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مانيوال

مختبر الرسم اليدوي

Faculty of Engineering

Department of Allied Engineering Sciences

Engineering Drawing

Week 2

Introduction: Tools and Practicing

- **Introduction to Engineering Drawing**

  - What is Engineering Drawing?
  - Drawing Tools and their uses
  - Drawing Scales
  - Title Block

Definition of Engineering Drawing

- Engineering Drawing is a type of technical drawing used to clearly define the requirements for engineered items such as views, dimensions and necessary information.
- It is a graphical language that transforms ideas from one mind to another.
- It communicates all needed information from the engineer who designed the part to the worker who will make it.

Drawing Tools and their Uses

- **Drawing board**: Is a smooth wooden board that is used to keep and support the drawing paper. The drawing board should be kept clean, flat and smooth.
- **Drawing paper**: A3 drawing paper with a margin of 1 cm at all sides.
- **Paper tape**: Used to hold the drawing paper on the drawing board.
- **Pencils**: Used to draw the required objects or shapes. The accuracy of the drawing depends on the quality of the pencils used.
- **T-square**: Usually fitted to the left side of the drawing board and slides along the edge of the board. Used to draw horizontal straight lines.

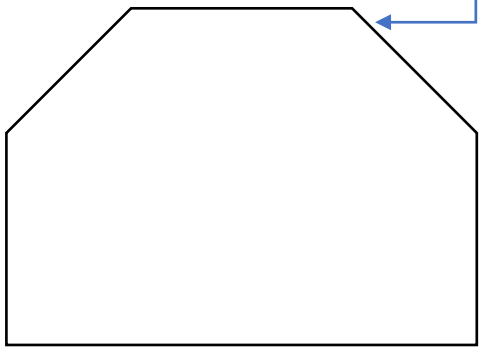
- **Set squares (triangles)**: Triangular-shaped squares with one of the angles is right angle (90 degrees). Two ser squares are usually used with 45,45,90 degrees or 30,60,90 degrees. In combination with T-square, set squares are used to draw straight lines at an angle.
- **Scale (ruler)**: Used to draw lines at a specific length.
- **Protractor**: Used to draw or measure angles.
- **French curves**: Used to draw curves that can’t be drawn using Compass.
- **Compass**: Used to draw circles or arcs at specific distance

Drawing Scales

Scale is the ratio of the linear dimension of an element of an object shown in the drawing to the real linear dimension of the same element of the object.

Size in Drawing : Actual Size

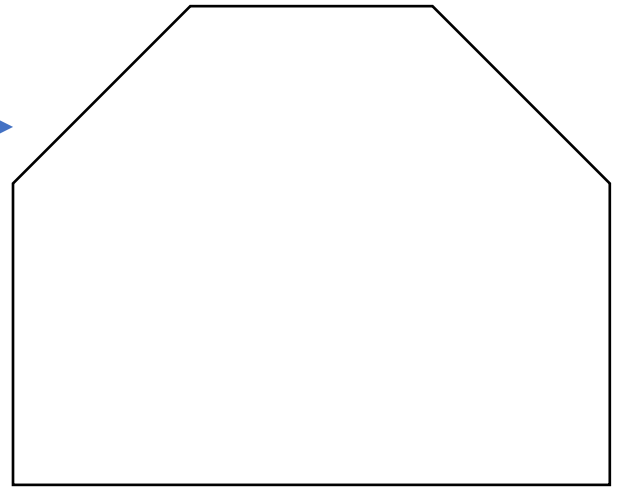
X:Y



SCALE 1:1 for full size

SCALE **X**:1 for ***enlargement*** scales

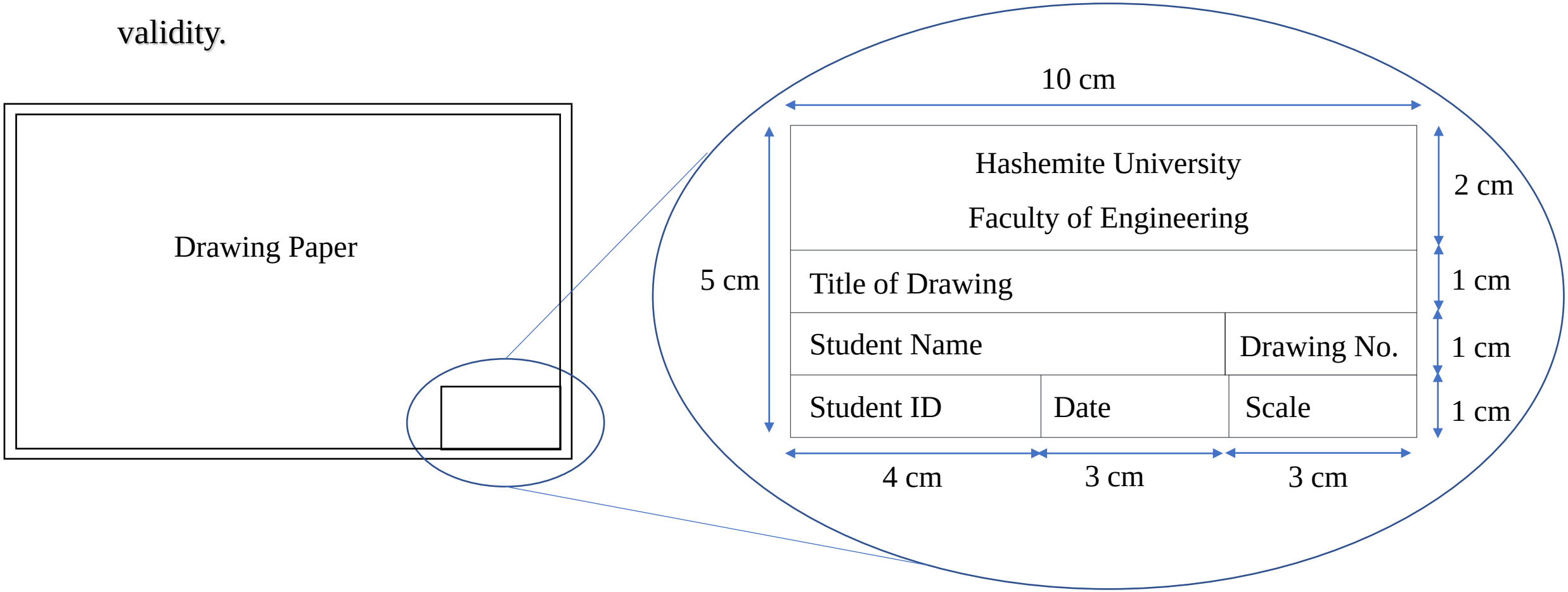
SCALE 1:**X** for ***reduction*** scales



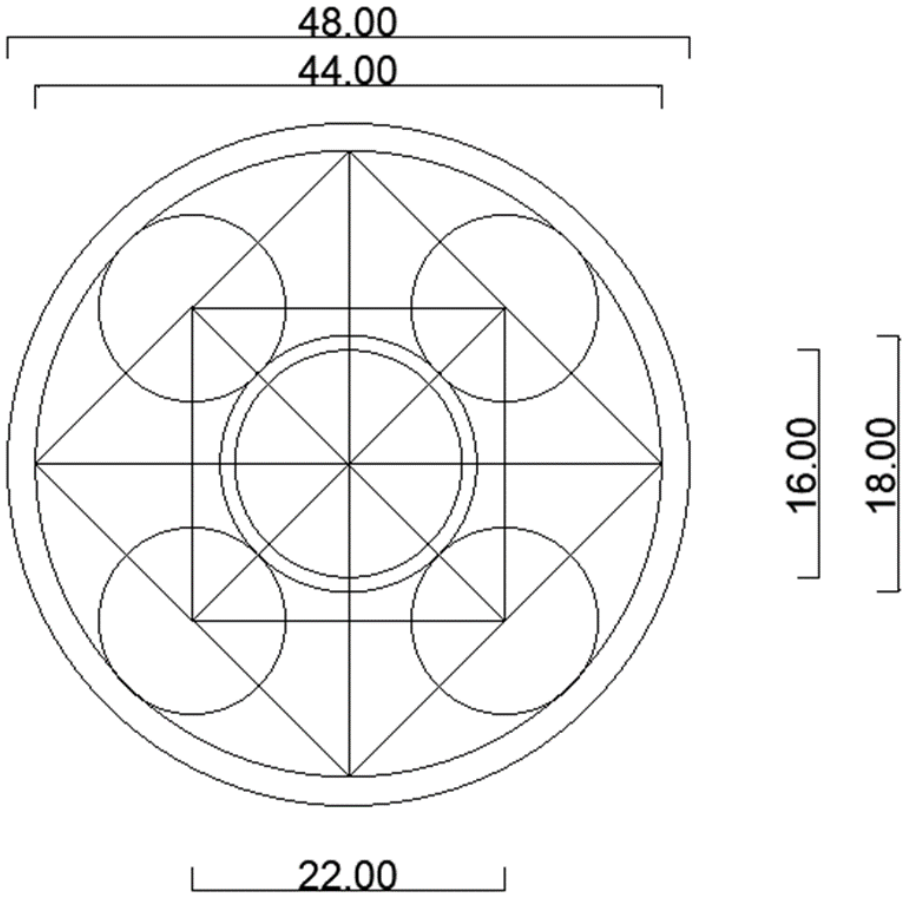
Title Block

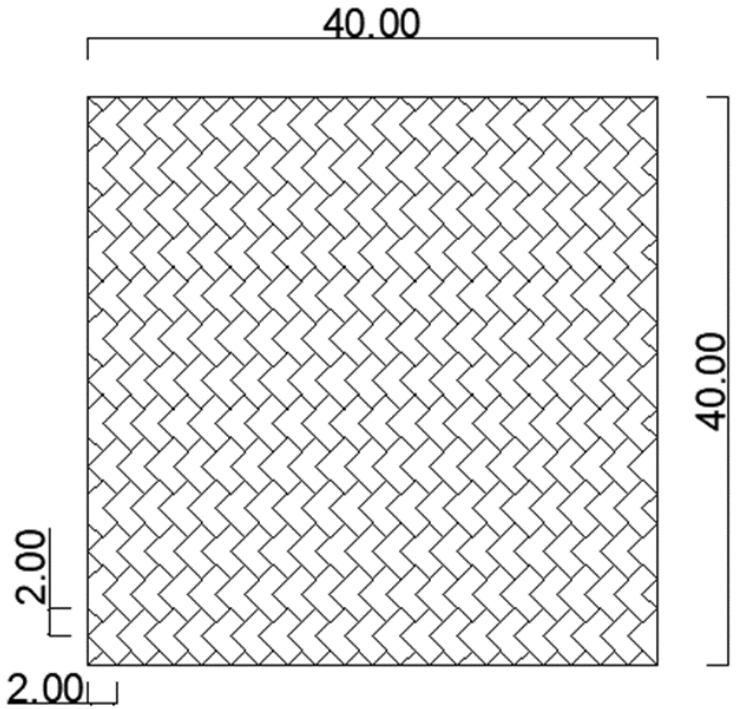
Usually located at the bottom right-hand corner of the drawing paper.

Contains all information necessary to identify the drawing and to verify its validity.

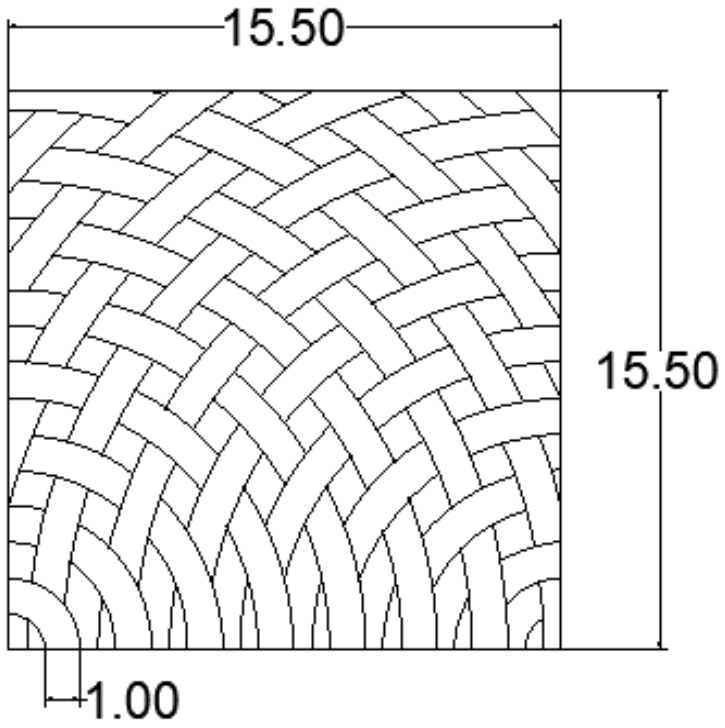


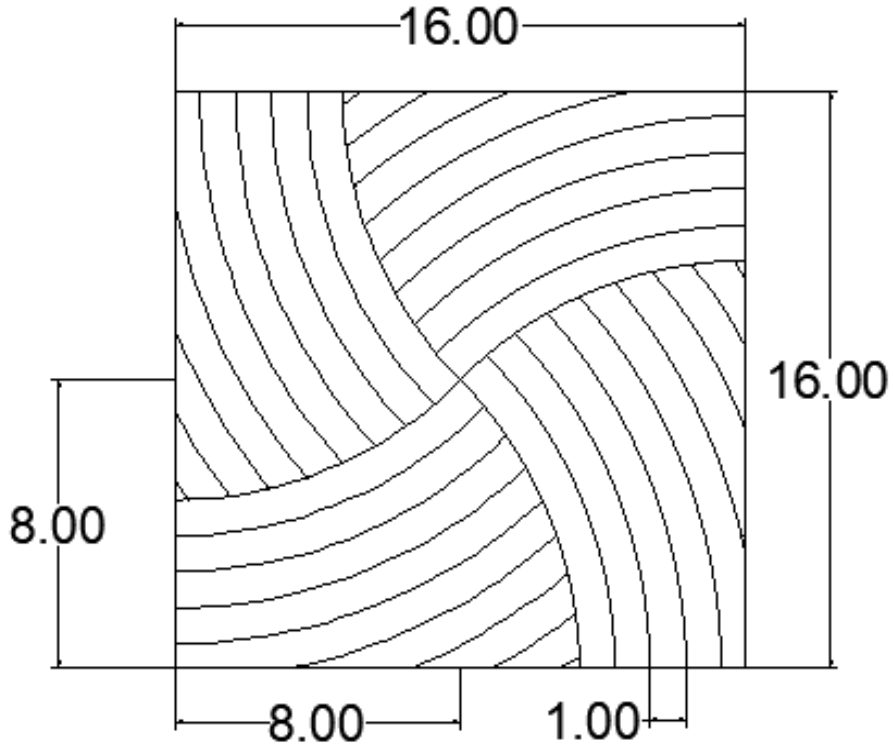
Exercises:





Exercises:



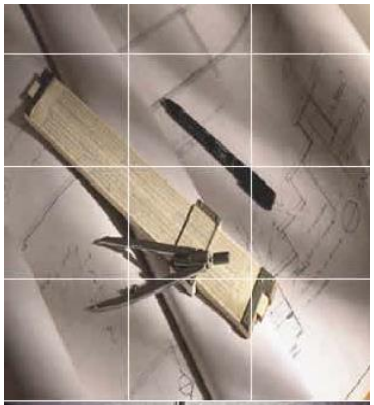


Chapter 2

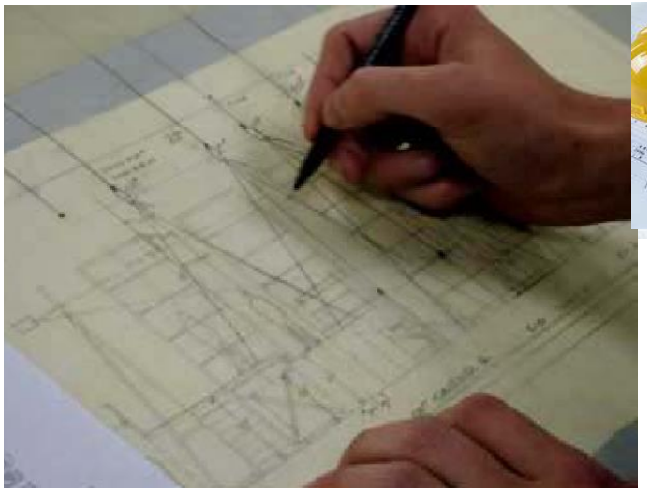
Using Drawing Tools & Applied Geometry

TOPICS

- Preparation of Tools.
- Using of Tools
- Applied Geometry

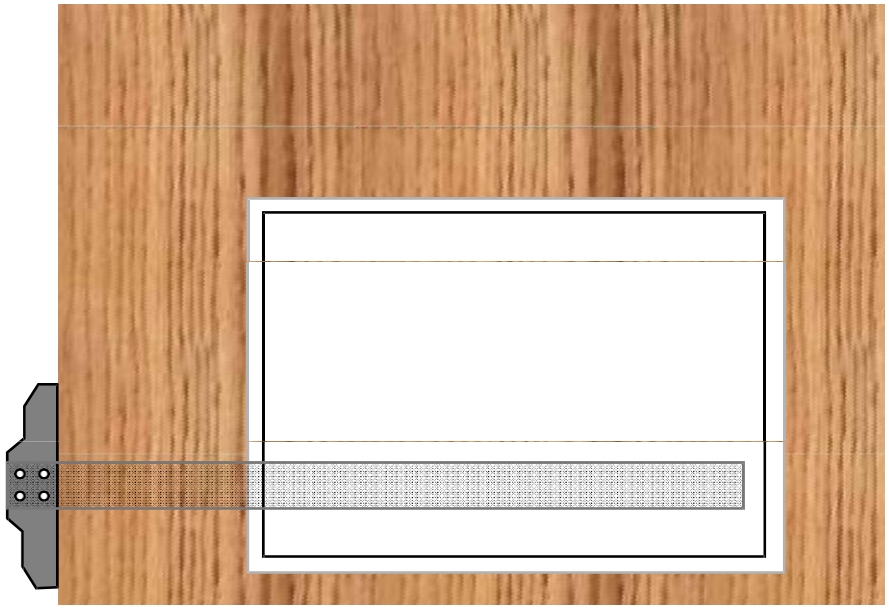


Preparation of Tools



Fastening Paper to Drafting Board

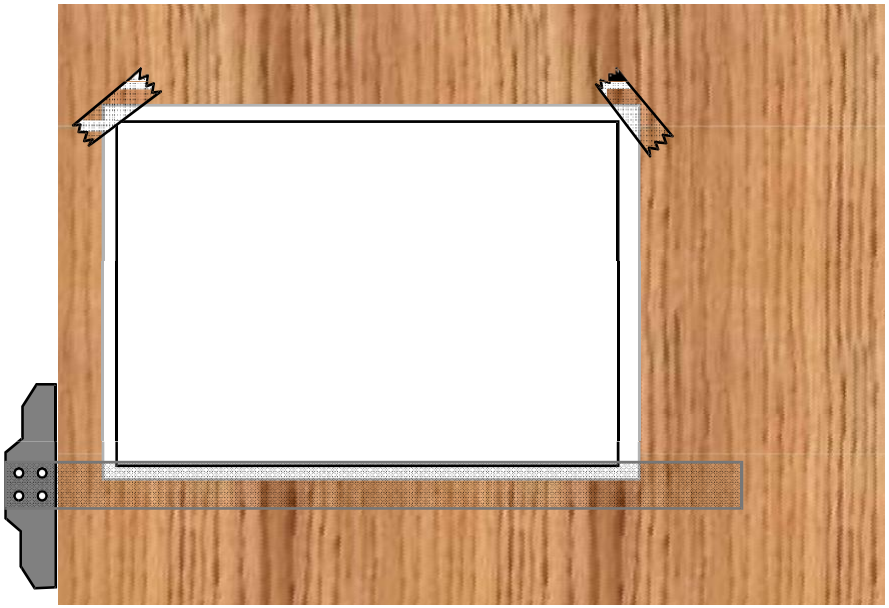
1. Place the paper close to the table’s left edge.
2. Move the paper until its lower edge place about the top edge of T-square.



Fastening Paper to Drafting Board

3. Align the top edge of the paper with T-square blade.

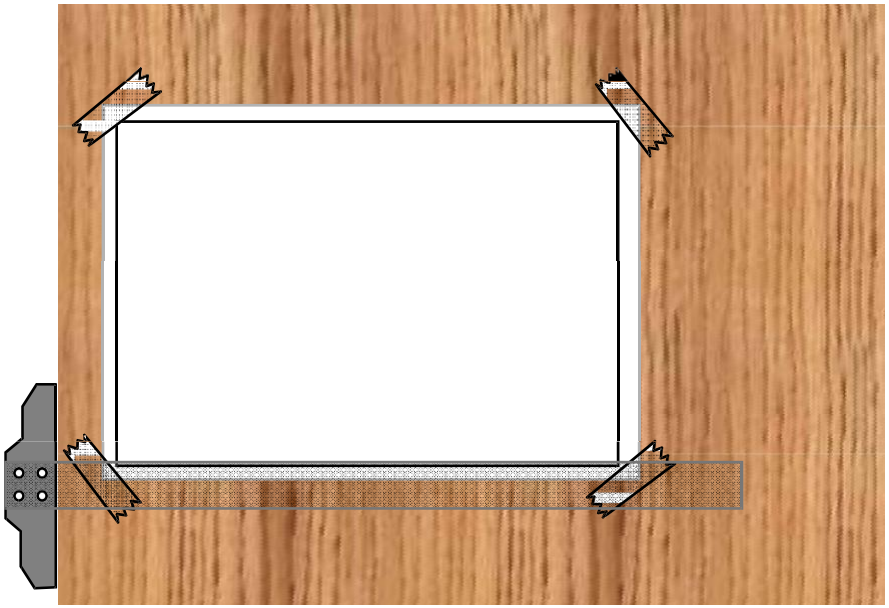
4. Attach the paper’s corners with tape.



Fastening Paper to Drafting Board

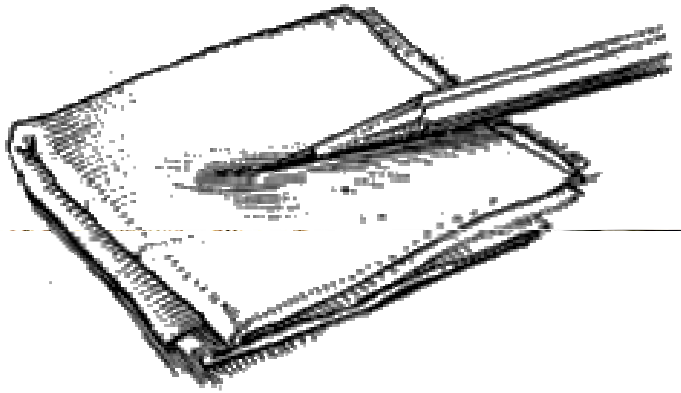
5. Move T-square down to smooth the paper.

6. Attach the remaining paper’s corners with tape.



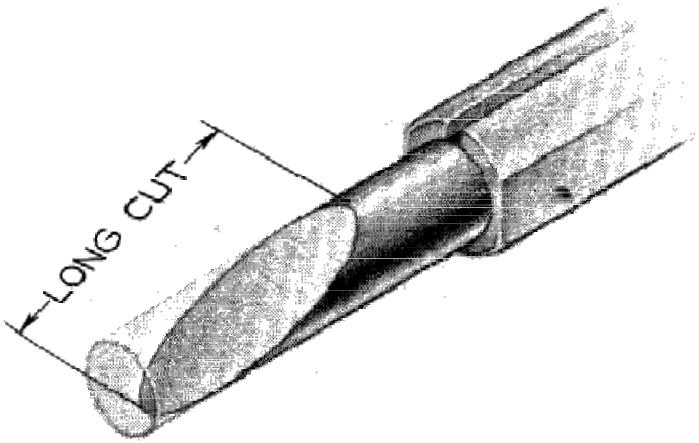
Sharpening the Pencil

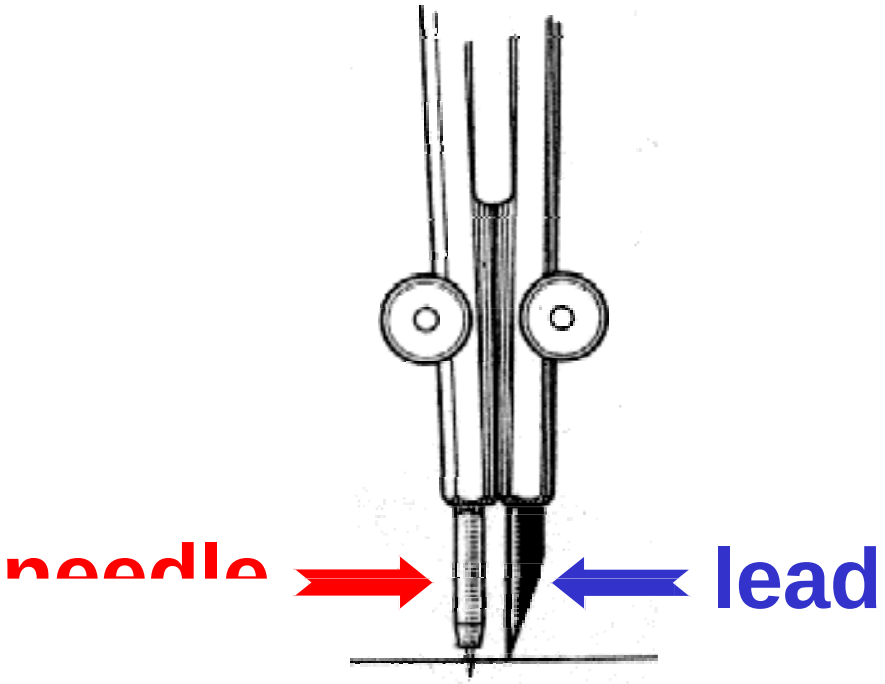
1. Remove the wood with penknife while expose a lead about 8-10 mm.
2. Polish the lead into a conical shape with a sandpaper.
3. Clean the lead with tissue paper.



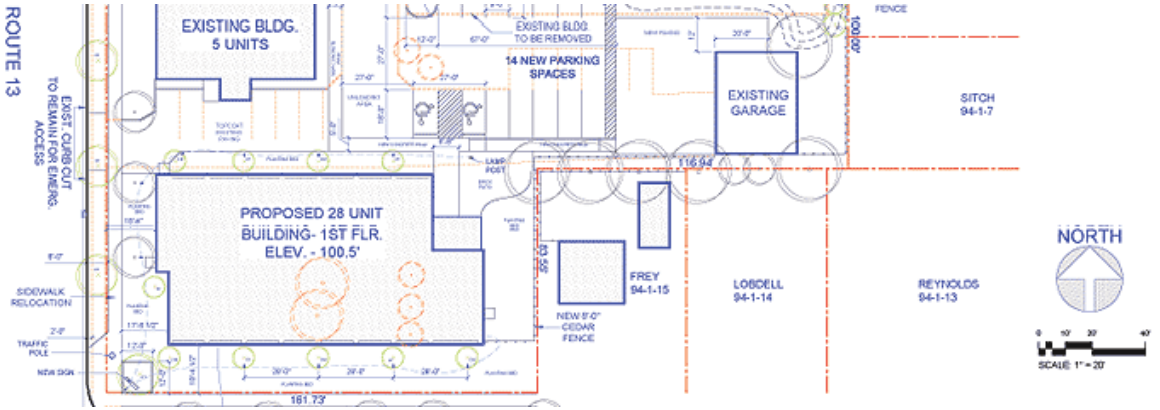
Preparing the Compass

1. Sharpen the lead with a sandpaper.
2. Adjust the **needle** and the **lead** so that the tip of the needle extends slightly more than the lead.





Using the Tools



Function of the Tools

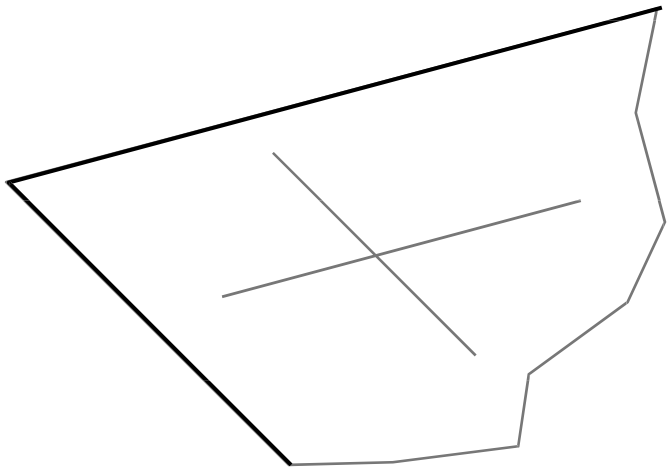
Tools	Shape to be drawn
1. T-square	Straight line
2. Triangles	
3. Compass	Arc, Circle
4. Circle template	

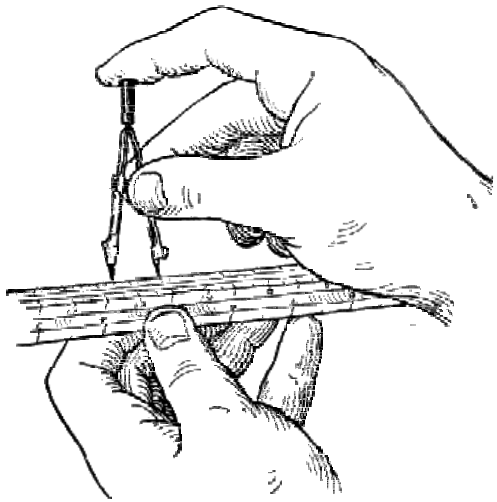
Using the Compass

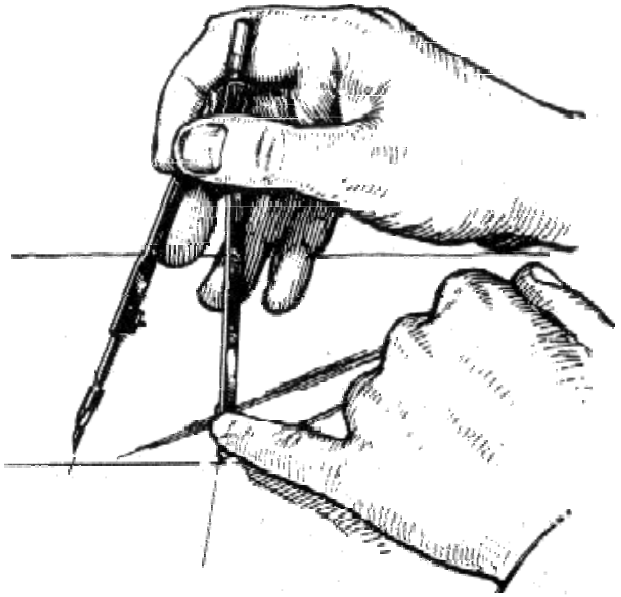
1. Locate the center of the circle by two intersecting lines.

2. Adjust the distance between needle and lead to a distance equal to radius of the circle.

3. Set the needle point at center.



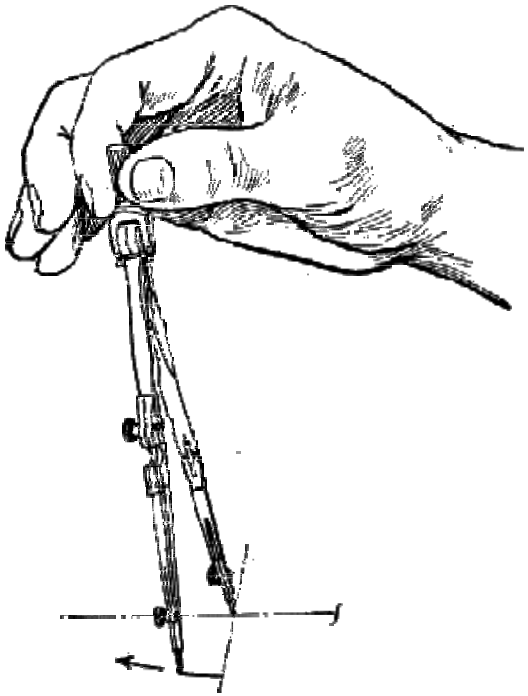


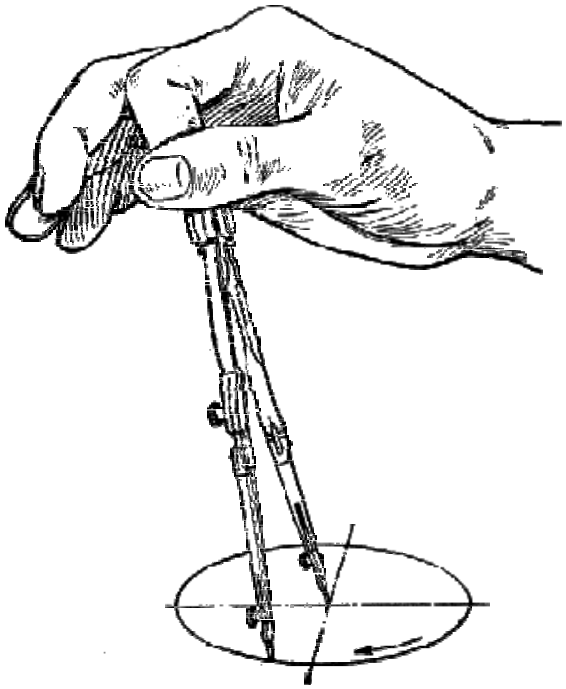


Using the Compass

4.Start circle. Apply enough pressure to the needle, holding compass handle between thumb and index fingers.

5. Complete circl . Revolve handle clockwise.

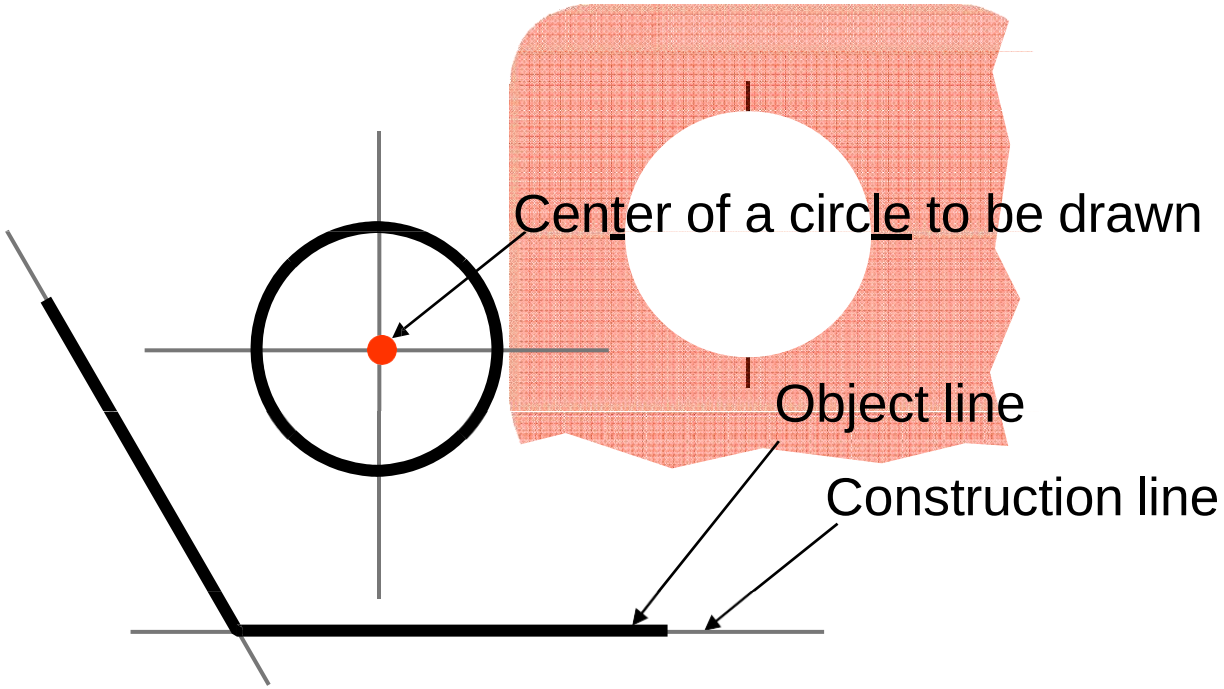




Using a Circle Template

1. Draw two perpendicular lines that pass through center of a circle to be drawn.
2. Place the template till all marking coincide with center lines.
3. Tracing the circle. (Hold the pencil normal to the paper.)

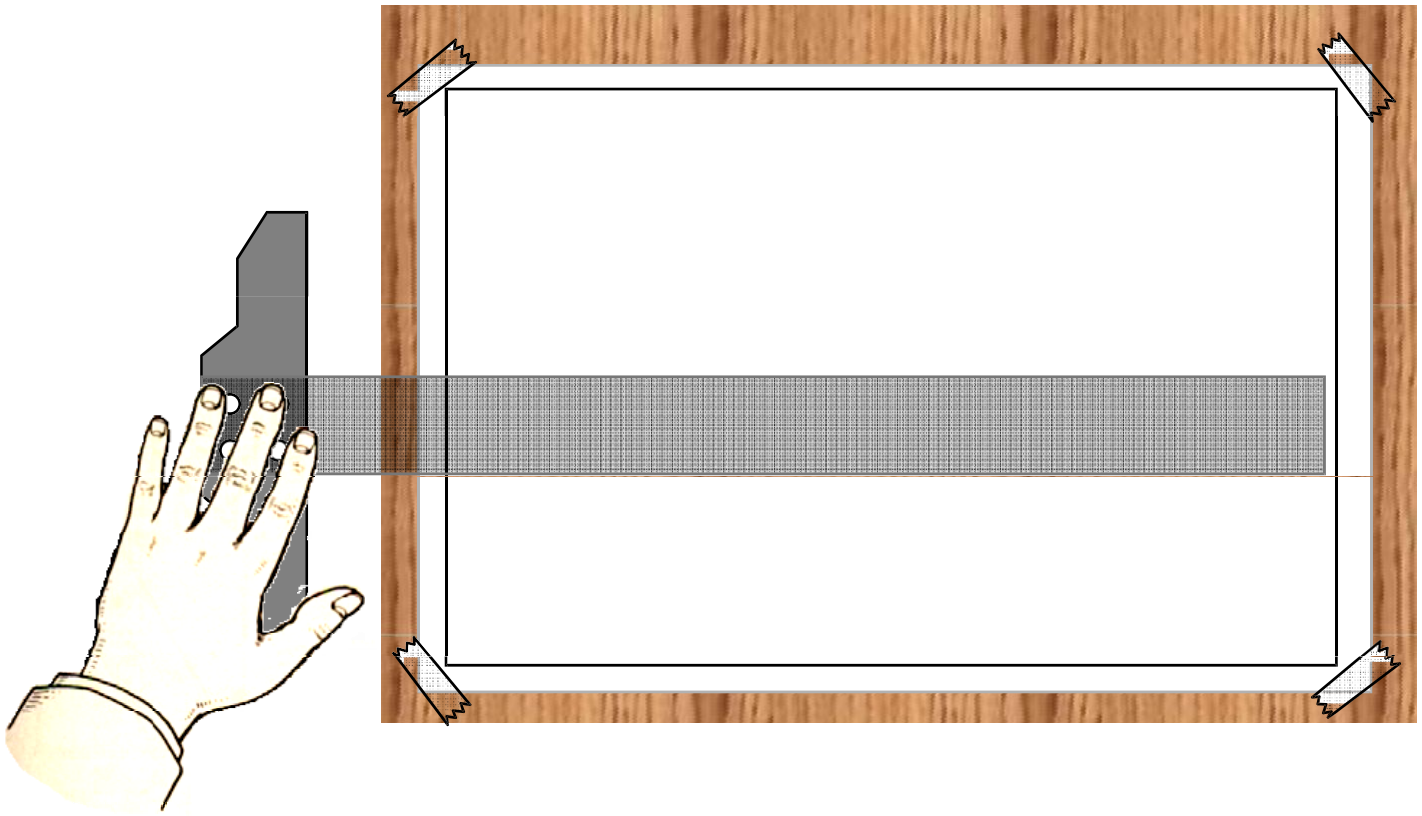
Given



Draw a Horizontal Line

1. Press the T-square head against the left edge of the table.

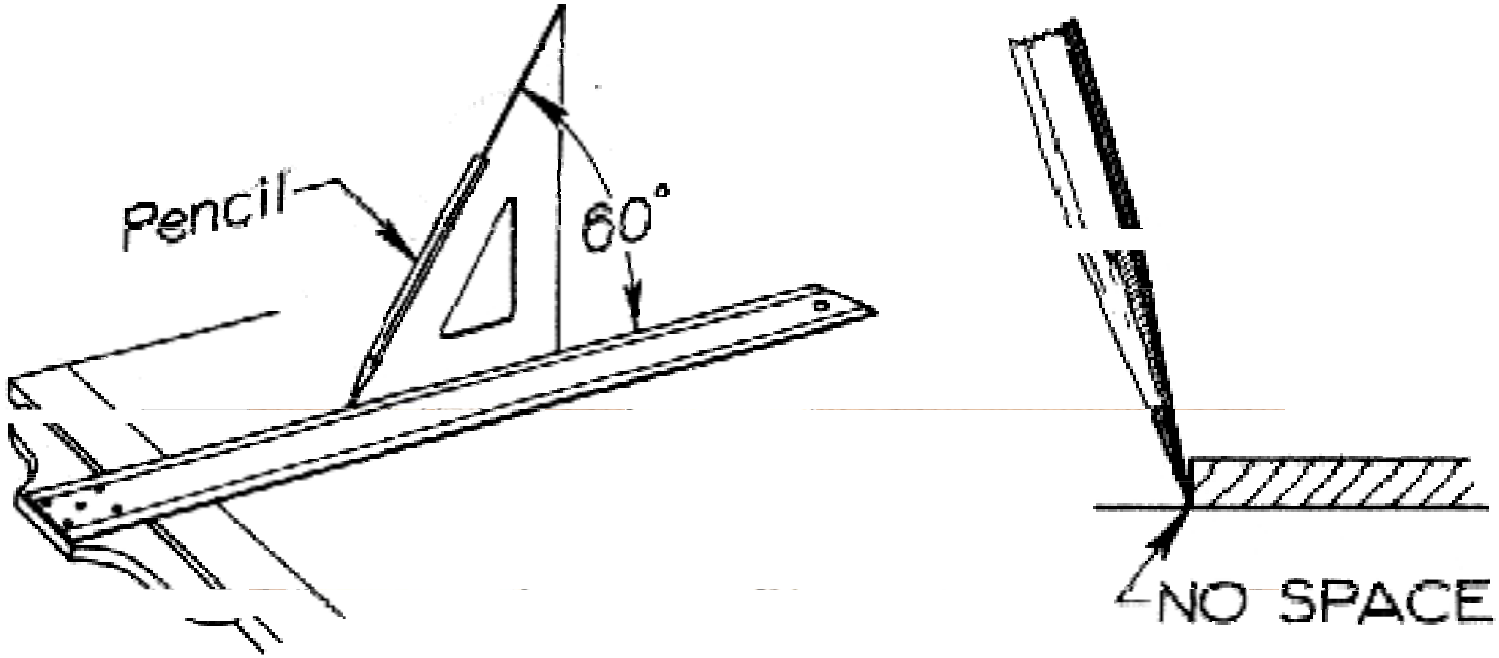
2. Smooth the blade to the right.



