

Formulas

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WHAT'S COVERED

In this lesson, you will learn how to identify the correct formula for a given shape. Specifically, this lesson will cover:

1. Definition of Formulas

1a. Area of a Rectangle

1b. Area of a Triangle

1c. Area of a Circle

1d. Volume of a Rectangular Prism

1e. Volume of a Cylinder

1f. Volume of a Sphere

2. Substitution in Formulas

1. Definition of Formulas

Formulas are often times thought of as special types of equations where two or more quantities are equated to one another.

There are several different types of formulas that we will come across when working in most math courses. Here are a few of the most common formulas.



TERM TO KNOW

Formula

A mathematical rule that relates two or more quantities.

1a. Area of a Rectangle

The area of a rectangle is equivalent to multiplying the length and width of the rectangle together.



FORMULA TO KNOW

Area of a Rectangle

$A = bh$, where A is the area, b is the base, and h is the height.

$$A = lw$$



Note that the area of a square is a special case of the area of a rectangle formula where the length and width are the same. The area of a square can be represented as $A = s \cdot s$, or $A = s^2$

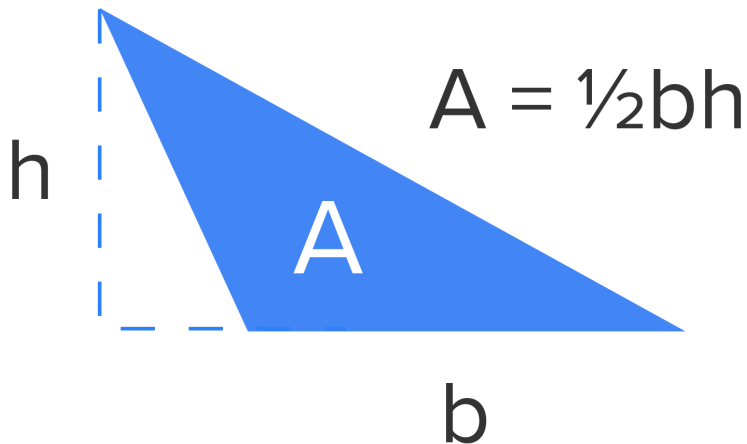
1b. Area of a Triangle

The area of a triangle is equivalent to the base times height, divided by 2, or multiplied by one-half.



Area of a Triangle

$A = \frac{1}{2}bh$, where A is area, b is base, and h is height.





HINT

Note that the height of a triangle is the distance of the line from one vertex (or corner) of the triangle to the opposite base, such that the line is perpendicular to the base.

1c. Area of a Circle

The area of a circle is equivalent to **pi** times the radius squared.

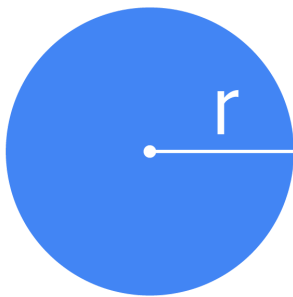


FORMULA TO KNOW

Area of a Circle

$$A = \pi r^2$$

$$A = \pi r^2$$



$$\pi \approx 3.14$$



HINT

Note that the radius of a circle is the distance from the center of a circle to the edge of the circle. Pi is a constant irrational number equal to 3.14159265....



TERM TO KNOW

Pi (π)

The ratio of a circle's circumference to its diameter; approximately equal to 3.14.

1d. Volume of a Rectangular Prism

The volume of a rectangular prism is equivalent to the length times the width times the height of the prism.

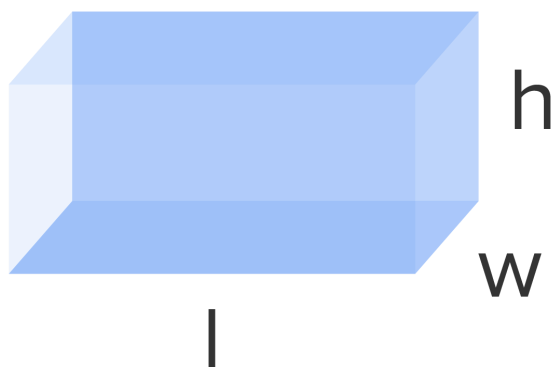


FORMULA TO KNOW

Volume of a Rectangular Prism

$$V = lwh, \text{ where } V \text{ is volume, } l \text{ is length, } w \text{ is width, and } h \text{ is height}$$

$$V = lwh$$



1e. Volume of a Cylinder

The volume of a right cylinder is equivalent to pi times the radius squared times the height.

