ENGINEERING DRAWING & DESCRIPTIVE GEOMETRY

Syllabus

Chapter One	**:**	**Principles of Engineering Drawing**	**Engineering Drawing 1104**
Chapter Two	**:**	**Geometrical Operation**	
Chapter Three	**:**	**Dimensions**	
Chapter Four	**:**	**Projections**	
Chapter Five	**:**	**Sectional views**	**Eng. Drawing & Descriptive Geometry 1111**
Chapter Six	**:**	**Pictorial Drawing**	
Chapter Seven	**:**	**Descriptive geometry**	

References

1- FUNDAMENTALS OF ENGINEERING DRAWING **by: Warren J. Luzadder**

2- TECHNICAL DRAWING **by: Goetsch nelson chalk**

3- الـرسـم الهندسـي د. فتحي شريف

4- الـرسـم الهندسـي كتاب منهجـي

5- DESCRIPTIVE GEOMETRY **by: Yousif Nicola**

CHAPTER ONE : PRINCIPLES OF ENGINEERING DRAWING

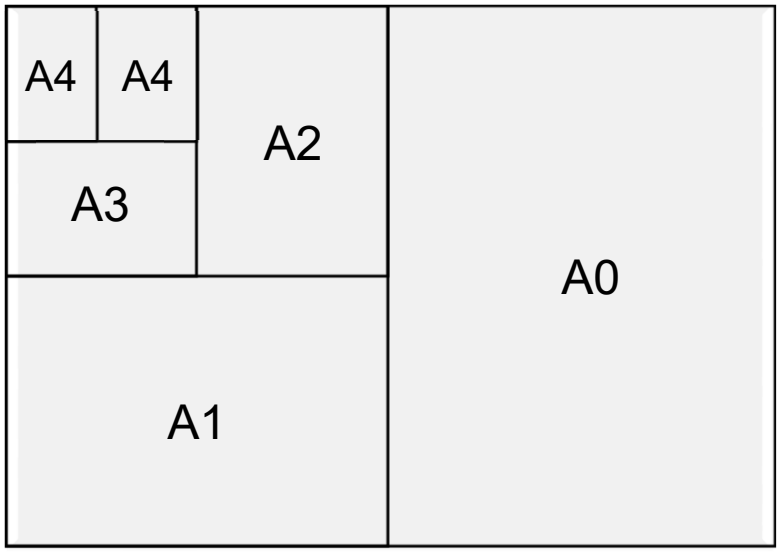
1.1 : INTRODUCTION

Engineering drawing is a formal and precise way of communicating Information about the shape, size, features and precision of physical objects. Drawing is the universal language of engineering.

1.2 : BASIC INSTRUMENTS

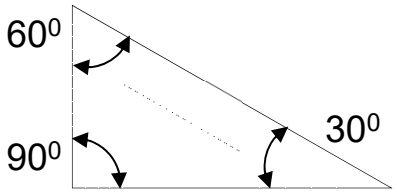
1.2.1 : Drawing Sheets

Symbol	Sheet Dimensions
A0	(1089 X 841) mm
A1	(841 X 594) mm
A2	(594 X 420) mm
A3	(420 X 297) mm
A4	(297 X 210) mm
A5	(210 X 148) mm

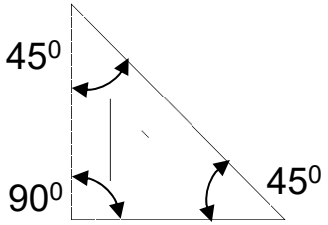


1.2.2 : T-SQUARE &TRINGLES

T - SQUARE

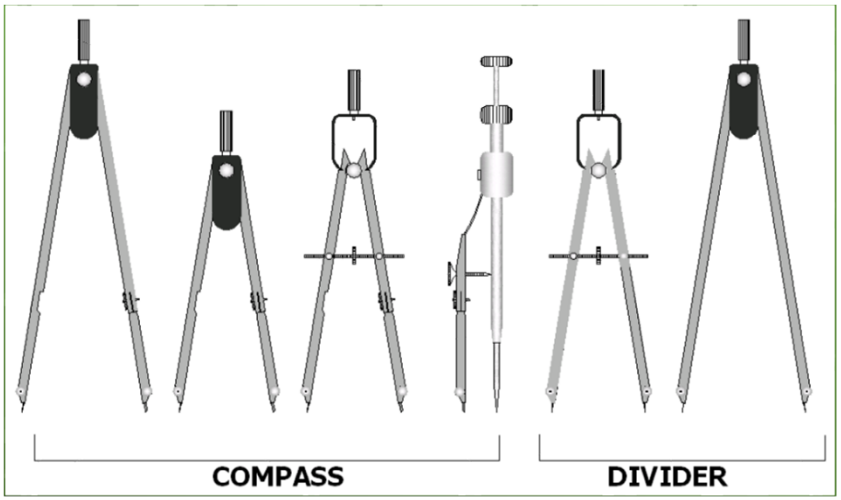


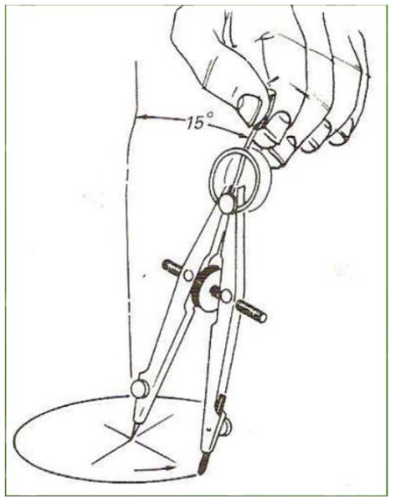
30^0 and 60^0 Triangle

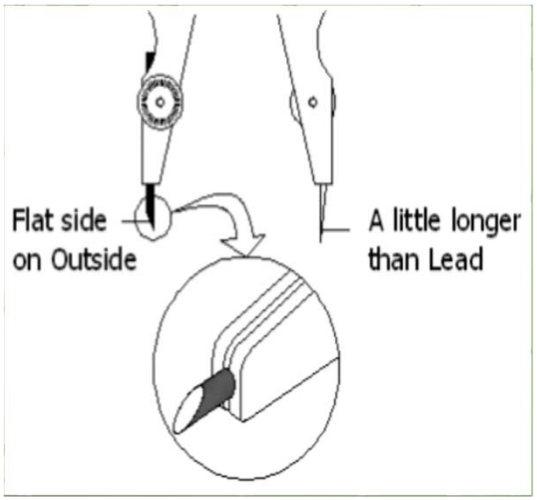


45^0 Triangle

1.2.3 : COMPASS AND DIVIDERS

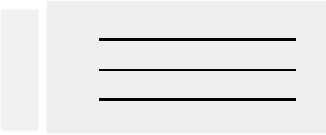






1.2.4 : PENCILS AND ERASERS

WOODEN PENCILS

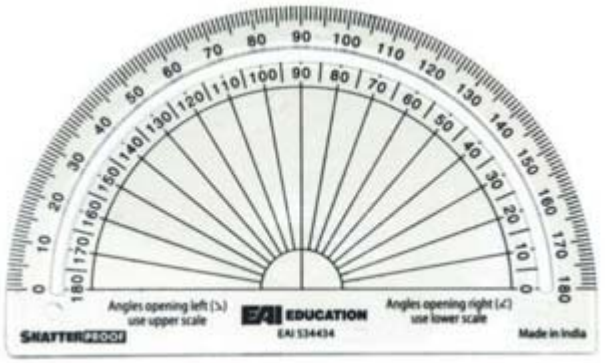


ERASER

MECHANICAL PENCILS (0.5 OR 0.7) mm

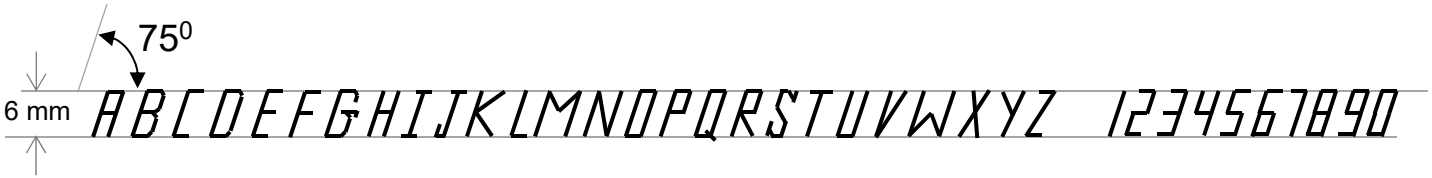
1.2.5 : TAPES AND SCALES

1.2.6 : PROTRACTOR

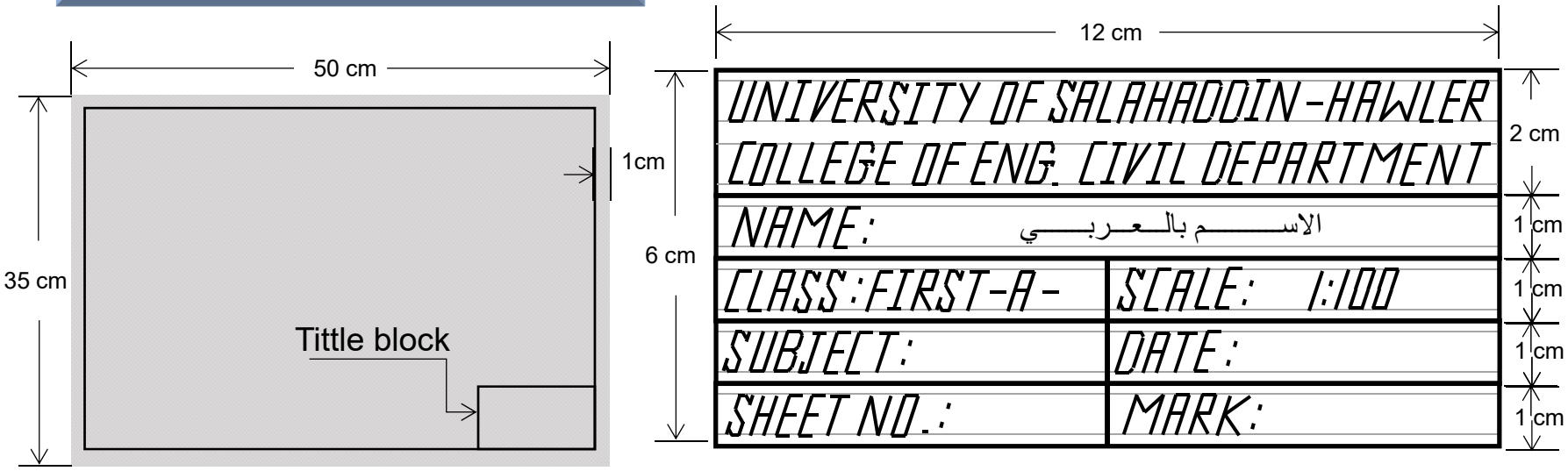


1.3 : LETTERING

In Engineering drawing there are dimensions and notes that are written on the sheet and must be clear , have convenient size and easy to read, letters and Numbers must be written in Engineering way.



1.4 : DRAWING SHEET PAPER



Tittle block

1.5 : TYPES OF LINES

Visible outline (Full Line)

Hidden Line (Dashed Line)

Break Line

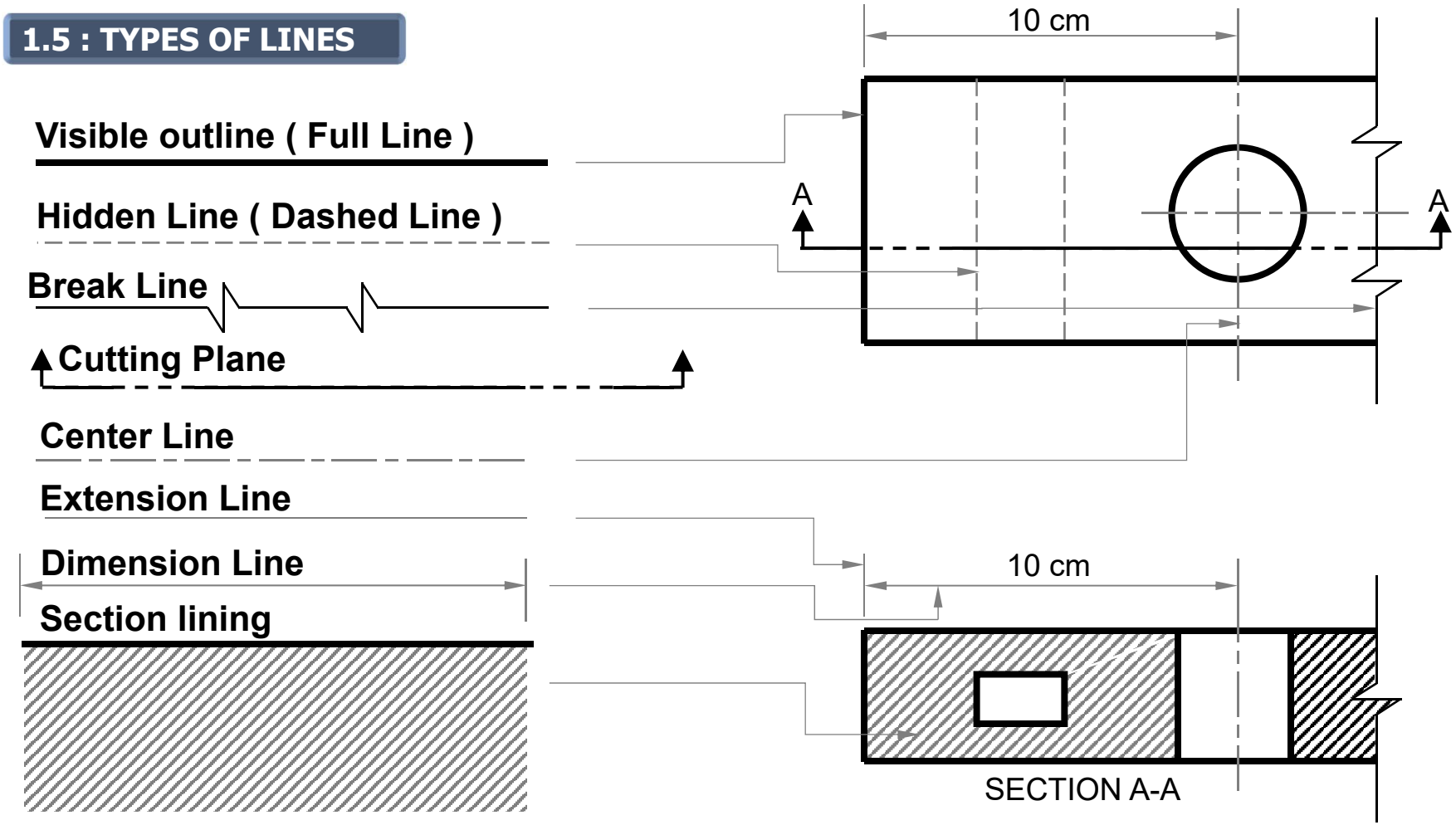
Cutting Plane

Center Line

Extension Line

Dimension Line

Section lining



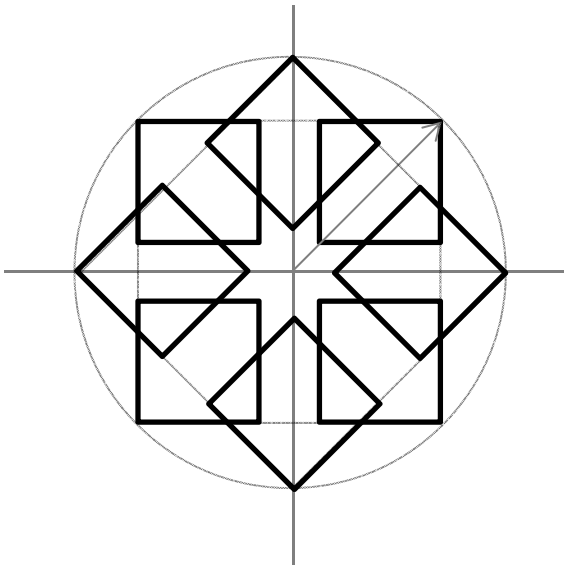
Note:

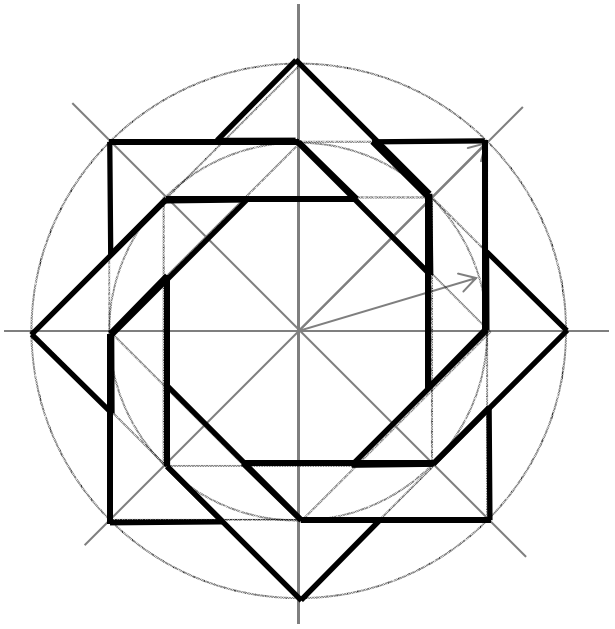
1- For lines have spacing, the space should be approximately (1) mm.
2- For Hidden line the dashes must be approximately (2 – 8) mm.
3- For Center line the long dashes must be approximately (5 – 20) mm and the dashes must be approximately (2) mm .