Draw a Horizontal Line

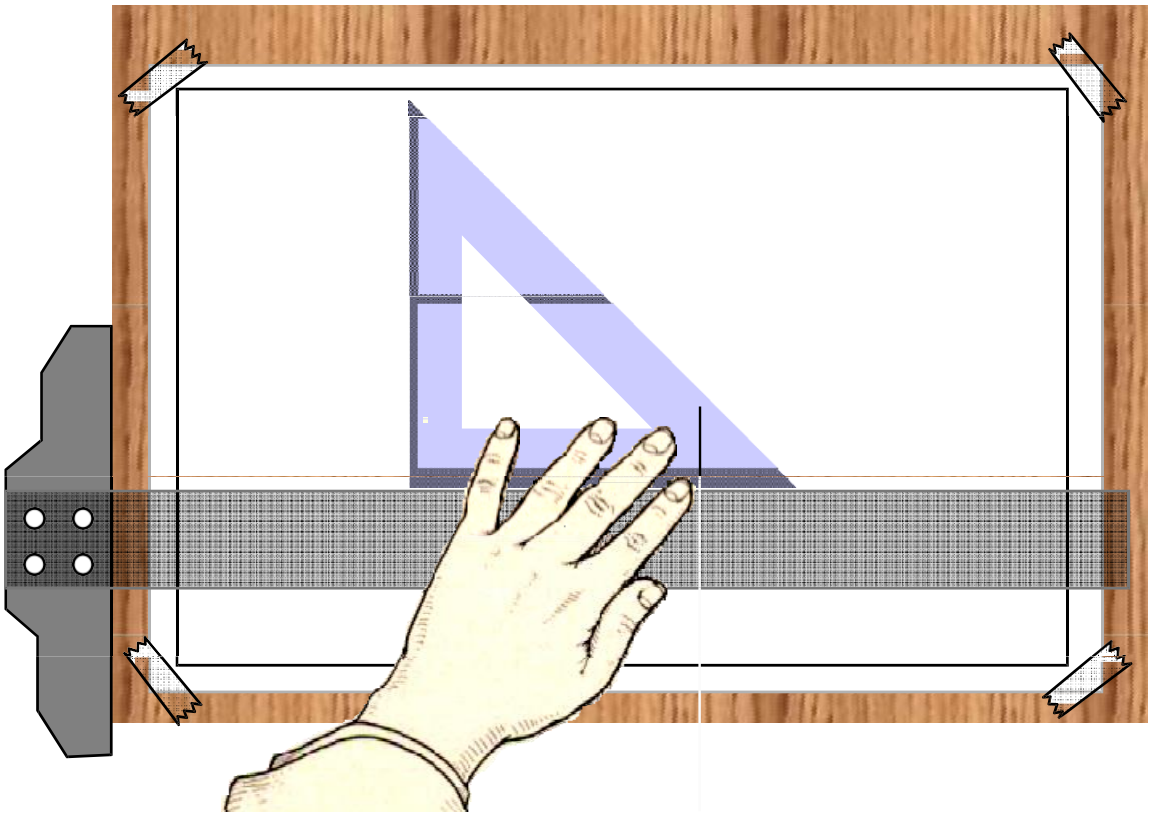
3. Lean the pencil at an angle about 60^{o} with the paper in the direction of the line and slightly “toed in”.

4. Draw the line from left to right while rotating the pencil slowly.



Draw a Vertical Line

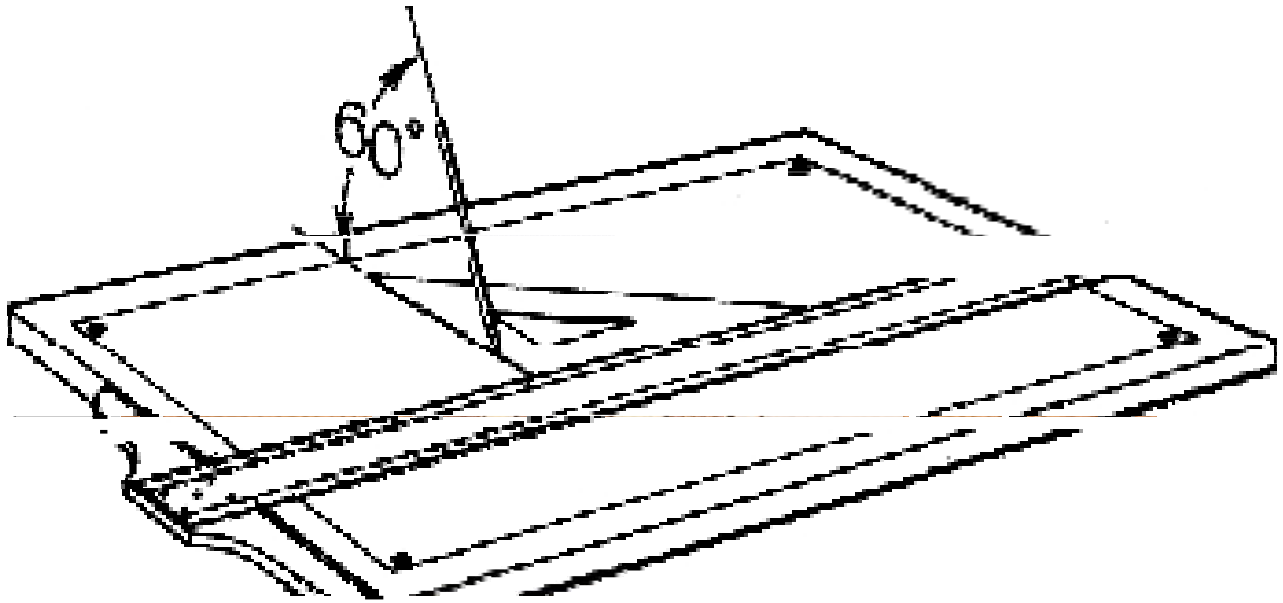
1. Set T-square as before. Place any triangle on T-square edge.
2. Slide your left hand to hold both T-square and triangle in position.



Draw a Vertical Line

3. Lean the pencil to the triangle.

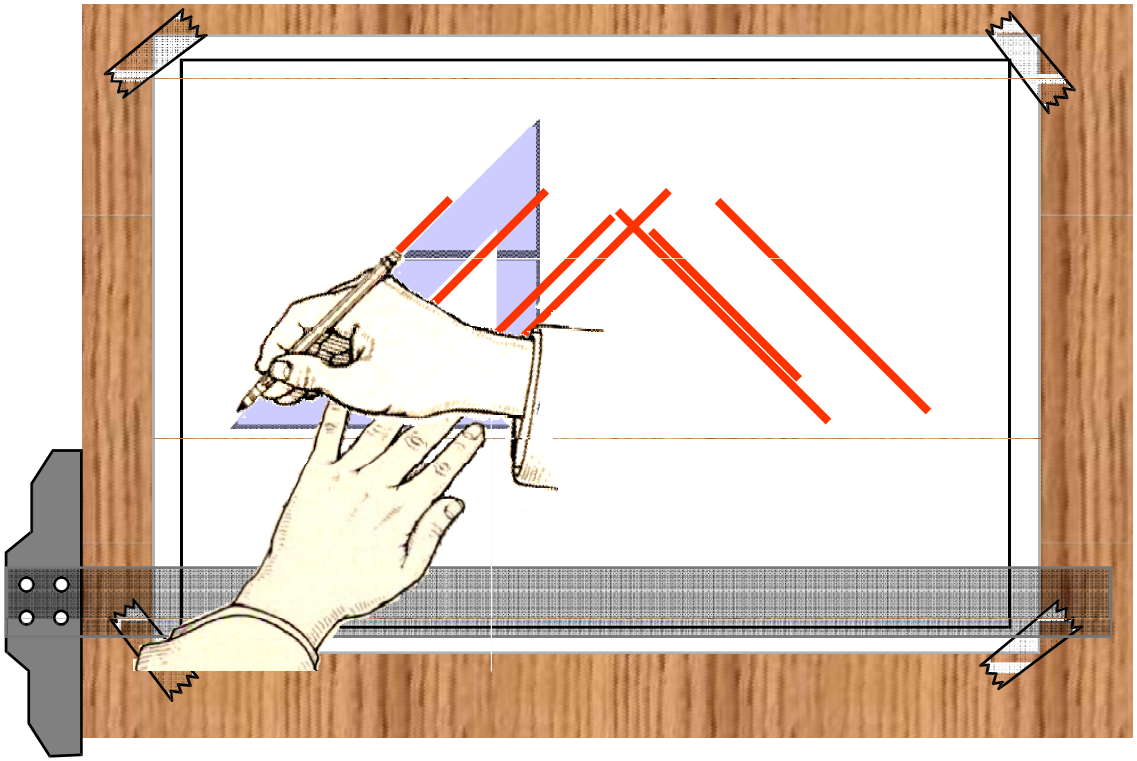
4. Draw the line upward while rotating the pencil slowly.



Draw a line at 45^{o} with horizontal

1. Place 45^{o} triangle on the T-square edge and press them firmly against the paper.

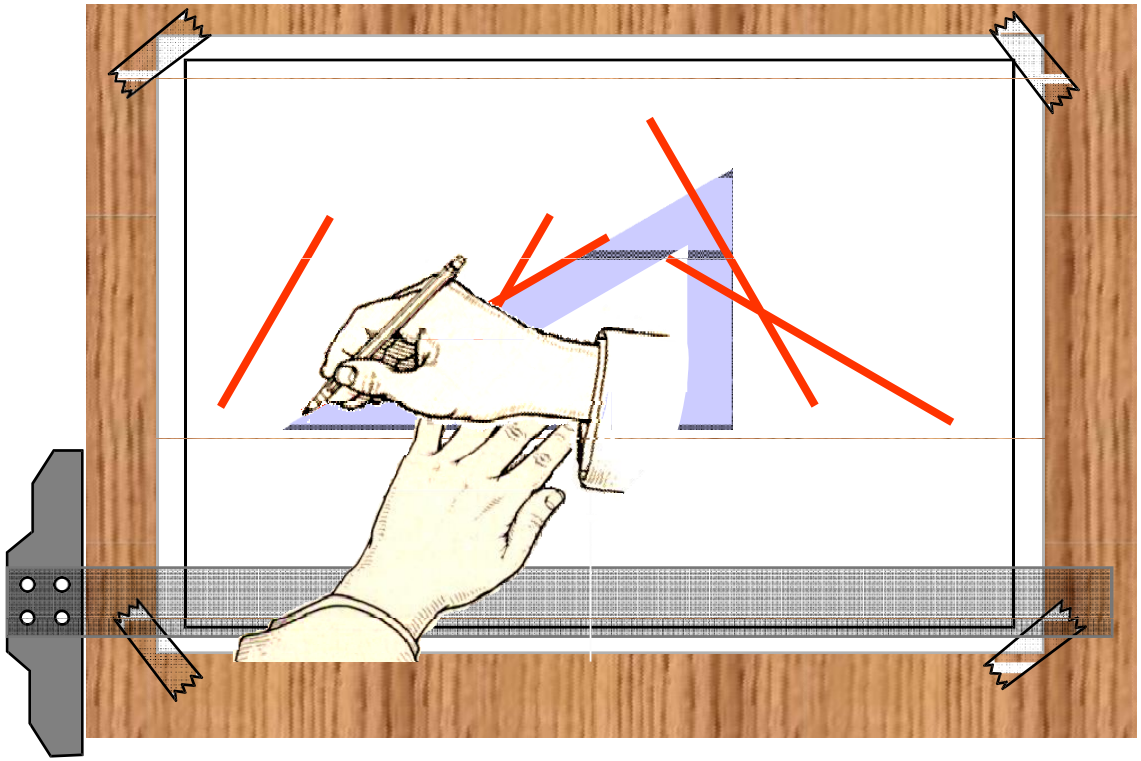
2. Draw the line in the direction as shown below.



Draw a line at angle 30^o and 60^o

1. Place 30^o-60^o triangle on the T-square edge and press them firmly against the paper.

2. Draw the line in the direction as shown below.



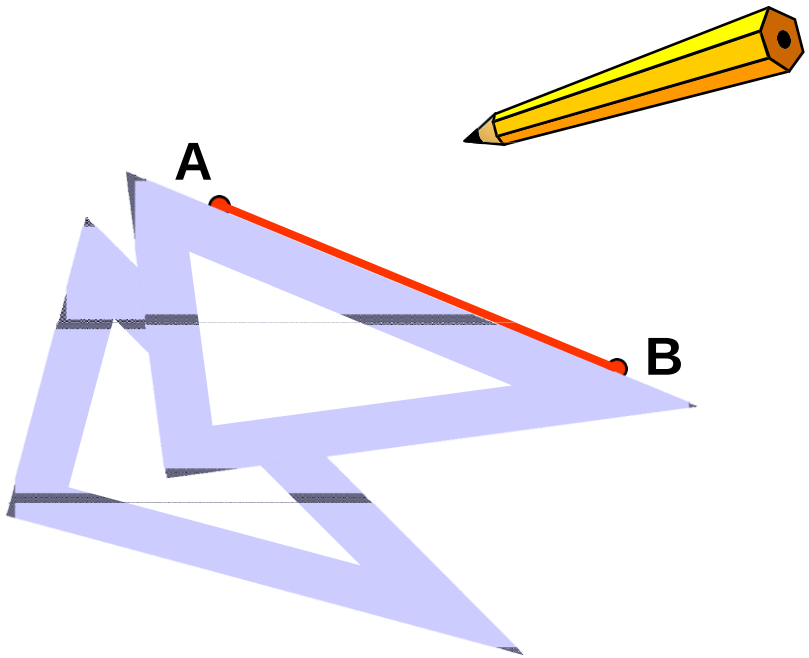
Draw the line passing through two given points

1. Place the pencil tip at one of the points.
2. Place the triangle against the pencil tip.
3. Swing the triangle around the pencil tip until its edge align with the second point.
4. Draw a line.

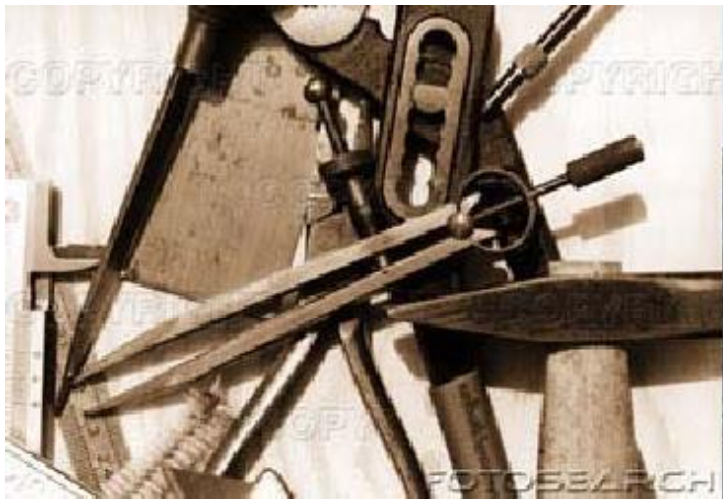
Given

A

B



Applied Geometry



Geometric construction techniques are procedures used to properly fit some details related to drawings avoiding randomness. For example, tangency between lines, arcs, etc.

In literature, there is a huge number of problems related to geometric construction. For example, how to draw an ellipse.

In this course tangency related problems will be detailed.

Cases we care about

1- Bisecting a Line.

2- Bisecting an angle.

3- Fillet and round.

4- To draw an arc of given radius tangent to two perpendicular lines.

5- Making an offset at distance R.

6- An arc (R) that is tangent to two lines.

7- An arc (R) that is tangent to an arc and line.

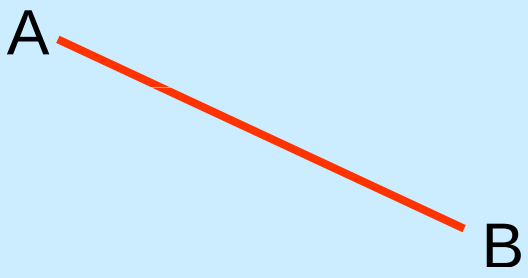
8-To draw a line tangent to a circle from a point outside the circle.

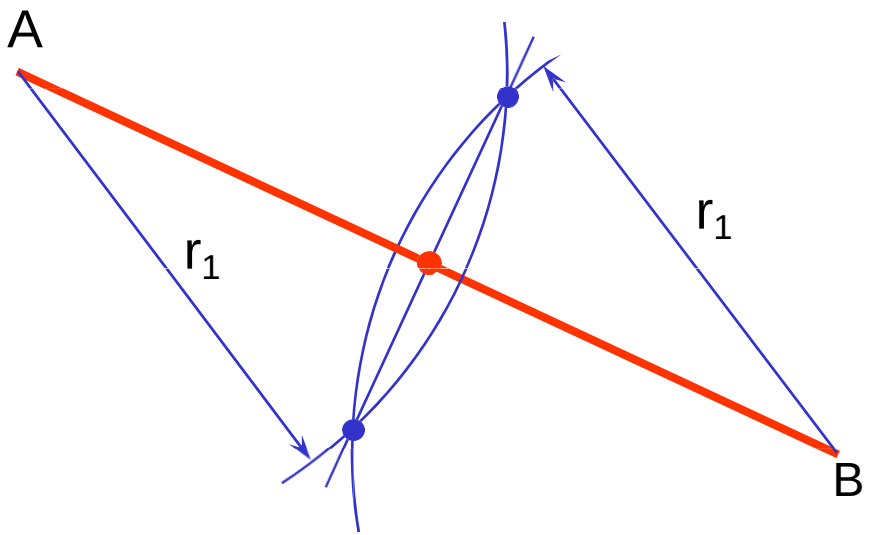
9-An arc (R) (or circle) that is tangent to two arcs (or circles).

To Bisect a Line

1. Swing two arcs of any radius greater than half-length of the line with the centers at the ends of the line.
2. Join the intersection points of the arcs with a line.
3. Locate the midpoint.

Given



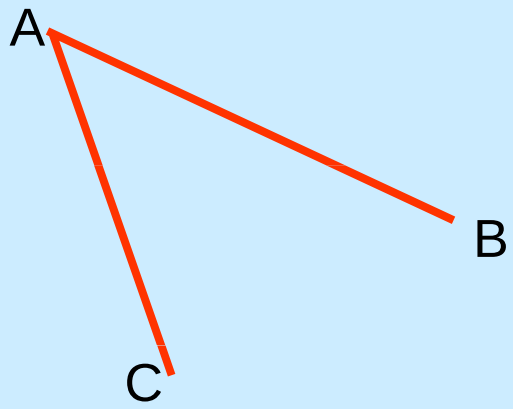


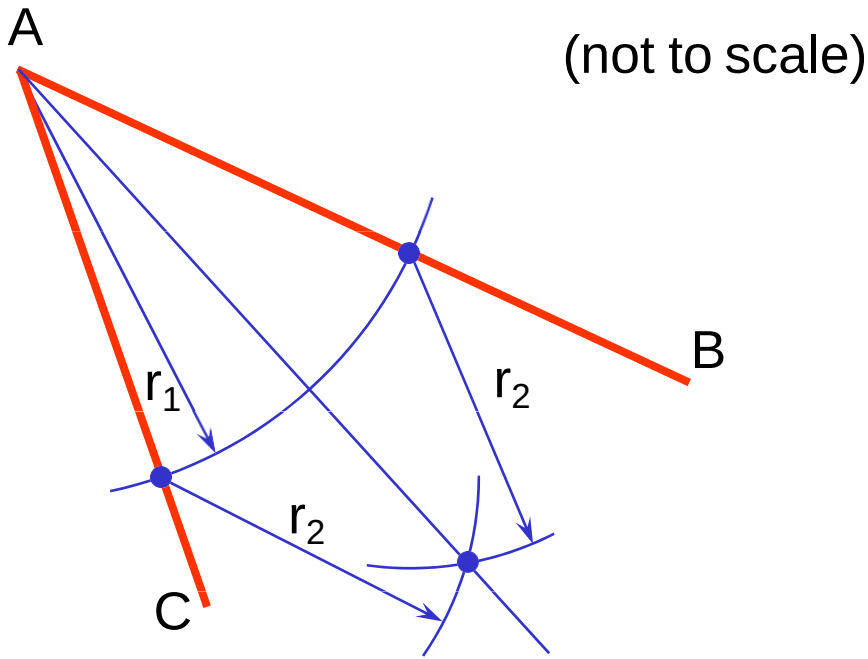
(not to scale)

To Bisect an Angle

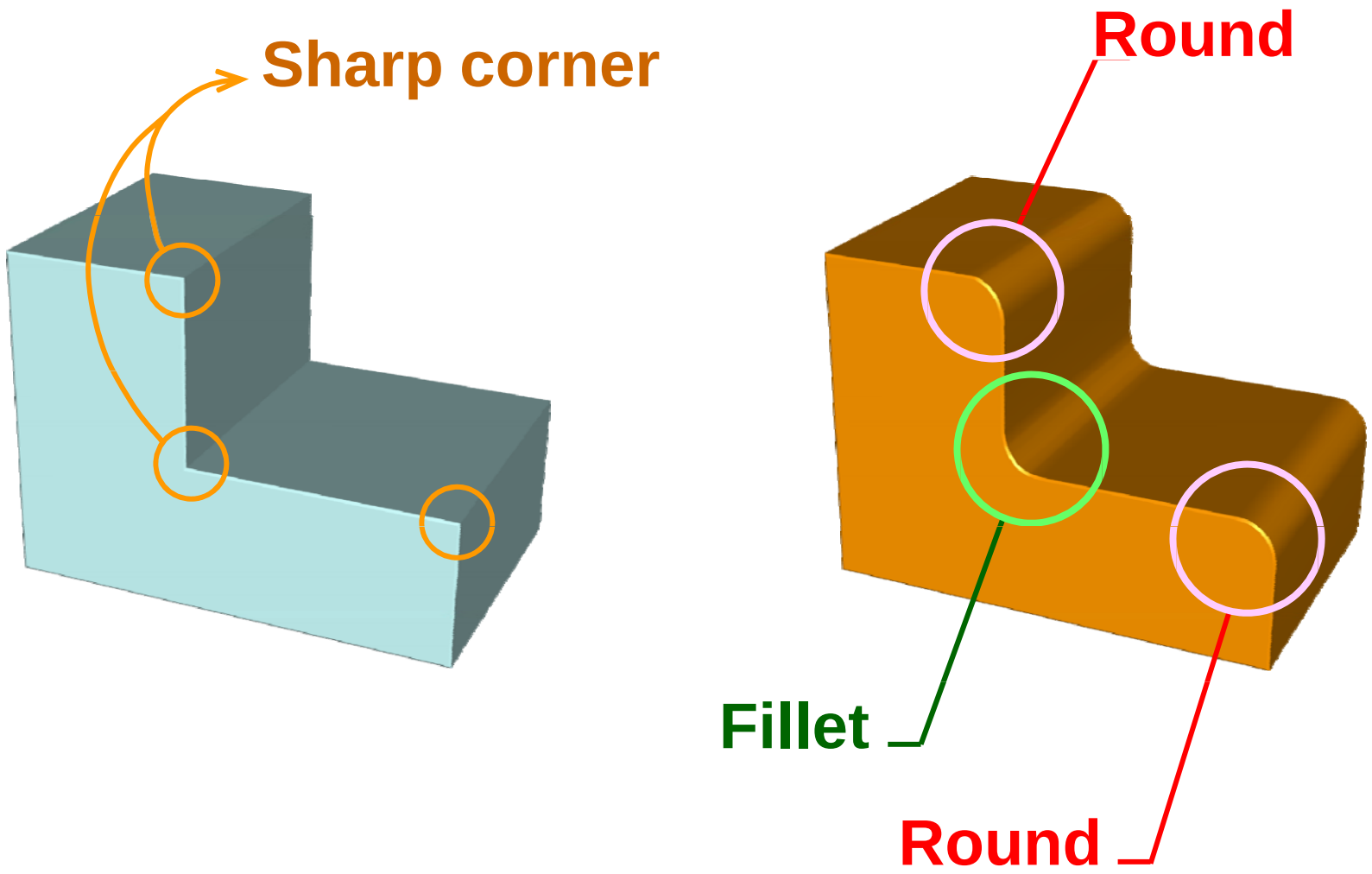
1. Swing an arc of any radius whose centers at the vertex.
2. Swing the arcs of any radius from the intersection points between the previous arc and the lines.
3. Draw the line.

Given

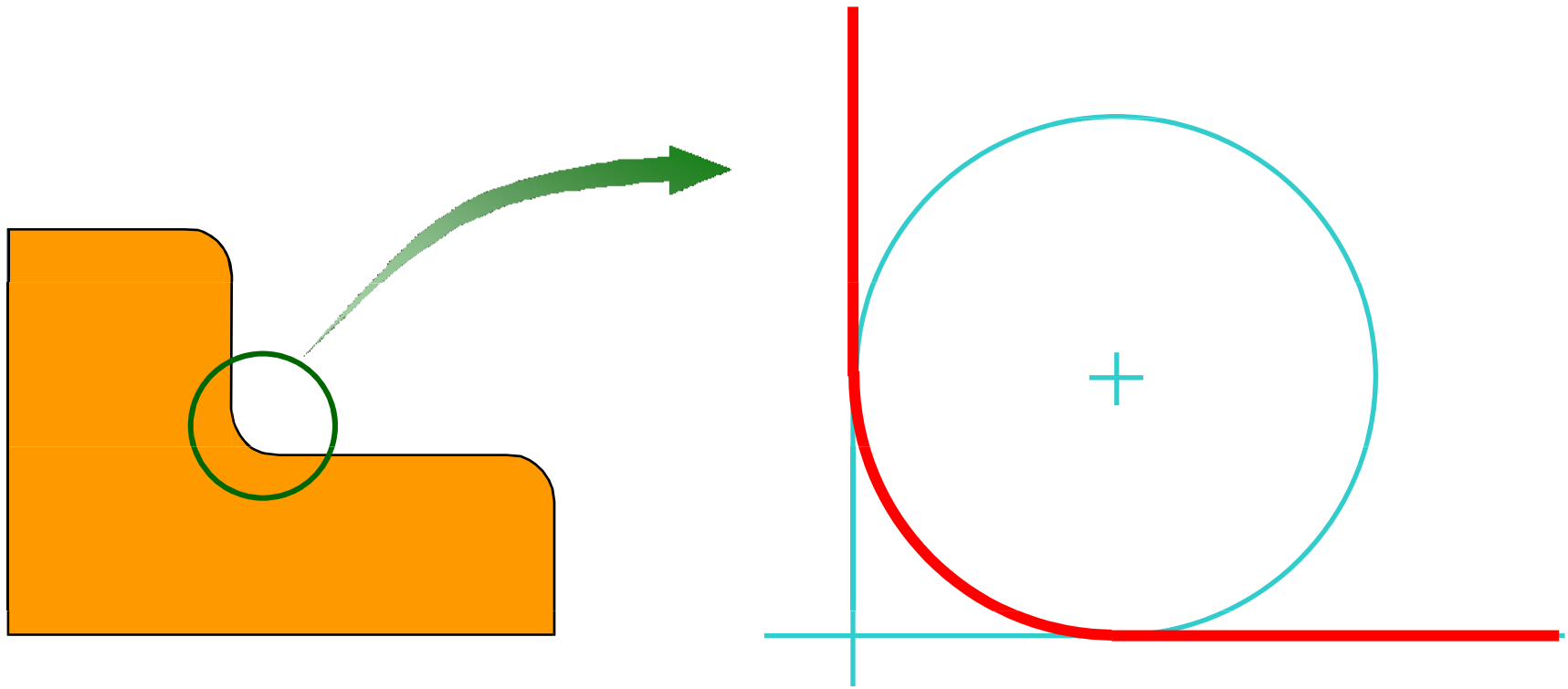




FILLET AND ROUND



FILLET AND ROUND

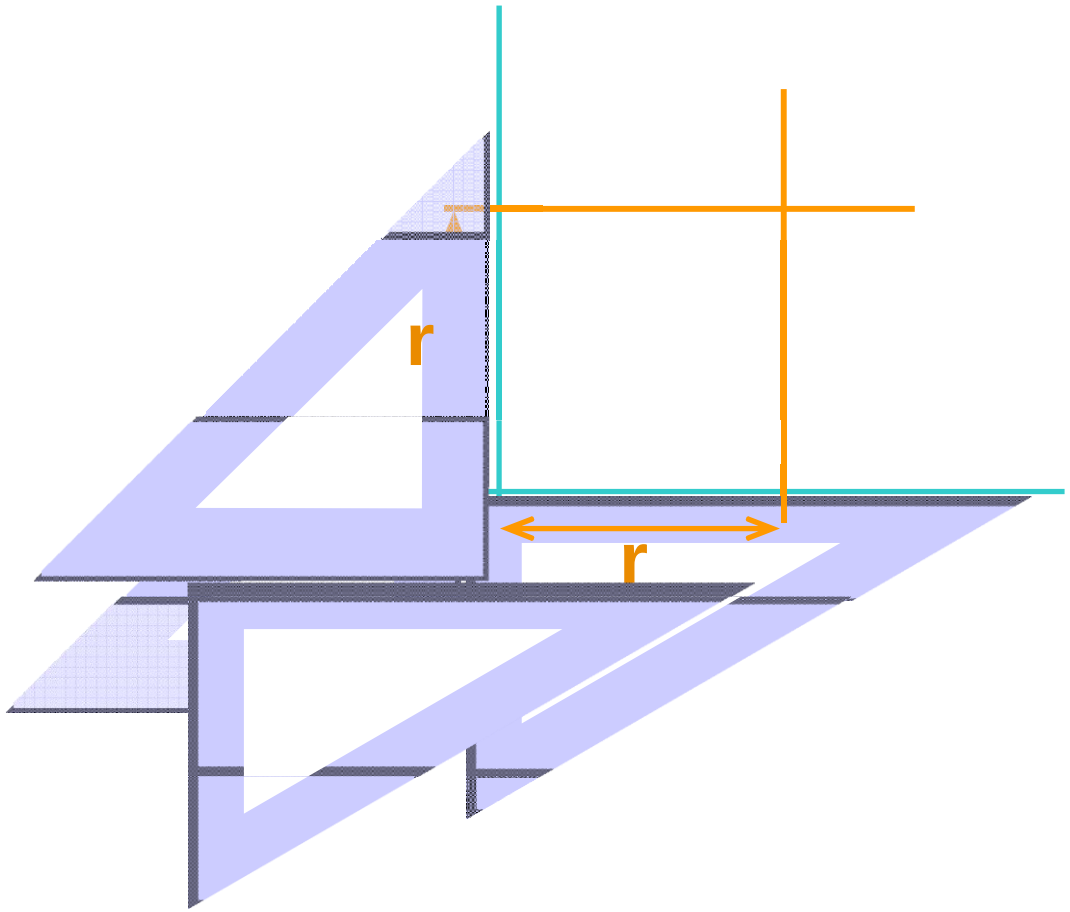


To draw the arc, we must find the location of the center of that arc.

How do we find the center of the arc?

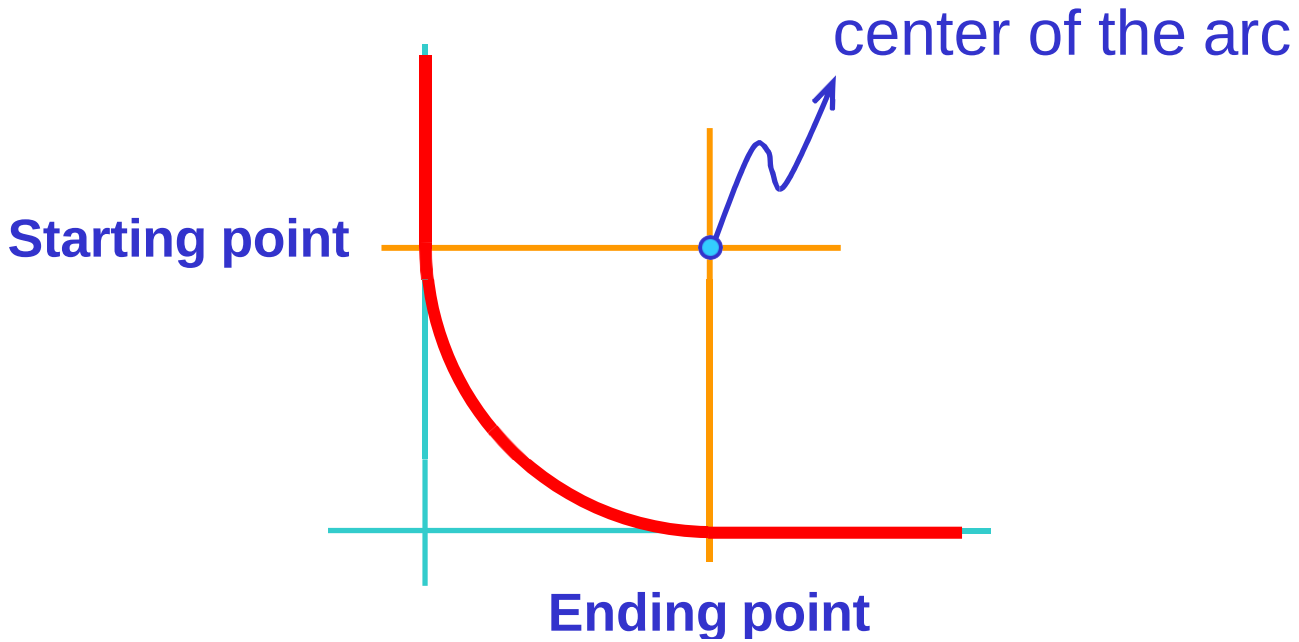
To draw an arc of given radius tangent to two perpendicular lines

Given arc radius r

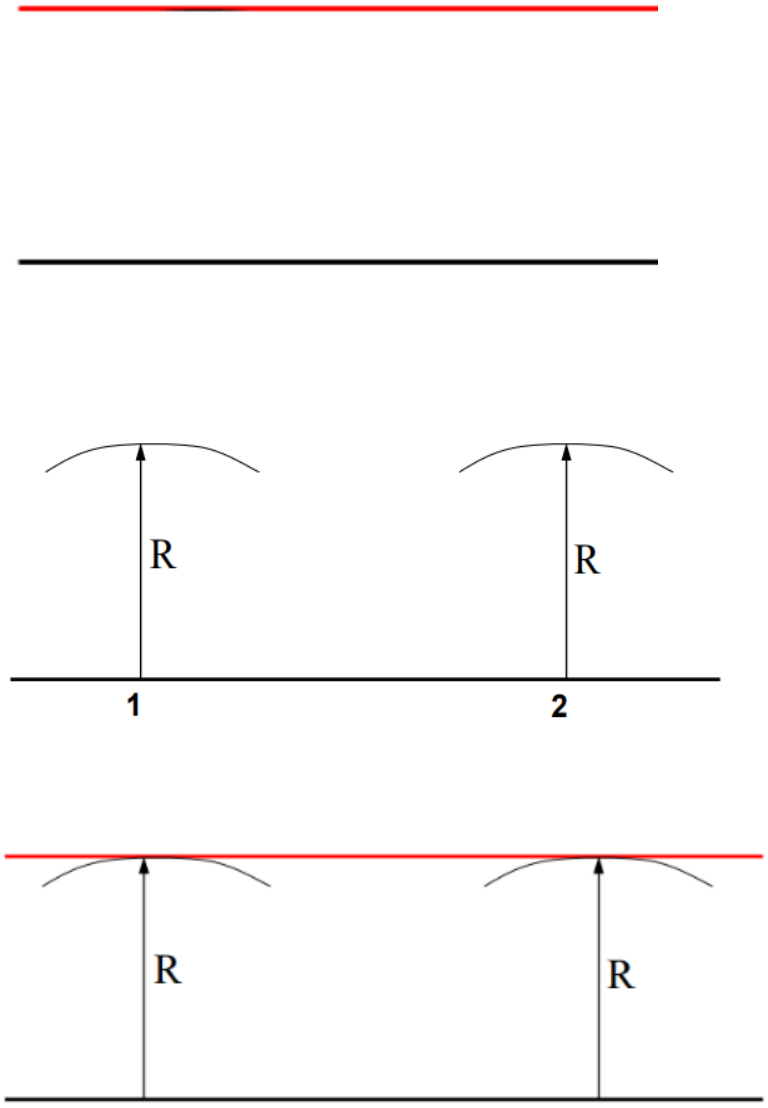


To draw an arc of given radius tangent to two perpendicular lines

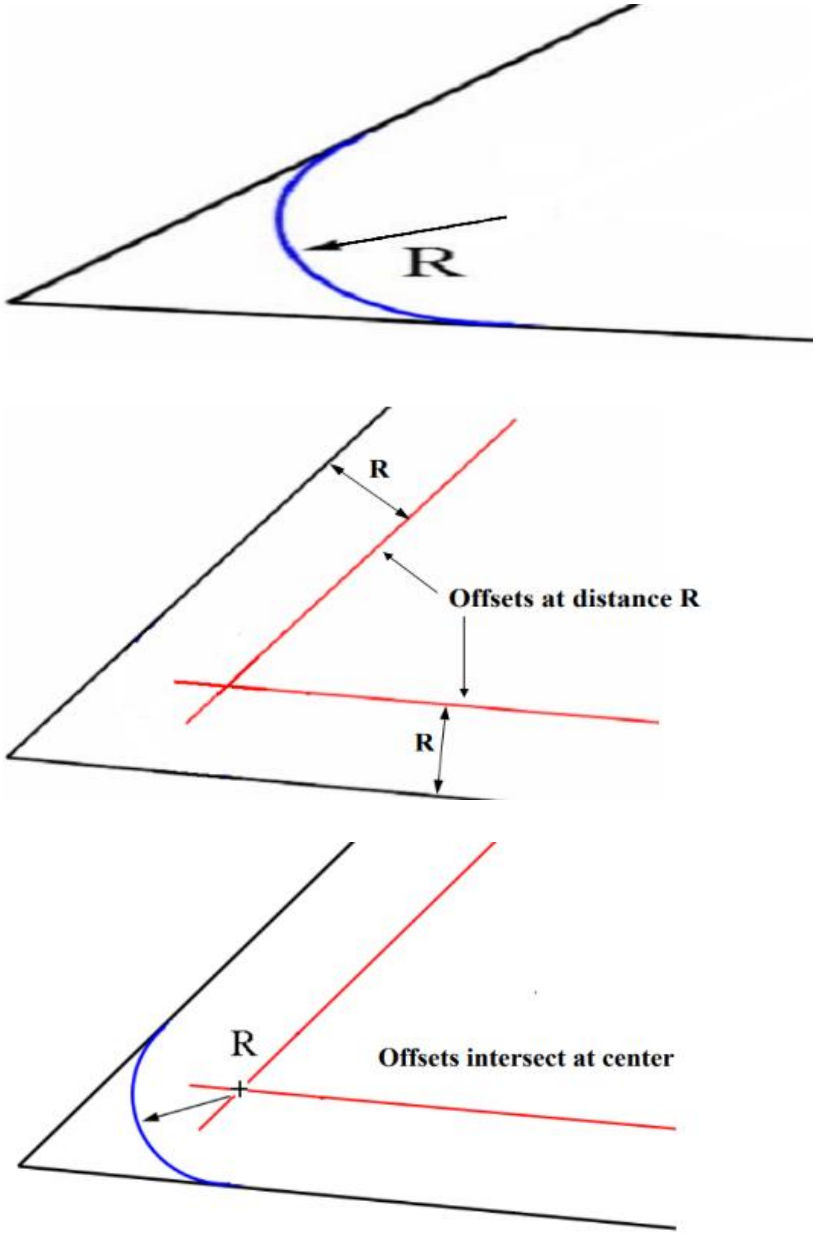
Given arc radius r



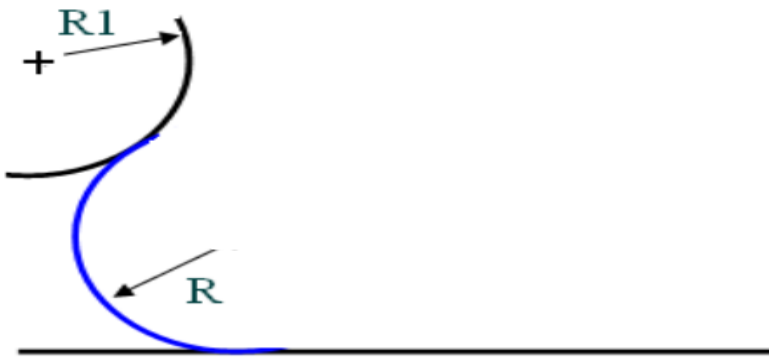
Making an offset at distance R

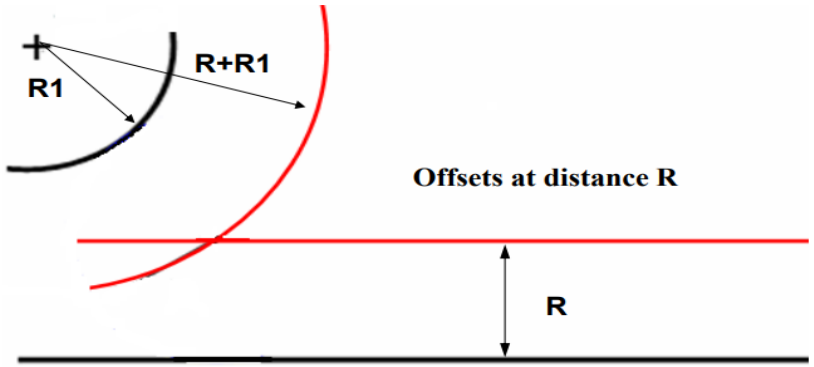


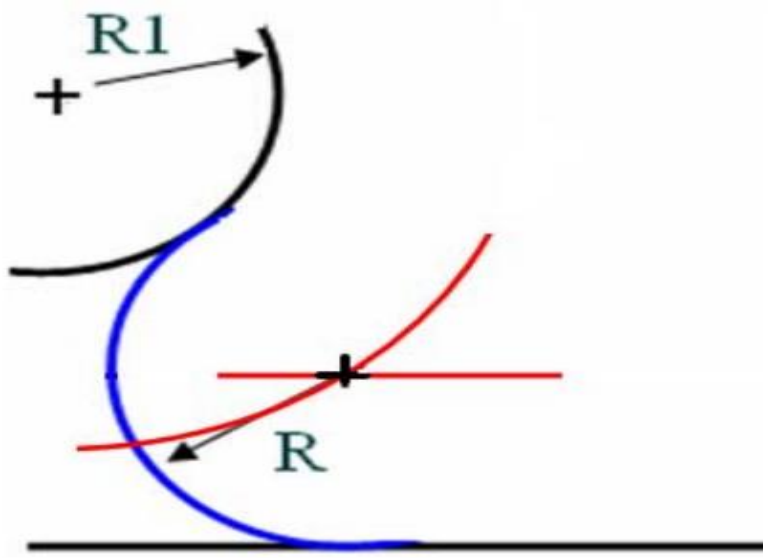
An arc (R) that is tangent to two lines

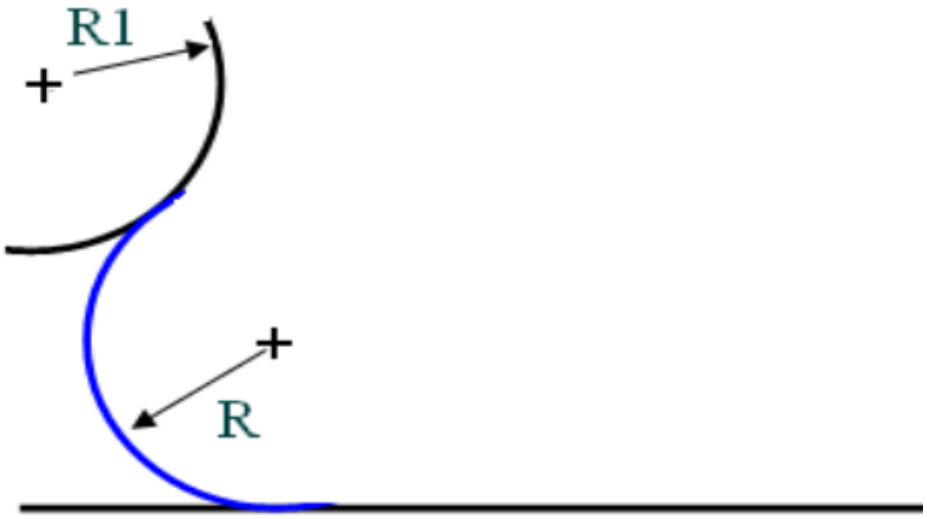


An arc (R) that is tangent to line and an arc (R1).



