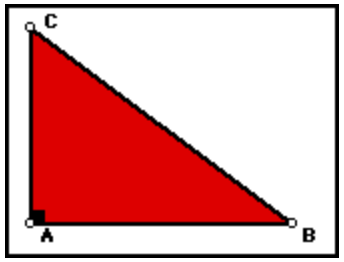
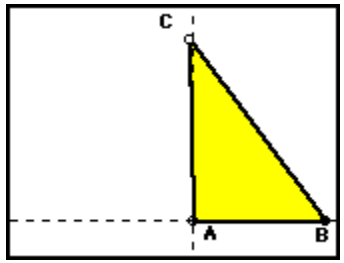
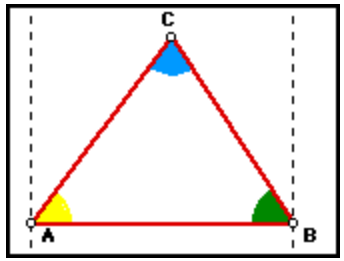
Introductions to Angles

MATHEMATICS







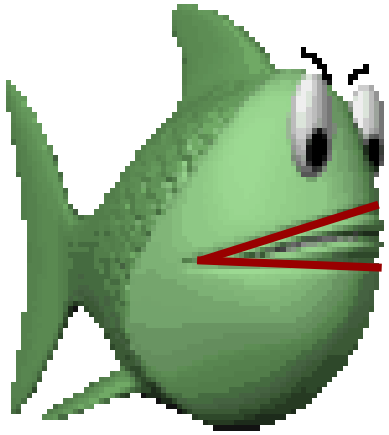
Contents

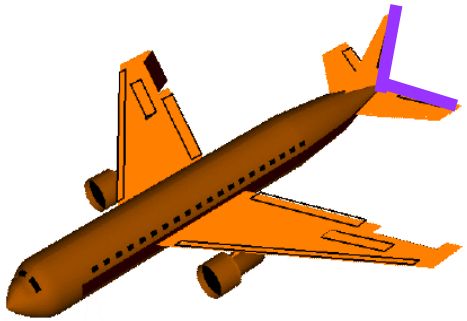
Recap Geometrical Terms

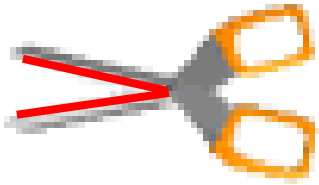
Point		**An exact location on a plane is called a point.**
Line		**A straight path on a plane, extending in both directions with no endpoints, is called a line.**
Line segment		**A part of a line that has two endpoints and thus has a definite length is called a line segment.**
Ray		**A line segment extended indefinitely in one direction is called a ray.**

Angles In Daily Life

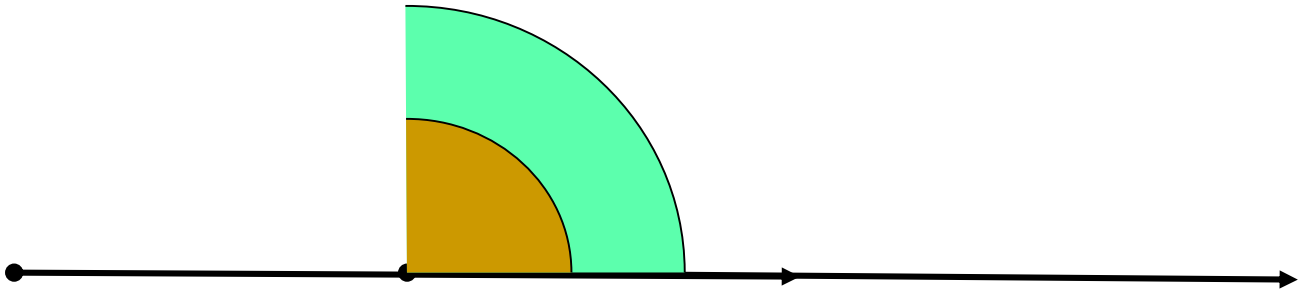
If we look around us, we will see angles everywhere.







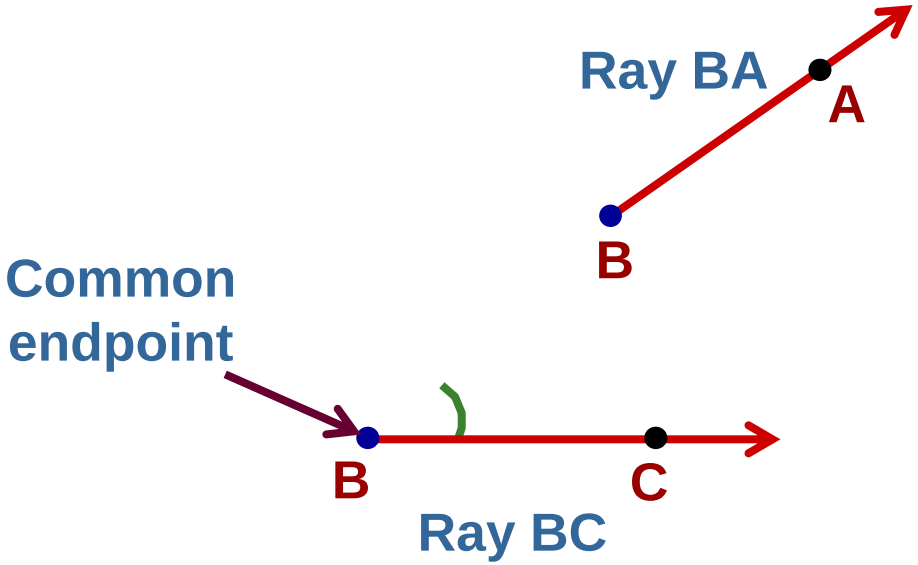
What quantity does an angle measure?



Angles measure some **amount of rotation**

What Is An Angle ?

When two non-collinear rays join with a common endpoint (origin) an angle is formed.



Common endpoint is called the vertex of the angle. B is the vertex of ∠ABC.

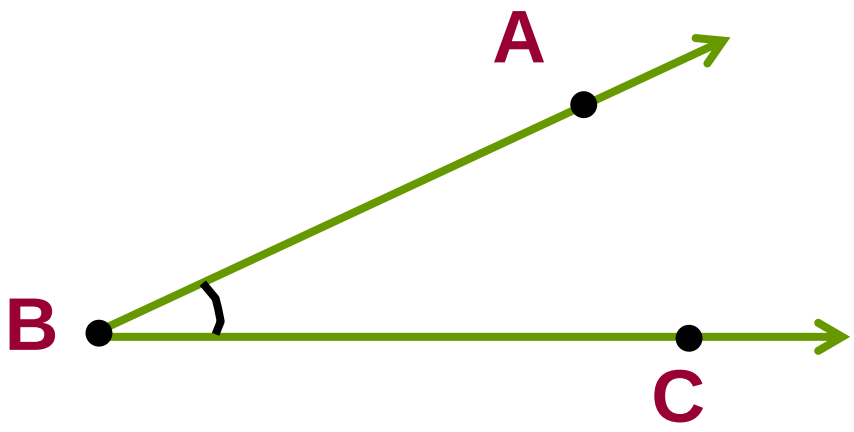
Ray BA and BC are two non-collinear rays

Ray BA and ray BC are called the arms of ∠ABC.

Fact: We can also think of an angle formed by rotating one ray away from its initial position.

Naming An Angle

To name an angle, we name any point on one ray, then the vertex, and then any point on the other ray.

