GEOMETRICAL DEFINITIONS OF PLANE FIGURES.

A **line** is length without breadth.

The **extremities of a line** are points.

A **straight line** is that which lies evenly between its extreme points.

A **plane surface** is that in which any two points, being taken, the straight line between them lies wholly in that surface.

The **extremities of a surface** are lines.

A **plane rectilineal angle** is the inclination of two straight lines to one another in a plane which meet together, but are not in the same straight line as in Fig. 1.

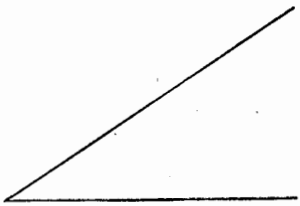

Fig. 1.

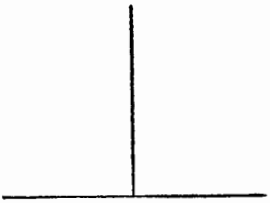

Fig. 2.

When a straight line, standing on another straight line, makes the adjacent angles equal to one another, each of the angles is called a **right angle** and the straight line which stands on the other is called a **perpendicular** to it as in Fig. 2.

An **obtuse angle** is that which is greater than a right angle as in Fig. 3.

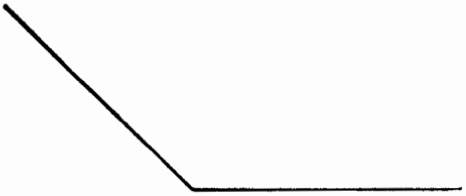

Fig. 3.

An **acute angle** is that which is less than a right angle as in Fig. 1.

A **term or boundary** is the extremity of anything.

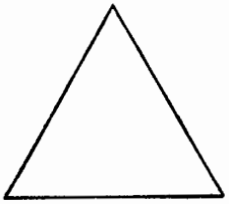

Fig. 4.

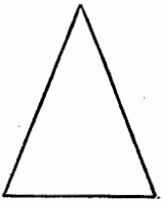

Fig. 5.

An **equilateral triangle** is that which has three equal sides as in Fig. 4.

An **isosceles triangle** is that which has two sides equal as in Fig. 5.

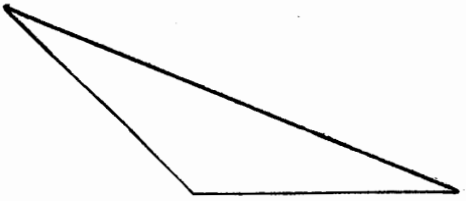

Fig. 6.

A **scalene triangle** is that which has three unequal sides as in Fig. 6.

A **right angled triangle** is that which has a right angle as in Fig. 7.

An **obtuse-angled triangle** is that which has an obtuse angle as in Fig. 6.

The **hypothenuse** in a right-angled triangle is the side opposite the right angle as in Fig. 7.

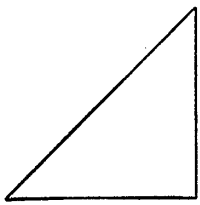

Fig. 7.

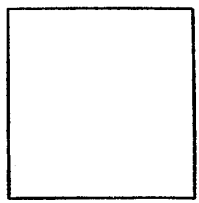

Fig. 8.

A **square** is that which has all its sides equal and all its angles right-angled as in Fig. 8.

A **rectangle** is that which has all its angles right angles, but only its opposite sides equal as in Fig. 9.

A **rhombus** is that which has all its sides equal, but its angles are not right angles as in Fig. 10.

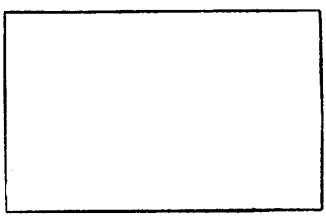

Fig. 9.

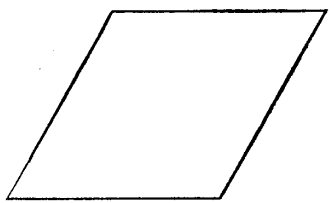

Fig. 10.