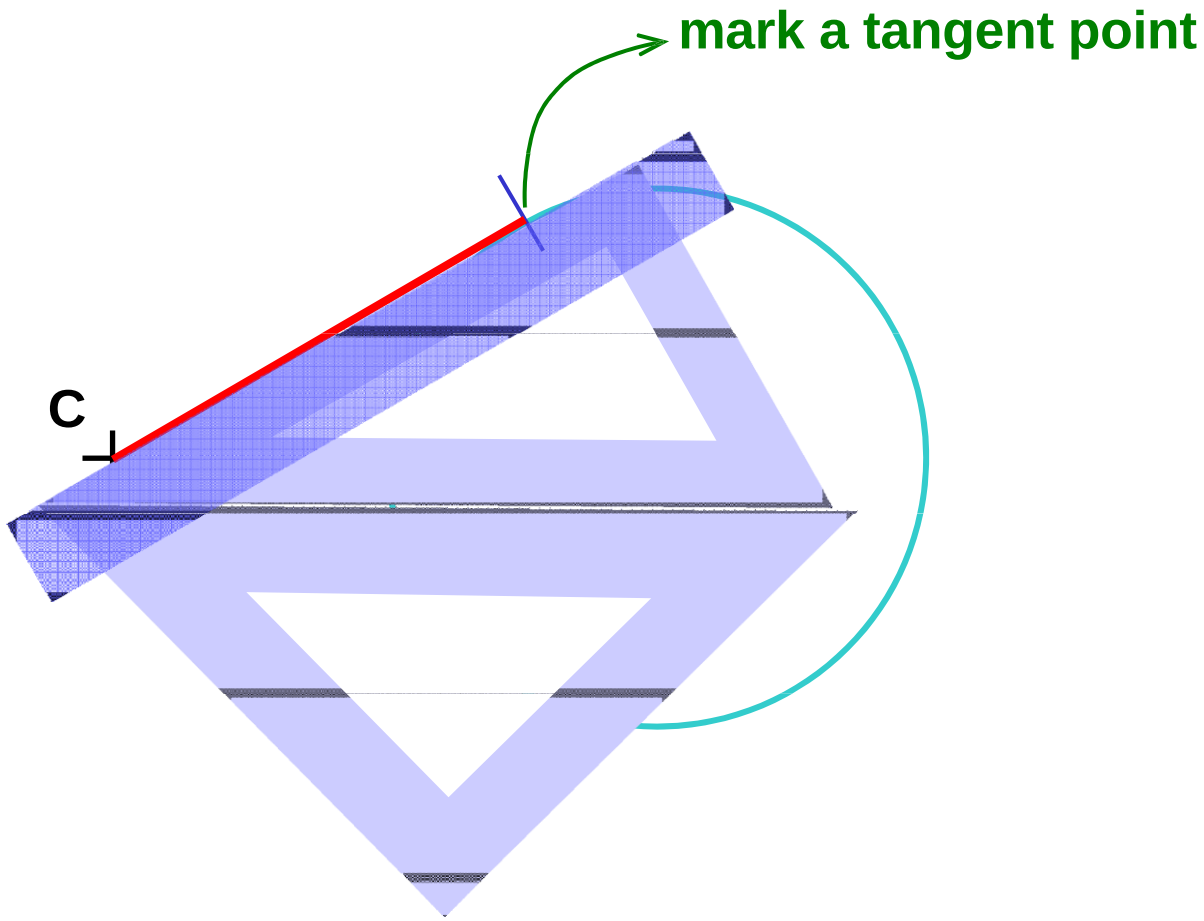




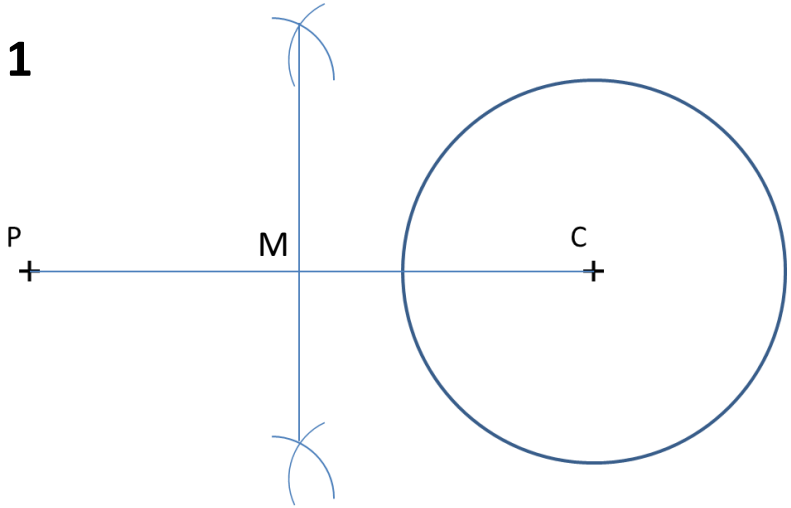


To draw a line tangent to a circle from a point outside the circle

Given

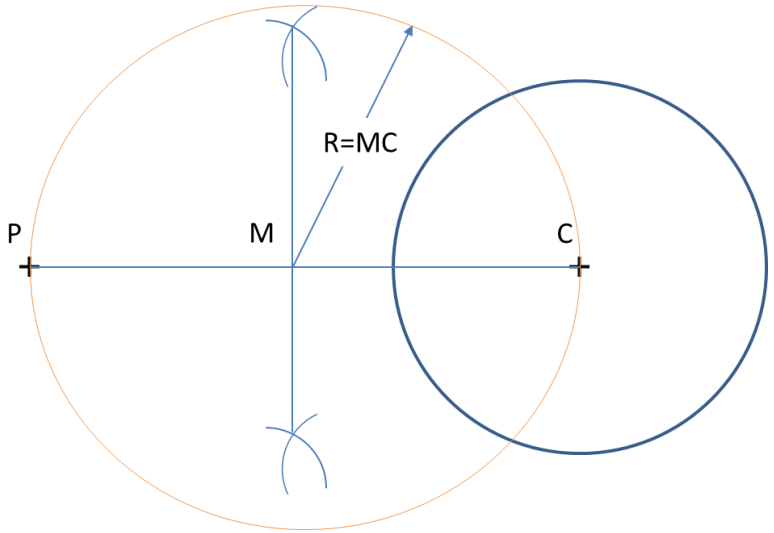


1



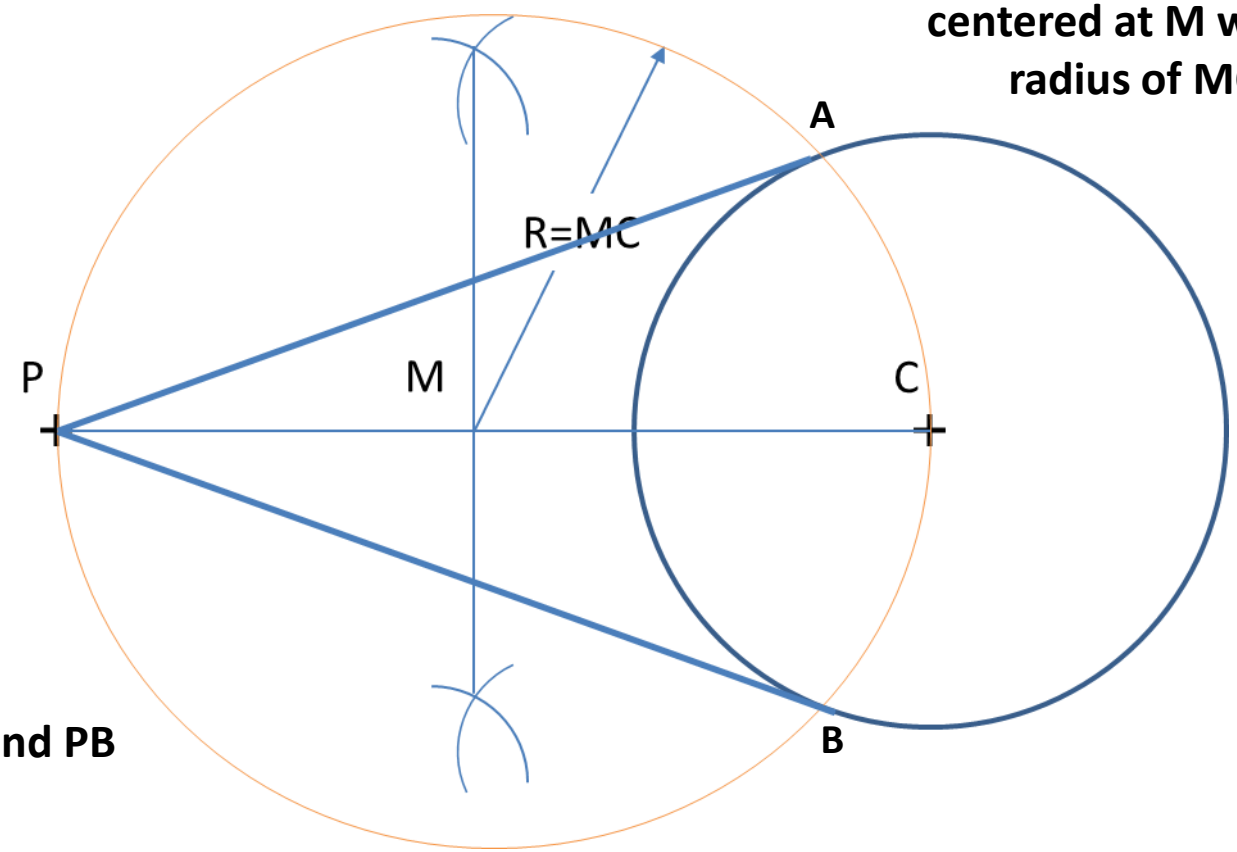
Bisect line PC at M

2



Draw a circle centered at M with a radius of MC

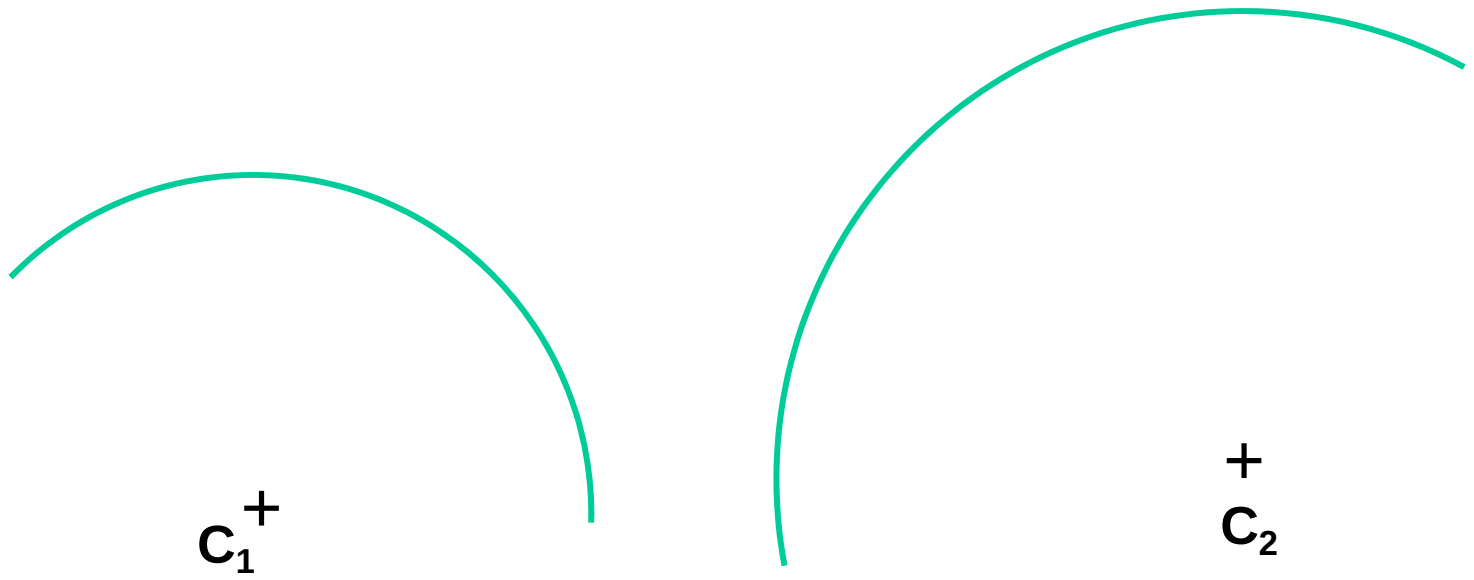
3



Connect PA and PB

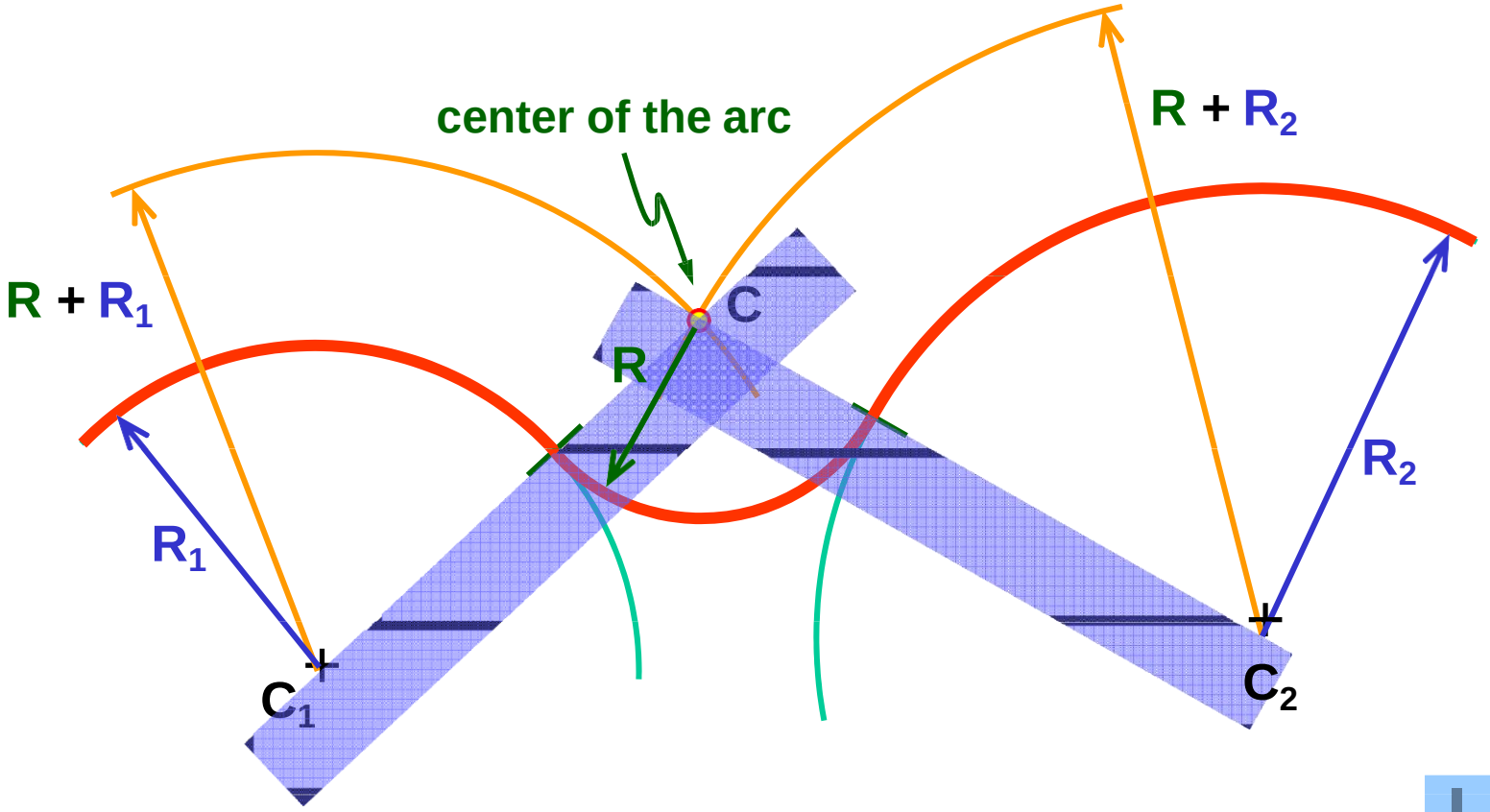
To draw a circle tangent to two circles I

Given Two circles and the radius of the third circle = R



To draw a circle tangent to two circles I

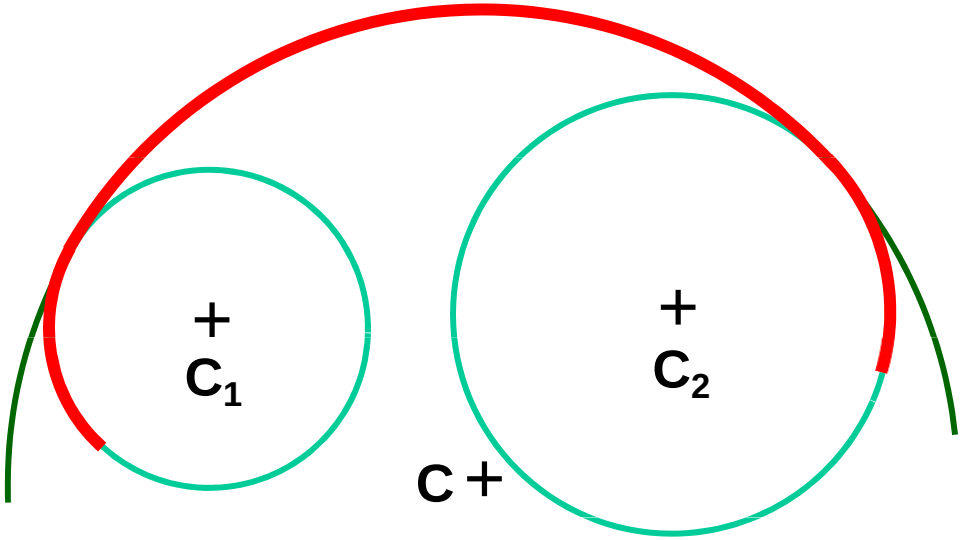
Given Two circles and the radius of the third circle = R



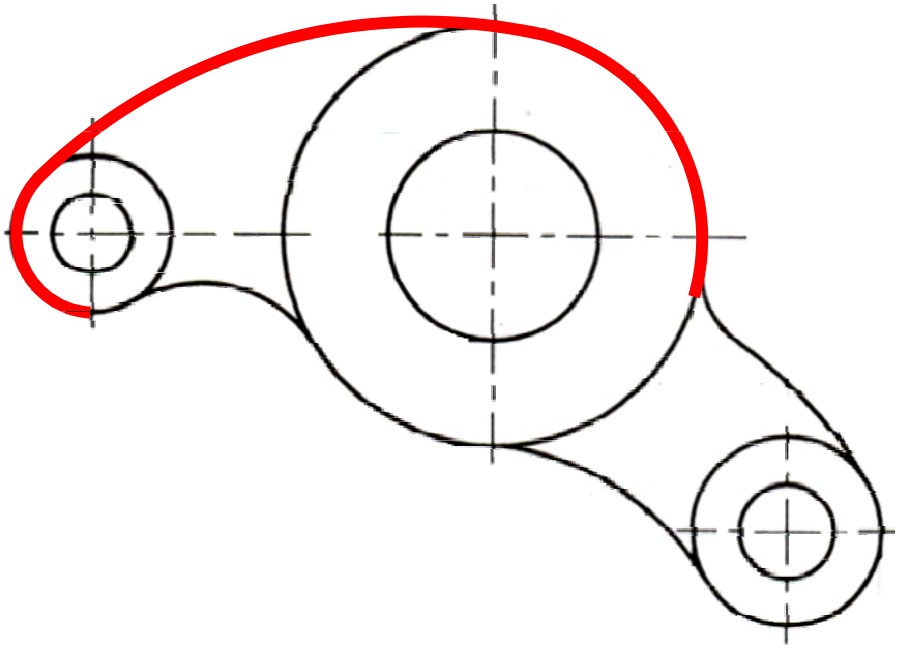
Repeat

To draw a circle tangent to two circles II

Given

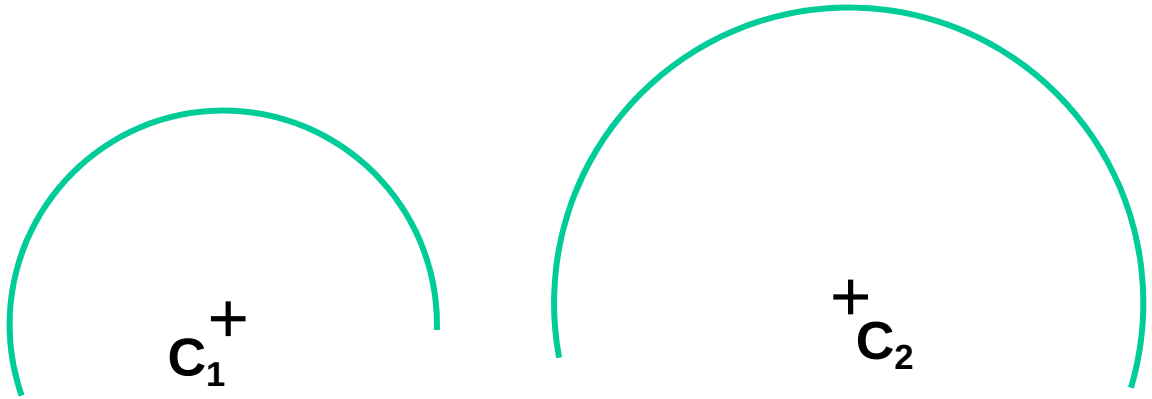


Example



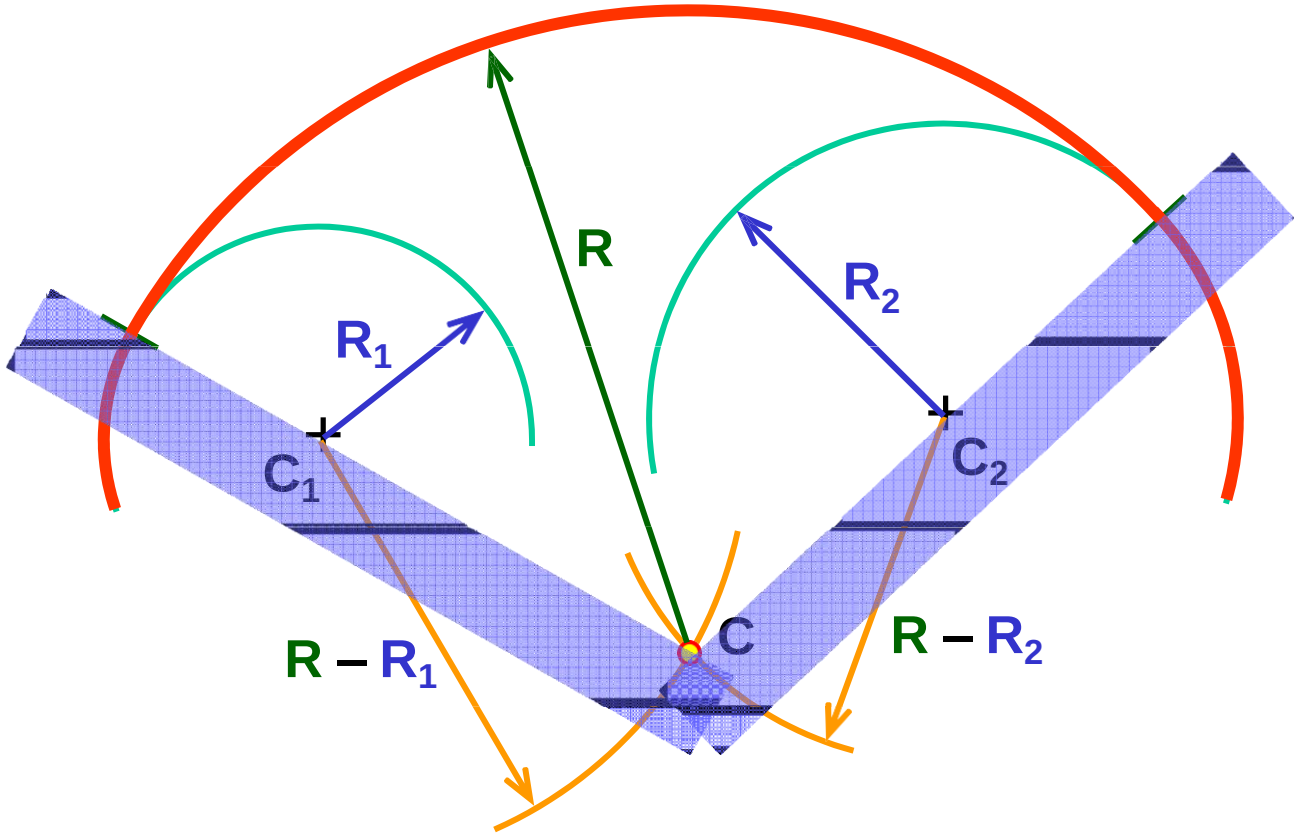
To draw a circle tangent to two circles II

Given Two circles and the radius of the third circle = R



To draw a circle tangent to two circles II

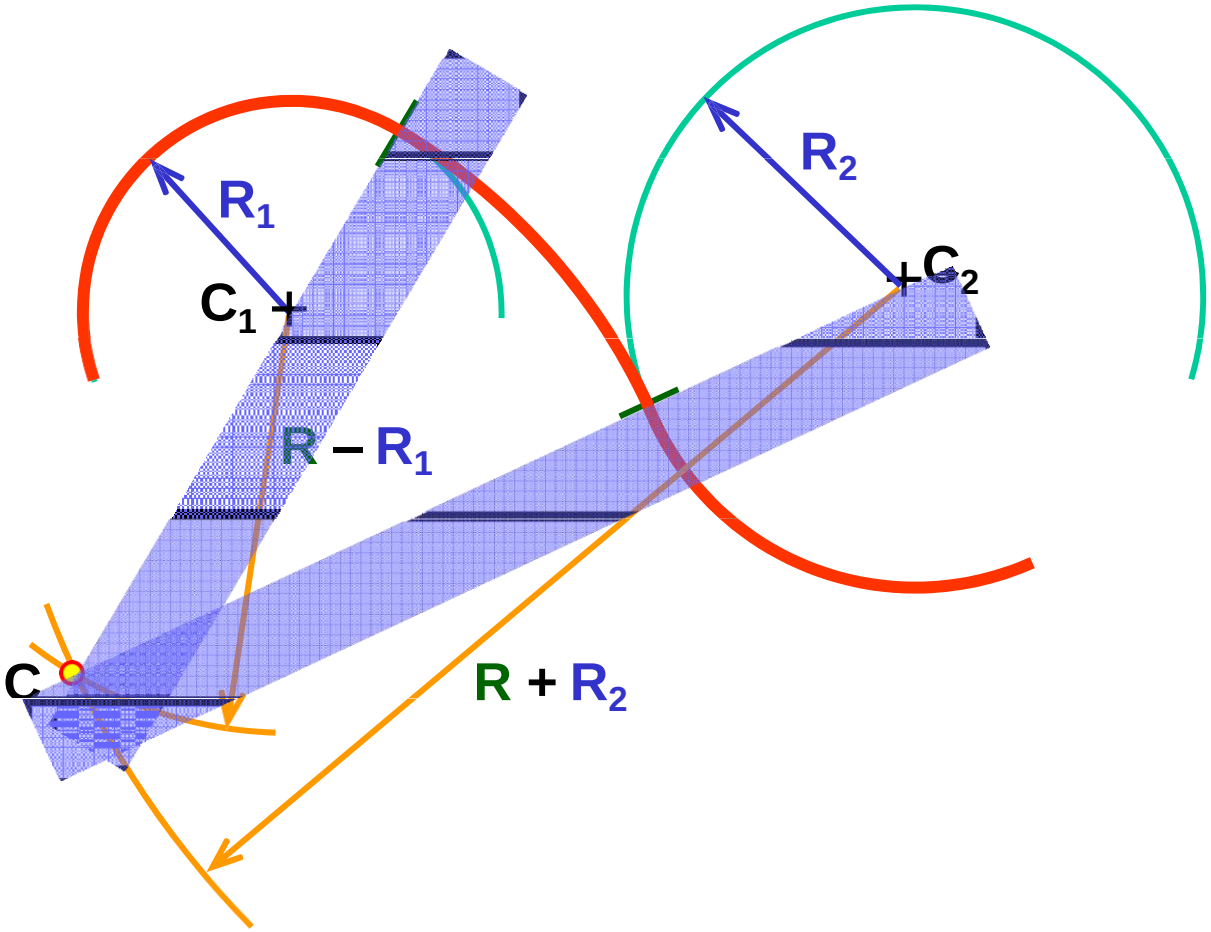
Given Two circles and the radius of the third circle = R



Repeat

To draw a circle tangent to two circles III

Given Two circles and the radius of the third circle = R



Polygons

Constructing a regular pentagon in a given circumscribing circle

1. Draw horizontal diameter AB and vertical diameter CD intersecting at O.

2. Draw the circle with radius equal to half of AB.

3. Construct the midpoint of OB and mark as E.

4. With E as a center and radius equal to CE, strike the arc CF to intersect AB at F.

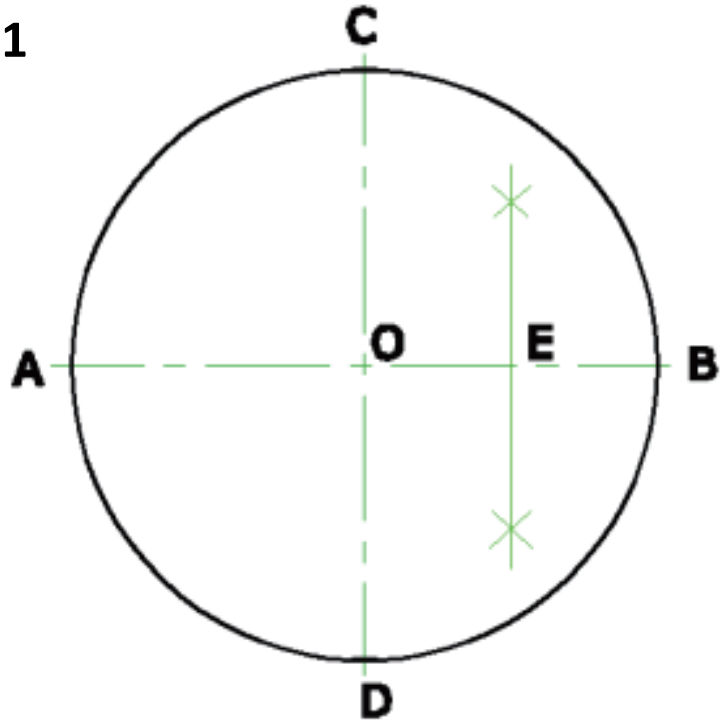
5. With C as a center and CF as a radius, strike the arc FG to intersect the circle at G.

Note: A line from G to C is one side of the pentagon.

6. Set a compass to GC and lay off this interval from C around the circle.

7. Connect the points of intersection

1



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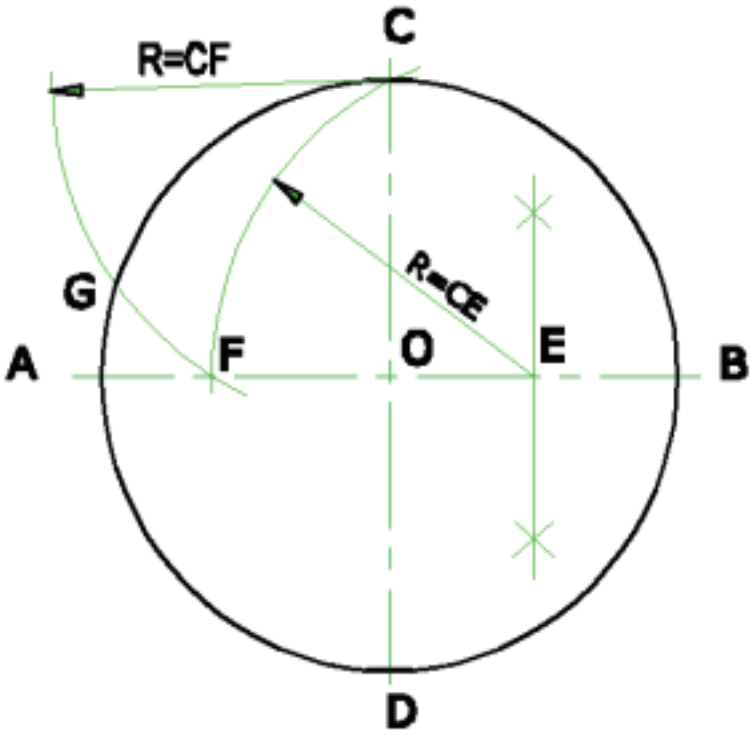

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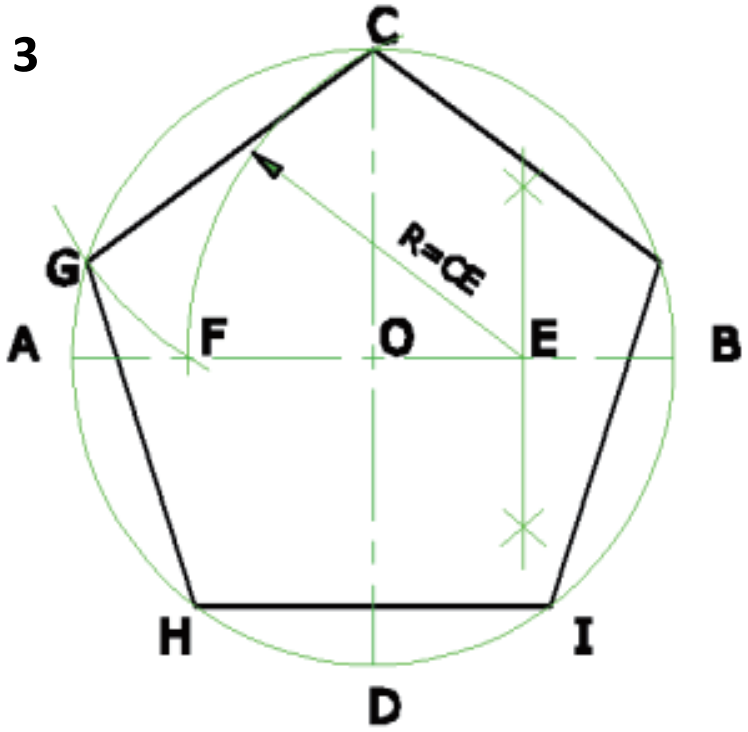
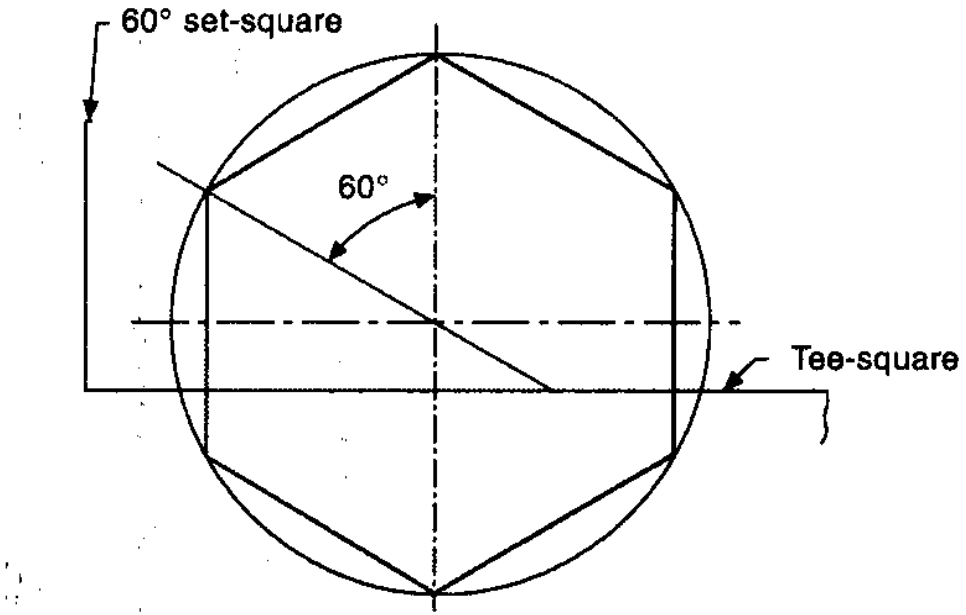


Constructing a regular hexagon in a given circumscribing circle

Draw vertical and horizontal center lines and a circle with a diameter equal to the given distance With a 60° set-square, draw points on the circumference 60° apart

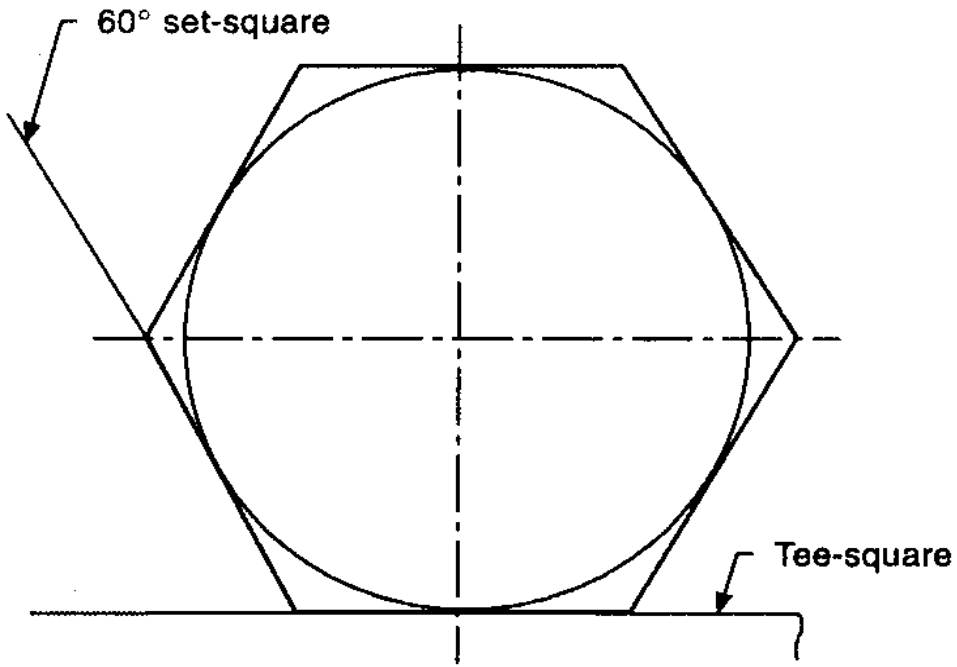
Connect these six points by straight lines to give the required hexagon.



Draw a hexagon, given the distance across the flats

1- Draw vertical and horizontal center lines and a circle with a diameter equal to the given distance.

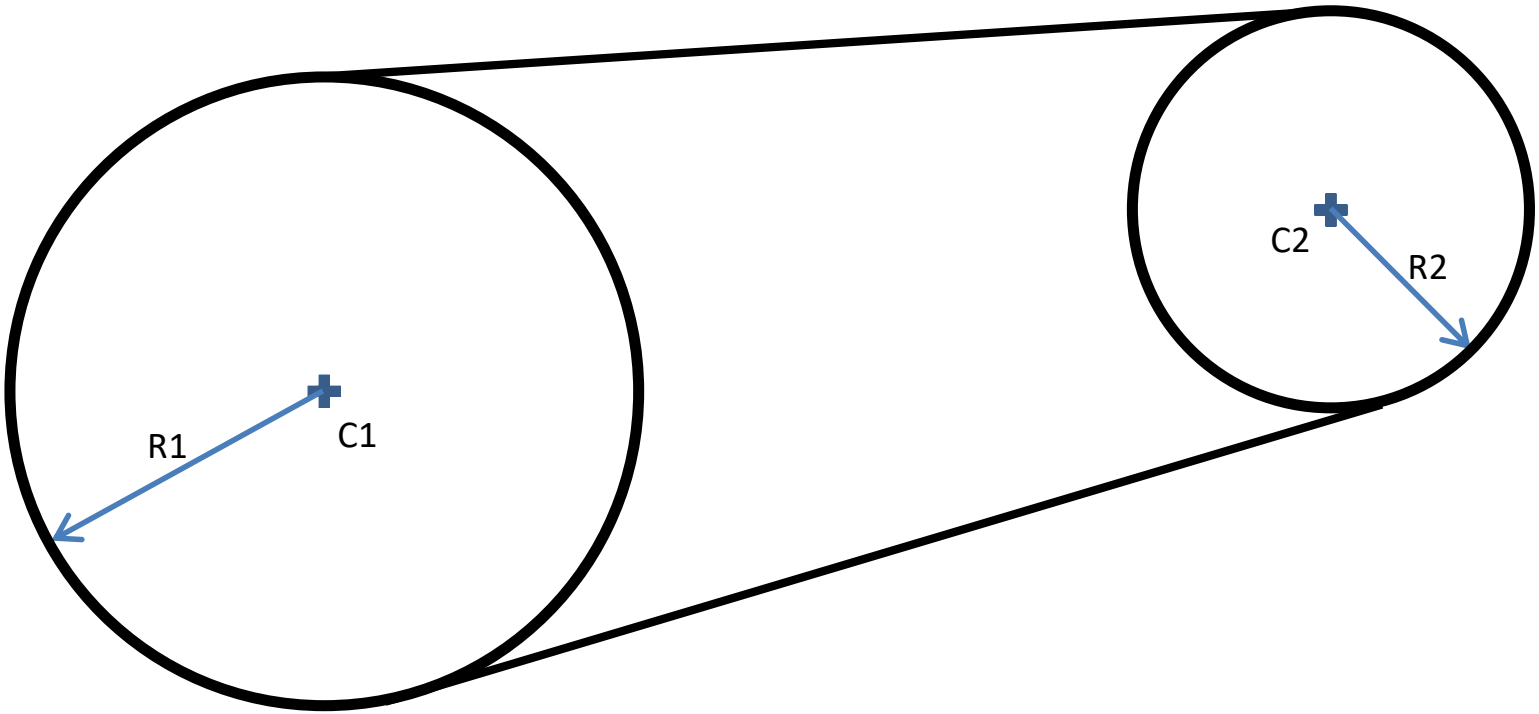
2- Use a 60° set-square and T-square as shown, to give the six sides.



