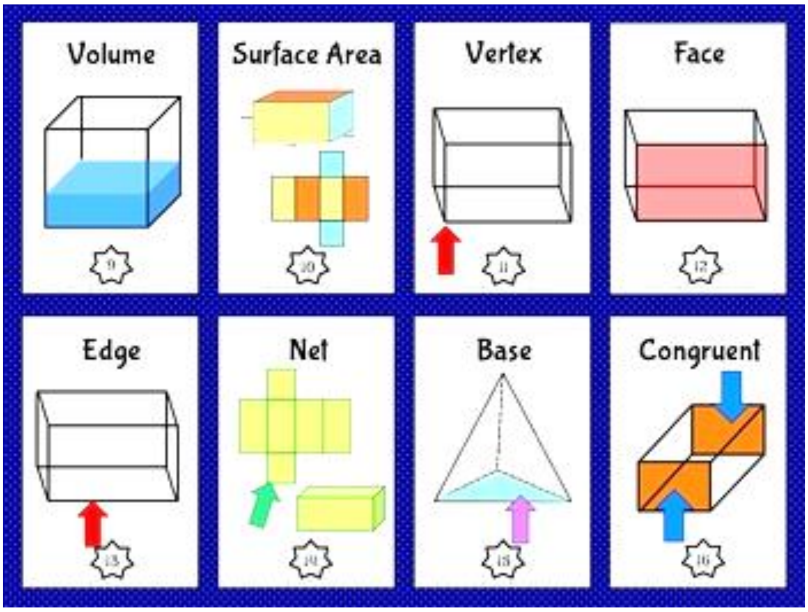
5

Understanding Elementary Shapes



Measuring line segments

When we measure a line segment, we measure its length or distance from one end point to the other.

When we measure the length, we must know the units of measurement. Today the metric system is used at most universally. The standard unit in this system is metre.

Conversion of units of length

10 millimetres (mm)	=	1 centimetre (cm)
10 centimetres (cm)	=	1 decimetre (dm)
10 decimeters (dm)	=	1 metre (m) = 1000 (mm)
10 metres (m)	=	1 decametre (dam)
10 decametres (dam)	=	1 hectametre (hm)
10 hectometres (hm)	=	1 kilometre (km) = 1000 (m)

However most often we use the following units.

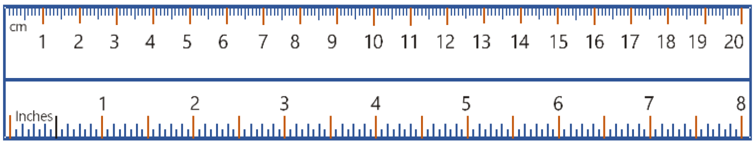
10 millimetres = 1 centimetres

100 centimetres= 1 metres

1000 metres = 1 kilometre

1 cm = 0.3937 inch.

By using a ruler: The ruler has centimetre and millimetre marks on one edge and other edge is divided into inches.



One small division = One-tenth of one cm = 0.1 cm = 1 mm

Two small division = Two-tenths of one centimetre = 0.2 cm = 2 mm

Quick Tips

- ✸ 1 km = 1000 m
- ✸ 1 m = 100 cm

There is a global standard, the international system of units (SI), the modern form of the metric system.

SPOT LIGHT

Numerical Ability 1

Convert into mm:

(i) 3.9 cm **(ii) 176.5 cm** **(iii) 3.8 dm**

Solution

(i) 1cm = 10mm

3.9cm = 3.9 × 10mm = 39mm

(ii) 1cm = 10mm

176.5cm = 176.5 × 10mm = 1765mm

(iii) 1dm = 10cm

3.8cm = 3.8 × 10cm = 38cm

= 38 × 10mm = 380mm

Building Concepts 1

Convert :

(i) 5.03m into m and cm **(ii) 1.24km in km and m.**

Explanation

(i) 5.03m = 5m + 0.03m

= 5m + 0.03 × 100cm

= 5m + 3cm = 5m 3cm

(ii) 1.24km = 1km + 0.24km

= 1km + 0.24 × 1000m

= 1km + 240m = 1km 240m

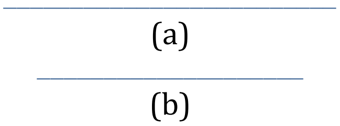
Do You Remember ?

- ✸ The distance between the endpoints of a **line segment** is called its length.

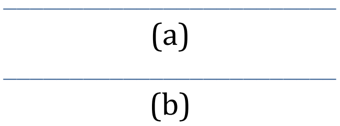
Comparison of line segments

Comparison by observation

The simplest way of comparing two line segments is to observe their lengths. Here we can easily observe that line segment 'b' is placed directly below line segment 'a'. Line segment 'a' extends further to the right.

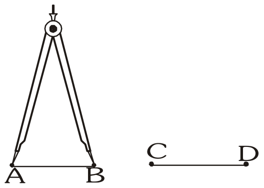


But if the lengths are almost equal then comparison by observation is not easy.



Comparison by divider

Let us compare the line segments $\overline{AB}$ and $\overline{CD}$, using a divider.



Place one point of the divider on A and open the other leg of the divider until the other point coincides with B. This measures the length of $\overline{AB}$. Now take the divider as it is and place one point of the divider at C and the other point along $\overline{CD}$. We will observe:

(i) If the other point touches $\overline{CD}$ exactly at D, then $\overline{AB}=\overline{CD}$.

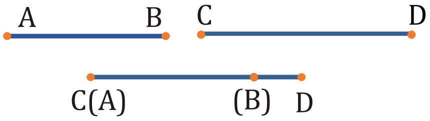
(ii) If the other point of the divider is beyond the point D on $\overline{CD}$, then $\overline{AB} > \overline{CD}$.

(iii) If the other point is between C and D on $\overline{CD}$, then $\overline{AB}<\overline{CD}$.

Comparison by tracing

We can also compare two-line segments, say $\overline{AB}$ and $\overline{CD}$, by tracing one of them and overlapping the traced line on the other, with one endpoint coinciding. We can easily make out which line is longer, which is shorter, or whether they are both equal.

$\overline{AB}$ is placed on $\overline{CD}$, with the endpoints C and A coinciding. Since the other two endpoints B and D do not coincide, we can say that



(i) $\overline{AB}$ is not equal to $\overline{CD}$.

(ii) $\overline{AB}$ is shorter than $\overline{CD}$ as the endpoint B of $\overline{AB}$ falls short of D, the endpoint of $\overline{CD}$.

Numerical Ability 2

If B is the midpoint of AC and C is mid point of BD. where A, B, C, D lie on a straight line, say why AB = CD?

Solution

Since B is the mid-point of AC.

AB = BC ... (1)

Since C is the mid-point of BD.

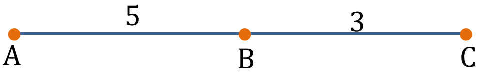
BC = CD ... (2)

From equation (1) and (2), we may find that

AB = CD

Building Concepts 2

If AB = 5cm, BC = 3cm then show that AC = BC + AB and point B is lying between A & C.



Explanation

Given that,

AB = 5 cm

BC = 3 cm

AC = 8 cm

It can be observed that AC = AB + BC

Clearly, point B is lying between A and C.

