GEOMETRY

Points and Lines

The Concept of a Point

Explain the concept of a point

A **point** – is a smallest geometric figure which gives a position of object in a plane

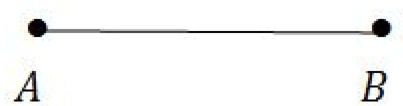
A line segment – is a straight line joining two points in a plane

The Concept of a Point to Draw a Line

Extend the concept of a point to draw a line

A line segment – is a straight line joining two points in a plane

$\overline{AB}$



A line passing through two points e.g A and B and extends without end *(i.e infinitely)* in both directions is denoted by

$\overleftrightarrow{AB}$

The Difference Between a Line, a Line Segment and a Ray

Distinguish between a line, a line segment and a ray

A ray - is a line starting from a point, say A and pass through a point, say B and extends without end in one direction.It is denoted by

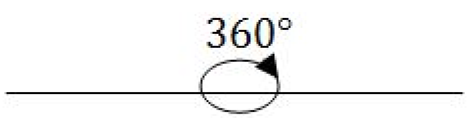
$\overrightarrow{AB}$

Angles and Lines

Angles

Draw angles

An angle – is a measure of an amount of turn. For instance, a complete turn has an angle of 360º

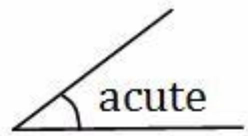


Measuring Angles of Different Size Using a Protractor

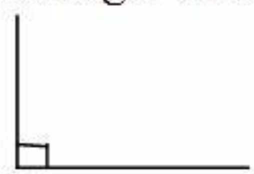
Measure angles of different size using a protractor

There are several types of angles including:- acute, right, complementary, obtuse, supplementary and reflex angle

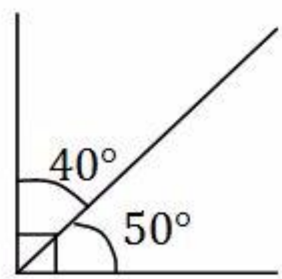
(a) An acute angle – is an angle less than $90°$



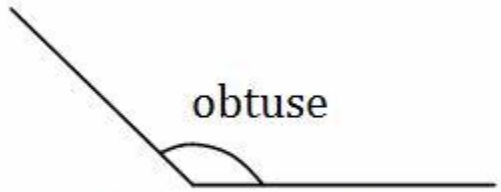
(b) A right angle – is an angle of $90°$



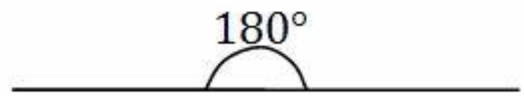
(c) Complementary angles – are angles whose sum is $90°$
e.g $40°$ and $50°$ are complementary angles



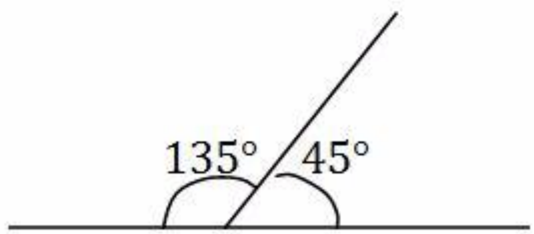
(d) An obtuse angle – is an angle between 90° and 180°



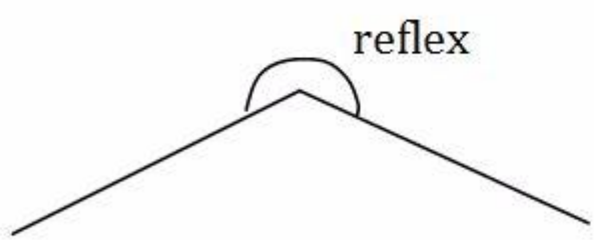
(e) A straight angle - is an angle of 180°



(f) Supplementary angle – are angles whose sum is 180°
e.g 135° and 45° are complementary angles



(g) A reflex angle - is an angle between 180° and 360°



Example 1

a. Two angles are supplementary. One angle is three times the other. What are the angles?

b. Two angles are complementary. One angle is 40º greater than the other. What are the angles?