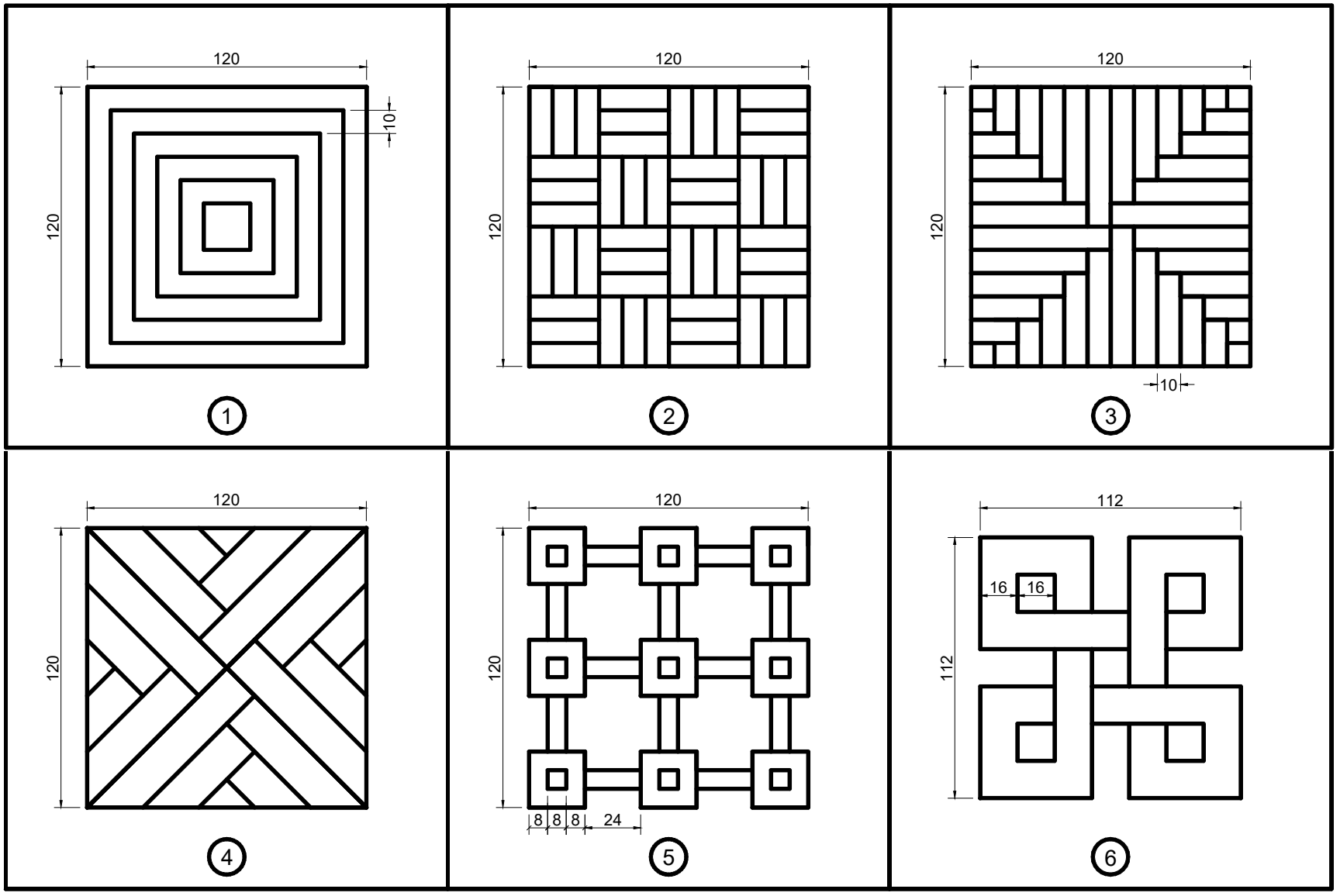
1.6 : SCALES

The Scales used in engineering practice are :

Full size scale	Reducing scale	Enlarging scale
1 : 1	1 : 5 1 : 10 1 : 20 1 : 25 1 : 50 1 : 100	10 : 1 5 : 1 2 : 1



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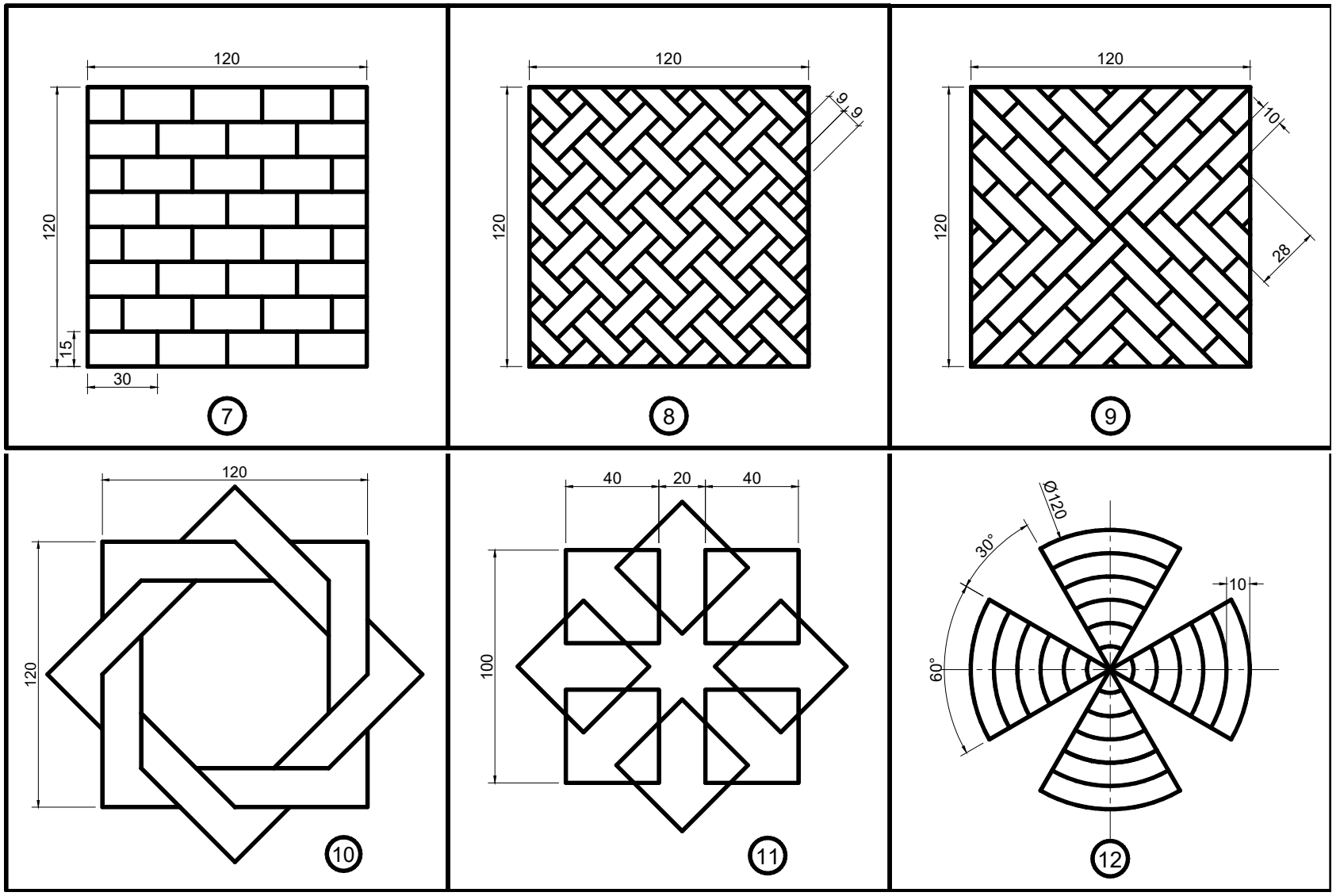
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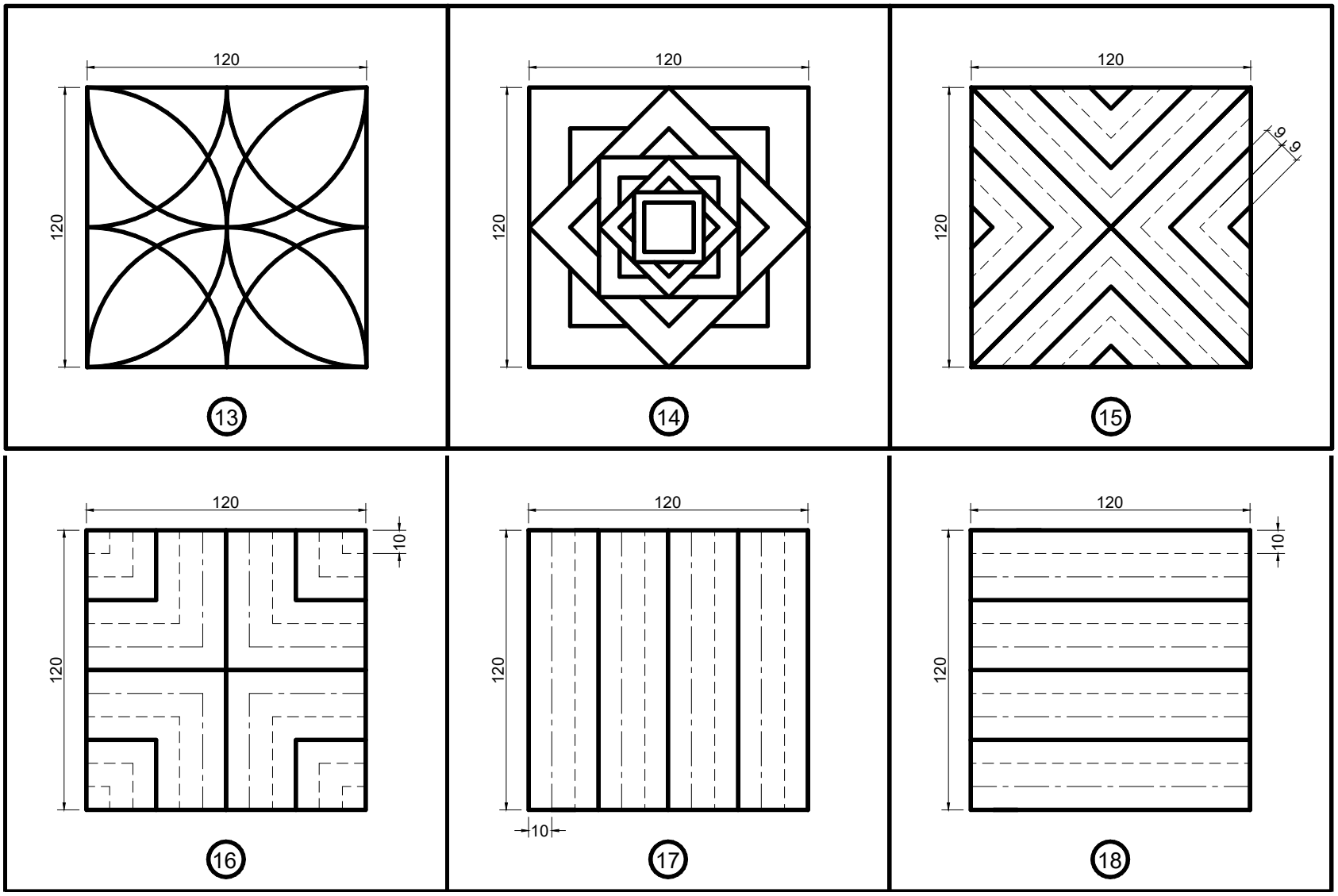
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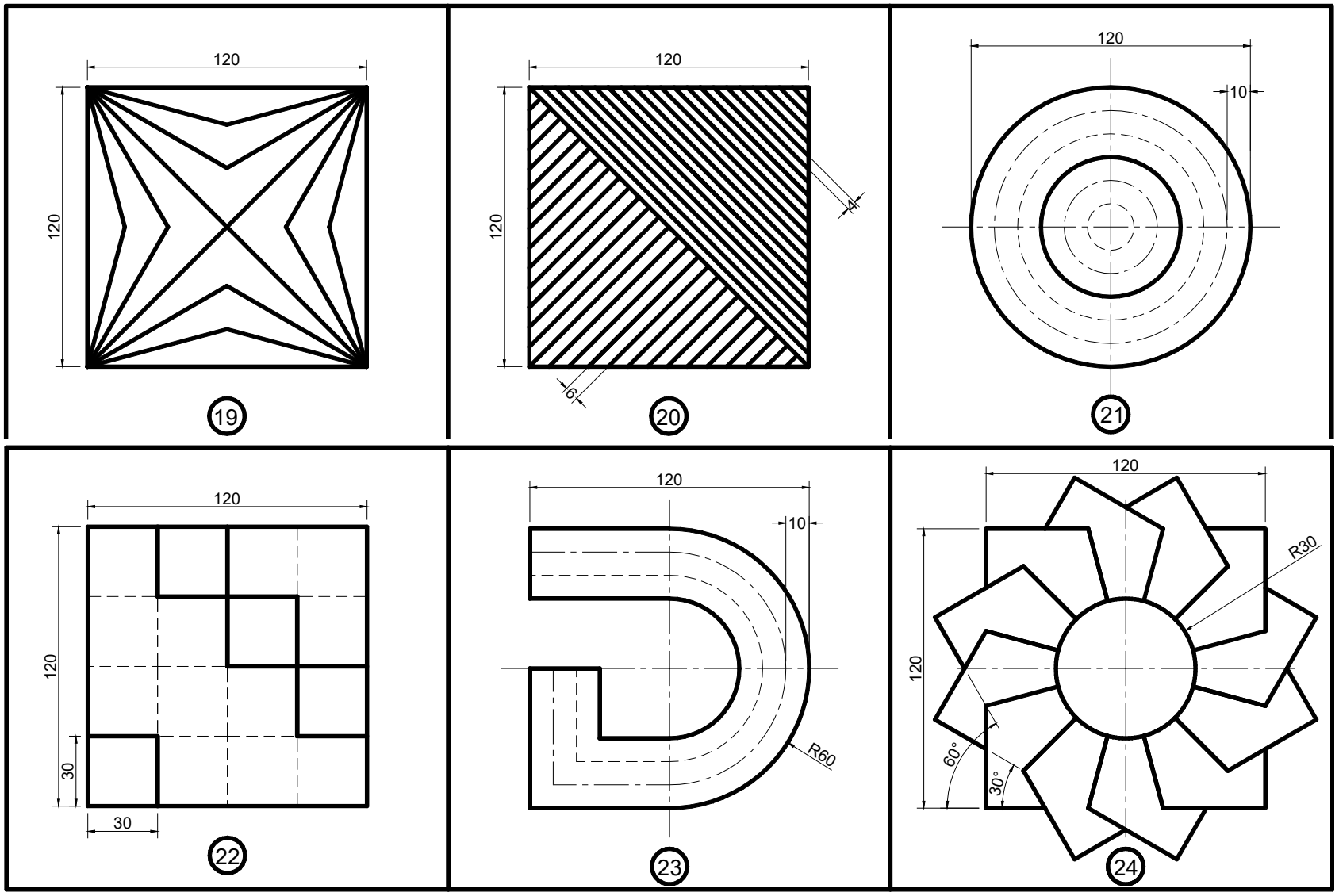
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24

CHAPTER TWO: GEOMETRICAL OPERATION

2.1 : INTRODUCTION

Geometrical operation means drawing engineering shapes using the drawing instruments only, without calculation.

2.2 : GEOMETRICAL OPERATIONS

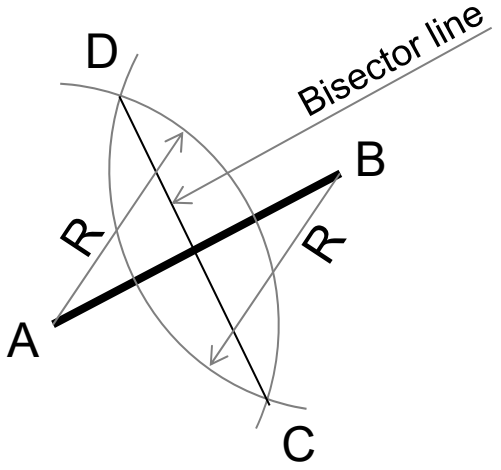
Most geometrical operation used for engineering drawing consist of The following operations :

2.2.1 : BISECTING A STRIGHT LINE

Given : line AB

1-Draw two arcs with R > AB/2 from Point A & B to intersect in C & D

2- Draw a straight line from C to D Which is a bisector line



2.2.2 : DIVIDING A STRAIGHT LINE IN TO A GIVEN NUMBER OF EQUAL PARTS

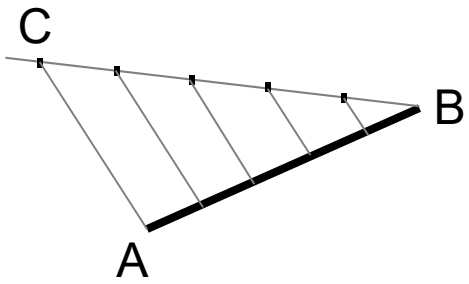
Given : Line AB (5 Parts)

1- Draw an auxiliary line like BC with a convenient angle with AB.

2- locate on BC the 5 equal part by divider with any convenient dimension.

3- Draw line AC.

4- Draw divider lines from located point on BC Parallel to AC

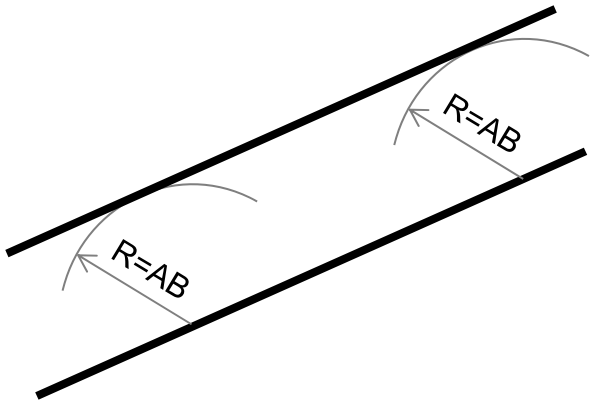


2.2.3 : DRAWING A STRAIGHT LINE PARALLEL TO ANOTHER LINE

Given : Straight line , distance AB

1- In any two points on a straight line (have enough Distance from each other) draw two arcs with R=AB

2- Draw a line tangent to Two arcs.

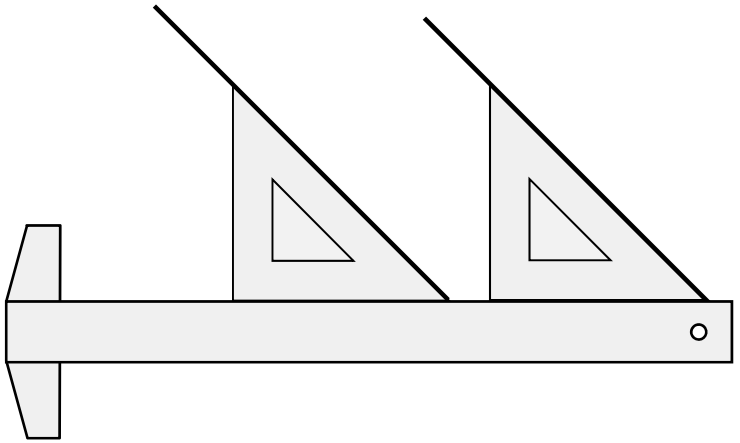


2.2.4 : DRAWING A STRAIGHT LINE // TO ANOTHER USIG T-SQUARE & TRIANGLE

Given : Straight line , Given distance

1- Put the triangle exactly on the given line

2- Put the T-square beside the triangle ,
Hold the T- square & move the triangle
To the desired location .



