

INTRODUCTION

PERIMETER, AREA AND VOLUME

This section of the math book begins with an introduction to formulas and how to use them, and a table with formulas for perimeter, area and volume. Not all of the formulas in the table are covered in this math book. They have been included because you will encounter them during your technical training as an apprentice. Perimeter, area, volume and right-angle triangles are each covered separately in the following four chapters.

It is important that you understand the difference between perimeter, area and volume, and how each is measured. The table below compares perimeter, area and volume.

$12'' = 1'$	$144 \text{ in}^2 = 1 \text{ ft}^2$	$1,728 \text{ in}^3 = 1 \text{ ft}^3$
↓	↓	↓
perimeter	area	volume
One-dimensional	Two-dimensional	Three-dimensional
inches	in^2	in^3
feet	ft^2	ft^3
yards	yd^2	yd^3
mm	mm^2	mm^3
cm	cm^2	cm^3
m	m^2	m^3

USING FORMULAS

Formulas and equations use mathematical abbreviations, symbols and constants. You need to know these abbreviations and symbols to solve formulas. You need to know how to move numbers, letters and symbols across the equal sign.

Formula: a mathematical rule expressed in symbols

Equation: a statement that two mathematical expressions are equal

Variable or unknown: letter or symbol used to represent a number

There are rules you must follow when you use a formula or solve an equation. The rules stay the same. Sometimes workers in the construction trades remember a short cut but the rules for solving the equation do not change.

Rules Used in Formulas

- Letters and symbols are used to represent numbers or quantities.

P	=	perimeter
A	=	area
V	=	volume
C	=	circumference
L	=	length
W	=	width
s	=	side
d	=	diameter
r	=	radius
b	=	base
h or H	=	height
π	=	pi (pronounced 'pie')

Examples:

$A = LW$ means area equals length times width

$V = \pi r^2 h$ means volume equals pi times radius squared times height

□ BEDMAS

Always follow the order of operations when solving an equation.

	Symbol
Brackets	()
Exponents	3^2 $3^2 = 3 \times 3$ 3^3 $3^3 = 3 \times 3 \times 3$
Division	÷
Multiplication	×
Addition	+
Subtraction	-

Any operation performed on one side of the equal sign must be performed on the other side of the equal sign. Inverse operations are used to solve formulas and equations. Inverse means opposite. An inverse operation undoes an operation.

Addition equations are solved using subtraction.

$$\chi + 4 = 7$$

$$\chi + 4 - 4 = 7 - 4$$

$$\chi = 3$$

Subtraction equations are solved using addition.

$$\chi - 4 = 7$$

$$\chi - 4 + 4 = 7 + 4$$

$$\chi = 11$$

Multiplication equations are solved using division.

$$\chi \times 3 = 15$$

$$\frac{\chi \times 3}{3} = \frac{15}{3}$$

$$\chi = 5$$

Division equations are solved using multiplication.

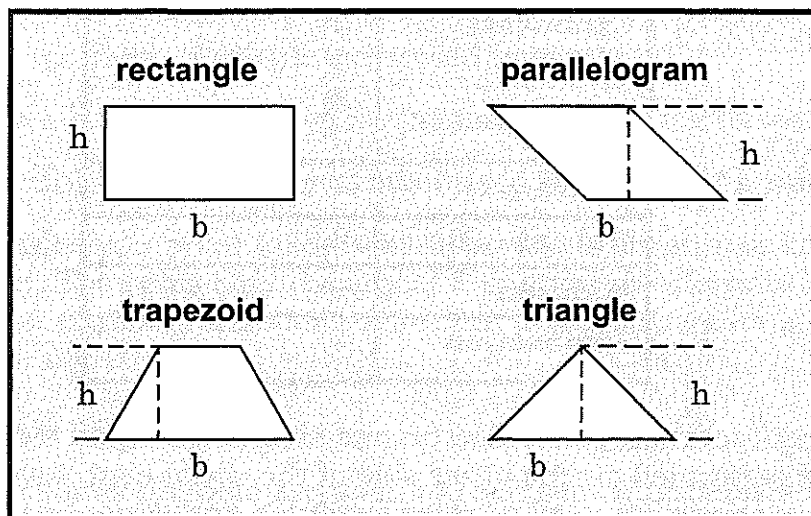
$$\frac{\chi}{4} = 6$$

$$\frac{\chi}{4} \times 4 = 6 \times 4$$

$$\chi = 24$$

◆ Height or Altitude

The perpendicular distance between the base and the opposite side is the height (h) or altitude (a). Some math books use altitude, others use height. This math book uses height (h) in formulas for perimeter, area and volume.