Solution

(a) Let one angle be x, the other angle is $3x$

Then $x + 3x = 180°$

$$4x = 180°, \quad x = \frac{180°}{4} = 45°$$

$$first\ angle, x = 45°, \quad second\ angle,\ 3x = 3(4$$

$\therefore$ The angles are $45°$ and $135°$

(b) Let one angle be x, the other angle is $x + 40°$

Then $x + (x + 40°) = 90°$

$$x + x + 40° = 90°$$

$$2x + 40° = 90°$$

$$2x = 90° - 40°$$

$$2x = 50°, \quad x = \frac{50°}{2} = 25°$$

$$first\ angle, x = 25°, \quad second\ angle,\ x + 40° = 2$$

$\therefore$ The angles are $25°$ and $65°$

Drawing Angles Using a Protractor

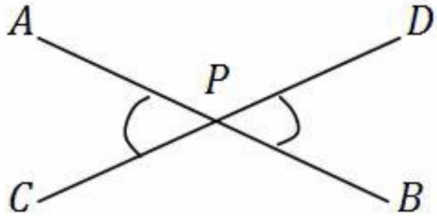
Draw angles using a protractor

The angles formed by crossing lines includes vertically opposite angles, alternate angle and corresponding angles

Vertically opposite angles

The angles on the opposite sides of the crossing lines are equal

Consider two line segments $\overline{AB}$ and $\overline{CD}$ crossing each other

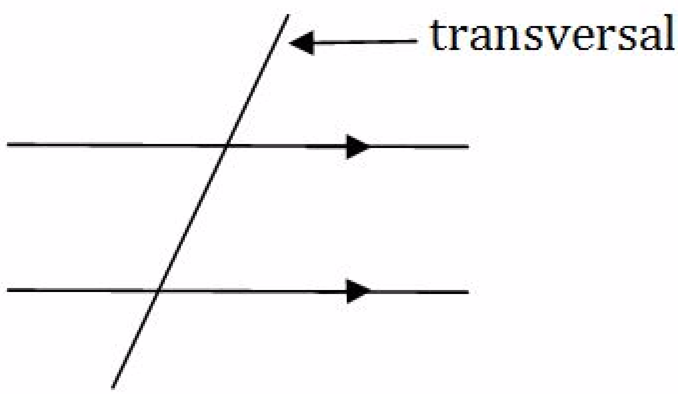


$\angle APC = \angle BPD$	(vertically opposite)
$\angle APD = \angle BPC$	(vertically opposite)

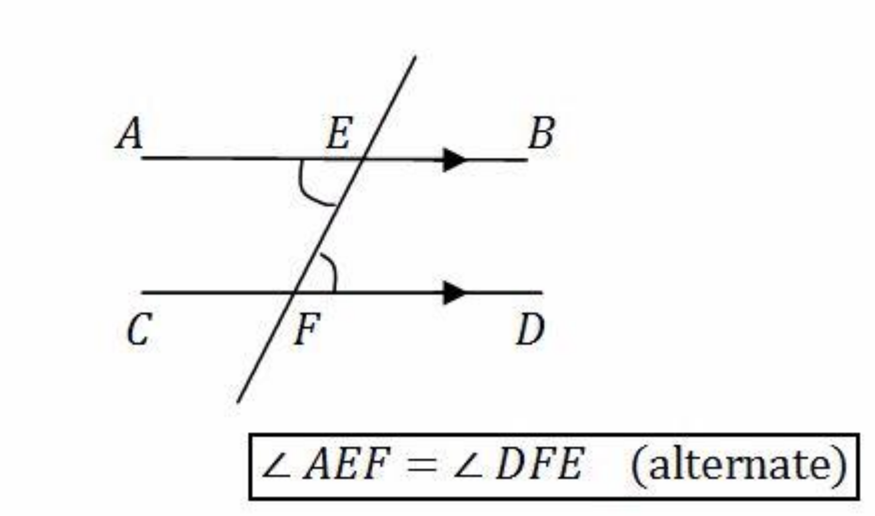
- They are also called $X-$ angles

Alternate angles

Consider a line segment crossing two parallel line segments. This line is called a **transversal**