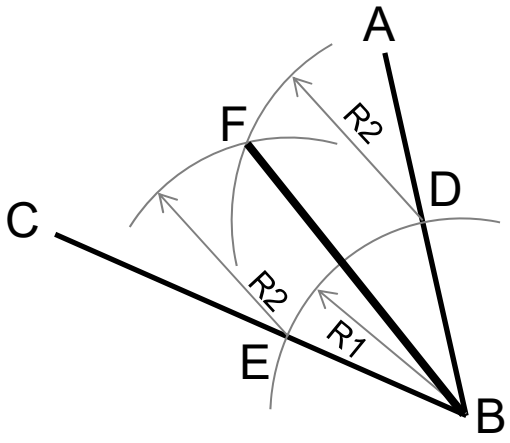
2.2.5 : BISECTING AN ANGLE

Given : Line AB , BC and angle ABC

1- Draw an arc with a convenient radius
(R1) from B to intersect AB & CB from
D & E

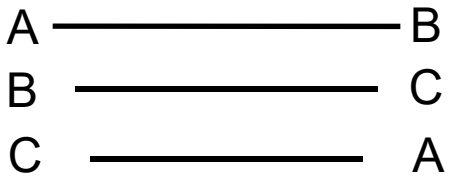
2- From D & E Draw an arc (R2) to intersect in F

3- Draw BF Which is the bisector line of angle.



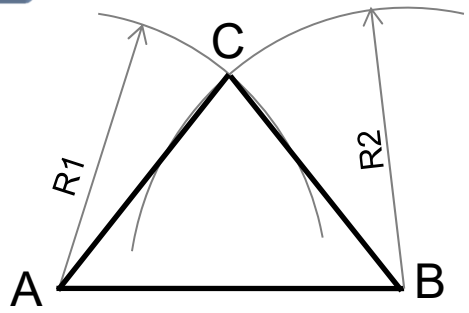
2.2.6 : DRAWING A TRIANGLE WITH KNOWING THE THREE SIDES

Given : Triangle sides



1- Draw one side for Example AB

2- From two points A & B draw Two arcs R1 = CA & R2 = BC to Intersect in C



3- Draw AC & BC to complete the Triangle

2.2.7 : DRAWING A REGULAR PENTAGON

Given : One side length of pentagon AB

1- Bisect AB & Find Middle of AB (O)

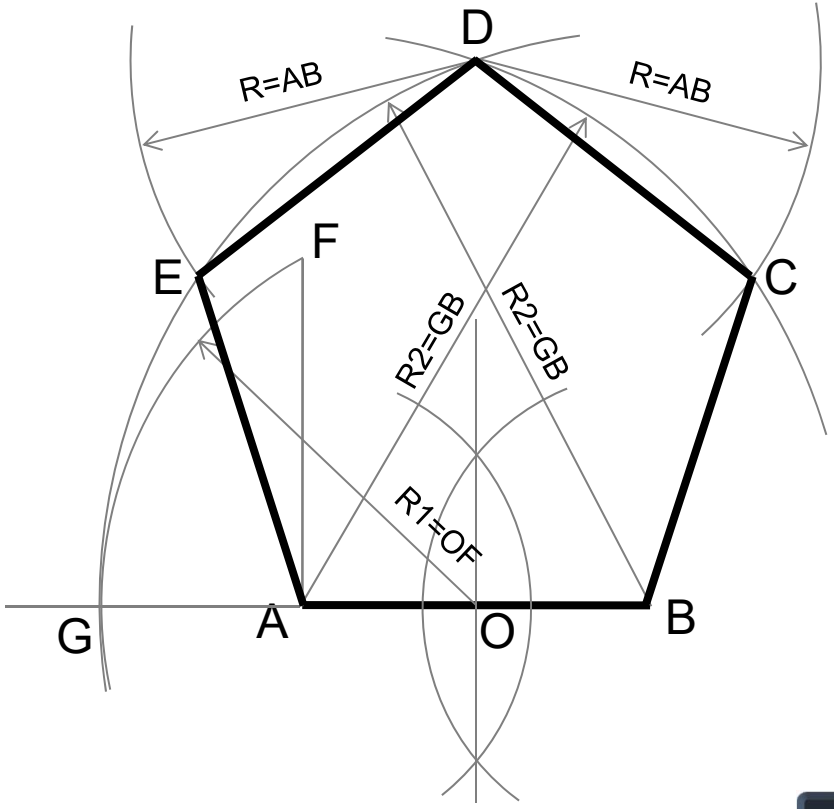
2- Draw AF = AB (AF is perpendicular to AB)

3- From (O) draw an arc R1 = OF to intersect With the extension of AB in (G) .

4- From A & B Draw two arcs R2 = GB to Intersect in D

5- From (D) Draw two arcs R=AB to Intersect with previous drawn Arc R2 In two Points E and C

6- Draw lines AB,BC,CD,DE and EA to Complete the Pentagon

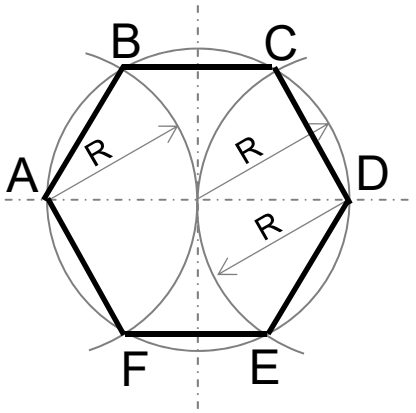


2.2.8 : DRAWING HEXAGON INSIDE THE CIRCLE

Given : Circle Radius = R

1- From two points A & D draw two arcs with radius =R To intersect with circle in points F,B,E and C

2- Draw lines AB,BC,CD,DE,EF and FA to complete the Hexagon.



2.2.9 : DRAWING PENTAGON INSIDE THE CIRCLE

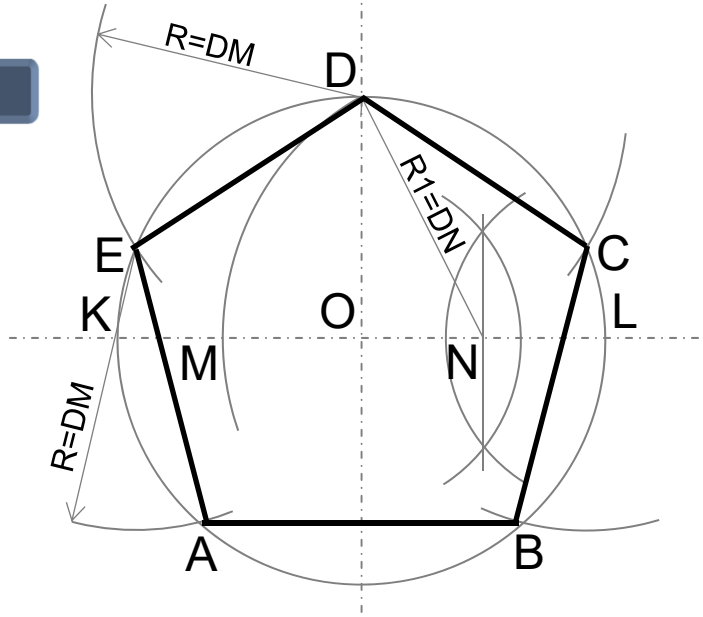
Given : Circle with diameter = KL

1- Bisect line OL in (N)

2- From N draw an arc with radius R1 = DN to Intersect with the horizontal center line in M

3- Divide the circle to five equal parts by Distance = DM

4- Draw line AB , BC , CD , DE , EA to Complete the pentagon.

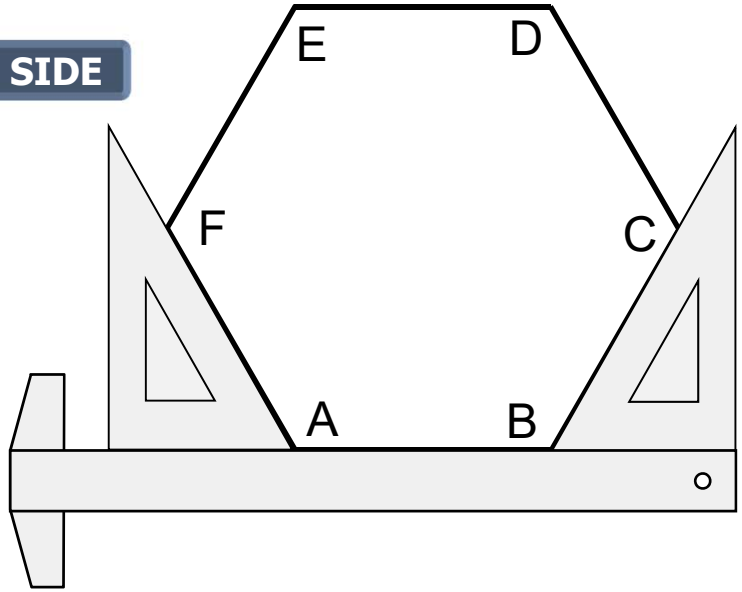


2.2.10 : DRAWING HEXAGON WITH KNOWING ONE SIDE

Given : One side length AB.

1- Using T-square and (30 & 60) degree triangle Draw AF & BC (AF = BC = AB).

2- From two points F and C Draw CD and EF (CD = EF = AB) then draw DE to complete the Hexagon



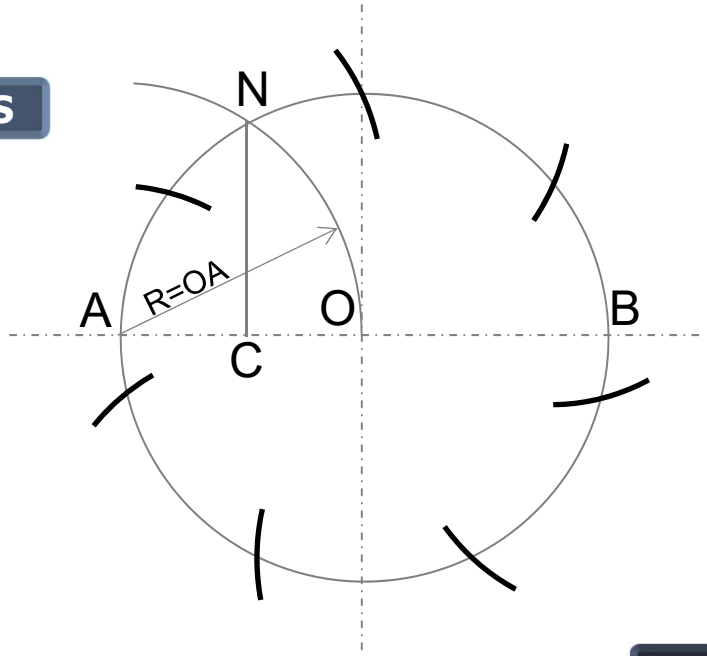
2.2.11 : DIVIDING A CIRCLE IN TO SEVEN EQUAL PARTS

Given : Circle with Diameter = AB

1- Draw arc with R = OA (From A) to cut circle in N.

2- Draw line NC (NC is perpendicular to AB in C)

3- Open the compass by distance = NC to divide The circle in to seven equal parts.

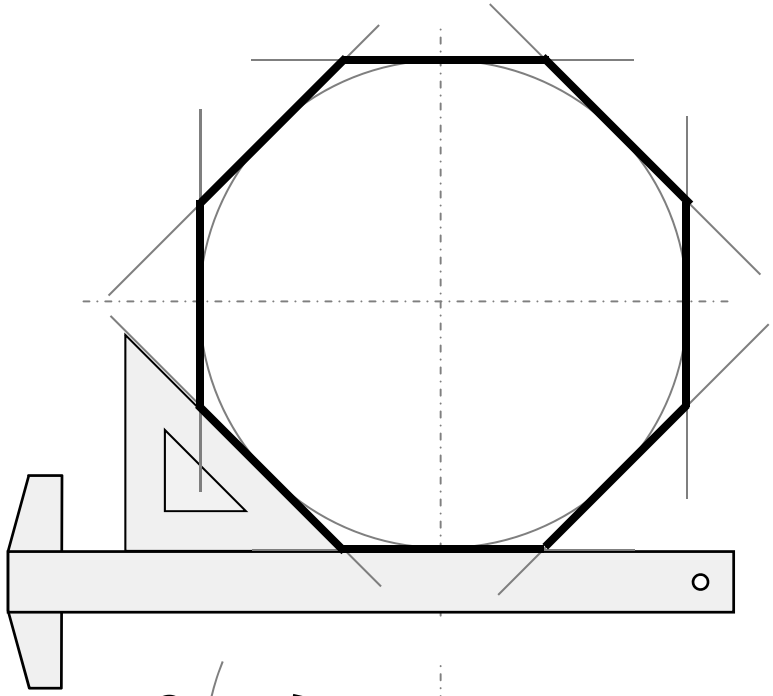


2.2.12 : DRAWING AN OCTAGON

Given : Distance between two sides

1- Draw a circle with Diameter = Distance Between two parallel sides

2- Using T-square and 45 degree triangle Draw other sides tangent to the circle as Shown.



2.2.13 : DIVIDING CIRCLE INTO 8 EQUAL PARTS

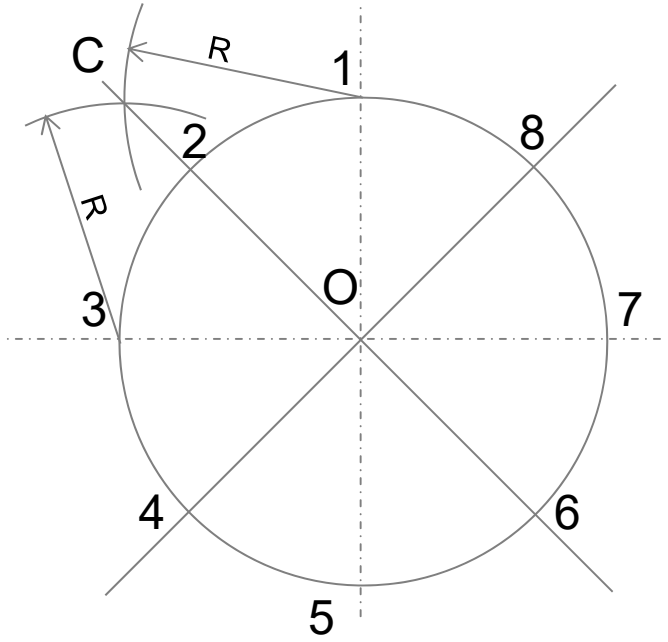
Given : Circle with radius = R

1- Draw the horizontal and vertical center lines Dividing circle into 4 equal parts.

2- From two points 1 & 3 draw two arcs with A convenient radius to intersect in C

3- Draw OC and extend it to cut circle in 6 & 2

4- By the same procedure find points 8 and 4



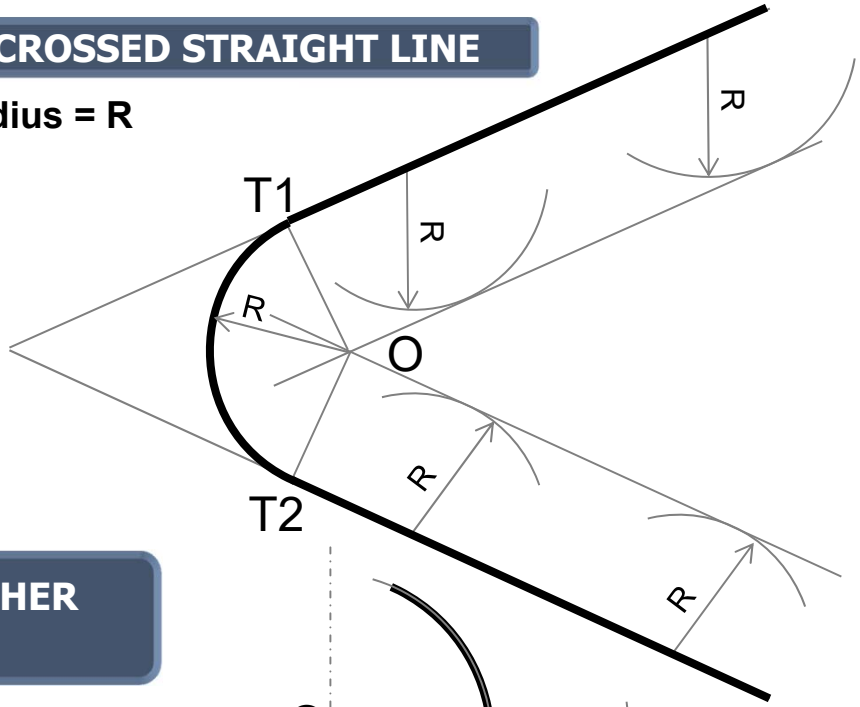
2.2.14 : DRAWING AN ARC TANGENT TO TWO CROSSED STRAIGHT LINE

Given : Two lines crossed by an angle and arc radius = R

1- Draw the two parallel lines by distance R to Intersect in O.

2- From (O) draw the two perpendicular Lines finding T1 and T2

3- From (O) draw an arc by radius = R Starting from T1 to T2.



2.2.15 : DRAWING AN ARC TANGENT TO ANOTHER ARC AND ALSO TAGENT TO A STRAIGHT LINE

Given : An Arc and a straight line

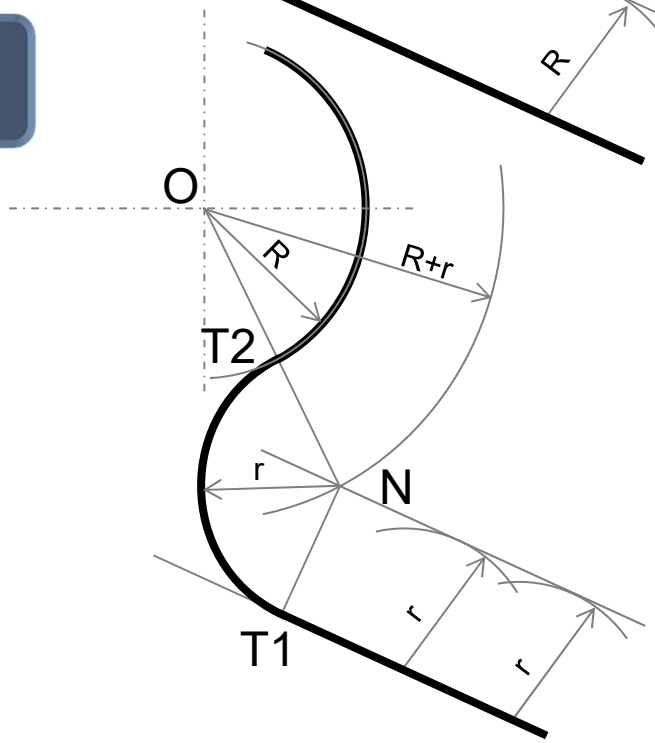
1- Draw parallel line for the given line by (r)

2- Draw an arc From (O) by radius (R + r) , N is the intersection point of arc and line.

