ME 111: Engineering Drawing

Lecture 2

01-08-2011

Geometric Constructions

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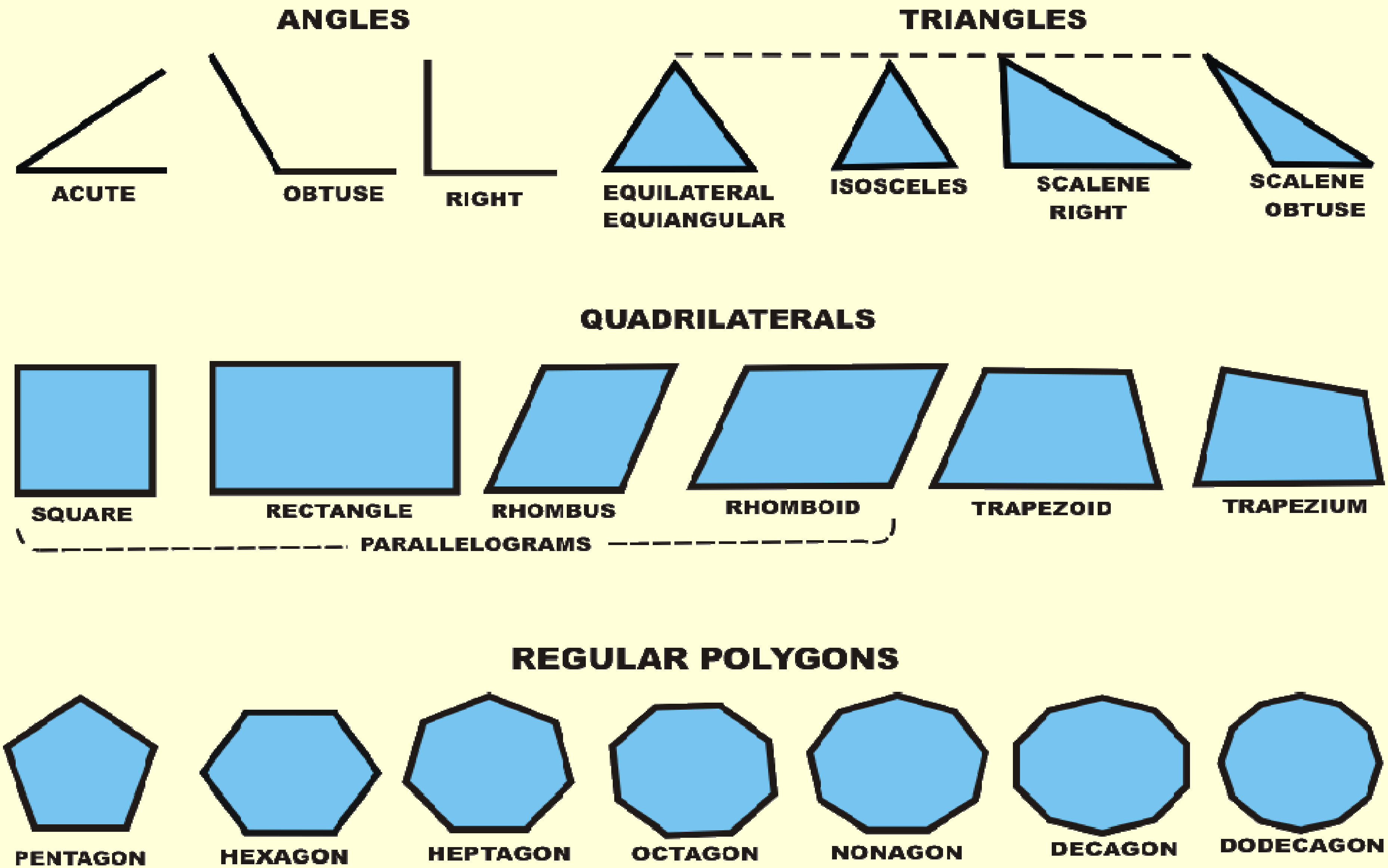
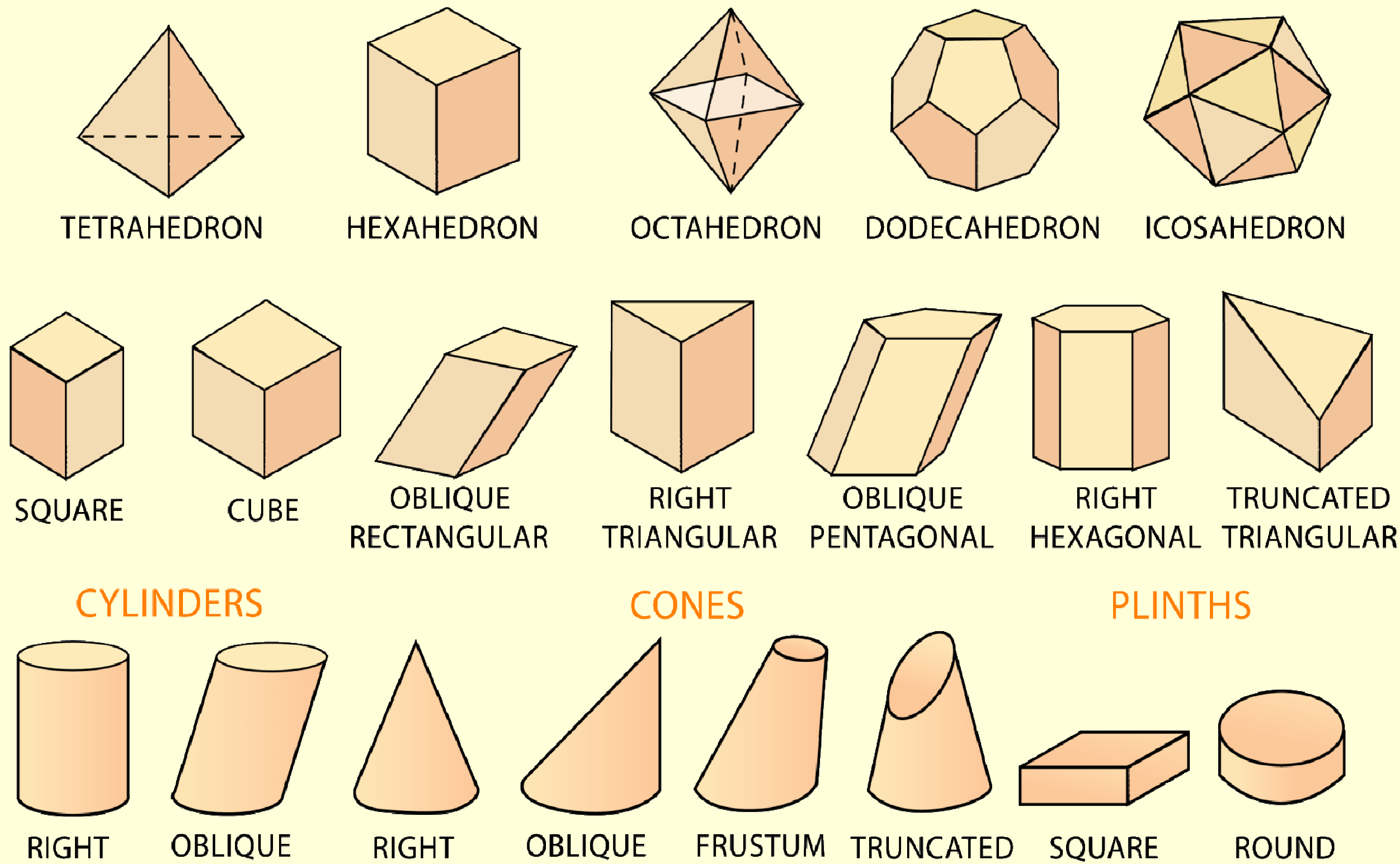
Geometric Construction