Be Alert !

- 500 cm < 1 km

Check your Concepts 1

1. Using a divider, compare the line segment and fill in the blanks by using the suitable symbol >, = or <.

(i) AB ___ BD

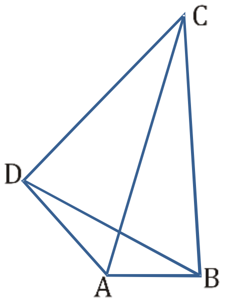
(ii) AD ___ BD

(iii) CD ___ BD

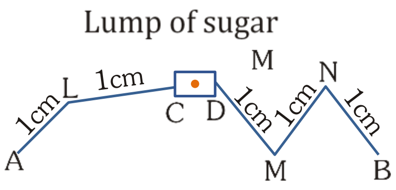
(iv) CD ___ AC

(v) BC ___ CD

(vi) AD ___ AC

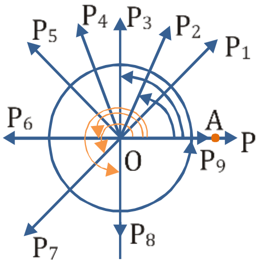


2. An ant is at A and a toad is at B. How much more than the ant will the toad have to walk to reach the lump of sugar? Give your answer in cm?



Measure of angles

The magnitude or measure of the angle is the measure of rotation. Suppose a ray OP starts rotating around O, from the fixed position OA to different position OP_1, OP_2, OP_3 etc. then measure of the angle will equal the measure of this rotation.



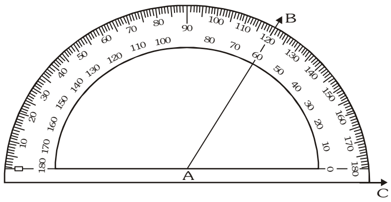
The word angle comes from the Latin word angulus, meaning “a corner”.

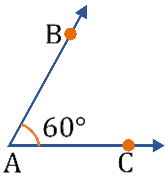
SPOT LIGHT

Measuring angles using protractor

The protractor is an instrument used to measure angles and draw angles of required magnitude. Suppose you have to measure the angle BAC. Place the protractor such that its centre falls on the vertex A of the angle and its horizontal edge (zero line) on the arm AC.

Now look at the protractor to find out which line of division on the rim falls on the arm AB.



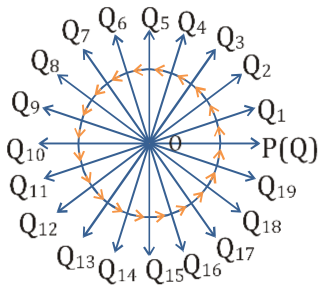


Read the degree measure from the protractor, use the anticlockwise, i.e. the inner scale.

Thus, by measurement ∠BAC = 60°.

Degree measure of an angle

$\overrightarrow{OQ}$ rotates from position $\overrightarrow{OP}$. When it has made one complete rotation, it reaches $\overrightarrow{OP}$ again. We say that the angle thus formed is 360 degrees. It is written as 360°. In other words, a circle is made up of 360°.



Let us take the example of the face of a clock. It is divided into 12 equal parts. The angle that the arms include between each other, say, at 10'o clock is exactly $\frac{2}{12}$ of the circle, that is $\frac{2}{12}$ of 360°

$= \frac{2}{12} \times 360° = 60°.$

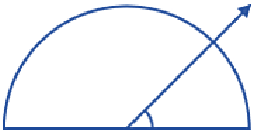
At 1.00 a.m. or 1.00 p.m. this angle is 30° and at 3.00 a.m. or 3.00 p.m. it is 90°.

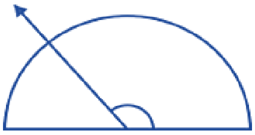
The turn (or full circle, revolution, rotation, or cycle) is one full circle. r in rpm (revolutions per minute). 1 turn = 360° = 2p rad = 400 grad = 4 right angles.

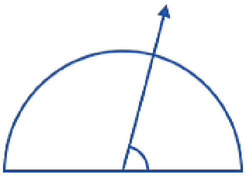
SPOT LIGHT

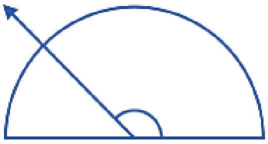
Numerical Ability 3

Find the measure of the angle shown in each figure. (First estimate with your eyes and then find the actual measure with a protractor).









Solution

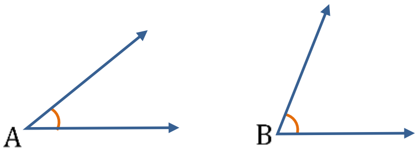
The measures of the angles shown in the above figure are 40°, 130°, 65°, 135° respectively.

Building Concepts 3

Which angle has a large measure? First estimate and then measure.

Measure of angle A =

Measure of angle B =



Explanation

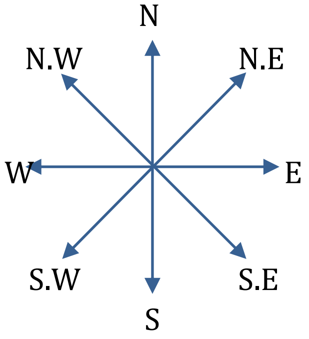
Measure of angle A = 40°

Measure of angle B = 68°

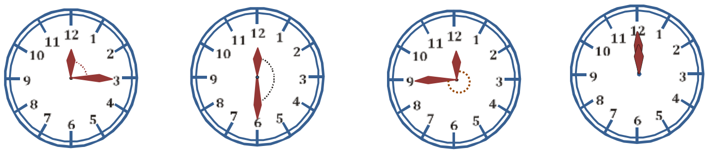
∠B has the greater measure than ∠A.

Quick Tips

- The turn from north to east is by a right angle. The turn from north to south is by two right angles. It is called a straight angle.



Rotation round the clock



quarter past 90° (a)

half past 180° (b)

quarter to 270° (c)

one round 360° (d)

When the minute hand of a clock starts at 12 and reaches at 3, it has reached quarter past and has made a quarter of a rotation and has turned through an angle of magnitude 90°.

At 6 (half past) the minute hand has made $\frac{1}{2}$ of a rotation and turned through an angle of measure 180°.

At 9 (quarter to), it has made $\left(\frac{3}{4}\right)$ three quarter of a rotation and turned through an angle of measure 270°. When the minute hand reaches 12, it has moved exactly once round the clock, i.e., it has made one rotation and through an angle of measure 360°.

Directions

You are familiar with the concept of direction. There are four main directions North (N), South (S), East (E), and West (W).

Jammu is to the North of Delhi, Kolkata is to its East, Rajkot to its West and Cochin to its South.

Midway between there are the four sub-directions, namely North-East (N.E.), South-East (S.E.), North-West (N.W.) and South-West (S.W.).

Degree, minutes and seconds

A degree is further subdivided into minutes and seconds.

We have 1° = 60 minutes and 1 minute = 60 seconds.