3- From (N) draw perpendicular line of given Line and find T1

4- Draw ON and find tangent point T2.

5- Draw arc with radius = r from center point N Starting from T1 and T2.



2.2.16 : DRAWING AN ARC TANGENT TO TWO ARCS

There are three cases to draw an arc tangent to two other arcs

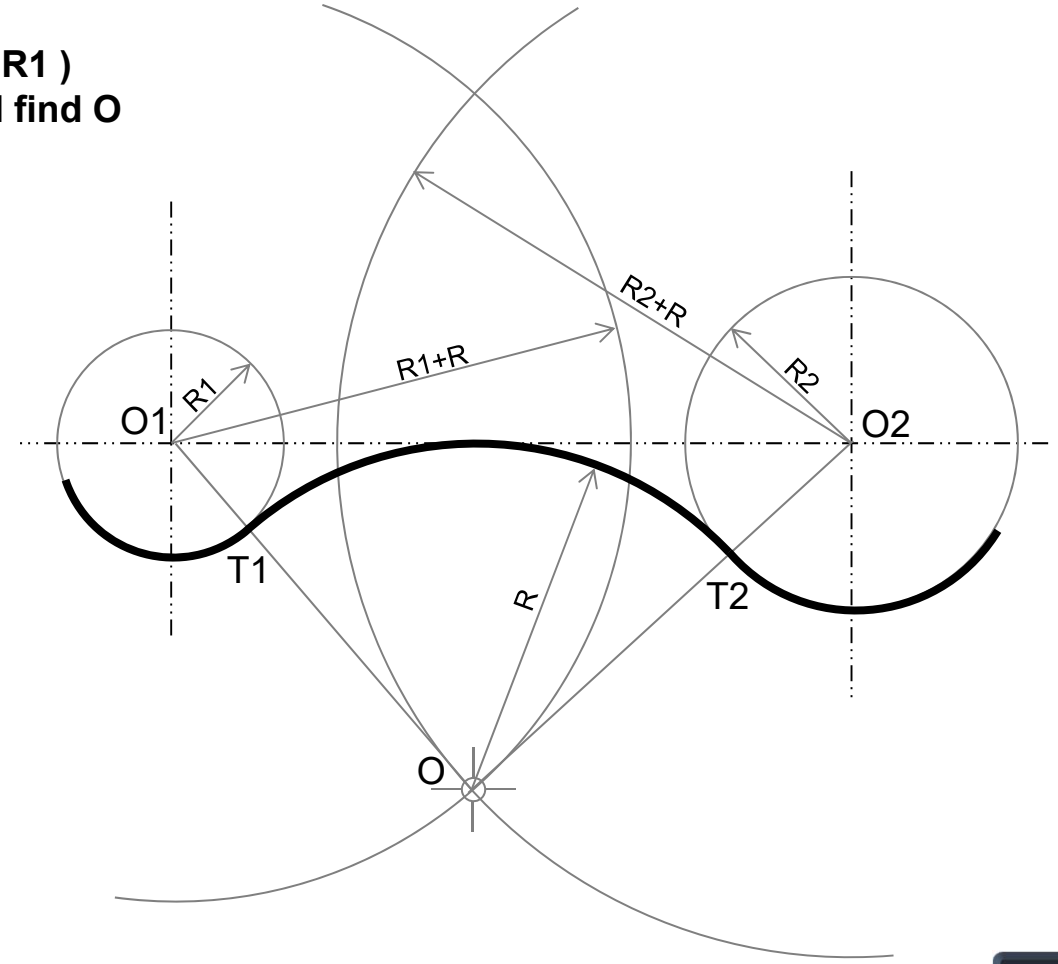
A: OUT TO OUT CASE

Given: Two arcs with R1&R2 From O1&O2 and R

1- Draw to arcs from O1 with radius (R+R1)
And from O2 with radius (R+R2) and find O

2- Draw OO1 and OO2 to find the two Tangent points T1 and T2

3- From O draw an arc with radius R Starting from T2 to T1



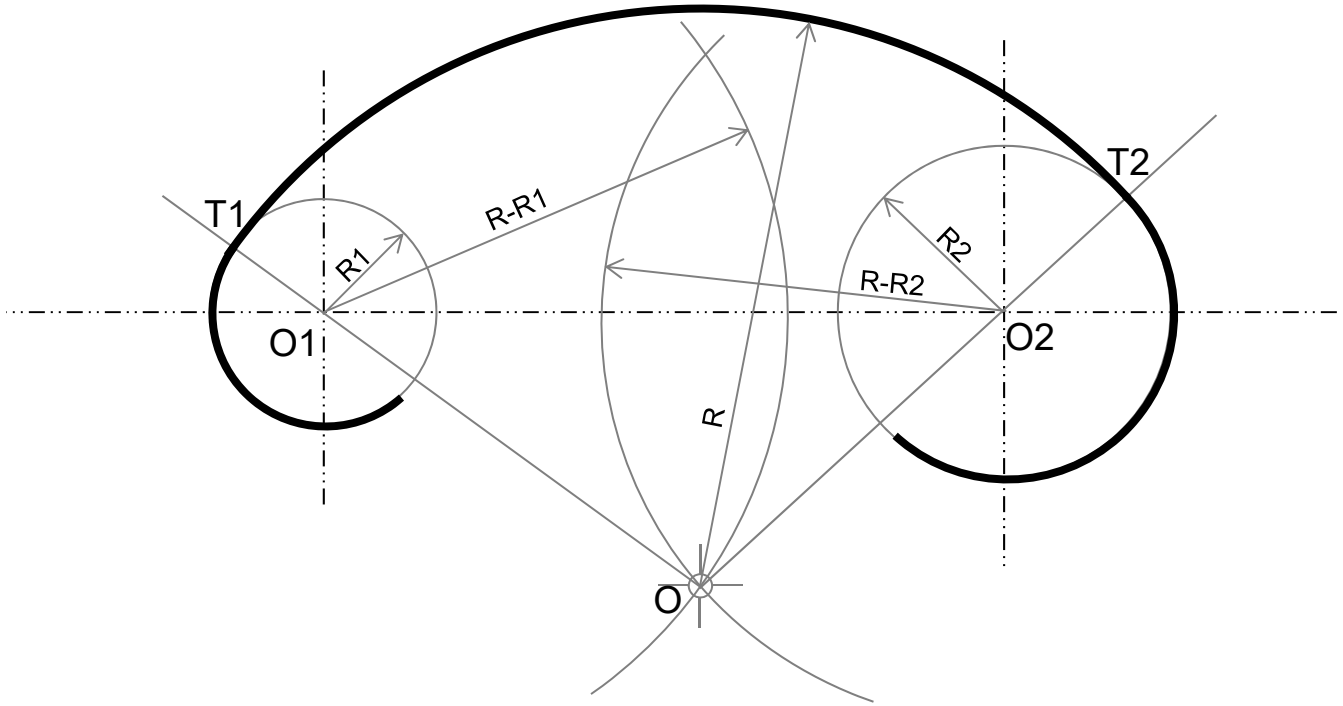
B: IN TO IN CASE

Given: Two arcs with R1 & R2 From O1 & O2 and R

1- Draw to arcs from O1 with radius (R-R1)
And from O2 with radius (R-R2) and find O

2- Draw OO1 and OO2 and extend it to find the two
Tangent points T1 and T2

3- From O draw an arc with radius
R Starting from T2 to T1



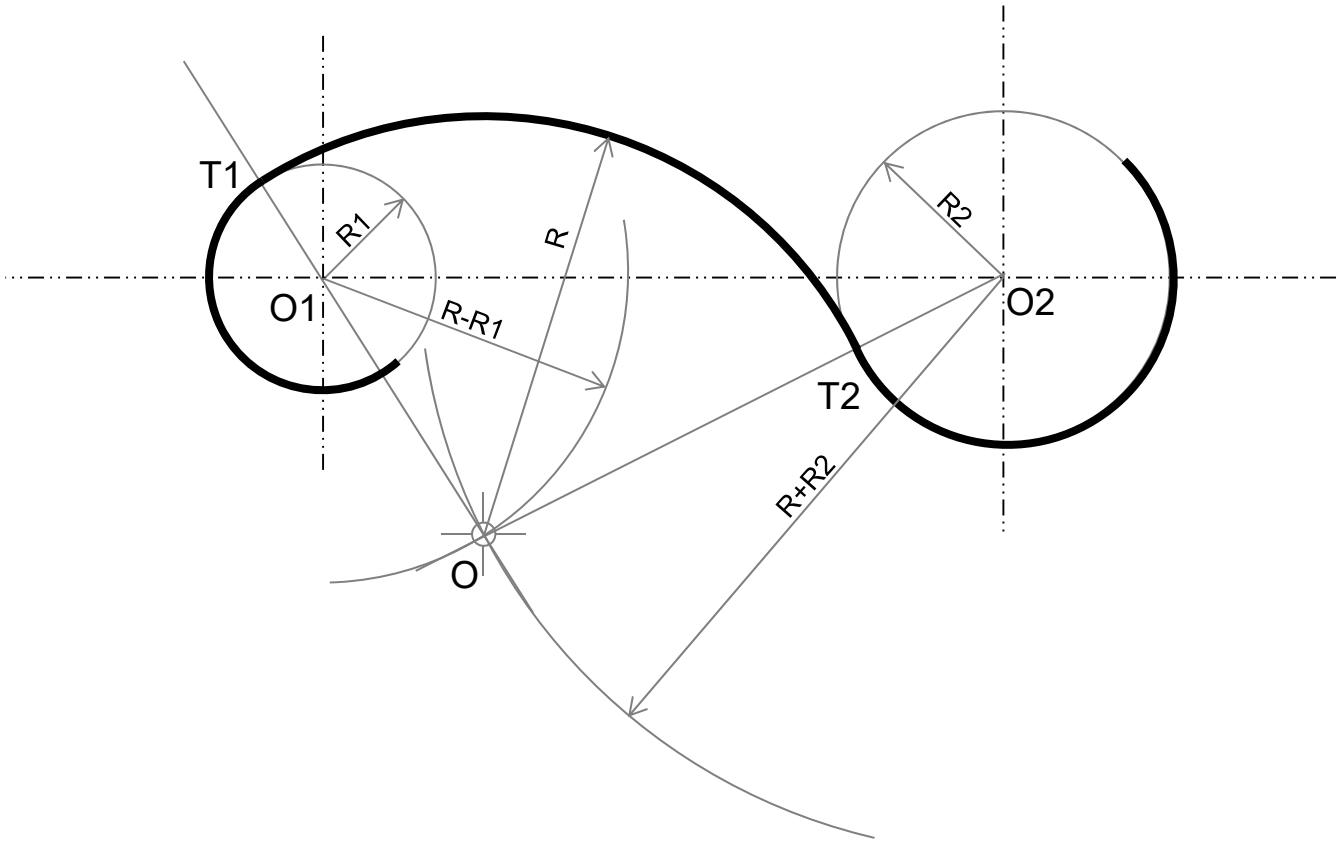
C: IN TO OUT CASE

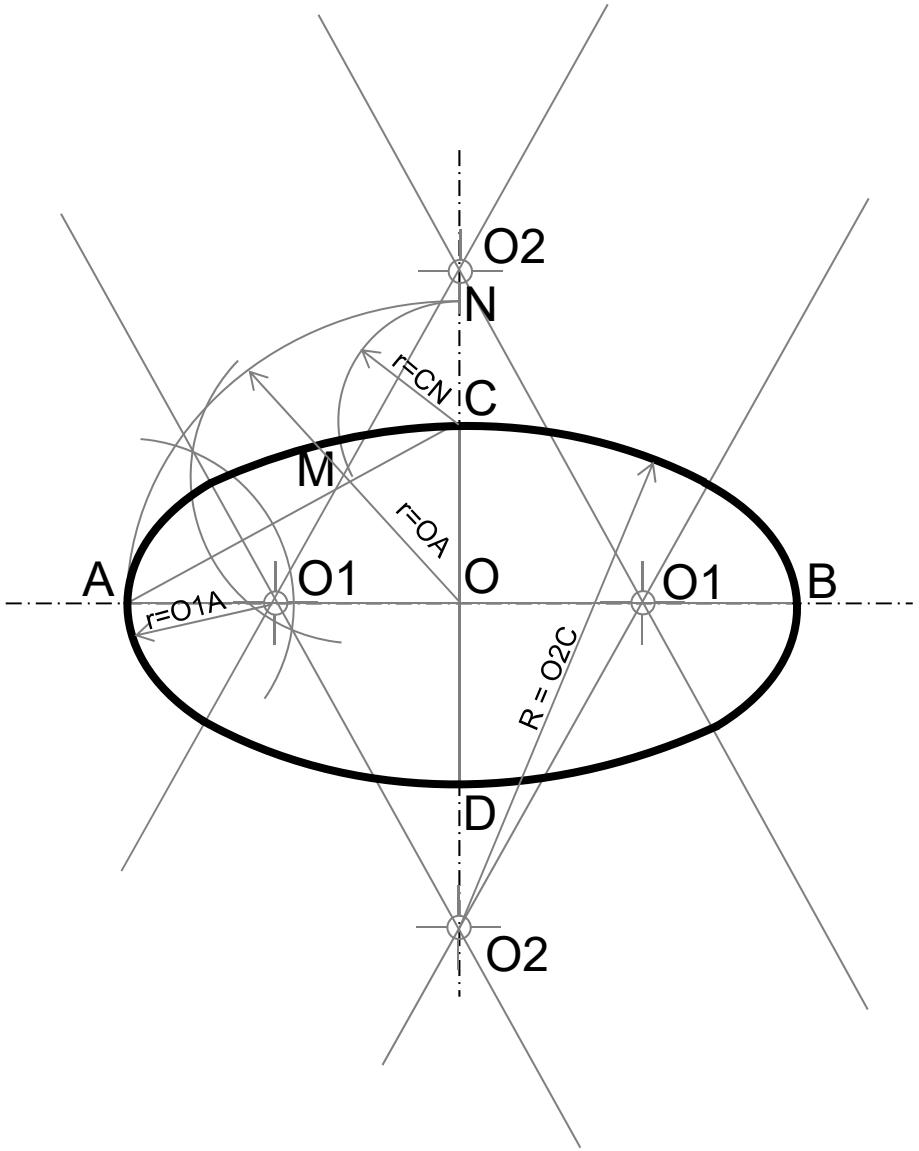
Given: Two arcs with R1 & R2 From O1 & O2 and R

1- Draw to arcs from O1 with radius (R-R1)
And from O2 with radius (R+R2) and find O

2- Draw OO1 and extend it to find T1 and OO2
To find the tangent point T2

3- From O draw an arc with radius R Starting from T2 to T1





2-2-17: DRAWING ELLIPS

Draw the Two Axis AB and CD

Draw from Origin an arc with r = OA to intersect with extension Line DC in N (AO = NO)

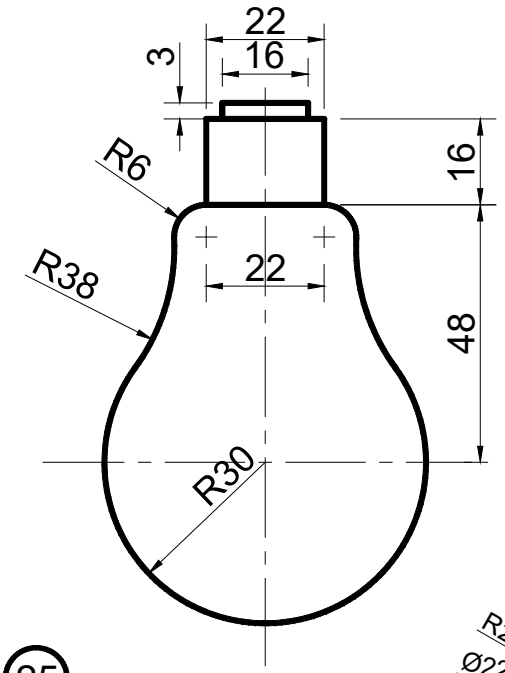
Draw Line AC

From point C Draw an Arc with r = CN to cut Line AC in M (CM = CN)

Draw a Bisector line to AM to Intersect with AB in O1 and Intersect with CD (extension Of CD) in O2