- **Construction of primitive geometric forms (points, lines and planes etc.) that serve as the building blocks for more complicated geometric shapes.**
- **Defining the position of the object in space**

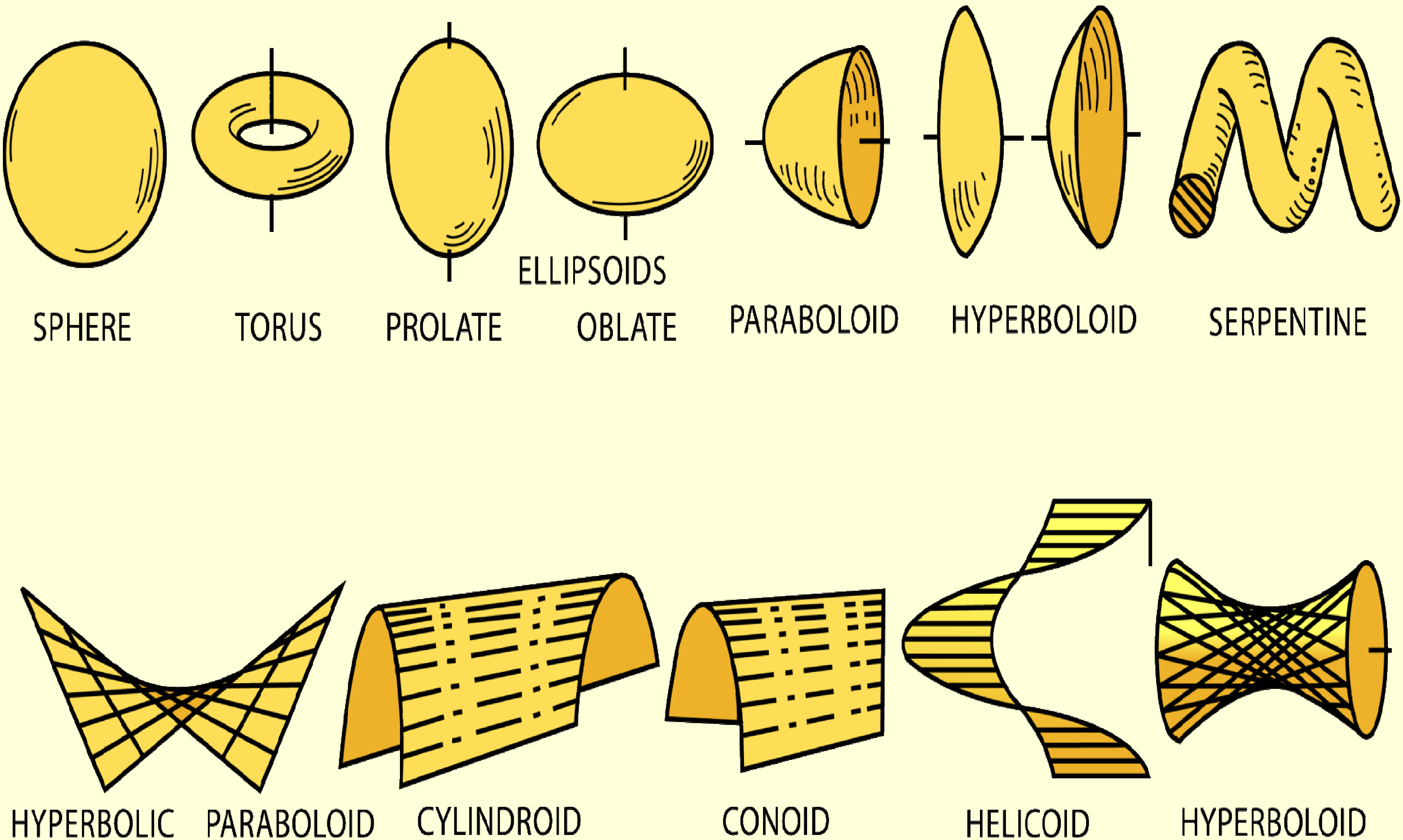
Lines and Planes



Solids


TETRAHEDRON
HEXAHEDRON
OCTAHEDRON
DODECAHEDRON
ICOSAHEDRON
SQUARE
CUBE
OBLIQUE RECTANGULAR
RIGHT TRIANGULAR
OBLIQUE PENTAGONAL
RIGHT HEXAGONAL
TRUNCATED TRIANGULAR
CYLINDERS
CONES
PLINTHS
RIGHT
OBLIQUE
RIGHT
OBLIQUE
FRUSTUM
TRUNCATED
SQUARE
ROUND

