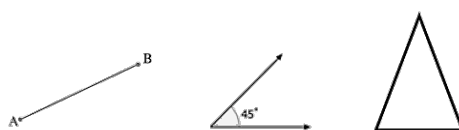# SHAPES AND ANGLES

Concepts Covered

- Measuring Right angle, and straight angle
- Revolution in a clock, Acute, Obtuse, Reflex Angles
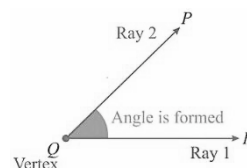- Measuring angles,
- Quadrilaterals, Polygons

Introduction

There are so many shapes around us made up of lines and curves like line segments, angles, triangles, polygons, circles, etc. These shapes are of different sizes and measures.

Angles

We can understand the concept of right and straight angles by directions. There are four directions-North, South, East, and West.
An angle is formed when two rays originate from the same originating point. The rays making an angle are called the arms of an angel. The originating point is called the vertex of an angle.

Measuring Angles

By observing an angle, we can only get the type of angle but to compare it properly we need to measure it.
An angle is measured in the **"degree"**. One complete revolution is divided into 360 equal parts so each part is one degree. We write it as 360° and read as "three hundred sixty degrees".
We can measure the angle using a ready-to-use device called **Protractor**.
It has a curved edge that is divided into 180 equal parts. It starts from 0° to 180° from right to left and vice versa.

$\angle ABC = 72°$

To measure an angle using a protractor-
(a) Place the protractor on the angle in such a way that the midpoint of the protractor comes on vertex B of the angle.
(b) Adjust it so that line BC comes on the straight line of the protractor.
(c) Read the scale which starts from 0° coinciding with the line BC.
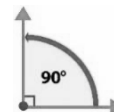(d) The point where the line AB comes on the protractor is the degree measure of the angle.
   Hence, ∠ABC = 72°
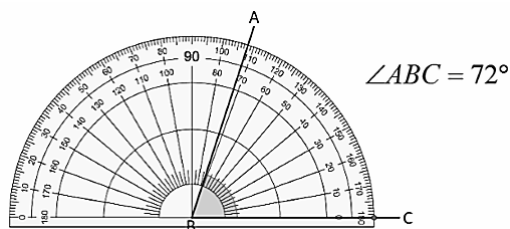
Type of Angles

Right Angle:

An angle that is precisely 90º is known as a right angle. When we move from North to East then it forms an angle of 90° which is called the Right Angle.
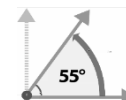
Straight Angle:

When the arms of the angles lie in the opposite direction, they form a straight angle. When we move from North to South then it forms an angle of 180° which is called a Straight Angle.
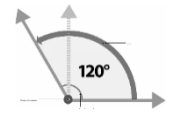
Acute Angle:

An angle smaller than a right angle is called an acute angle. For example, here 55° is an acute angle.
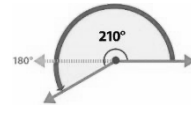
Obtuse Angle:

If an angle is larger than a right angle but less than a straight angle, it is called an obtuse angle. For example, here 120° is an Obtuse angle.

Reflex Angle:

A reflex angle is larger than a straight angle but less than a complete angle.

Complete Angle:

When we move four right angles in the same direction then we reach the same position again i.e. if we make a clockwise turn from North to reach North again then it forms an angle of 360° which is called a Complete Angle. This is called one revolution.

In a clock, there are two hands i.e. minute hand and the hour hand, which move clockwise every minute.