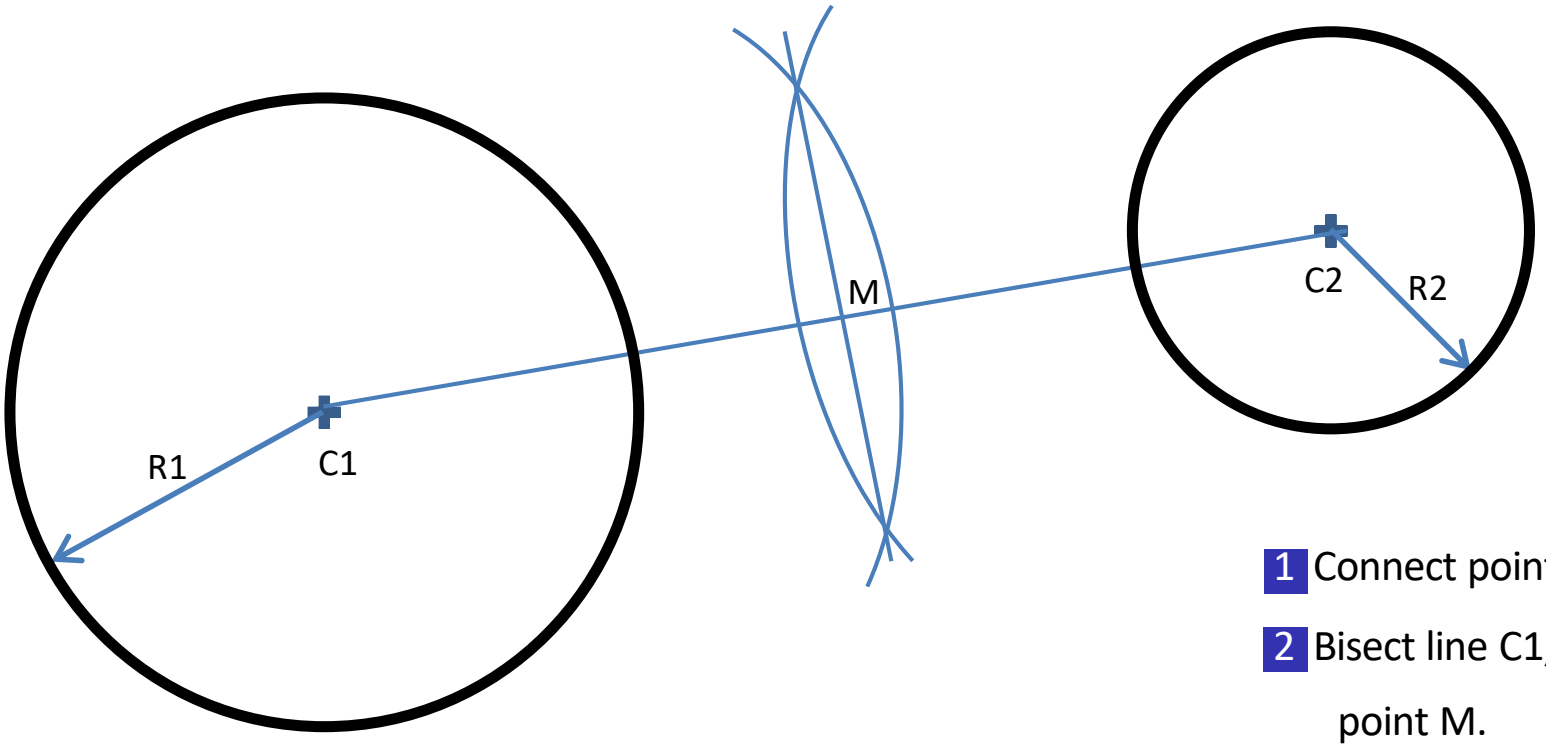
Geometric construction part 2: Tangent lines and Ellipse from Major and Minor Axes.

- **In this part of geometric construction, tangent lines of two circles with different radii will be presented.**
- **Two cases of tangency including external and internal tangent lines of circles are shown with steps.**
- **Drawing an Ellipse from major and minor axes method is presented in detail.**

Draw external tangent lines to two circles with different radii.

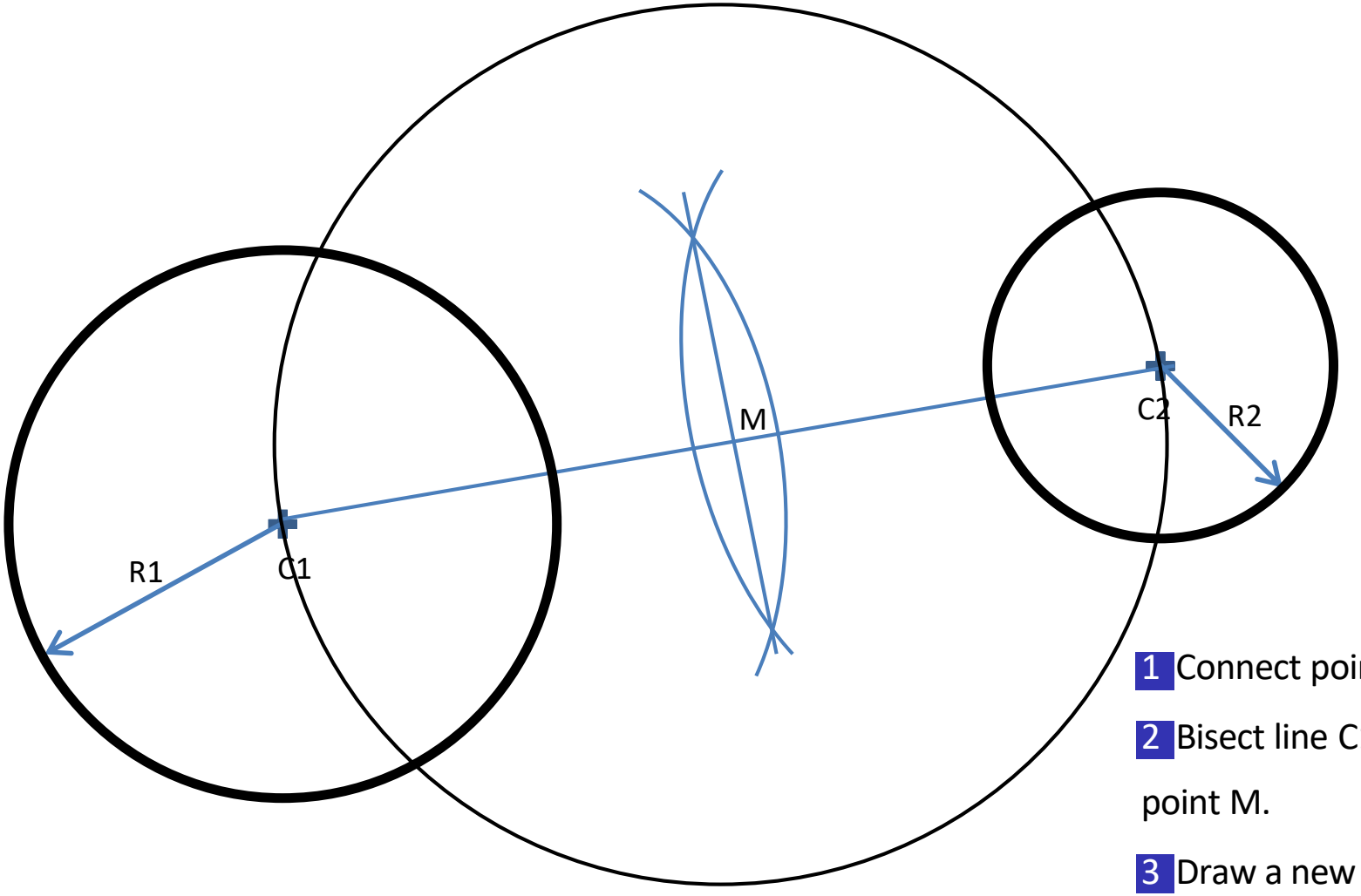


Draw external tangent lines to two circles with different radii.



1. Connect points C1 and C2.
2. Bisect line C1,C2 at the mid-point M.

Draw external tangent lines to two circles with different radii.

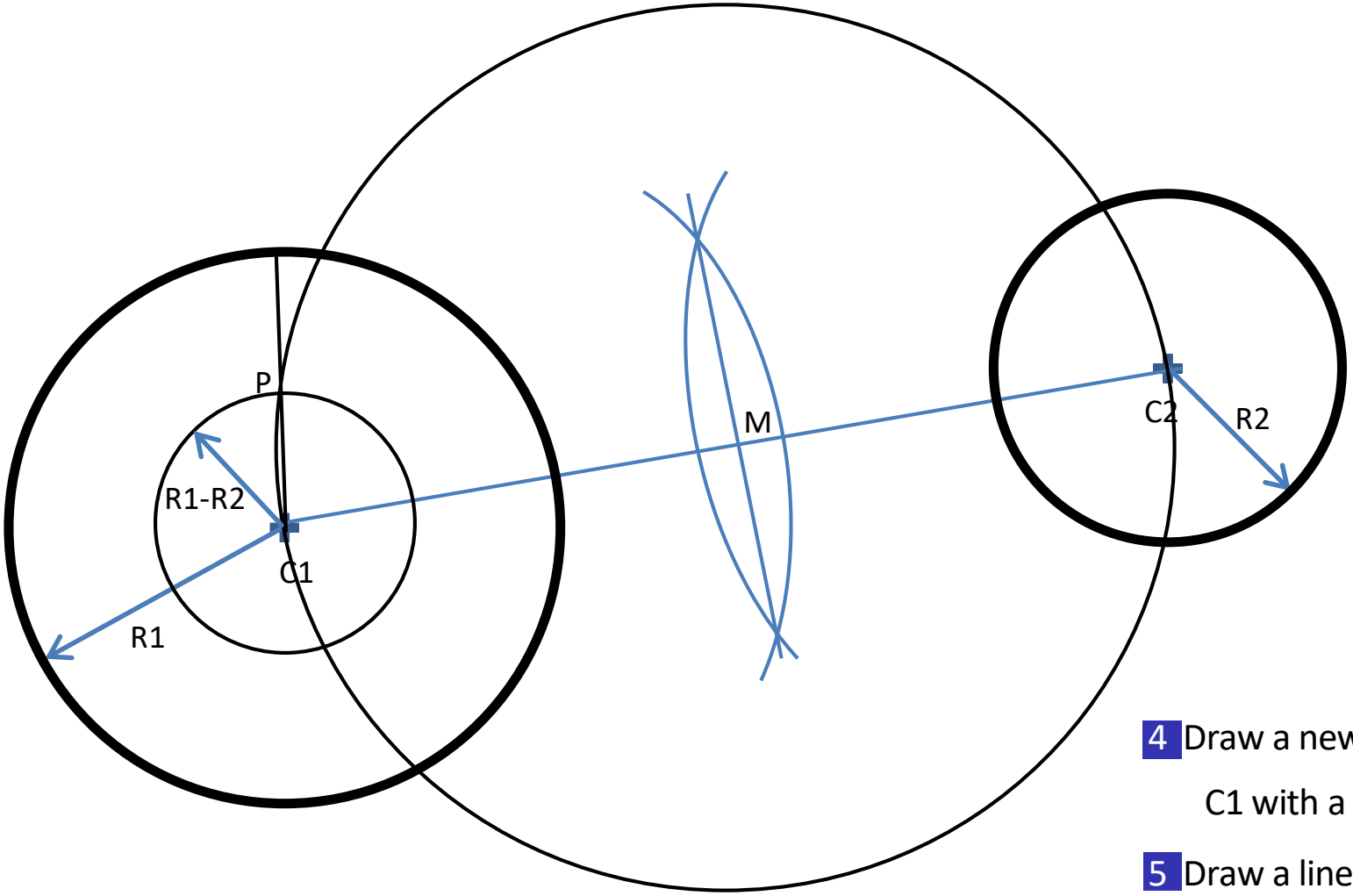


1 Connect points C1 and C2.

2 Bisect line C1,C2 at the mid-point M.

3 Draw a new circle from point M (center) with a radius of M,C1.

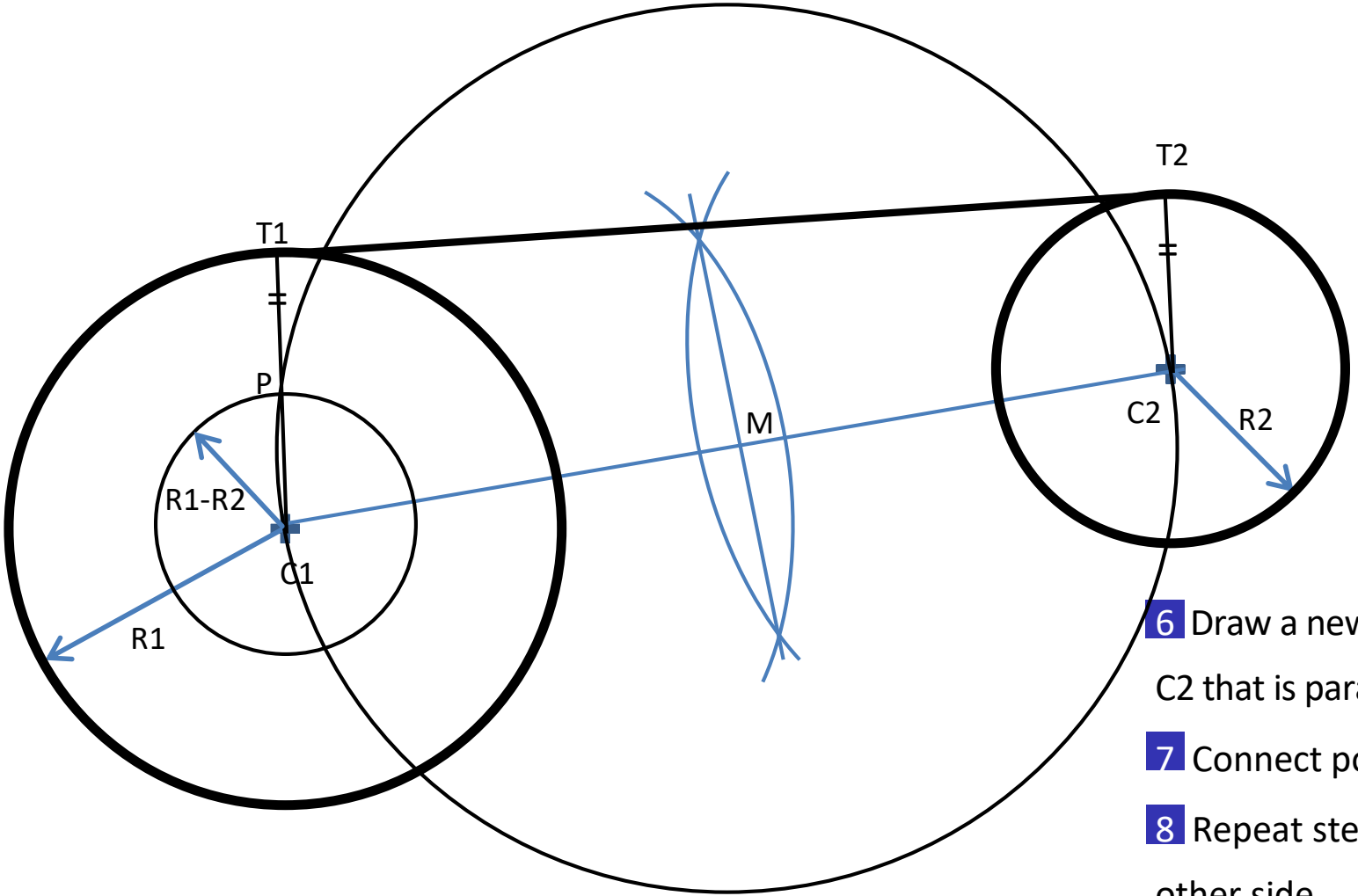
Draw external tangent lines to two circles with different radii.



4 Draw a new circle from point C1 with a radius of R1-R2.

5 Draw a line from point C1 passing through point P.

Draw external tangent lines to two circles with different radii.

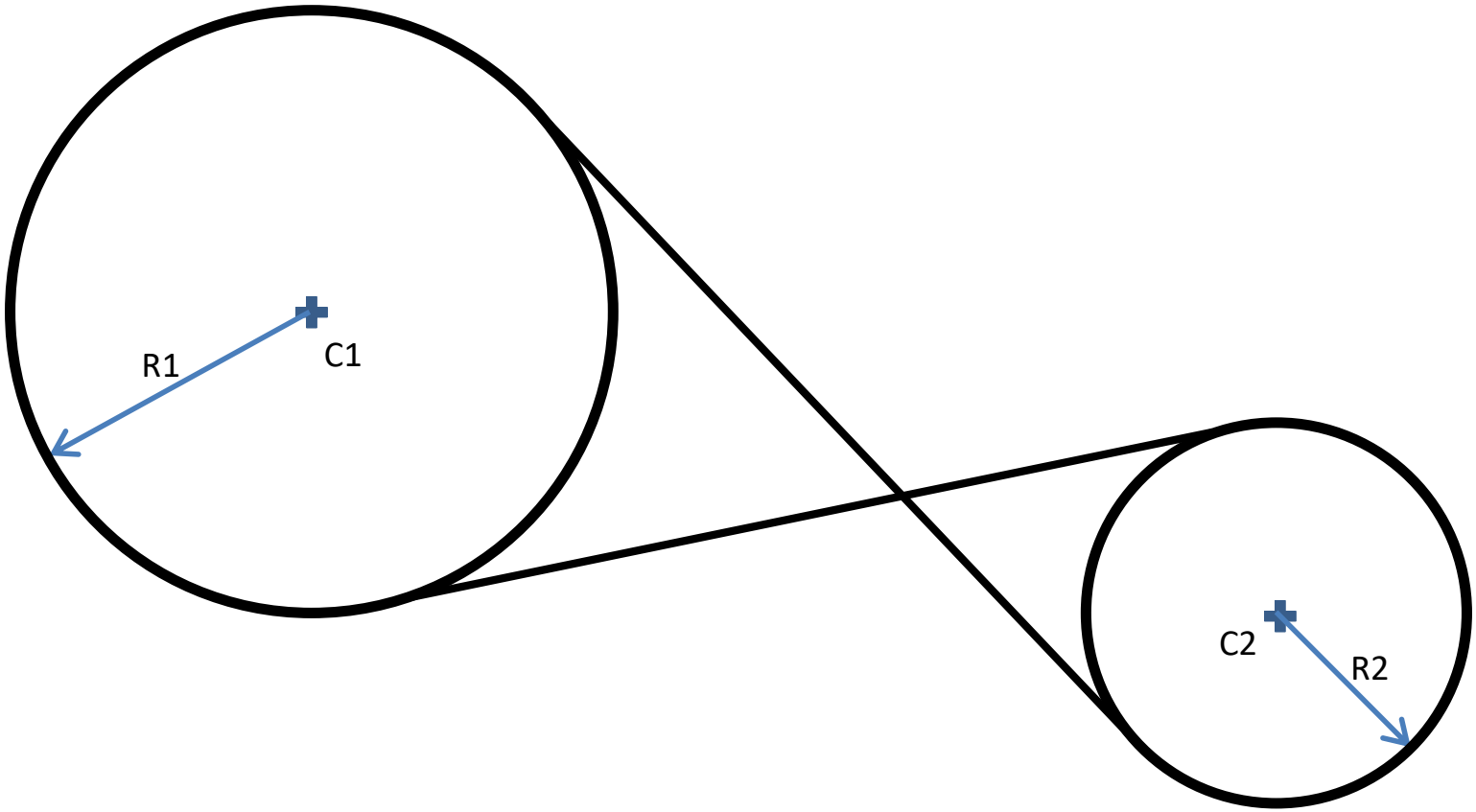


6 Draw a new line from point C2 that is parallel to line C1,P.

7 Connect points T1, T2.

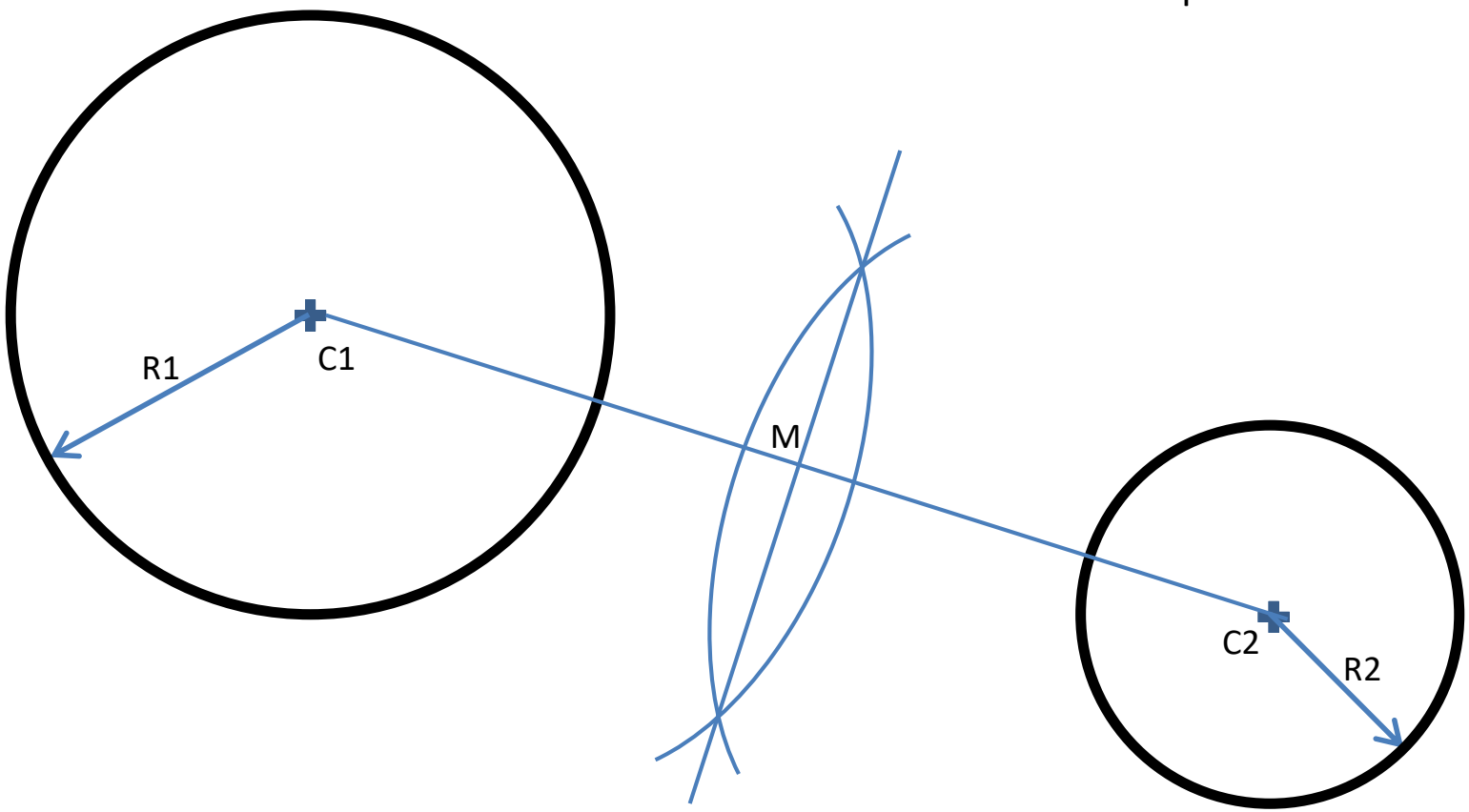
8 Repeat steps 5 &6 for the other side.

Draw internal tangent lines to two circles with different radii.



Draw internal tangent lines to two circles with different radii.

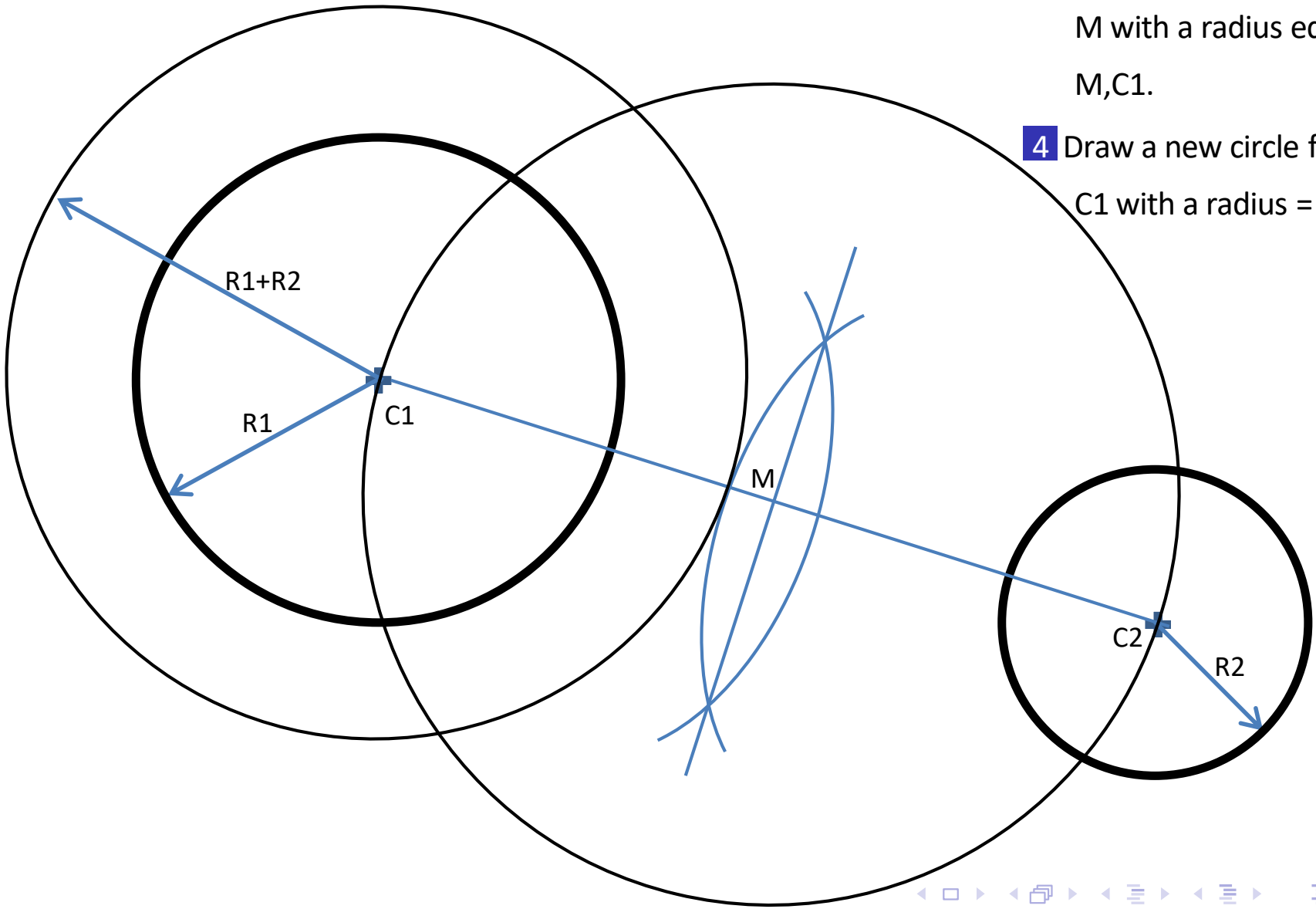
1. Connect points C1 and C2.
2. Bisect line C1,C2 at the mid-point M.



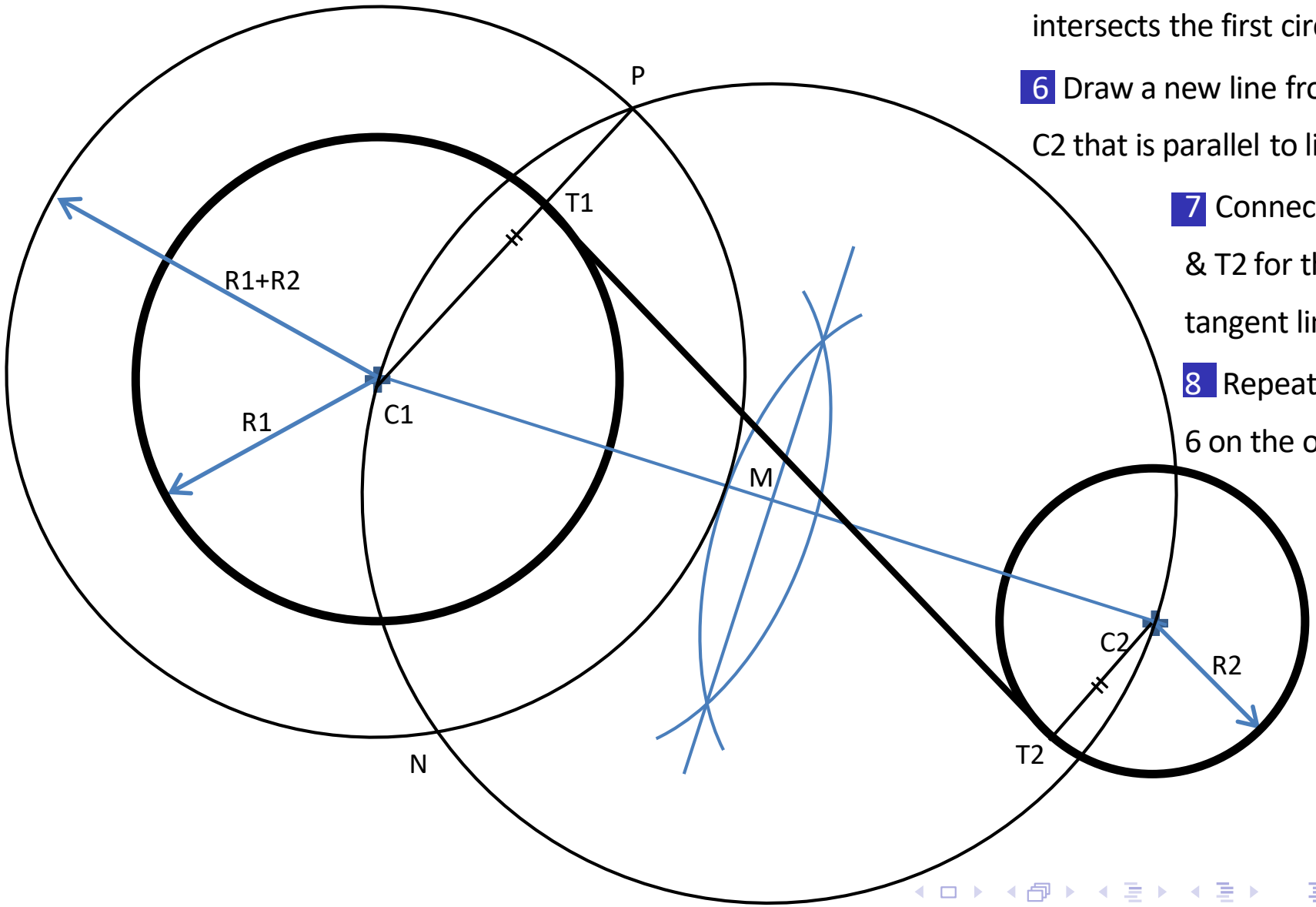
Draw internal tangent lines to two circles with different radii.

3 Draw a new circle from point M with a radius equal to M,C1.

4 Draw a new circle from point C1 with a radius = R1+R2.



Draw internal tangent lines to two circles with different radii.



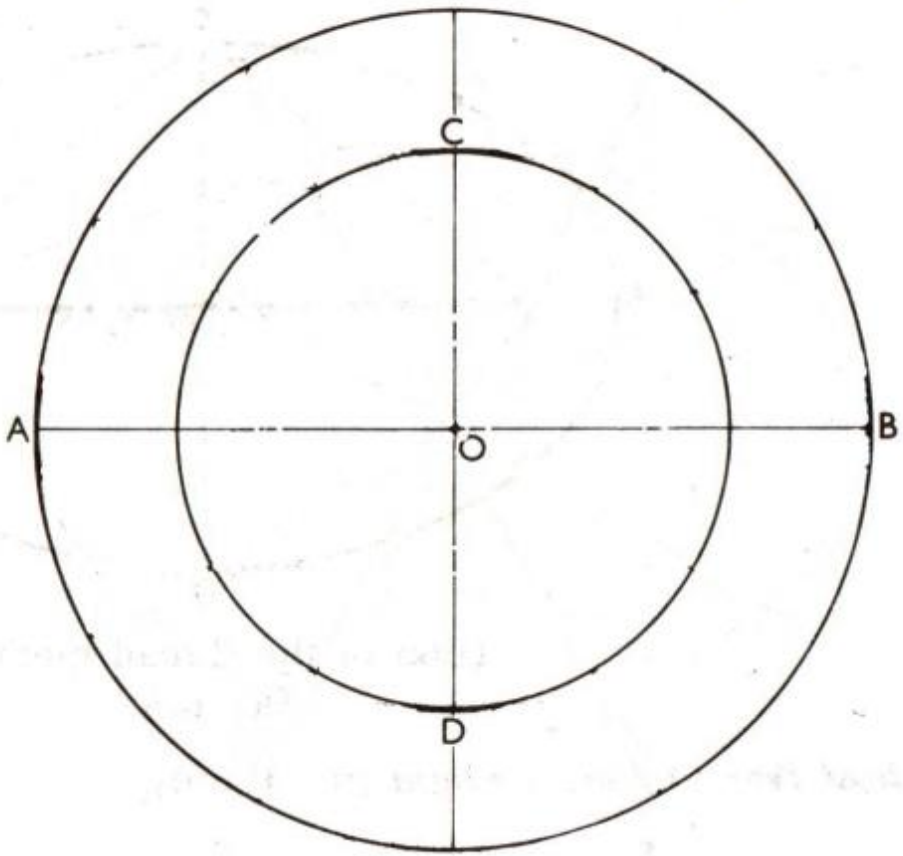
5 Connect points C1 and P that intersects the first circle at T1.

6 Draw a new line from point C2 that is parallel to line C1,P.

7 Connect points T1 & T2 for the first tangent line.

8 Repeat steps 5 & 6 on the other side.

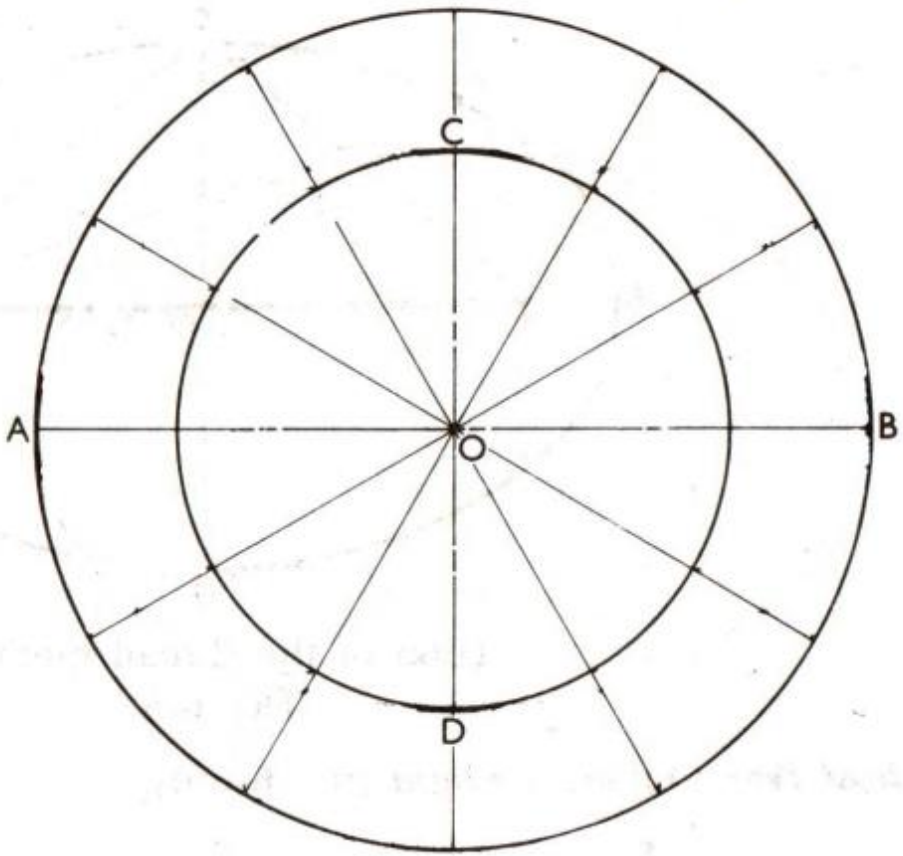
Ellipse from Major and Minor Axis



Concentric circle method

1. Draw major and minor axes and two circles.

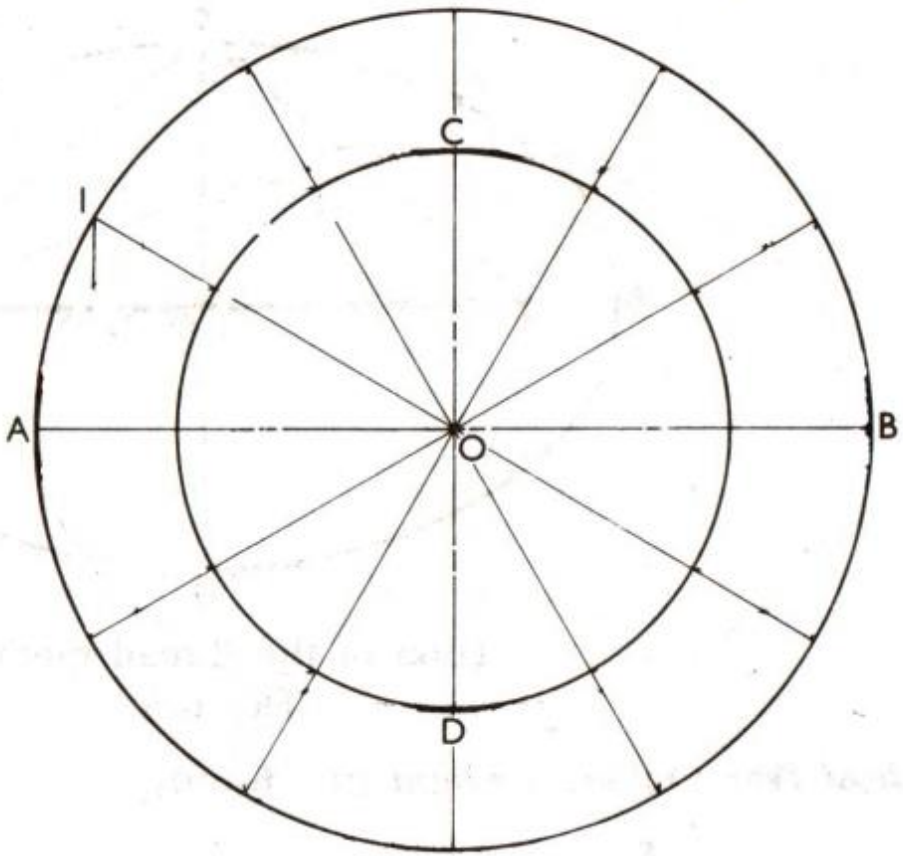
Ellipse from Major and Minor Axis



Concentric circle method

1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.

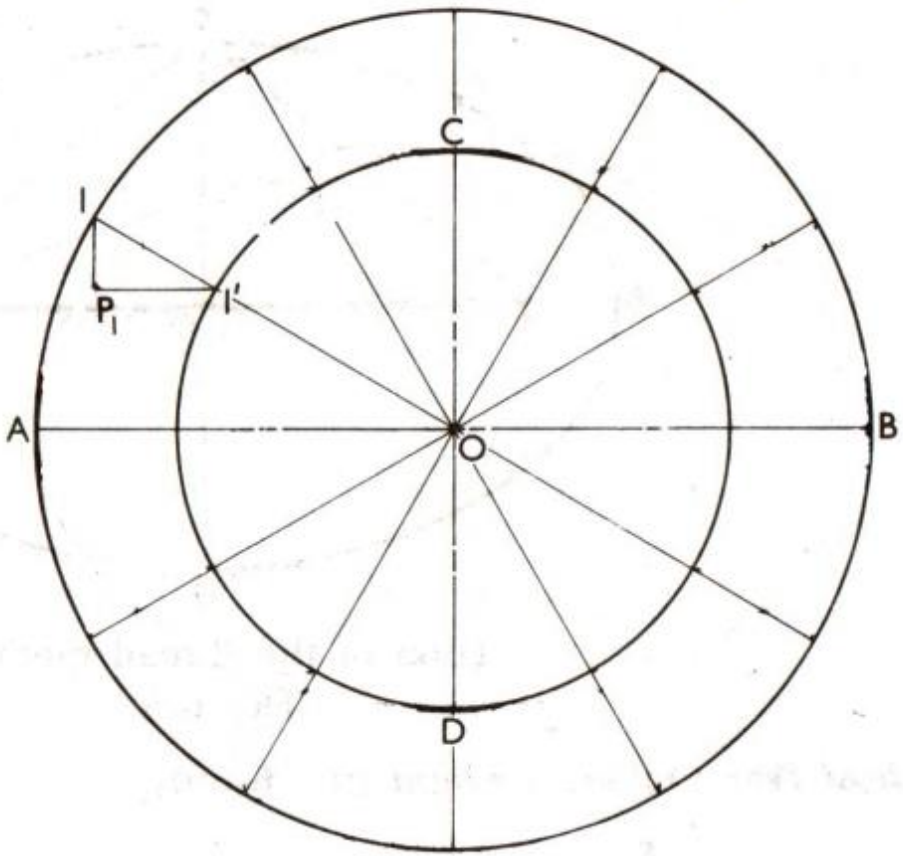
Ellipse from Major and Minor Axis



Concentric circle method

1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.
3. Draw a vertical at 1.

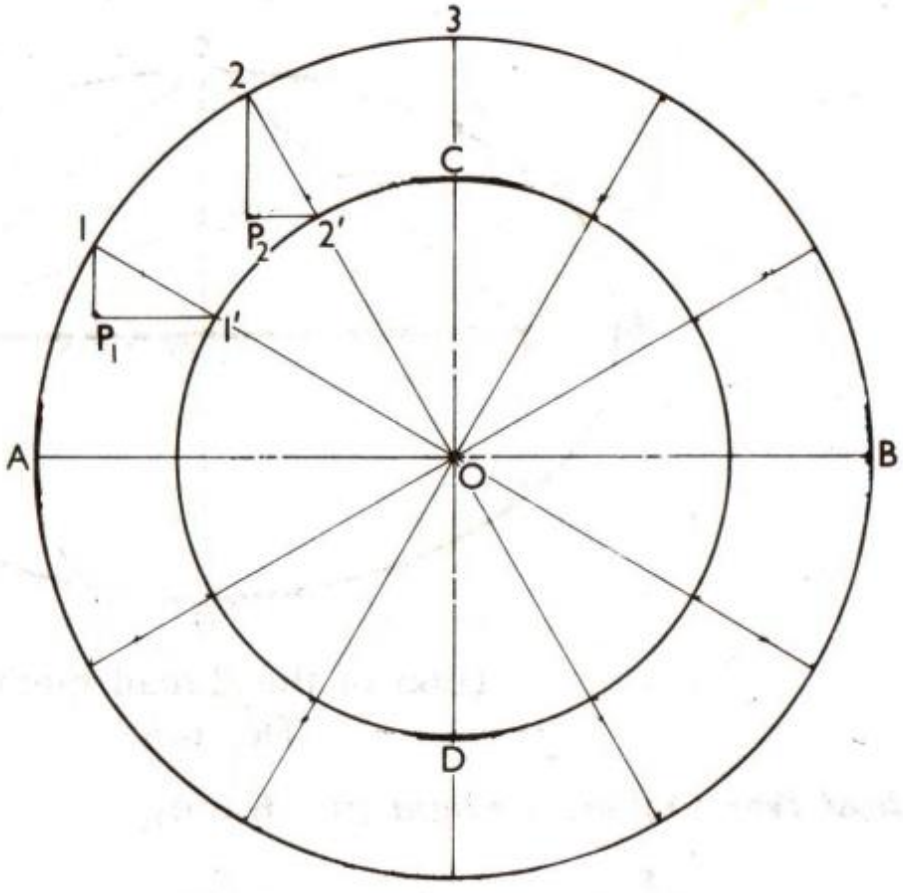
Ellipse from Major and Minor Axis



Concentric circle method

1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.
3. Draw a vertical at 1.
4. Draw horizontal at 1'.