The minutes are denoted by a dash (') and second by double dash (").

$$\boxed{\begin{array}{l} 1^\circ = 60' \\ 1' = 60'' \end{array}}$$

Thus 1° = 60' and 1' = 60".

Note: The degree, minute of arc and second of arc are sexagesimal subunits of the Babylonian unit. 1 Babylonian unit = 60° = $\frac{\pi}{3}$ rad.

Building Concepts 4

(i) Through what angle does the minute hand of clock turn in 45 minutes, and the hour hand in 30 minutes?

(ii) What rotation is needed to turn

(a) From North to South-West in a clockwise direction?

(b) From South-West to South-East in a counter clockwise direction?

Explanation

(i) In one hour the minute hand completes a full circle of 360°. Therefore in 45 minutes it goes through an angle equal to $\frac{45}{60} \times 360^\circ$ ar 270°.

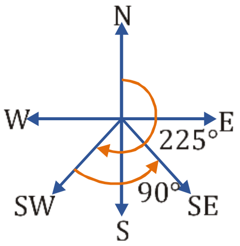
In one hour, the hour hand turns through an angle of $\frac{1}{12}$ of 360° or 30°. Therefore in 30 minutes it turns through 15°.

(ii) (a) Adding a turn of 180° from North to South and of 45° from South to South-West, we get 180° + 45°, or 225°.

(b) The turn from South-West to South-East is equal to 45° + 45°, or 90°.

The quadrant is ¼ of a turn, i.e. a right angle. It is unit used in Euclid's elements. 1 quad. = 90° = π/2 rad = ¼ turn = 100 grad.

SPOT LIGHT



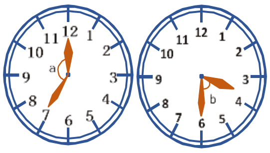
Numerical Ability 4

Find the angles between the hands of a clock at

(i) 7 O'clock, (ii) 3: 30 O'clock.

Solution

On the clock dial the angle between the hands pointing to any two adjacent numericals is equal to $\frac{1}{12}\times360°$, or 30°.



(i) At 7 O'clock, $\angle a = 5 \times 30° = 150°$.

(ii) At 3:30 O'clock, $\angle b = 2\times 30° + 15° = 75°$

Check your Answers 1

1. (i) < (ii) < (iii) > (iv) < (v) > (vi) <

2. 1 cm

Check your Concepts 2

1. Through what angle does the minute hand of a clock turn in 20 minutes?

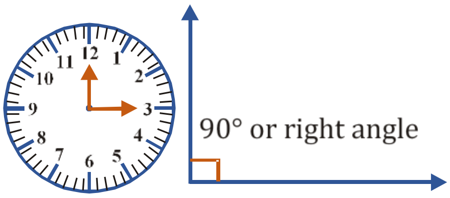
Do You Remember ?

✸ A right angle is an angle which is exactly in the shape 'L'.

Types of angles

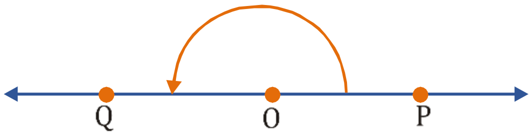
Right angle

When the clock shows 3 O'clock, the angle between its two hands is equal to 90°. This is called a right angle. An angle of magnitude exactly 90° is called a right angle.



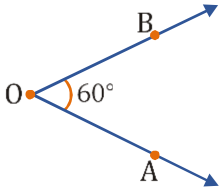
Straight angle

When the arms of an angle are opposite rays forming a straight line, the angle thus formed is called a straight angle. ∠POQ is a straight angle and its measure is equal to two right angles, that is 180°. Thus the measure of ∠POQ = 2 × 90° = 180°.



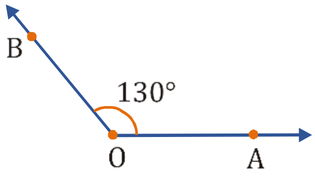
Acute angle

An angle of magnitude less than a right angle is called an acute angle. ∠AOB is an acute angle. $0° < x < 90°$



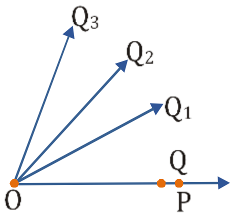
Obtuse angle

An angle of magnitude more than 90° and less than 180° is called an obtuse angle. ∠AOB is an obtuse angle. $90° < x < 180°$



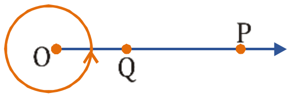
Zero angle

As $\overrightarrow{OP}$ takes positions $\overrightarrow{OQ_1}, \overrightarrow{OQ_2}, \overrightarrow{OQ_3}$, etc., the angle becomes bigger and bigger. However, when $\overrightarrow{OP}$ has not yet moved, the angle formed between $\overrightarrow{OP}$ and $\overrightarrow{OQ}$ is zero. This angle is called a zero angle.



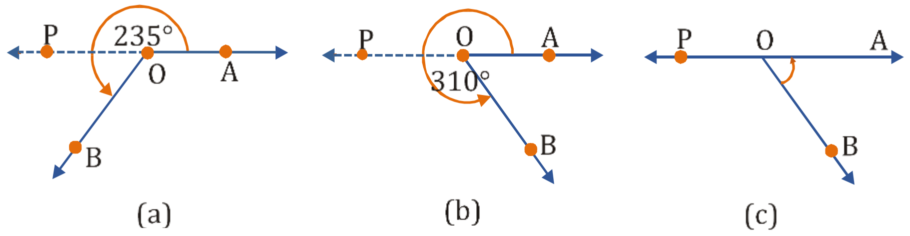
Complete angle (360°)

When $\overrightarrow{OQ}$ makes a complete revolution, it covers 360° and again coincides with $\overrightarrow{OP}$. The angle formed by $\overrightarrow{OQ}$ with is one complete circle, that is 360°. Such an angle is called a complete angle.

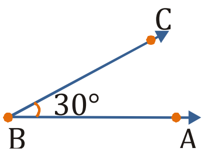
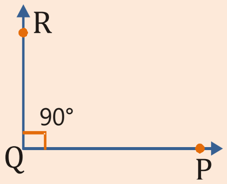
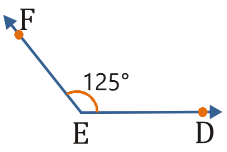
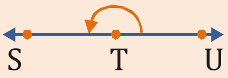
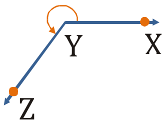


Reflex angle

An angle of magnitude more than 180° and less than 360° is called a reflex angle. Therefore, ∠AOB (in a and b) is a reflex angle. It is more than 180°. Now, ∠AOP is 180° and ∠AOB is greater than that. (Note that angles are usually measured in the anticlockwise direction.) But in (c), ∠AOB is not a reflex angle as the measure of the angle is less than 180°. $180^\circ < x < 360^\circ$



(a) (b) (c)

Types of angle	Measure	Figure
Zero angle	0°	
Acute angle	Between 0° and 90°	
Right angle	90°	
Obtuse angle	Between 90° and 180°	
Straight angle	180°	
Reflex angle	More than 180°	

Building Concepts 5

Classify the angles whose magnitude are given below :

(i) 122° **(ii) 17°** **(iii) 182°** **(iv) 0°**

(v) 179.99° **(vi) 90.5°** **(vii) 360°**

Explanation

(i) Angle is greater than 90° so 122° is an obtuse angle.
(ii) Angle 17° is less than 90° so it is an acute angle.
(iii) Angle 182° is greater than 180° so it is a reflex angle.
(iv) Zero angle
(v) Obtuse angle
(vi) Obtuse angle
(vii) Complete angle

The angle of the equilateral triangle is 1/6 of a turn. It was the unit used by the Babylonians, and is especially easy to construct with ruler and compass.

