

## Notes on Polygon

A polygon is a closed figure bounded by three or more line segments that intersect exactly to form a closed curve.

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### *Basic Terms in Polygons*

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■ **Sides:** The line segments that form a polygon are termed as sides. From the above polygon, we can say that line segment AB, BC, CD, DA are four sides of the polygon.

■ **Vertex:** The meeting point of two sides is termed as vertex.

■ **Adjacent Sides:** In a polygon, any two sides that have a common end are termed as adjacent sides. From the above polygon, we can say that sides CD and BC are adjacent as they terminate at a common end C. Similarly, sides AB and DA, AB and BC, CD and DA are also adjacent.

■ **Adjacent Vertices:** End points of the same side of the polygon are termed as adjacent vertices. From the above polygon, we can say that C and D are adjacent vertices while A and C are not adjacent vertices.

**Diagonals:** The line joining the non-adjacent vertices of a polygon is termed as diagonals.

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## classification of polygons

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### Regular Polygon

In a regular polygon, all the sides of the polygon are equal, and all the interior angles are the same.

### Irregular Polygon

A polygon with an irregular shape. It means the sides and angles of the polygon are not equal.

### Convex Polygon

In a convex polygon, the measure of the interior angle is less than 180 degrees

### Concave Polygon

In a concave polygon, at least one angle measures more than 180 degree. The vertices of a concave polygon are inwards as well as outwards

Important  
point on  
Polygon

Exterior angle + Adjacent Angle =  $180^\circ$

Sum of the All interior angles of n side polygon =  $(2n-4) \times 90$

Question 3:

Find the sum of the interior angles of a :

i) nonagon

$n = 9$  sides

sum of the interior angles =  $(2n - 4) \times 90$   
=  $(2 \times 9 - 4) \times 90$

=  $14 \times 90^\circ$

=  $1260^\circ$

### Question 4:

Find the measure of each interior angle of a :

(i) regular decagon

#### Answer:

(i) A decagon has 10 sides

So,  $n = 10$

Sum of interior angles of a decagon

$= (2 \times 10 - 4) \times \text{right angles}$

$16 \times 90^\circ = 1440^\circ$

Since, the interior angles of a regular polygon are of the same measures, so we have each

interior angle of = sum of the interior angles / n

$(1440^\circ/10) = 144^\circ$  regular decagon

### Question 5:

Five of the angles of a hexagon are each  $115^\circ$ . Calculate the measure of the sixth angle.

#### Answer:

A hexagon has 6 sides

Sum of interior angles of a hexagon  $= (2n - 4) \times 90$

$= (2 \times 6 - 4) \times \text{right angles}$

$= 8 \times 90^\circ$

$= 720^\circ$

Sixth angle  $= 720^\circ - (115^\circ + 115^\circ + 115^\circ + 115^\circ + 115^\circ)$

$= 720^\circ - 575^\circ$

$= 145^\circ$

### Question 6:

The angles of a heptagon are  $(x + 3)^\circ$ ,  $(2x + 5)^\circ$ ,  $(x + 8)^\circ$ ,  $(3x + 1)^\circ$ ,  $(5x - 6)^\circ$ ,  $(2x + 9)^\circ$  and  $(x - 5)^\circ$ . Calculate x.

Answer :

In a heptagon,  $n = 7$

So, Sum of its interior angles  $= (2n - 4) \times 90$

$= (2 \times 7 - 4) \times 90^\circ$

$= (14 - 4) \times 90^\circ$

$$= 10 \times 90^\circ = 900^\circ$$

But sum of its angles are :

$$\begin{aligned} & (x + 3)^\circ + (2x + 5)^\circ + (x + 8)^\circ + (3x + 1)^\circ + (5x - 6)^\circ + (2x + 9)^\circ \\ & + (x - 5)^\circ \\ & = x + 3 + 2x + 5 + x + 8 + 3x + 1 + 5x - 6 + 2x + 9 + x - 5 = 900 \\ & \Rightarrow 15x + 15 = 900^\circ \\ & \Rightarrow 15x = 900 - 15 \\ & \Rightarrow x = (885^\circ / 15^\circ) \\ & = 59^\circ \end{aligned}$$

Hence,

$$x = 59^\circ$$

**Question 7:**

An octagon has three equal angles each of measure  $115^\circ$ . If all the remaining angles have equal measure, find the measure of each of these remaining angles.

**Answer :**

$$\begin{aligned} & \text{Sum of angles of an octagon (n = 8)} \\ & = (2n - 4) \times 90 \\ & = (2 \times 8 - 4) \times 90^\circ \\ & = (16 - 4) \times 90^\circ \\ & = 12 \times 90^\circ \\ & = 1080^\circ \end{aligned}$$

$$\text{Sum of three angles of it} = 115^\circ \times 3 = 345^\circ$$

So, Sum of remaining 5

$$\text{angles } 1080^\circ - 345^\circ = 735^\circ$$

So, Measure of each angle =

$$(735^\circ / 5)$$

$$= 147^\circ$$

**Question 8:**

The sum of the interior angles of a polygon is  $2160^\circ$ . How many sides does this polygon have?

**Answer:**

The number of sides of the polygon be n.

Then, sum of interior angles of the polygon

$$= (2n - 4) \text{ right angles}$$

$$= (2n - 4) \times 90^\circ$$

$$\text{So, } (2n - 4) \times 90^\circ = 2160^\circ$$

$$= (2n - 4) = 2160 / 90$$

$$= 2n = 24 + 4$$

$$n = 28 / 2$$

$$n = 14 .$$

9 – Find the number of sides of a polygon if each of its interior angles measure :

(i)  $140^\circ$

Let the number of sides of the polygon be  $n$ . Then ,  
sum of its interior angles

$$= (2n-4) \text{ right angles}$$

$$\text{Measure of each interior angle} [(2n-4) \times 90/n]$$

$$\text{So, } [(2n-4) \times 90/n] = 140$$

$$= (2n - 4) \times 90^\circ = 140 n$$

$$= 180n - 360^\circ = 140 n$$

$$= 180n - 140 = 360$$

$$= 40n = 360^\circ$$

$$n = (360^\circ/40) = 9$$

Hence, the polygon has 9 sides.

**Question 10:**

Find the measure of each exterior angle of a regular decagon.

Answer :

$$n = 10$$

$$\text{Each interior angle} = ((2 \times 10 - 4) \times 90^\circ/10]$$

$$= (20 - 4) \times 9$$

$$= 16 \times 9$$

$$= 144$$

Each exterior angle =  $180^\circ$  - Each interior angle

$$= 180^\circ - 144$$

$$= 36$$

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