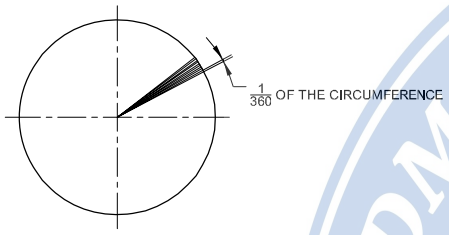
Drawing of geometrical figures - Angle & triangle

Angles: Angle is the inclination between two straight lines meeting at a point or meeting when extended. AB and BC are two straight lines meeting at B. The inclination between them is called an angle. The angle is expressed in degrees or radians.

Concept of a degree: When the circumference of a circle is divided into 360 equal parts and radial lines are drawn through these points, the inclination between the two adjacent radial lines is defined as one degree. Thus a circle is said to contain 360°. (Fig 1)

Fig 1



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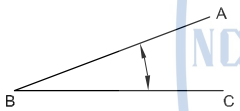
Acute angle: An angle that is less than 90° is called an acute angle. (Fig 2)

Fig 2



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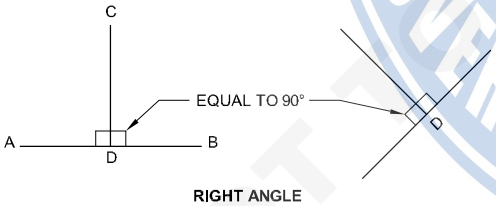
Right angle: The angle between a reference line and a perpendicular line is called a right angle. (Fig 3)

Fig 3



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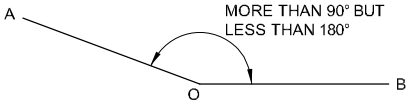
Obtuse angle: This refers to an angle between 90° and 180°. (Fig 4)

Fig 4



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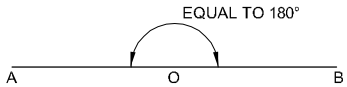
Straight angle: This refers to an angle of 180°. This is also called the angle of a straight line. (Fig 5)

Fig 5



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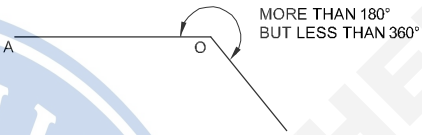
Reflex angle: It is the angle that is more than 180°, but less than 360°. (Fig 6)

Fig 6



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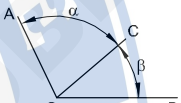
Adjacent angles: These are the angles lying on either side of a line. (Fig 7)

Fig 7



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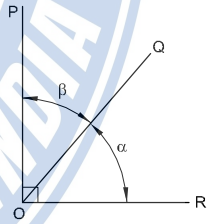
Complementary angles: When the sum of the two angles is equal to 90°, angle POQ + angle QOR = 90° angle POQ and angle QOR are complementary angles to each other. (Fig 8)

Fig 8



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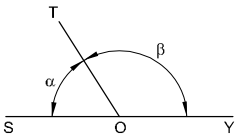
Supplementary angle: When the sum of the two adjacent angles is equal to 180°, for example, angle SOT + angle TOY = 180°, angle SOT and angle TOY are supplementary angles to each other. (Fig 9)

Fig 9



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Triangle - different types

Triangle is a closed plane figure having three sides and three angles. The sum of the three angles always equals to 180°.

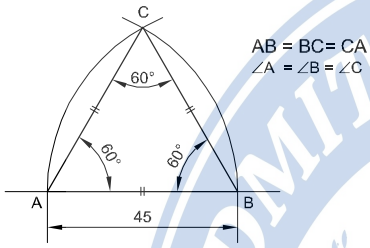
To define a triangle, we need to have a minimum of three measurements as follows:

- 3 sides or
- 2 sides and one angle or
- 2 angles and one side

Types of triangles

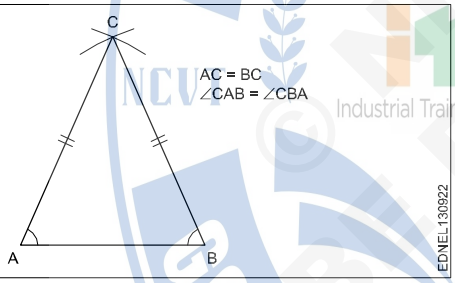
1 **Equilateral triangle** is a triangle having all the three sides equal. Also all the three angles are equal (60°). (Fig 1)

Fig 1



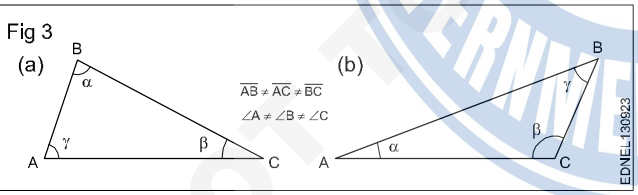
2 **Isosceles triangle** has two of its sides equal. The angles opposite the two equal sides are also equal. (Fig 2)

Fig 2



3 **Scalene triangle** has all three sides unequal in length. All three angles are also unequal. (Fig 3)

Fig 3



4 **A right-angled triangle** is one in which one of the angles is equal to 90° (Right angle). The side opposite the right angle is called the hypotenuse. (Fig 4)

5 **An Acute angled triangle** is one in which all the three angles are less than 90°. (Fig 5)

6 **Obtuse angled triangle** has one of the angles more than 90°. (Fig 6)

The sum of the three angles in any triangle is equal to 180°.

