when a cube is unfolded, it will give 6 squares.



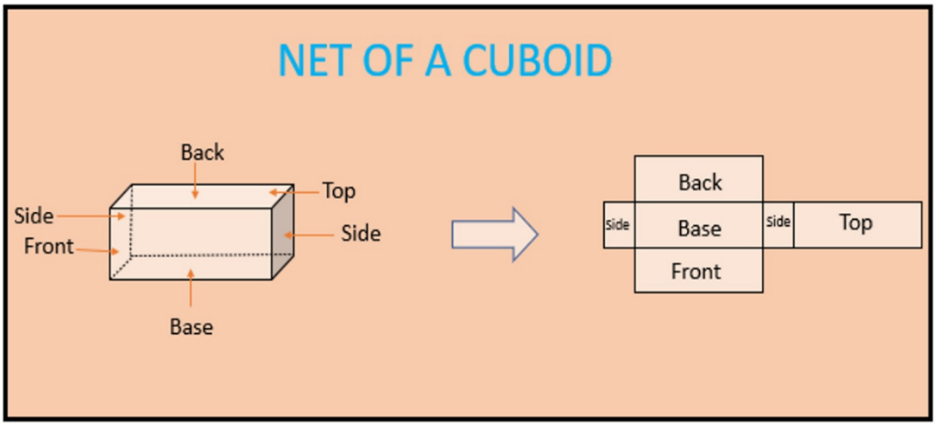
- There are 11 nets of a cube.
- The figure of each net is shown below.



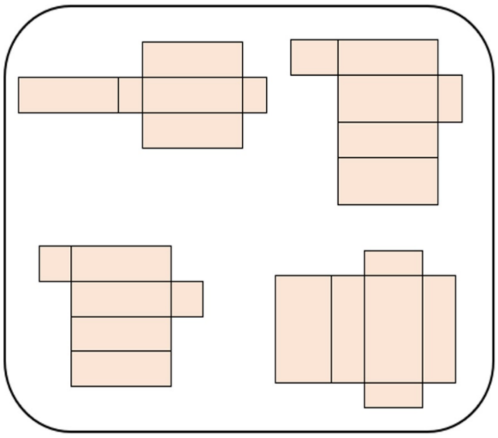
- ***Not every net that has 6 square faces can be folded into a cube.***

Nets of Cuboid:

- A cuboid has 6 faces.
- Each face of the cuboid is a rectangle. Therefore, when a cuboid is unfolded, it will give 6 rectangles.



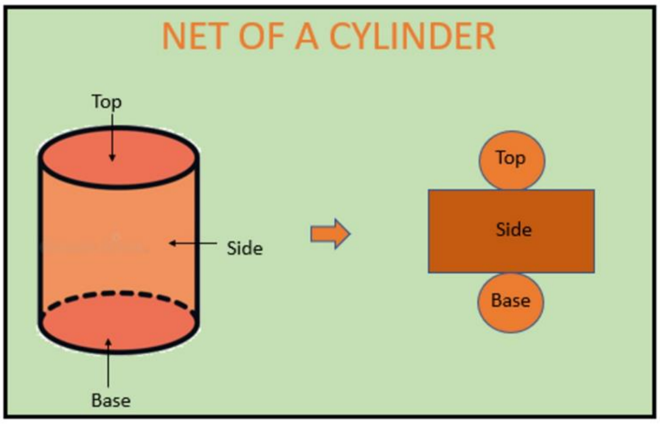
- There are 54 different nets of the cuboid.
- A few nets of the cuboid are shown below.



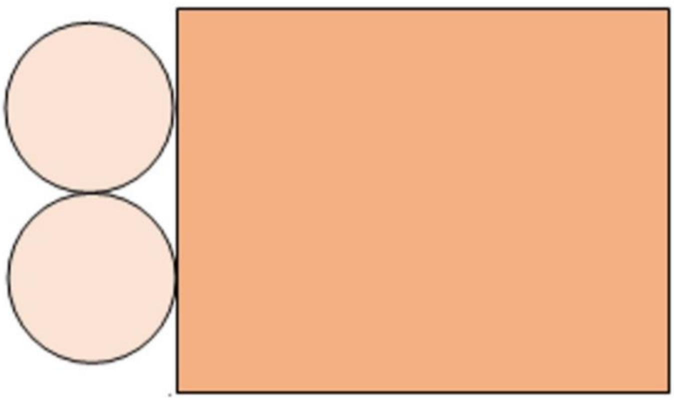
- ***Not every net that has 6 rectangular faces can be folded into a cuboid.***

Net of Cylinder

- A cylinder has 3 faces.
- Two of the faces are circular, and one is rectangular.
- Therefore, when a cylinder is unfolded, it will give 2 circles and 1 rectangle.

