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CHAPTER FIVE

Geometric Figures and Measurement

Summary

THEOREM OF TRIANGLES & SUM OF INTERIOR ANGLES OF POLYGON

Mathematics For Grade 7

Addis Ababa Education bureau

OBJECTIVES ; After completing this summary you should be able to :-

- **Identify alternate interior angles and corresponding angles**
- **Define complementary and Supplementary angles**
- State Angle - sum theorem
- Relate the measure of remote interior angles and exterior angle of a triangle

- Formulate the sum of all and each interior , exterior angles of polygon.

- Solve the sum the all and each interior angles of polygon.

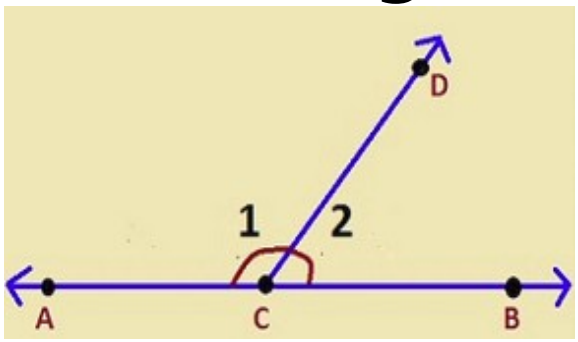
- Formulate and solve the numbers of triangles of the given polygon.

- Differentiate equilateral , equiangular and regular polygons.

THEOREM OF TRIANGLES

A straight angle can also be formed by two or more angles that sum to 180 degrees.

Here, angle 1 + angle 2 = 180^0



Example 6. Calculate the marked angle in the above figures $m(< 2) = 60^0$,then find the $m(<1)$?

Solution :- $m(<1) + m(< 2) = 180^0$

$$m(<1) + 60 = 180^0$$

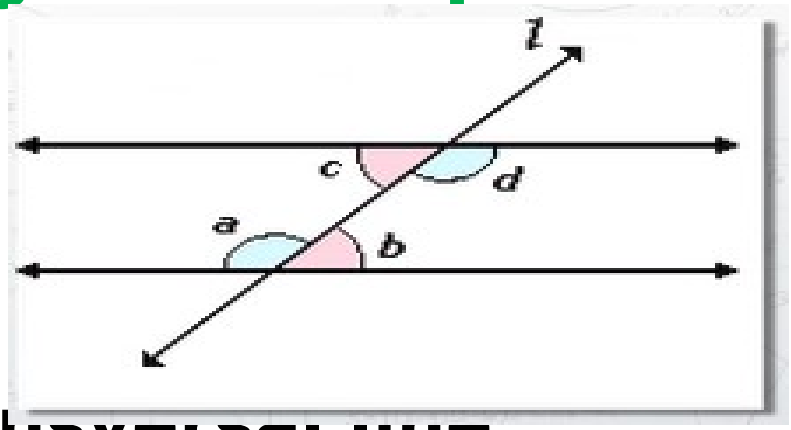
$$m(<1) = 180^0 - 60^0 = 120^0$$

Therefore $m(<1) = 120^0$

Alternate interior angles

- **A transversal line** is a line that crosses or passes through two other lines

Theorem: If two parallel lines are cut by the transversal line ,the **alternate interior angles are equal.**