Find O1 & O2 of other Sides

Using 4-Center Method Draw An Ellipse R = O2C , r = O1A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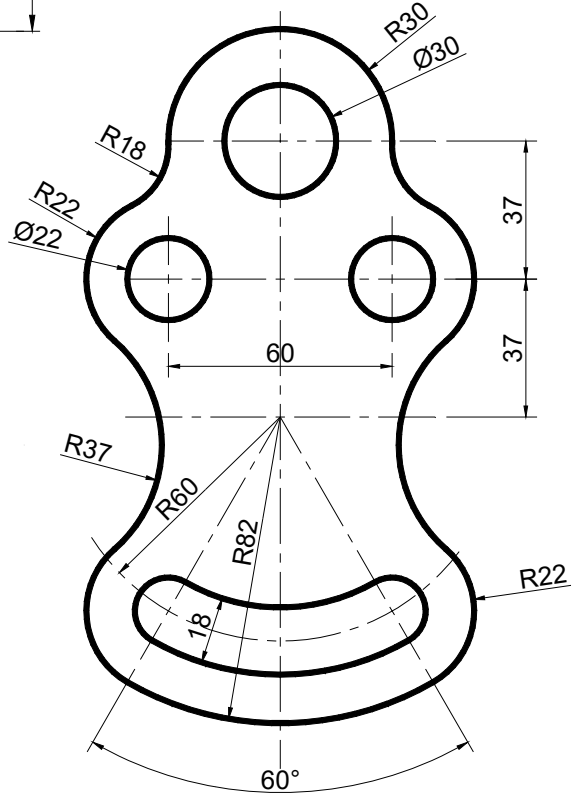
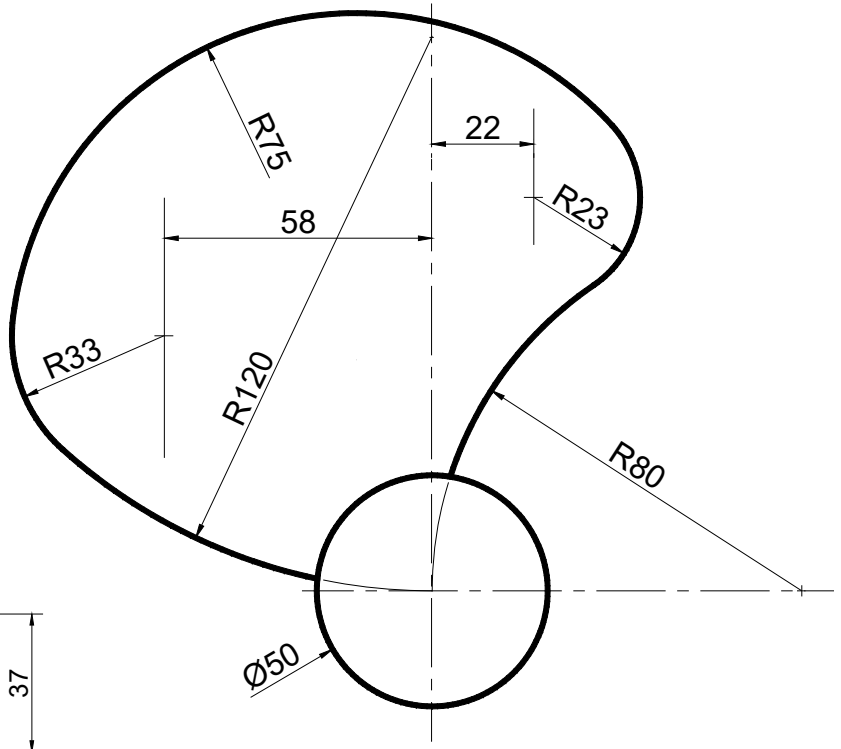
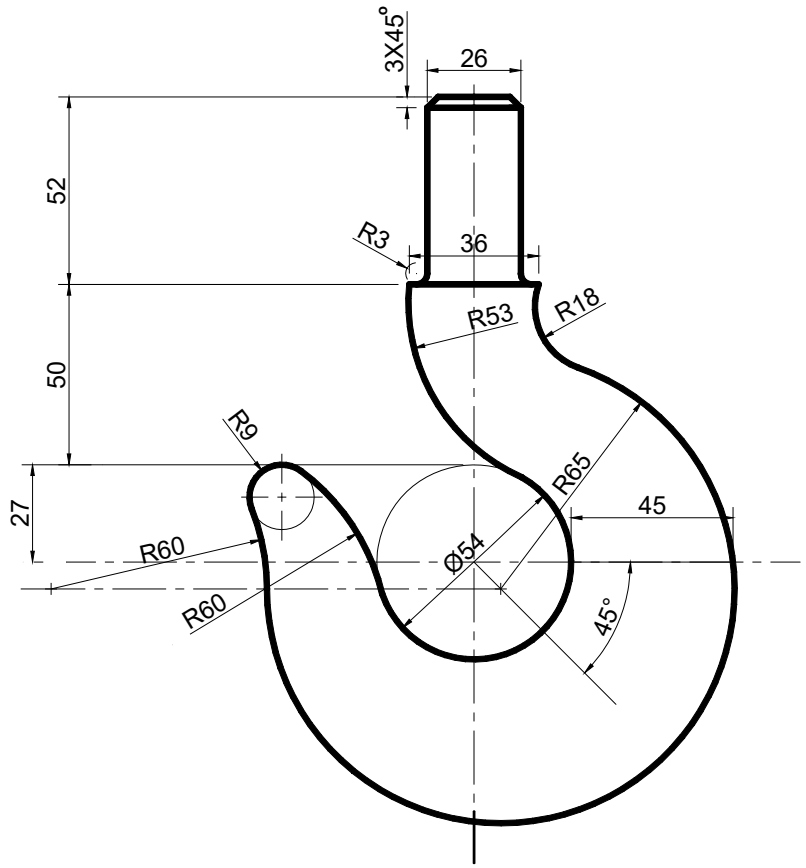
25


R30
Ø30
R18
R22
Ø22
37
37
60
R37
R60
R82
R22
18
60°

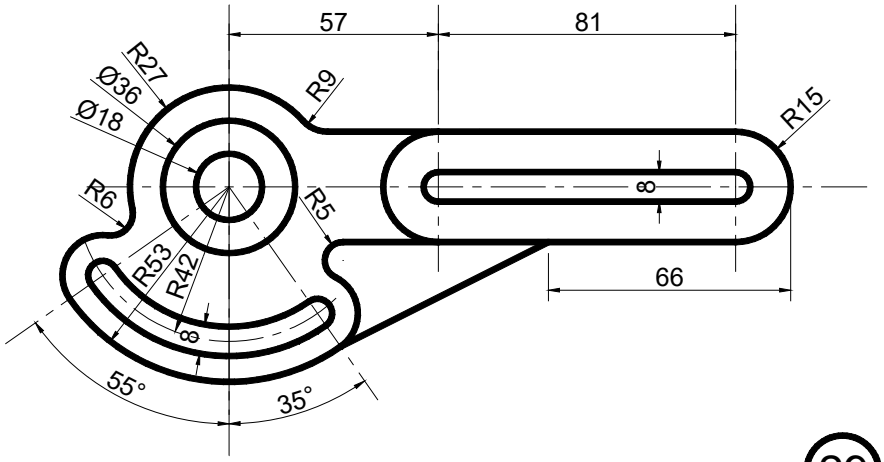
26


R75
22
R23
58
R33
R120
R80
Ø50

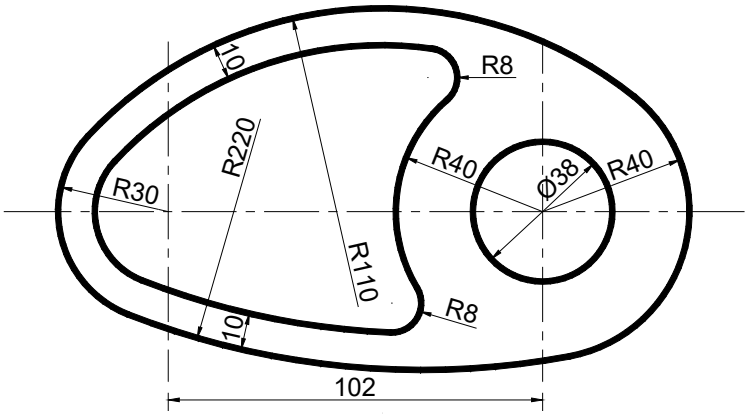
27


3X45°
26
52
R3
36
R53
R18
50
R9
27
R60
R60
Ø54
R65
45
45°

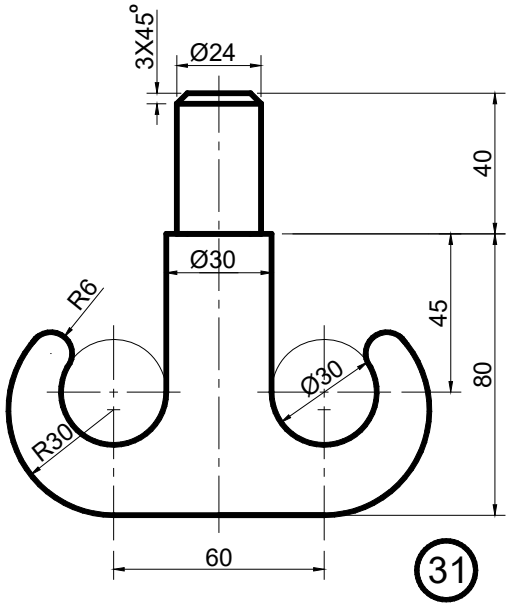
28


57
81
R27
Ø36
Ø18
R9
R15
R6
R5
8
R53
R42
66
8
55°
35°

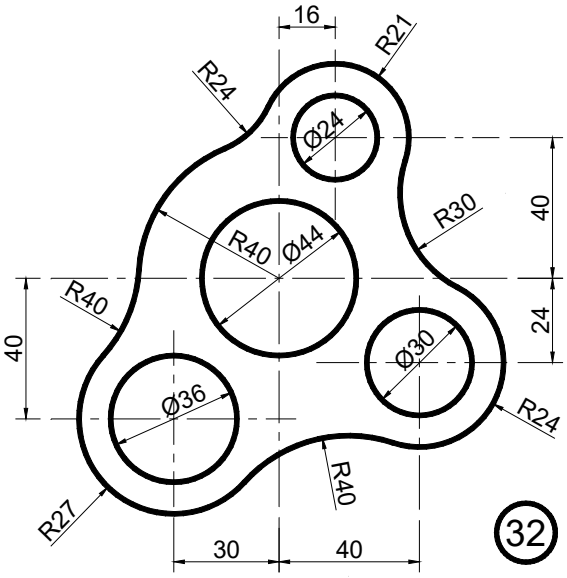
29


10
R8
R220
R40
Ø38
R40
R30
R110
R8
10
102

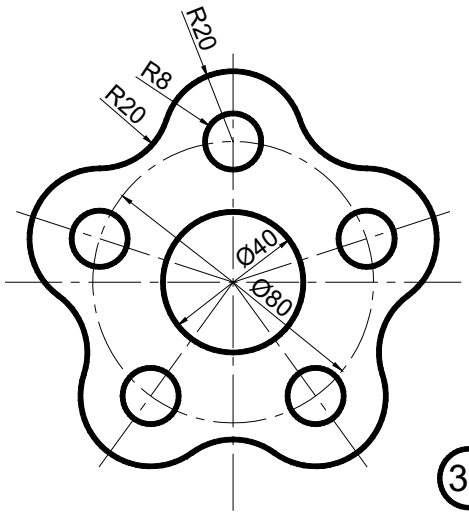
30


3X45°
Ø24
40
Ø30
45
R6
Ø30
80
R30
60

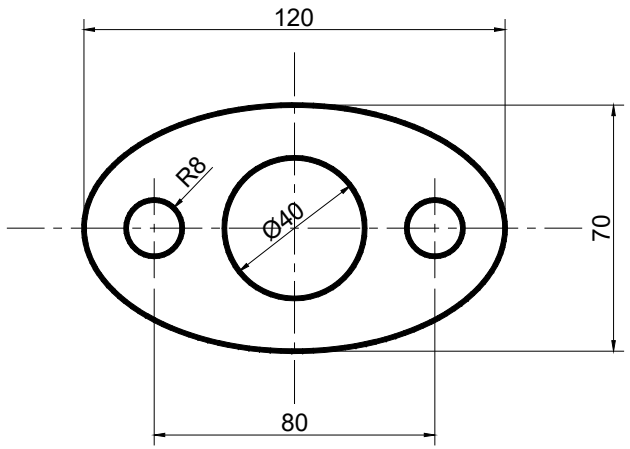
31


16
R21
R24
Ø24
R30
40
R40
Ø44
R40
24
Ø30
Ø36
R24
R40
R27
30
40

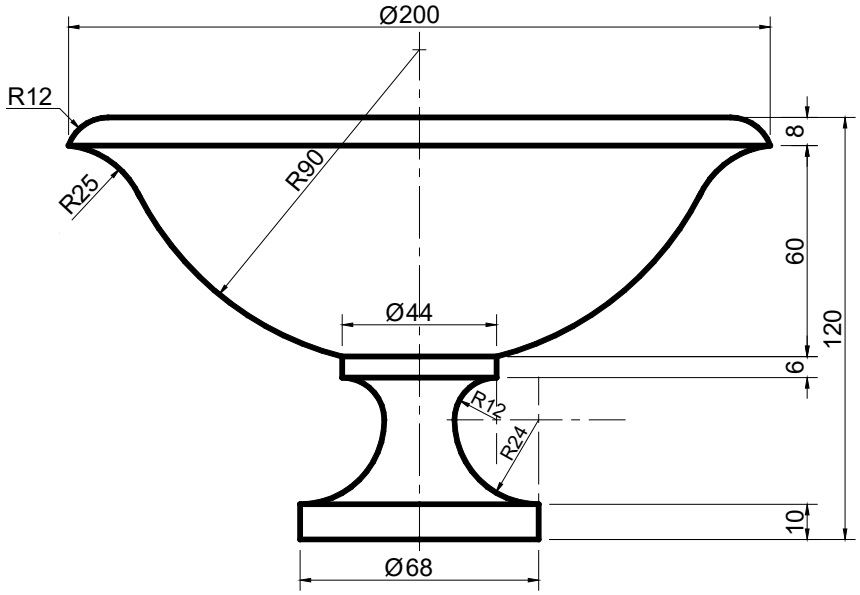
32


R20
R8
R20
Ø40
Ø80

33


120
R8
Ø40
70
80

34


Ø200
R12
8
R90
R25
60
120
Ø44
6
R12
R24
10
Ø68

35

CHAPTER THREE : DIMENSIONS

3.1 : INTRODUCTION

A detail drawing, in addition to giving the shape of a part, must furnish information such as the distance between surfaces, location of holes, kind of finish, type of material and number required.

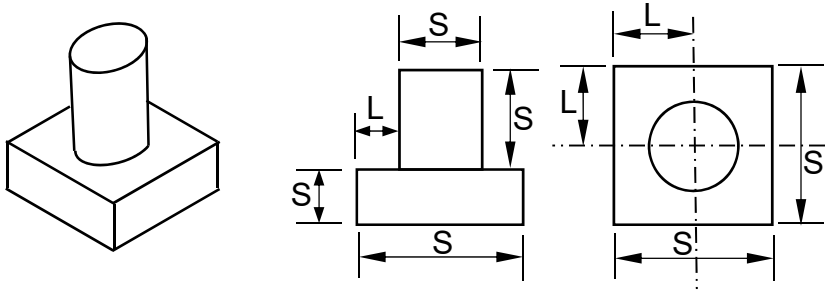
3.2 : THEORY OF DIMENTIONING

Any part may be dimensioned easily and systematically by dividing it into simple geometric solid. Even complicated parts, when analyzed, are usually found to be composed principally of Cylinders, Pyramids, Prisms……

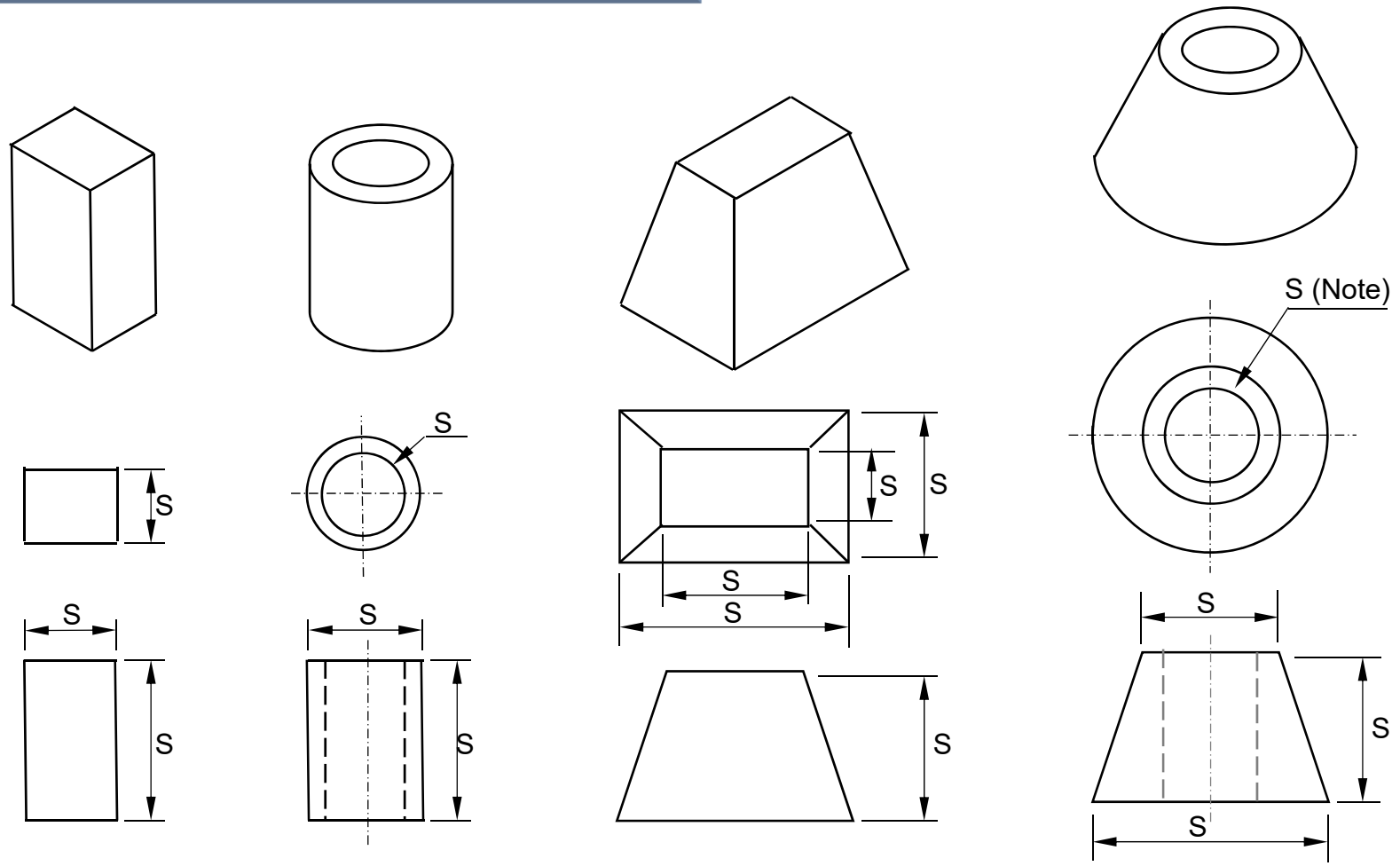
3.2.1 : SIZE DIMENSION AND LOCATION DIMENSION

Size dimension (S) give the size of a piece, component part.

Location dimension (L) fix the relationship of the component part.