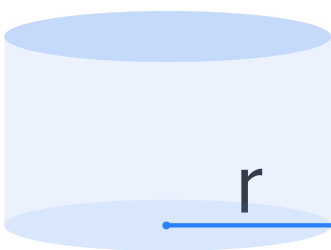


FORMULA TO KNOW

Volume of a Cylinder

$V = \pi r^2 h$, where V is volume, r is the radius of the circular base, h is height, and π is approximately 3.14

$$V = \pi r^2 h$$



$$h \quad \pi \approx 3.14$$

1f. Volume of a Sphere

The formula for the volume of a sphere, which is equivalent to four-thirds times pi times the radius cubed, or $\frac{4}{3}\pi r^3$.

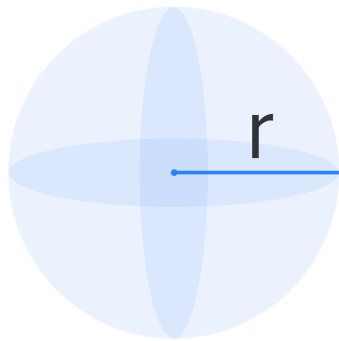


FORMULA TO KNOW

Volume of a Sphere

$V = \frac{4}{3} \pi r^3$, where V is volume, r is the radius, and π is approximately 3.14

$$V = \frac{4}{3} \pi r^3$$



$$\pi \approx 3.14$$



HINT

To leave your answer as an exact value, you can choose to leave pi as π multiplied by a number, for instance, $37\pi \text{ cm}^3$. If you need to give a decimal approximation, use $\pi = 3.14$.

2. Substitution in Formulas

Formulas become most handy when we are given the value of several quantities and asked to determine the value of another quantity. For example, suppose we are told that a rectangle has an area of 40 square feet and a base of 4 feet. What would the height of the rectangle be?

To calculate the length of the rectangle, we can take the area, A , and base, b , and substitute them in the formula for a rectangle's area. We can then solve for the height, h .

$$A = bh \quad \text{Area of a Rectangle Formula}$$

$$40 \text{ sq. ft} = 4 \text{ ft} \cdot h \quad \text{Substitute known values: } A = 40 \text{ sq. ft}, b = 4 \text{ ft}$$

$$10 \text{ ft} = h \quad \text{Divide both sides by 4 ft}$$

$$\text{height} = 10 \text{ feet} \quad \text{Our solution}$$

When we wish to tell whether or not we can use a formula in this way, we simply need to check that we have a value of all but one variable in the formula. If that is the case then we can solve for the unknown quantity using the appropriate formula.



SUMMARY

The **definition of formulas** states that formulas are used to relate two or more different quantities. There are many **examples of common formulas**, such as area of a rectangle or triangle, or the volume of a sphere or cylinder. We most often use formulas when we are given one or more of those variables, and we need to solve for an unknown variable, or something that we want to find. This is done by **substituting** values for known variables into our formula and then evaluating the formula to find the unknown variable.

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TERMS TO KNOW

Equation

A mathematical statement that two expressions or quantities have the same value.

Formula

A mathematical rule that relates two or more quantities.

Pi (π)

The ratio of a circle's circumference to its diameter; approximately equal to 3.14.

Variable

A symbol (usually a letter) used to represent a value that can change.



FORMULAS TO KNOW

Area of Circle

$$A_{circle} = \pi r^2$$

Area of Rectangle

$$A_{rectangle} = bh$$

Area of Triangle

$$A_{triangle} = \frac{1}{2}bh$$

Volume of Cylinder

$$V_{cylinder} = \pi r^2 h$$

Volume of Rectangular Prism

$$V_{rect.prism} = lwh$$

Volume of Sphere

$$V_{sphere} = \frac{4}{3} \pi r^3$$