Curved surfaces



Primitive geometric forms

- Point
- Line
- Plane
- Solid
- …….etc

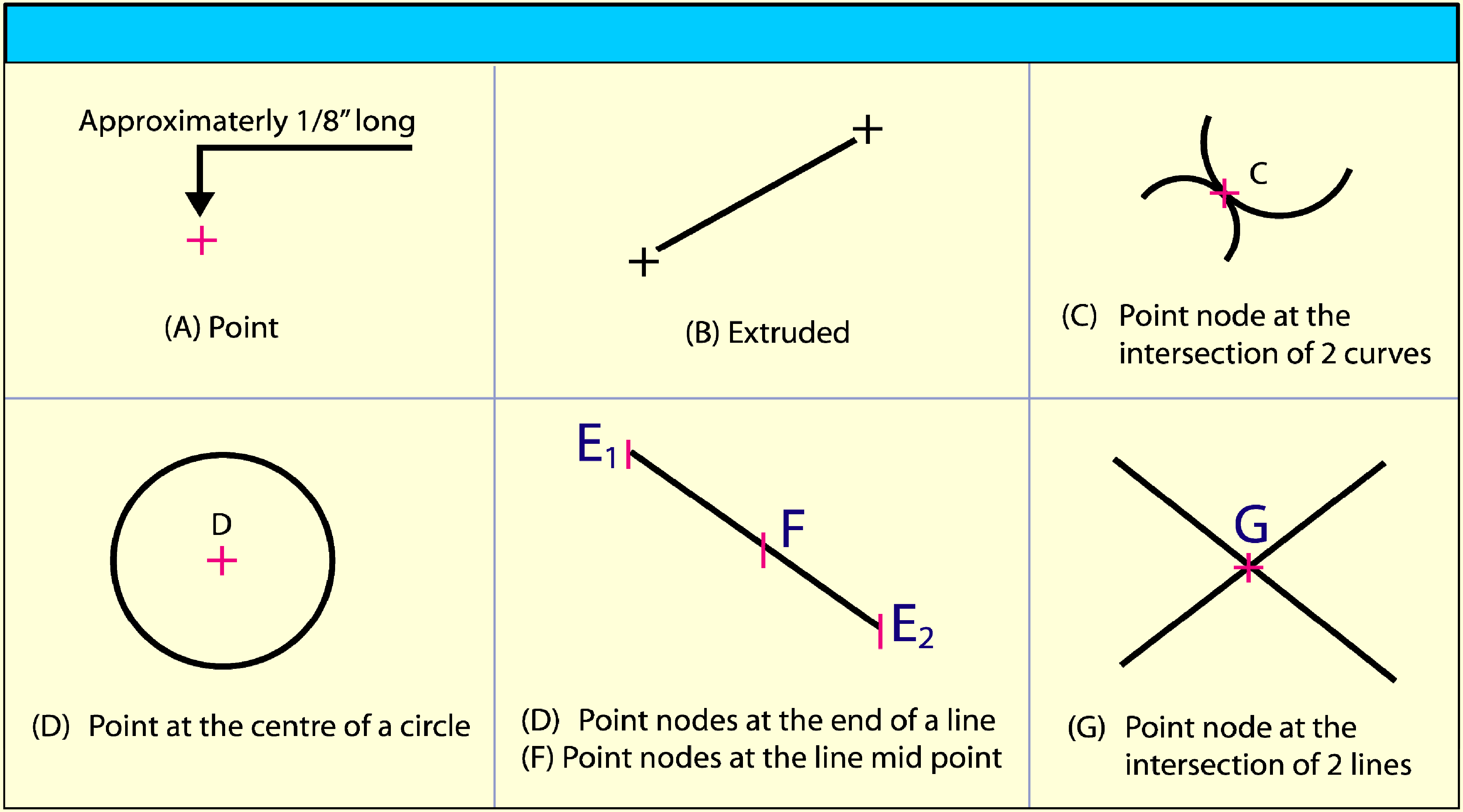
The basic 2-D geometric primitives, from which other more complex geometric forms are derived.

- **Points,**
- **Lines,**
- **Circles, and**
- **Arcs.**

Point

- **A theoretical location that has neither width, height, nor depth.**
- **Describes exact location in space.**
- **A point is represented in technical drawing as a *small cross* made of dashes that are approximately *3 mm long*.**

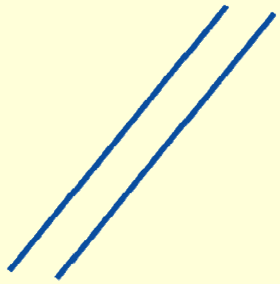
A point is used to mark the locations of centers and loci, the intersection ends, middle of entities.



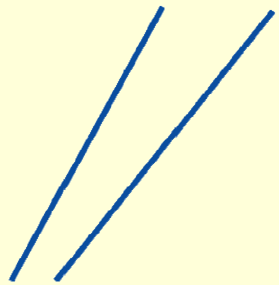
Line

- A geometric primitive that has length and direction, but no thickness.
- It may be straight, curved or a combination of these.
- Lines also have important relationship or conditions, such as parallel, intersecting, and tangent.
- Lines – specific length and non-specific length.
- Ray – Straight line that extends to infinity from a specified point.

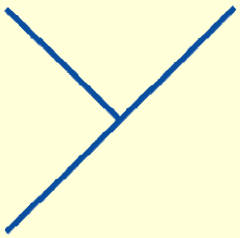
Relationship of one line to another line or arc