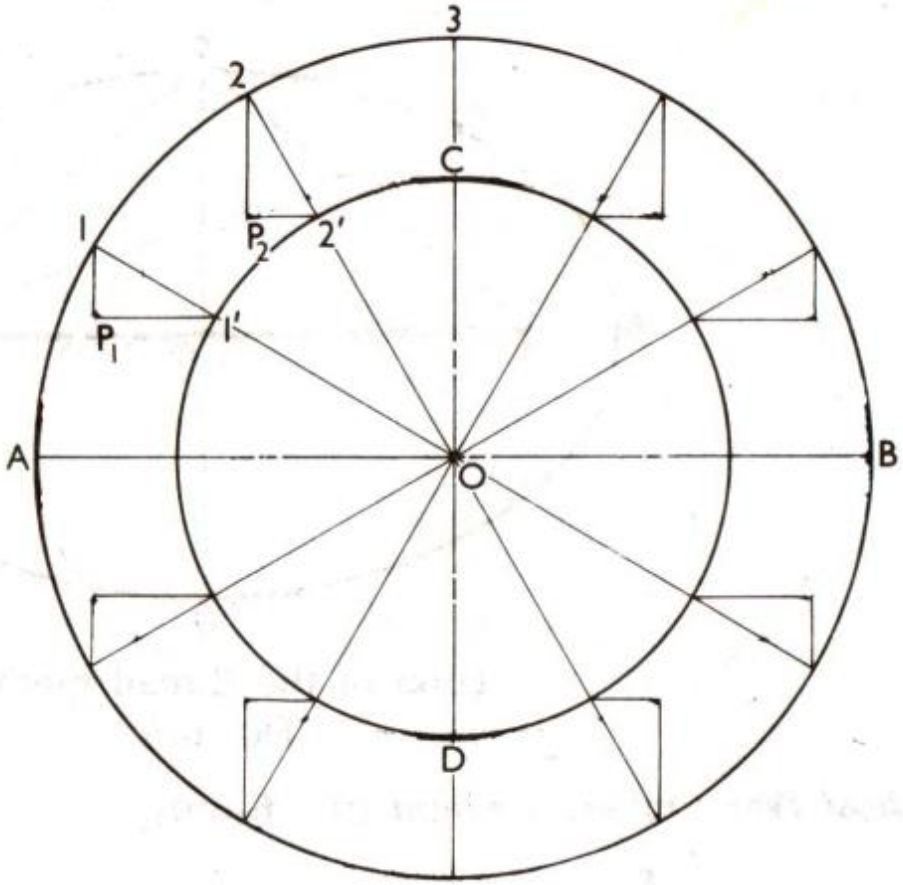
Ellipse from Major and Minor Axis



Concentric circle method

1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.
3. Draw a vertical at 1.
4. Draw horizontal at 1'.
5. Repeat the procedure described in the last two steps

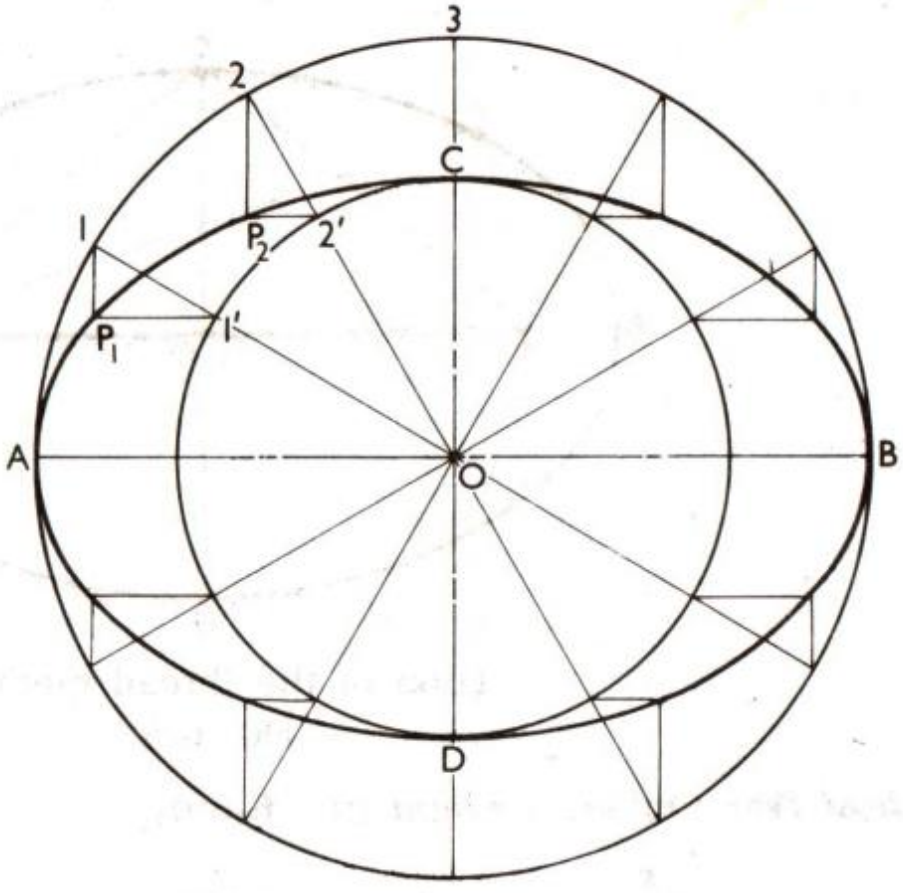
Ellipse from Major and Minor Axis



Concentric circle method

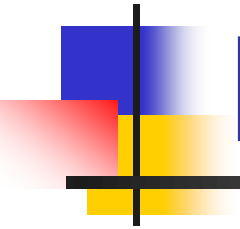
1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.
3. Draw a vertical at 1.
4. Draw horizontal at 1'.
5. Repeat the procedure described in the last two steps

Ellipse from Major and Minor Axis



Concentric circle method

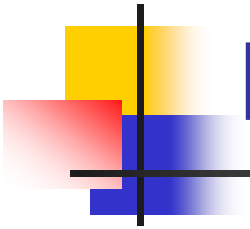
1. Draw major and minor axes and two circles.
2. Divide it for sufficient points to draw the ellipse.
3. Draw a vertical at 1.
4. Draw horizontal at 1'.
5. Repeat the procedure described in the last two steps.
6. Use french curves to connect the Intersection points.



Engineering Drawing

Week 6

Dimensioning



Dimensioning

Before an object can be built, complete information about both the size and shape of the object must be available. The exact shape of an object is communicated through orthographic drawings, which are developed following standard drawing practices. The process of adding size information to a drawing is known as dimensioning the drawing.

Units of Measure

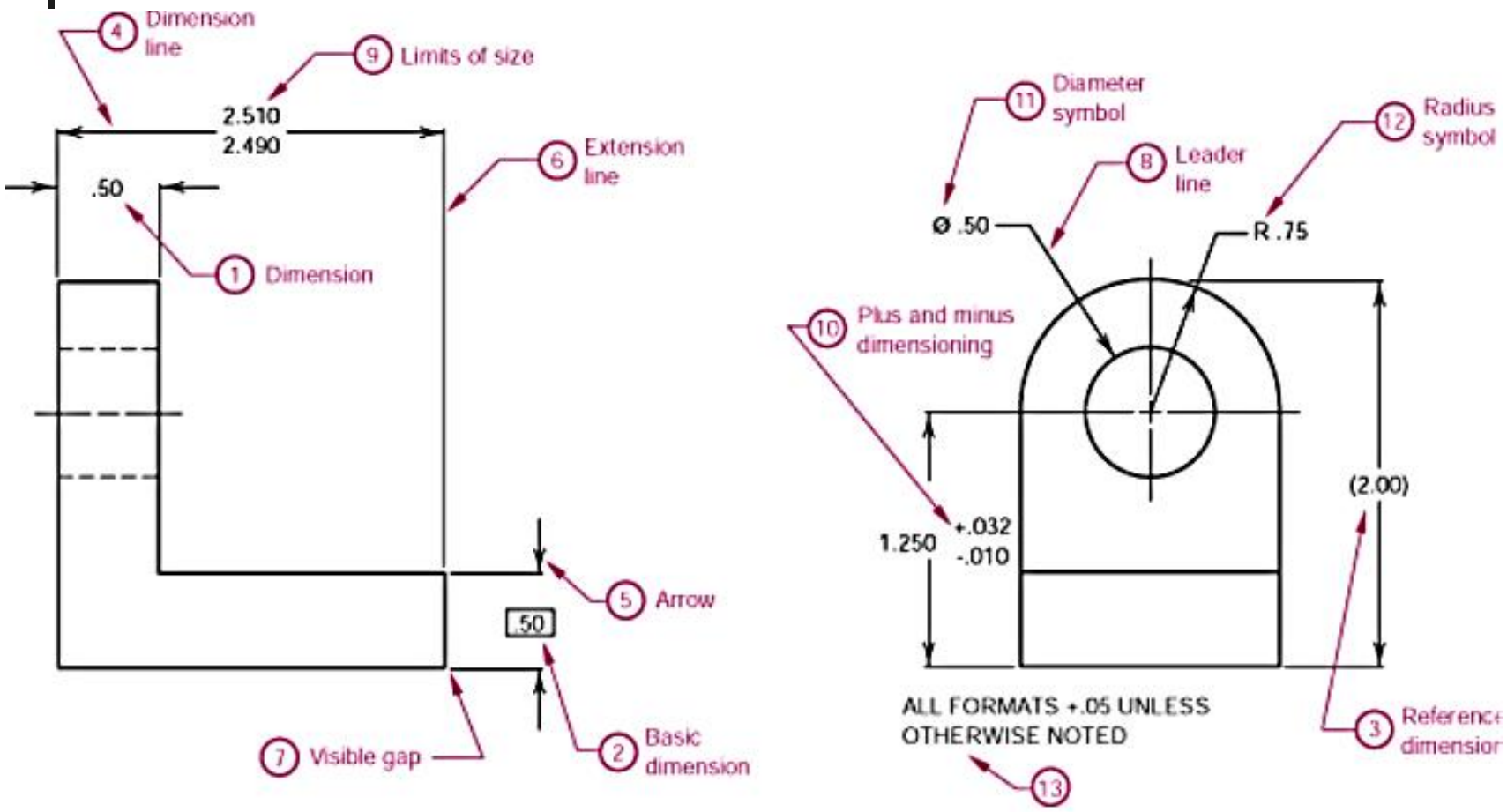
- Most countries outside of the United States use the metric system of measure, or the international system of units (SI), which is based on the meter.
- Angular dimensions are shown either in decimal degrees or in degrees, minutes, and seconds.
- All dimensioning components should be written with thin solid lines (2H).

Dimensioning Components

- **Dimension**: is the numerical value that defines the size or geometric characteristic of a feature.
- **Dimension line**: is the thin solid line which shows the extent and direction of a dimension.
- **Arrows** are placed at the ends of dimension lines to show the limits of the dimension.
- **Extension line** is the thin solid line perpendicular to a dimension line indicating which feature is associated with the dimension.

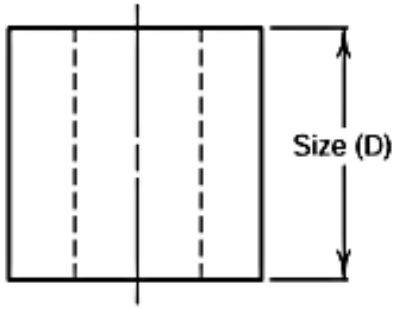
Dimensioning Components

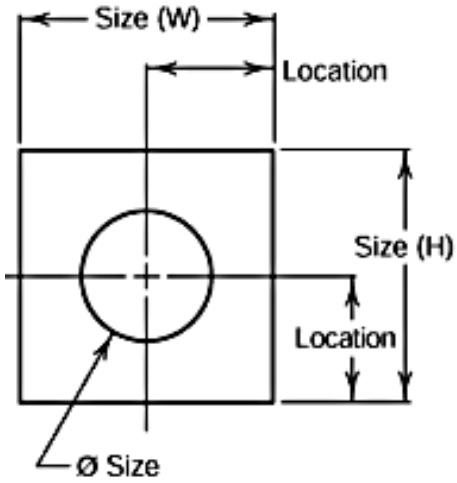
- **Leader line** is the thin solid line used to indicate the feature with which a dimension, note, or symbol is associated.
- **Diameter symbol** is the symbol which is placed preceding a numerical value indicating that the associated dimension shows the diameter of a circle. The symbol used is the Greek letter *phi*.
- **Radius symbol** is the symbol which is placed preceding a numerical value indicating that the associated dimension shows the radius of a circle. The radius symbol used is the capital letter *R*.


4 Dimension line
9 Limits of size
2.510
2.490
6 Extension line
.50
1 Dimension
5 Arrow
.50
7 Visible gap
2 Basic dimension
11 Diameter symbol
12 Radius symbol
8 Leader line
Ø .50
R .75
10 Plus and minus dimensioning
1.250
+.032
-.010
(2.00)
ALL FORMATS +.05 UNLESS OTHERWISE NOTED
13
3 Reference dimension

Basic Concepts

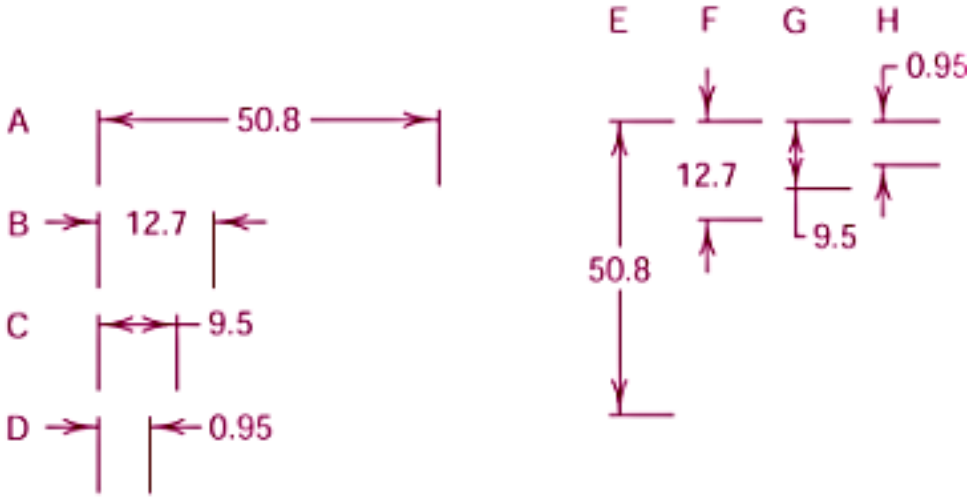
- Dimensions are used to describe the size and location of features on parts for manufacture.
- Dimensions should not be excessive, either through duplication or dimensioning a feature more than one way.
- Size dimension might be the overall width of the part or the diameter of a drilled hole.
- Location dimension might be length from the edge of the object to the center of the drilled hole.





Dimensions Placement

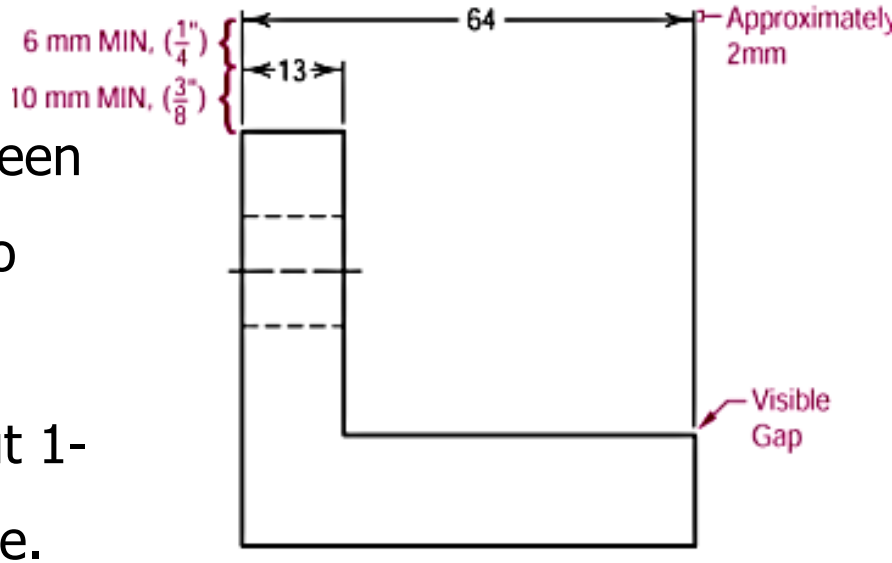
- Dimension placement depends on the space available between extension lines. When space permits, dimensions and arrows are placed between the extension lines.



Millimeter dimensioning

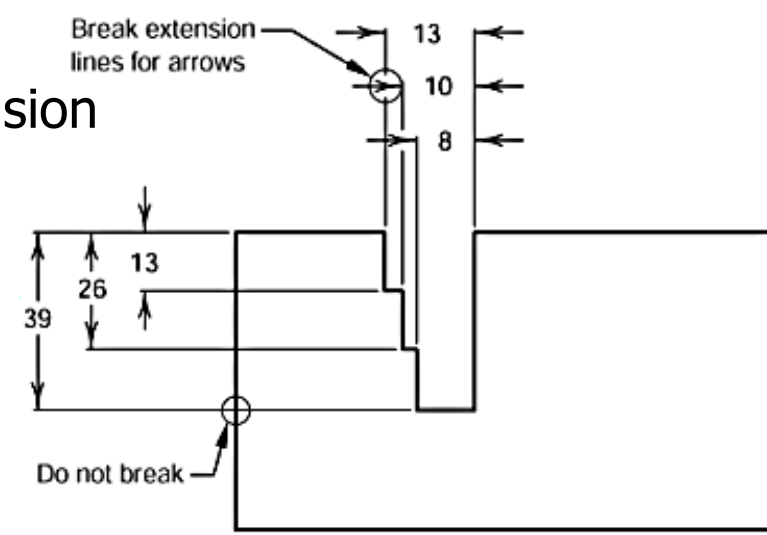
Dimensions Spacing

- The minimum distance from the object to the first dimension is 10mm (3/8 inch). The minimum spacing between dimensions is 6mm (1/4 inch).
- There should be a visible gap between an extension line and the feature to which it refers.
- Extension lines should extend about 1-2mm beyond the last dimension line.



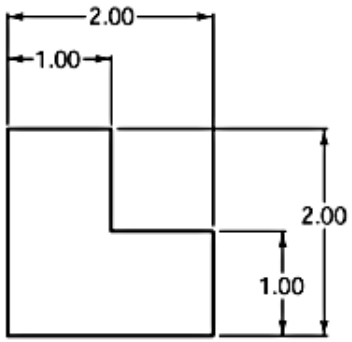
Extension Lines

- Extension lines are used to refer a dimension to a particular feature and are usually drawn perpendicular to the associated dimension line.
- Extension lines should not cross dimension lines and should avoid crossing other extension lines whenever possible.
- When extension lines cross object lines or other extension lines, they are not broken.
- If extension lines cross or are close to arrowheads, they are broken for the arrowhead.

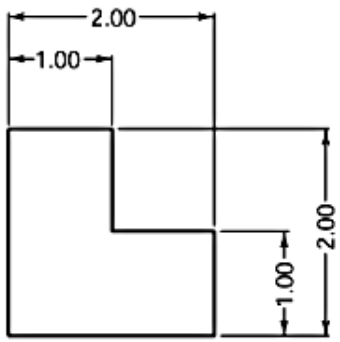


Reading Direction

- All dimension and note text must be oriented to be read from the bottom of the drawing (relative to the drawing format).
- Placement of all text to be read from the bottom of the drawing is called unidirectional dimensioning.
- Aligned dimensions have text placed parallel to the dimension line with vertical dimensions read from the right of the drawing sheet.



Unidirectional
Current standard



Aligned
Old standard

Engineering Drawing

Week 7

Section Views

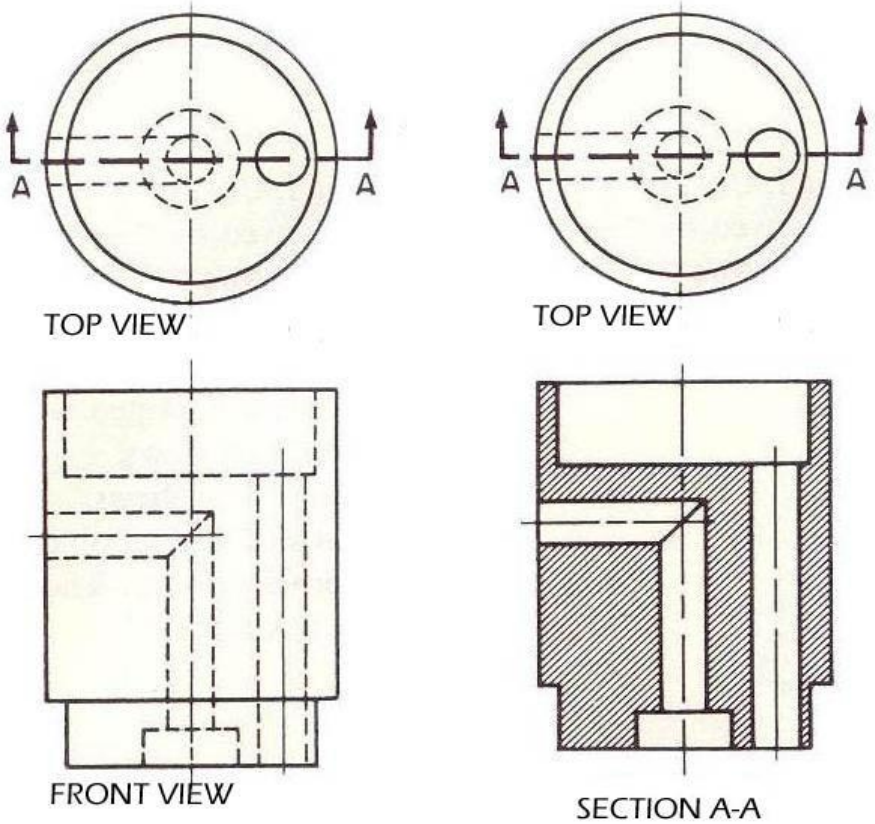
What is a "Section View" ?

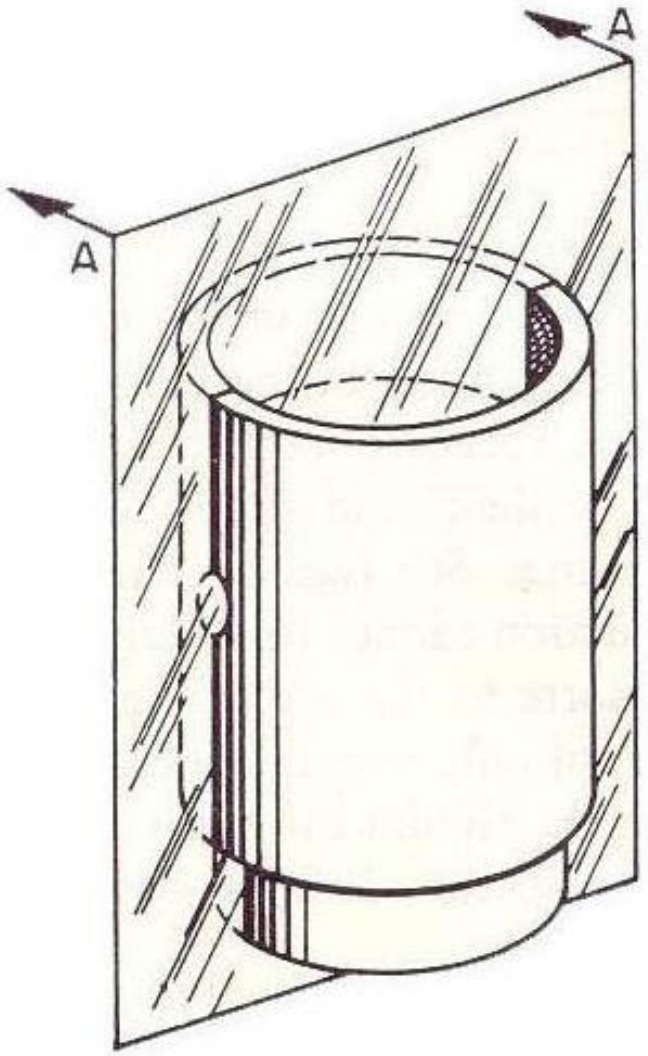
- A section view is a view used on a drawing to show an area or hidden part of an object by cutting away or removing some of that object.
- The cut line is called a "cutting plane" and can be done in several ways.
- A sectional view must show which portions of the object are solid material and which are spaces. This is done by section lining (cross-hatching) the solid parts with uniformly spaced thin lines generally at 45º.

Full Section

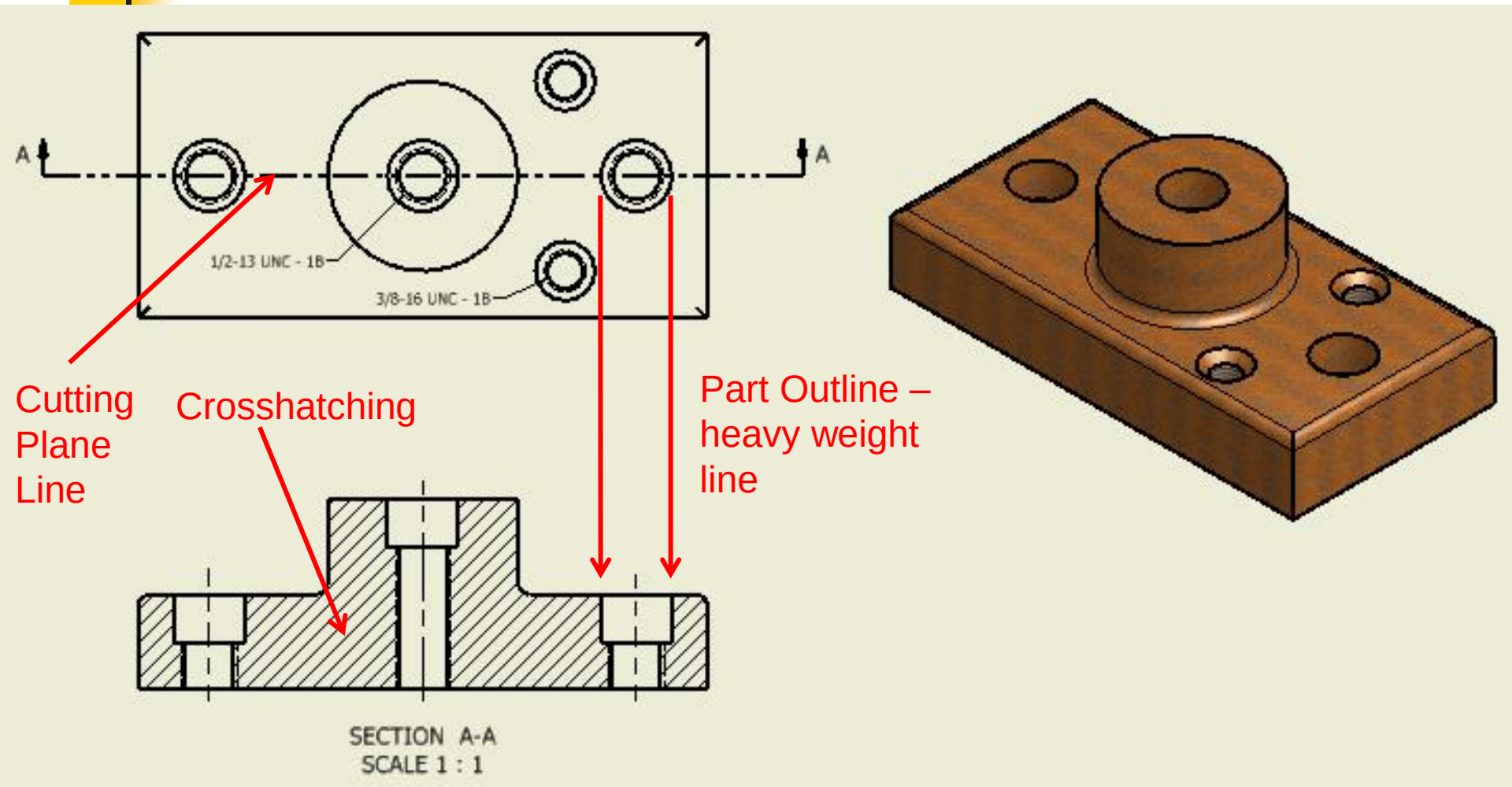
- In a full section, the cutting plane line passes fully through the part.
- Normally a view is replaced with the full section view.
- The section-lined areas are those portions that have been in actual contact with the cutting-plane.

Full Section





Full Section



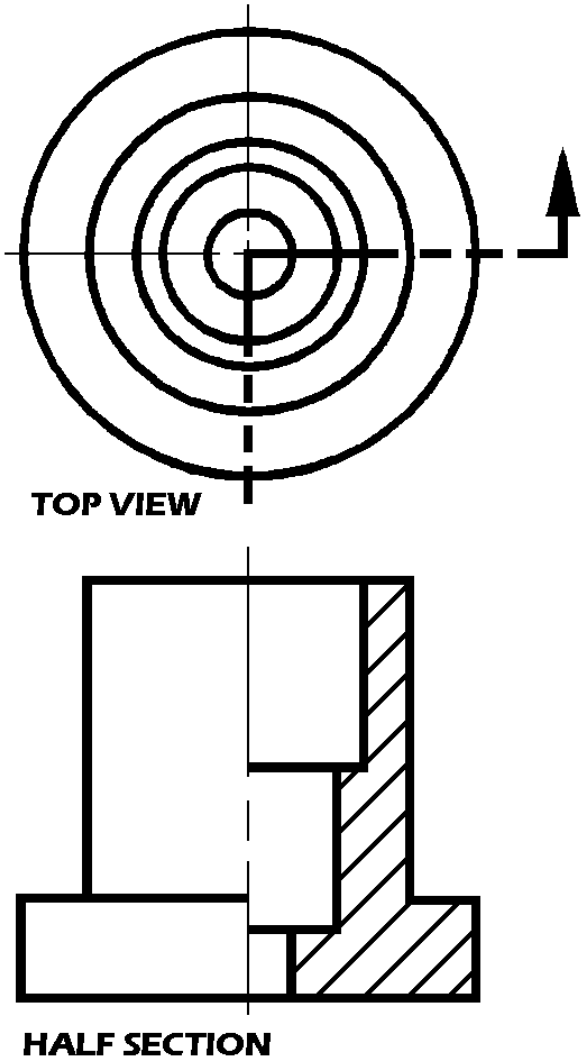
When the section line cuts the object, the edges of the cuts are represented with heavy weighted lines and **not** hidden lines.

Half Section

- Half Section is used to the exterior and interior of the part in the same view.
- The cutting-plane line cuts halfway through the part and removes one quarter of the material.
- The line that separates the different types (interior and exterior) may be a centerline or a visible line.

Half Section

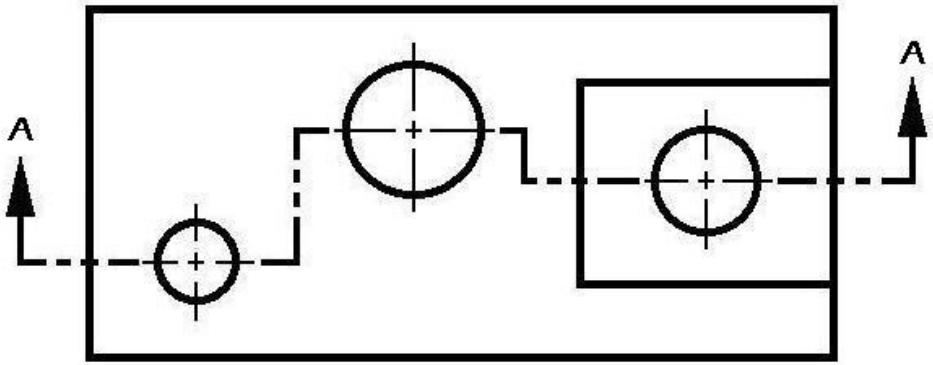
- A half section is made by cutting halfway through an object.
- Thus, one half is drawn in section and the other half is an outside view.
- Usually, hidden lines are not used in the un-sectioned half (inside details are visible on the section view).



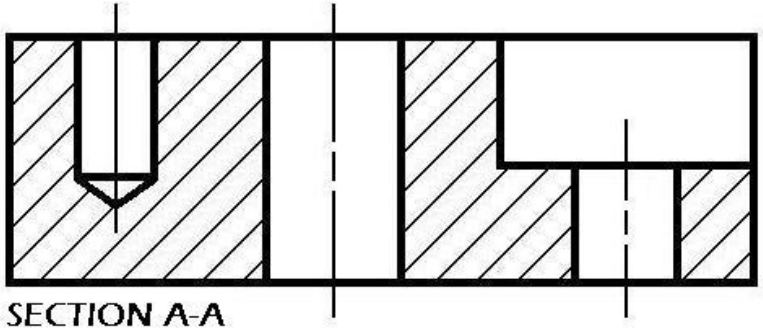
Offset Section

- Used to show parts and features that do not line up with each other.
- Cutting-plane line does not travel in a straight line.
- The offsets or bends in the cutting-plane line do not show in the section.
- The versatility of this section makes it very useful.

Offset Section



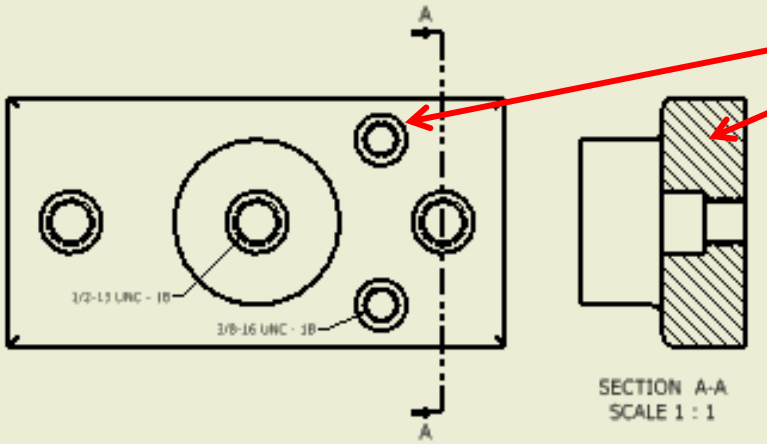
OFFSET SECTION LINE



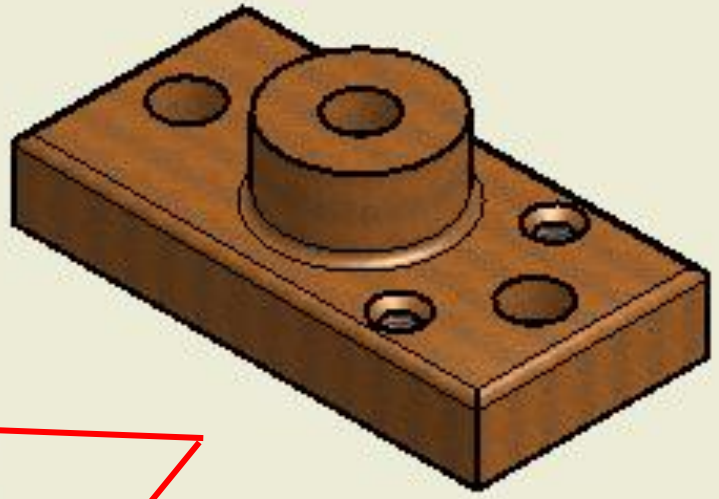
SECTION A-A

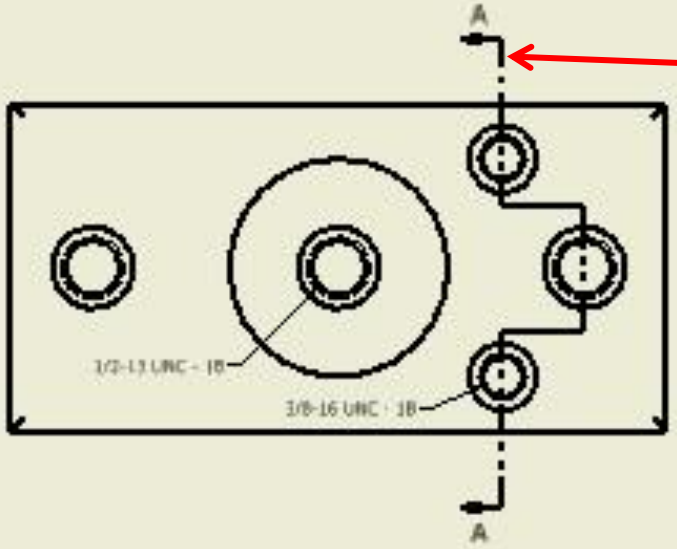
Offset Section

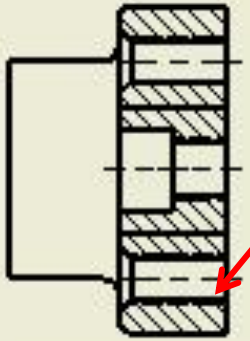
Cutting Plane line does not include holes behind the line.



SECTION A-A
SCALE 1 : 1







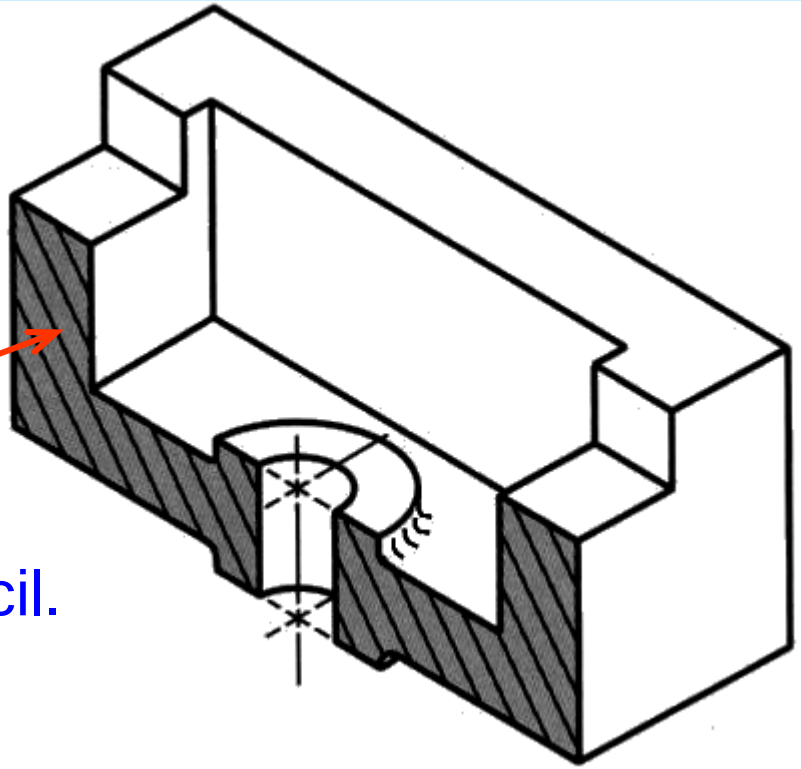
SECTION A-A
SCALE 1 : 1

Offset Cutting Plane line does include holes along the line.

Section Lining

Section lines or ***cross-hatch lines*** are used to *indicate the surfaces that are cut* by the cutting plane.

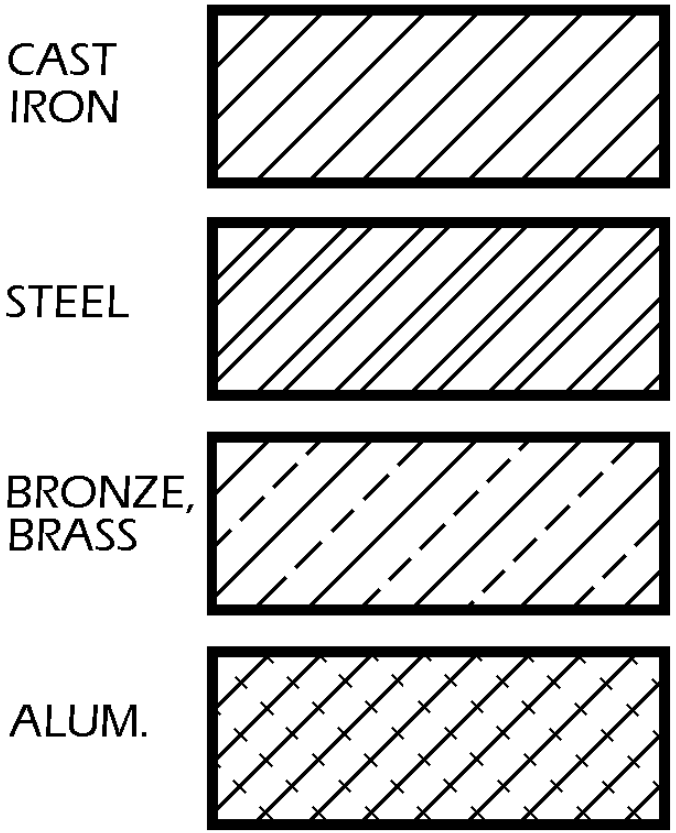
Section lines



Drawn with **4H** pencil.

Section Lining

- Materials – Common materials
- The symbol for cast iron can be used for most section views.
- Refer to any common drafting text for additional symbols.



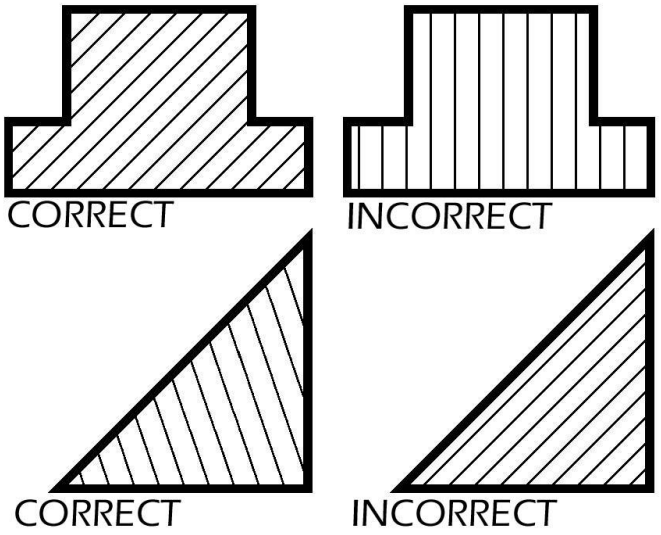
Section Lining

- 45-degree angle fine lines should be used.
- 1/8” between lines (1-3 mm).
- All lines should be uniformly spaced.
- Thin sections may be blackened in completely.