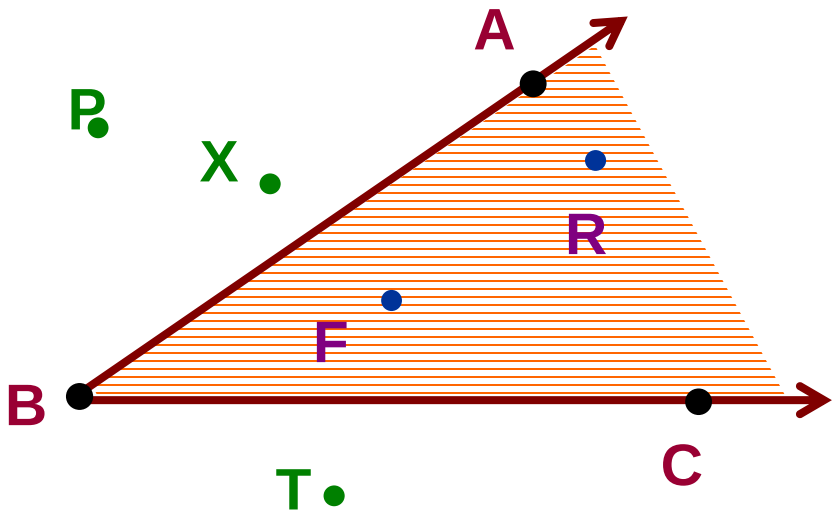


For example: ∠ABC or ∠CBA

We may also name this angle only by the single letter of the vertex, for example ∠B.

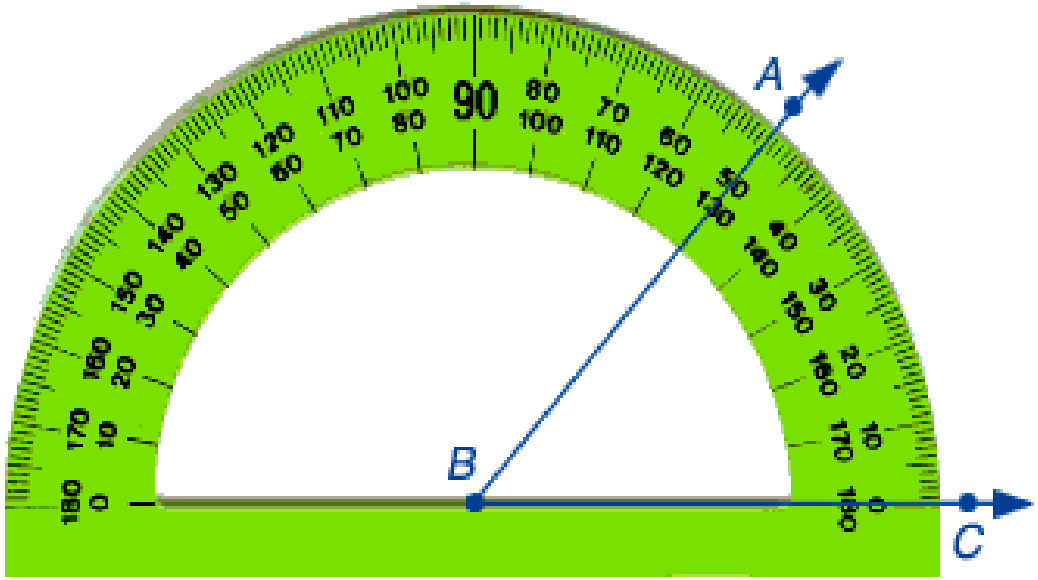
Interior And Exterior Of An Angle

An angle divides the points on the plane into three regions:



- **Points lying on the angle (An angle)**
- **Points within the angle (Its interior portion.)**
- **Points outside the angle (Its exterior portion.)**

Measurement Of An Angle



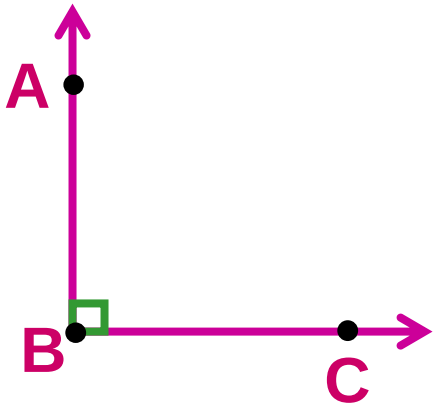
Protractor is used to measure and draw angles.

Angles are accurately measured in degrees.

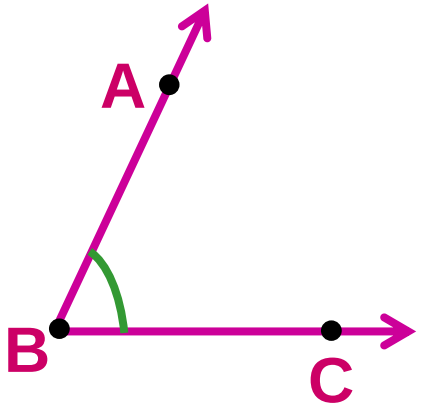
Types Of Angles

There are four main types of angles.