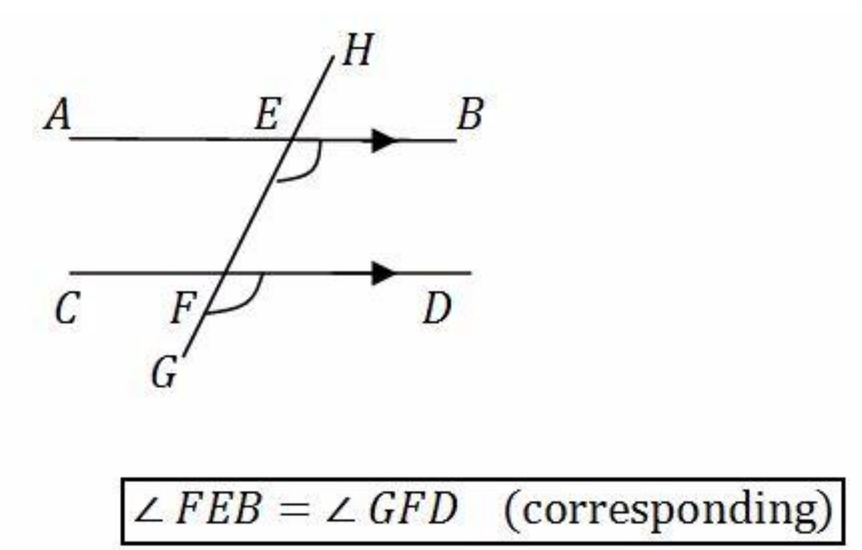
The angles within the parallel line segments on the opposite sides of the transversal are equal



They are also called Z - *angles*

Corresponding angles

The angles on the same side of the transversal and on the same side of the parallel lines are equal.They are called corresponding angles and sometimes called *F - angles*



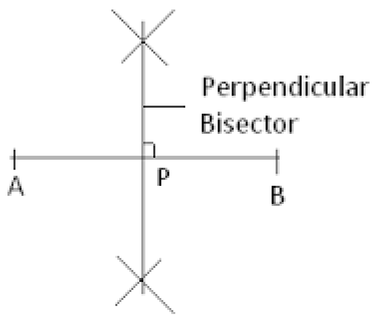
There are also three other pairs of corresponding angles in the diagram above.When showing that two angles are equal you must give reason whether they are vertically opposite, or alternate or corresponding angles.

Constructions

Construction of a Perpendicular Bisector to a Line Segment

Construct a perpendicular bisector to a line segment

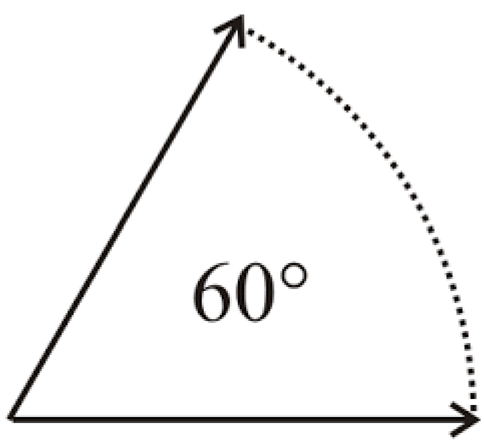
Perpendicular Bisector to a Line Segment is shown below