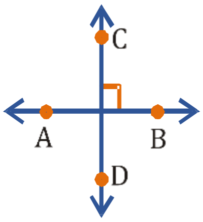
SPOT LIGHT

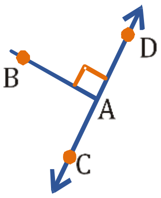
Lines

Perpendicular lines

When two lines intersect so that four right angles are formed, we say that the lines are perpendicular to each other.

The symbol '⅂' (a square corner) is used in a diagram to show that AB is perpendicular to CD. The symbol '⊥' stands for 'is perpendicular to' and to express the fact that AB is perpendicular to CD. We write AB⊥CD.





Parallel lines

Lines that never meet and are always at equal distance from each other are called parallel lines. Line AB, CD are parallel. We use the symbol '||' for 'parallel to'.

So here we can write AB is parallel to CD or AB || CD.

Numerical Ability 5

Which of the following are models for perpendicular lines:

(i) The adjacent edges of a table top.
(ii) The lines of a railway track.
(iii) The line segments forming the letter 'L'
(iv) The letter V.

Solution

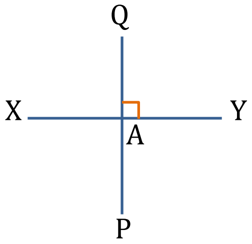
(i) The adjacent edges of a tabletop are perpendicular to each other.
(ii) The lines of a railway track are parallel to each other.
(iii) The line segments forming the letter L are perpendicular to each other.
(iv) The sides of letter V are inclined at some acute angle on each other.

hence, (a) and (c) are the models for perpendicular lines and (b) is the model for parallel lines.

Building Concepts 6

Let $\overline{PQ}$ be the perpendicular to the line segment $\overline{XY}$. Let $\overline{PQ}$ and $\overline{XY}$ intersect in the point A. What is the measure of $\angle PAY$?

Explanation



From the figure, it can be easily observed that the measure of $\angle PAY$ is 90°.

If two -line segments have a common end point, they are called adjacent sides.

SPOT LIGHT

Do You Remember ?

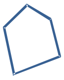
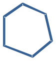
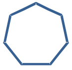
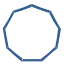
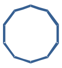
- A triangle is a polygon with the least number of sides.

Polygons

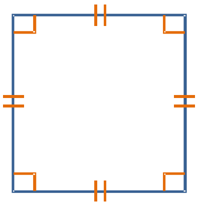
Polygons are simple closed figures that consist of line segments joining in turn, so that each line segments intersect exactly two other line segments at their end points.

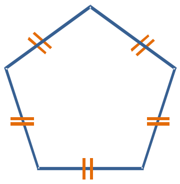
Types of polygons

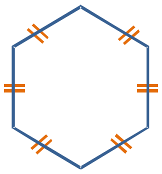
Polygons are classified according to the number of sides they have :

Name	Number of sides	Figures
Triangle	3	
Quadrilateral	4	
Pentagon	5	
Hexagon	6	
Heptagon	7	
Octagon	8	
Nonagon	9	
Decagon	10	

Regular polygon


Squar


Regular pentagon


Regular hexagon

A regular polygon is a polygon with all its sides and all its angles equal.

Note: The sum of interior angles of a n sided polygon is equal to (2n −4) × 90°.

Building Concepts 7

For each polygon write down the number of sides and name of the polygon.

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

(vii) 

(viii) 

(ix) 

(x) 

(xi) 

(xii) 

Explanation

(i) The given polygon has 3 sides. It is a triangle.

(ii) The given polygon has 7 sides. It is a heptagon.

(iii) The given polygon has 6 sides. It is a hexagon.

(iv) The given polygon has 7 sides. It is a heptagon.

(v) The given polygon has 4 sides. It is a quadrilateral.

(vi) The given polygon has 5 sides. It is a pentagon.

(vii) The given polygon has 7 sides. It is a heptagon.

(viii) The given polygon has 6 sides. It is a hexagon.

(ix) The given polygon has 7 sides. It is a heptagon.

(x) The given polygon has 8 sides. It is a octagon.

(xi) The given polygon has 10 sides. It is a decagon.

(xii) The given polygon has 9 sides. It is a nonagon.

Numerical Ability 6

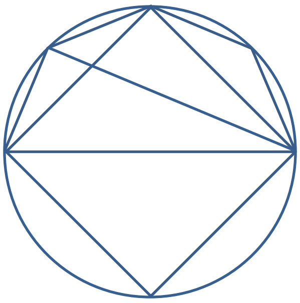
If there are 36 spokes in a bicycle wheel, then find the angle between a pair of adjacent spokes.

Solution

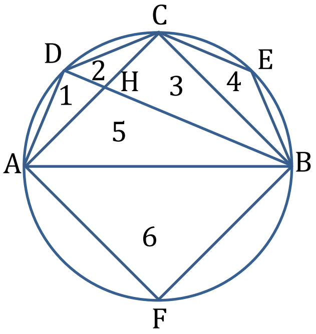
$$= \frac{360°}{36°} = 10°$$

Building Concepts 8

How many triangles are in the figure?



Explanation



The triangle 6 shown in figure and another is ADB, ACB, BDC, ADC, so that total number of triangles is 10.

A line joining the non adjacent vertices of a polygon is called a diagonal of polygon.

SPOT LIGHT

Triangle

A 3-sided polygon, is called triangle.

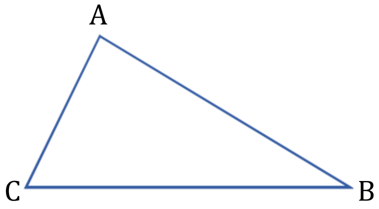
Classification of triangles

Triangles are classified either with reference to their sides or to their angles.

On the basis of side

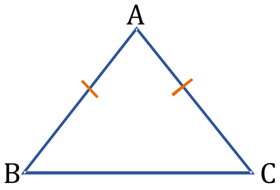
Scalene triangle

A scalene triangle is one that has all sides unequal.



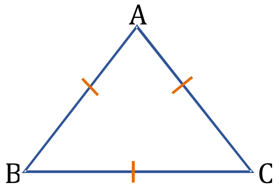
Isosceles triangle

An isosceles triangle is one that has two sides equal.



Equilateral triangle

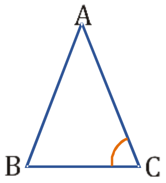
An equilateral triangle is one that has all sides equal.



On the basis of angle

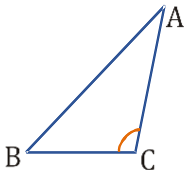
Acute angled triangle

An acute angled triangle is one that has all its angles acute.