The sum of any two sides is more than the third side.

Fig 4

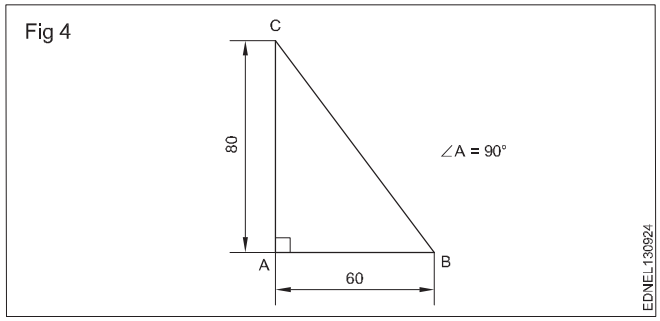


Fig 5

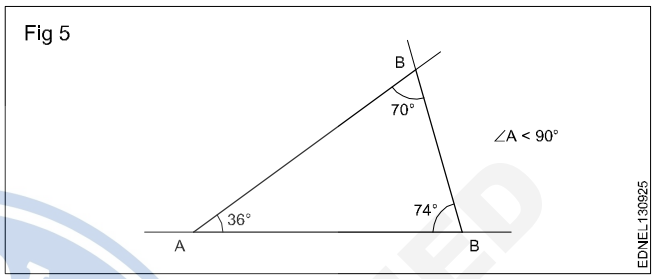
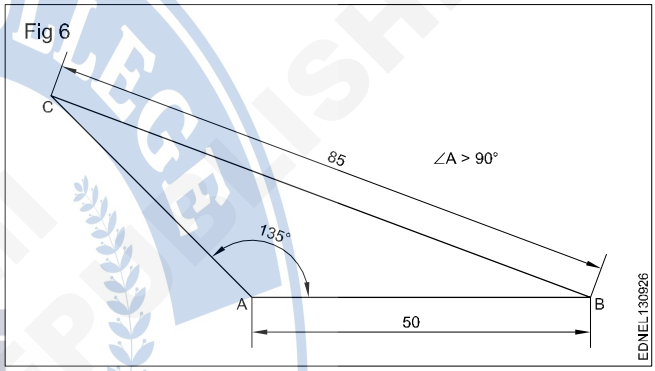


Fig 6

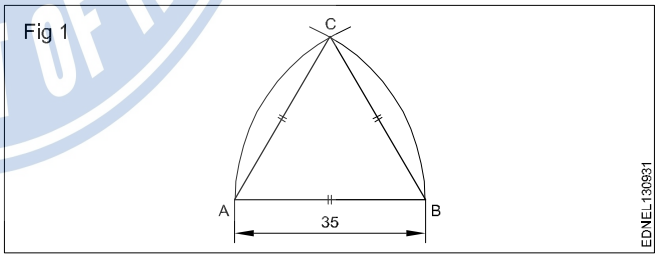


Procedure to draw the triangle

1 **Equilateral triangle (Fig 1) AB = BC = CA = 35 mm.**

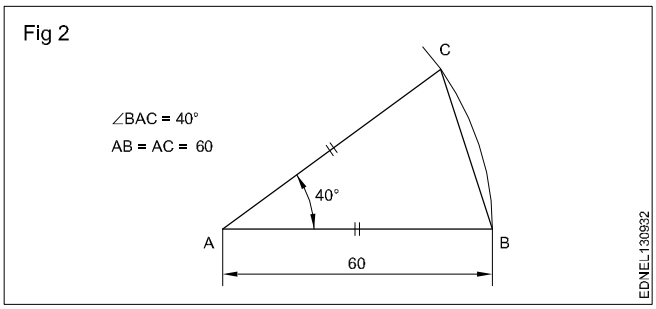
- Draw a line and mark AB 35 mm side of the triangle.
- Draw radius from centre A and B, arcs cutting mark at C (Fig 1).
- Join CA and CB.
- ABC is a required triangle.

Fig 1



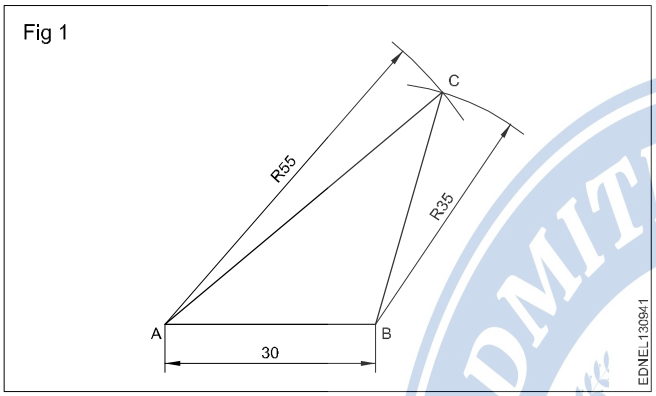
2 **Isosceles triangle : AB = AC = 60 mm & ∠BAC = 40° .**