Contruction of an Angle of 60° Using a Pair of Compasses

Construct an angle of 60° using a pair of compasses

Angle of 60°



Bisection of a Given Angle

Bisect a given angle

Activity 1

Bisect a given angle

Copying a Given Angle by Construction

Copy a given angle by construction

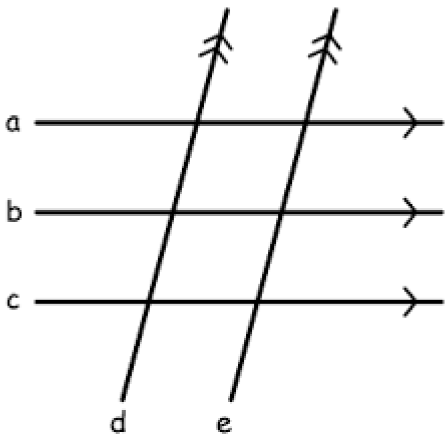
Activity 2

Copy a given angle by construction

Parallel Lines

Construct parallel lines

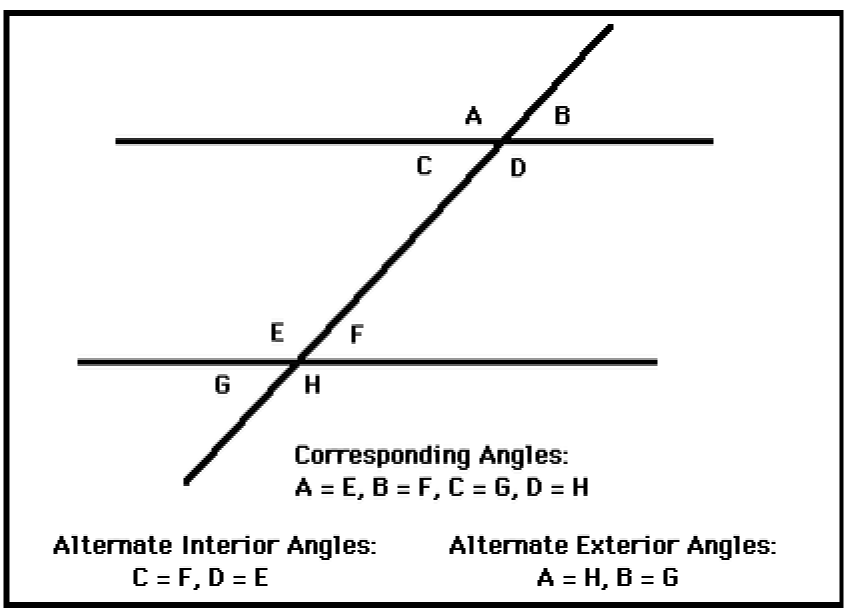
Parallel lines can be shown as below:



Different Types of Angles Formed by Parallel Lines and a Transversal

Identify different types of angles formed by parallel lines and a transversal

Different types of angles are shown below.



Polygons And Regions

A Polygon and a Region

Describe a polygon and a region

A**polygon**is a plane figure whose sides are three or more coplanar segments that intersect only at their endpoints. Consecutive sides cannot be collinear and no more than two sides can meet at any one vertex.

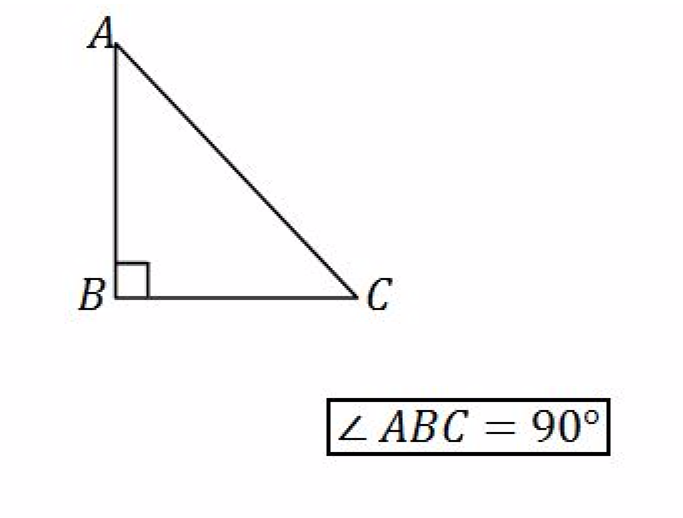
A**polygonal region**is defined as a polygon and its interior.