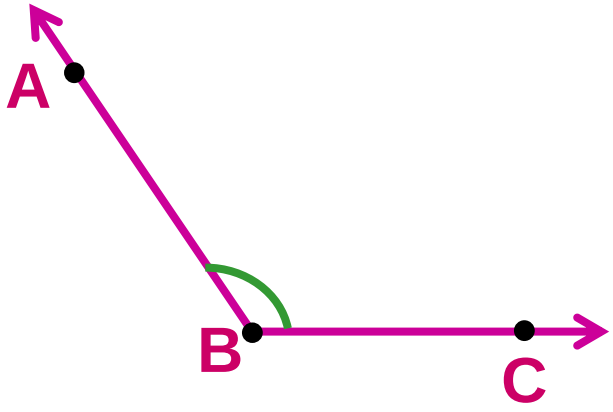
Right angle



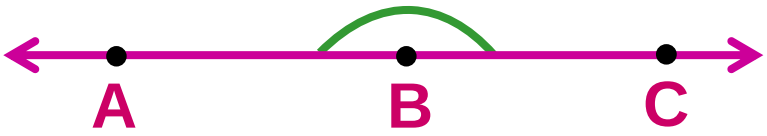
Acute angle

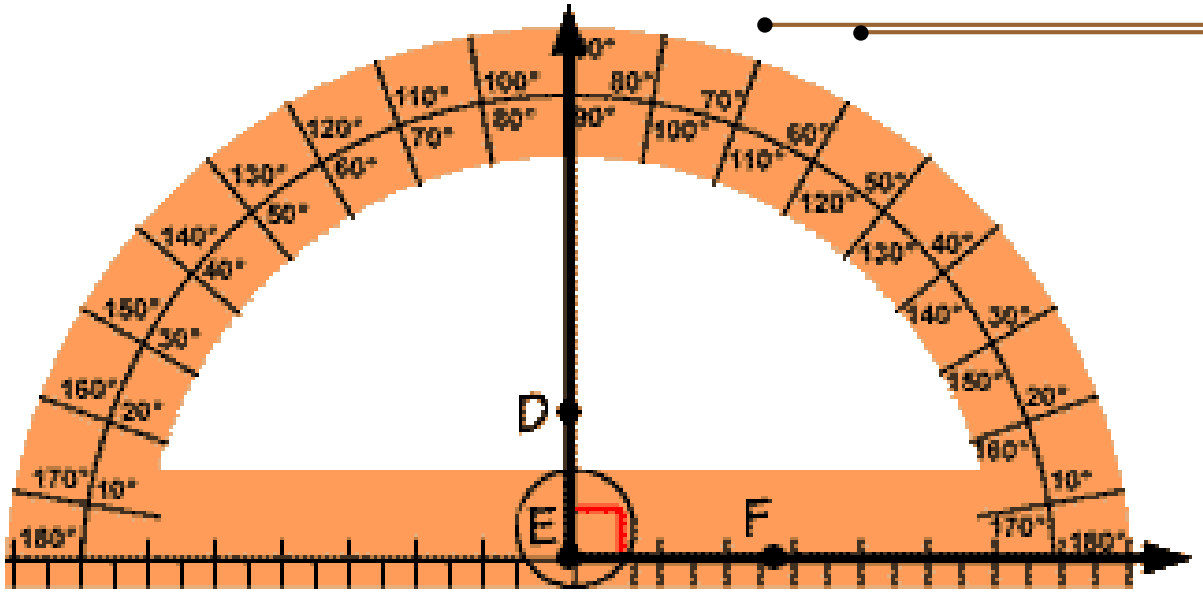


Obtuse angle



Straight angle



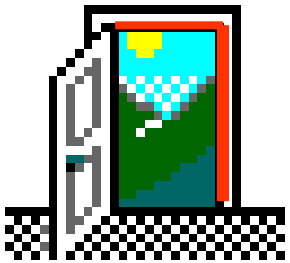


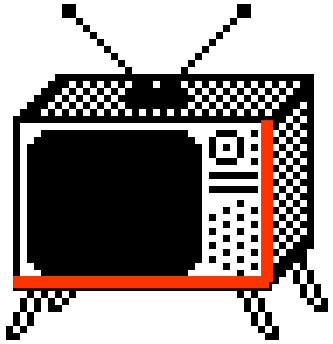
right angle measures 90°

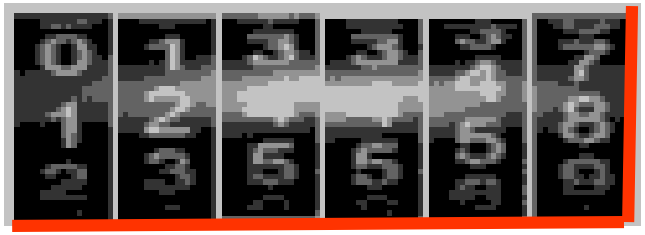
Right angle: An angle whose measure is 90 degrees.

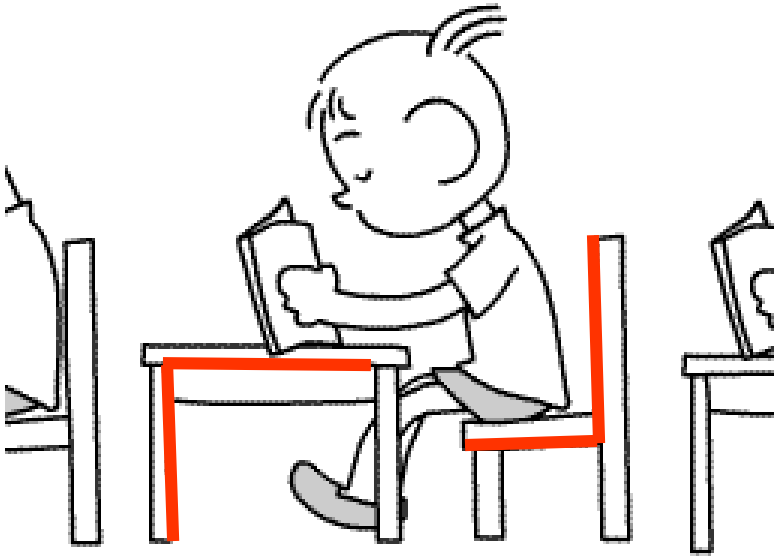
Straight Angle	Right Angle	Acute Angle	Obtuse Angle

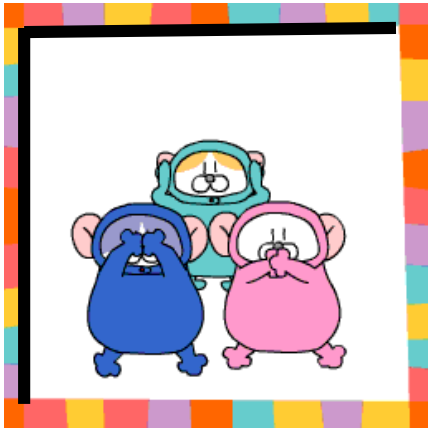
Examples Of Right Angle

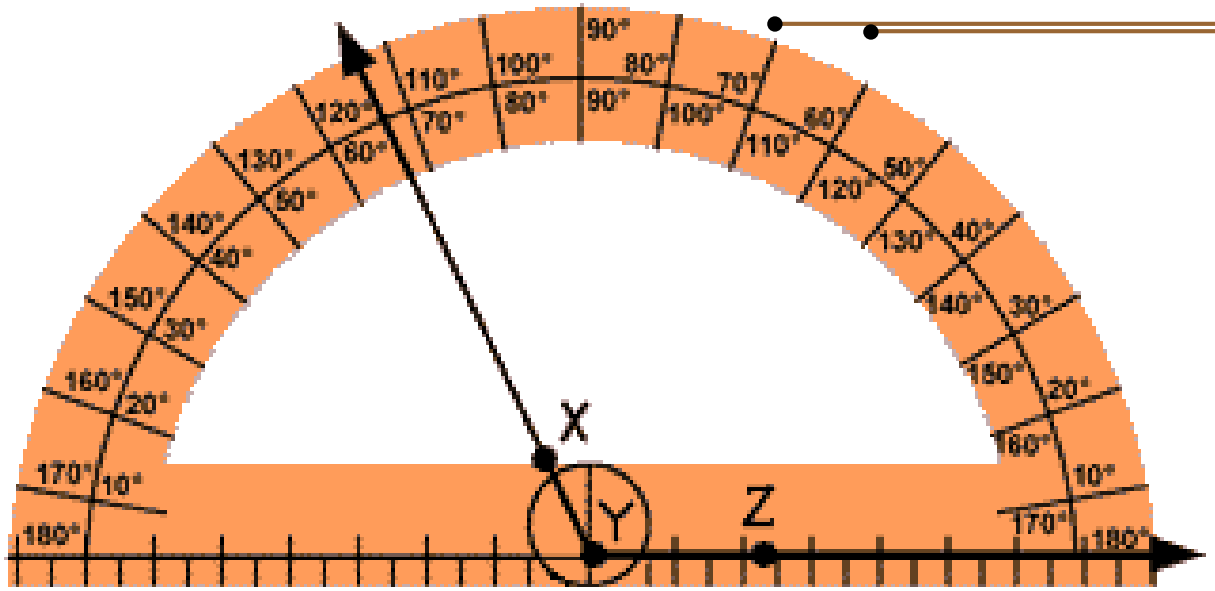










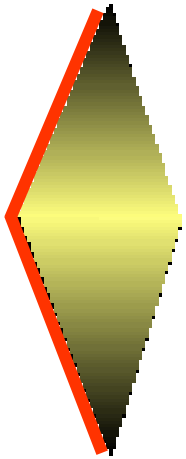


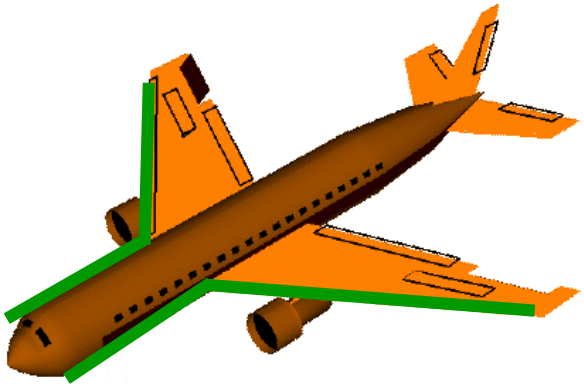
obtuse angle measures greater than 90°
and less than 180°

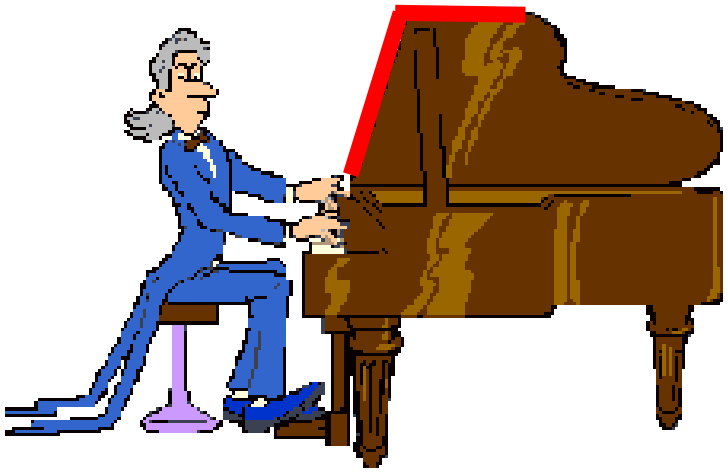
Obtuse angle: An angle whose measure is greater than 90 degrees.