- Draw the side AB equal to 40 mm. `A' as the centre, draw an arc of radius AB.
- Draw a line AC at 40° to AB.
- Join BC to form the triangle ABC. (Fig 2)



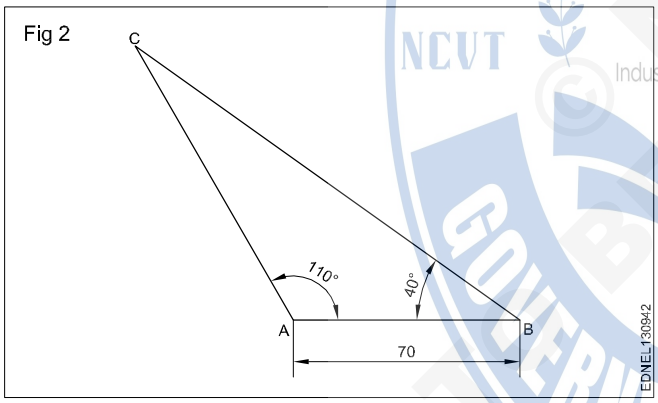
Exercise

1 Scalene triangle: AB = 30 mm, AC = 55 mm & BC= 35 mm. (Fig 1)

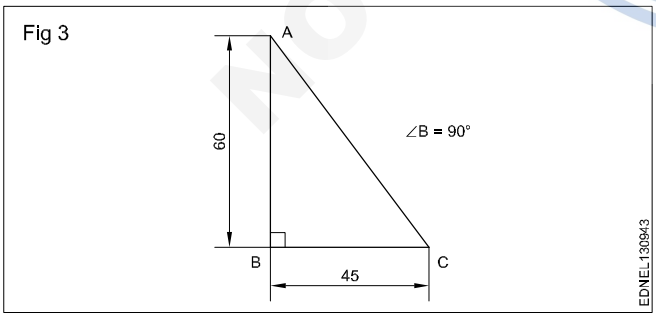


2 Scalene triangle: AB = 70 mm. (Fig 2)

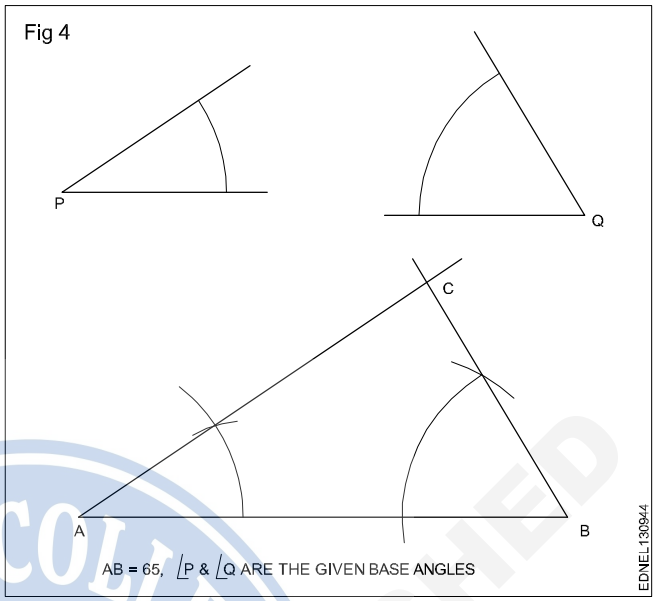
$\angle ABC = 40° \ \& \ \angle BAC = 110°$



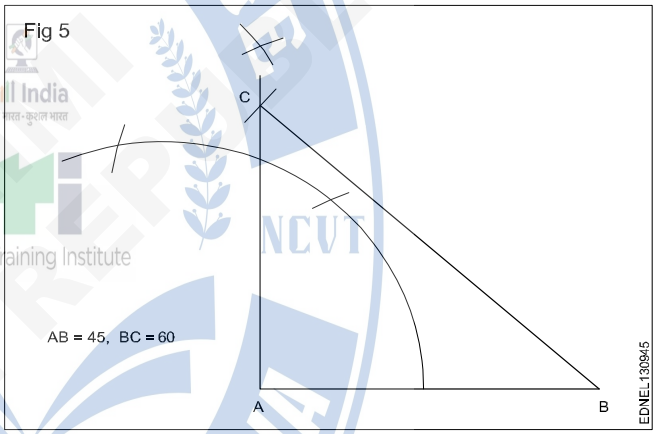
3 Right angled triangle: AB = 60 mm, BC = 45 mm. (Fig 3)



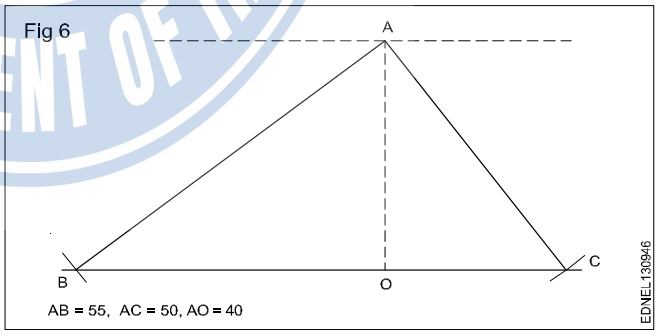
4 Draw a triangle when one side and 2 angles being given in Fig 4.