In this subject, we will use fine lines (2H) spaced at 2 mm for section lines.

Section Lining – Line Placement

- Lines should never be parallel or perpendicular to the object lines.
- If the outline of the object has 45-degree lines, 30 or 60-degree lines should be used.



Engineering Drawing

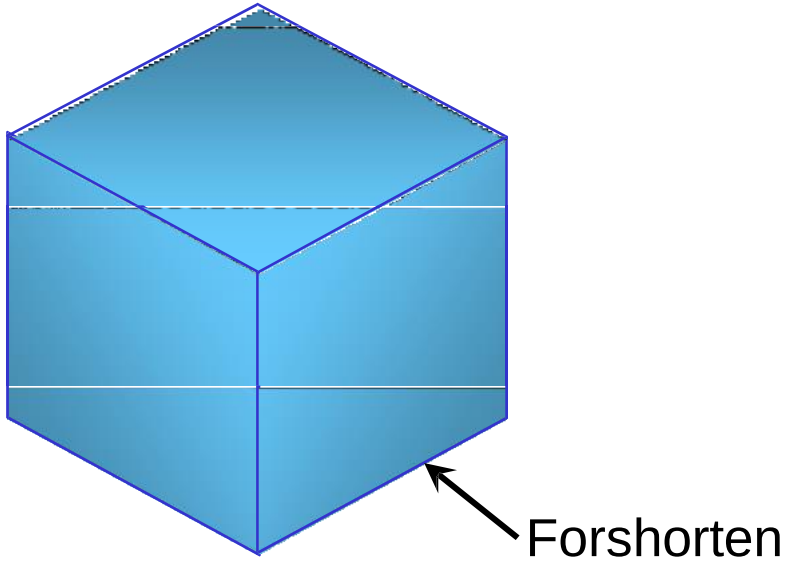
Week 8

Isometric drawing

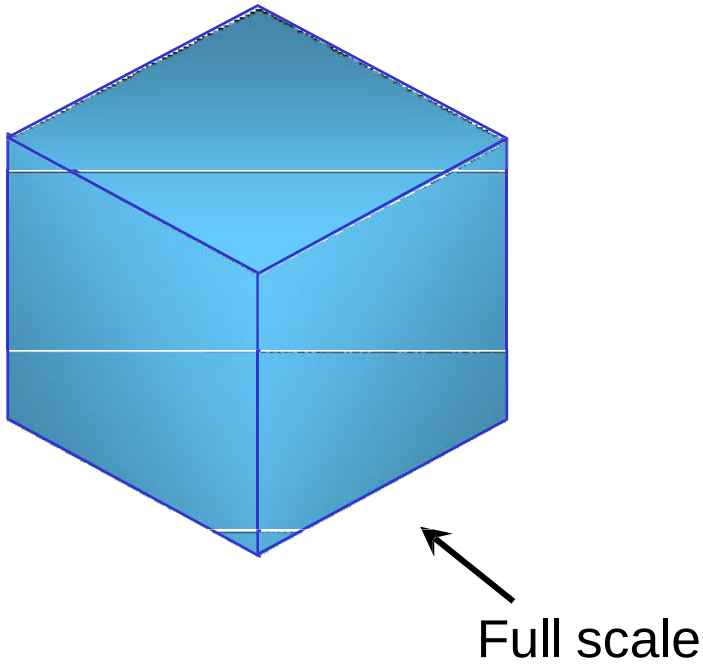
Isometric Drawing

Isometric drawing is a drawing drawn on an isometric axes using ***full scale***.

Isometric projection
(True projection)



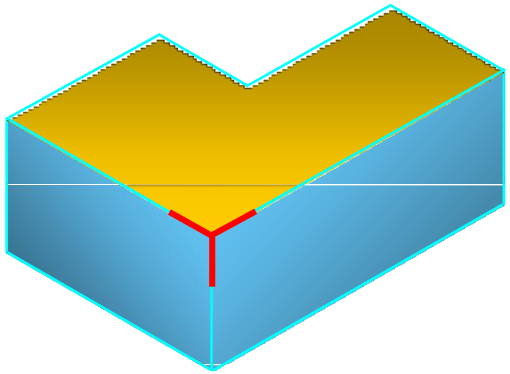
Isometric drawing
(Full scale)



Positions of Isometric Axes

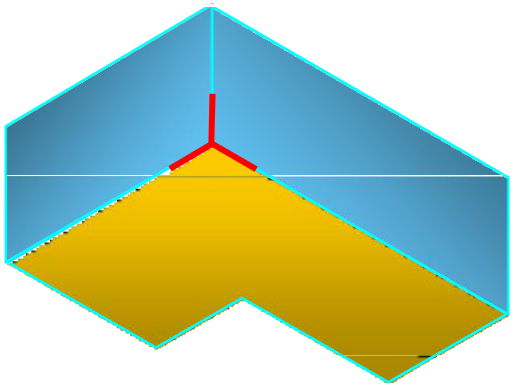
Isometric axes can be arbitrarily positioned to create different views of a single object.

Regular isometric



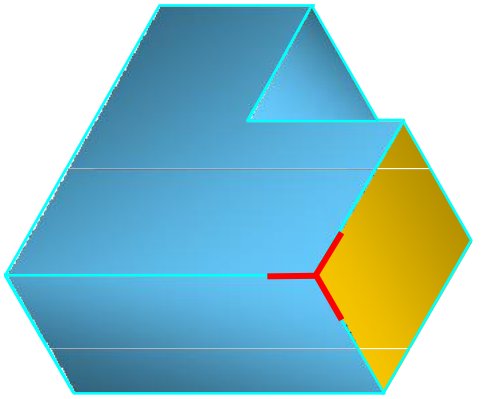
View point is looking down on the top of the object.

Reverse axis isometric



View point is looking up on the bottom of the object.

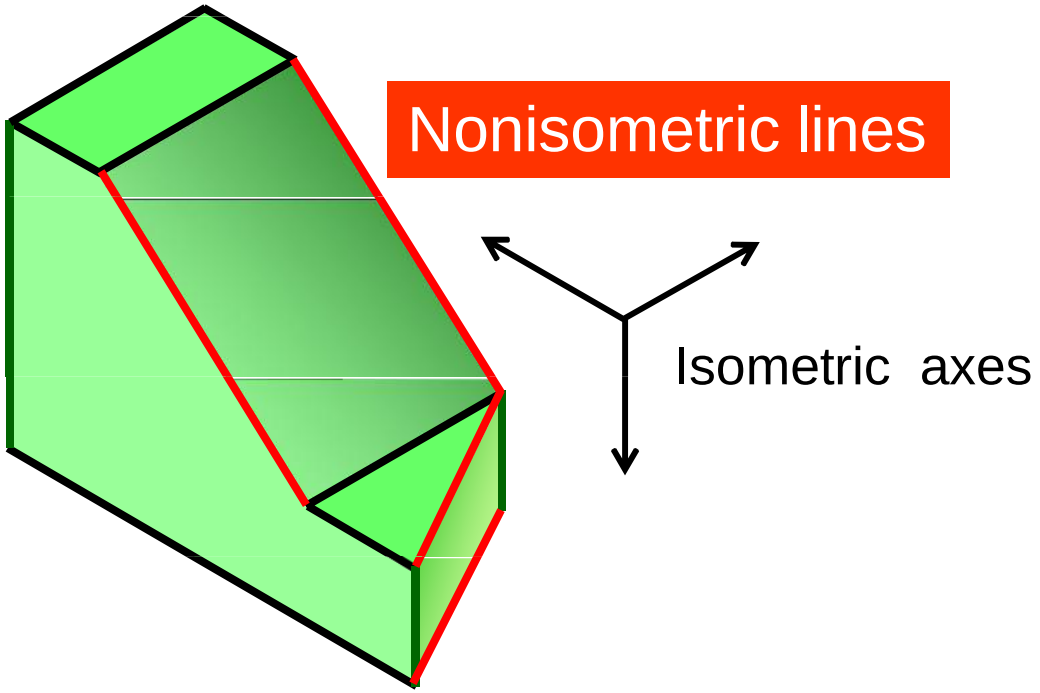
Long axis isometric



View point is looking from the right (or left) of the object.

Distance in Isometric Drawing

- **True-length distances** are shown along isometric lines.
- ***Isometric line*** is the line that run ***parallel*** to any of the isometric axes.



Isometric Sketching

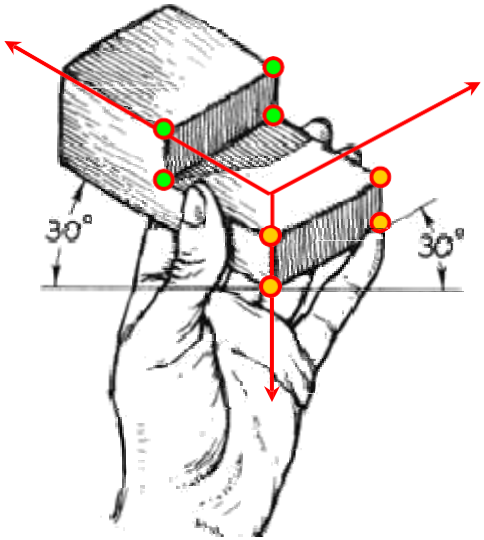
Sketch from an actual object

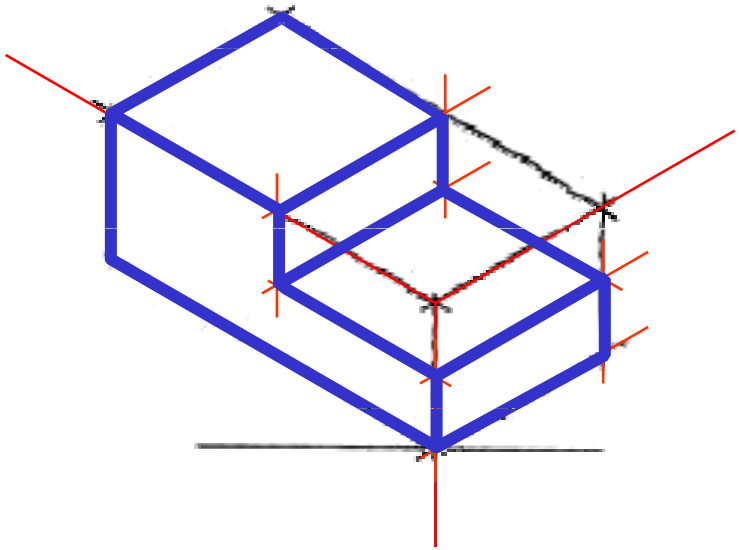
1. Place the object in the position which its shape and features are clearly seen.
2. Define an isometric axis.
3. Sketching the enclosing box.
4. Estimate the size and relationship of each details.
5. Darken all visible lines.

Sketch from an actual object

STEPS

1. Positioning object.
2. Select isometric axis.
3. Sketch enclosing box.
4. Add details.
5. Darken visible lines.

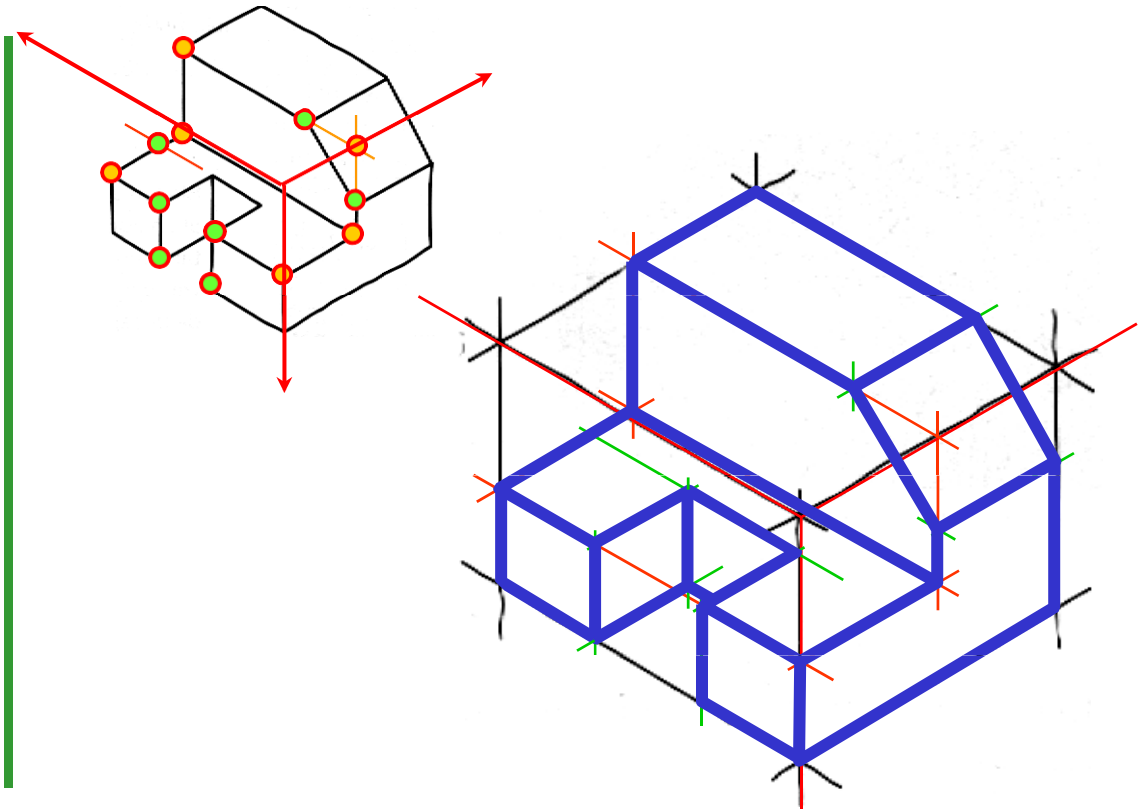




Sketch from an actual object

STEPS

1. Positioning object.
2. Select isometric axis.
3. Sketch enclosing box.
4. Add details.
5. Darken visible lines.

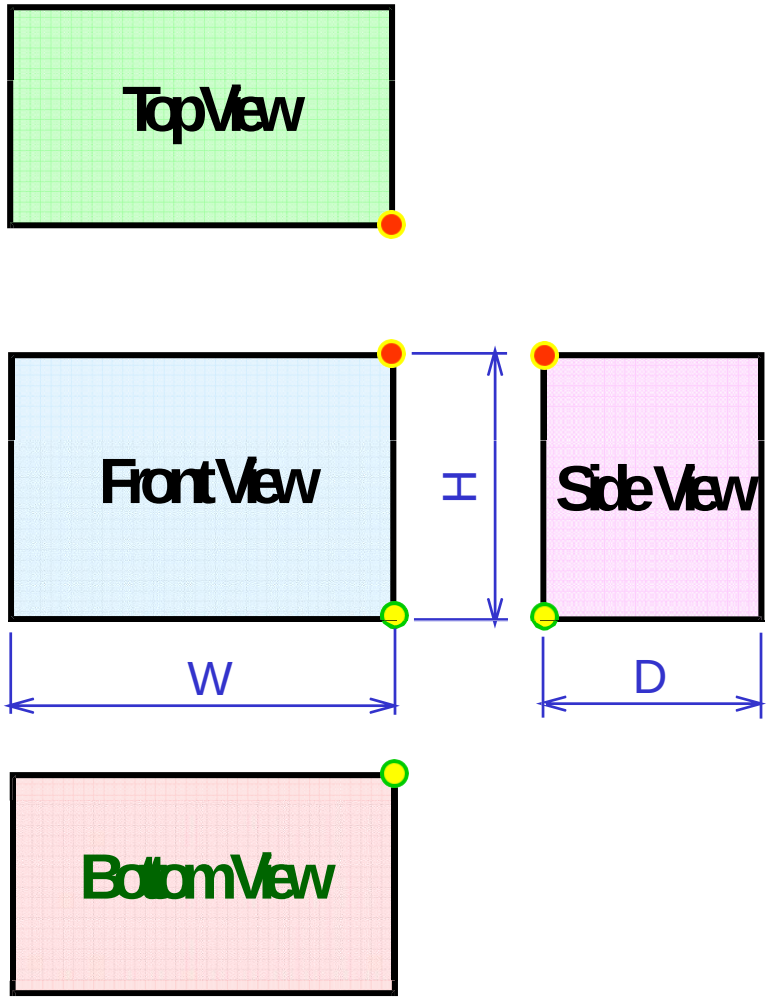


Note In isometric sketch/drawing), hidden lines are ***omitted*** unless they are absolutely necessary to completely describe the object.

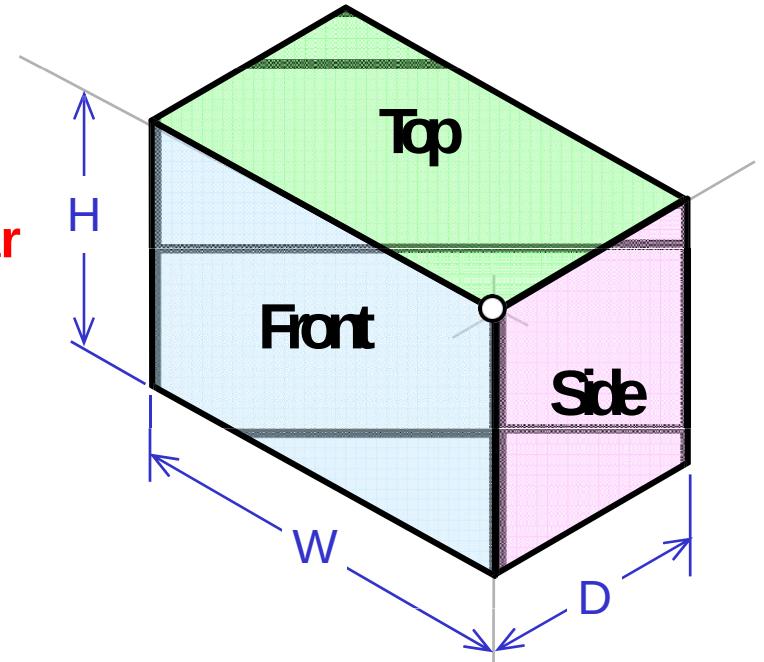
Sketch from multiview drawing

1. Interprete the ***meaning of lines/areas*** in multiview drawing.
2. Locate the lines or surfaces relative to isometric axis.

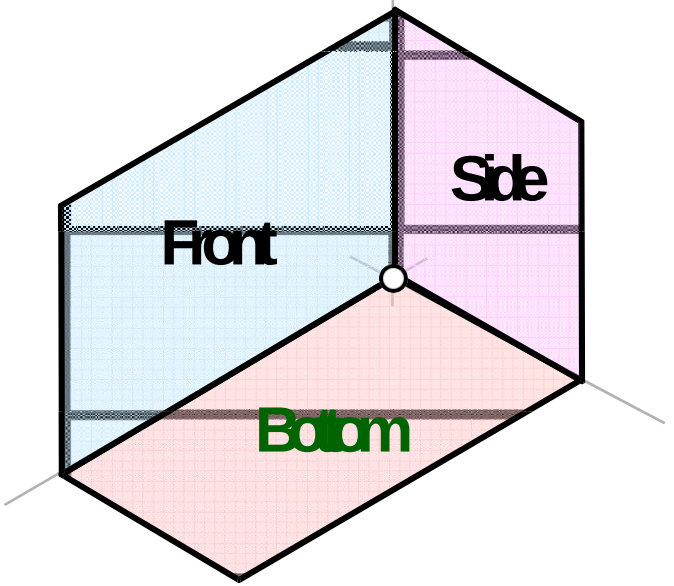
Example 1 : Object has only normal surfaces



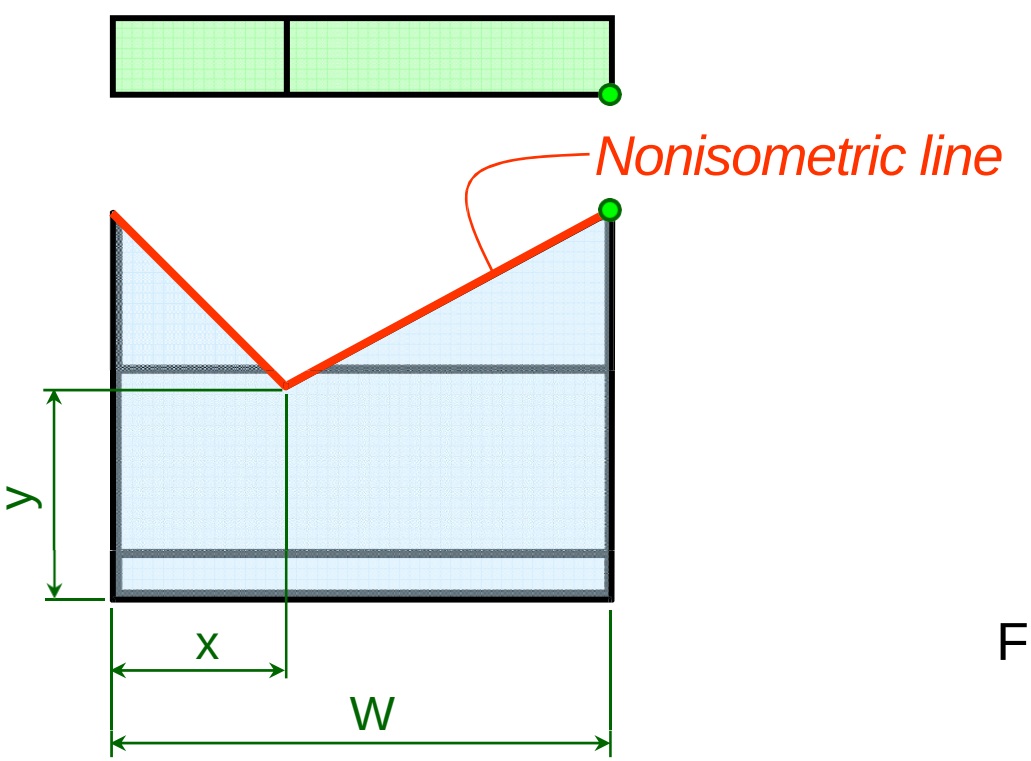
Regular

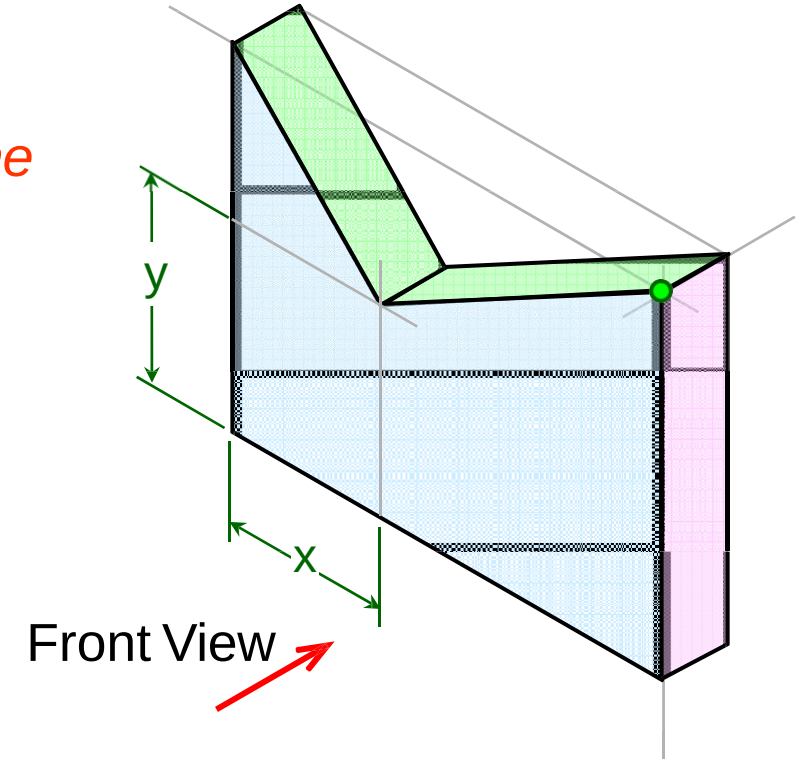


Reverse

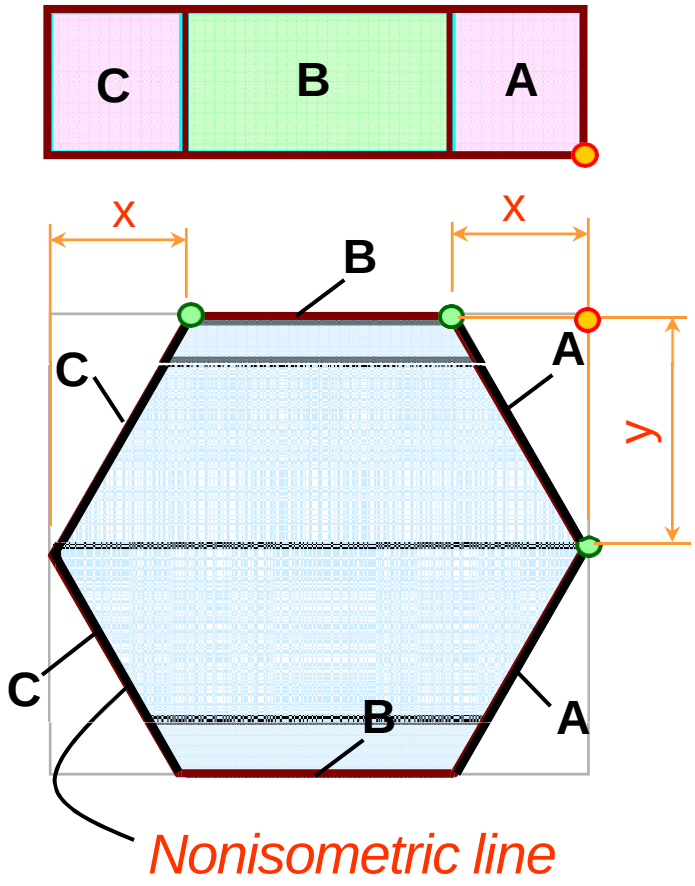


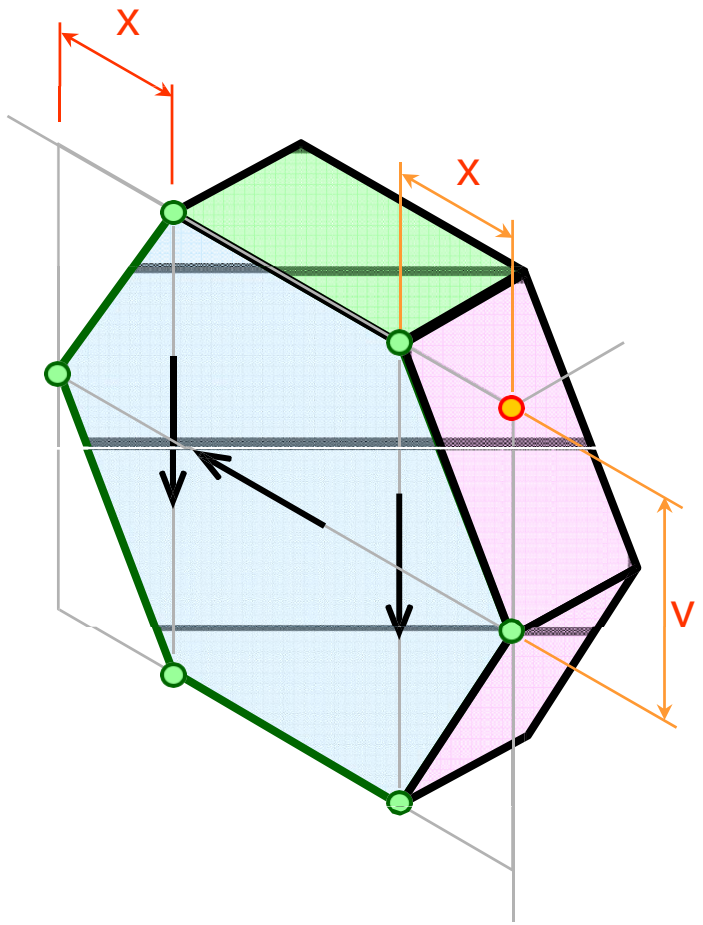
Example 2 : Object has inclined surfaces



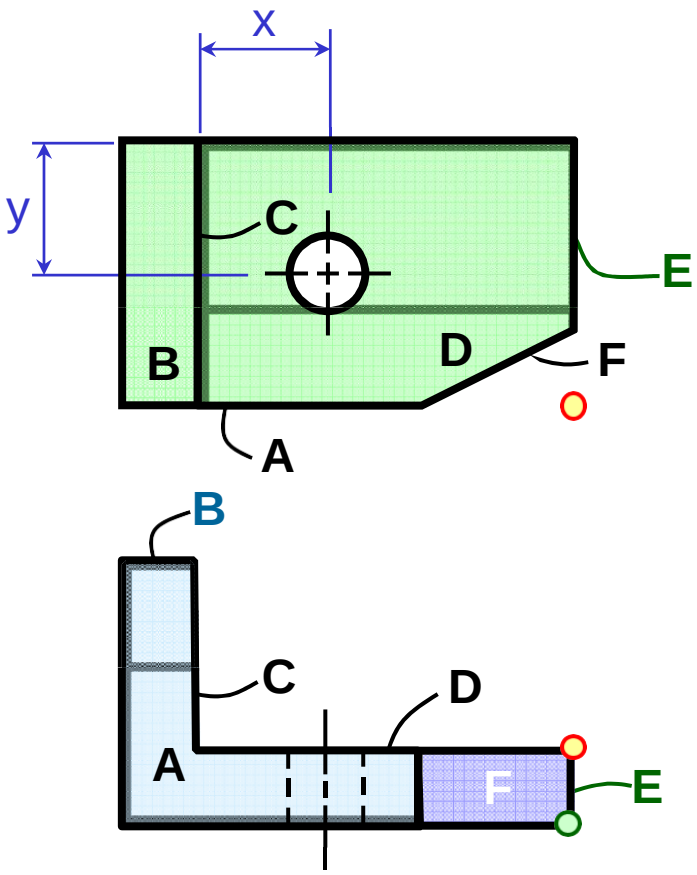


Example 3 : Object has inclined surfaces

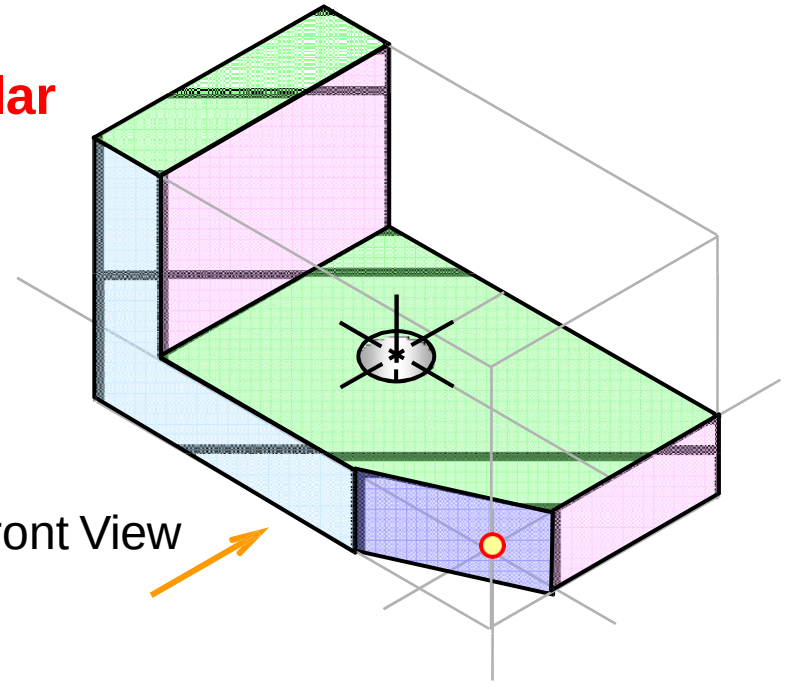




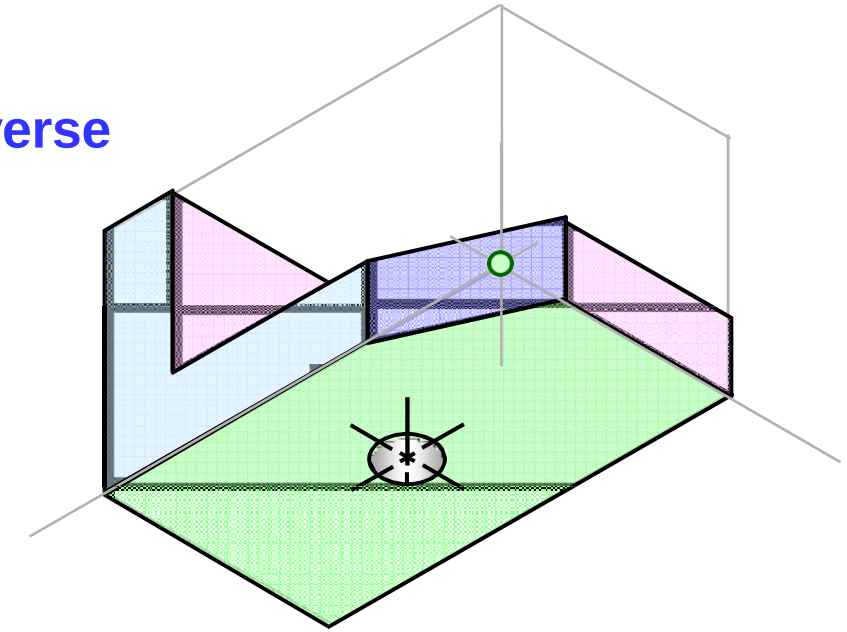
Example 4



Regular



Reverse

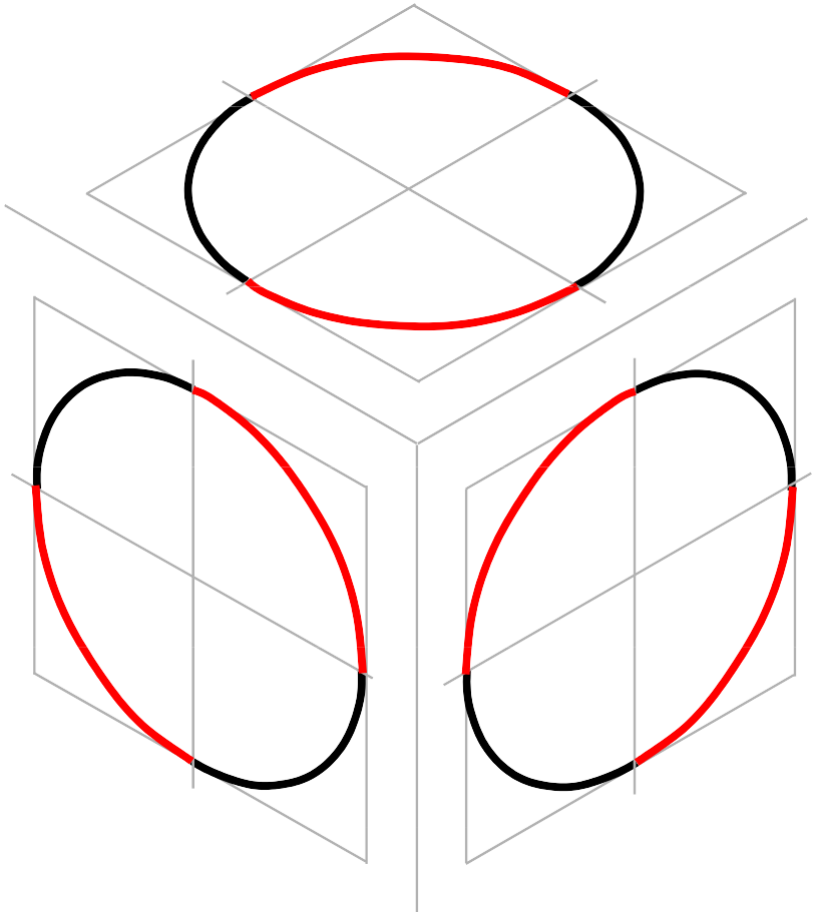


Circle & Arc in Isometric

- In isometric drawing, a circle appears as an ellipse.

Sketching Steps

1. Locate the center of an ellipse.
2. Construct an isometric square.
3. Sketch arcs that connect the tangent points.

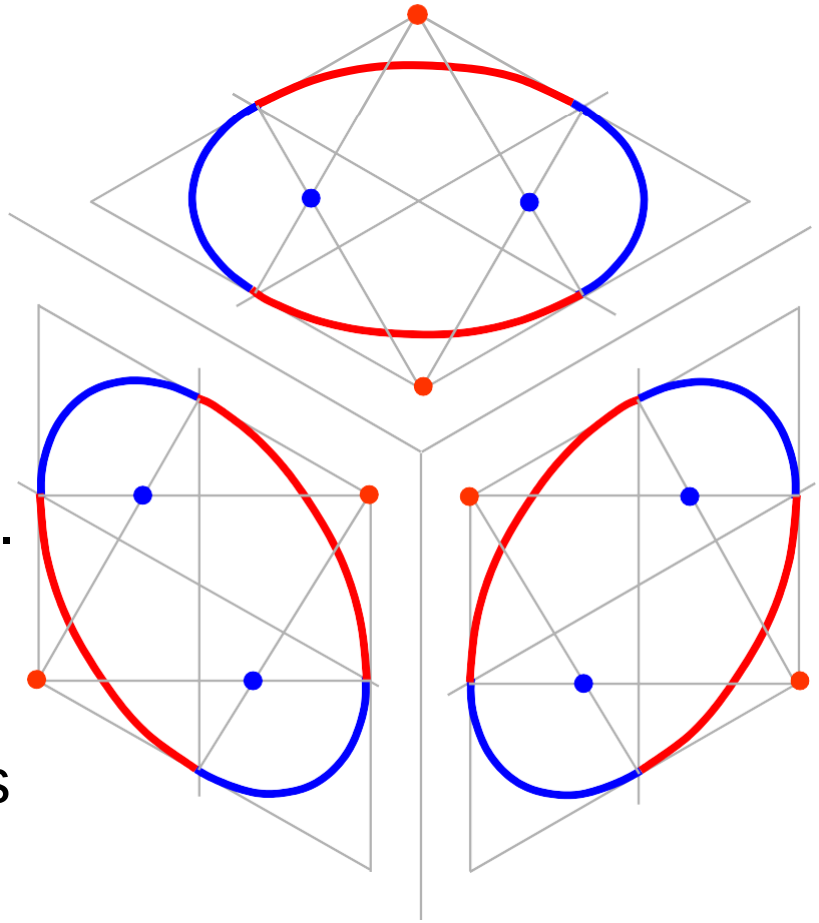


Circle & Arc in Isometric

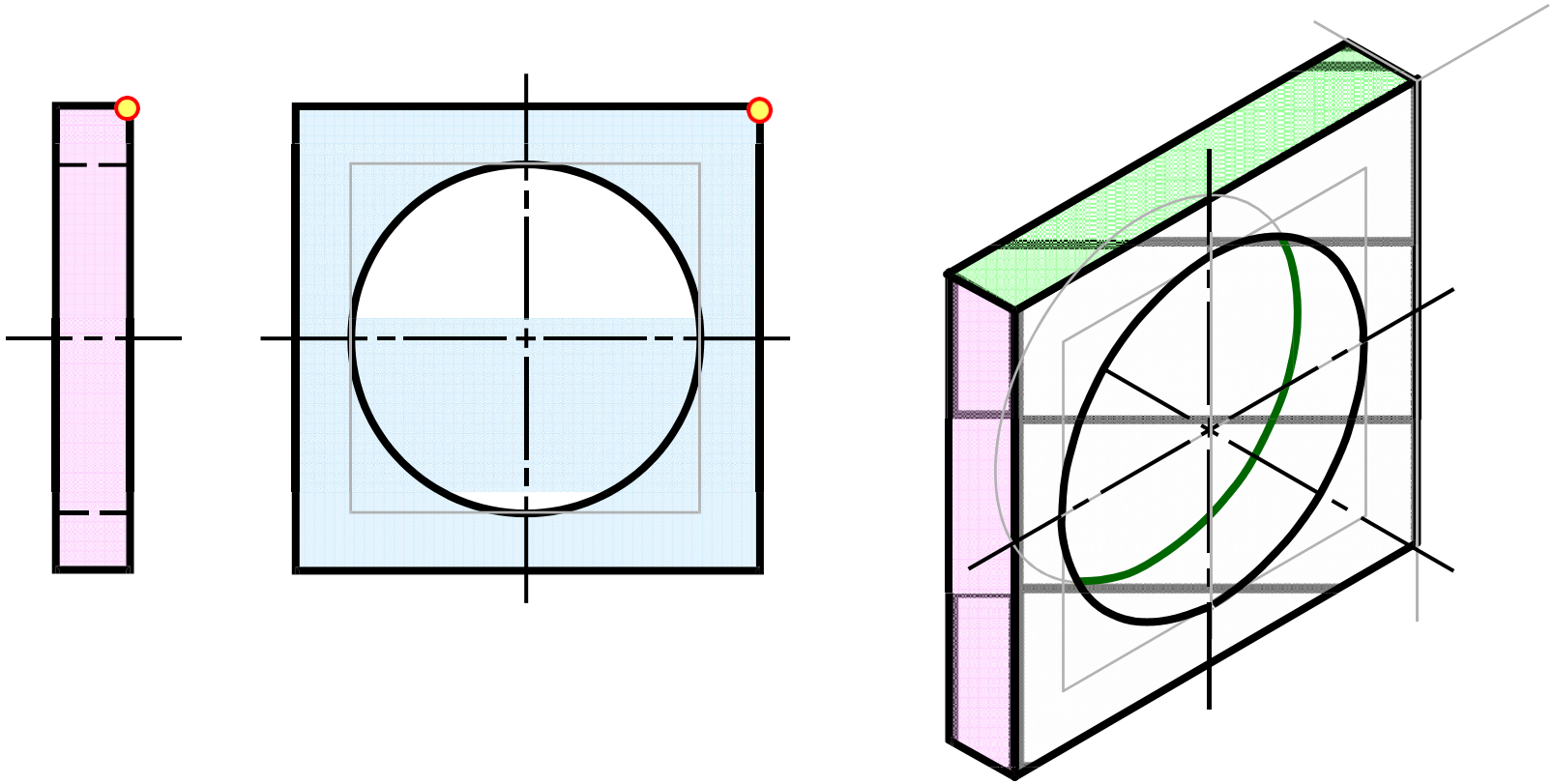
- ***Four-center*** method is usually used when drawn an isometric ellipse with drawing instrument.