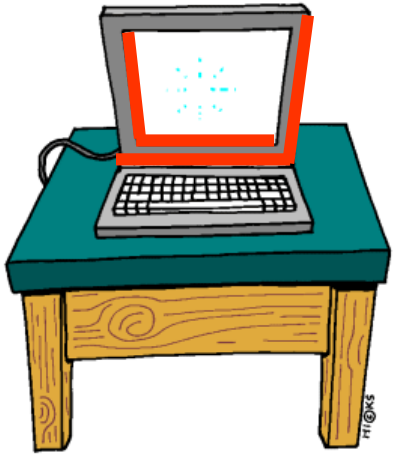
Straight Angle | Right Angle | Acute Angle | Obtuse Angle

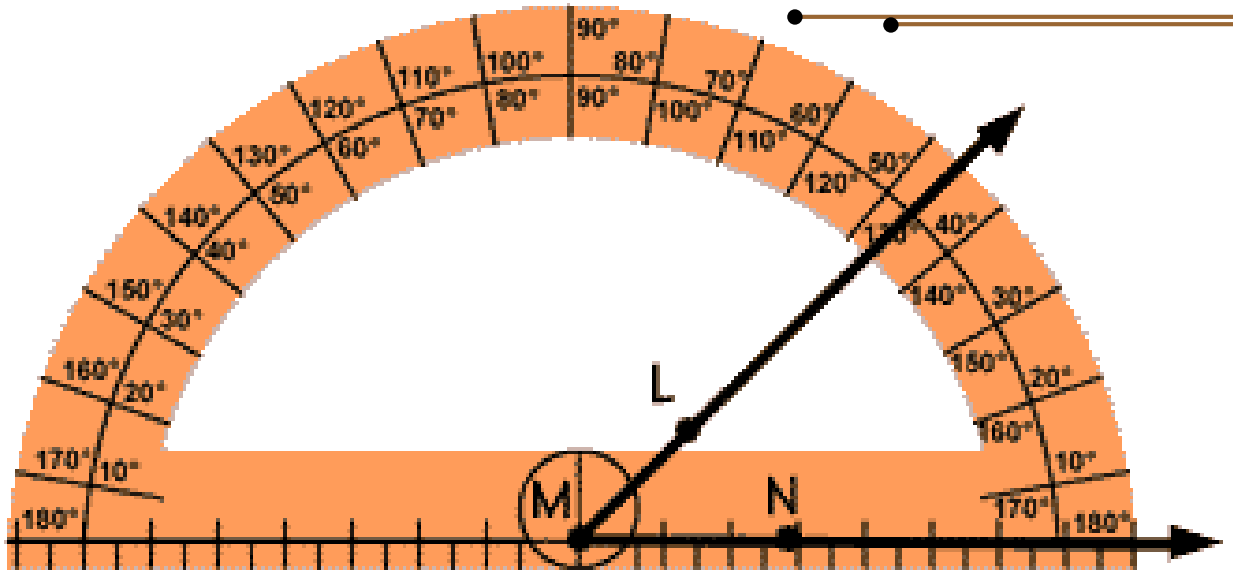
Examples Of Obtuse Angle









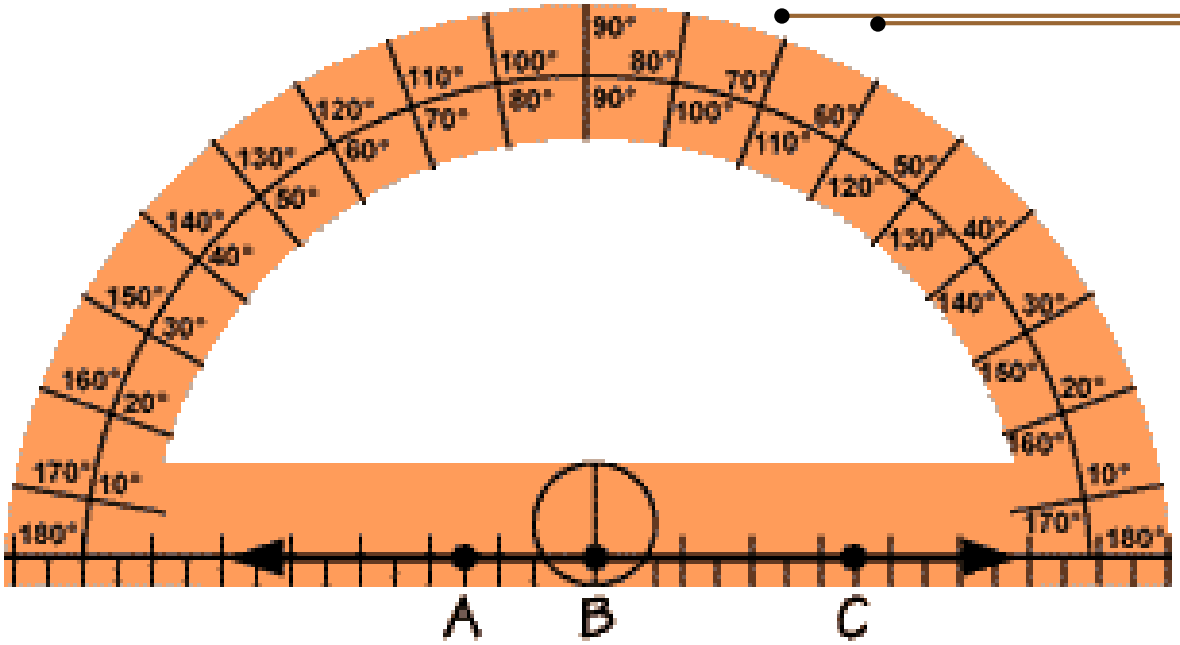


acute angle measures less than 90°

Acute angle: An angle whose measure is less than 90 degrees.