Different Types of Triangles

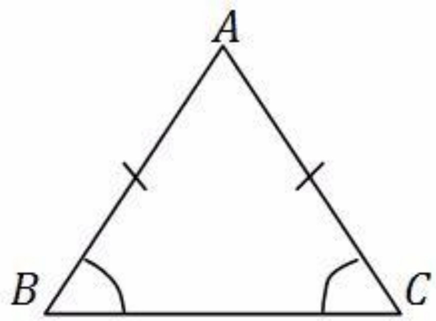
Construct different types of triangles

A triangle – is a polygon with three sides.The sides connect the points called vertices

A **right – angled triangle** – has one angle equal to 90º



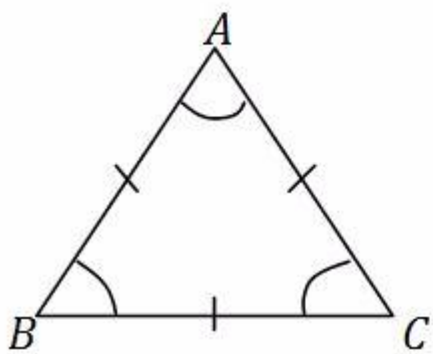
An **isosceles triangle** – has two equal sides and two equal angles



$$\angle ABC = \angle BCA$$

$$\overline{AB} = \overline{AC}$$

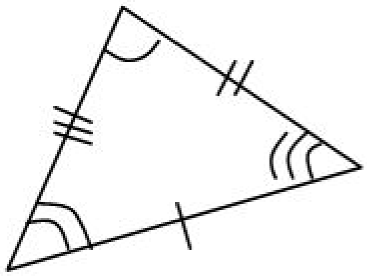
An **equilateral triangle** – has three equal sides and all angles equal



$$\angle ABC = \angle BCA = \angle CAB$$

$$\overline{AB} = \overline{BC} = \overline{CA}$$

NOTE:A triangle with all sides different and all angles different is called scalene triangle



A triangle with vertices *A*, *B* and *C* is denoted as

$$\Delta ABC$$

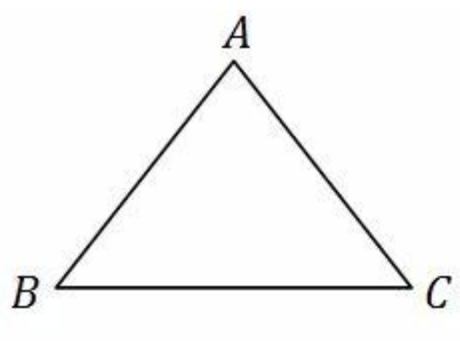
A triangle has two kinds of angles

a. Interior angles

b. Exterior angles

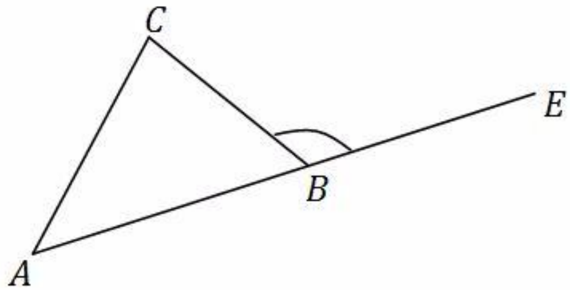
Interior angle – is an angle inside the triangle.The sum of interior angles of a triangle is