Sketching Steps

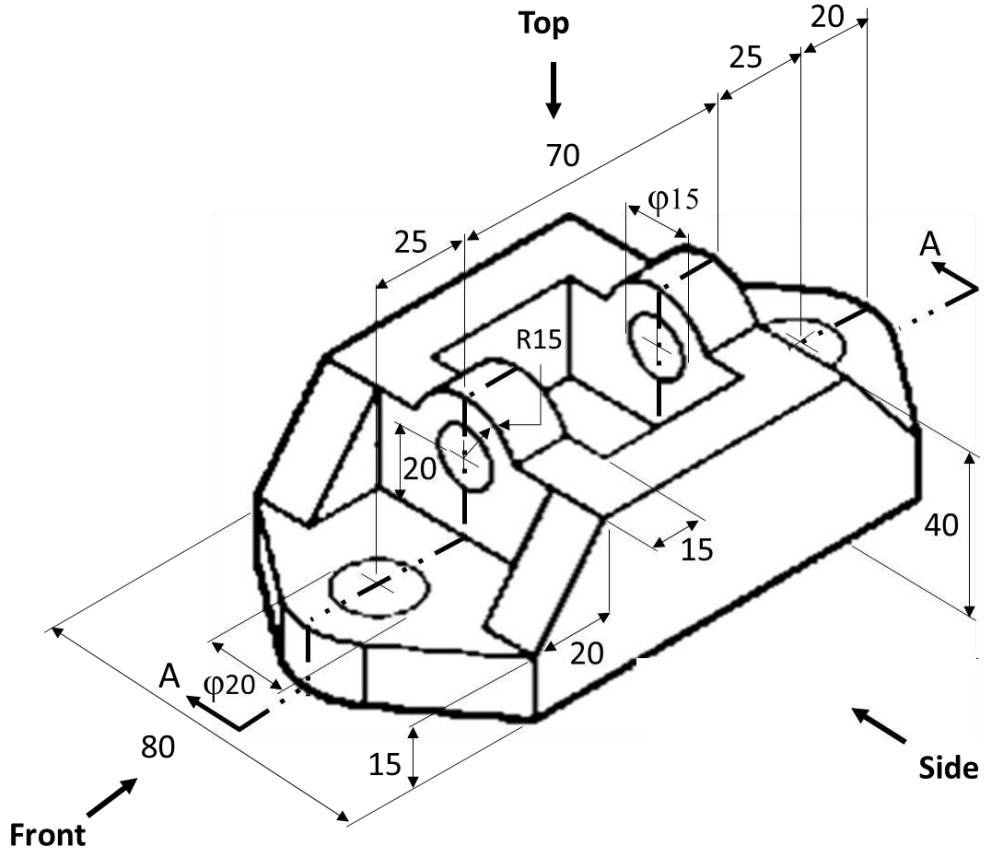
1. Locate the center of an ellipse.
2. Construct an isometric square.
3. Construct a perpendicular bisector from each tangent point.
4. Locate the four centers.
5. Draw the arcs with these centers and tangent to isometric square.



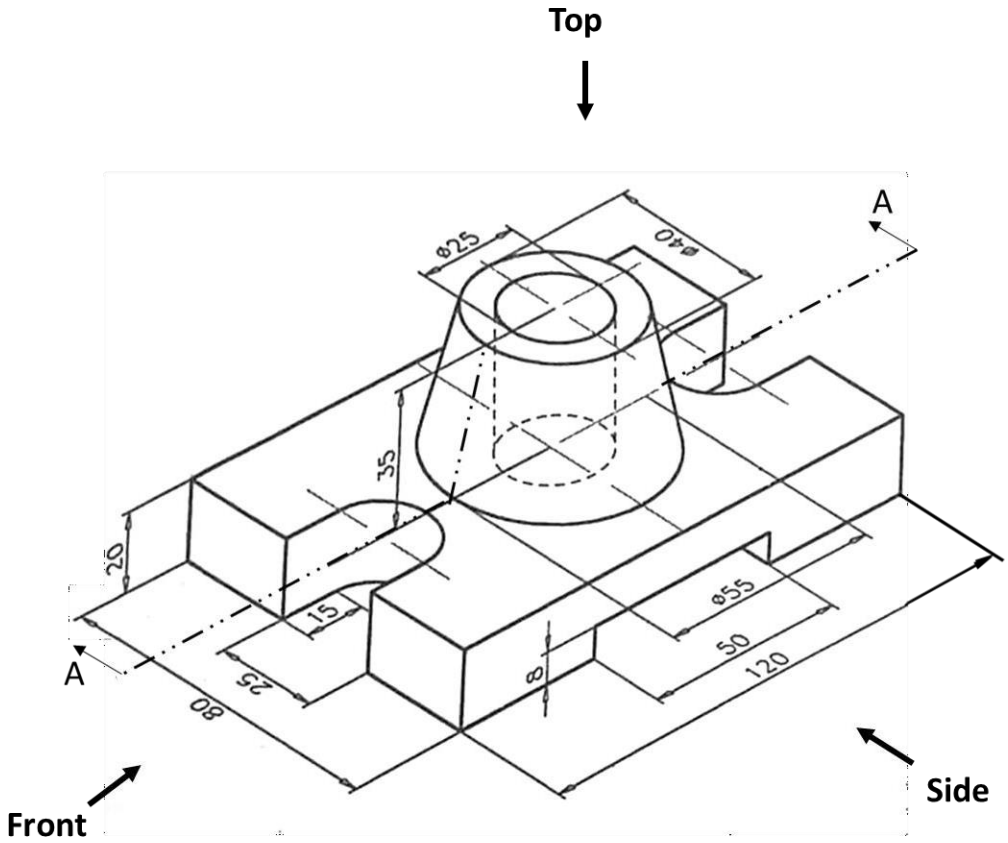
Example 5



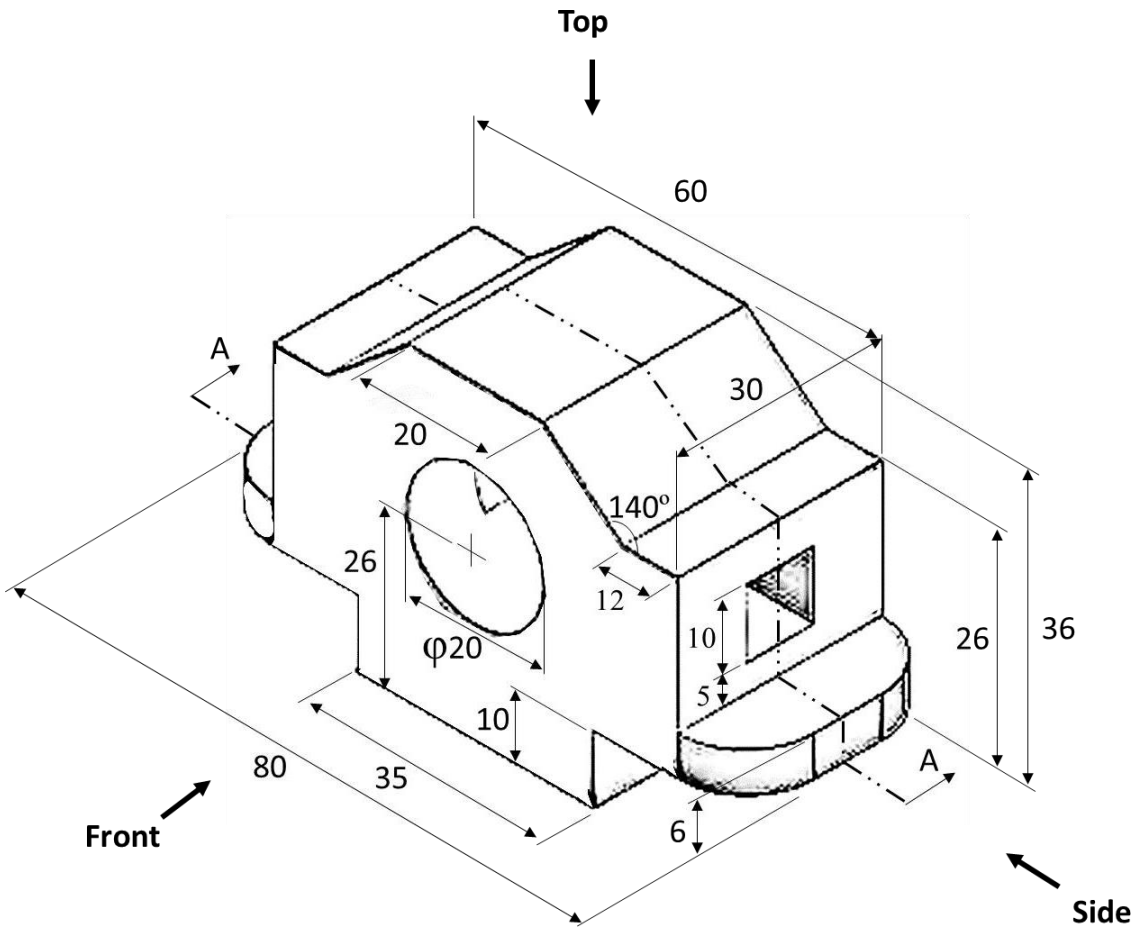
For the object shown below, draw the Right-side section view (Section A-A) with dimensions. All dimensions are in mm.



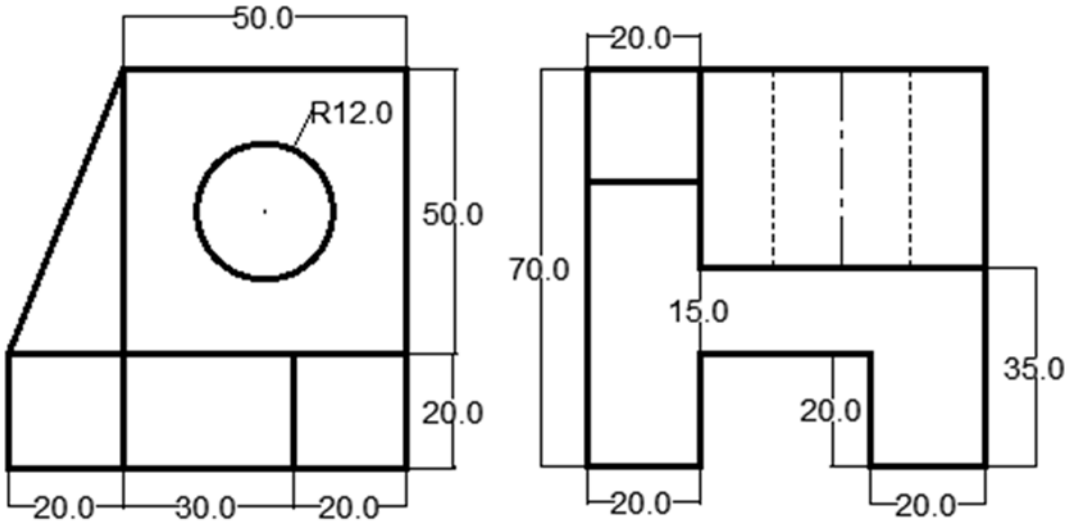
For the object shown below, draw the Right-side section view (Section A-A) with dimensions. All dimensions are in mm.



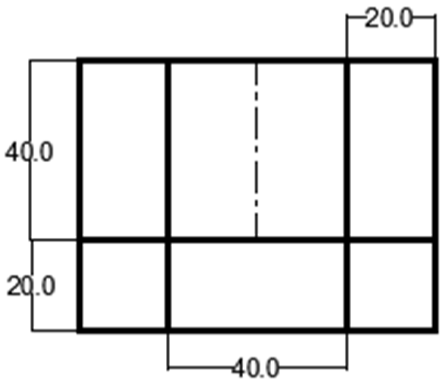
For the object shown below, draw the front section view (Section A-A) with dimensions. All dimensions are in mm.



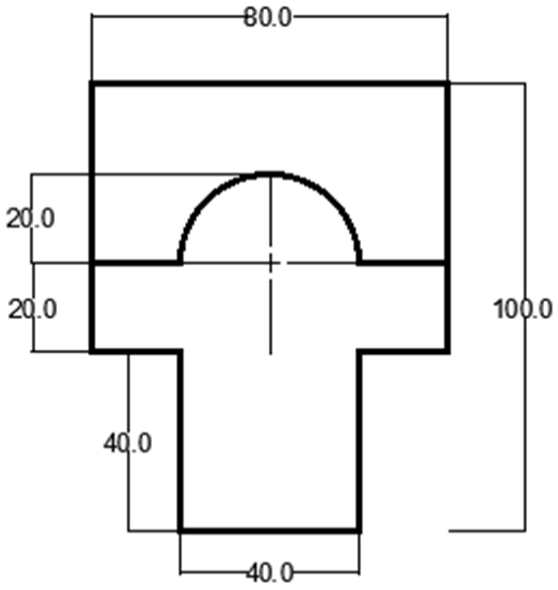
Given the views shown below, draw the missing front view and the 30º isometric object. All dimensions are in mm.



Given the views shown below, draw the missing right-side view and the 30º isometric object. All dimensions are in mm.

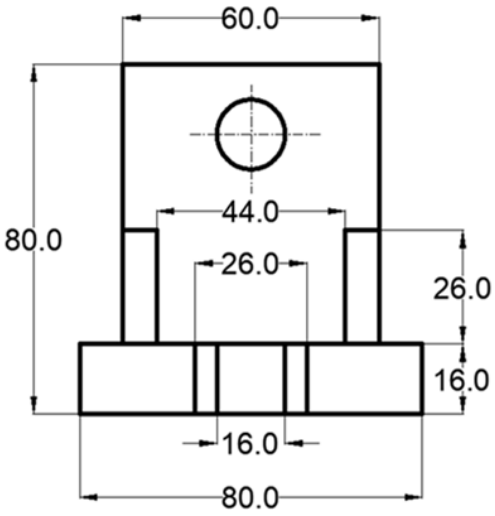


Front view

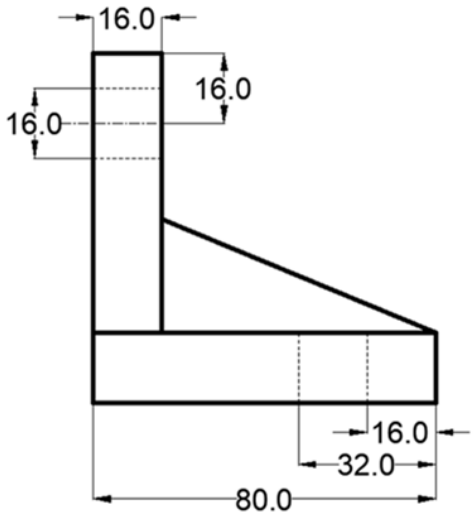


Top view

Given the views shown below, draw the missing top view and the 30º isometric object. All dimensions are in mm.

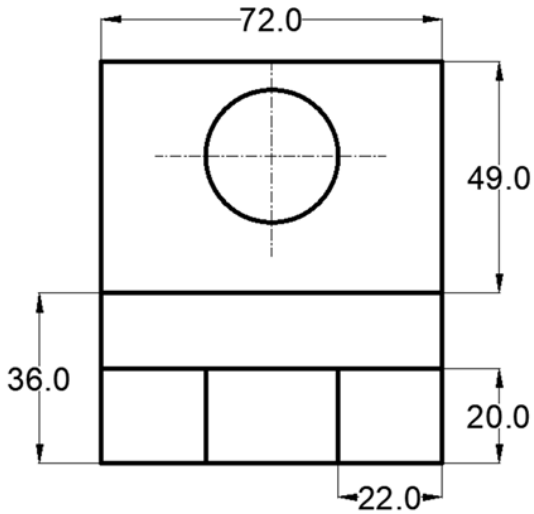


Side view

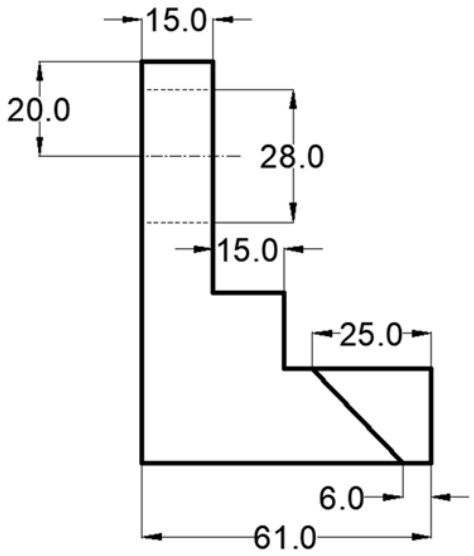


Front view

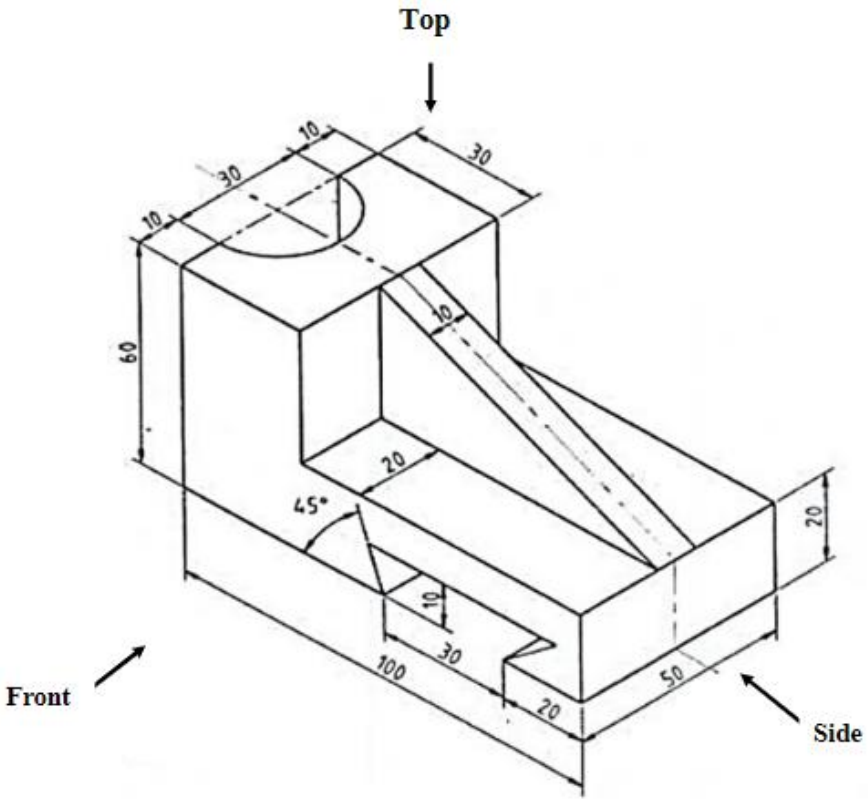
Given the views shown below, draw the missing top view and the 30º isometric object. All dimensions are in mm.

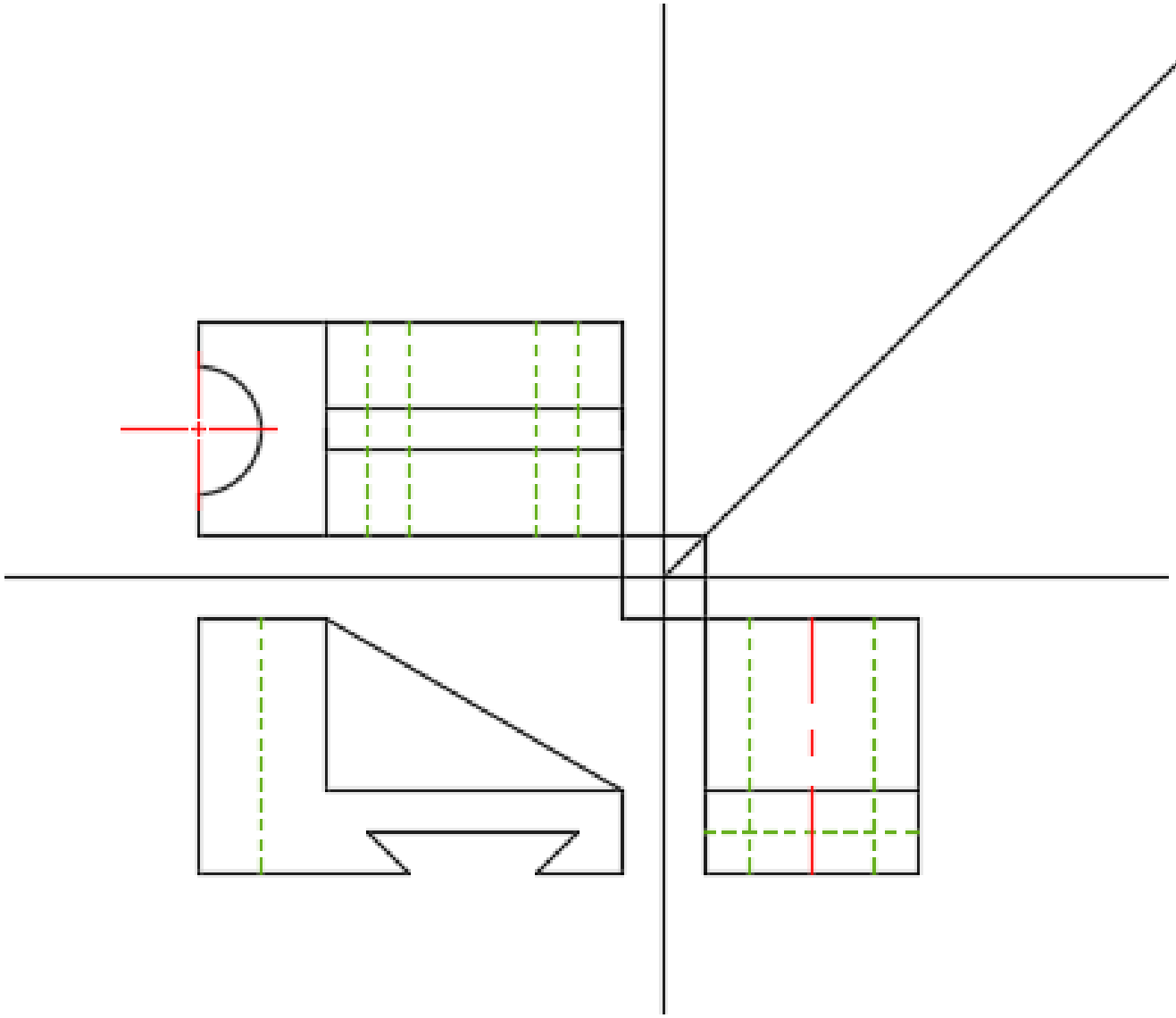


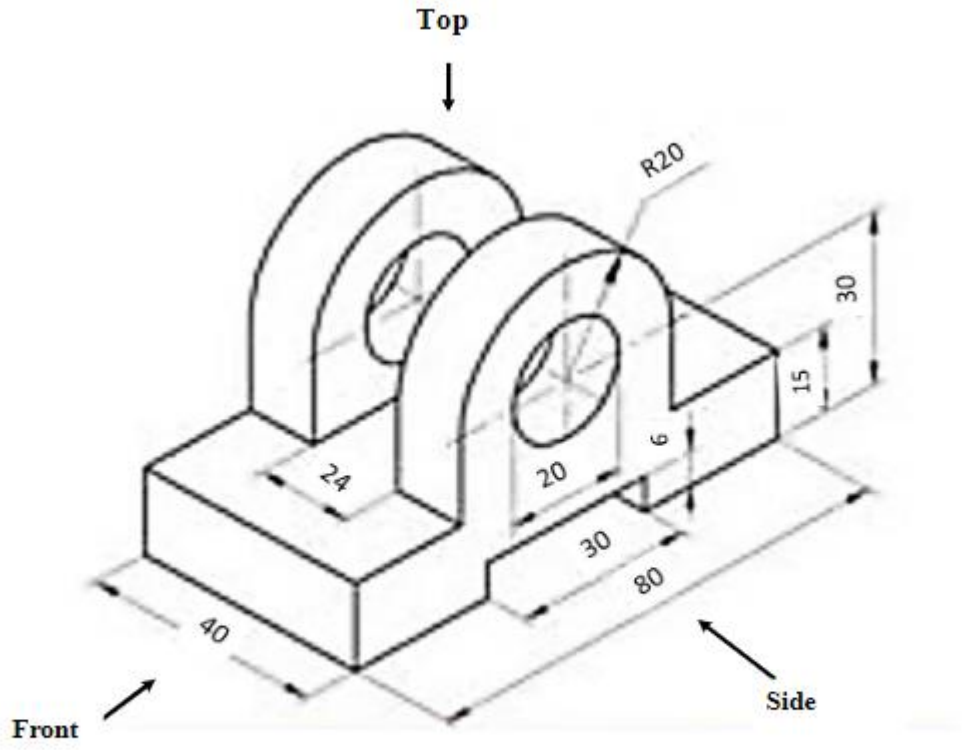
Side view

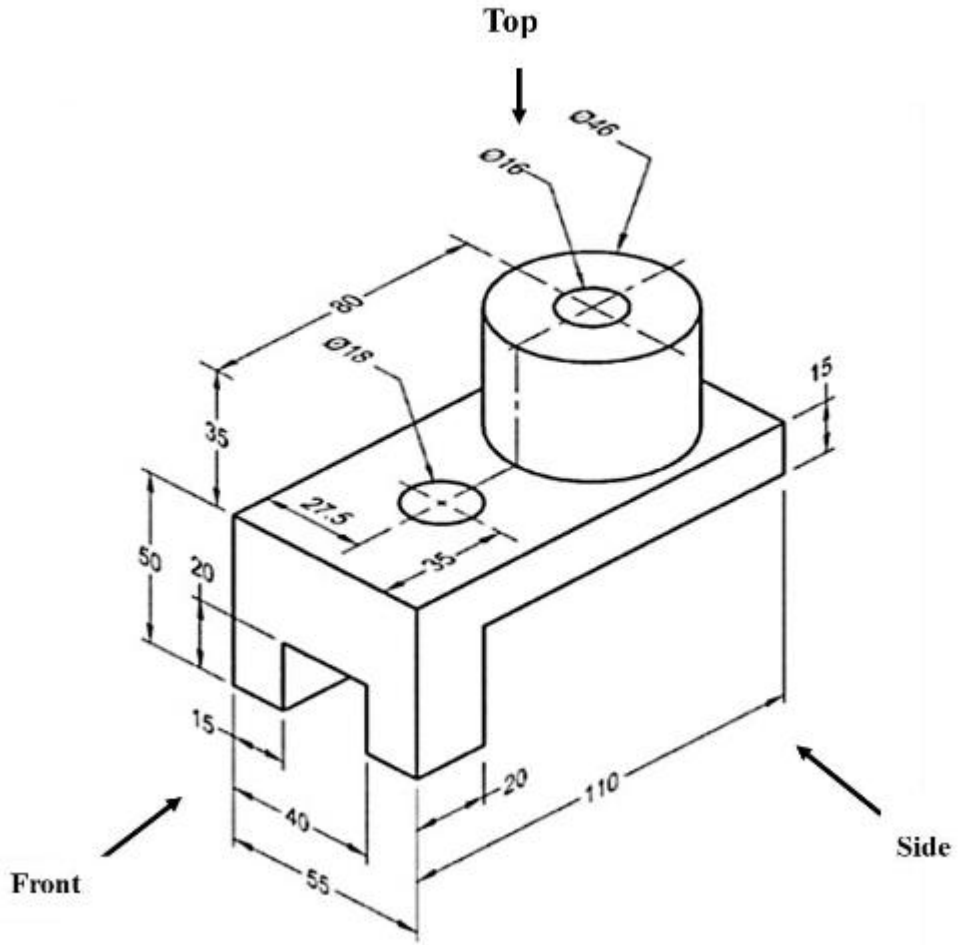


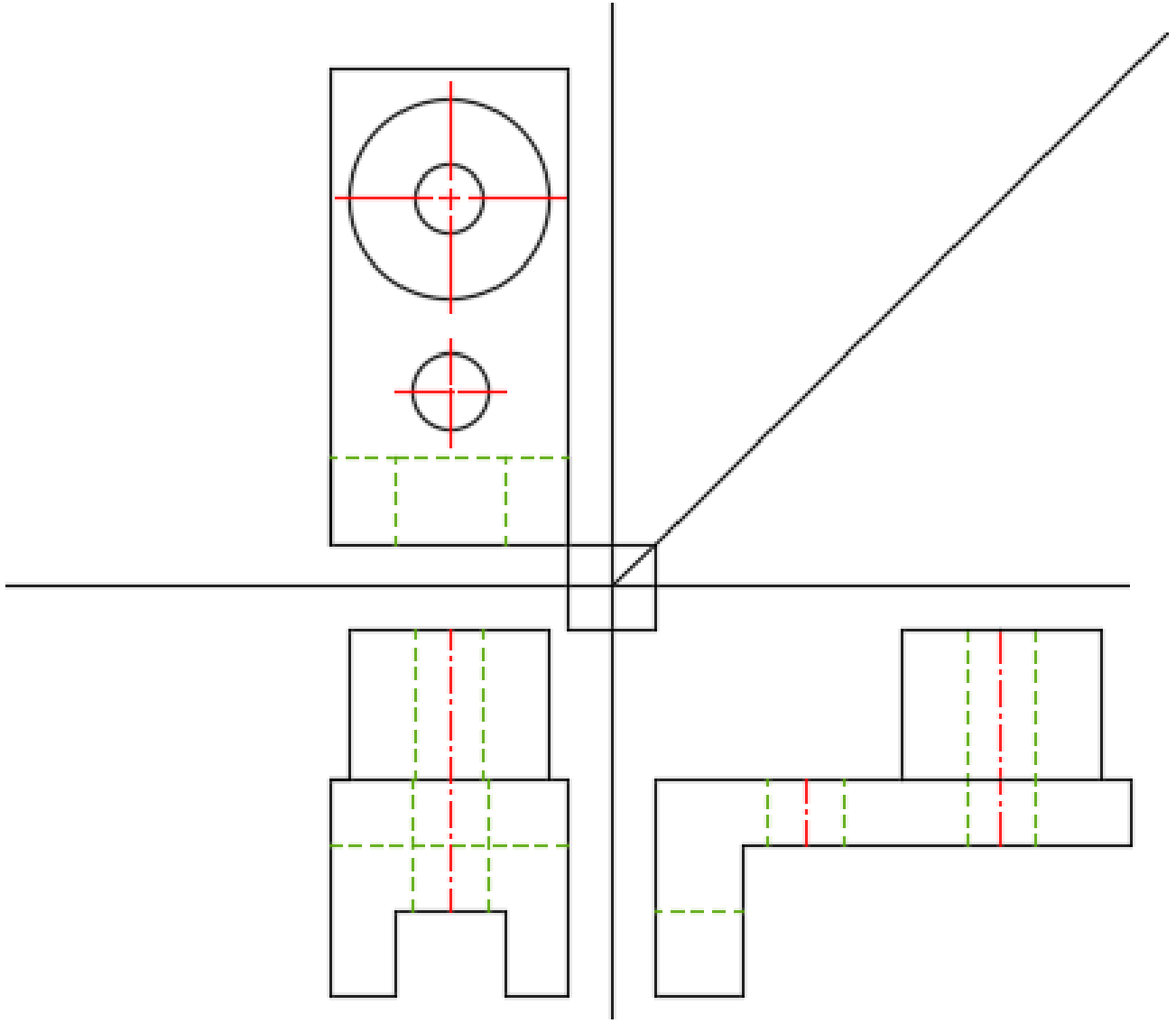
Front view

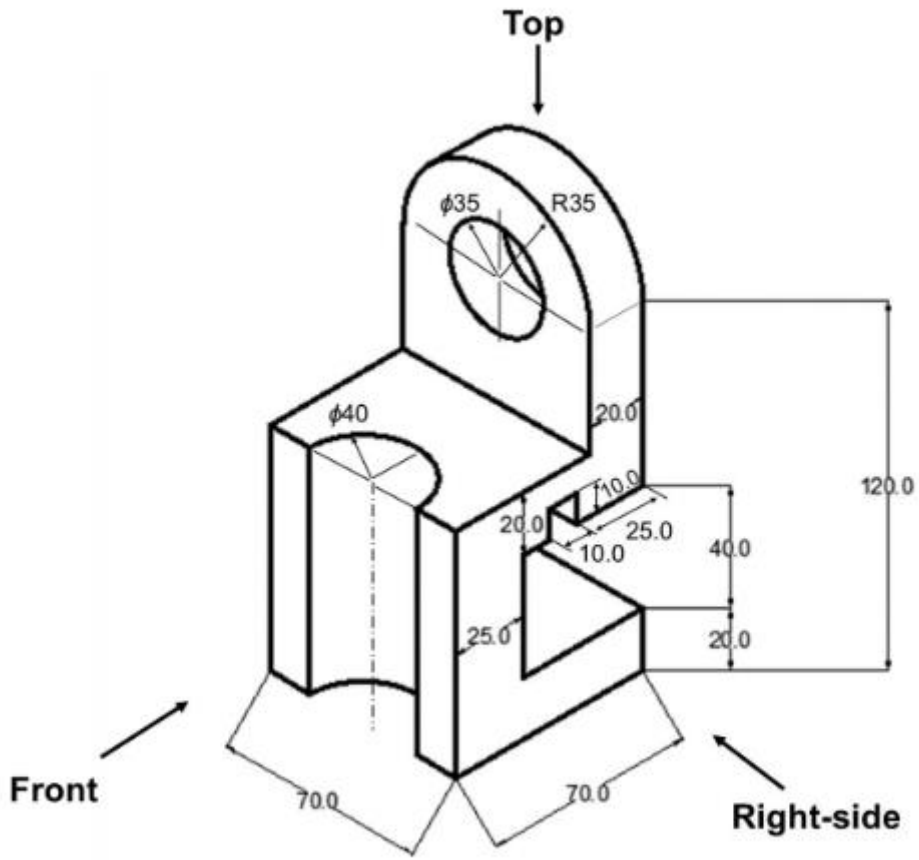

Top
Front
Side
10
30
30
10
60
10
20
45°
20
10
30
100
20
50

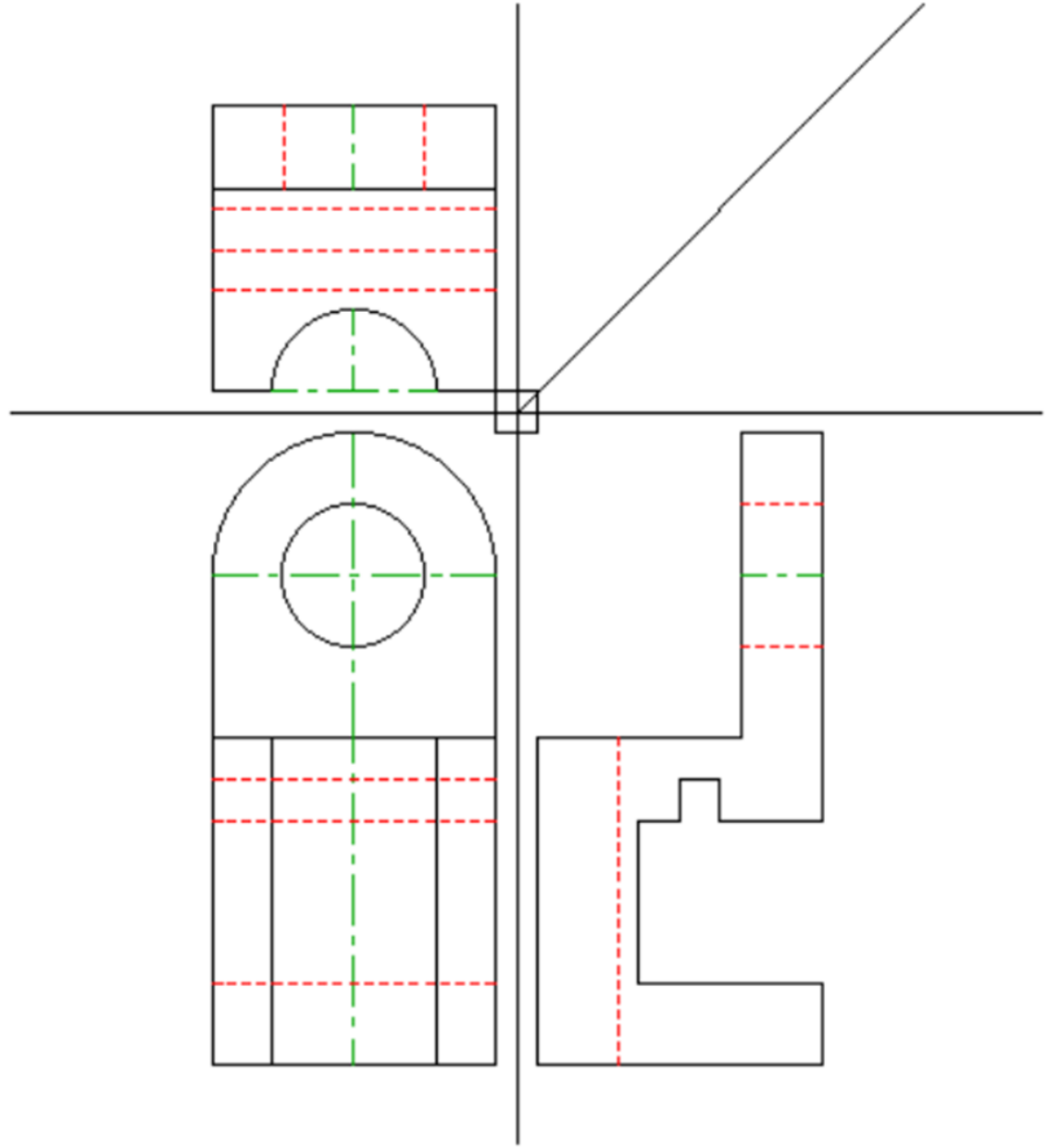



Top
R20
30
15
6
24
20
30
80
40
Front
Side

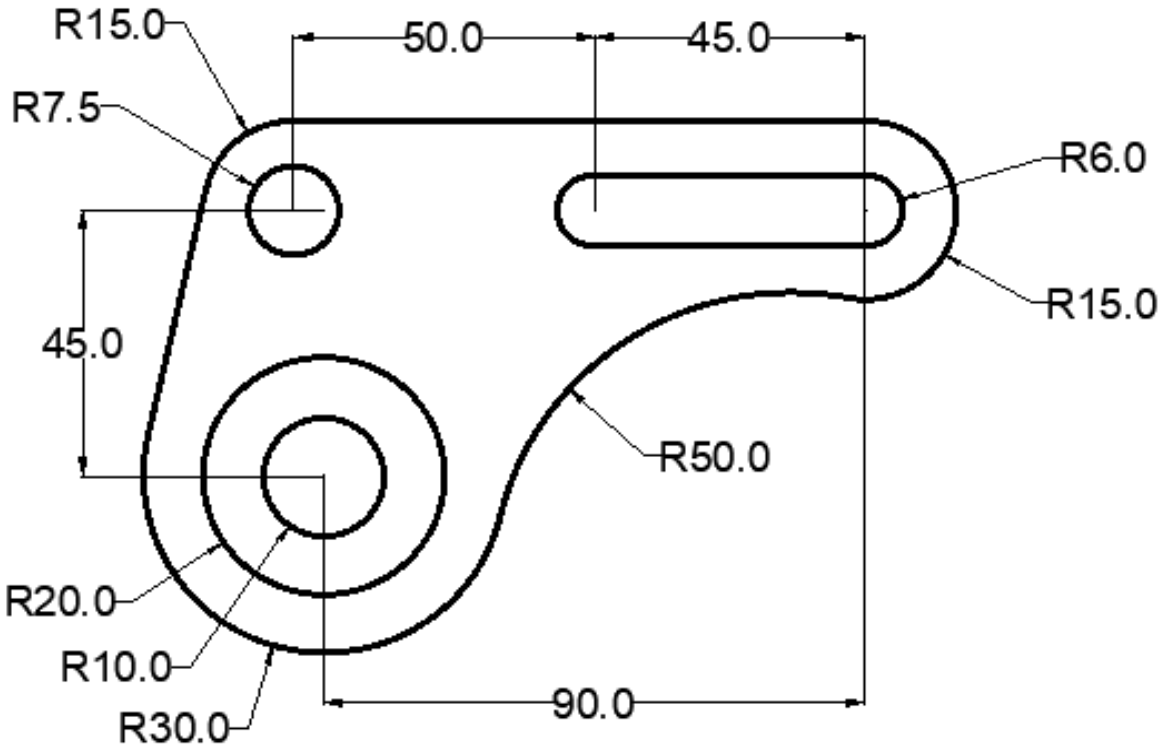

Top
Ø16
Ø16
80
35
27.5
35
15
50
20
15
40
55
20
110
Front
Side

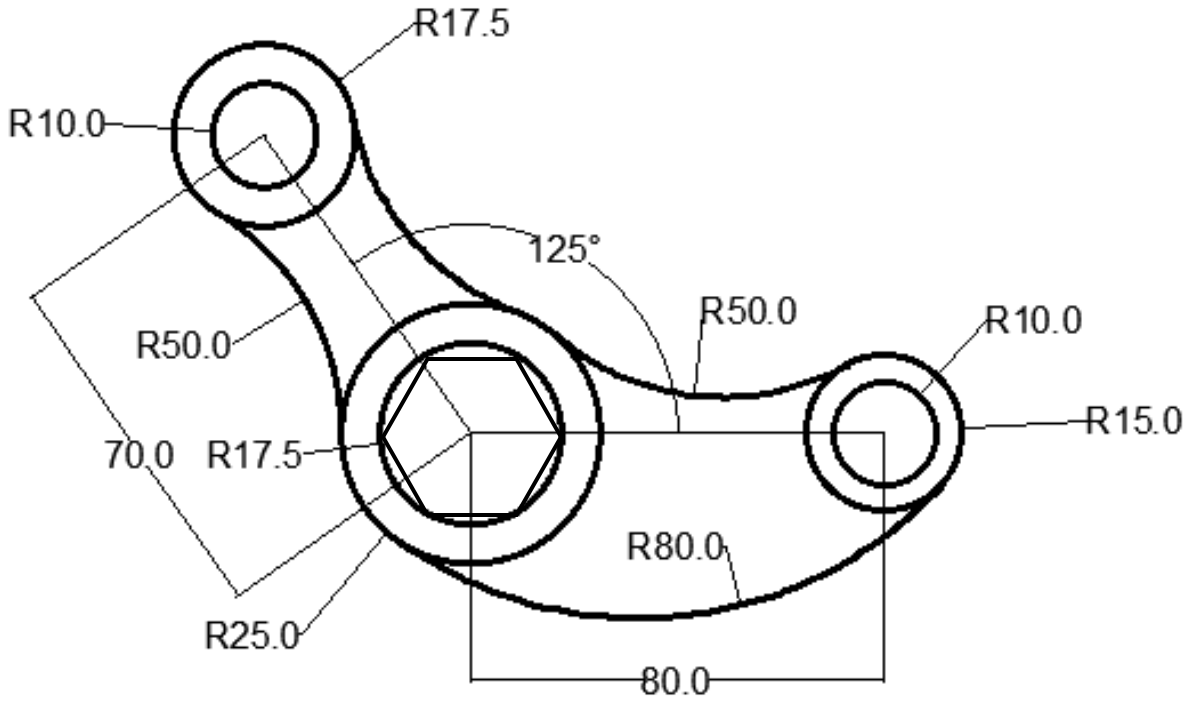


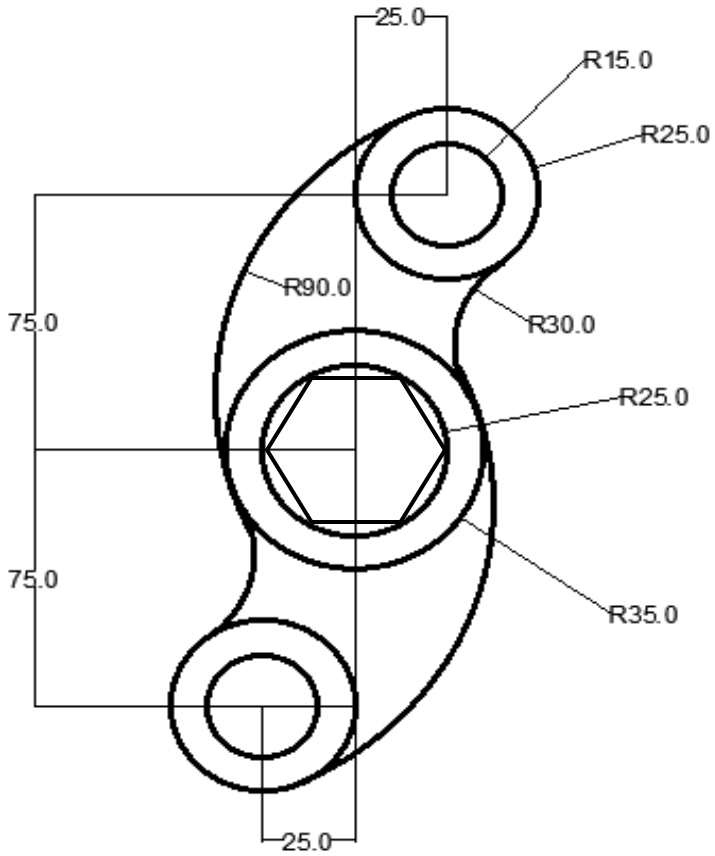

Top
ϕ35
R35
ϕ40
20.0
10.0
20.0
25.0
10.0
40.0
120.0
25.0
20.0
Front
70.0
70.0
Right-side

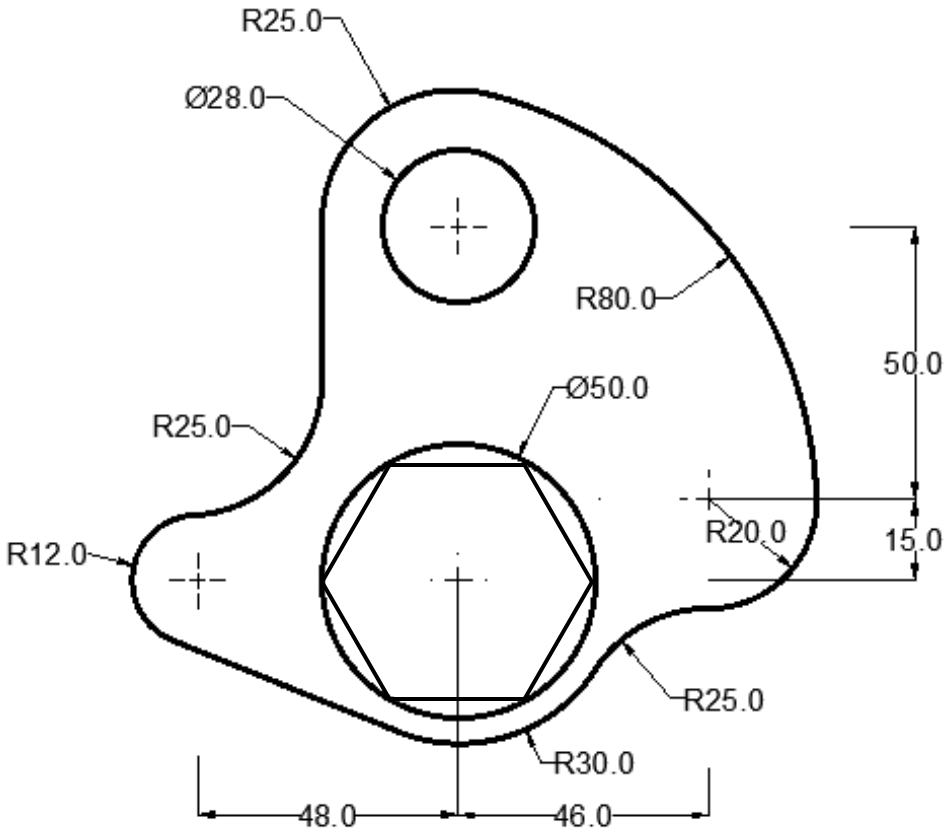


Draw the following objects using geometric construction techniques. All dimensions are in mm.