◆ Units of Measurement

Always include the units of measurement. This is especially important when you are calculating perimeter, area and volume.

		Metric	Imperial
perimeter	linear measurement one-dimensional	mm cm m	in ft yd
area	squared units two-dimensional	mm ² cm ² m ²	in ² ft ² yd ²
volume	cubed units three-dimensional	mm ³ cm ³ m ³	in ³ ft ³ yd ³

◆ Pi (pronounced 'pie')

Pi is used to calculate the circumference, area and volume of circles. The symbol ' π ' is the ratio of the circumference of a circle to its diameter. Pi, a Greek letter that means perimeter, is always the same number, 3.14, no matter how large or small the circle is. Pi is an infinite decimal

which means the decimal never ends. Computers have calculated pi to over 50 000 decimal places. Pi is an irrational number meaning it cannot be written as a fraction and has no repeating pattern.

For simplicity in everyday calculations, the approximation 3.14 or 3.1416 is used depending on the level of accuracy required. Pi can also be written as $\frac{22}{7}$.

♦ Multiplication or Division

Both multiplication and division can be shown several ways.

Multiplication:

$$3 \times 4 = 3 \cdot 4 = (3)(4) =$$

Division:

$$3 \div 4 = \frac{3}{4} \quad 4 \overline{)3}$$

♦ Exponents and Square Roots

Exponents:

$$\text{base} \longrightarrow 2^2 \longleftarrow \text{exponent}$$

$$2^2 = 2 \times 2 = 4$$

$$2^3 = 2 \times 2 \times 2 = 8$$

Square roots are represented by the symbol ' $\sqrt{\quad}$ '. Taking the square root of a number is the opposite of squaring it.

Perfect Square	$\sqrt{\quad}$
$\sqrt{1}$	1
$\sqrt{4}$	2
$\sqrt{9}$	3
$\sqrt{16}$	4
$\sqrt{25}$	5
$\sqrt{36}$	6
$\sqrt{49}$	7
$\sqrt{64}$	8
$\sqrt{81}$	9
$\sqrt{100}$	10

Perfect Square	$\sqrt{\quad}$
$\sqrt{121}$	11
$\sqrt{144}$	12
$\sqrt{169}$	13
$\sqrt{196}$	14
$\sqrt{225}$	15
$\sqrt{256}$	16
$\sqrt{289}$	17
$\sqrt{324}$	18
$\sqrt{361}$	19
$\sqrt{400}$	20

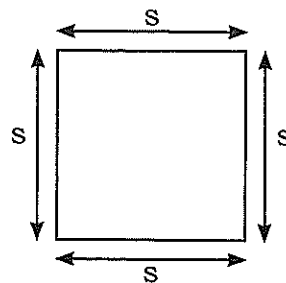
BASIC GEOMETRIC SHAPES

The basic geometric shapes are square, rectangle, triangle, parallelogram, trapezoid, hexagon and circle.

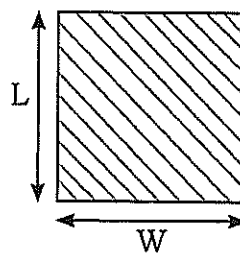
♦ Square

A square has four equal sides that are perpendicular or at “right angles” to each other. The sum of the four angles in a square is always equal to 360° .