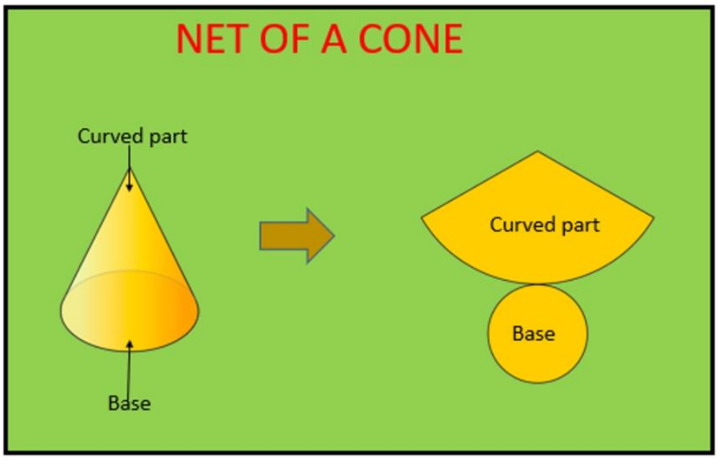


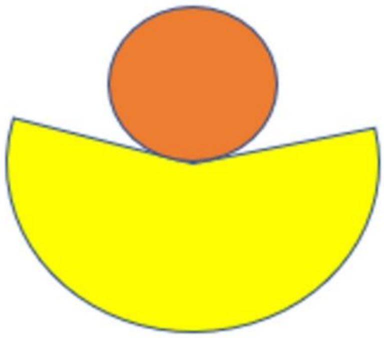
- The figure given below cannot be folded into a cylinder.



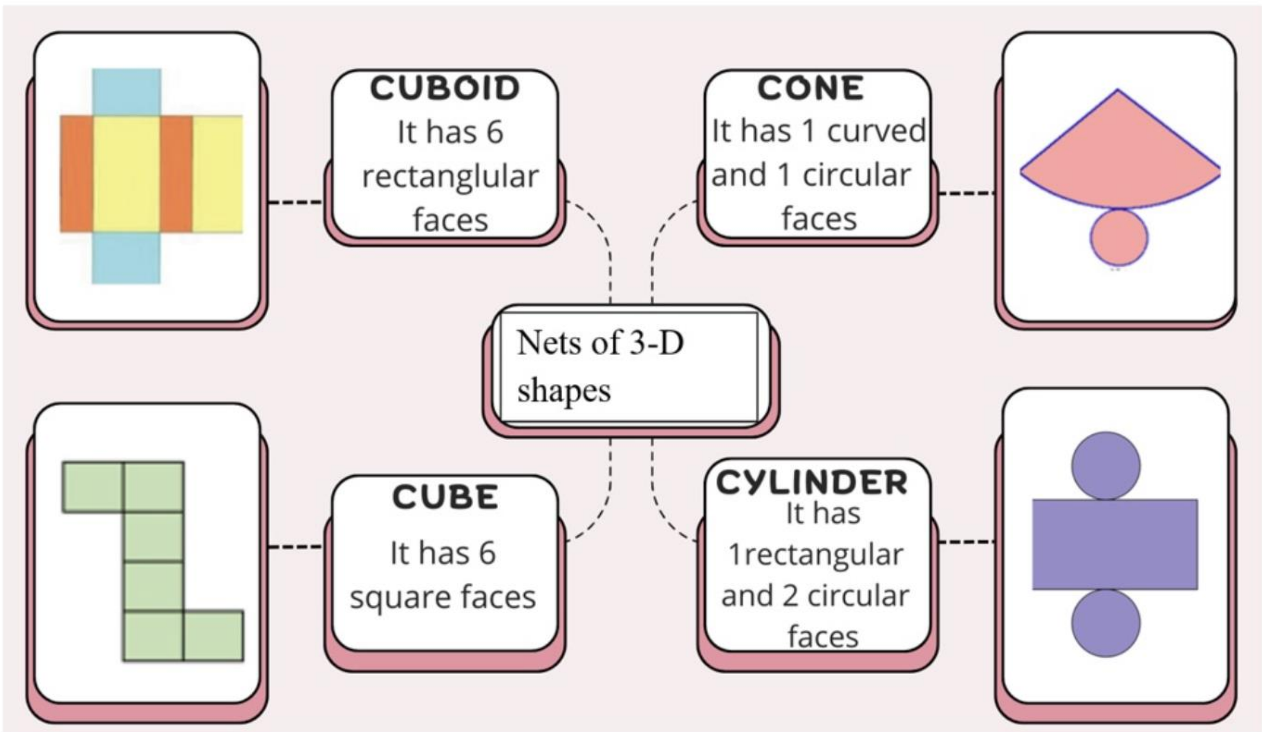
Net of Cone

- A cone has 2 faces.
- One curved face and one flat face.
- A net of cones has two parts:
- One is the circle, which represents the flat part.
- The second one is the sector that represents the curved part.
- Therefore, when a cone is unfolded, it will give one circle and one sector.