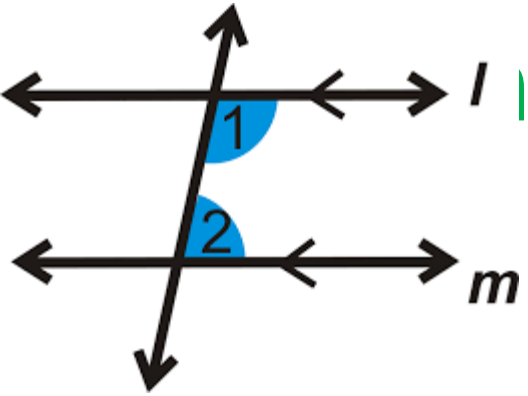


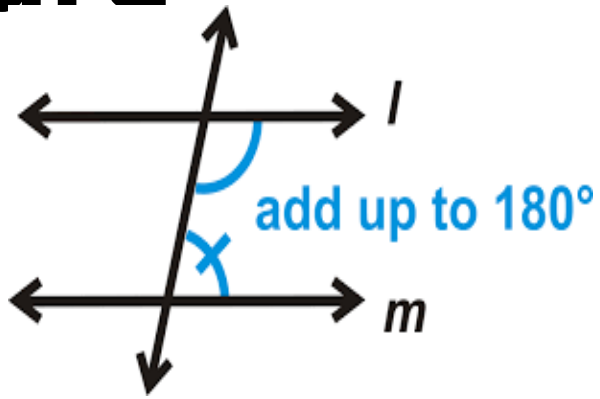
- Line *l* is transversal line
- <c and <b , <a and <d are pairs of alternate interior angles
- m(<c) = m(<b) and m(<a) = m(<d)

Supplement interior angles

Theorem: If two parallel lines are cut by the transversal line, then interior angles on the same sides of the transversal line are

Supplementary

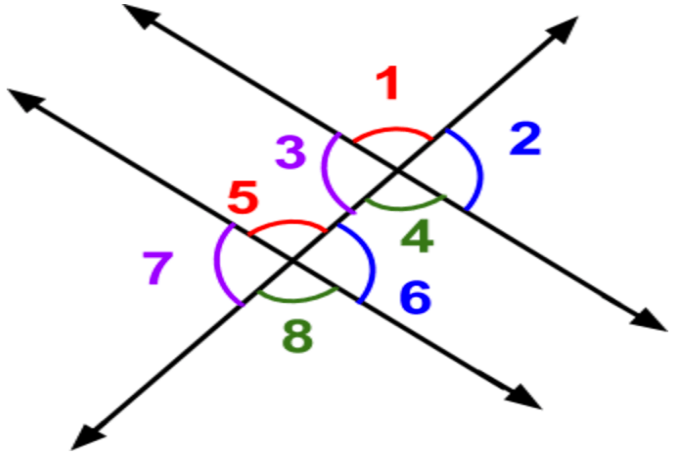




m(<1)+ m(< 2) = 180⁰ .....<1 and <2 are

Corresponding angles

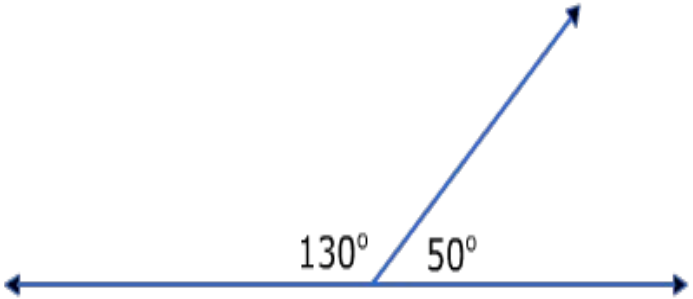
Theorem: If two parallel lines are cut by transversal line, then the corresp... ...es are equal.