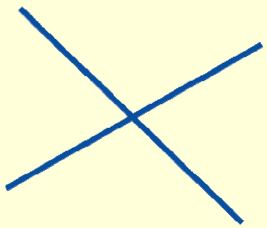
Parallel Line Condition



Nonparallel Line Condition

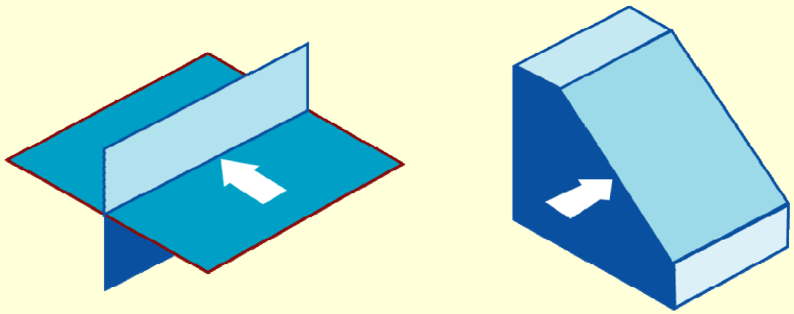


Perpendicular Line Condition



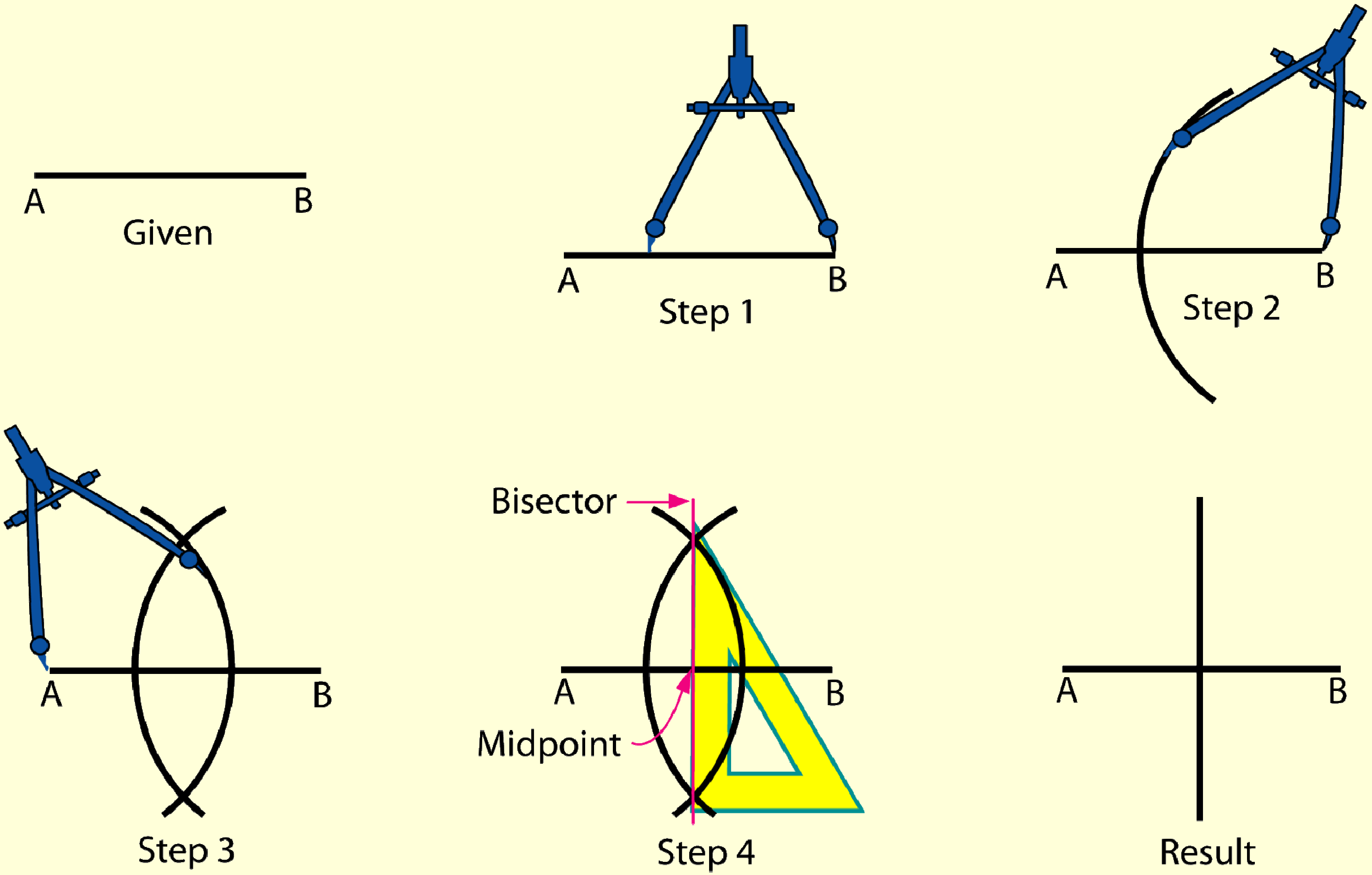
Intersecting Lines

Tangent Condition

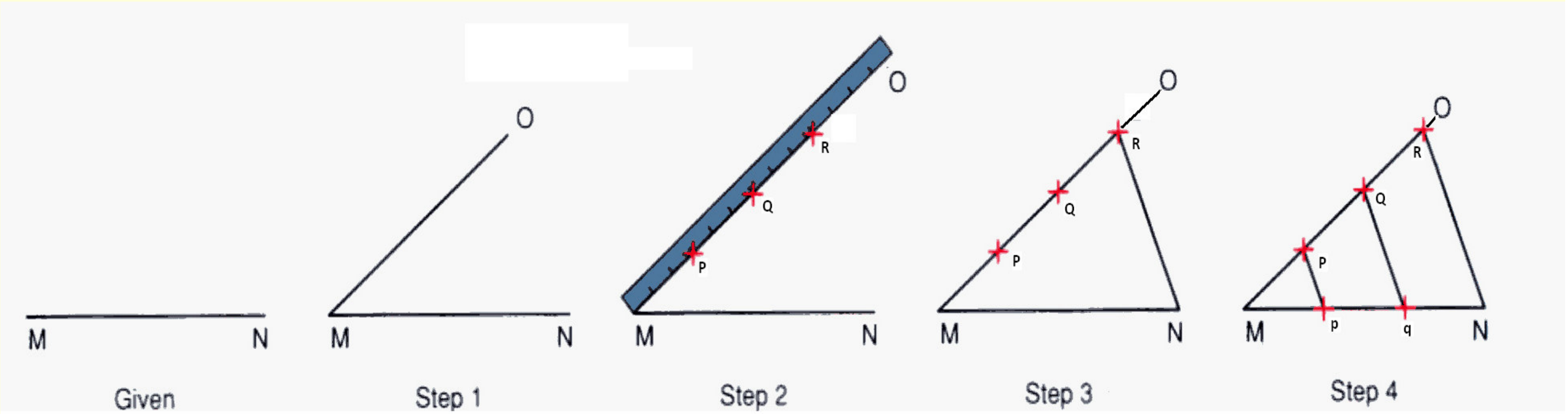


Line at the Intersection of Two Planes (Edge)