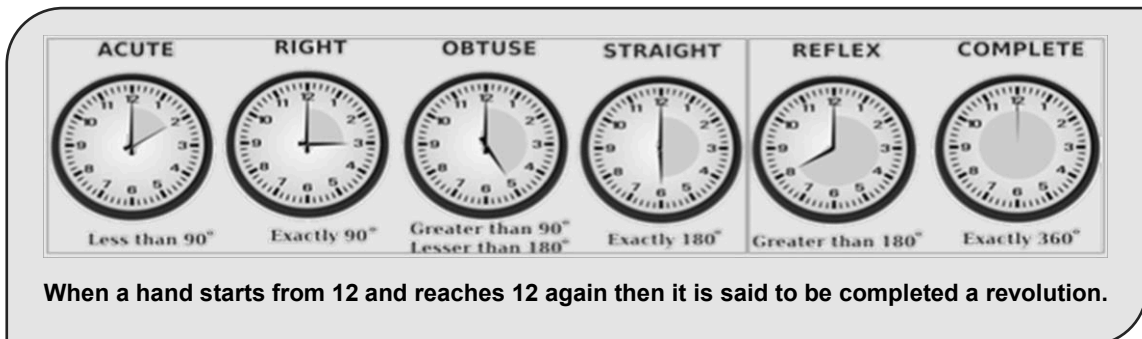When the clock hand moves from one position to another then turns through an angle.

Example:

How many right angles make the angle 360°?
Solution: We know 90° is equivalent to 1 right angle.

Hence, 360° is equivalent to $\frac{360°}{90°}$ = 4 right angles.

Angles Made by Clock at Different Time

- On a clock, we may see various angles based on their amplitude: acute, straight, obtuse, flat angles, and even complete angles.
- The full circumference of the clock is 360°. The distance between each number on the clock is similar to 30° (360/12) since the clock is divided into 12 pieces.
- For example, the angle created between 1 o'clock and 2 o'clock is 30°.

When a hand starts from 12 and reaches 12 again then it is said to be completed a revolution.

Example:

What type of angle is formed between the hands of a clock at 9 o'clock?
Solution: A right angle is formed between the hands of a clock at 9 o'clock.

Example:

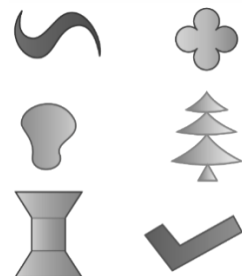**What is the angle made by the hour and the minute hand at 8 o'clock?**
Solution: Angle made between 2 numbers in a clock = 30 degrees
Numbers between 8 and 12 = 4
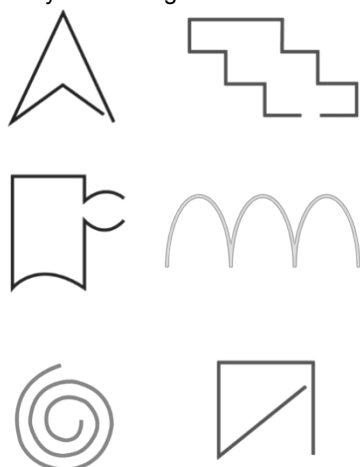Therefore, total angle made is = 30 × 4 = 120 degrees

Closed-Sided Figure

A closed-form is an enclosed shape or figure whose line segments and/or curves are linked or meet in geometry.

Open-Sided Figure:

An open shape is a shape or figure whose line segments and/or curves do not intersect in geometry.
They do not begin and terminate at the same location.

Polygons

A polygon is a simple closed curve formed by three or more-line segments such that
(i) No two-line segments intersect except at their endpoints.
(ii) No two-line segments with a common endpoint are coincident.
In other words, a polygon is a simple closed two-dimensional shape formed by joining the straight-line segments.

For example: equilateral triangle, square, scalene triangle, rectangle, etc.
We can classify the polygons based on their sides and vertices –

Number of Sides	Name of Polygon	Figure	Number of Sides	Name of Polygon	Figure
3	Triangle		7	Heptagon	
4	Quadrilateral		8	Octagon	
5	Pentagon		9	Nonagon	
6	Hexagon		10	Decagon	

Shapes and Their Properties

Circle:

A circle is a round-shaped figure that has no corners or edges, it is a closed, two-dimensional curved shape.

The angles in a circle sum to 360 degrees. A circle can be divided into smaller sections. The arc of a circle is a section that is named according to its angle.
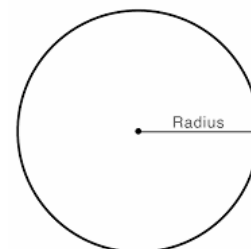
Triangle:

A triangle is a closed, two-dimensional form with three straight sides in geometry.
The sum of angles of a triangle is 180 degrees.