Straight Angle | Right Angle | Acute Angle | Obtuse Angle

Examples Of Acute Angle

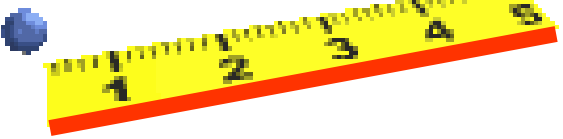


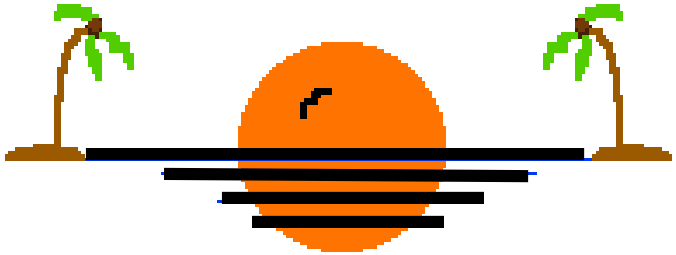
straight angle measures 180°

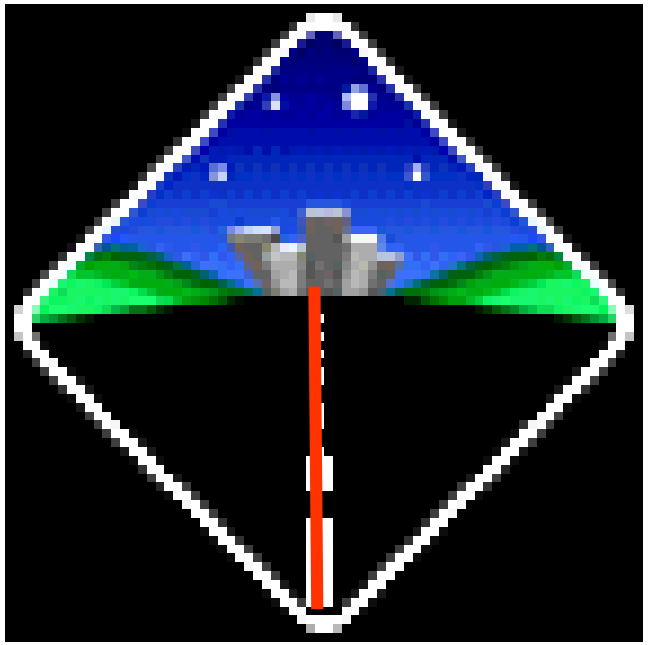
Straight angle: An angle whose measure is 180 degrees.

Straight Angle	Right Angle	Acute Angle	Obtuse Angle

Examples Of Straight Angle

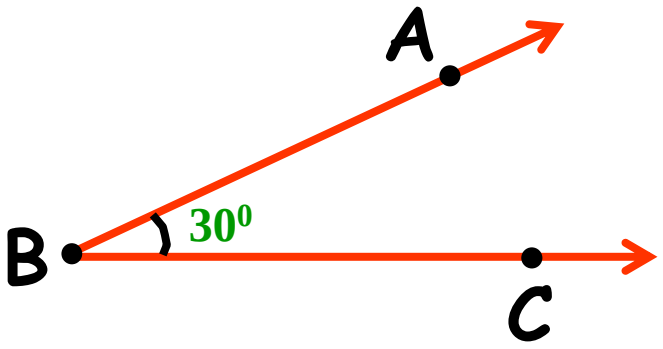


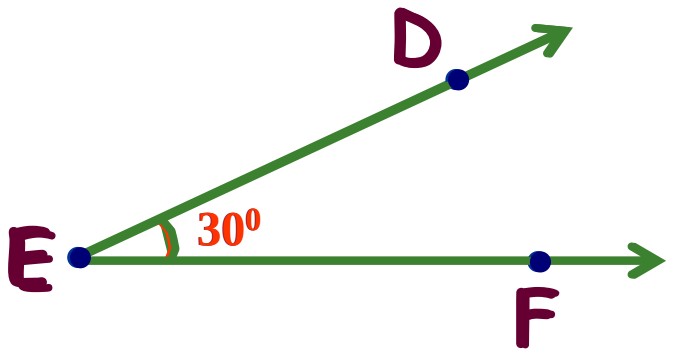




Congruent Angles

Two angles that have the same measure are called congruent angles.





Congruent angles have the same amount of rotation.

Note: Symbol for congruent is $\cong$

$$\measuredangle ABC \cong \measuredangle DEF$$

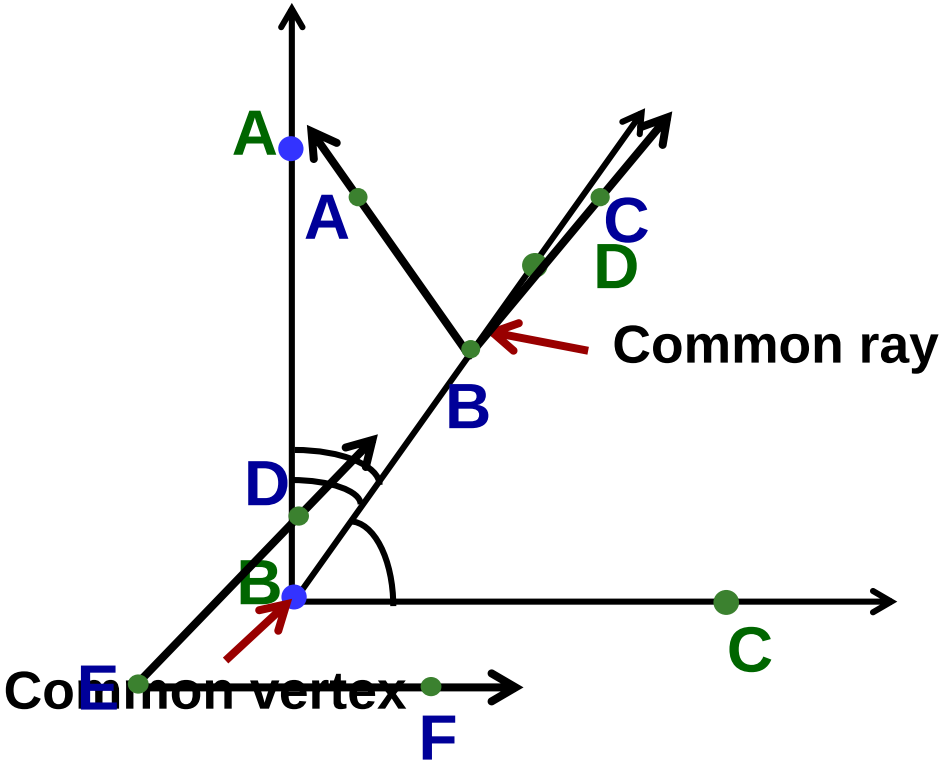
$$or \ \angle ABC \cong \angle DEF$$

Pairs Of Angles : Types

- *Adjacent angles*
- *Vertically opposite angles*
- *Complimentary angles*
- *Supplementary angles*
- *Linear pair of angles*

Adjacent Angles

Two angles that have a common vertex and a common ray are called adjacent angles.



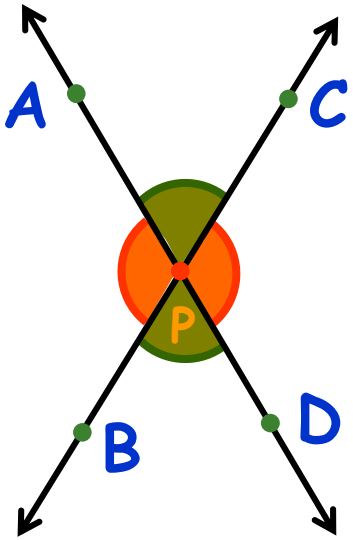
Adjacent Angles ∠ABD and ∠DBC

∠ABC and ∠DEF are not adjacent angles

Adjacent angles do not overlap each other.

Vertical Angles (Opposite ∡s)

Vertical angles are pairs of angles formed by **two lines intersecting at a point.**



$\angle APC = \angle BPD$

$\angle APB = \angle CPD$

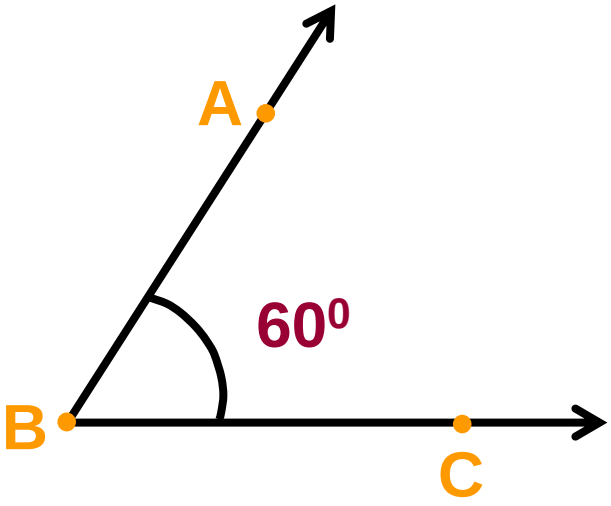
Four angles are formed at the point of intersection.