Bisecting a line



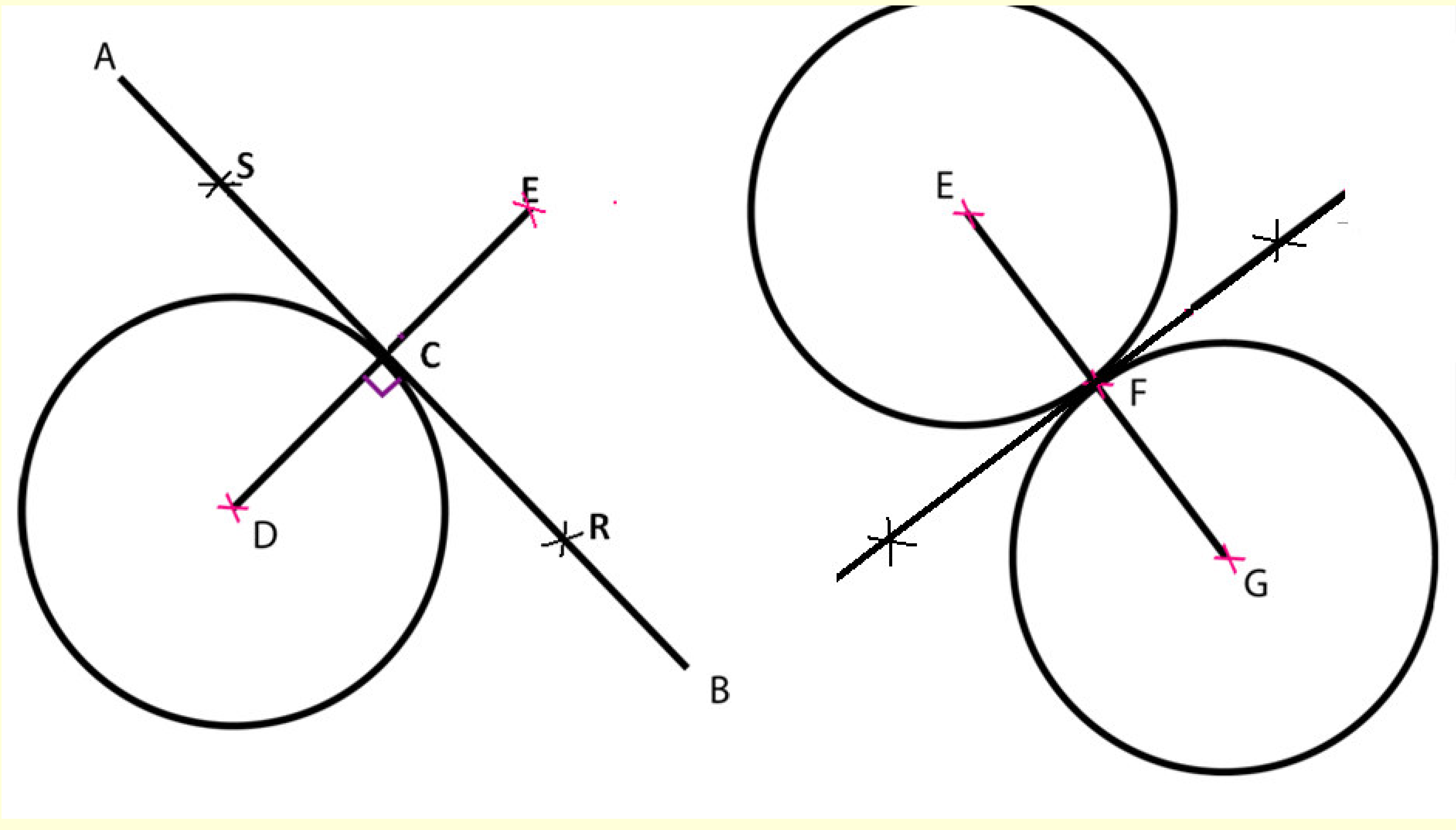
Dividing a line into equal parts



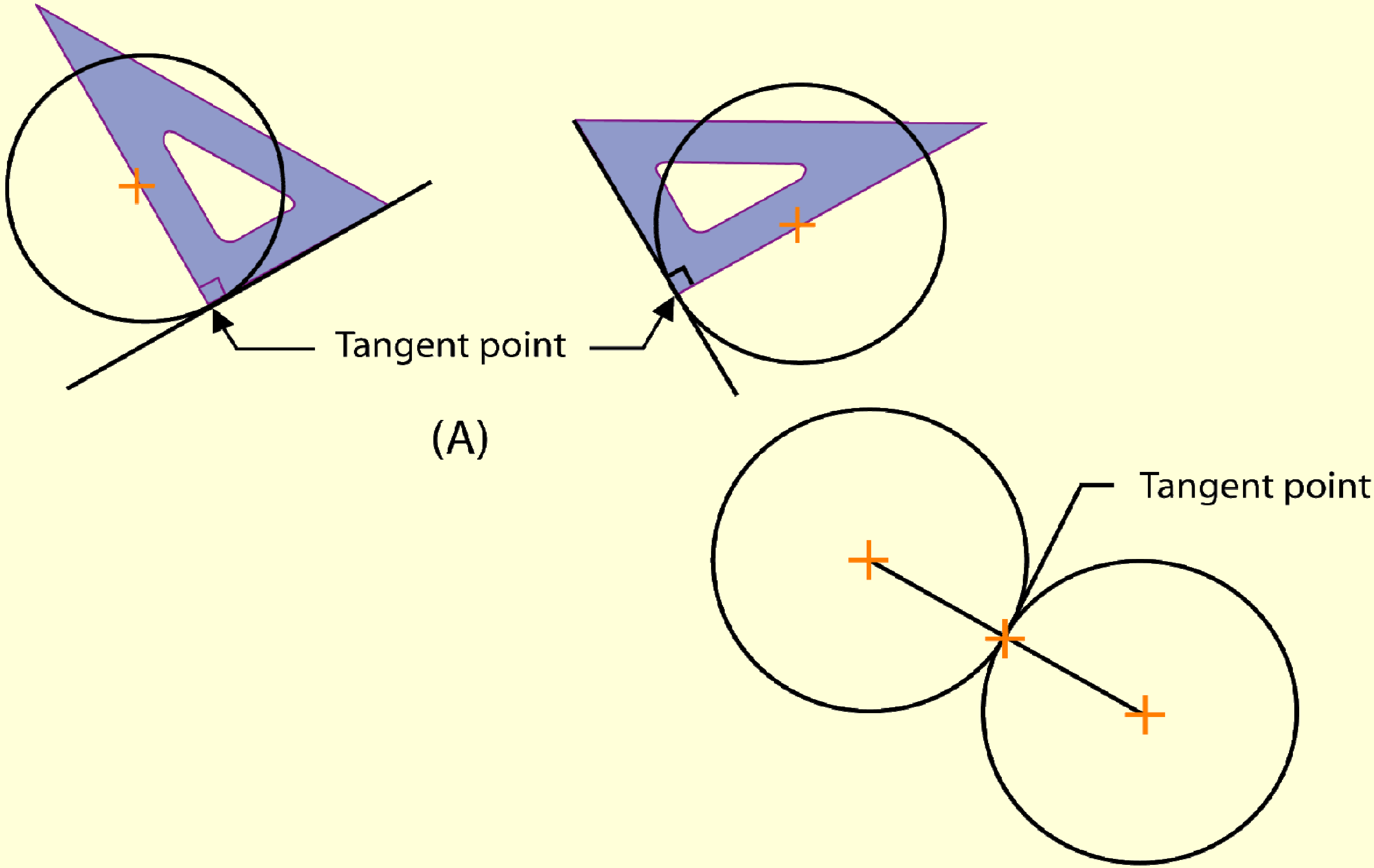
Steps:

- Draw a line MO at any convenient angle (preferably an acute angle) from point M.
- From M and along MO, cut off with a divider equal divisions (say three) of any convenient length.
- Draw a line joining RN.
- Draw lines parallel to RN through the remaining points on line MO. The intersection of these lines with line MN will divide the line into (three) equal parts.