Quadrilaterals:

A quadrilateral is a closed shape and a type of polygon that has four sides, four vertices, and four angles. It is formed by joining four non-collinear points. **The sum of interior angles of quadrilaterals is always equal to 360 degrees.**

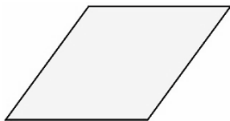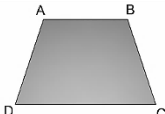| Name	Properties	Image
Rectangle	It has two pairs and opposite equal sides. The opposite sides are parallel. All the angles are the right angle.	
Square	All four sides are equal. The opposite sides are parallel. All the angles are the right angle.	
Parallelogram	It has two pairs of parallel opposite equal sides. Square and rectangles are also parallelograms.	
Rhombus	All four sides are equal. The opposite sides are parallel. Opposite angles are equal. Diagonals intersect each other at the center at 90°.	
Trapezium	The bases of a trapezium are parallel to each other. The length of both diagonals is equal. The adjacent interior angles sum up to 180°.	

Example:

How many angles and diagonals does a quadrilateral have?
Solution: A quadrilateral has 4 angles and 2 diagonals.

Example:
Write the name of quadrilateral which have equal sides.
Solution: There is two quadrilateral which have equal sides: Square and Rhombus.

Pentagon:

A pentagon is a five-sided geometric form with five angles.
The sum of angles of a pentagon is 540 degrees.

Hexagon:

A hexagon is a six-sided geometric form with six angles.
The sum of angles of a hexagon is 720 degrees.

Heptagon:

A heptagon is a seven-sided geometric form with seven angles.
The sum of angles of a heptagon is 900 degrees.

Octagon:

An octagon is an eight-sided geometric form with eight angles.
The sum of angles of an octagon is 1080 degrees.

Nonagon:

A nonagon is a nine-sided geometric form with nine angles.
The sum of angles of a nonagon is 1260 degrees.

Decagon:
A decagon is a ten-sided geometric form with ten angles.
The sum of angles of a decagon is 1440 degrees.

Check Your Concept - 1

(i) A flat surface that extends infinitely in all directions is called…………:
    (A) Line   (B) Line Segment
    (C) Plane   (D) Point

(ii) Three or more points that lie on the same line are called:
    (A) Non-collinear   (B) Straight
    (C) Collinear   (D) None of these

(iii) A line has ……………… length.
    (A) Definite   (B) Indefinite
    (C) No   (D) None of these

Example:

Count the number of sides of the polygons given below and name them:
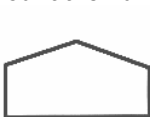
(i)   (ii)   (iii)   (iv)

Solution: (i) In this figure, the number of sides of the polygon is five, so it is a pentagon.
                (ii) In this figure, the number of sides of the polygon is eight, so it is an octagon.
                (iii) In this figure, the number of sides of the polygon is six, so it is a hexagon.
                (iv) In this figure, the number of sides of the polygon is three, so it is a triangle.

Check Your Concept - 2

(i) An angle whose measure is equal to half of a revolution is:
    (A) Right Angle   (B) Acute Angle
    (C) Straight Angle   (D) Obtuse Angle

(ii) A quadrilateral whose opposite sides are parallel is called:
    (A) Square   (B) Rectangle
    (C) Parallelogram   (D) None of these

(iii) Where will the hand of a clock stop if it starts at 12 and makes $\frac{3}{4}$ of a revolution, clockwise?
    (A) 6   (B) 9
    (C) 3   (D) None of these

(1) Sneha turns two right angles. How many degrees does she turn through?
Solution: 1 right angles = 90º
∴ 2 right angles = 90º + 90º = **180º**

(2) A figure is said to be regular if its sides are equal in length and angles are equal in measure. Can you identify the regular quadrilateral?
**Solution:** Square is a regular quadrilateral as all sides and angles are equal.
As per the property mentioned above,
(1) All sides are equal
(2) All angles are 90° (means equal).