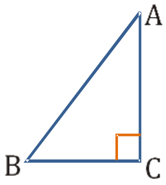
Obtuse angled triangle

An obtuse angled triangle is one that has one of its angles obtuse.



Right angled triangle

A right angled triangle is one that has one of its angles right angle.



The hypotenuse in a right angled triangle is the side opposite the right angle and this hypotenuse is the longest side of a right angled triangle.

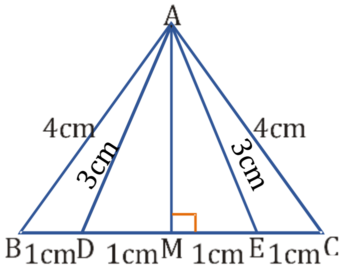
Quick Tips

- In a triangle largest angle is opposite largest side and smallest angle is opposite to smallest side.
- In an isosceles triangle the angles opposite to equal sides are equal.
- In an equilateral triangle all the angles are of 60°.
- In a right angled triangle the two smallest angles add to 90°.

Angle sum property of triangle

The sum of the interior angles of a triangle is 180°.

Building Concepts 9



Study the figure and answer the following questions

(i) Name the equilateral triangles.

(ii) Name the isosceles triangles.

(iii) Name the scalene triangles.

(iv) Name the acute triangles.

(v) Name the obtuse triangles.

(vi) Name the right triangles.

Explanation

(i) ΔABC

(ii) ΔADE, ΔADC, ΔAEB

(iii) ΔABD, ΔABM, ΔAEC, ΔAMC, ΔAME, ΔADM

(iv) ΔABC, ΔADC, ΔAEB, ΔADE

(v) ΔADB, ΔAEC

(vi) ΔAMB, ΔAMD, ΔAME, ΔAMC

> A triangle can not have more than one right angle.
>
> **SPOT LIGHT**

Numerical Ability 7

Find the angles of a triangle which are in the ratio 2 : 3 : 4.

Solution

Let the measures of the given angles be (2x), (3x), (4x).

Then as we know that the sum of the angles of the triangle is 180°.

$\therefore\ 2x + 3x + 4x = 180°$

$\Rightarrow 9x = 180° \Rightarrow x = 20°$

Hence the measures of the given angles

are $2x = 2 \times 20° = 40°$

and $3x = 3 \times 20° = 60°$

and $4x = 4 \times 20° = 80°$

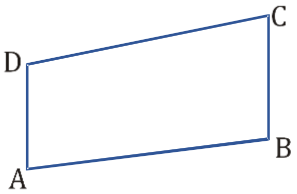
Quadrilaterals

Definition of Quadrilaterals

A 4-sided polygon is called quadrilateral.

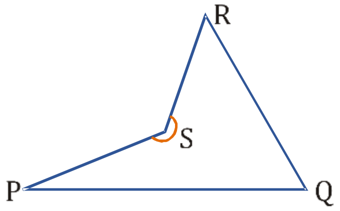
Convex quadrilateral

A quadrilateral in which the measure of each angle is less than 180°, is called a convex quadrilateral.



Concave quadrilateral

A quadrilateral in which the measure of one of the angles is more than 180° is called a concave quadrilateral.



Angle sum property of quadrilateral

The sum of the interior angles of quadrilateral is 360°.

Numerical Ability 8

The angles of a quadrilateral are in the ratio 1 : 2 : 3 : 4. Find the measure of each of the four angles.

Solution

Let the measure of the angles of the given quadrilateral be x, (2x), (3x) and (4x). Then,

$x + 2x + 3x + 4x = 360°$ [∴ The sum of the angles of a quadrilateral is 360°]

$\Rightarrow \quad 10x = 360°$

$\Rightarrow \quad x = 36°$

Hence the required angles are 36°, 72°, 108° and 144°.

Building Concepts 10

The three angles of a quadrilateral are 70°, 60° and 110°. Find the fourth angle.

Explanation

Sum of all the angles of a quadrilateral is 360°.

Fourth angle = 360° – (70° + 60° + 110°) = 120°

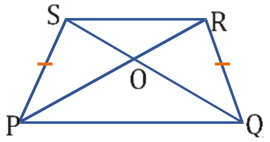
Properties of Special Quadrilaterals

Trapezium

A quadrilateral having exactly one and only one pair of parallel sides is called a trapezium.

ABCD is a trapezium in which AB || DC.

(a)



(b)

A trapezium is said to be an isosceles trapezium if its non-parallel sides are equal. PQRS is an isosceles trapezium in which PQ || SR and PS = QR.

The diagonal of an isosceles trapezium are always equal.

SPOT LIGHT

Parallelogram

A quadrilateral in which both pairs of opposite sides are parallel, is called a parallelogram.

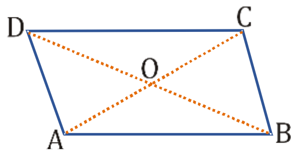
Properties of a parallelogram

(i) The opposite sides of a ||gm are equal and parallel.

(ii) The opposite angles of a ||gm are equal.

(iii) The diagonals of a ||gm bisect each other.

Thus, in a parallelogram ABCD, we have



(i) AB = DC, AD = BC and AB || DC, AD || BC

(ii) $\angle BAD = \angle BCD$ and $\angle ABC = \angle ADC$

(iii) If the diagonals AC and BD intersect at O, then OA = OC and OB = OD.

Rhombus

A parallelogram in which all the sides are equal is called a rhombus.

Properties of a rhombus

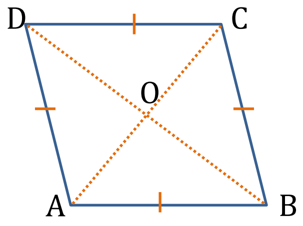
(i) The opposite sides of a rhombus are parallel.

(ii) All the sides of a rhombus are equal.

(iii) The opposite angles of a rhombus are equal.

(iv) The diagonals of a rhombus bisect each other at right angles.

Thus, in a rhombus ABCD, we have



(i) AB || DC and AD || BC.

(ii) AB = BC = CD = DA.

(iii) $\angle DAB = \angle BCD$ and $\angle ABC = \angle CDA$.

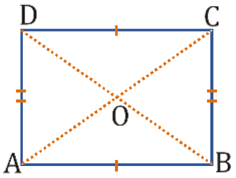
(iv) Let the diagonals AC and BD intersect at O. Then, OA = OC, OB = OD and $\angle AOB = \angle COD = \angle BOC = \angle AOD$ = 1 right angle.

Rectangle

A parallelogram in which each angle is a right angle is called a rectangle.

Properties of a rectangle

(i) Opposite sides of a rectangle are equal and parallel.
(ii) Each angle of a rectangle is 90°.
(iii) Diagonals of a rectangle are equal.
Thus, in a rectangle ABCD, we have



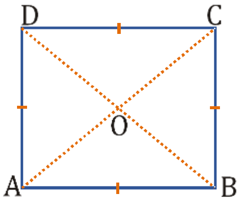
(i) AB = DC, AD = BC and AB || DC, AD || BC.
(ii) ∠A = ∠B = ∠C = ∠D = right angle.
(iii) Diagonal AC = diagonal BD.