Example, consider the triangle below



$$\boxed{\angle ABC + \angle BCA + \angle CAB = 180°}$$

Exterior angle - is an angle outside the triangle.Consider the triangle below



$\angle CBE$ – is an exterior angle of a triangle

From the triangle above

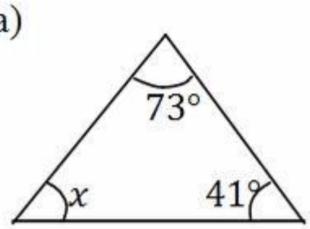
$$\angle CBE + \angle CBA = 180°$$

$$\boxed{\angle CBE = 180° - \angle CBA} \quad \text{(angles on a straight line)}$$

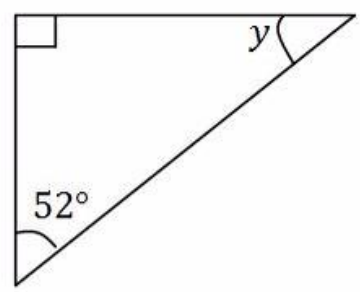
Example 2

Find the angles x and y in the diagrams below

(a)



(b)



Solution

(a) $x + 41° + 73° = 180°$

$$x + 114° = 180°$$
$$x = 180° - 114°$$
$$x = 66°$$

(b) $y + 52° + 90° = 180°$

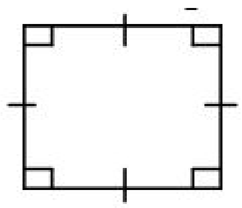
$$y + 142° = 180°$$
$$y = 180° - 142°$$
$$y = 38°$$

Different Quadrilaterals

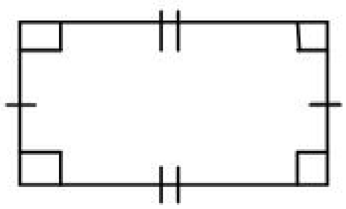
Construct different quadrilaterals

A quadrilateral – is a polygon with four sides.Examples of quadrilaterals are a square, a rectangle, a rhombus, a parallelogram, a kite and a trapezium

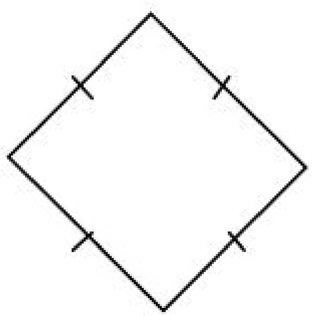
A square – has equal sides and all angles are 90º



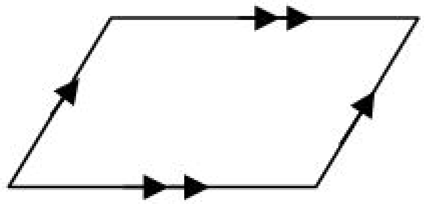
A rectangle – has two pairs of opposite sides equal and all angles are 90º



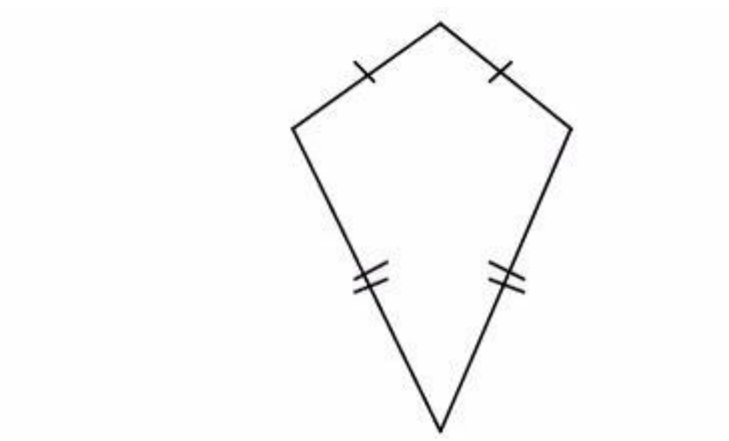
A rhombus – has all sides equal.Opposite angles are also equal