(3) A diagonal is a line segment that joins any two vertices of the polygon and is not a side of the polygon. Draw a rough sketch of a pentagon and draw its diagonals.
Solution: Pentagon is a polygon that has five sides. It can be observed here that AC, AD, BD, BE, and CE are the diagonals.
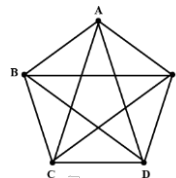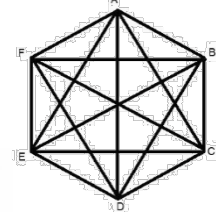
(4) Draw a hexagon and write its sides and diagonals?
Solution: Hexagon ABCDEF
Sides of Hexagon: AB, BC, CD, DE, EF, and FA.
Diagonals of Hexagon: AC, AD, AE, BD, BE, BF, CE, CF, and DF

(5) In a square PQRS, the diagonals bisect at O, then △POQ is_____
Solution: Since we know that diagonals of a square are equal and perpendicularly bisect each other. So, ∠POQ = 90º and PO = OQ
Hence, △POQ is an isosceles right-angled triangle

(6) What are the 3 parts of a triangle?
Solution: A triangle is a shape formed when three straight lines meet. All triangles have three sides and three corners (angles). The point where two sides of a triangle meet is called a vertex. The base of a triangle can be any one of its three sides, but it is usually the bottom one.

(7) If A, B, and C are three points on a line such that AB = 5 cm, BC = 3 cm, and AC = 8 cm, which one of them lies between the other two?
Solution: Given that, AB = 5 cm, BC = 3 cm, AC = 8 cm
Here, AC = AB + BC Therefore, point B is lying between A and C.
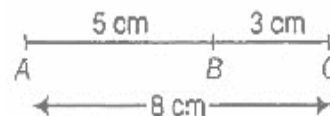
(8) Through how many degrees does the hour hand of a clock turn in 5 minutes?
Solution: We know that the hour hand completes 1 rotation in 12 hours. i.e., 360º = 12 hours
⇒ 360º = 60 × 12 minutes
⇒ 1 minute = $\left(\frac{360}{60 \times 12}\right)^{\circ}$
∴ 5 minutes = $\left(\frac{360}{60 \times 12} \times 5\right)^{\circ} = \left(\frac{5}{2}\right)^{\circ} = \left(\mathbf{2\frac{1}{2}}\right)^{\circ}$

(9) Find the value of xº.
Solution: 8º + 35º + xº = 180º
43º + xº = 180º
xº = 180º − 43º
x₀ = **137º**

(10) Write the type of angles?
Solution: Types of Angles
- Right Angle - When measured the angle is exactly 90 degrees.
- Straight Angle - When measured the angle is exactly 180 degrees.
- Acute Angle - When measured the angle is less than 90 degrees.
- Obtuse Angle - When measured the angle is greater than 90 degrees but less than 180 degrees.
- Reflex Angle - When measured the angle is greater than 180 degrees.

(11) Study the given figure and match the following?

Column I	Column II
(a) ∠AOB	(i) Straight
(b) ∠AOE	(ii) Acute
(c) ∠AOC	(iii) Right
(d) ∠BOD	(iv) Obtuse

Solution: (a) ∠AOB is an acute angle.
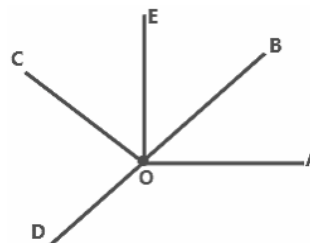
(b) ∠AOE is a right angle.

(c) ∠AOC is an obtuse angle.

(d) ∠BOD is a straight angle.

(12) Match the following:

Column I	Column I
(a) Straight Angle	(i) Less than one-fourth of a revolution
(b) Right Angle	(ii) More than half of a revolution
(c) Acute Angle	(iii) Half of a revolution
(d) Obtuse Angle	(iv) One-fourth of a revolution
(e) Reflex Angle	(v) Between 1/4 and 1/2 of a revolution
	(vi) One complete revolution

Solution: (i) Straight angle is half of a revolution.

(ii) Right angle is one-fourth of a revolution.

(iii) Acute angle is less than one-fourth of a revolution.

(iv) Obtuse angle is between 1/4 and 1/2 of a revolution.

(v) Reflex angle is more than half of a revolution.

(13) Draw a rough sketch of a regular hexagon. Connecting any three of its vertices, draw a triangle.