A **quadrilateral** figure which has its opposite sides parallel is called a parallelogram as in Figs. 8, 9 and 10.

A line joining two opposite angles of a quadrilateral is called a **diagonal.**

An **ellipse** is a plane figure bounded by one continuous curve described about two points, so that the sum

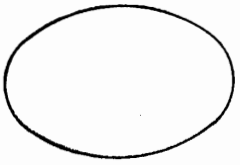

Fig. 11.

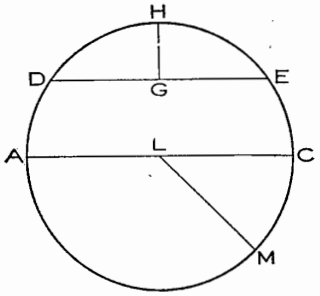

Fig. 12.

of the distances from every point in the curve to the two foci may be always the same—Fig. 11.

PROPERTIES OF THE CIRCLE.

A **circle** contains a greater area than any other plane figure bounded by the same length of circumference or outline.

A **circle** is a plane figure contained by one line and is such that all straight lines drawn from a point within the figure to the circumference are equal, and this point is called the center of the circle.

A **diameter** of a circle is a straight line drawn through the center and terminated both ways by the circumference, as AC in Fig 12.

A **radius** is a straight line drawn from the center to the circumference as LH in Fig. 12.

A **semicircle** is the figure contained by a diameter and that part of circumference cut off by a diameter as AHC in Fig. 12.

A **segment** of a circle is the figure contained by a straight line and the circumference which it cuts off as DHE in Fig. 12.

A **sector** of a circle is the figure contained by two straight lines down from the center and the circumference between them as LMC in Fig. 12.

A **chord** is a straight line, shorter than the diameter, lying within the circle, and terminated at both ends by the circumference as DE in Fig. 12.

An **arc** of a circle is any part of the circumference as DHE in Fig. 12.

The **versed sine** is a perpendicular joining the middle of the chord and circumference, as GH in Fig. 12.

Circumference. Multiply the diameter by 3.1416 the product is the circumference.

Diameter. Multiply the circumference by .31831, the product is the diameter, or multiply the square root of the area by 1.12837, the product is the diameter.

Area. Multiply the square of the diameter by .7854, the product is the area.

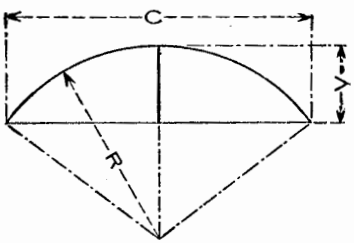

Fig. 13.

Side of the square. Multiply the diameter by .8862, the product is the side of a square of equal area.

Diameter of circle. Multiply the side of a square by

1.128, the product is the diameter of a circle of equal area.

To find the versed sine, chord of an arc or the radius when any two of the three factors are given.—Fig. 13.

$$R=\frac{C^2+4V^2}{8V} \qquad C=2\sqrt{V(2R-V)}$$

$$V=R-\sqrt{\frac{4R^2-C^2}{4}}$$

To find the length of any line perpendicular to the chord of an arc, when the distance of the line from the

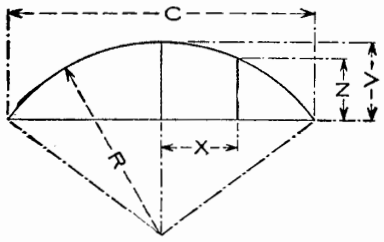

Fig. 14.

center of the chord, the radius of the arc and the length of the versed sine are given—Fig. 14.

$$N=\sqrt{(R^2-X^2)}-(R-H) \qquad R=\frac{C^2+4V^2}{8V}$$

$$C=2\sqrt{V(2R-V)} \qquad V=R-\sqrt{\frac{4R^2-C^2}{4}}$$

To find the diameter of a circle when the chord and versed sine of the arc are given.

$$AC=\frac{DG^2+GH^2}{GH}$$

To find the length of any arc of a circle, when the

chord of the whole arc and the chord of half the arc are given—Fig. 15.