3.3 : DIMENSIONS GEOMETRIC SHAPE



PRISM **CYLINDER** **PYRAMID** **CONE**

3.4 : DIMENSION COMPONENT

Projection lines

Dimension line and Arrow heads

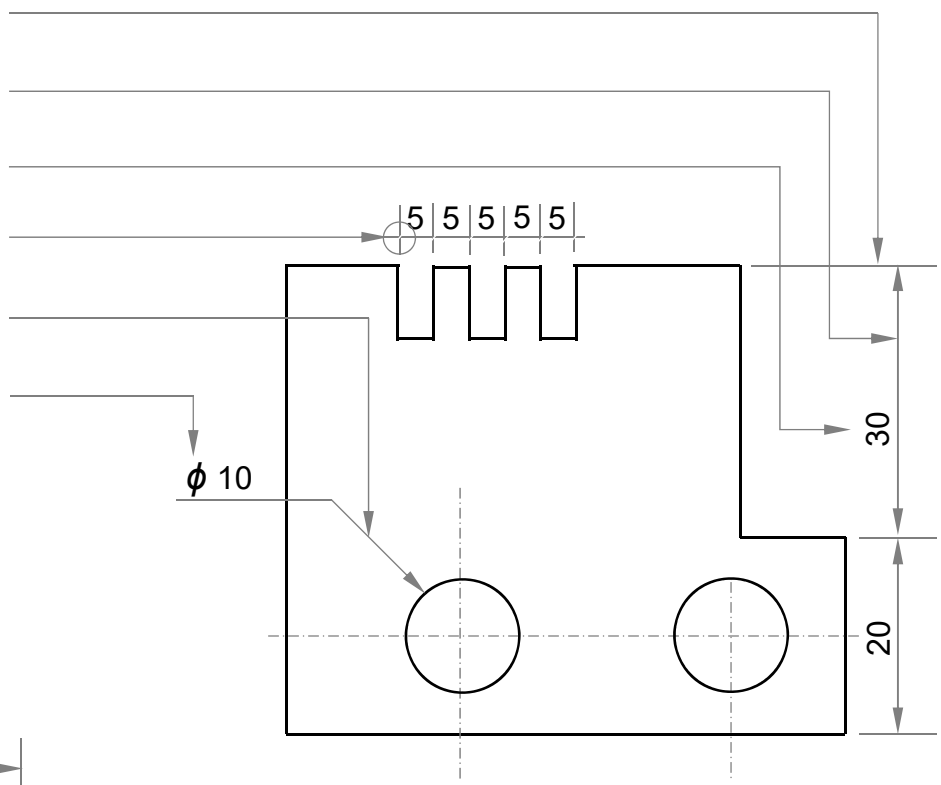
Dimension value

Oblique stroke

Leader line

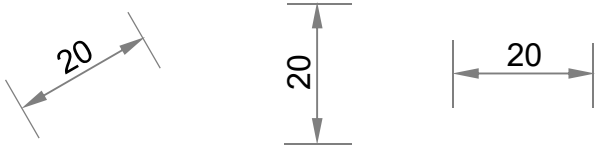
Symbols

Notes



3.5 : NOTES

1-



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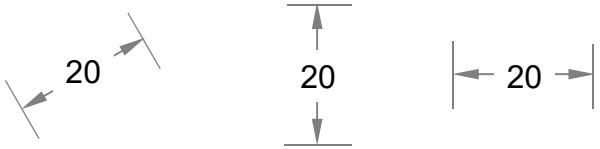

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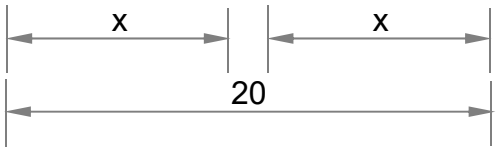

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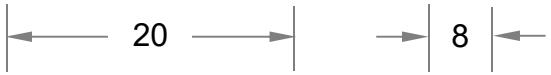

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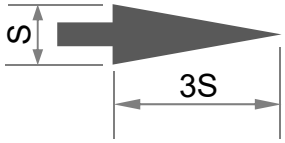
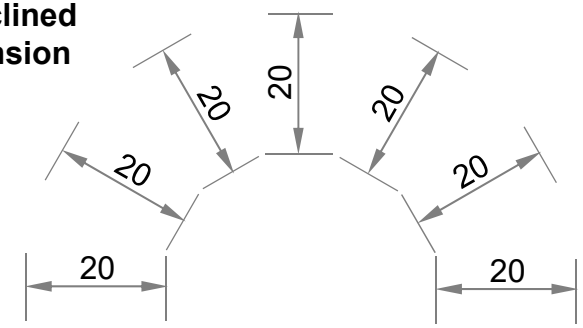


S= (2 – 3) t
t= line thickness

6-

For inclined dimension



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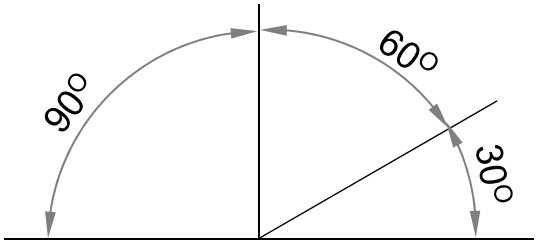
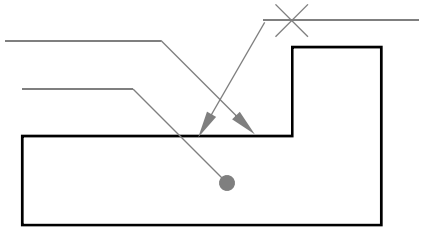


8-

For Leader lines



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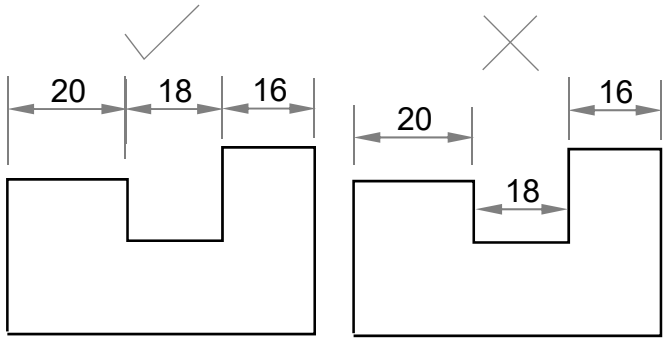
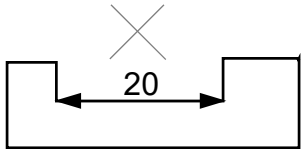


Don't use object line as dimension line

10-



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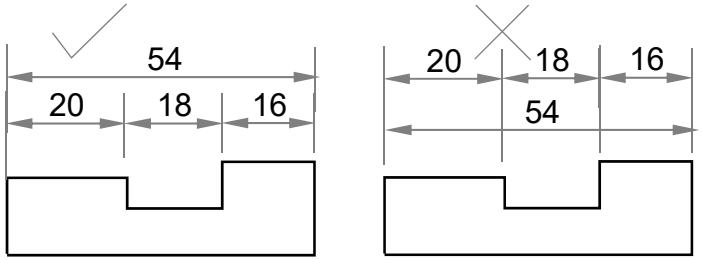

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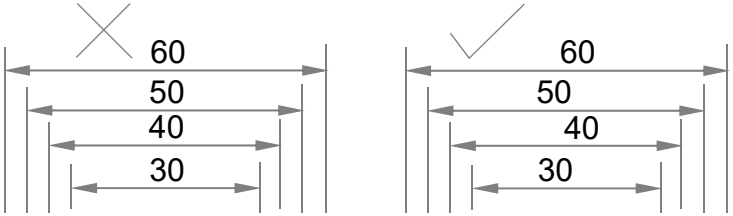

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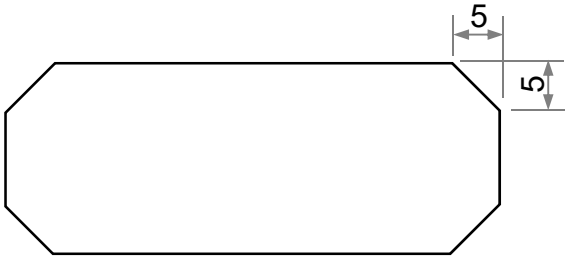
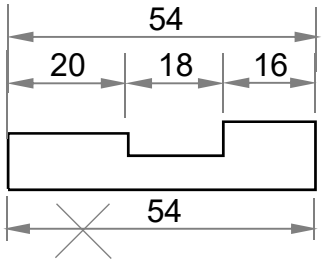


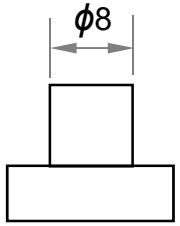
Don't repeat the dimension

14-



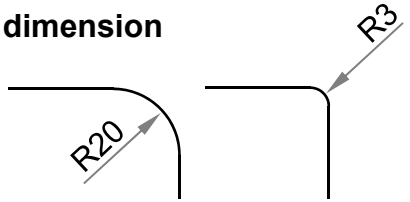
For Cylindrical shape

15-



For arc dimension

16-



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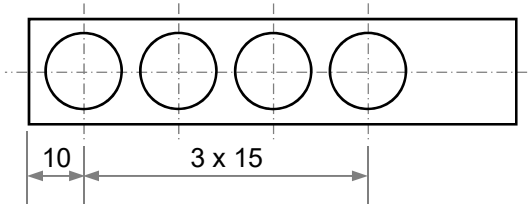


CHAPTER FOUR : PROJECTIONS

4.1 : INTRODUCTION

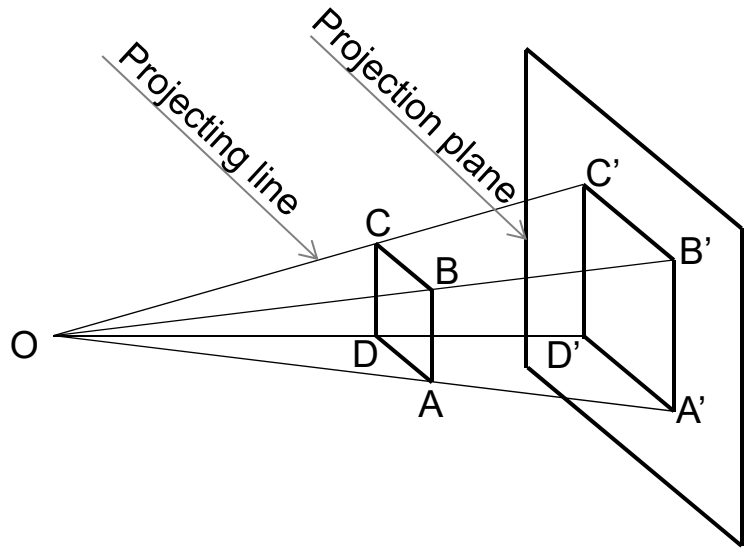
Projection is a method to represent the exact shape of an Object on the plane.

4.2 : PROJECTION TYPE

The two main type of the projection are (Perspective projection and Orthographic projection)

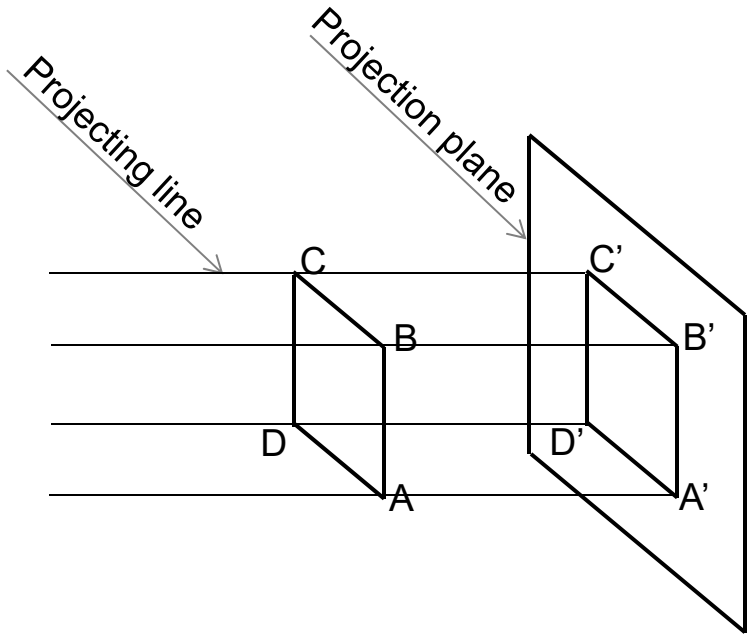
4.2.1 : PERSPECTIVE PROJECTION

In Perspective projection , the Projecting line or visual rays converge At a point.



4.2.2 : ORTHOGRAPHIC PROJECTION

Orthographic projection or parallel Projection is the projection system that Engineers use for manufacturing and Construction drawings, In which the Projecting lines are parallel and perpendicular to the projection plane.

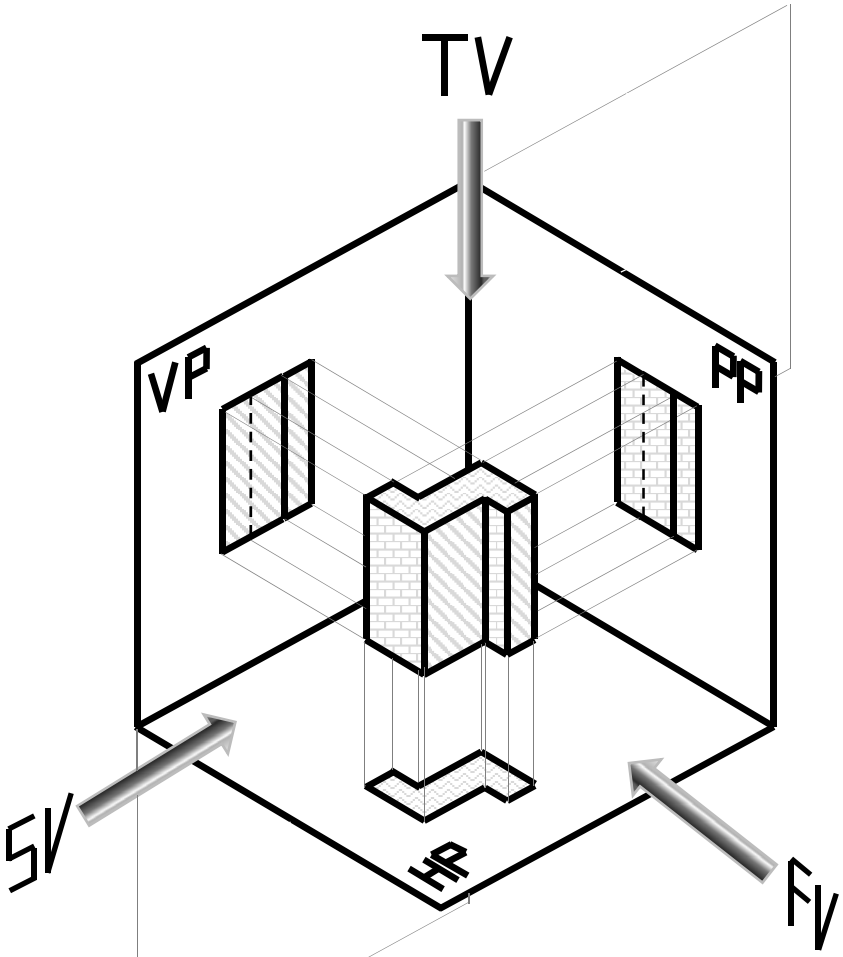


4.3 : PROJECTION PLANES

1- Horizontal Plane (H.P):
The projection on the Horizontal Plane called ---------- TOP VIEW (T.V)

2- Vertical Plane (V.P):
The projection on the Vertical Plane called ---------- FRONT VIEW (F.V)

3- Profile Plane (P.P):
The projection on the Profile Plane called ----------SIDE VIEW (S.V)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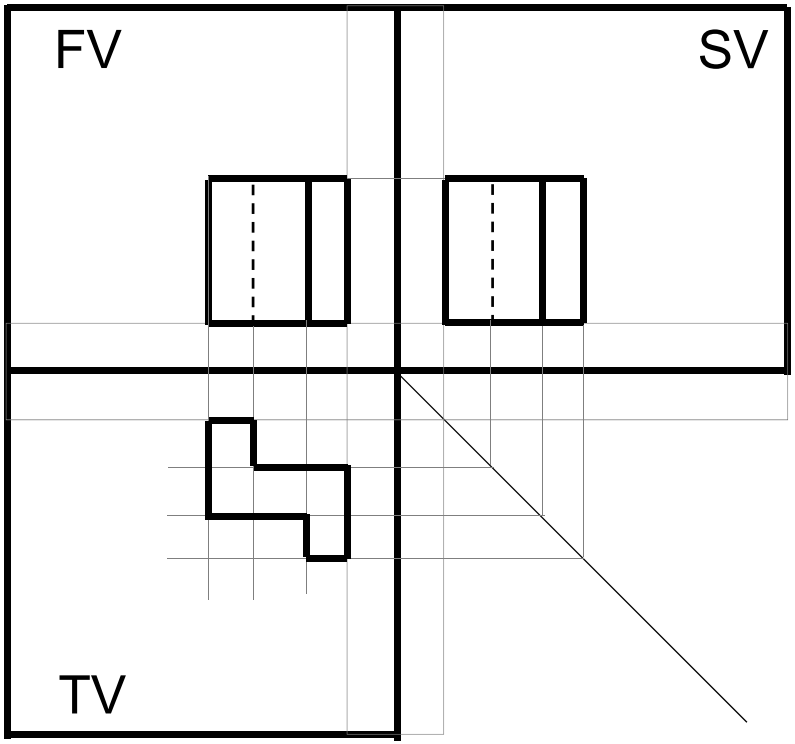
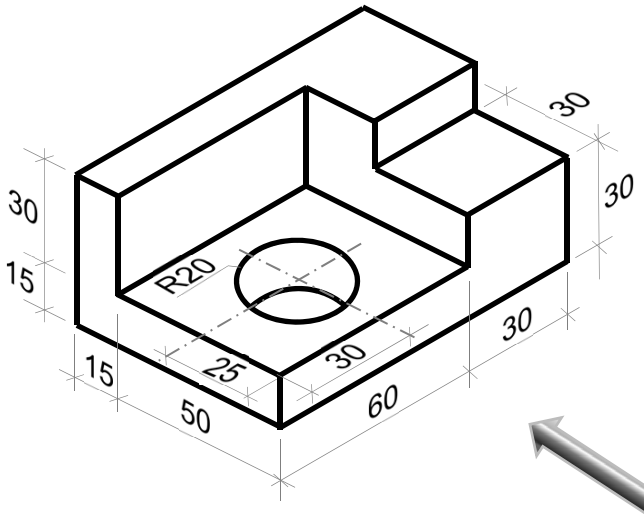
VP
PP
SV
HP
FV


