

Geometric Formulas – sidebar

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Why do we need to know these?

As you move through your math and science classes, there are several geometric formulas that you will be expected to know without looking them up. These basic formulas come up frequently, and you will need them to solve problems.

What should you know?

The Pythagorean Theorem. This works only for right triangles – in fact, you can use it to decide if a triangle is a right triangle. In a right triangle with legs a and b and hypotenuse c , $a^2 + b^2 = c^2$.

The Distance Formula: The distance formula is an application of the Pythagorean Theorem. The distance between 2 points (x_1, y_1) and (x_2, y_2) is given

$$\text{by } D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} .$$

The Midpoint Formula: The midpoint of the line segment between two points (x_1, y_1) and (x_2, y_2) is the point $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$. By the way, I've never found any particular reason to memorize the Midpoint Formula. The point that's exactly halfway between two points is the point that's halfway between in the x 's and in the y 's. And the number that's exactly halfway between two numbers is their mathematical average.

Parallelogram Formulas (including Squares and Rectangle): The perimeter (measure around the outside) of any polygon is the sum of all its side lengths. If you must have a formula, the perimeter of a parallelogram with base b and height h is $P = 2b + 2h$. The area of a parallelogram with base b and height h is $A = bh$.

Triangle Formulas: The perimeter of a triangle is the sum of all 3 side lengths. The area of a triangle with base b and height h is $A = \frac{1}{2}bh$.

Circle Formulas: The circumference (measure around the outside) of a circle with radius r is $C = 2\pi r$. The area of a circle with radius r is $A = \pi r^2$. The number π is approximately 3.14, and most calculators have a special π button.

Rectangular box formulas: The surface area of a rectangular box is the sum of the areas of all six of its rectangular faces. The volume of a rectangular box is the product of

its length, width, and height. That is, the volume of a rectangular box with length l , width w , and height h is $V = lwh$.

Cylinder formulas: A right circular cylinder has two parallel, identical, circular bases and a wall to connect them that is perpendicular to them. The surface area of a right circular cylinder is the area of the wall plus the areas of the two bases. The surface area of a right circular cylinder with base radius r and height h is $A = 2\pi rh + 2\pi r^2$; note that this is the area of the wall plus the areas of the two bases. The volume of a right circular cylinder with base radius r and height h is $V = \pi r^2 h$; note that this is the area of the base times the height.

Note about lengths, areas, and volumes: Note that the formulas for lengths (circumference and perimeter) involve side lengths on their own. Formulas for areas involve two lengths multiplied together. Formulas for volumes involve three lengths multiplied together. This can help you keep the formulas straight.

This same property affects the units – distance, circumference, and perimeter are measured in units of length (cm, feet, miles, etc.) Areas are measured in square units. Volumes are measured in cubic units.

Similar figures: Figures are *similar* if they are exactly the same shape, though possibly different sizes. Two triangles are similar if all their angles are the same. You might also hear similar figures called proportional – and that's the key. Corresponding sides of the figures have the same ratio.

Other formulas: There are many other formulas (for example, for the volume of a cone or the surface area of a sphere, or the law of cosines) that might come up. You will probably not be expected to have them memorized when you start using them in a class, but you might need to learn them. Many textbooks have common geometric formulas printed on the inside covers. You can also find the formulas online, but be careful!