5 Draw a right angled triangle when the base and hypotenuse being given in Fig 5.



6 Draw a triangle with the altitude and two sides being given in Fig 6.



Drawing of geometrical figures - Circle

Circle: Circle is a plane figure bounded by a curve, formed by the locus of a point which moves so that it is always at a fixed distance from a stationary point the "Centre".

Radius: The distance from the centre to any point on the circle is called the "Radius".

Diameter: The length of a straight line between two points on the curve, passing through the centre is called the "Diameter". (D: Dia or d) It is twice the radius.

Circumference: It is the linear length of the entire curve, equal to πD .

Arc: A part of the circle between any two points on the circumference or periphery is called an 'Arc'.

Chord: A straight line joining the ends of an arc is called the chord. (Longest chord of the circle is the diameter)

Segment: A part of the circle or area bound by the arc and chord is the segment of the circle.

Sector: It is the part of a circle bounded by two radii (plural of radius) meeting at an angle and an arc.

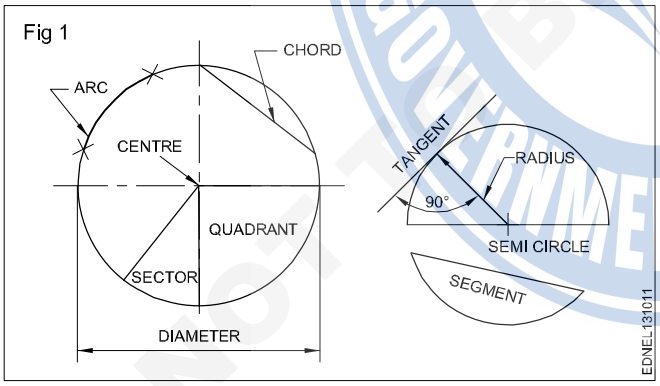
Quadrant: Part of a circle with radii making 90° with each other is a quadrant (one-fourth of the circle).

Half of the circle is called a semi-circle.

Tangent: The tangent of a circle is a straight line just touching the circle at a point. It does not cut or pass through the circle when extended.

Fig 1 shows all the above elements.

Fig 1



Concentric circles: When two or more circles (drawn) have a common centre, they are called concentric circles. Ball-bearing is the best example of concentric circles. (Fig 2)

Eccentric circles: Circles within a circle but with different centres are called eccentric circles. (Fig 3)

Fig 2

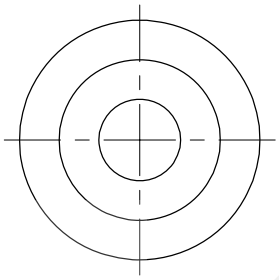
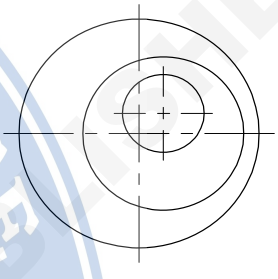


Fig 3

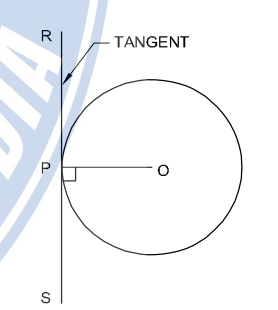


Circle and Arcs

Exercise

1 Draw a tangent to a given circle of ϕ 50 mm at any point `P' on it. (Fig 1)

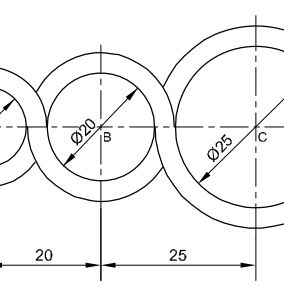
Fig 1



2 Draw a loop of 3 circles pattern. (Fig 2)

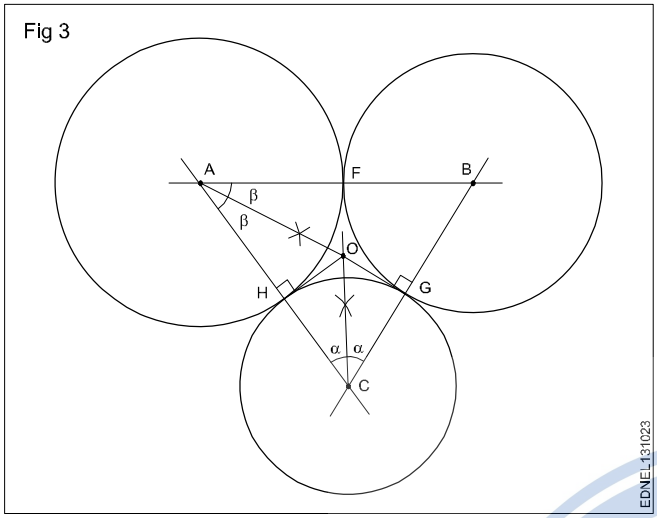
Draw any line MN and mark points A,B and C. So that AB = 20 mm and BC = 25 mm.