FV
SV
TV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30
15
R20
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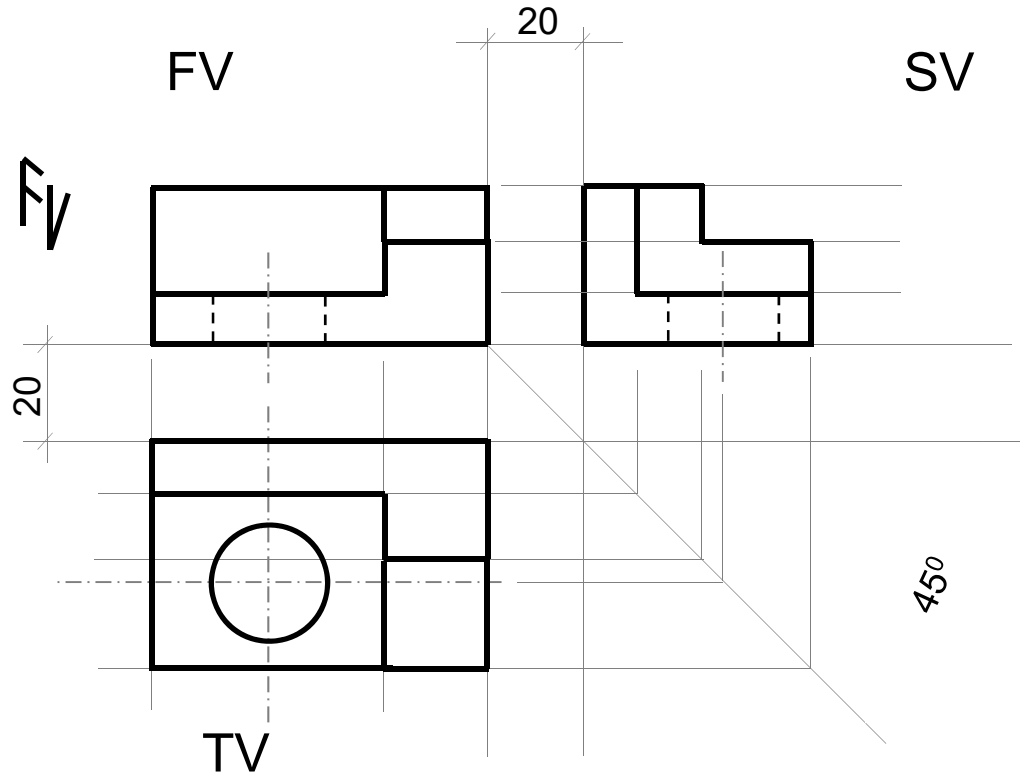
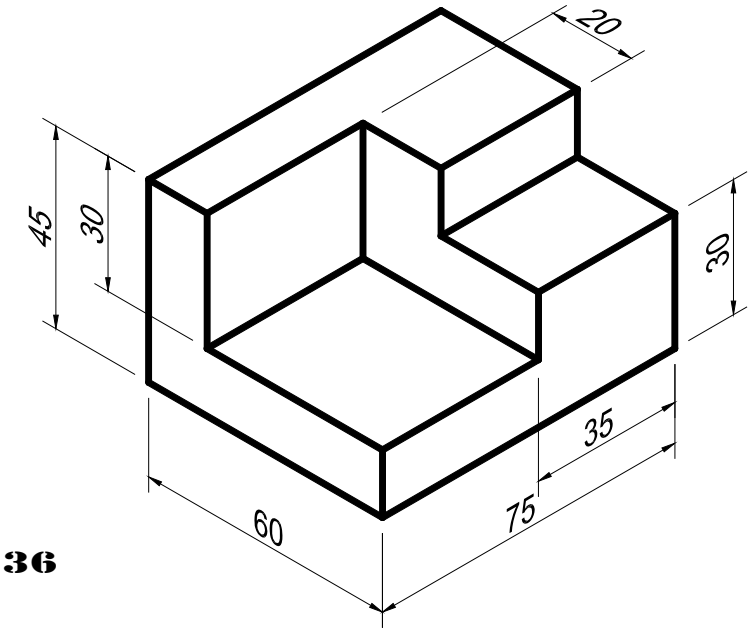
25
30
30
50
60


20
FV
SV
20
45°
TV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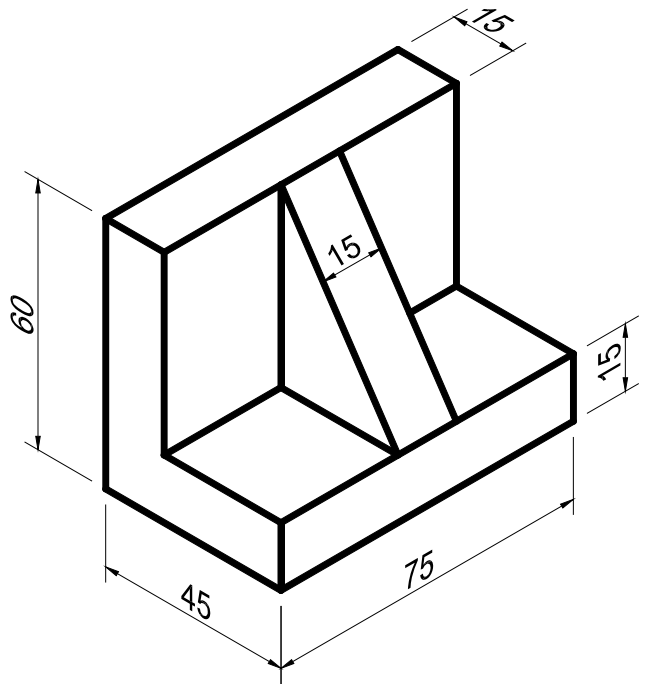
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75

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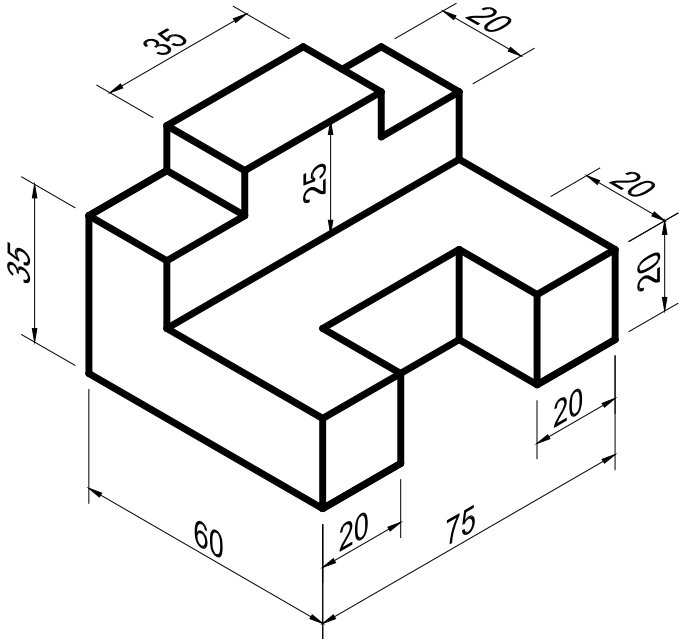
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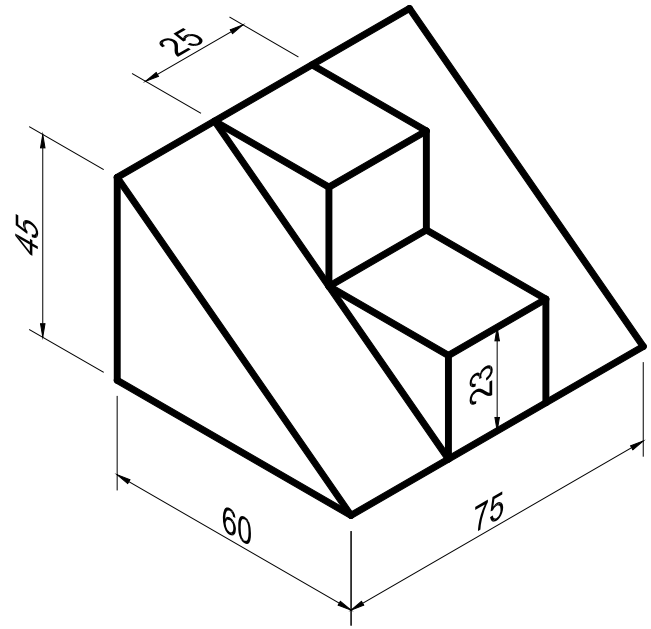
75

38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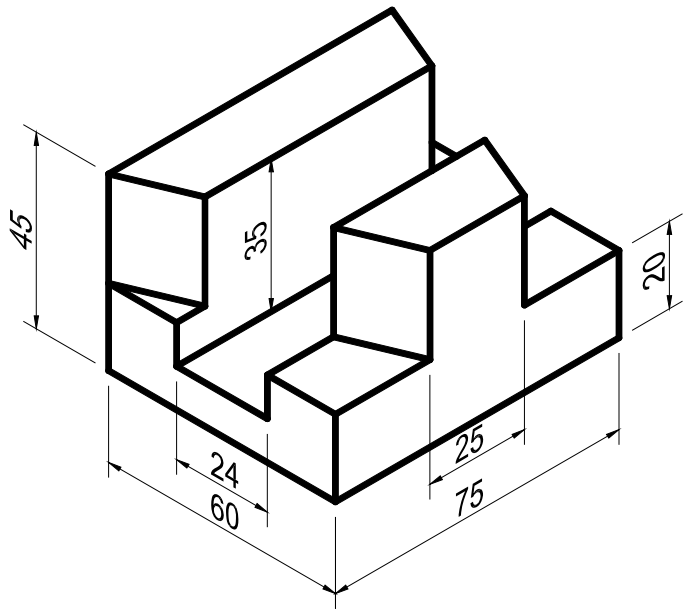
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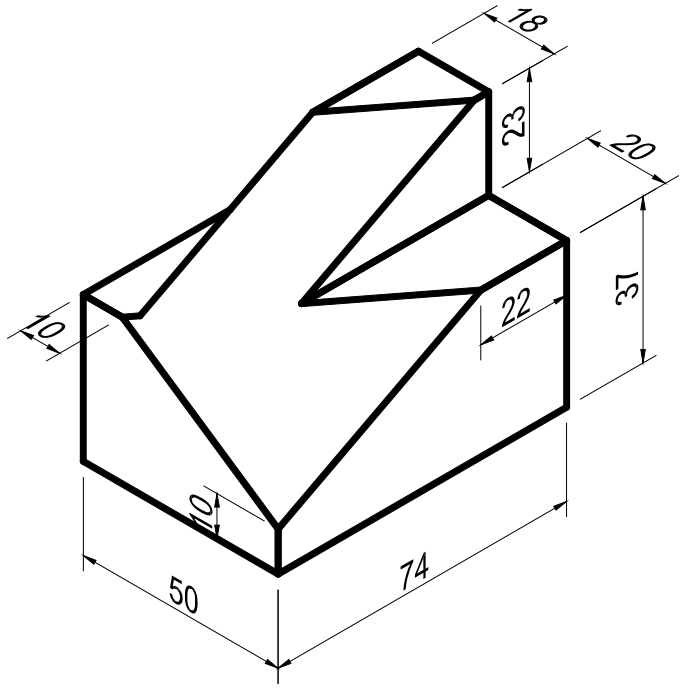
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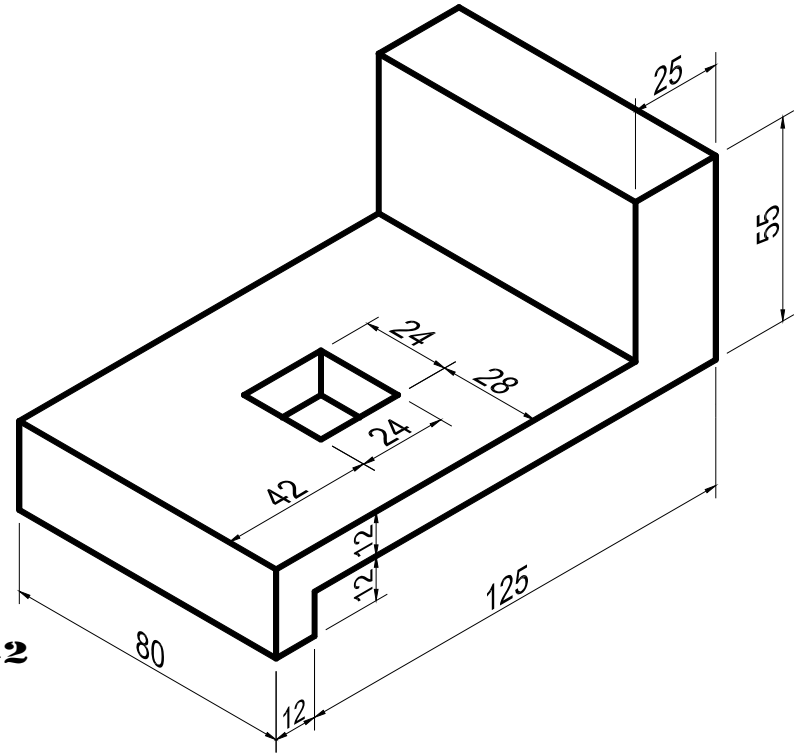
74

42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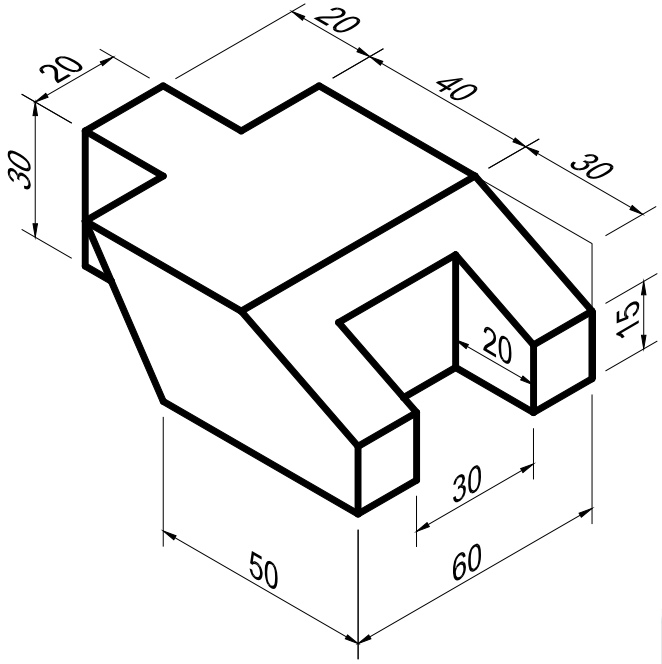
12

43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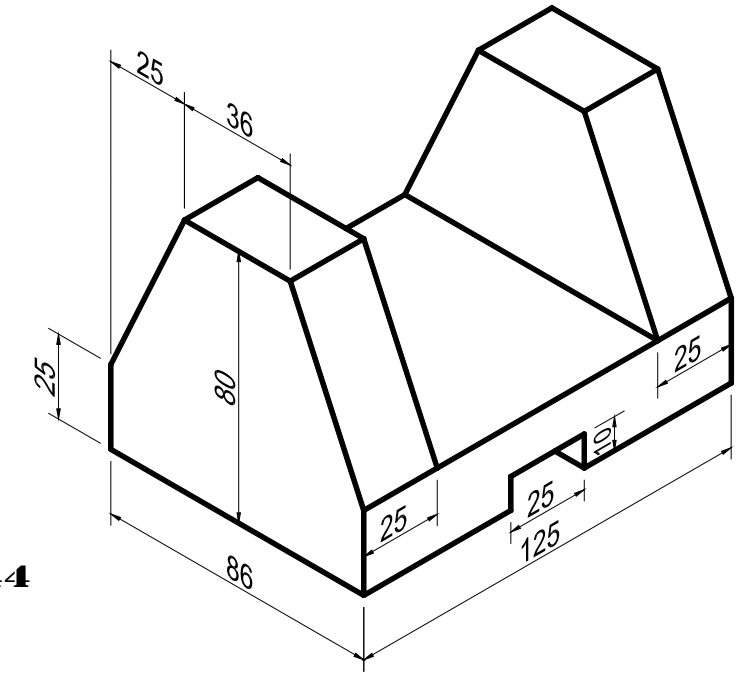
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25
125
86

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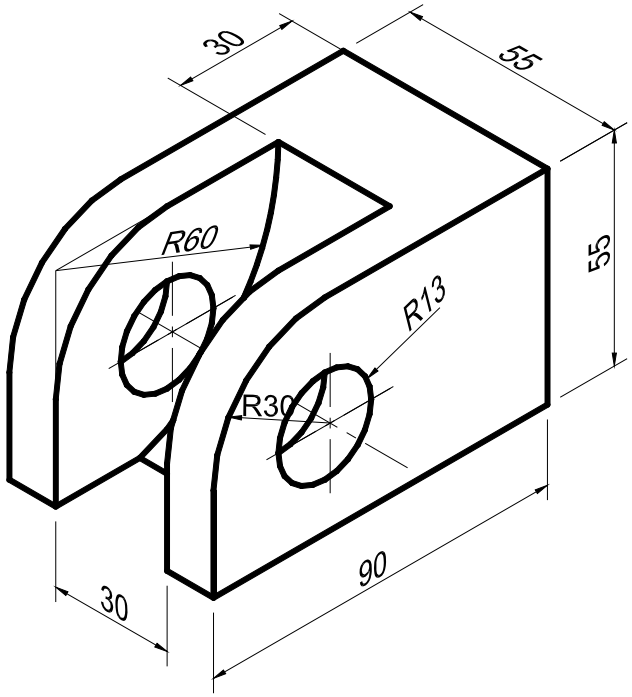
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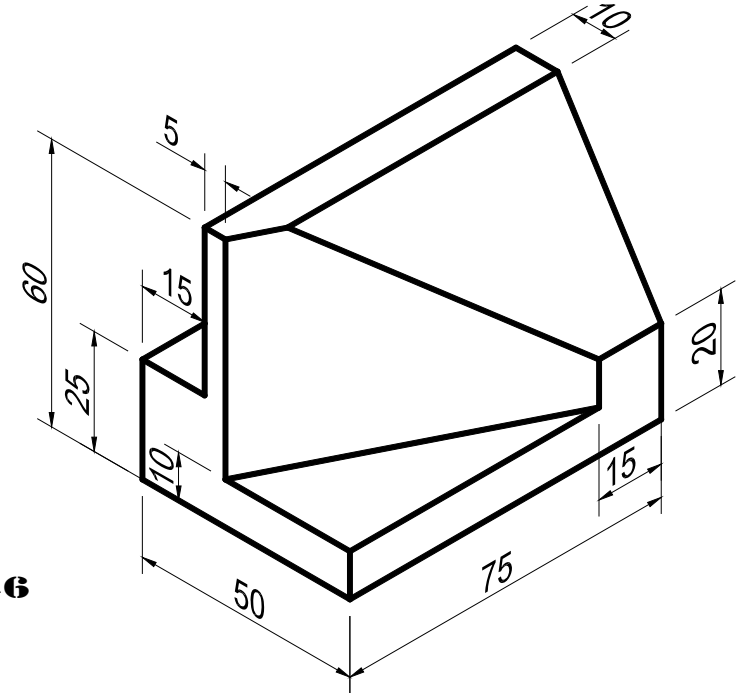
55
55
R60
R13
R30
30
90