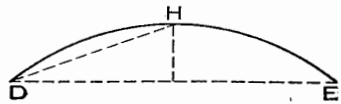

Fig. 15.

$$\text{Arc DHE} = \frac{8\text{DH} - \text{DE}}{3}$$

DEFINITION OF POLYGONS.

A **polygon,** if its sides are equal, is called a regular polygon, if unequal, an irregular polygon.

A **pentagon** is a five-sided figure.

A **hexagon** is a six-sided figure—Fig. 16.

A **heptagon** is a seven-sided figure.

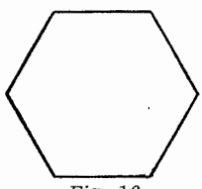

Fig. 16.

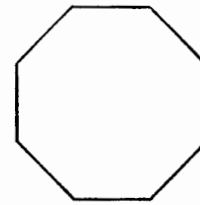

Fig. 17.

An **octagon** is an eight-sided figure—Fig. 17.

A **nonagon** is a nine-sided figure.

A **decagon** is a ten-sided figure.

A **unadecagon** is an eleven-sided figure.

A **duodecagon** is a twelve-sided figure.

GEOMETRICAL DEFINITION OF SOLID FIGURES.

A **solid** has length, breadth and thickness. The boundaries of a solid are surfaces.

A **solid angle** is that which is made by two or more

plane angles, which are not in the same plane, meeting at one point.

A **cube** is a solid figure contained by six equal squares—Fig. 18.

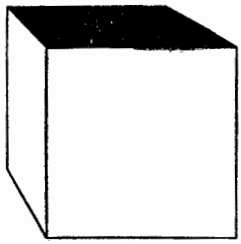

Fig. 18.

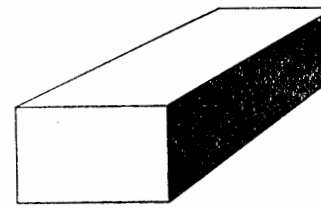

Fig. 19.

A **prism** is a solid figure contained by plane figures of which two that are opposite are equal, similar, and parallel to one another, the other sides are parallelograms—Fig. 19.

A **pyramid** is a solid figure contained by planes, one of which is the base, and the remainder are triangles, whose vertices meet a point about the base, called the vertex or apex of the pyramid—Fig. 20.

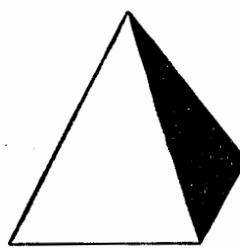

Fig. 20.

Fig. 21.

A **cylinder** is a solid figure described by the revolution of a rectangular or parallelogram about one of its sides—Fig. 21.

The **axis** of a cylinder is the fixed straight line about which the parallelogram revolves.

The **ends** of a cylinder are the circles described by the two revolving sides of the parallelogram.

A **sphere** is a solid figure described by the revolution of a semicircle about its diameter, which remains fixed—Fig. 22.

The **axis** of a sphere is the fixed straight line about which the semicircle revolves.

The **center** of a sphere is the same as that of the semicircle.

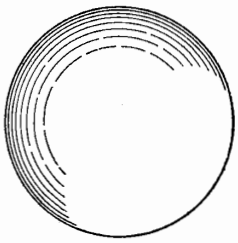

Fig. 22.

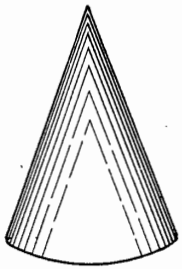

Fig. 23.

The **diameter** of a sphere is any straight line which passes through the center and is terminated both ways by the surface of the sphere.

A **cone** is a solid figure described by the revolution of a right-angled triangle about one of its sides containing the right angle, which side remains fixed—Fig. 23.

The **axis** of a cone is the circle described by that side of the triangle containing the right angle which revolves.

The **base** of the cone is the circle described by that side of the triangle containing the right-angle which revolves.

If a cone be cut obliquely so as to preserve the base entirely, the section is an **ellipse.**

When a cone is cut by a plane parallel to one of the sloping sides, the section is a **parabola,** if cut at right angles to its base, an **hyperbola.**