Distance Encyclopedia Article

Distance

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Distance

Distance has two different meanings. It is a number used to characterize the shortest length between two geometric figures, and it is the total length of a path. In the first case, the distance between two points is the simplest instance.

The absolute distance between two points, sometimes called the displacement, can only be a positive number. It can never be a negative number, and can only be **zero** when the two points are identical. Only one straight line exists between any two points P_1 and P_2. The length of this line is the shortest distance between P_1 and P_2.

In the case of parallel lines, the distance between the two lines is the length of a perpendicular segment connecting them. If two figures such as line segments, triangles, circles, cubes, etc. do not intersect, then the distance between them is the shortest distance between any pair of points, one of which lies on one figure, one of which lies on the other.

To determine the distance between two points, we must first consider a coordinate system. An *xy* coordinate system consists of a horizontal axis (*x*) and vertical axis (*y*). Both axes are infinite for positive and negative values. The crossing point of the lines is the origin (O), at which both *x* and *y* values are zero.

We define the coordinates of point P_1 as (x_1, y_1),and point P_2 by (x_2 and y_2). The distance, the length of the connecting straight line (P_1 P_2) which is the shortest distance between the two points, is given by $d=(x_1-x_2)^2 + (y_1-y_2)^2$ in many types of physics and engineering problems, for example, in tracking the trajectory of an atomic particle, or in determining the lateral **motion** of a suspension bridge in the presence of high winds.

Path length

The other meaning of distance is the length of a path. This is easily understood if the path consists entirely of line segments, such the **perimeter** of a pentagon. The distance is the sum of the lengths of the line segments that make up the perimeter. For curves that are not line segments, a continuous path can usually be approximated by a sequence of line segments. Using shorter line segments produces a better approximation. The limiting case, when the lengths of the line segments go to zero, is the distance. A common example would be the **circumference** of a **circle**, which is a distance.