Fig 2



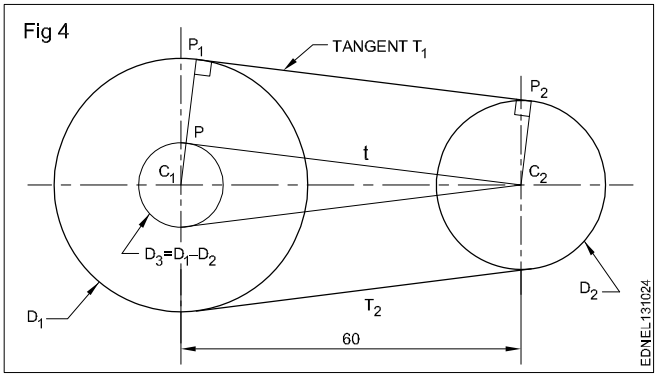
3 3 Draw three circles tangential to each other if centres A, B & C are given. (Fig 3)

Fig 3



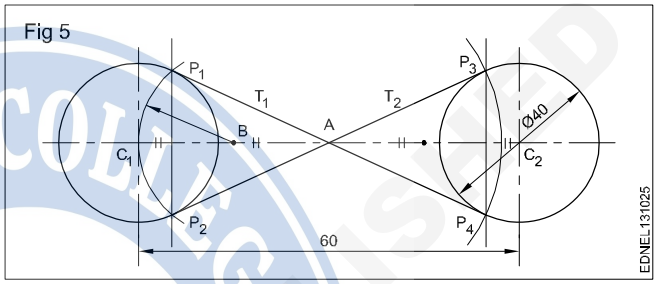
4 Draw external tangents to circles of dia 40 and 30 and centre distance 60 mm. (Fig 4)

Fig 4



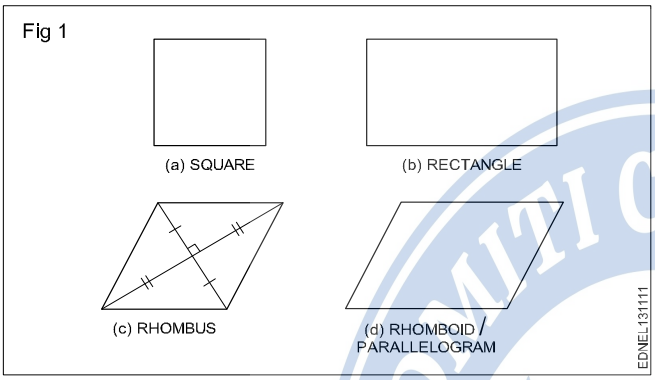
5 Draw internal tangents to circles of the same diameter 40 each and a centre distance of 60 mm. (Fig 5)

Fig 5



Drawing of geometrical figures - Square, rectangle and parallelogram

A quadrilateral is a plane figure bounded by four sides and four angles. The sum of the four angles in a quadrilateral is (interior angles) equal to 360°. The side joining opposite corners is called diagonal. To construct a quadrilateral out of four sides, four angles and two diagonals a minimum of five dimensions are required of which two must besides. Quadrilaterals are also referred as Trapezium. (Fig 1)



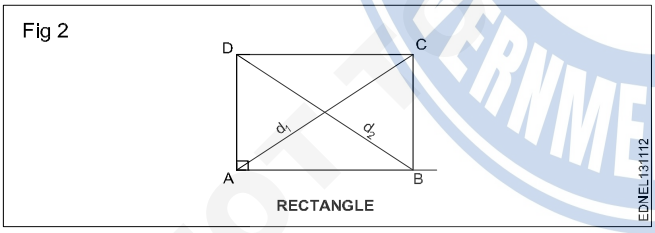
Types of quadrilaterals (Fig 1)

- Square
- Rectangle
- Rhomboid / Parallelogram

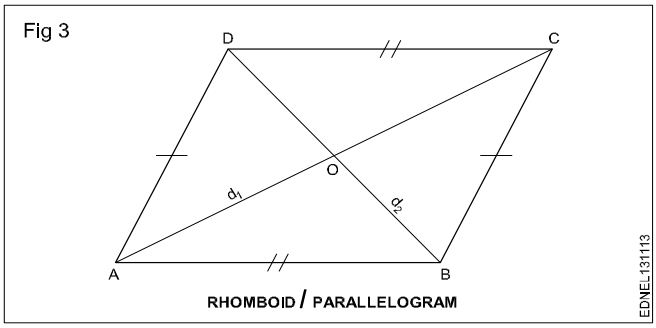
Square: In a square all the four sides are equal and its four angles are at right angles. The two diagonals are equal and perpendicular to each other.

Rectangle (Fig 2): In a rectangle, opposite sides are equal and parallel and all four angles are right angles.

Fig 2 shows a rectangle ABCD, Sides AB = DC and BC = AD. Diagonals AC and BD are equal. Diagonals are not bisected at right angles.



Rhomboid/Parallelogram (Fig 3): In a parallelogram, opposite sides are equal and parallel. Opposite angles are also equal. Diagonals are not equal but bisect each other.