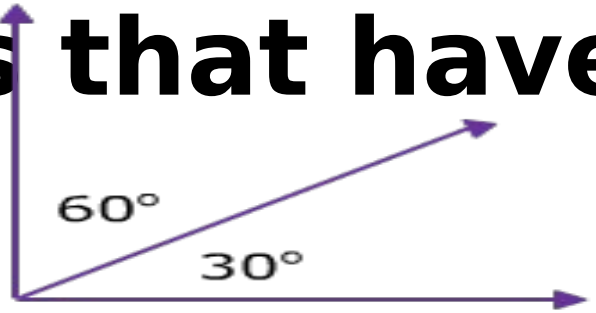
As shown in the above figure, m(∠1)=

Complementary and supplementary angles

- **Supplementary angles** are two angles that have a sum of **180°.**



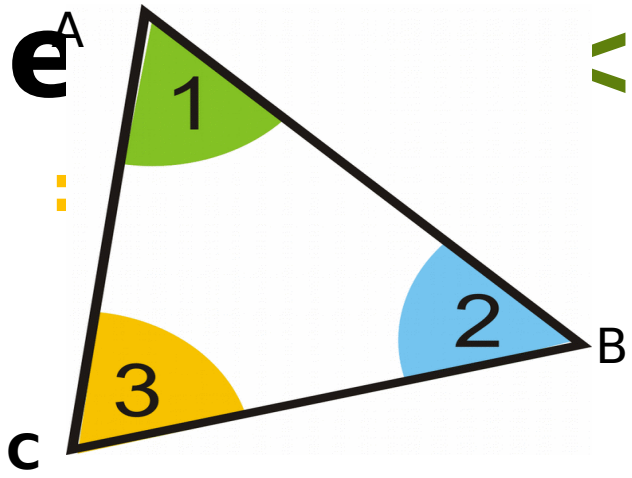
- **Complementary angles** are two angles that have a sum of **90°.**



ANGLE – SUM THEOREM

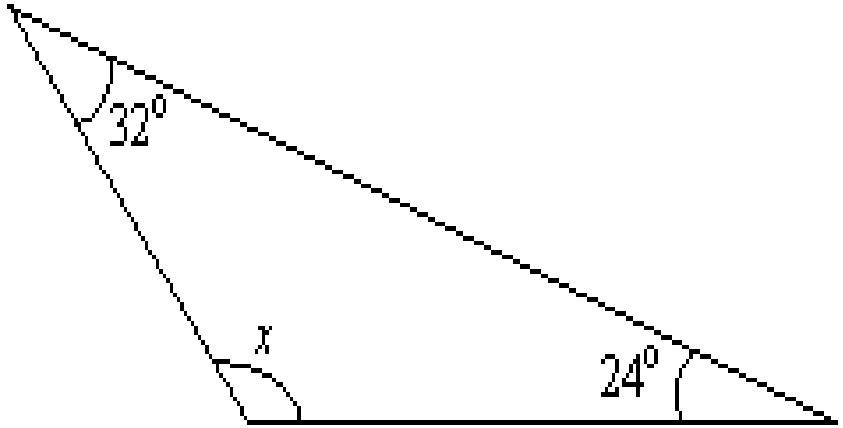
Theorem : Angle sum theorem of triangle states that the sum of the degree measures of the interior angles of a triangle is180°

In the triangle m(<1)+ m(<2)+ m(<3) :



Worked Example

Find the value of x in the following triangle.



Solution: $x + 24° + 32° = 180°$ (sum of angles is 180°)