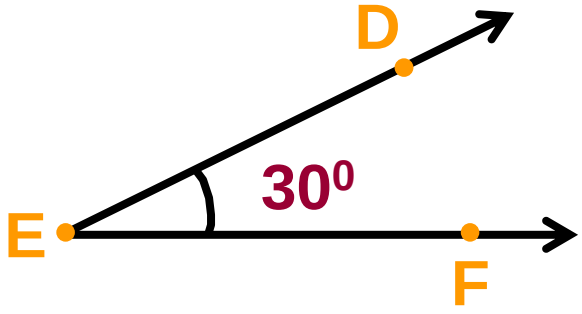
Vertical (or opposite) angles are **congruent.**

Point of intersection 'P' is the **common vertex of the four angles.**

Complementary Angles

If the **sum of two angles is 90^0**, then they are called complementary angles.





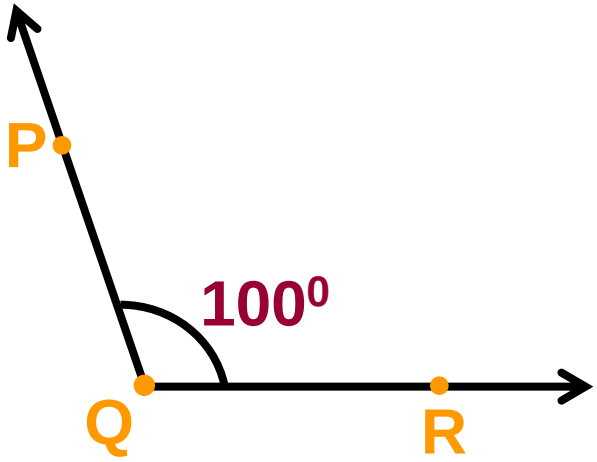
$\angle ABC$ and $\angle DEF$ are complementary because

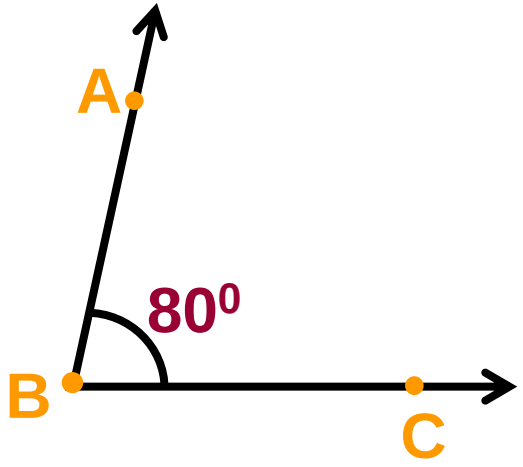
$$\angle ABC + \angle DEF$$

$$60^0 + 30^0 = 90^0$$

Supplementary Angles

If the sum of two angles is 180^0 then they are called supplementary angles.





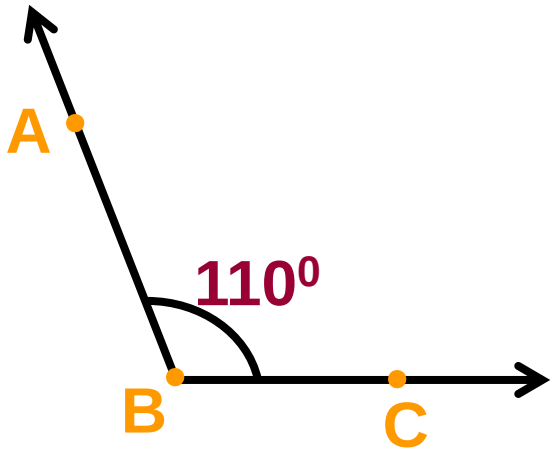
$\angle$PQR and $\angle$ABC are supplementary, because

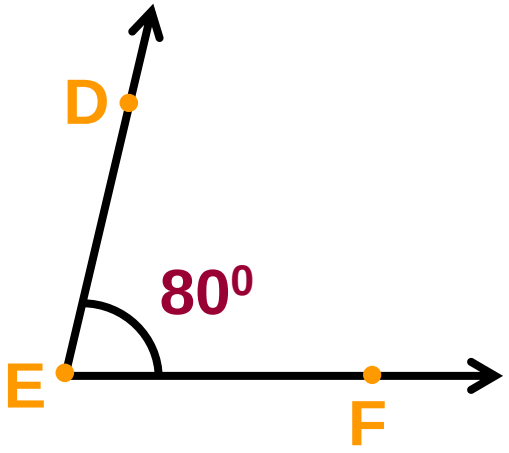
$\angle PQR + \angle ABC$

$$100^0 + 80^0 = 180^0$$

Contd….

If the sum of two angles is **more than 180^0** or **less than 180^0**, then they are **not supplementary angles.**





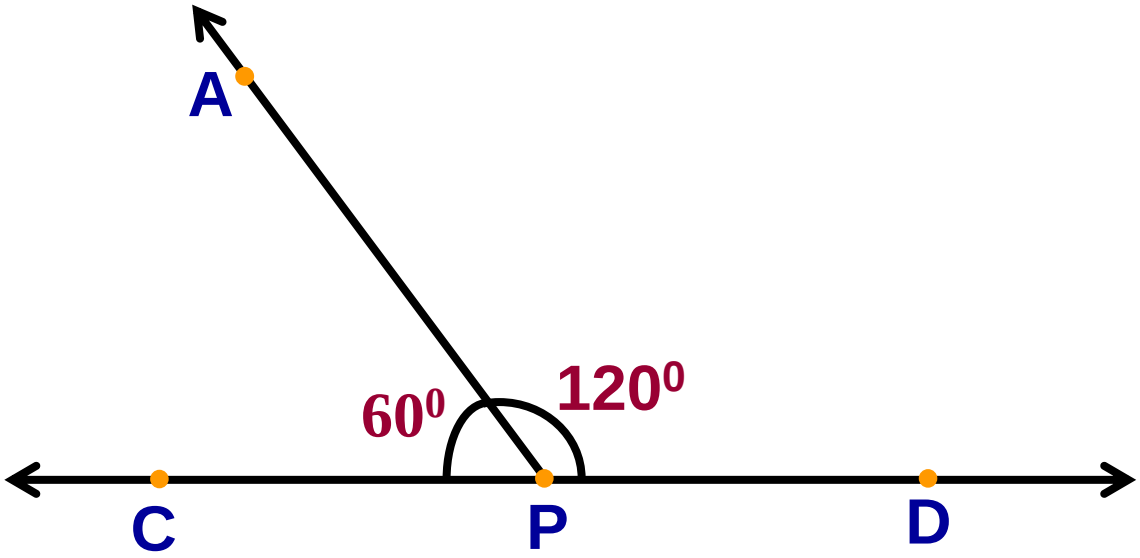
$\angle DEF$ and $\angle PQR$ are **not supplementary** because

$$\angle ABC + \angle DEF$$

$$110^0 + 80^0 = 190^0$$

Linear Pair Of Angles

Two adjacent supplementary angles are called linear pair of angles.