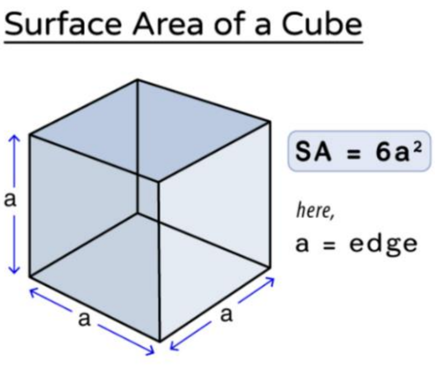
- The net given below cannot be folded into a cone.



4.4 Surface area

Surface Area of a Cube

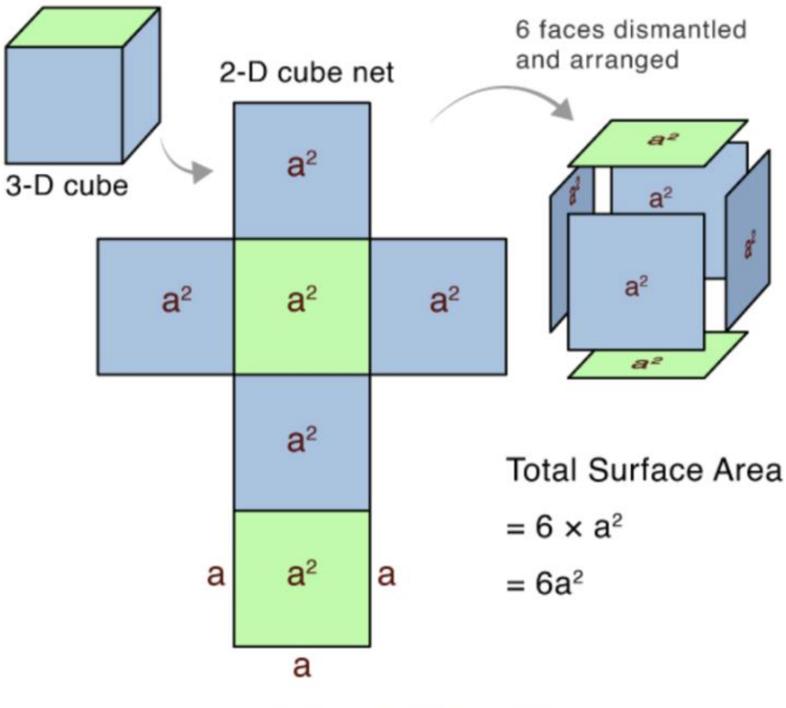
The surface area or the total surface area of a cube is the entire space occupied by its outer faces. In other words, it is the number of unit squares needed to cover its shape. It is expressed in square units such as m^2, cm^2, mm^2, or in^2.



Surface Area of a Cube

How to Find the Surface Area of a Cube

Let us understand how we consider the faces of a cube and calculate its surface area with the help of a net.