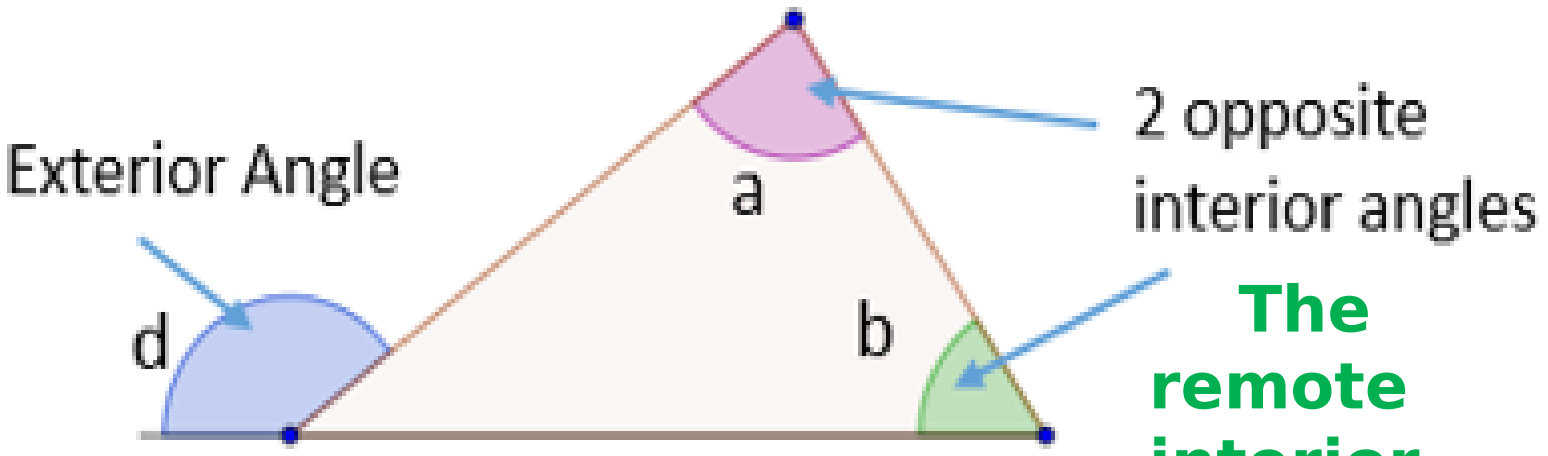
$$x + 56° = 180°$$

$$x = 180° - 56° = 124°$$

So , the value of x is 124°

Exterior Angle Theorem

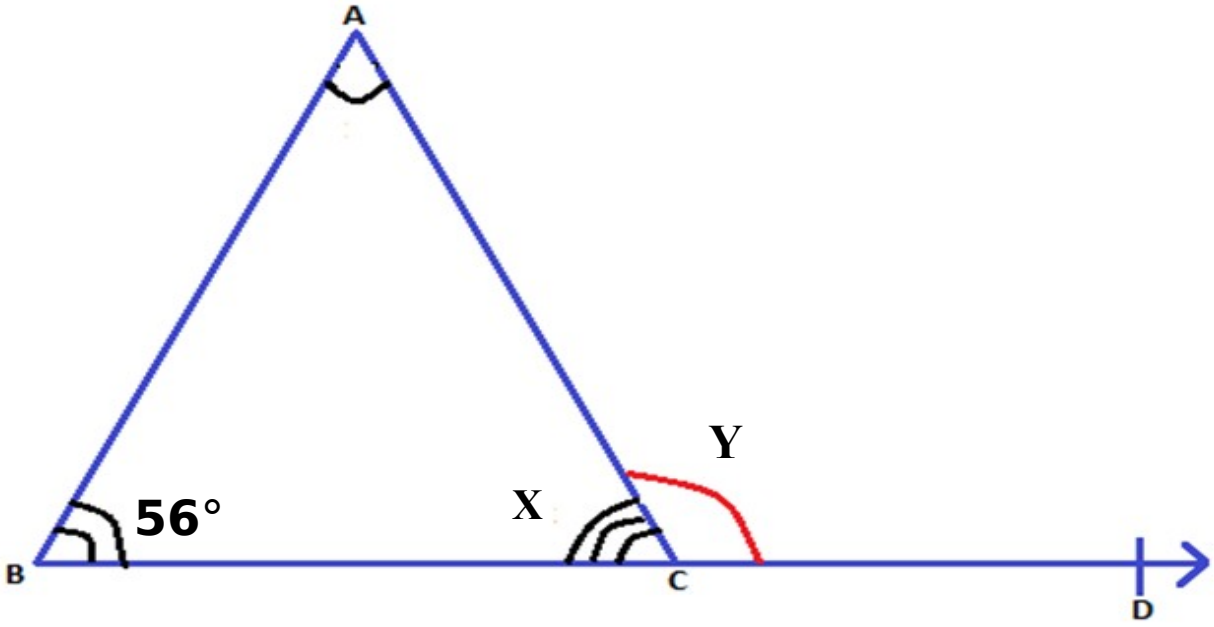
The exterior angle of a triangle is equal to the sum of the two opposite interior angles.



$$d = a + b$$

Worked example

Calculate the values of unknown variable in the fi



Solution:

$m(\angle ABC) + m(\angle BCA) + m(\angle CAB) = 180°$

---------- by angle sum theorem

$56° + x + 72° = 180°$ ------ Substitution

$x + 128° = 180°$

$x = 180° - 128°$

$X = 52°$

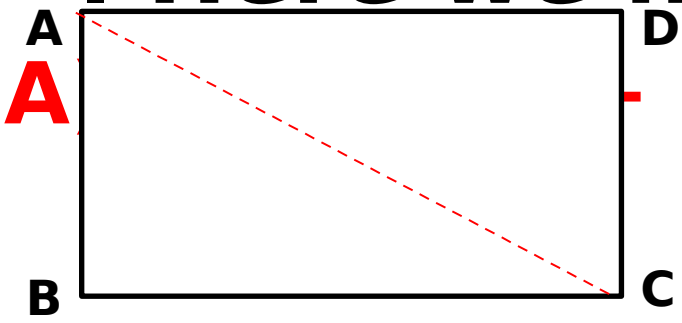
Now, $m(\angle ABC) + m(\angle BAC) = m(\angle ACD)$

---------- by remote

The sum of the interior angles of a convex polygon

- The measures of all the interior angles of a quadrilateral always add up to 360°
- You can see this by checking that the angles in this quadrilateral (tetragon) add up to 360° . Here we have;

m(∠A) + m(∠B) + m(∠C) + m(∠D) = 360°



- **By dividing the quadrilateral in to two triangles so that the measures of the interior angles of the two triangles add up to**

$$180° + 180° = 360°$$

- **As shown below the given Table Number of sides of a polygon and the respective sum of degree measures of all its interior angles.**

Sum of Interior Angles in Polygons



Convex Polygon	# of Sides	# of Triangles from 1 Vertex	Sum of Interior Angle Measures
Triangle	3	1	1* 180 = 180
Quadrilateral	4	2	2* 180 = 360
Pentagon	5	3	3* 180 = 540
Hexagon	6	4	4* 180 = 720
Heptagon	7	5	5* 180 = 900
Octagon	8	6	6* 180 = 1080
n-gon	n	n – 2	(n – 2) * 180

- **The formula for the number of triangle (T) , determined by diagonals drawn from one vertex of an n - sided polygon is $T = n - 2$**

- **Since you have already seen that the sum of the measures of the three angles of a triangles is 180° , you can make the following generalization**

- **The formula for the sum(S) , of the measures of all the interior angles of a polygon of n - sides is given by**

$$S = (n - 2) \times 180°$$

Worked example: **Find the numbers of triangle(T) and sum of the measure(S) of all the interior angles in a polygon having 7 sides.**

Solution: $n = 7$ sides, $T = n - 2 = 7 - 2 = 5$ 

$$S = (n - 2) \times 180°$$

$$S = (7 - 2) \times 180° \ ,$$

$$S = 5 \times 180°$$

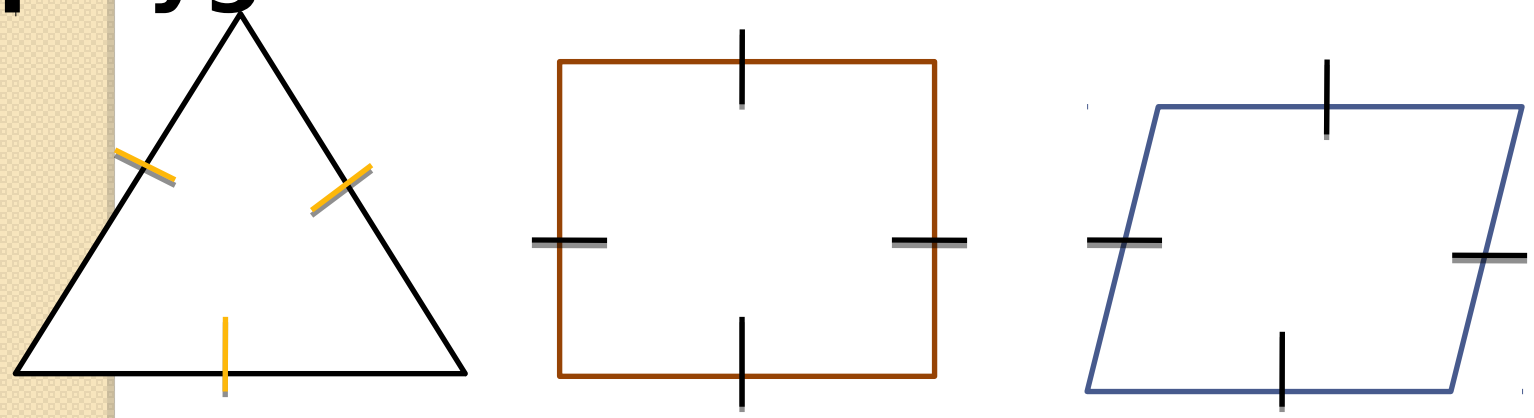
$$S = 900°$$

Therefore; the sum S, of the measures of all the angles of the polygon is 900°.