$\angle APC + \angle APD$

$$60^0 + 120^0 = 180^0$$

Name the adjacent angles and linear pair of angles in the given figure:

Test Yourself 2

Adjacent angles:

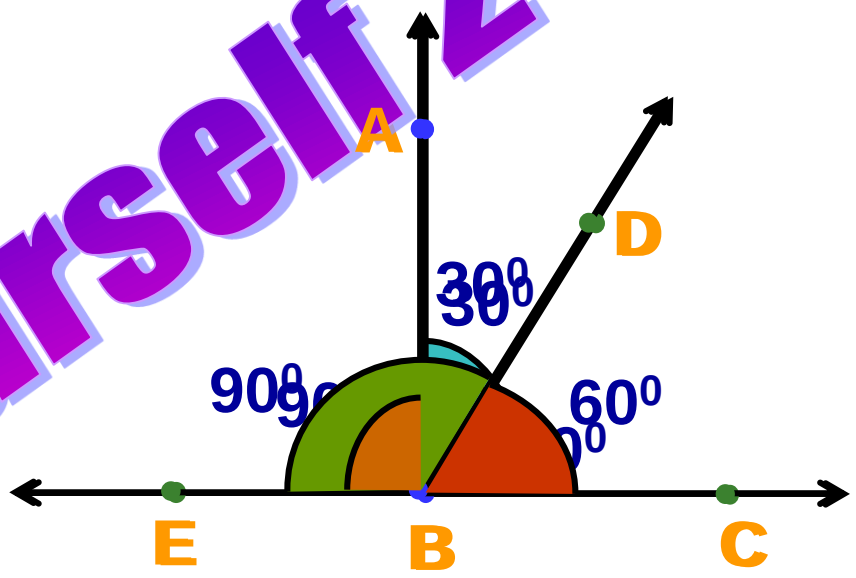
∠ABD and ∠DBC

∠ABE and ∠DBA

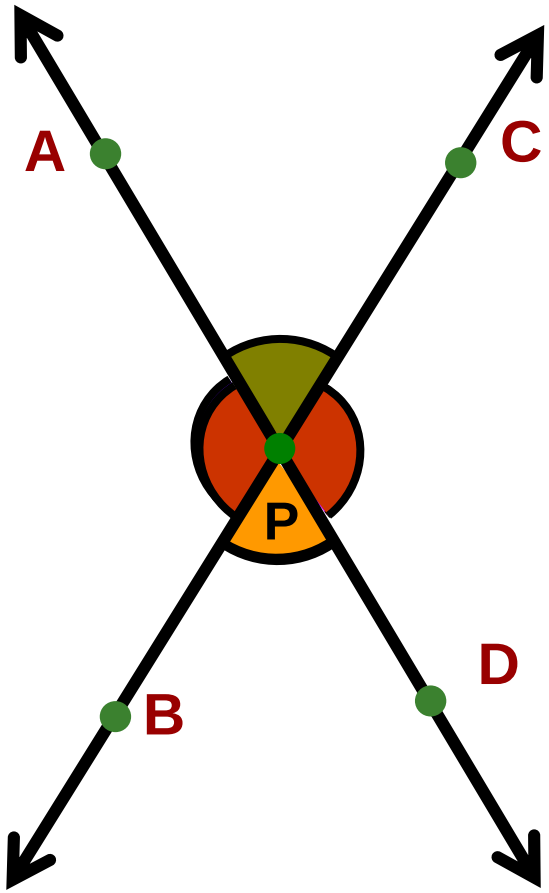
Linear pair of angles:

∠EBA, ∠ABC

∠EBD, ∠[illegible]



Name the vertical angles and adjacent angles in the given figure:



Vertical (opposite) angles: ∠APC and ∠BPD

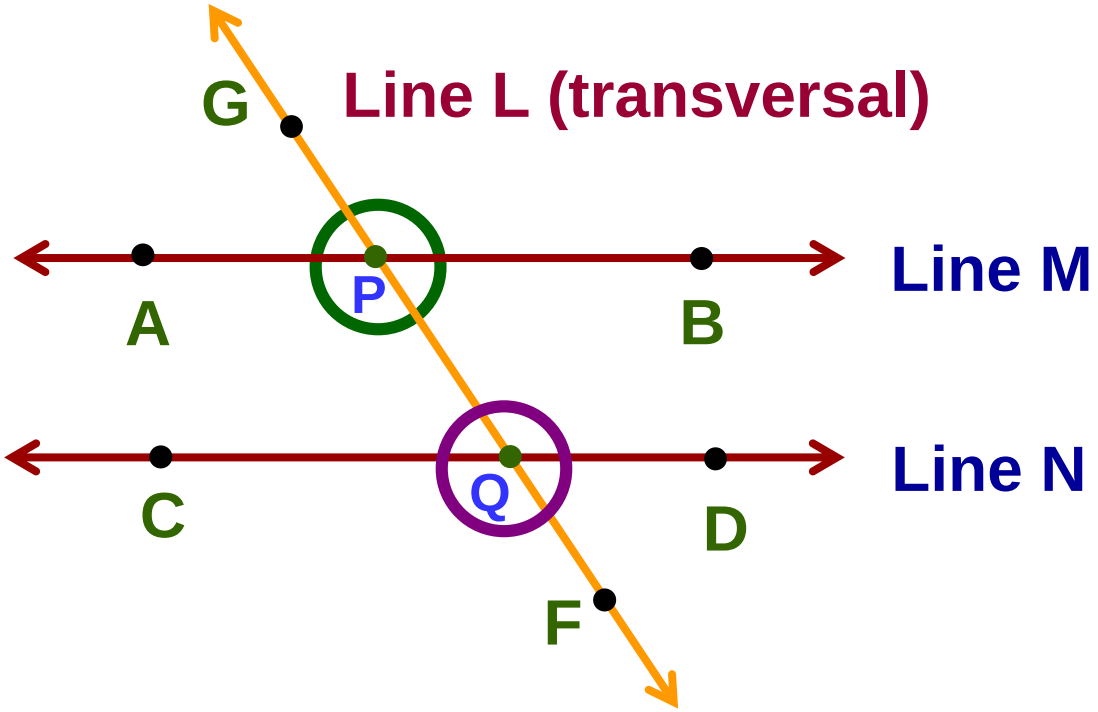
Adjacent angles: ∠APC and ∠CPD

∠APB and ∠CPD

∠APB and ∠BPD

Pairs Of Angles Formed by a Transversal

A line that intersects two or more lines at different points is called a **transversal**.



Four angles are formed at point P and another four at point Q.

Line L intersects line M at P and line N at Q.

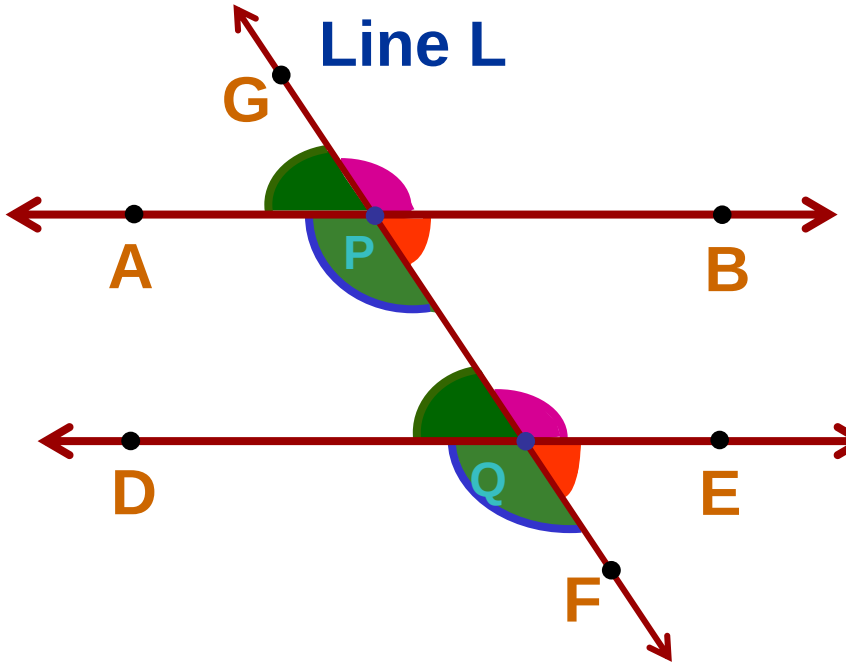
Eight angles are formed in all by the transversal L.