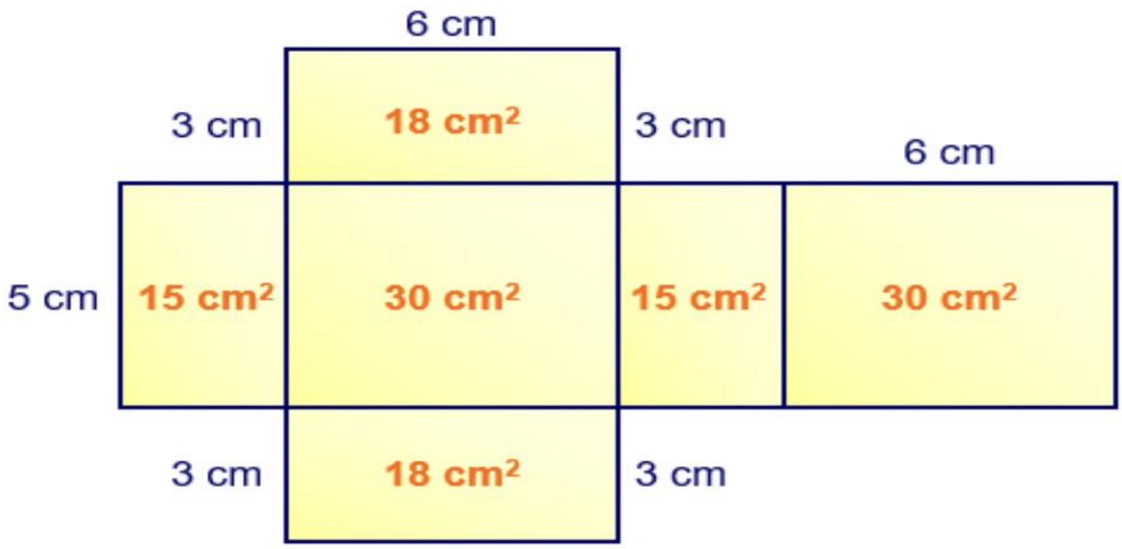


How to Find the Surface Area of a Cube

Surface area of a Cuboid

Using nets to find the surface area of Cuboids

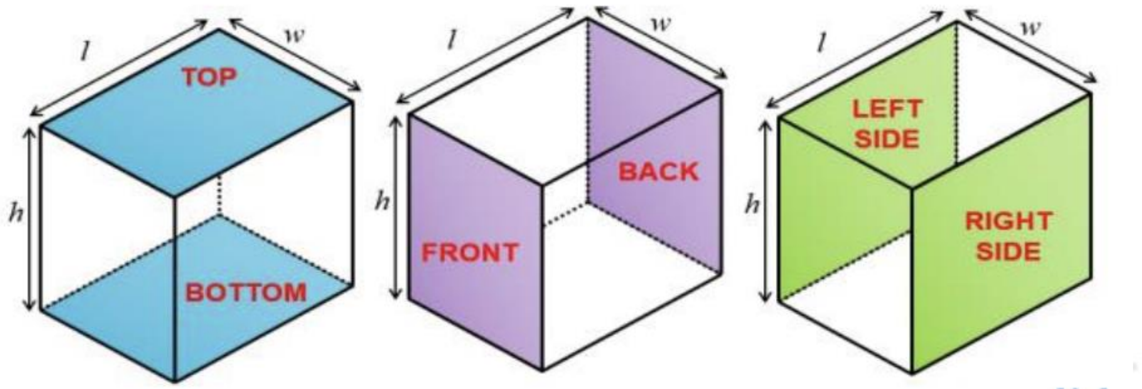
It can be helpful to use the net of a 3-D shape to calculate its surface area. Here is the net of a 3 cm by 5 cm by 6 cm cuboid.



The surface area is calculated **by adding all the areas together**.

$15\ cm^2 + 15\ cm^2 + 18\ cm^2 + 18\ cm^2 + 30\ cm^2 + 30\ cm^2 = 126\ cm^2$

This is the sum of all the areas of individual faces. This can be found by finding the area of individual faces, with or without drawing the net of the shape.



Area of top = lw
Area of bottom = lw

Area of front = hw
Area of back = hw

Area of left = lh
Area of right = lh

Area of top & bottom = $2lw$

Area of front & back = $2hw$

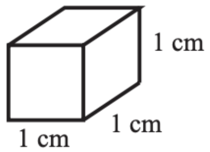
Area of left & right = $2lh$

Surface area of a cuboid $= 2lw + 2hw + 2lh$

$= 2(lw + hw + lh)$

4.5 Volume

Concept of Volume: The Unit Cube



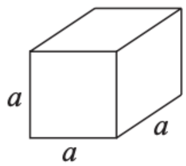
The volume of this cube is 1 cm^3 (1 cubic centimetre)

Volume of a cube

Volume of a cube $= a \times a \times a$

$= a^3$

where a is the length of the each side of the cube



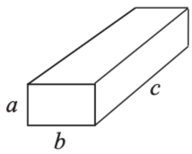
Note: If the sides of the cube are measured in *cm*, the volume will be measured in cm^3.

Volume of a cuboid

Volume $= a \times b \times c$

$= abc$

where a, b and c are the lengths of the sides of the cuboid



Capacity

The capacity of a container is how much it can hold.
The units of capacity are cm^3, millilitres (*ml*), and litres (l).

- 1 millilitre (*ml*) =essential 1000 cm^3

4.6 STEM: Measures of area and volume

It is important to be able to select the most suitable metric units for measurement. Some of the metric units that you already know are

- mm, cm, m, km (length)
- mm^2, cm^2, m^2, km^2, hectares (area)
- A hectare is 10,000 m^2. Convert *km* to *m* and then m^2 to hectares.
- A quadrat is a square frame used to sample organisms, such as plants, in a large area.