45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5
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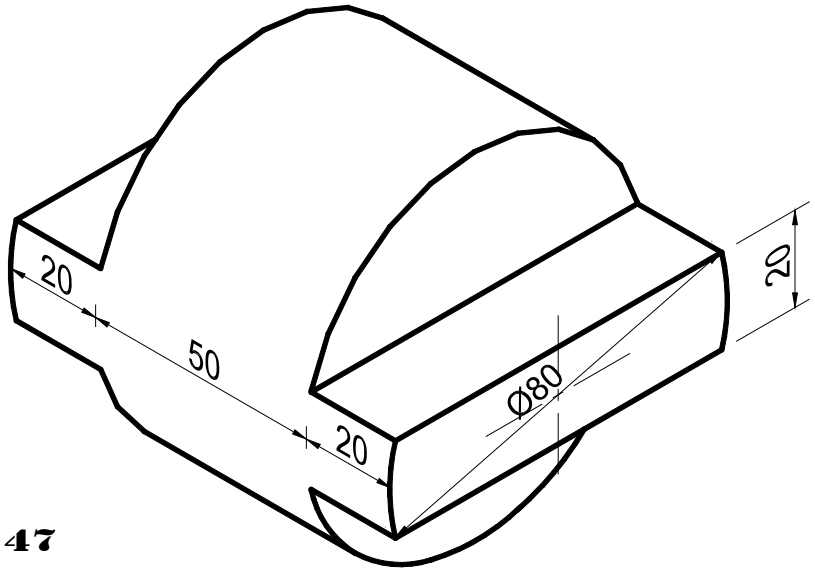
75

46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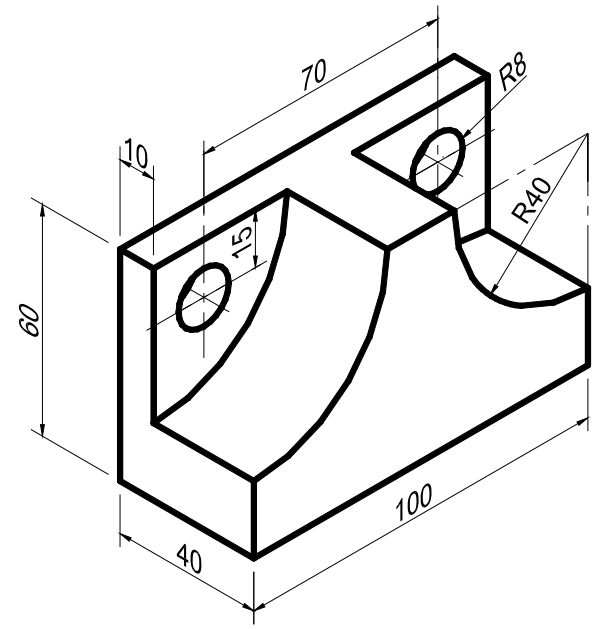
20
Ø80
20

47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R8
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R40
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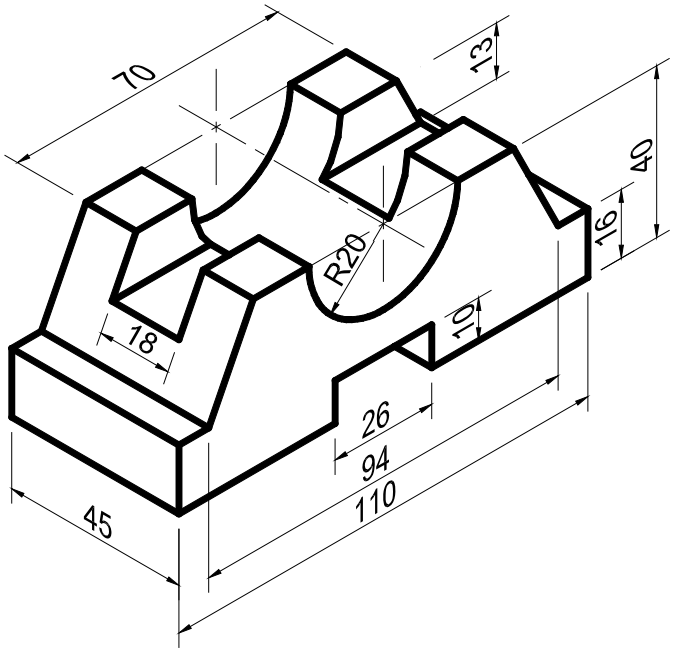
100
40

48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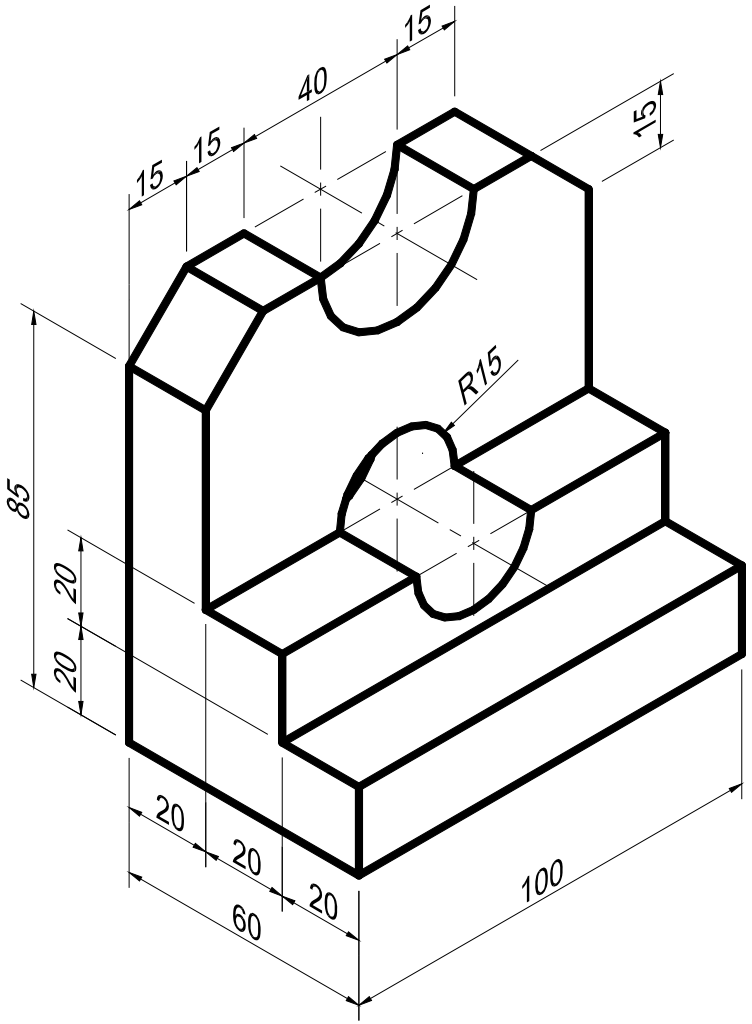
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R15
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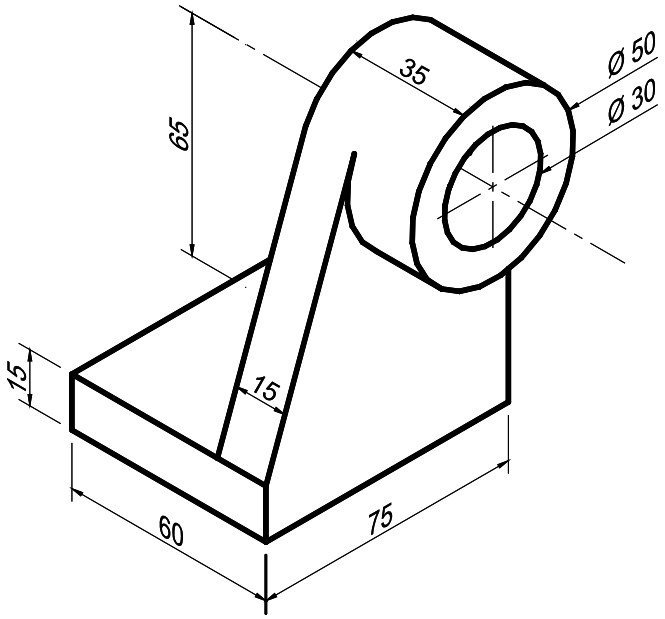
51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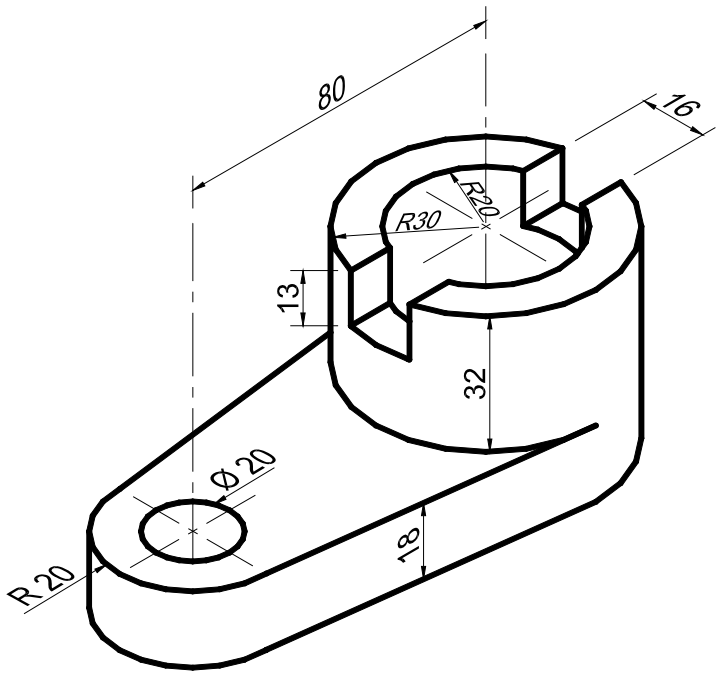
52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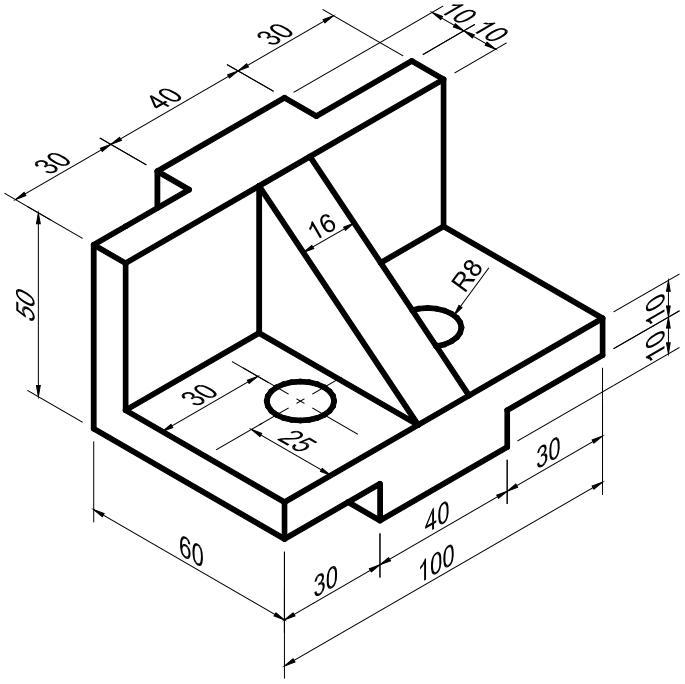
R20
R30
13
32
Ø 20
18
R 20

53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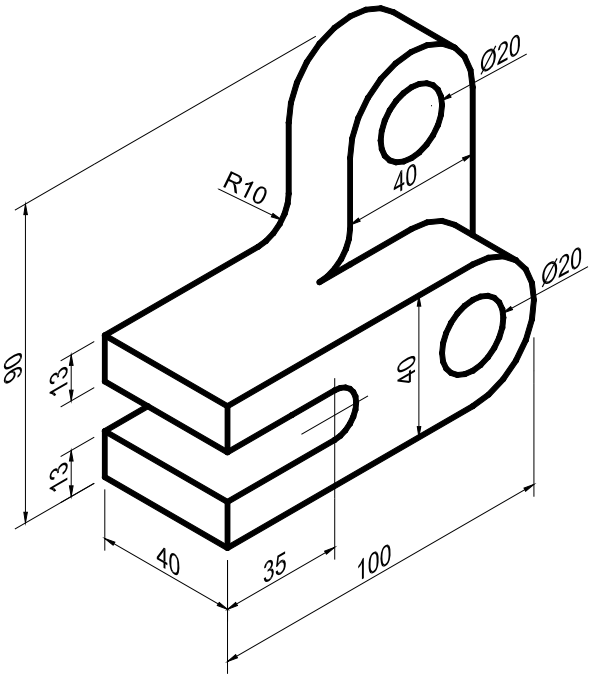
54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R10
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Ø20
90
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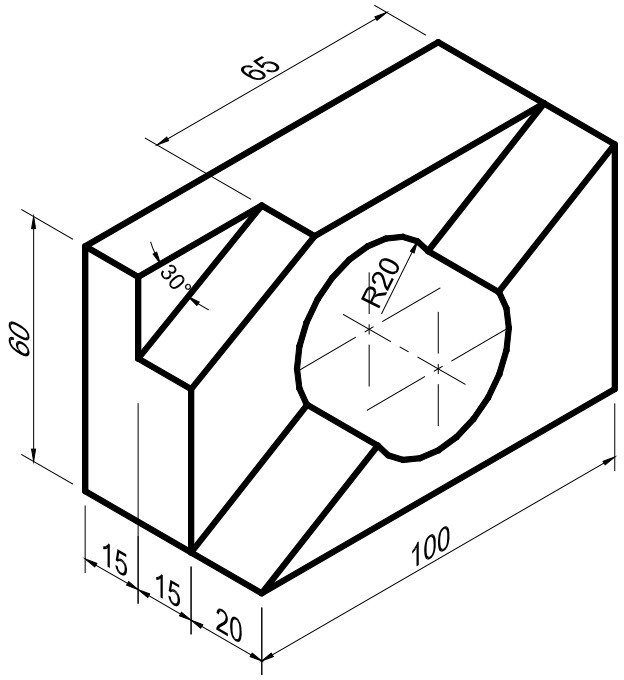
13
40
35
100

55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R20
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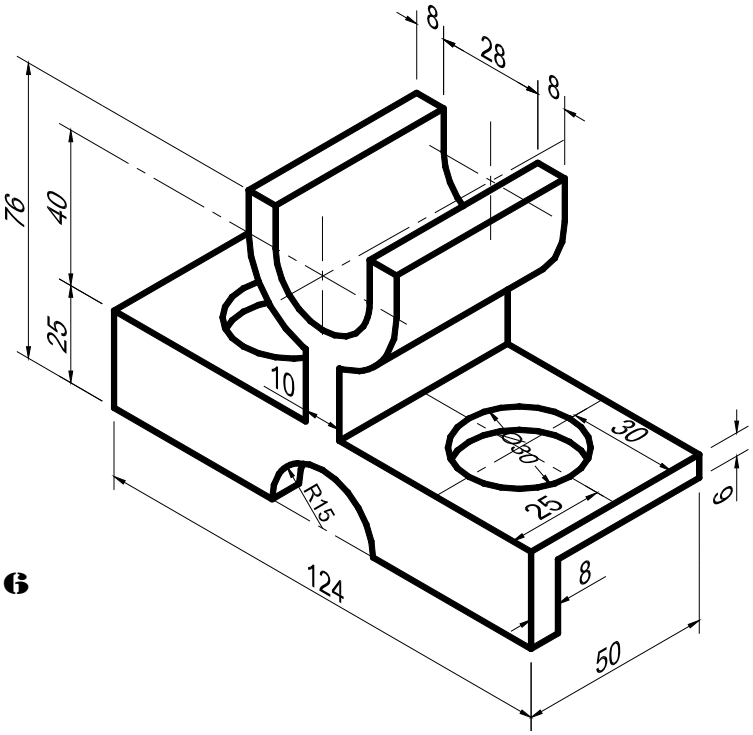
56


8
28
8
76
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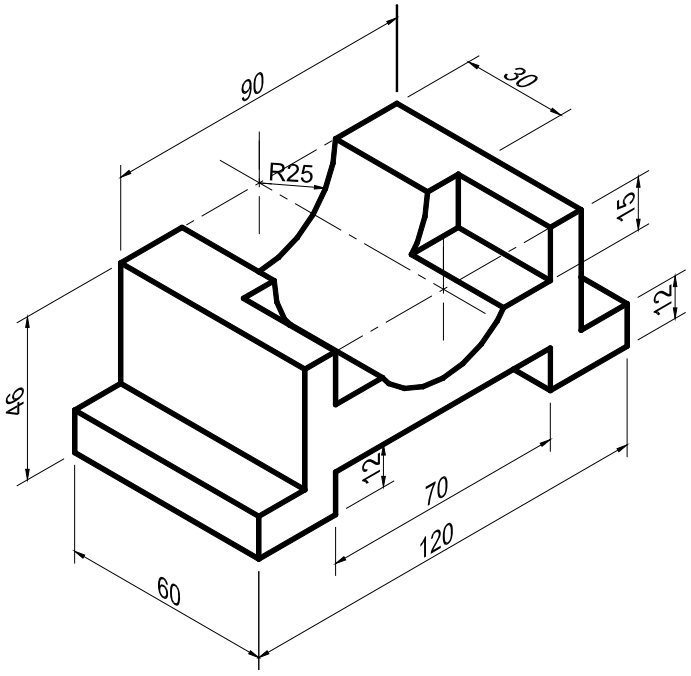
Ø30
30
9
R15
25
124
8
50

57


90
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R25
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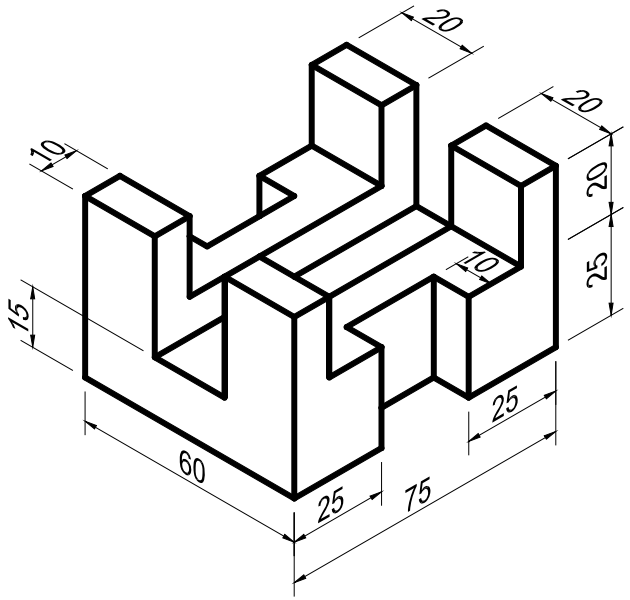
58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