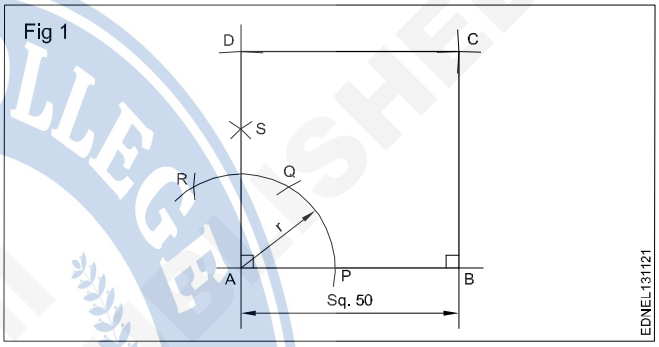


Procedure to draw the square, rectangle and parallelogram

Square

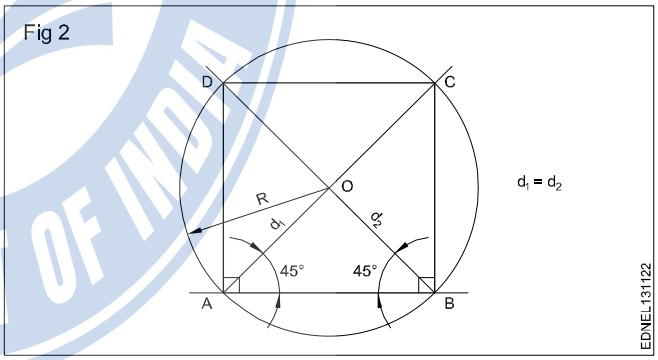
1 **1st method** (Fig 1)**:** A square of side 50 mm by erecting perpendicular using compass and 45° set square.

Draw a line 50mm. 'A' as centre draw an arc of convenient radius. Same arc cut and mark as PQR. Draw a line perpendicular, mark 50mm and make a square as shown in figure.

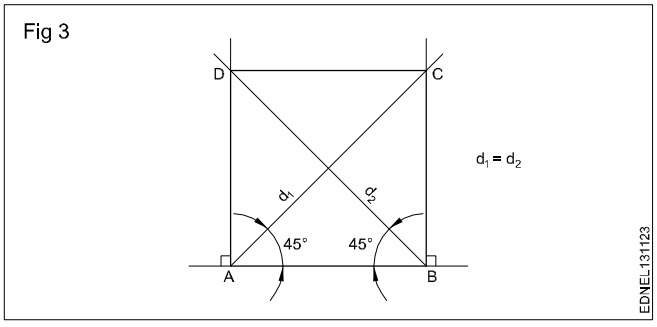


2 **2nd method (Fig 2):** A square of side 60 mm using 45° setsquare and compass.

Draw a horizontal line AB = 60 mm. From point 'A' & 'B' using 45° setsquare draw diagonal and circle of radius OA with centre 'O'. Join points AD, DC & CB to complete the required square.



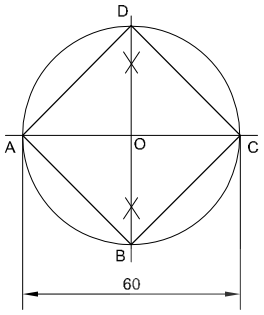
3 **3rd method (Fig 3):** A square of side 60 mm long by erecting perpendicular and also using 45° setsquare. Mark AD, BC and join ABCD to get the required square.



4 Square having diagonal 60 mm (Fig 4)

Draw horizontal and vertical centre lines intersect at 'O' and make a circle. Join all the points ABC&D to get the required square.

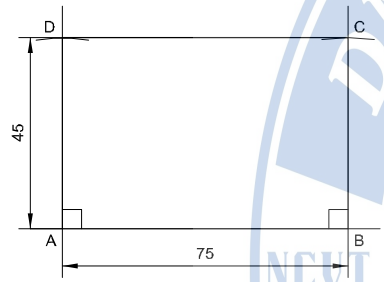
Fig 4



5 Rectangle (Fig 5)

Draw AB = 75 mm and side AD = 45 mm using setsquare and compass. Draw BC = 45 mm using setsquare and compass. Join ABCD to get the required rectangle.

Fig 5

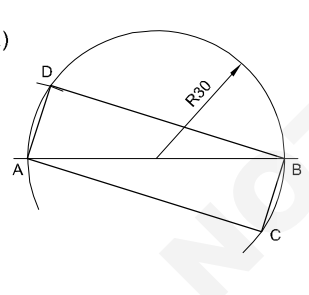


6 Rectangle - Diagonal - 60 mm and one side 20 mm
1st method (Fig 6a)

2nd method (Fig 6b)

ADBC is the required rectangle of side 20 mm and diagonal 60 mm by using setsquare and compass.