To convert from

• cm^3 to mm^3, you **multiply** by 10^3 or 1000

• mm^3 to cm^3, you **divide** by 10^3 or 1000

• m^3 to cm^3, you **multiply** by 100^3 or 1,000,000

• cm^3 to m^3, you **divide** by 100^3 or 1,000,000

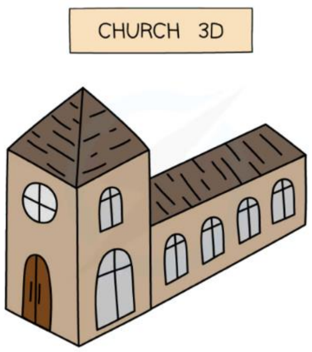
4.7 Plan and elevations

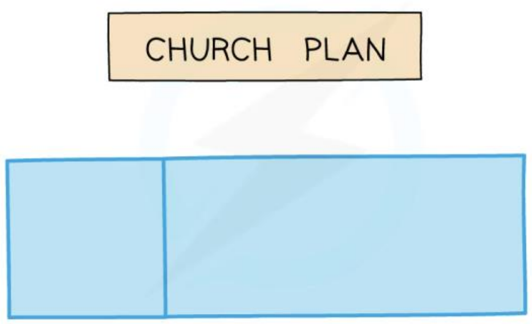
What are plans and elevations?

- They are two-dimensional views of a three-dimensional object.
- They are the mathematical shapes you would see when looking directly at a 3D object from a given direction.

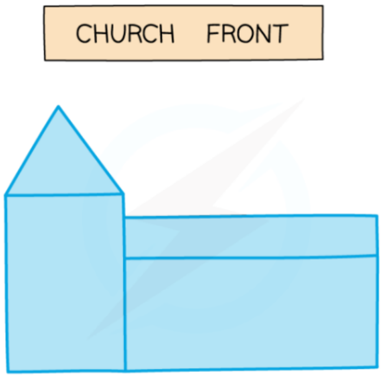
How do I draw plans and elevations?

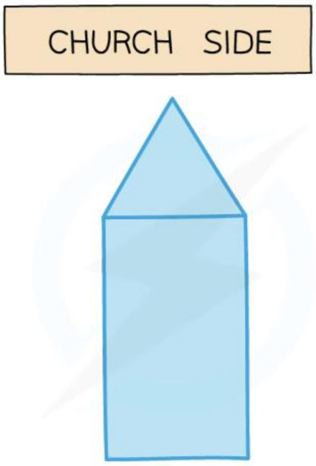
Consider looking at a 3D object, such as a building
- Consider the different directions you could look at the object from.
- There is the front view, the side view, and the plan view from directly above.





- The view you would see looking **directly down** on an object is called the **plan view**.
- This is commonly known as a **bird's-eye view**.





- The shape you would see stood directly in **front** of the object is the **front elevation**.

- The shape you would see directly **facing** The side of the object is called the **side elevation**.

UNIT (2) EQUATIONS AND FORMULAE

2.1 Solving one-step equations

2.2 Solving two-step equations

2.3 More complex equations

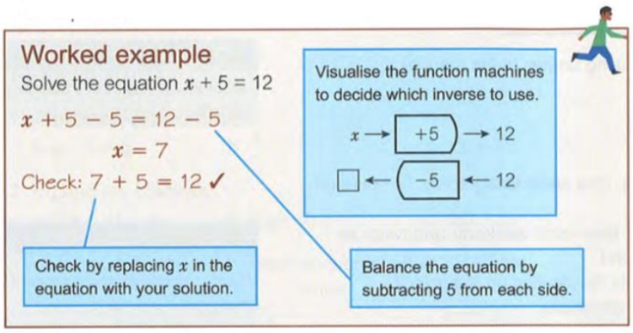
A **function** is a **rule**.
The function "+3" adds 3 to a number.
The **inverse** function is -3, because it reverses the effect of the function +3.

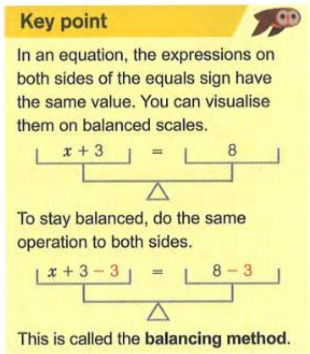
- The inverse of "**positive**" is "**negative**."
- The inverse of "**negative**" is "**positive**."
- The inverse of "**multiply**" is "**divide**."
- The inverse of "**divide**" is "**multiply**."