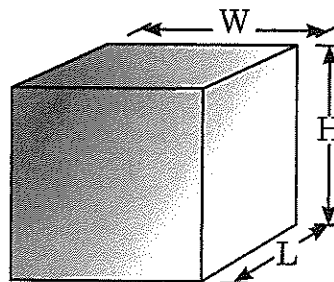
$$P = s + s + s + s = 4s$$



$$A = LW \text{ or } A = s^2$$



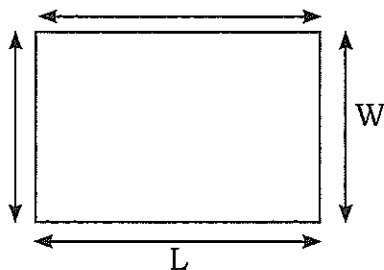
$$V = LWH \text{ or } A = s^3$$



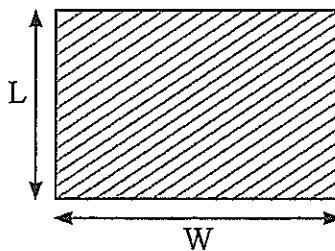
◆ Rectangle

A rectangle has 4 sides. The opposite sides are equal and the sides are perpendicular to each other. The sum of the four angles in a rectangle is always equal to 360° .

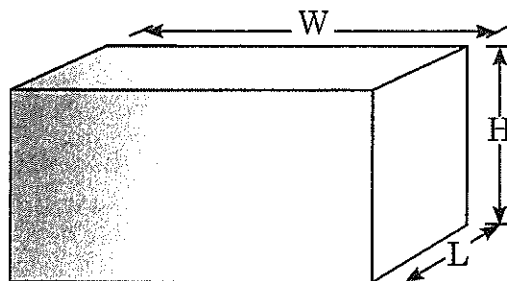
$$P = 2(L+W)$$



$$A = LW$$



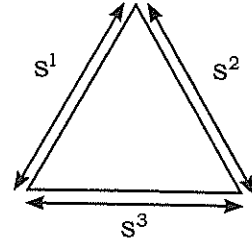
$$V = LWH$$



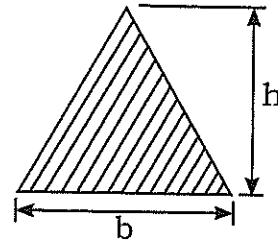
♦ Triangle

A triangle has 3 sides and 3 angles. The sum of the angles is always equal to 180° .

$$P = s^1 + s^2 + s^3$$

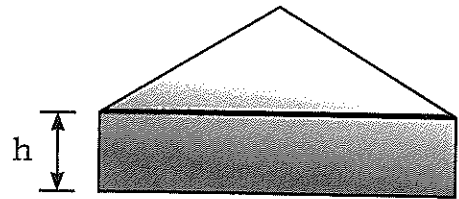


$$A = \frac{1}{2} bh = \frac{bh}{2}$$



The three-dimensional figure of a triangle is called a triangular prism.

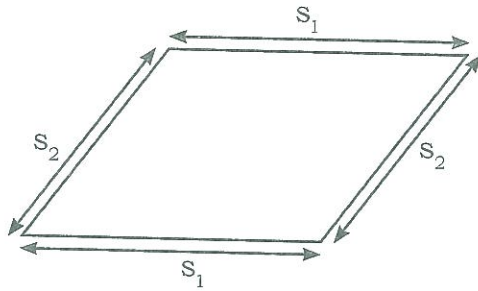
$$V = \text{area of base} \times h$$



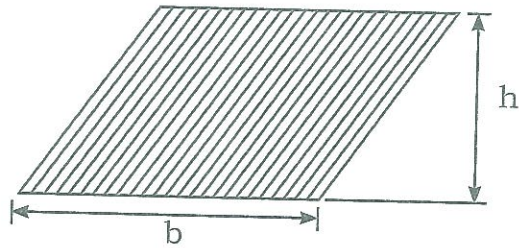
◆ Parallelogram

A parallelogram is a 4-sided figure. The opposite sides are parallel and equal in length. The sum of the four angles in a parallelogram is 360° .