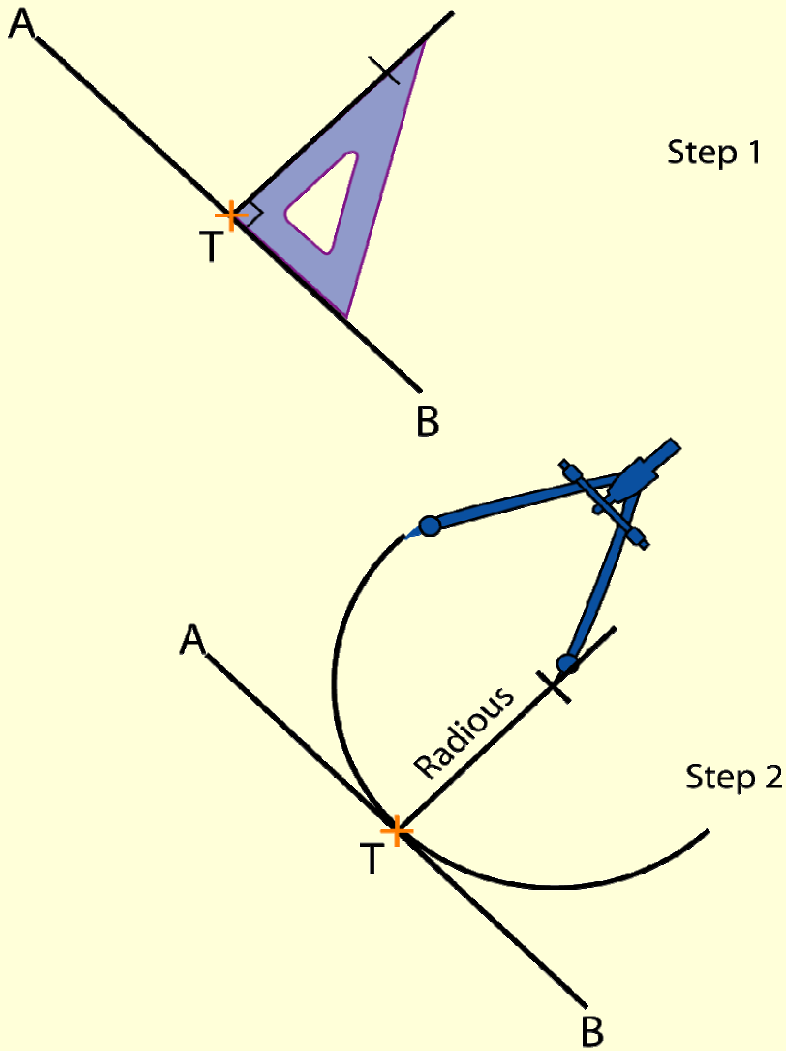
Planar tangent condition exists when two geometric forms meet at a single point and do not intersect.



Locating tangent points on circle and arcs



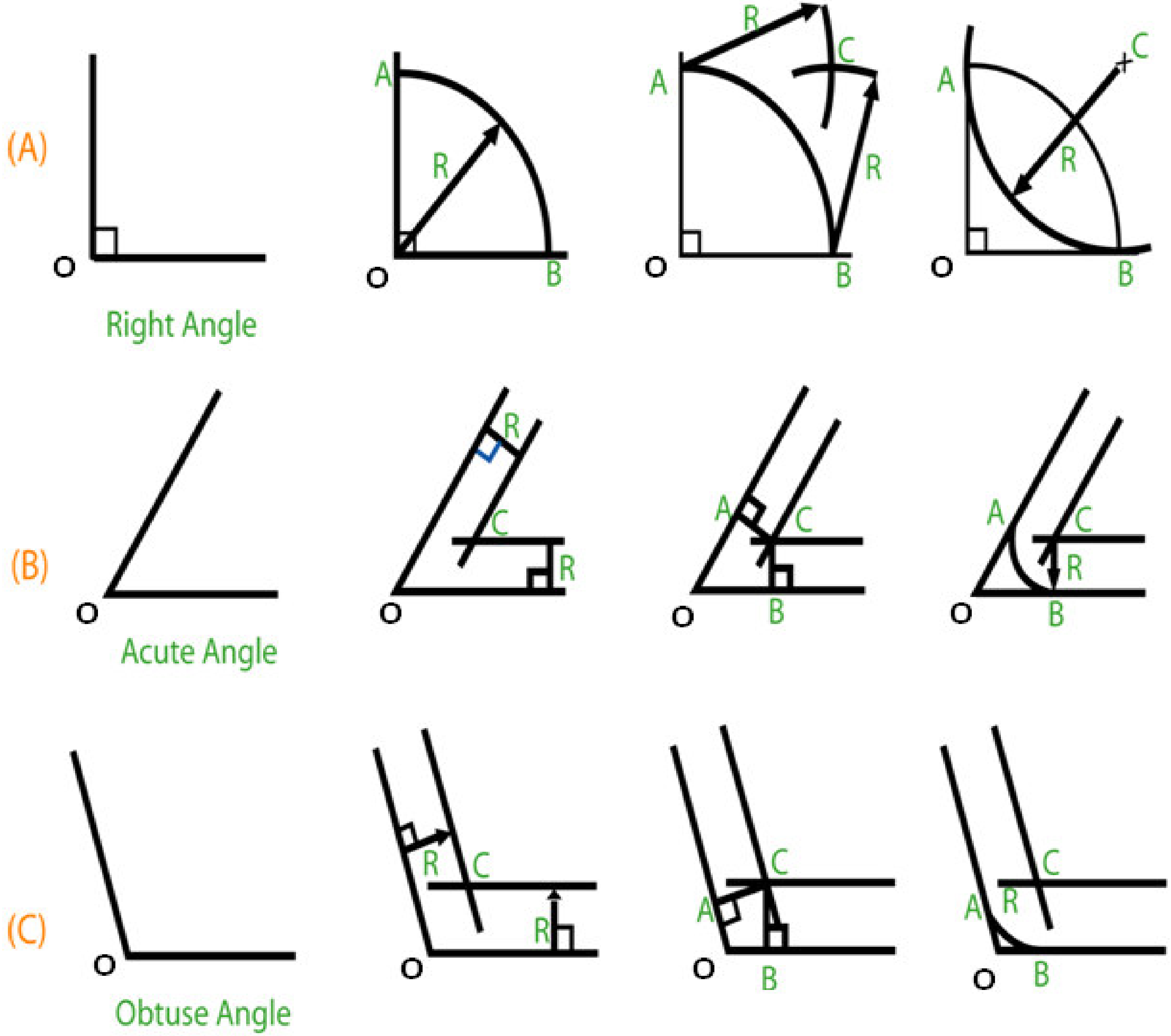
Drawing an arc tangent to a given point on the line