An **equation** contains "an unknown number (a letter)" and an '=' sign.

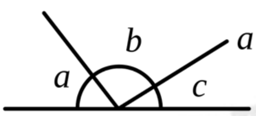
Solving an equation means determining the value of the unknown number.

Solving a one-step equation

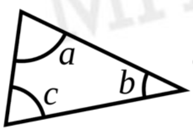




- Angles in a **straight line** add up to 180°.
- Angles in a **triangle** add up to 180°.
- Angles **around a point** add up to 360°.
- Angles in a **quadrilateral** add up to 360°.

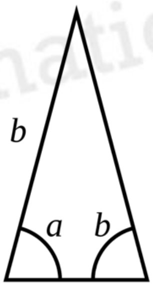


$a + b + c = 180°$



$a + b + c = 180°$

$a = b$



Solving two-step equation

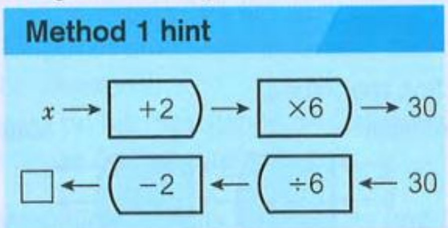
Investigation **Reasoning**

Here are two ways of solving the equation $6(x + 2) = 30$.

Method 1

Balance the equation by dividing both sides by 6 and then subtract 2:

$$6(x + 2) = 30$$
$$x + 2 = \frac{30}{6}$$
$$x + 2 = 5$$
$$x = 3$$



Method 2

Expand the brackets, then balance by subtracting 12 and dividing by 6:

$$6(x + 2) = 30$$
$$6x + 12 = 30$$
$$6x = 30 - 12$$
$$6x = 18$$
$$x = 3$$

More complex equations

- The **coefficient** of a is the number that is multiplying x. In the term 4x, the coefficient of x is 4.

Worked example

Solve the equation $3x - 1 = 2x + 5$

$$3x - 1 = 2x + 5$$
$$3x - 2x - 1 = 2x - 2x + 5$$
$$x - 1 = 5$$
$$x - 1 + 1 = 5 + 1$$
$$x = 6$$

Check: $3 \times 6 - 1 = 17$

$2 \times 6 + 5 = 17$ ✓

You need to end up with $x = \square$, so start by subtracting $2x$ from both sides, which leaves an x term on the left-hand side and no x term on the right.

Simplify.

Add 1 to both sides.

Substitute $x = 6$ into both sides to check they have the same value.

Solving algebraic equations with variables on both sides of the equal sign.

Steps: 1. Get variables on the same side of the equal sign by applying the opposite operation to both sides of the equation.

2. Combine like terms.

3. Now you should have a two-step equation.

4. Solve.

5. Check the answer.

Please, Remember "**WAC**" **W** – *Work* **A** – *Answer* **C** - *Check*

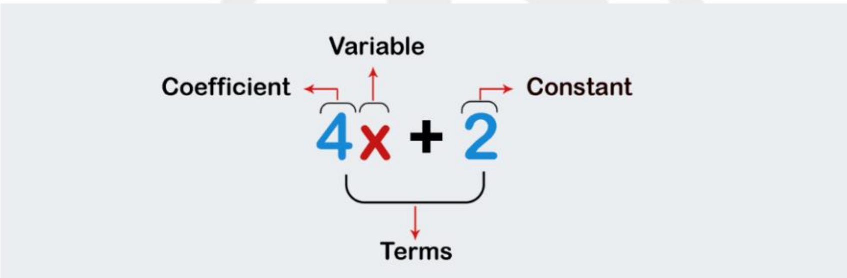
UNIT (3) WORKING WITH POWERS

3.1 Simplifying expressions

Key concepts

- Solving equations: Working with **inverse operations** to find the value of a variable.
- Rearranging an equation: Working with inverse operations to isolate a highlighted variable.
- In solving and rearranging, we **undo** the operations starting from the last one.