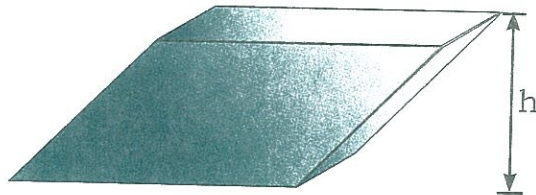
$$P = 2(s_1 + s_2)$$



$$A = bh$$



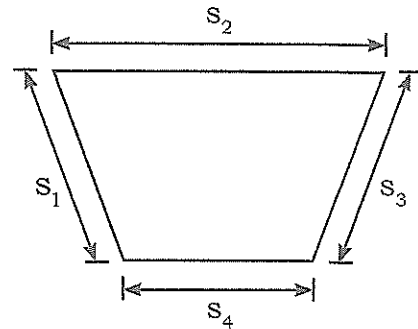
$$V = \text{area of base} \times h$$



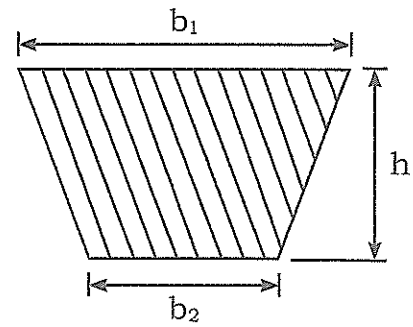
◆ Trapezoid

A trapezoid is a 4-sided figure that has two parallel sides. The two parallel sides are called bases. The height is a perpendicular line dropped from the shorter base to the longer base. The sum of the four angles in a trapezoid is 360° .

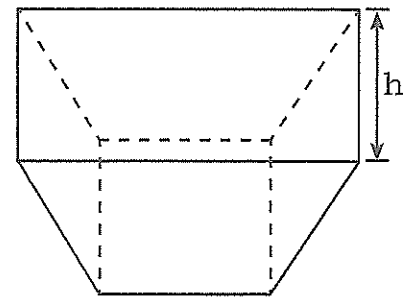
$$P = s_1 + s_2 + s_3 + s_4$$



$$A = \left(\frac{b_1 + b_2}{2} \right) h$$



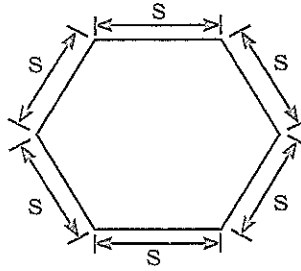
$$V = \text{area of base} \times h$$



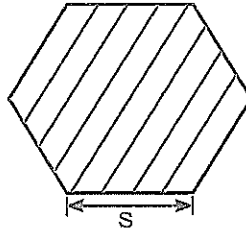
♦ Hexagon

A hexagon is a 6-sided figure. The 6 sides are equal in length.

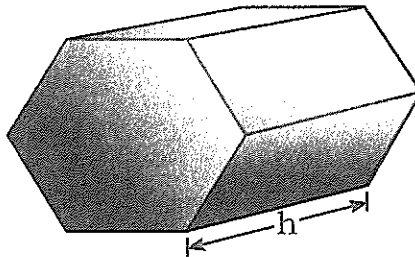
$$P = 6s$$



$$A = 2.59 \times s^2$$



$$V = \text{area of base} \times h$$



♦ Circle

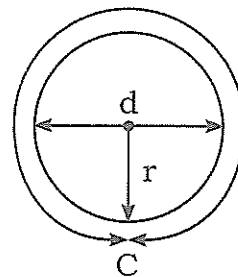
A circle is a closed curved line. The distance to the centre point is the same at any point along the circle.

A straight line drawn from the centre of a circle to the edge is called the radius.

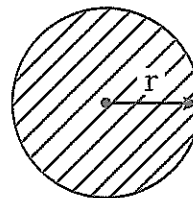
A straight line drawn through the centre of a circle, from one edge to the other, is called the diameter. The diameter equals twice the length of the radius.

The distance around the outside of a circle is called the circumference.

$$C = \pi d \text{ or } 2\pi r$$



$$A = \pi r^2$$



$$V = \frac{4\pi r^3}{3} \text{ or } \frac{\pi d^3}{6}$$