Pairs Of Angles Formed by a Transversal

- ***Corresponding angles***
- ***Alternate angles***
- ***Interior angles***

Corresponding Angles

When two parallel lines are cut by a **transversal**, pairs of **corresponding angles** are formed.



$\angle GPB = \angle PQE$

$\angle GPA = \angle PQD$

$\angle BPQ = \angle EQF$

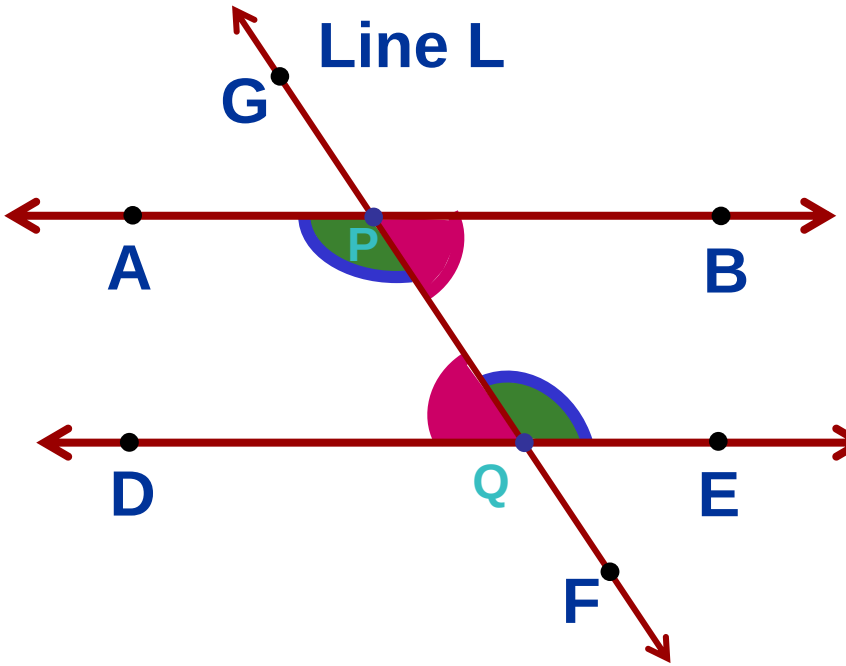
$\angle APQ = \angle DQF$

Four pairs of corresponding angles are formed.

Corresponding pairs of angles are **congruent**.

Alternate Angles

Alternate angles are formed on opposite sides of the transversal and at different intersecting points.



$\angle BPQ = \angle DQP$

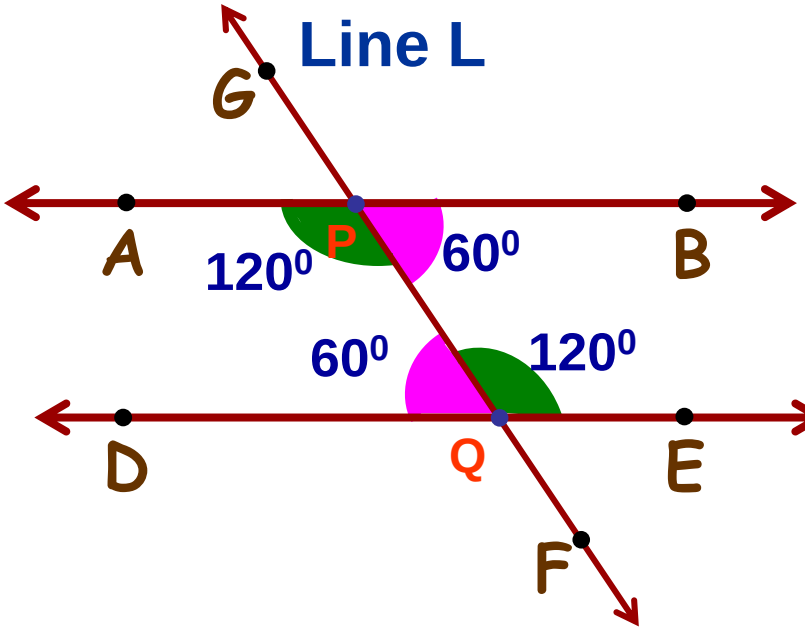
$\angle APQ = \angle EQP$

Two pairs of alternate angles are formed.

Pairs of alternate angles are congruent.

Interior Angles

The angles that lie in the area between the two parallel lines that are cut by a transversal, are called **interior angles.**



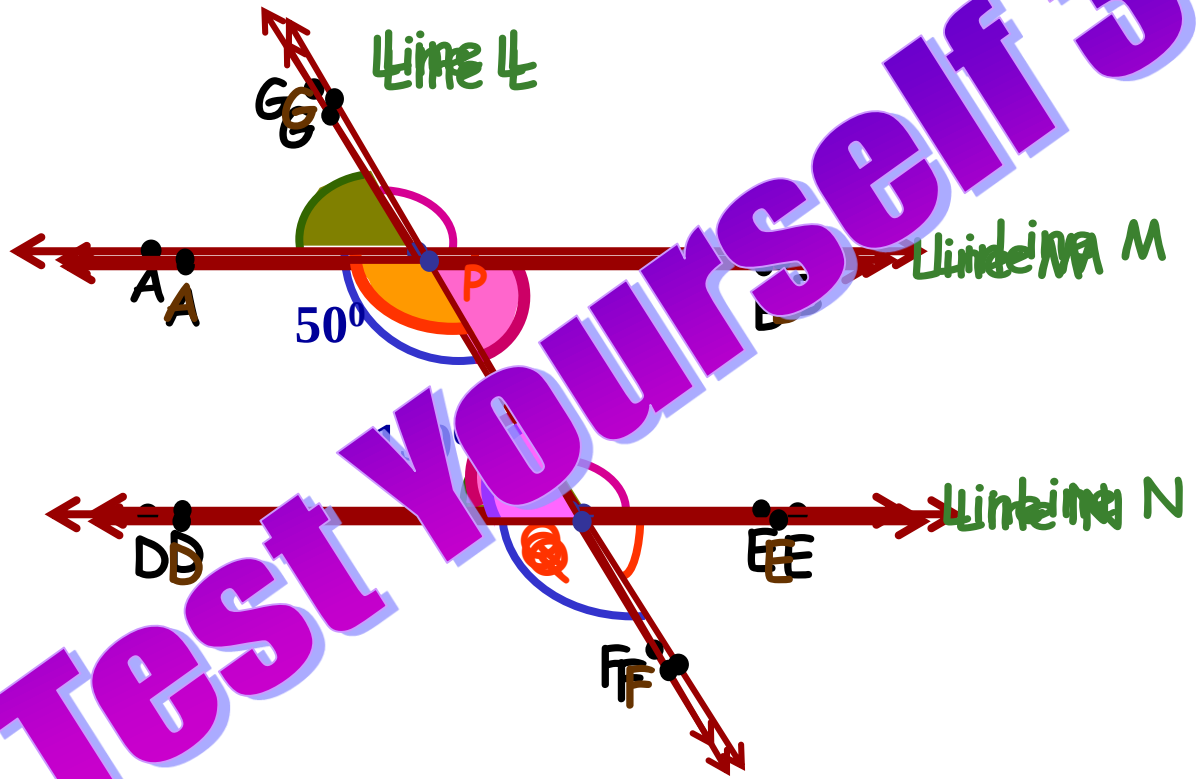
$\angle BPQ + \angle EQP = 180^0$

$\angle APQ + \angle DQP = 180^0$

The measures of interior angles in each pair **add up to 180^0.**

A pair of interior angles lie on the **same side** of the transversal.

Name the pairs of the following angles formed by a transversal.



Test Yourself 3

Interior angles