Key Words: Solve, Rearrange, Term, Inverse, operation



Expression → $4x + 2$

Equation → $4x + 2 = 6$

For each step in solving an equation we must do the **inverse** operation

Solve:

$5(x-3) = 20$

Expand

$5x - 15 = 20$

$+15$ $+15$

$5x = 35$

$\div 5$ $\div 5$

$x = 7$

Solve:

$12 = 3x - 18$

$+18$ $+18$

$30 = 3x$

$\div 3$ $\div 3$

$x = 10$

Solve:

$7p - 5 = 3p + 3$

$-3p$ $-3p$

$4p - 5 = 3$

$+5$ $+5$

$4p = 8$

$\div 2$ $\div 2$

$p = 2$

Examples

Rearrange to make r the subject of the formulae :

$Q = \frac{2r-7}{3}$

$\times 3$ $\times 3$

$3Q = 2r - 7$

$+7$ $+7$

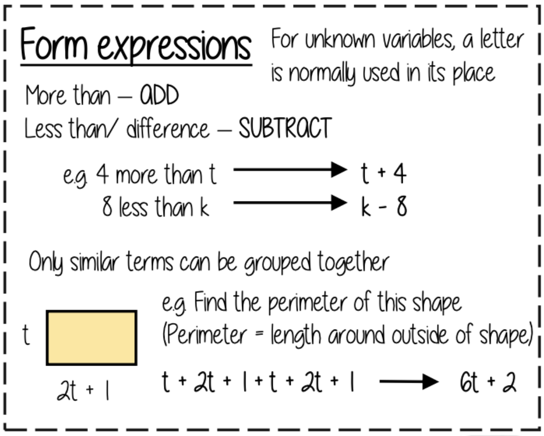
$3Q + 7 = 2r$

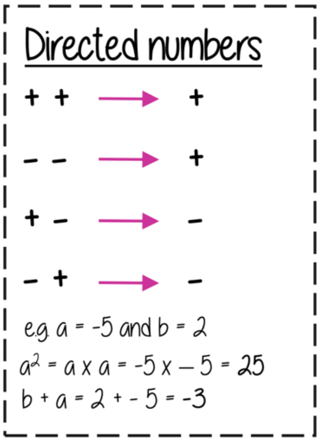
$\div 2$ $\div 2$

$\frac{3Q+7}{2} = r$

3.2 More Simplifying

Variable**:** A **variable** is a better that represents a number.





- An **equation** has an equals **(=)** sign. It is true for particular values.
  For example, $2x + 5 = 11$ is only true for x = 3.

- The **identity** symbol (≡) shows that two expressions are always equivalent.
  For example x + x + 5 ≡ 2x + 5.

Laws of indices

(1) When we **multiply** powers of the same **variables,** we need to **add** the powers.

Key Point

$$a^m \times a^n = a^{m+n}$$

(2) When we **divide** powers of the same **variables,** we need to **subtract** the powers.

Key Point

$$a^m \div a^n = a^{m-n}$$

(3) When we **raise** the power of a variable to another power, **multiply** both powers.

Key Point

$$(a^m)^n = a^{mn}$$

(4) Any number to the **power** of zero equals **1**.

Key Point

$$a^0 = 1$$

3.3 Factorising expressions

Key Concepts

Expanding brackets
Single: Where each term inside the bracket is multiplied by the term on the outside of the bracket.
Double: Where each term in the first bracket is multiplied by all terms in the second bracket.

Factorising expressions
Putting an expression back into brackets. To "factorise fully" means take out the HCF.

Difference of two squares
When two brackets are repeated with the exception of a sign change. All numbers in the original expression will be square numbers.

Key Words

Expand
Factorise
Simplify
Product
Solve

Key point

Expanding removes brackets from an expression. **Factorising** inserts brackets into an expression.

expand

$6(a + 3) = 6a + 18$

factorise

To factorise $6a + 18$, write the common factor of its terms, 6, outside the brackets. This is called 'taking out the common factor'.

Examples

Linear expressions

Expand and simplify where appropriate

1) $7(3 + a) = 21 + 7a$

2) $2(5 + a) + 3(2 + a) = 10 + 2a + 6 + 3a$
$= 5a + 16$

3) Factorise $9x + 18 = 9(x + 2)$

4) Factorise $6e^2 - 3e = 3e(2e - 1)$

Quadratic expressions

Expand and simplify:

1) $(p + 2)(2p - 1)$
$= 2p^2 + 4p - p - 2$
$= 2p^2 + 3p - 2$

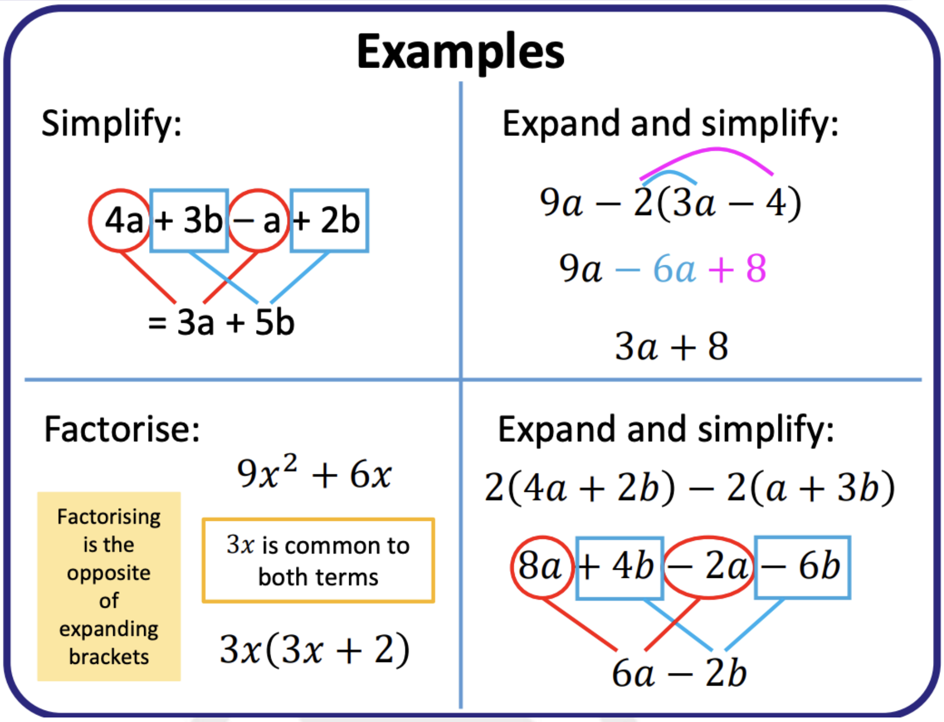
2) $(p + 2)^2$
$(p + 2)(p + 2)$
$= p^2 + 2p + 2p + 4$
$= p^2 + 4p + 4$

Factorise:

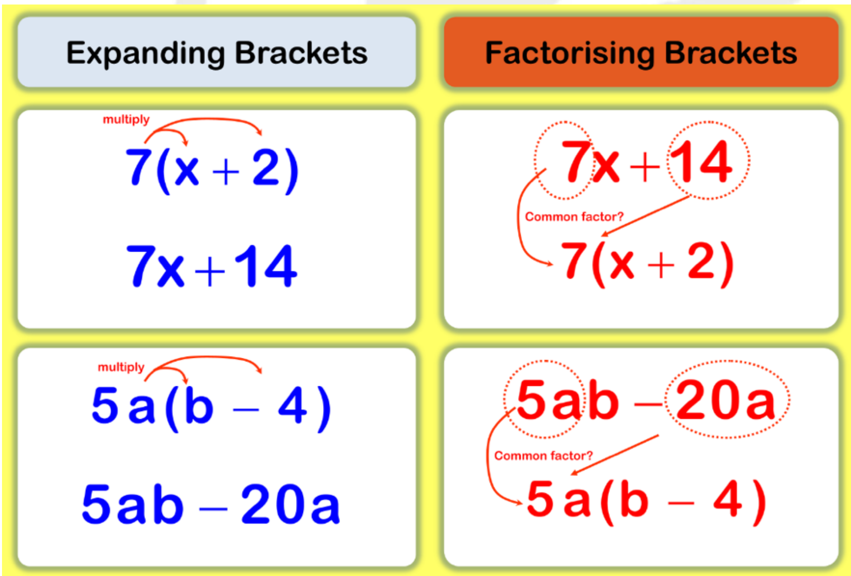
3) $x^2 - 2x - 3$
$= (x - 3)(x + 1)$

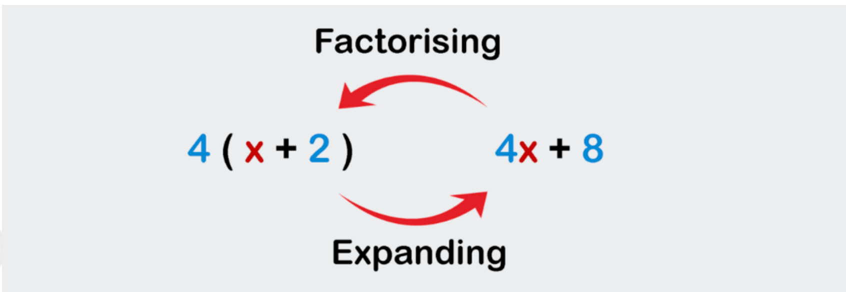
Factorise and solve:

4) $x^2 + 4x - 5 = 0$
$(x - 1)(x + 5) = 0$
Therefore the solutions are:
Either $x - 1 = 0$
$x = 1$
Or $x + 5 = 0$
$x = -5$



3.4 Expanding and Factorising





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