Square

A parallelogram in which all the sides are equal and each angle is a right angle is called a square.

Properties of a square

(i) The sides of a square are all equal.
(ii) Each angle of a square is 90°.
(iii) The diagonals of a square are equal and bisect each other at right angles.
Thus, in a square ABCD, we have

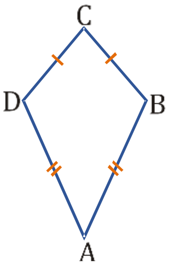


(i) AB = BC = CD = DA
(ii) ∠A = ∠B = ∠C = ∠D = 90°.
(iii) Diagonal AC = diagonal BD.
(iv) Let the diagonals AC and BD intersect at O.
Then, OA = OC, OB = OD and ∠AOB = ∠COD = ∠BOC = ∠AOD = 1 right angle.

Kite

A quadrilateral which has two pairs of equal adjacent sides but unequal opposite sides is called a kite.

ABCD is a kite in which



CB = CD and AB = AD but AD ≠ BC and AB ≠ CD.

Numerical Ability 9

Two sides of a ||gm are in the ratio 4:3. If its perimeter is 56cm, find the lengths of its sides.

Solution

Suppose the sides of the ||gm is 4x and 3x and as we know that in a ||gm, opposite sides are equal. So other two sides will be 4x and 3x.

Perimeter = Sum of its all sides

$\Rightarrow 56 = 4x + 3x + 4x + 3x$

$\Rightarrow 56 = 14x$

$\Rightarrow x = \frac{56}{14} = 4$

So, the other two sides are 4x = 4 × 4 = 16cm and 3x = 3 × 4 = 12 cm.

Building Concepts 11

Specify the type of quadrilateral ABCD in each case, given the following information.

(i) **AB||CD, BC||AD, ∠DAB = 60°**

(ii) **AB||CD, AD||BC, ∠DAB = ∠ABC**

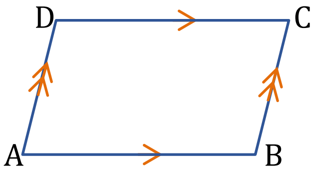
(iii) **AB||CD, AD||CB, AB = CD, BC = AD, DA ⊥ AB**

(iv) **AO = OC, DO = OB, DB ⊥ AC, ∠DAB = 63°, O being the point of intersection of diagonals.**

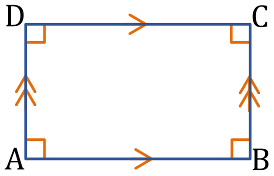
(v) **AB = CD, CD = AD = BC**

Explanation

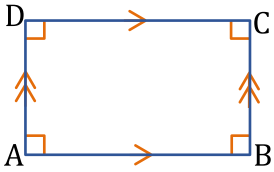
(i) Parallelogram



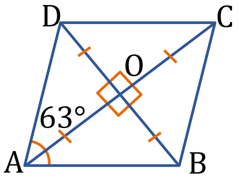
(ii) Rectangle



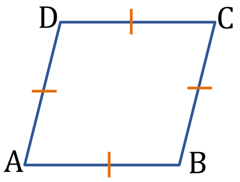
(iii) Rectangle



(iv) Rhombus



(v) Rhombus



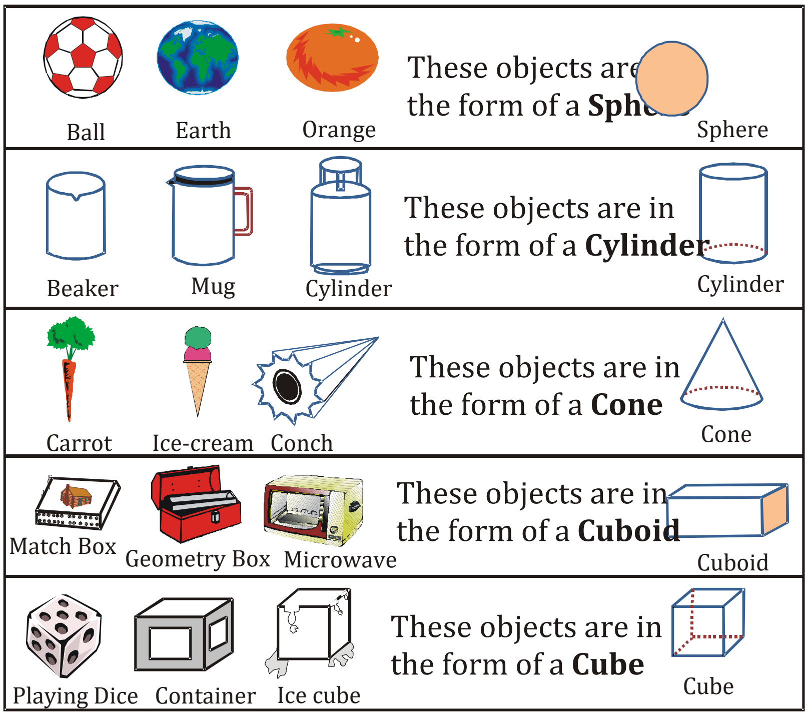
Solid Figures

Three dimensional shapes

The figures such as triangles, squares, rectangles, quadrilaterals, polygons etc., have only the length and the breadth; they do not have the height or depth, and hence they are called as two dimensional figures. We can only see these shapes, but can not handle them. But the solids can be handled and the properties of these can be experienced. These solid shapes have length, breadth, and height and hence they are called as three-dimensional or 3D shapes.

Solid figure

A closed figure which lies in more than one plane is called a space figure or solid figure.



These objects are in the form of a **Sphere**

These objects are in the form of a **Cylinder**

These objects are in the form of a **Cone**

These objects are in the form of a **Cuboid**

These objects are in the form of a **Cube**

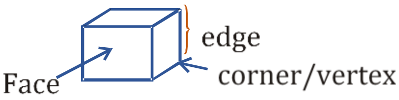
Faces, edges and vertices of solid figure

Face

The surface of a solid is called its face.

Edge

An edge is a line segment that is the intersection of two faces.



A cuboid has 6 faces, 12 edges and 8 vertices.

SPOT LIGHT

Vertex

A vertex in a solid shape is the point where the edges meet.

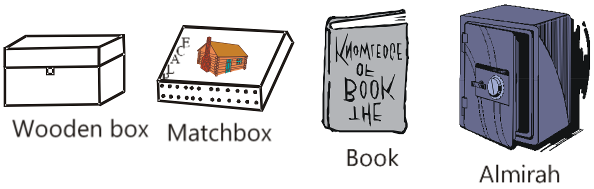
Euler's formula

If a polyhedron has F number of faces, V number of vertices and E number of edges then

$$F + V - E = 2$$

Cuboid

Solids such as a wooden box, a match box, a brick, a book, an almirah, etc. are all in the shape of a cuboid. Some of these shape are given below in the diagram.

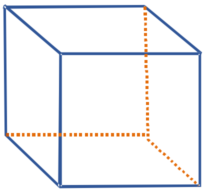


Do You Remember ?