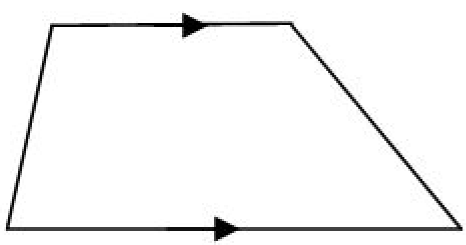
A parallelogram – has two pairs of opposite sides equal.Opposite angles are also equal



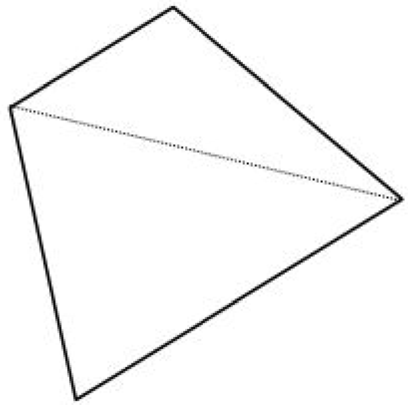
A kite – has two pairs of adjacent sides equal.One pair of opposite angles are also equal



A trapezium – has one pair of opposite sides pair



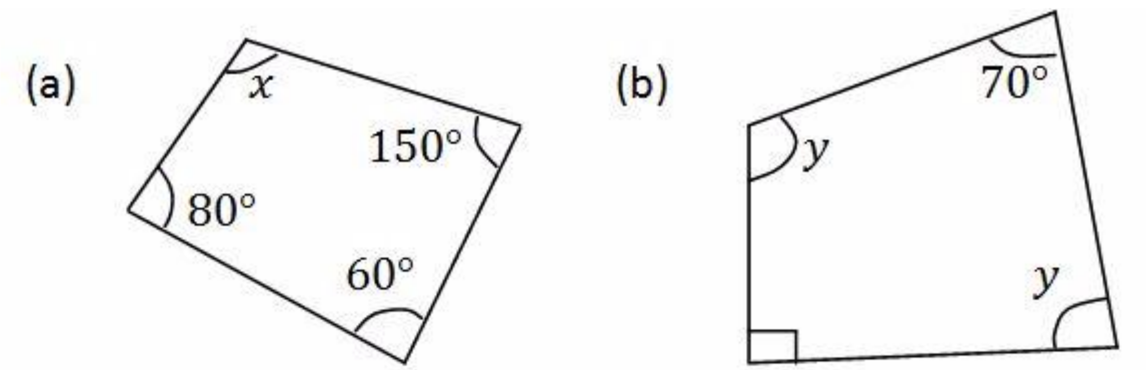
Any quadrilateral is made up of two triangles. Consider the below quadrilateral.



Sum of angles of quadrilateral = 2 ×180º = 360º

Example 3

Find the angles *x* and *y* in the diagrams below



Solution

(a) $x + 150° + 80° + 60° = 360°$

$$x + 290° = 360°$$
$$x = 360° - 290°$$
$$x = 70°$$

(b) $y + y + 70° + 90° = 360°$

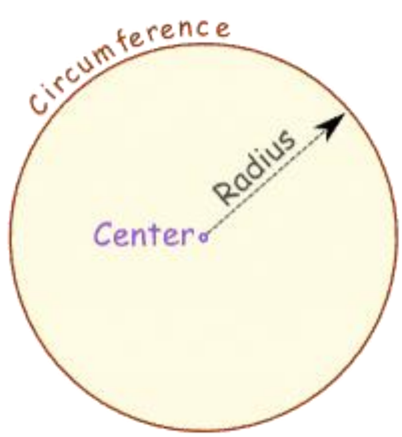
$$2y + 160° = 360°$$
$$2y = 360° - 160°$$
$$2y = 200°$$
$$y = \frac{200°}{2} = 100°$$
$$y = 100°$$

Circles

A Circle

Draw a circle

To make a circle: Draw a curve that is "radius" away from a central point.