Fig 6

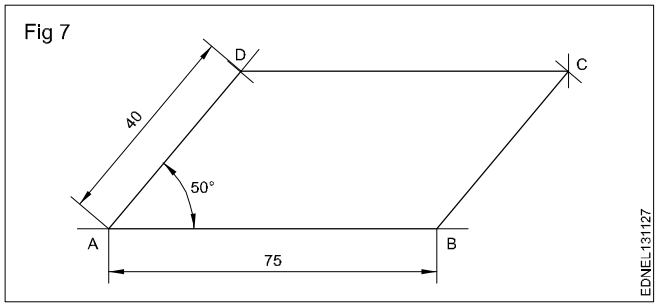


7 Parallelogram (Fig 7)

Sides = 75 mm and 40 mm, angle 50°

- Draw line AD equal to 40 mm and 50° angle to AB.
- 'D' as centre, draw an arc of radius equal to AB.
- 'B' as centre, draw an arc of radius equal at AD, upwards such that they meet at a point 'C'. Join ABCD to get the required parallelogram.

Fig 7



8 Parallelogram (Fig 8)

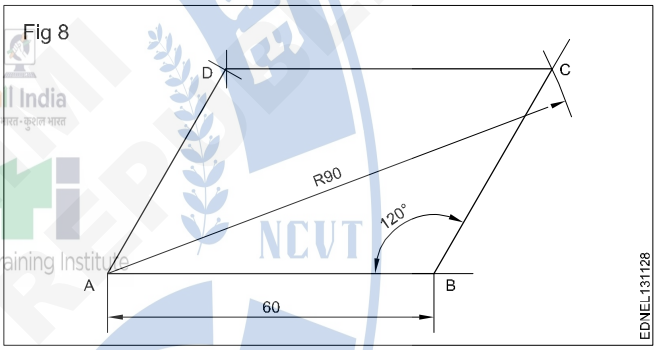
Parallelogram - Side AB = 60 mm

Diagonal AC = 90 mm ∠ABC = 120°

- Draw a line AB = 60 mm. Draw a line from B to an angle 120° to AB.
- 'A' as centre with radius 90 mm, draw an arc cutting 120° line from 'B' at 'C'.
- 'C' as centre, radius = AB, draw an arc.
- 'A' as centre and BC as radius, draw another arc, both arcs meet at 'D'. Join AD and DC.

ABCD is the required parallelogram.

Fig 8



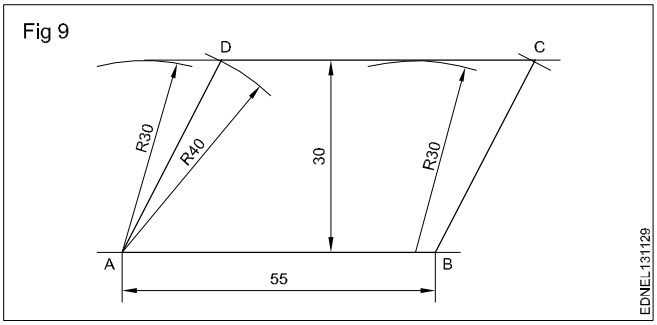
9 Parallelogram (Fig 9)

Sides AB = 55 mm, BC = 40 mm and vertical height = 30 mm.

- Draw the line AB = 55 mm long.
- 'A' and 'B' as centres and radius (R) 30 mm, draw arcs above the line.
- Draw a parallel tangential line to AB touching the arcs.
- 'A' and 'B' as centres, draw an arc of 40 mm radius cutting the line at 'D' and 'C'.

ABCD is the required parallelogram.

Fig 9



Lettering and numbering - Single stroke

Styles of lettering: Many styles of lettering are in use today. However, a few styles which are commonly used are shown in Fig 1.

Fig 1

Standard heights/Width: The standard heights recommended by BIS SP: 46-2003 are in the progressive ratio of "square root 2". They are namely 2.5 - 3.5 - 5 - 7 - 10 - 14 and 20 mm. The height of lower case letter (without tail or stem) are 2.5, 3.5, 5, 7, 10 and 14 mm.

There are two standard ratios for the line thickness "d". They are A & B. In A = line thickness (d) is h/14 and in B=line thickness (d) is h/10.

Lowercase means small letters, as opposed to capital **letters**. The word yes, is for example, is in **lowercase**, while the word YES is in **upper case**. For many programmes, this distinction is very important. Programmes that distinguish between **uppercase** and **lowercase** are said to be case sensitive

The width of different letters in terms of "d" is as follows:

Lettering A

Width (W)	Capital letters	Width
1	I	1d
5	J,L	5d
6	C,E,F	6d
7	B,D,G,H,K,N,O,P,R,S,T,U & Z	7d
8	A,Q,V,X,Y	8d
9	M	9d
12	W	12d

Lower case letters and numerals

Width (W)	Letters/Numerals	Width
1	i	1d
3	j,l	3d
4	f,t,l	4d
5	c,r	5d
6	a,b,d,e,g,h,k,n,o,p,q,s,u,v;3;5	6d
7	a,0 (zero), 2,4,6,7,0,8,9	7d
9	m	9d
10	w	10d

The width of different letters in terms of stroke (line) is as follows:

Uppercase Lettering BIS SP: 46-2003

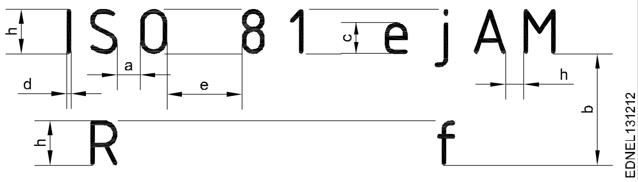
Width (W)	Capital letters
1	I
4	J
5	C,E,F,L
6	B,D,G,H,K,N,O,P,R,S,T,U & Z
7	A,M,Q,V,X,Y
9	W

Lower case letters and numerals

Width (W)	Letters/Numerals
1	i
2	l
3	j,l
4	c,f,r,t
5	a,b,d,e,g,h,k,n,o,,q,s,u,v,x,y,x
	0,2,3,5 to 9
	0,2,3,5 to 9
6	a,4

Spacing of letters: Recommended spacing between characters, a minimum spacing of baselines and minimum spacing between words as per BIS SP: 46-2003 are given below in Fig 2.

Fig 2

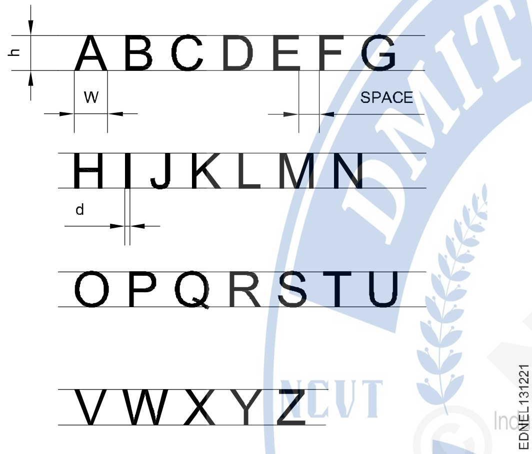


Lettering

Procedure

1 Print 10 mm single stroke capital letters and numerals in vertical style using either scale or set-square and by freehand. (Fig 1)

Fig 1



- Draw horizontal parallel lines (thin lines) of 10 mm distance.

10 mm distances denote the height of the letter.

- Mark the width of the letters recommended by BIS (IS:9609-1983)

The width of different letters in terms of `d' is as follows: `d' indicates stroke thickness i.e d: h/10.

Width (W)	Capital letters
1	I
4	J
5	C,E,F,L
6	B,D,G,H,K,N,O,P,R,S,T,U & Z
7	A,M,Q,V,X,Y
9	W

For curved letters use a smooth freehand curve.

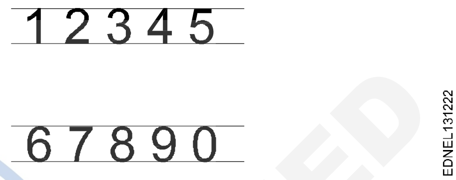
Print straight line letters using either scale or set-squares.

To maintain the uniform thickness of the line, use a conical point soft grade pencil and avoid too much sharpness.

Guidelines of both top and bottom should always be drawn with a sharp pencil.

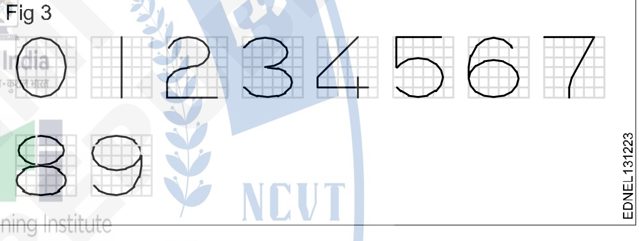
Numerals 2.1 (Fig 2)

Fig 2



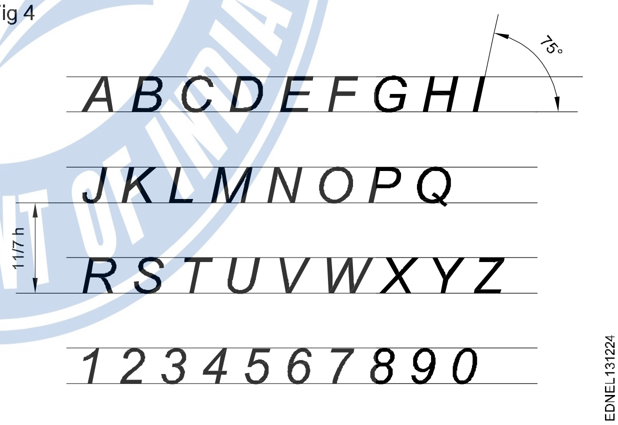
- Follow the same procedure of letters.
- `h' is height of numerals and `d' is the stroke thickness.
- Width of numerals in terms of `d' is as follows shown in square grid (Fig 3).

Fig 3



2 Print 10 mm single stroke capital letters and numerals in inclined style (Fig 4).

Fig 4



Practice the following lettering exercises in A3/A4 paper as per the given ratio

1 Single stroke inclined letters of ratio 7:6, 7:5, 7:4, 7:3, 7:1 (Fig 5)

Fig 5

2 Single stroke vertical letters of ratio 7:6, 7:5, 7.4, 7:3, 7:1 (Fig 6)

Fig 6

SINGLE STROKE VERTICAL LETTERS

EDNEL131226