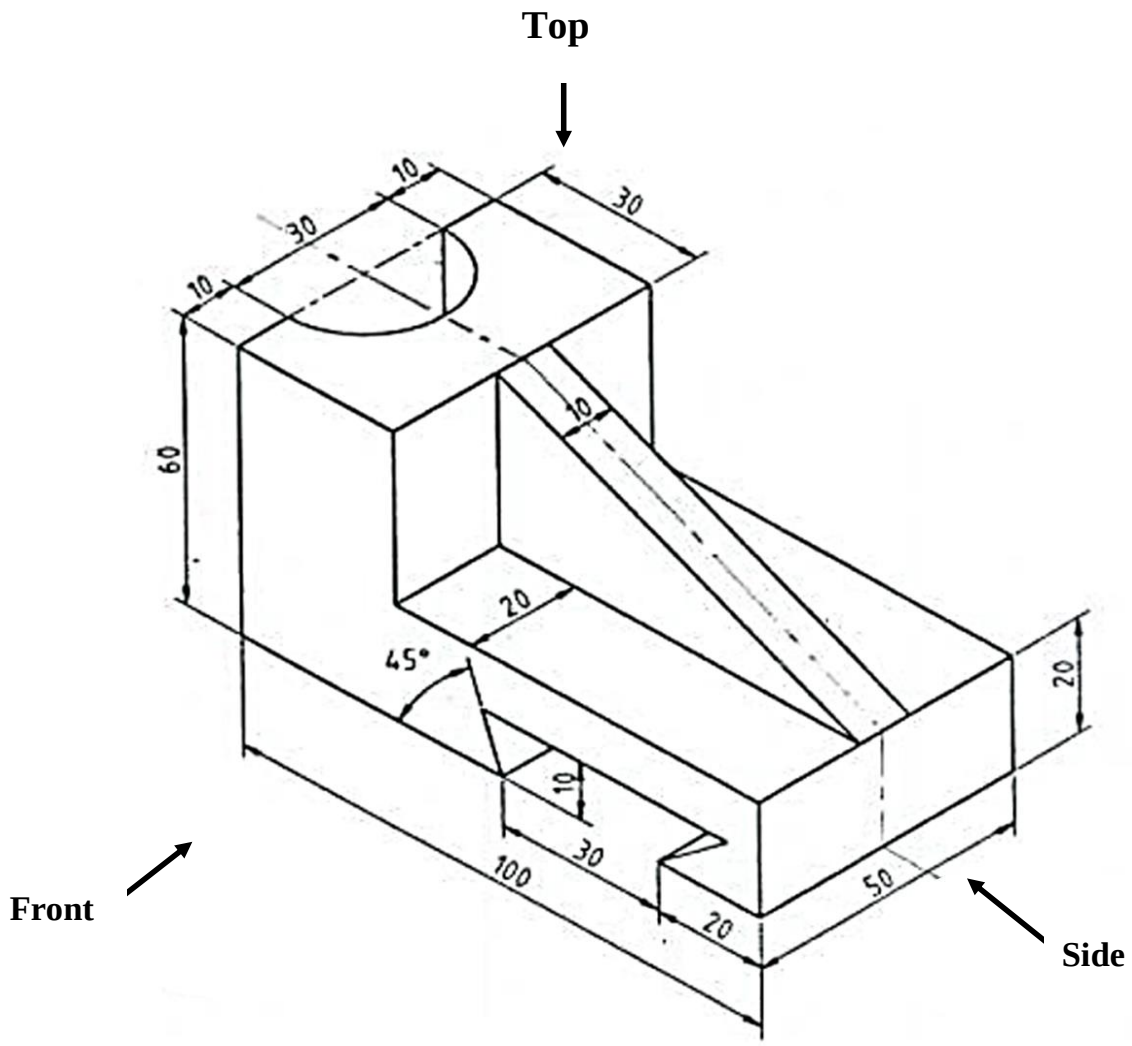


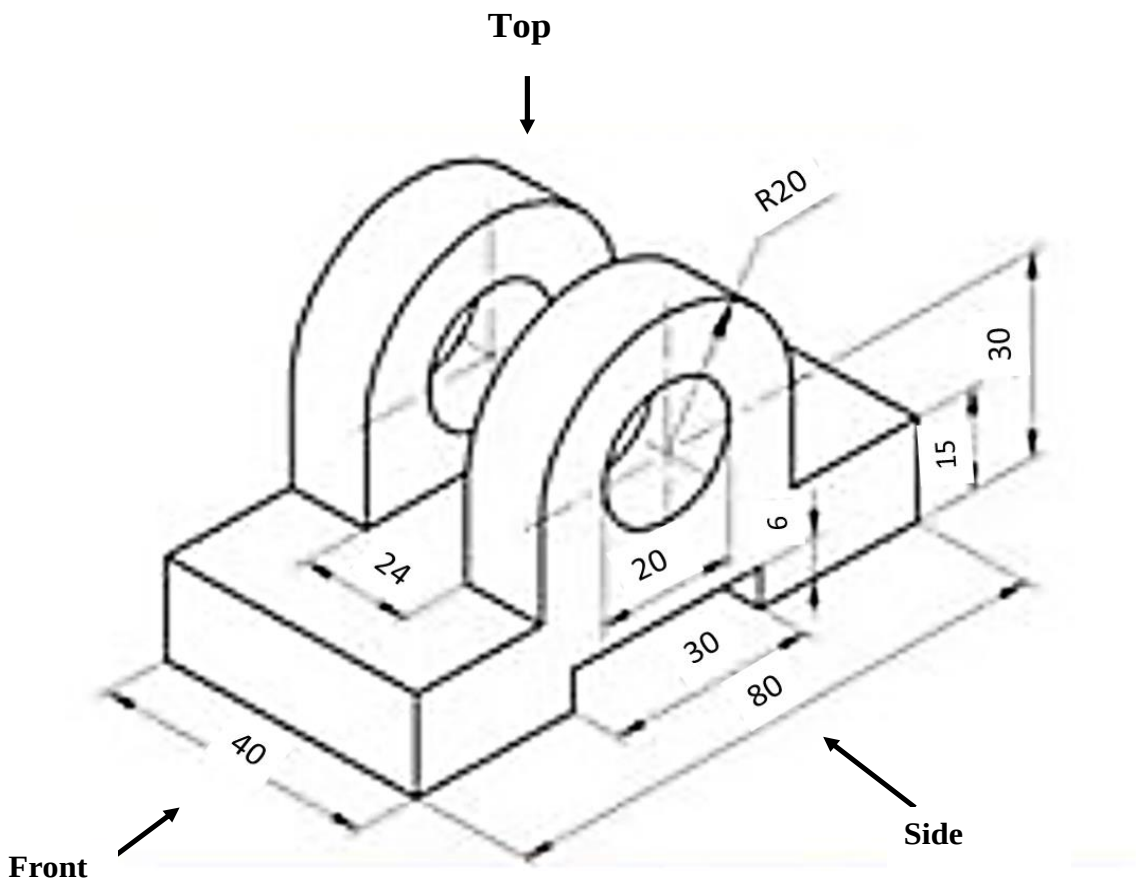

R17.5
R10.0
125°
R50.0
R50.0
R10.0
R15.0
70.0
R17.5
R80.0
R25.0
80.0

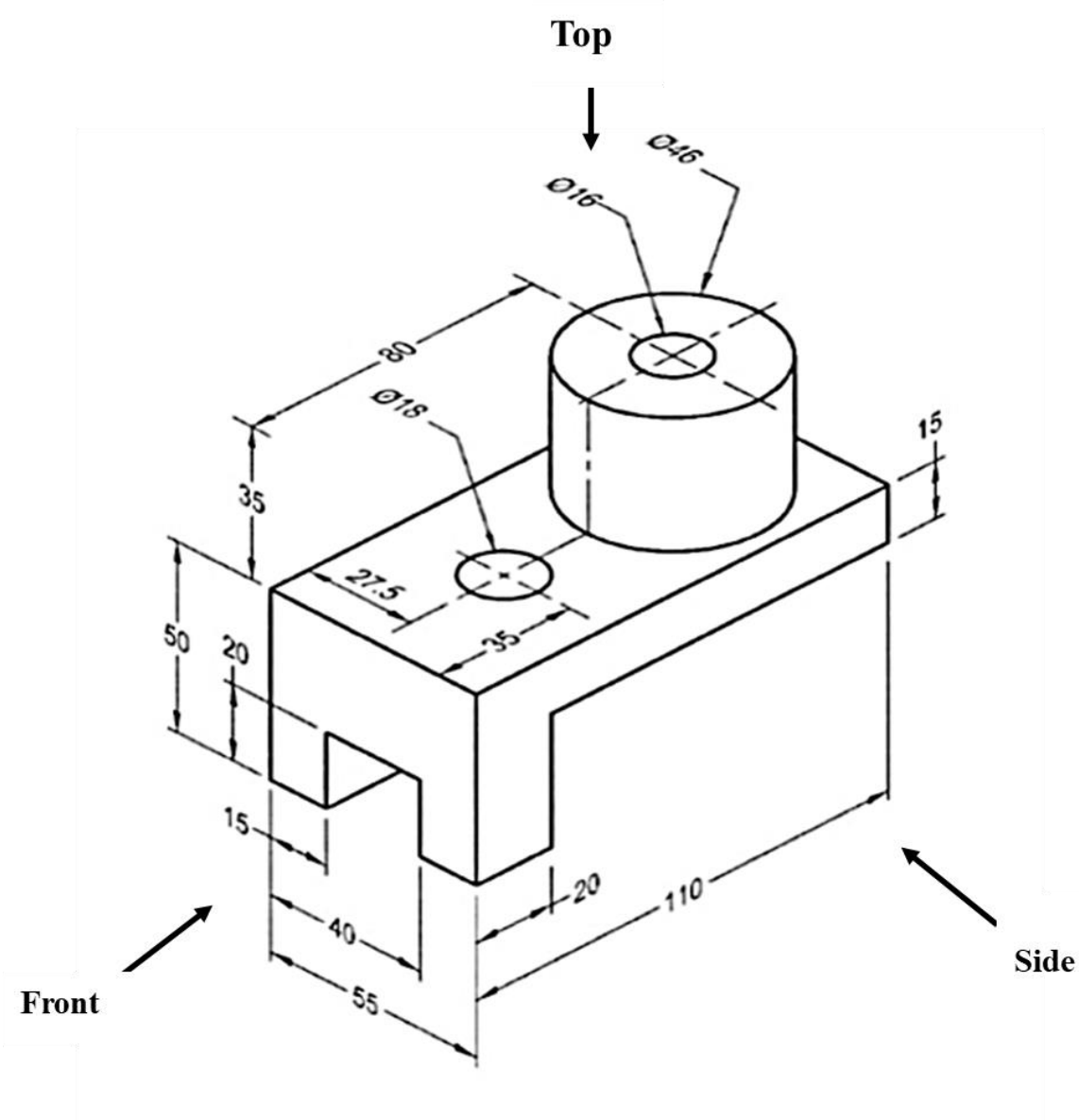

25.0
R15.0
R25.0
R90.0
75.0
R30.0
R25.0
75.0
R35.0
25.0

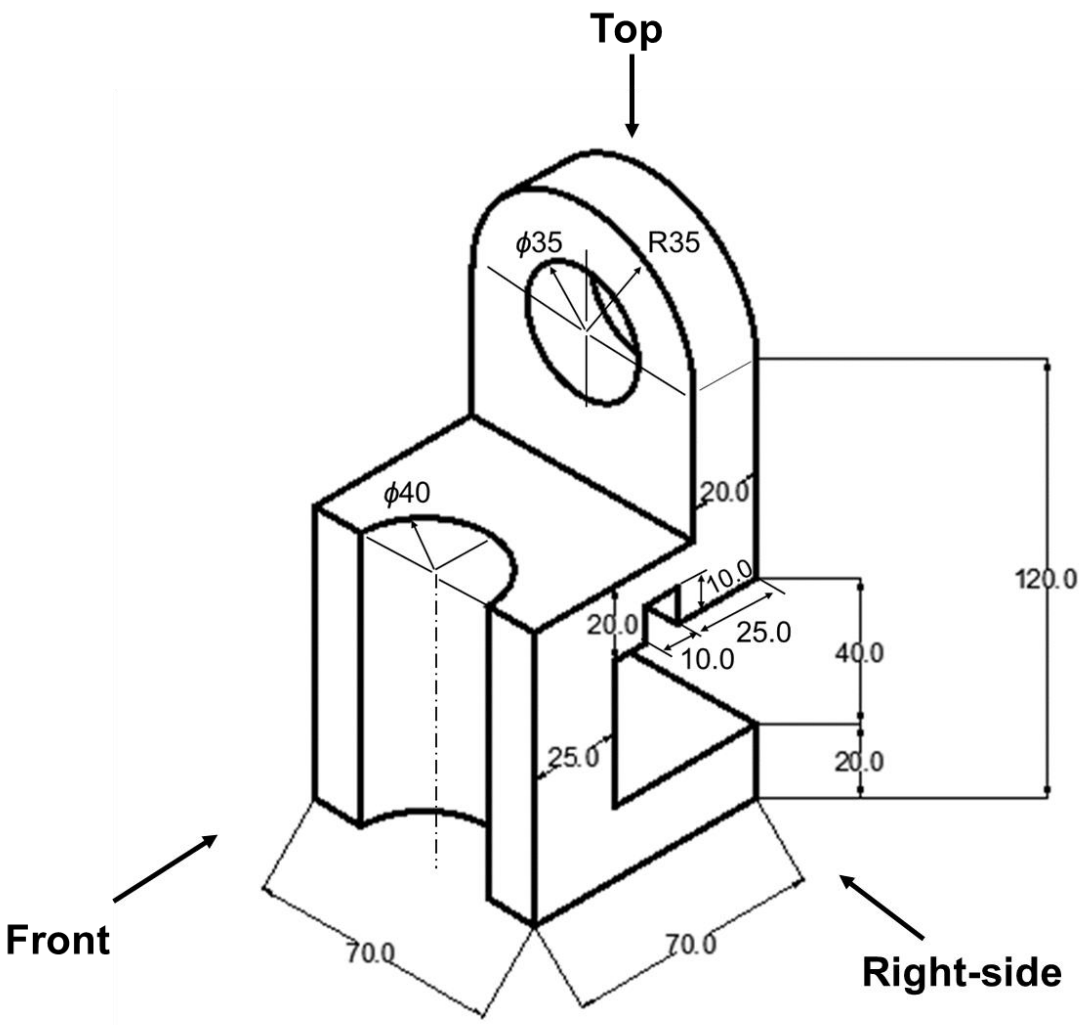

R25.0
Ø28.0
R80.0
50.0
Ø50.0
R25.0
R20.0
15.0
R12.0
R25.0
R30.0
48.0
46.0

For the objects shown below, draw the front, top, and the right-side views. All dimensions are in mm.

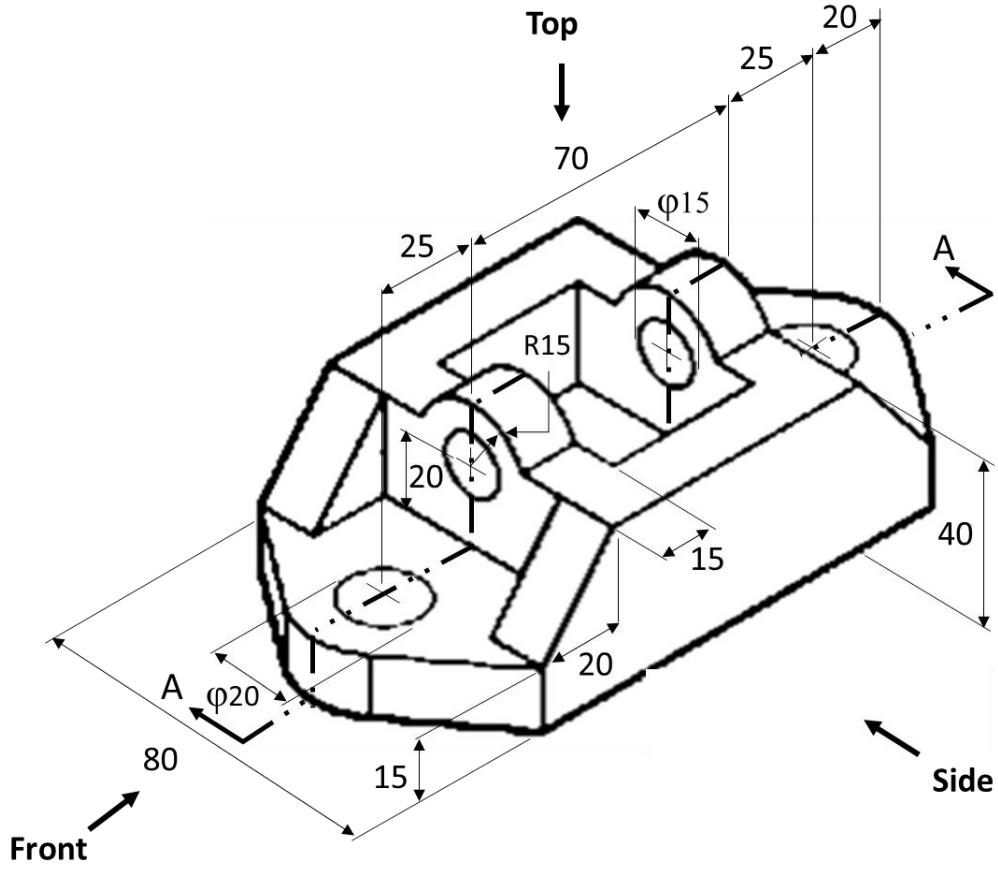


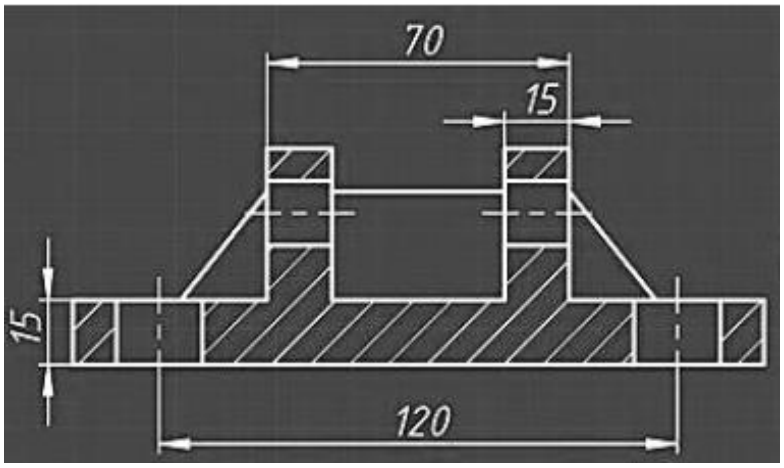

Top
R20
30
15
6
24
20
30
80
40
Front
Side


Top
Front
Side
Ø46
Ø16
Ø18
80
35
15
27.5
35
50
20
15
40
55
20
110

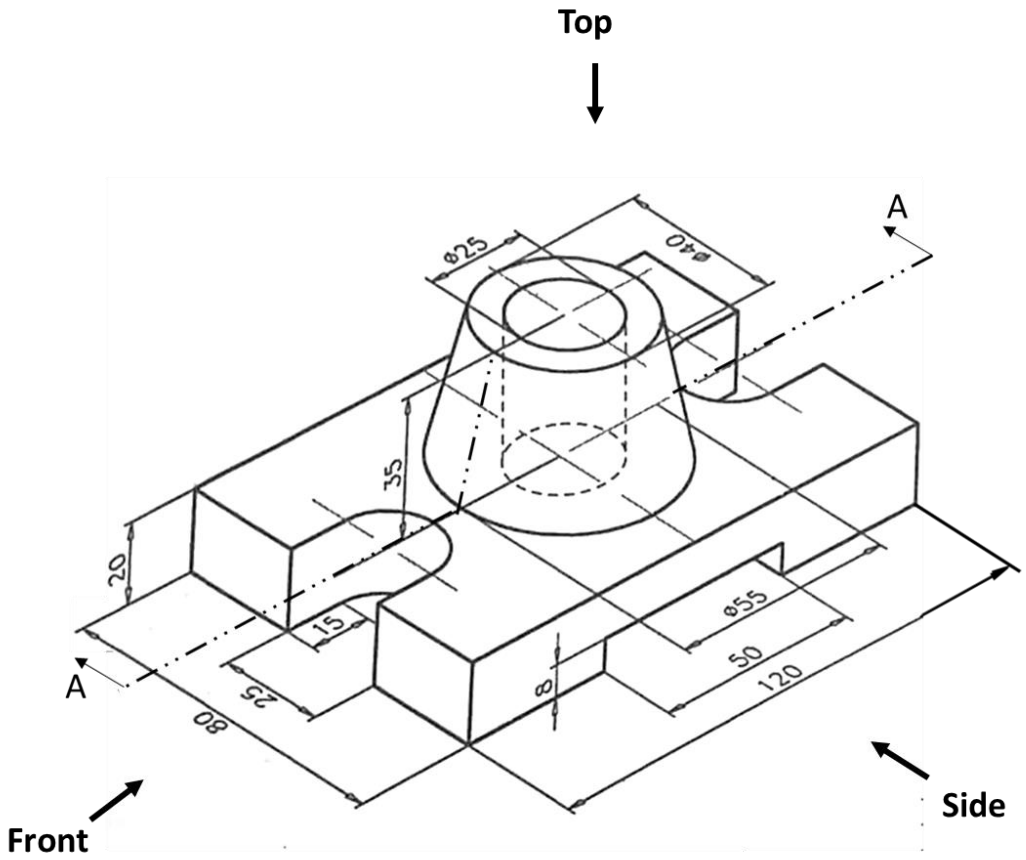

Top
ϕ35
R35
ϕ40
20.0
10.0
20.0
25.0
10.0
40.0
120.0
25.0
20.0
Front
70.0
70.0
Right-side

For the object shown below, draw the Right-side section view (Section A-A) with dimensions. All dimensions are in mm.

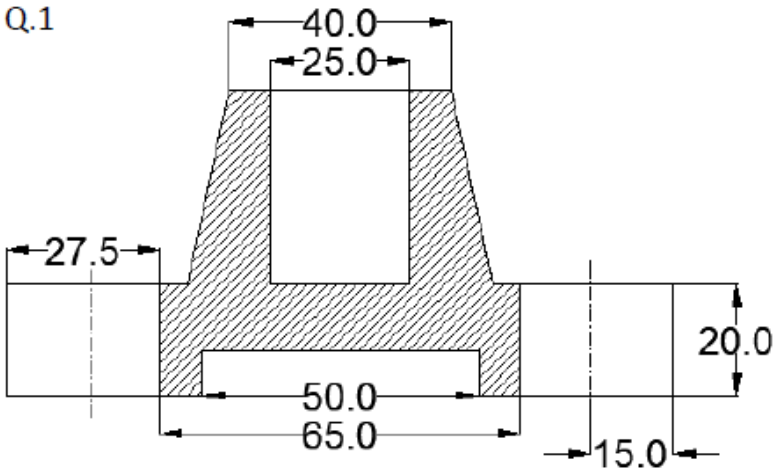




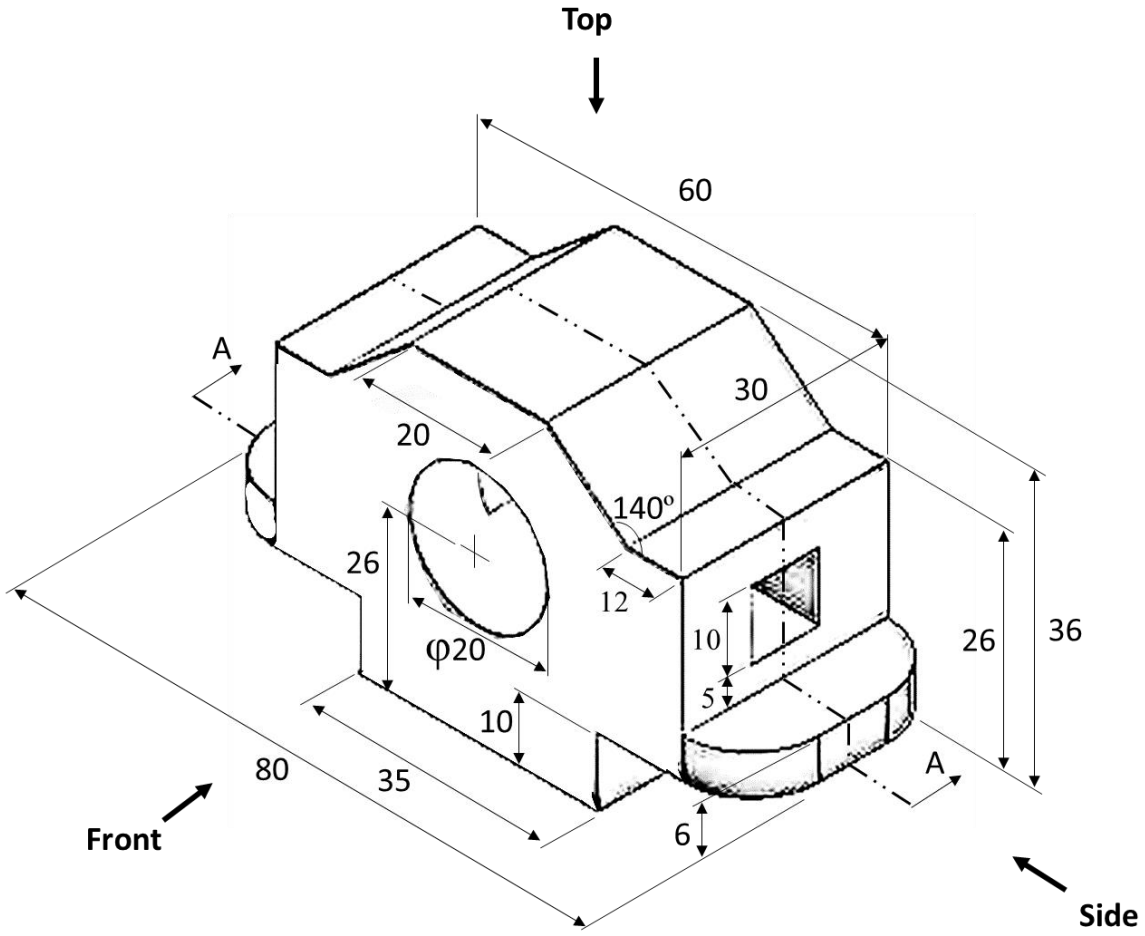
For the object shown below, draw the Right-side section view (Section A-A) with dimensions. All dimensions are in mm.

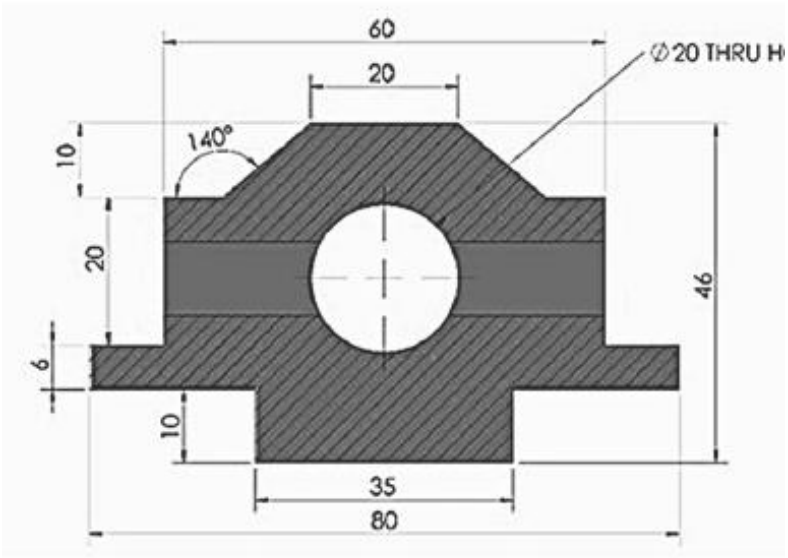


Q.1

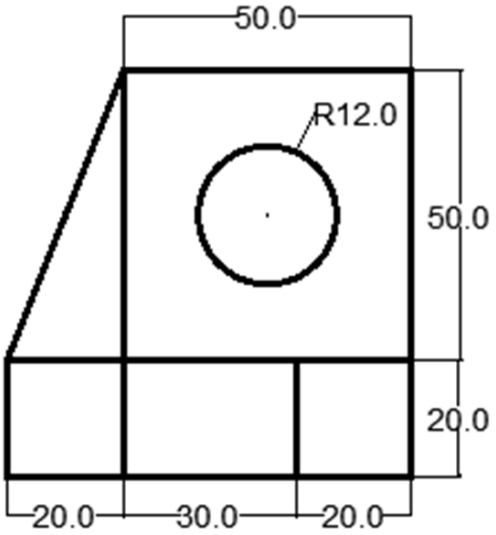


For the object shown below, draw the front section view (Section A-A) with dimensions. All dimensions are in mm.

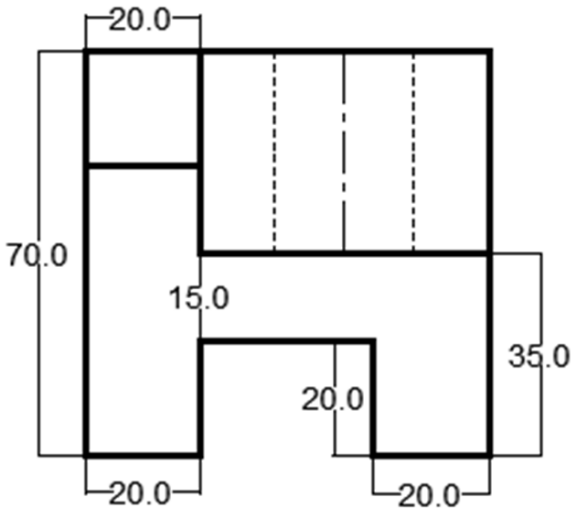




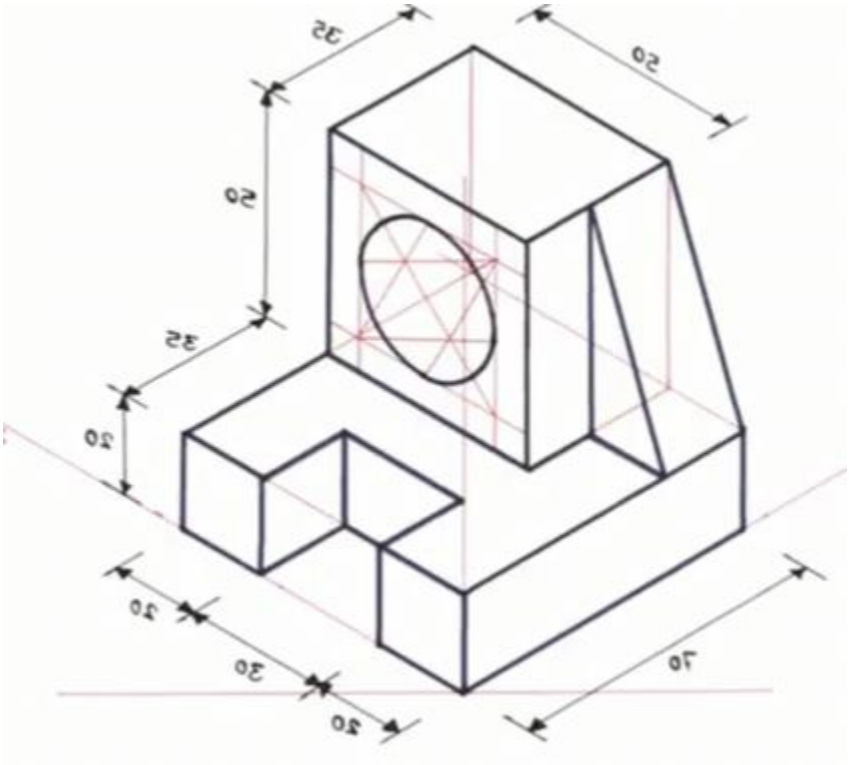
Given the views shown below, draw the missing front view and the 30º isometric object. All dimensions are in mm.



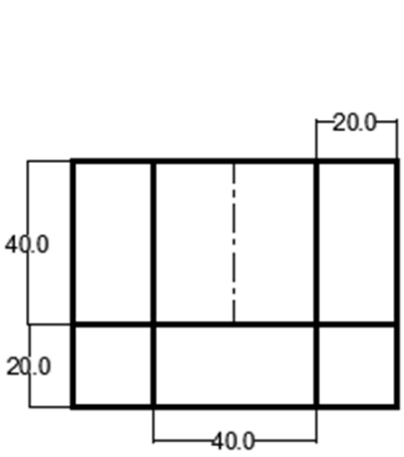
Right side view



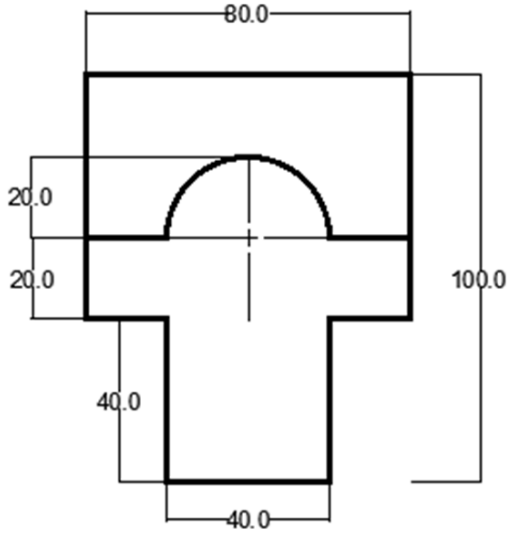
Top view



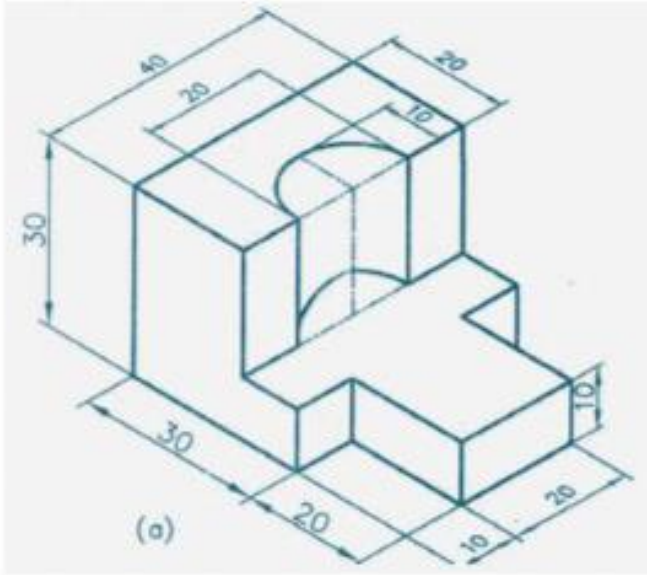
Given the views shown below, draw the missing right-side view and the 30º isometric object. All dimensions are in mm.



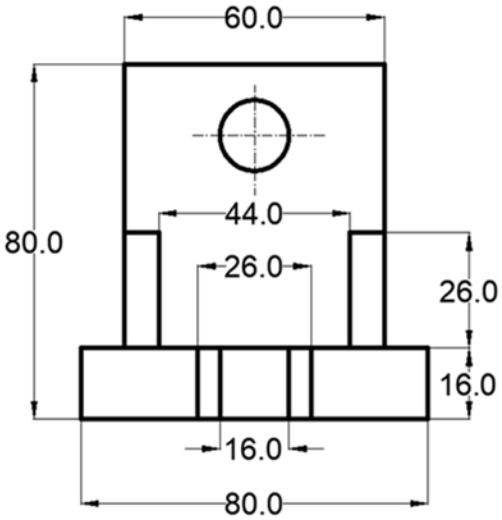
Front view



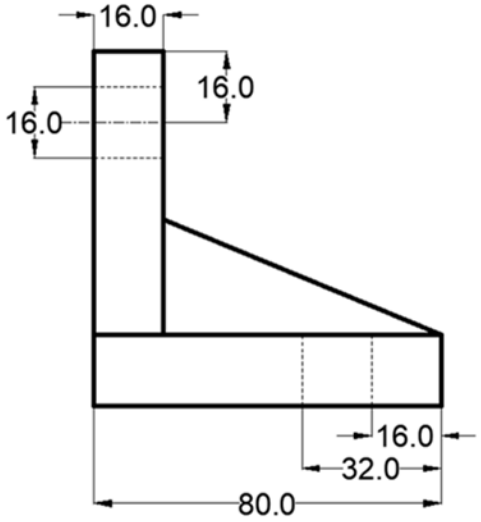
Top view



Given the views shown below, draw the missing top view and the 30º isometric object. All dimensions are in mm.

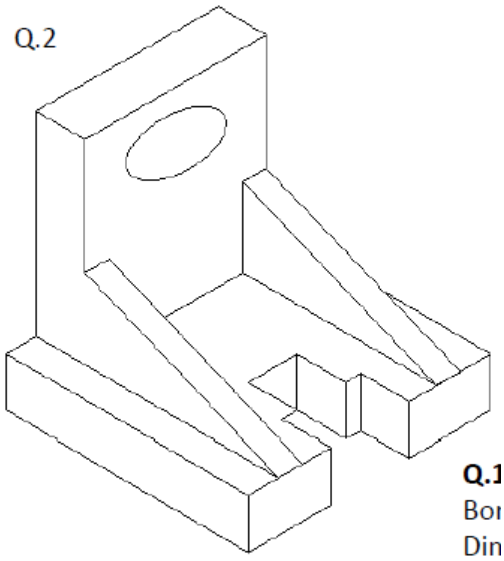


Side view

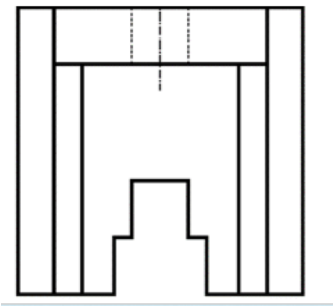


Front view

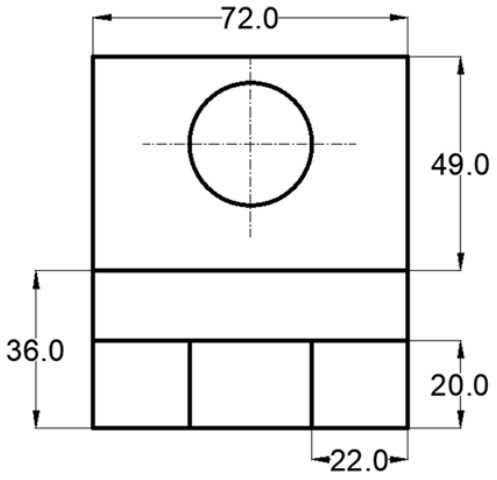
Q.2



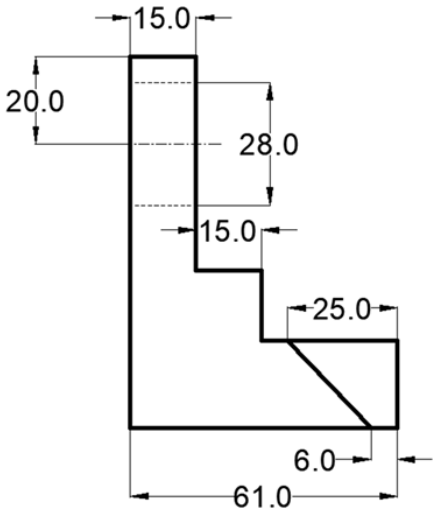
Q.1
Bor
Din



Given the views shown below, draw the missing top view and the 30º isometric object. All dimensions are in mm.



Side view



Front view

Q.2