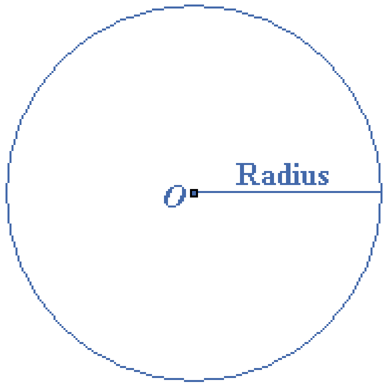
And so:All points are the same distance from the center.

You can draw it yourself:Put a pin in a board, put a loop of string around it, and insert a pencil into the loop. Keep the string stretched and draw the circle!

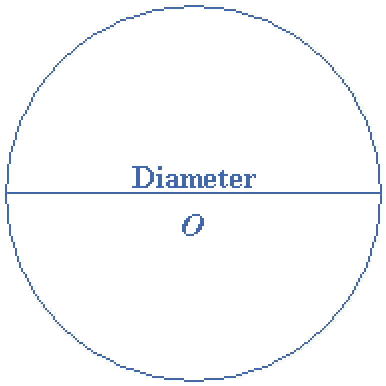
Different Parts of a Circle

Describe different parts of a circle

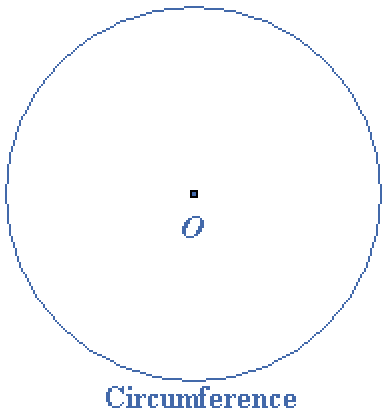
The **radius** of the circle is a straight line drawn from the center to the boundary line or the circumference. The plural of the word radius is **radii**.



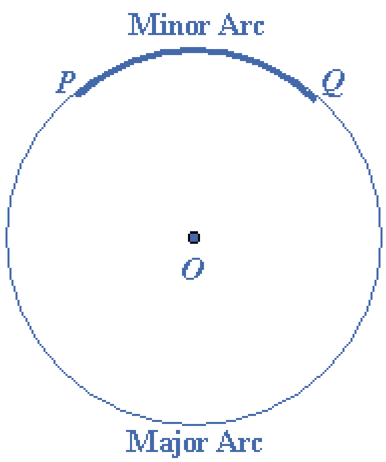
The **diameter** is the line crossing the circle and passing through the center. It is the twice of the length of the radius.



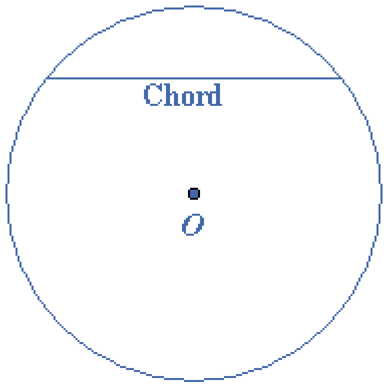
The **circumference** of a circle is the boundary line or the perimeter of the circle.



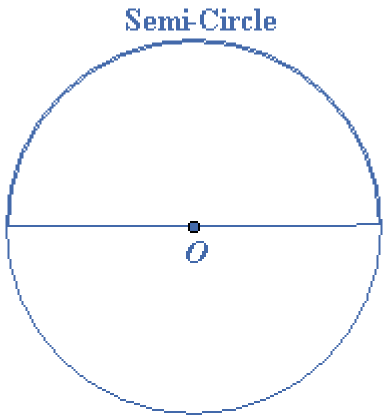
An **arc** is a part of the circumference between two points or a continuous piece of a circle. The shorter arc between and is called the **minor arc**. The longer arc between and is called the **major arc**.



The **chord** is a straight line joining two points on the circumference points of a circle. The diameter is a special kind of the chord passing through the center.



A**semi-circle**is an arc which is half of thecircumference.



A **tangent** is a straight line which touches the circle. It does not cut the circumference. The point at which it touches, is called the **point of contact**.