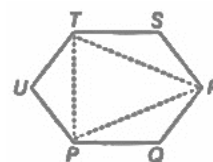**Identify the type of triangle you have drawn.**

Solution: Here, PQRSTU is a regular hexagon.

Joining its alternate vertices P, R, and T.

We get, △TPR, which is a regular triangle (since all sides are equal).

Thus, the triangle so formed is equilateral.

(14) Draw a rough sketch of a regular octagon. Draw a rectangle by joining exactly four of the vertices of the octagon.

Solution: Here, ABCDEFGH is a regular octagon. Joining vertices G and D,

we get GD Now, joining H and C, we get HC. Thus, we get a rectangle HCDG

Again, by joining A, F, and B, E, we can get another rectangle ABEF.
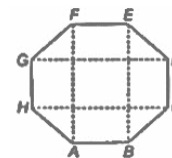
(15) Draw a rough sketch of a pentagon and draw its diagonals.

Solution: Rough sketch is shown below

Here, ABCDE is a pentagon.

By joining any two vertices, we get diagonals as (AC), (AD), (BD), (BE), and (CE)
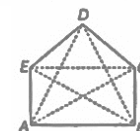
(16) The number of triangles in the figure is.

Solution: In the given figure, total of 13 triangles are formed. i.e.

△AEG, △AGD, △EFG, △DFG, △AED, △EDF, △BFE, △DFC, △AEF, △ADF, △ABF, △ACF and △ABC.
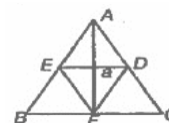
FILL IN THE BLANKS

(1) The Instrument used to measure angle is called _____.
(2) The Standard unit for measuring an angle is called _____ and is denoted by _____.
(3) 90.5º is called _____ angle.
(4) The sum of angles of a quadrilateral is _____.
(5) Each of its angle's rectangle measures _____.
(6) When an angle measures more than a straight angle, it is called a _____.
(7) Right angle is equal to _____.
(8) Straight angle is equal to _____.
(9) A quadrilateral having one pair of sides parallel is called _____.

TRUE OR FALSE

**(1)** A parallelogram has both diagonals equal.
(2) A square is also a parallelogram.
(3) The diagonals of a rhombus are equal.
(4) A polygon is regular if all sides are equal.
(5) Each angle of a rectangle is a right angle.
(6) The opposite sides of a rectangle are equal in length.
(7) All the sides of a rhombus are of equal length.
(8) All the sides of a parallelogram are of equal length.
(9) The opposite sides of a trapezium are parallel.
(10) The measure of an acute angle < 90°

OBJECTIVE TYPE QUESTIONS

(1) The angle measure for one complete revolution is
    (A) 180°   (B) 360°
    (C) 90°   (D) None of these

(2) The angle measure for half a revolution is
    (A) 90°   (B) 180°
    (C) 360°   (D) None of these

(3) The angle measure for one-fourth revolution is
    (A) 90°   (B) 360°
    (C) 180°   (D) None of these

(4) Through what angle measure does the hour hand of a clock turn through when it goes from 3 to 9?
    (A) 90°   (B) 360°
    (C) 180°   (D) None of these

(5) Through what angle measure does the hour hand of a clock turn through when it goes from 5 to 8?
    (A) 90°   (B) 180°
    (C) 360°   (D) None of these

(6) Through what angle measure does the hour hand of a clock turn through when it goes from 12 to 9?
    (A) 270°   (B) 180°
    (C) 360°   (D) 90°.

(7) Through what angle does the hour hand of a clock turn through, when it goes from 2 to 11?
    (A) 270°   (B) 90°
    (C) 360°   (D) 180°.