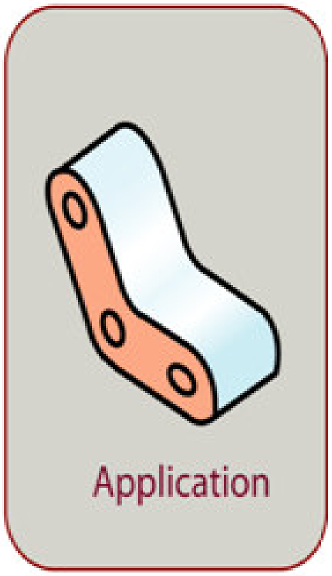


Steps

- **Given line AB and tangent point T. Construct a line perpendicular to line AB and through point T.**
- **Locate the center of the arc by making the radius on the perpendicular line. Put the point of the compass at the center of the arc, set the compass for the radius of the arc, and draw the arc which will be tangent to the line through the point T.**

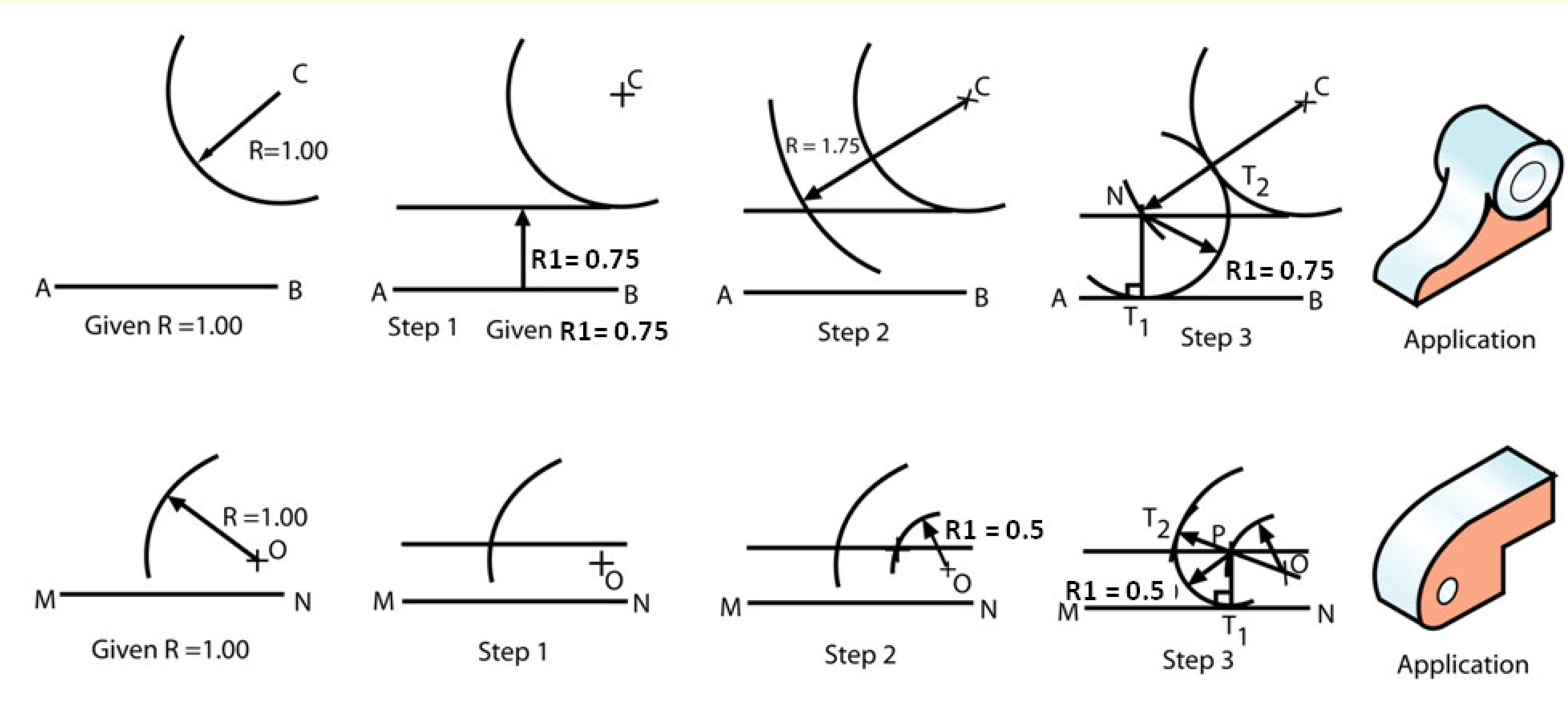
Drawing an arc, tangent to two lines



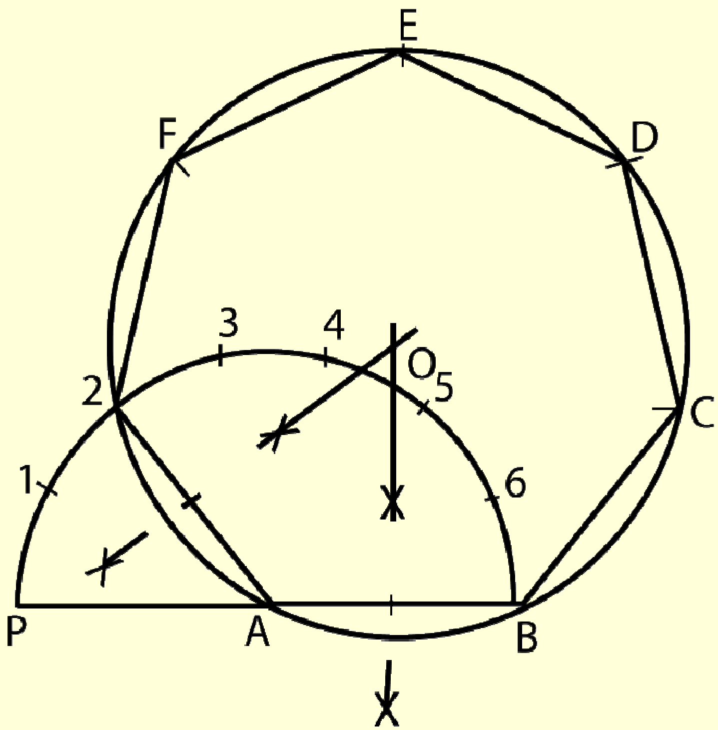


Drawing an arc, tangent to a line and an arc

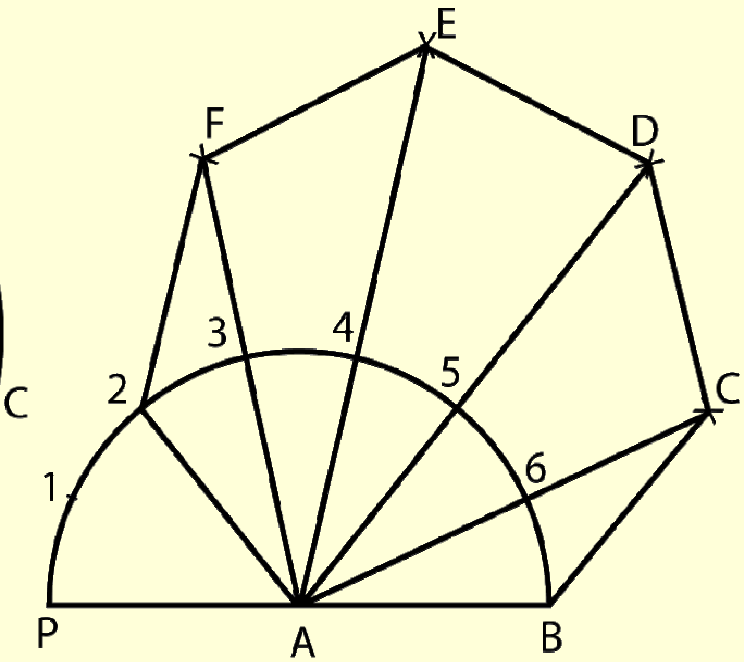
(a) that do not intersect (b) that intersect