- In cube all the faces are square and cuboid all the faces are rectangle.

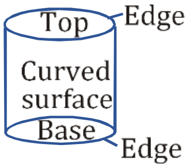
Cube

A cuboid whose length, breadth and height are equal is called a cube.



Cylinder

Objects such as a circular pillar, a circular pipe, a test tube, a circular storage tank, a measuring jar etc. are in the shape of cylinder.



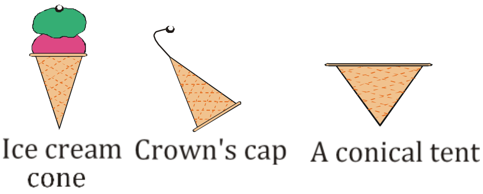
A cylinder has a curved lateral surface and two circular faces at its ends. It has no corner or vertex. It has two plane faces, namely, the top and the base. The distance between its end faces is called its length.

Sphere

An object which is in the shape of a ball is said to have the shape of a sphere. A sphere has curved surface, it has no vertex and no edge.

Cone

Objects such as an ice-cream cone, a conical tent, a conical vessel etc. are in the shape of a cone.



A cone has plane circular end as the base and a curved surface tapering into a point, called its vertex. It has no circular edge and one vertex.

Pyramid

A pyramid is a solid where base is a plane rectilinear figure and whose side faces are triangles having a common vertex, called the vertex of the pyramid.

The length of perpendicular drawn from the vertex of a pyramid to its base is called the height of the pyramid.

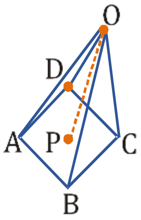
The side faces of a pyramid are called its lateral faces.

Square pyramid

A solid whose base is a square and whose side faces are triangles having a common vertex is called a square pyramid.

A square pyramid OABCD with O as vertex, the square ABCD as its base and OP as its height.

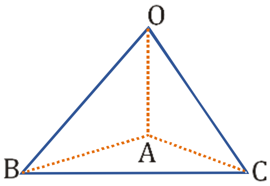
A square pyramid has 4 lateral triangular faces and 8 edges.



Triangular pyramid

A solid whose base is a triangle and whose side faces are triangles having a common vertex is called a triangular pyramid.

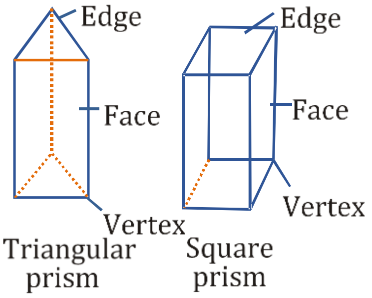
A triangular pyramid OABC with O as vertex and ΔABC as its base.



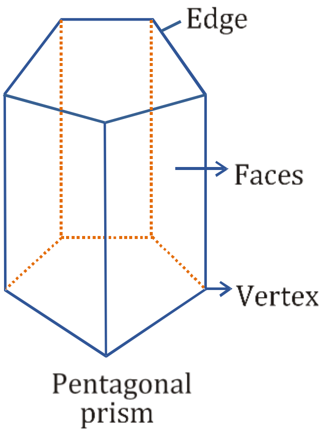
A triangular pyramid has 3 triangular lateral faces, one triangular base and 6 edges.

Prism

Prisms are polyhedra whose top and base are congruent polygons and the other faces are parallelograms.



Triangular prism   Square prism



Pentagonal prism

Check your Answers 2

1. 120°

Building Concepts 12

Which type of solid shape is a

(i) Dice **(ii) Gas pipe** **(iii) Football** **(iv) Brick**

(v) Ice-cream cone **(vi) Kaleidoscope**

Explanation

(i) Cube (ii) Cylinder (iii) Sphere (iv) Cuboid

(v) Cone (vi) Triangular prism

Numerical Ability 10

A polyhedron has 4 faces and 6 edges. How many vertices will it have?

Solution

As we know that

For a polyhedron, $F + V - E = 2$

here $F = 4$, $E = 6$

$\Rightarrow 4 + V - 6 = 2$

$\Rightarrow V - 2 = 2$

$\Rightarrow V = 2 + 2 = 4$

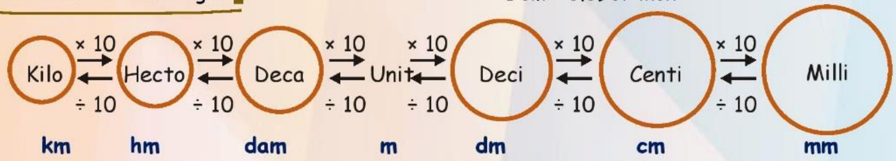
So, the polyhedron has 4 vertices.

Memory Map

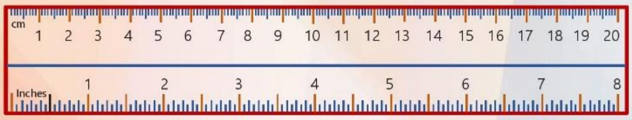
Measuring line segments

Conversion of units of length

1 cm = 0.3937 inch



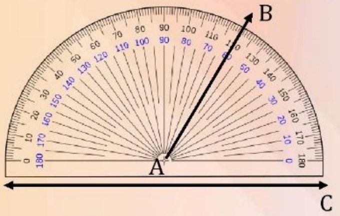
By using a ruler



Comparison of line segments

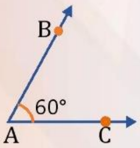
Measuring of angles

Measuring angles using protractor



Degree measure of an angle

A circle is made up of 360°.

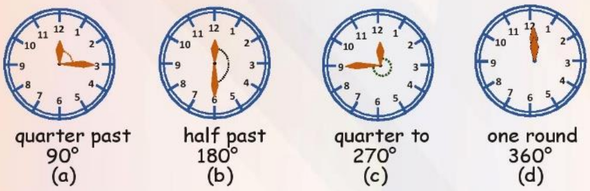


The magnitude or measure of the angle is the measure of rotation.

Types of angles

Zero angle (0°)
Acute angle
(0° < x < 90°)
Right angle (90°)
Obtuse angle
Straight angle (180°)
Reflex angle
(180° < x < 360°)
Complete Angle

Rotation round the clock

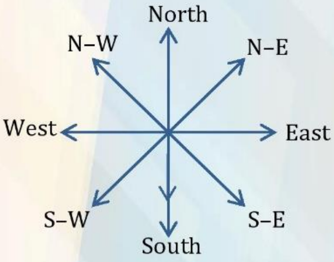


quarter past 90° (a)
half past 180° (b)
quarter to 270° (c)
one round 360° (d)

Degree, minutes and seconds

1° = 60 minutes (60') and 1 minute = 60 seconds (60")
1 Babylonian unit = 60° = π/3 rad

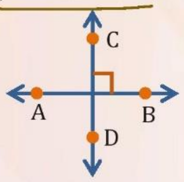
Directions



Lines

Perpendicular lines

AB⊥CD



Parallel lines

AB||CD

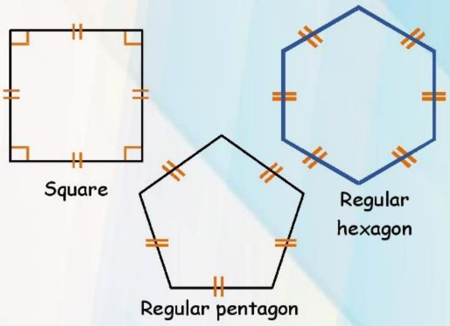
Polygons

Types of polygons

Polygons	Sides
Triangle	(3)
Quadrilateral	(4)
Pentagon	(5)
Hexagon	(6)
Heptagon	(7)
Octagon	(8)
Nonagon	(9)
Decagon	(10)

Regular polygons

- A regular polygon is a polygon with all its sides and all its angles equal
- The sum of interior angles of a n sided polygon is equal to (2n – 4) × 90°.