Equilateral, equiangular and regular polygons

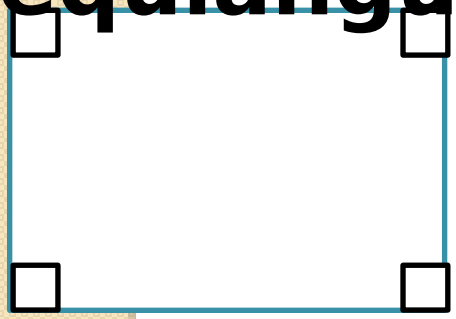
Definition: A polygon whose all sides are congruent is called an Equilateral polygon.

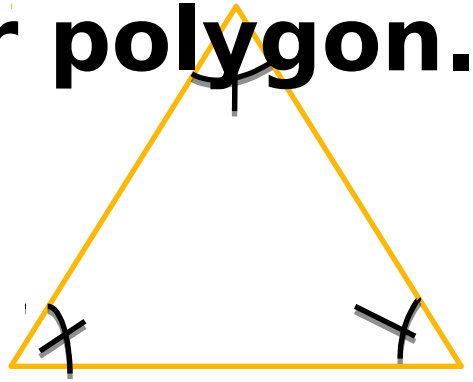
An Equilateral triangle ,square and a rhombus are examples of equilateral polygons.

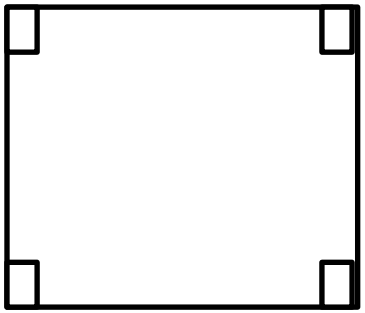


Definition : A polygon whose all angles are congruent (of the same size angle) is called an equiangular polygon.

A rectangle ,an Equilateral triangle and square is an example of equiangular polygon.







Definition : A polygon which is both equilateral and equiangular is called a regular polygon.

Equilateral triangle and square are examples of regular

Worked example: The angles of a pentagon are x , $3x$, $3x$, x and $2x$. What is the value of x ?

Solution: The sum of the measure of interior angles of pentagon (n=5) ; hence $S = (n-2)180° = (5-2)180° = 540°$

Thus , $x + 3x + 3x + x + 2x = 540°$

$10x = 540°$/divided both sides by 10/

$x = 540/10$

- **The measure of each interior angle of an n-sided regular polygon is**

$$\frac{(n-2)x180^\circ}{n}$$

- ***The measure of each exterior angle is***

$$\frac{360^\circ}{n}$$

- ***The sum of each interior* angle and each exterior angle of regular polygon is 180°**

Worked example: Find the degree measure of each interior and exterior angle of 18 - sided regular polygon ?

Solution: For n = 18 sided regular polygon

The degree measure of each interior is

$$\frac{(n-2)x180^\circ}{n}$$

$$= \frac{(18-2)X180}{18}$$

$$= 16 X10^\circ$$

$$= 160^\circ$$

=

= 16 X10°

= 160°

- The degree measure each exterior angle is

The degree measure each exterior angle is

$$\frac{360^\circ}{n}$$

$$= \frac{360^0}{18}$$

$$= 20^0$$

=

= 20^0

ACTIVITY



1. In a 8 sided polygon; find

a) The numbers of triangle from a vertex

b) Sum of all interior angles

c) Sum of each interior and exterior angles

2. If the sum of the measures of all the interior angles of a polygon is 1080^{0}, how many sides does the

3. Find the Supplement of the angle two - third of 210° ?

4.As shown in the figure, find the largest angle measure of the triangle