(8) Through what angle does the hour hand of a clock turn through, when it goes from 6 to 3?
    (A) 90°   (B) 180°
    (C) 270°   (D) 360°

(9) Find the number of right angles turned through by the hour hand of a clock when it goes from 12 to 3.
    (A) 1   (B) 2
    (C) 3   (D) 4

(10) Find the number of right angles turned through by the hour hand of a clock when it goes from 4 to 10.
    (A) 1   (B) 2
    (C) 3   (D) 4

(11) Find the number of right angles turned through by the hour hand of a clock when it goes from 3 to 12.
    (A) 1   (B) 2
    (C) 3   (D) 4

(12) How many right angles do you make if you start facing north and turn clockwise to south?
    (A) 1   (B) 2
    (C) 3   (D) 4

(13) How many right angles do you make if you start facing east and turn clockwise to south?
    (A) 1   (B) 2
    (C) 3   (D) 4

(14) How many right angles do you make if you start facing south and turn clockwise to east?
    (A) 1   (B) 2
    (C) 3   (D) 4

(15) How many right angles do you make if you start facing east and turn clockwise to east?
    (A) 1   (B) 2
    (C) 3   (D) 4

(16) The measure of a right angle is
    (A) 45°   (B) 90°
    (C) 60°   (D) 180°

(17) The measure of a straight angle is
    (A) 90°   (B) 45°
    (C) 180°   (D) 60°

(18) The measure of an acute angle is
    (A) < 90°   (B) > 90°
    (C) = 90°   (D) None of these

(19) The measure of an obtuse angle is
    (A) < 90°   (B) > 90° and < 180°
    (C) = 90°   (D) None of these

(20) The measure of a reflex angle is
    (A) 180°   (B) < 180°
    (C) > 180°   (D) < 90°

(21) The angle between the hour's hand and the minute's hand of a clock at a 6' O clock is a/an
    (A) Right angle   (B) Acute angle
    (C) Straight angle   (D) Obtuse angle

(22) If two of the angles of a triangle are 70° and 80°, then the third angle of the triangle is
    (A) 210°   (B) 180°
    (C) 30°   (D) 120°

(23) Which of the following is true?
    (i) A triangle can have utmost two right angles.
    (ii) A triangle can have two obtuse angles.
    (iii) A triangle can have three acute angles.
    (A) i, ii and iii   (B) Only ii and iii
    (C) Only ii   (D) Only iii

(24) Name the Polygon with 5 sides
    (A) Triangle   (B) Pentagon
    (C) Quadrilateral   (D) Hexagon

(25) The angle formed between the east and the north direction is
    (A) 180 °   (B) 60°
    (C) 80 °   (D) 90°

(26) Name the Polygon with 7 sides
    (A) Heptagon   (B) Pentagon
    (C) Quadrilateral   (D) Hexagon

(27) A triangle can have _____ right angles.
    (A) 1   (B) 3
    (C) 2   (D) none of these

(28) If a bicycle wheel has 36 spokes, then the angle between a pair of adjacent spokes is
    (A) 15°   (B) 10°
    (C) 20°   (D) 12°

(29) There are _____ main directions.
   (A) 3   (B) 1
   (C) 2   (D) 4

(30) An angle more than 180° and less than 360° is called.
   (A) Zero angle   (B) Right angle
   (C) Reflex angle   (D) Straight angle

(31) If an angle is larger than a right angle, but less than a straight angle, it is called an
   (A) Obtuse angle   (B) Right angle
   (C) Acute angle   (D) Straight angle

(32) How many degrees are there in between the clock hands when it displays the 7′ O clock?
   (A) 240°   (B) 180°
   (C) 210°   (D) 150°

Answer Key

CHECK YOUR CONCEPT

(1)   **(i)** (C)   **(ii)** (C)   **(iii)** (B)
(2)   **(i)** (C)   **(ii)** (C)   **(iii)** (B)

FILL IN THE BLANKS

(1) Protractor   **(8)** 180º
(2) Degree, °   **(9)** Trapezium
(3) Obtuse
(4) 360º
(5) 90
(6) Reflex Angle
(7) 90º

TRUE OR FALSE

(1) False   **(6)** True
(2) True   **(7)** True
(3) False   **(8)** False
(4) True   **(9)** False
(5) True   **(10)** True

OBJECTIVE TYPE QUESTION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(B)	(B)	(A)	(C)	(A)	(A)	(A)	(C)	(A)	(B)
(11)	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**
(C)	(B)	(A)	(C)	(D)	(B)	(C)	(A)	(B)	(C)
(21)	**(22)**	**(23)**	**(24)**	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**
(C)	(C)	(D)	(B)	(D)	(A)	(A)	(B)	(D)	(C)
(31)	**(32)**								
(A)	(C)								