Triangle

Classification of triangles

On the basis of sides
- ➢ Scalene triangle
- ➢ Isosceles triangle
- ➢ Equilateral triangle

On the basis of angles
- ➢ Acute angled triangle
- ➢ Obtuse angled triangle
- ➢ Right angled triangle

Angle sum property of triangles

The sum of the interior angles of a triangle is 180°.

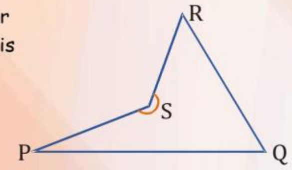
Quadrilaterals

A 4-sided polygon is called quadrilateral.

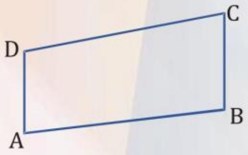
Angle sum property of quadrilateral

The sum of the interior angles of quadrilateral is 360°.

Concave quadrilateral

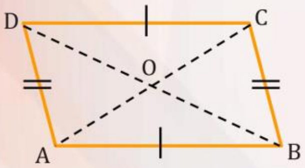


Convex quadrilateral



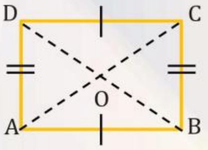
Properties of special Quadrilaterals

Parallelogram



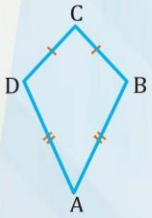
AB = DC, AD = BC and AB || DC, AD || BC
∠BAD = ∠BCD and ∠ABC = ∠ADC
& OA = OC and OB = OD.

Rectangle



Rectangle ABCD,
AB || DC, AD || BC.
∠A = ∠B = ∠C = ∠D = right angle.
Diagonal AC = diagonal BD.

Kite

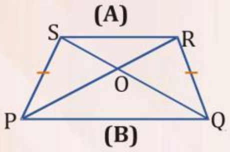


ABCD is a kite in which CB = CD and AB = AD but AD ≠ BC and AB ≠ CD.

Trapezium

ABCD is a trapezium in which AB || DC.
PQRS is an isosceles trapezium in which PQ || SR and PS = QR and PR = QS.

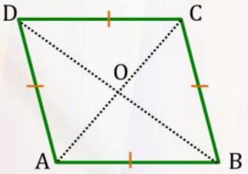
(A)



(B)

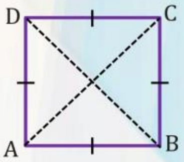
Rhombus

Rhombus ABCD, we have
AB || DC and AD || BC.
∠DAB = ∠BCD and ∠ABC = ∠CDA.
OA = OC, OB = OD and ∠AOB = ∠COD = ∠BOC = ∠AOD = 1 right angle.



Square

Square
AB = BC = CD = DA
∠A = ∠B = ∠C = ∠D = 90°
Diagonal AC = diagonal BD

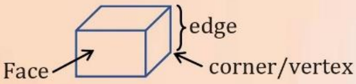


Three dimensional shape

Solid figure

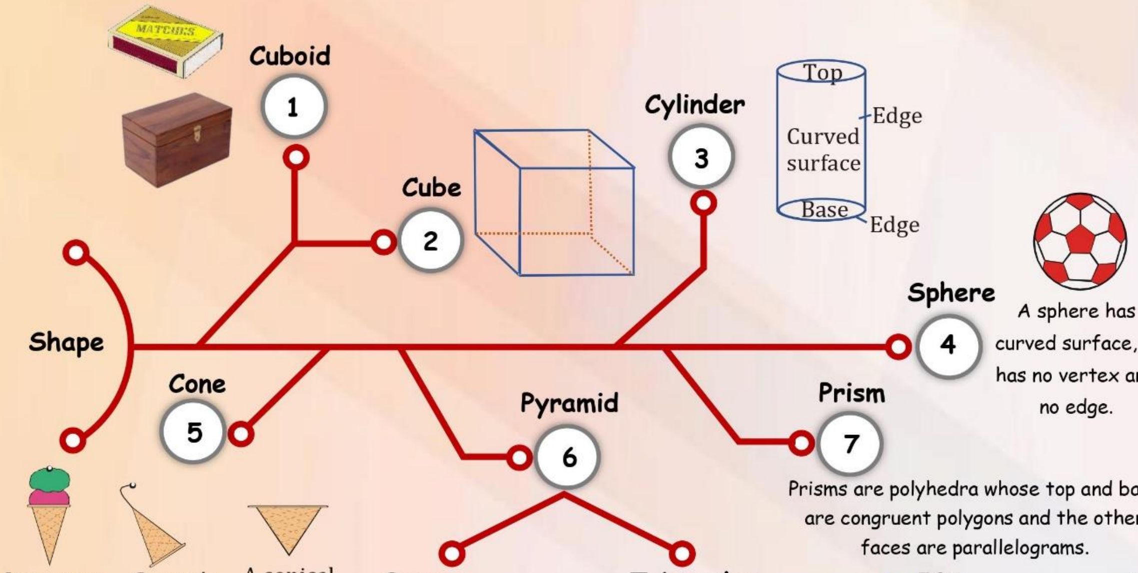
A closed figure which lies in more than one plane is called a space figure or solid figure.

Faces, edges and vertices of solid figure



Euler's formula

$F + V - E = 2$

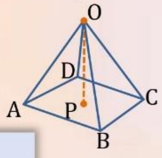


A sphere has curved surface, it has no vertex and no edge.

Prisms are polyhedra whose top and base are congruent polygons and the other faces are parallelograms.

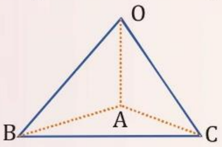
Square pyramid

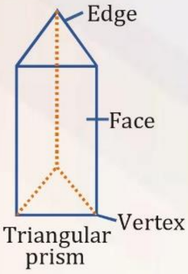
A square pyramid has 4 lateral triangular faces and 8 edges.

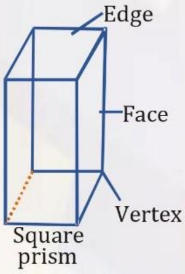


Triangular pyramid

A triangular pyramid has 3 triangular lateral faces, one triangular base and 6 edges.







Net of solid shapes

A net is a flat diagram on one plane that is folded to make a hollow solid. Alternatively, if a hollow solid is opened out, the result is its net.

(i) A net is also known as a layout.

(ii) The nets of a solid may have different shapes.