Construction of Regular Polygon of given length AB



(A)



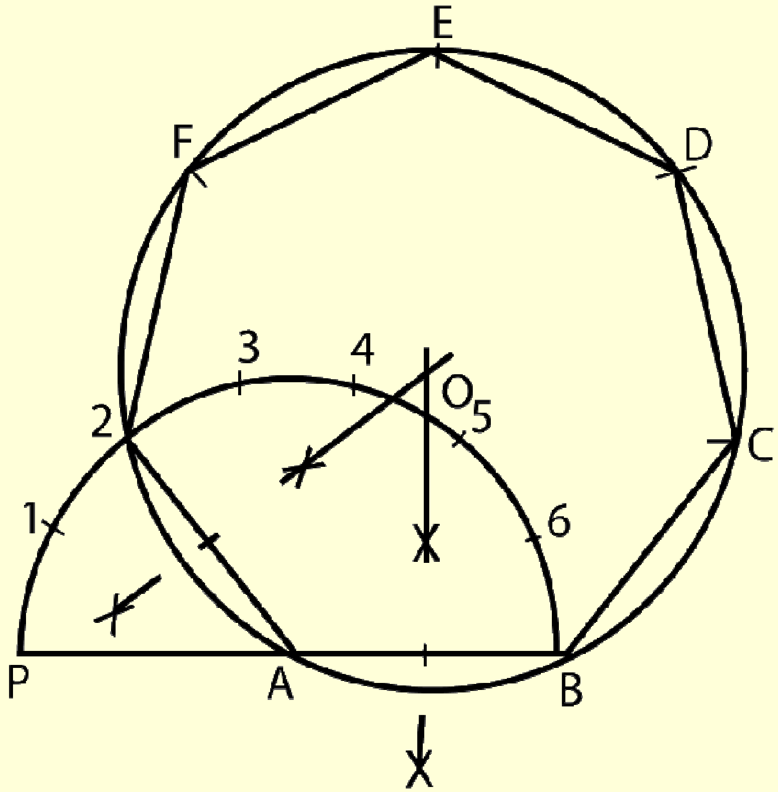
(B)

Draw a line of length AB. With A as centre and radius AB, draw a semicircle.

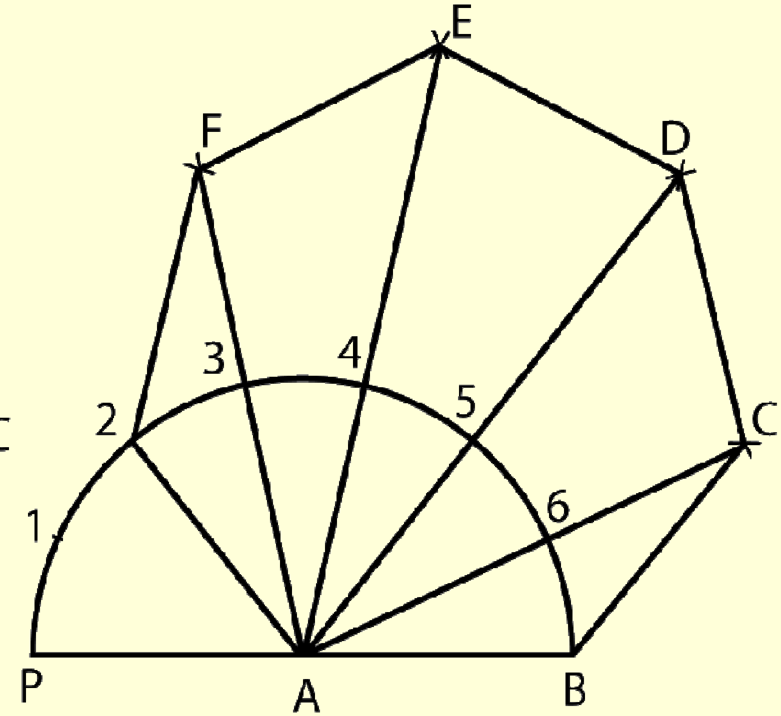
With the divider, divide the semicircle into the number of sides of the polygon.

Draw a line joining A with the second division-point 2.

Construction of Regular Polygon of given length AB……



(A)

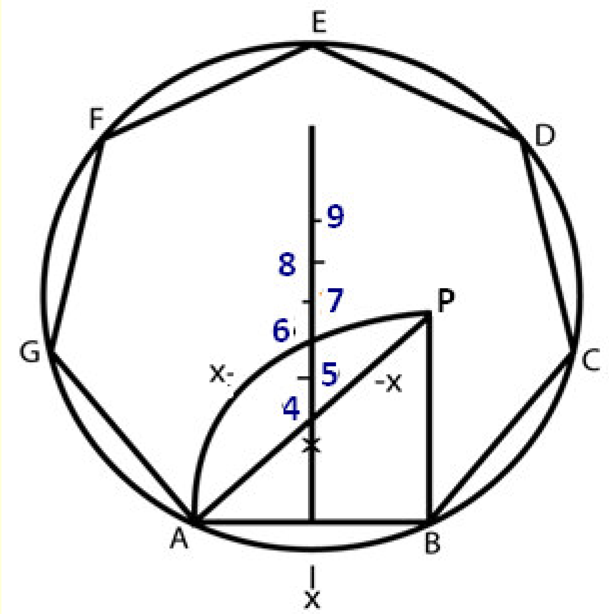


(B)

The perpendicular bisectors of A2 and AB meet at O. Draw a circle with centre O and radius OA. With length A2, mark points F, E, D & C on the circumferences starting from 2 (*Inscribe circle method*)

With centre B and radius AB draw an arc cutting the line A6 produced at C. Repeat this for other points D, E & F (*Arc method*)

General method of drawing any polygon



Draw AB = given length of polygon

At B, Draw BP perpendicular & = AB

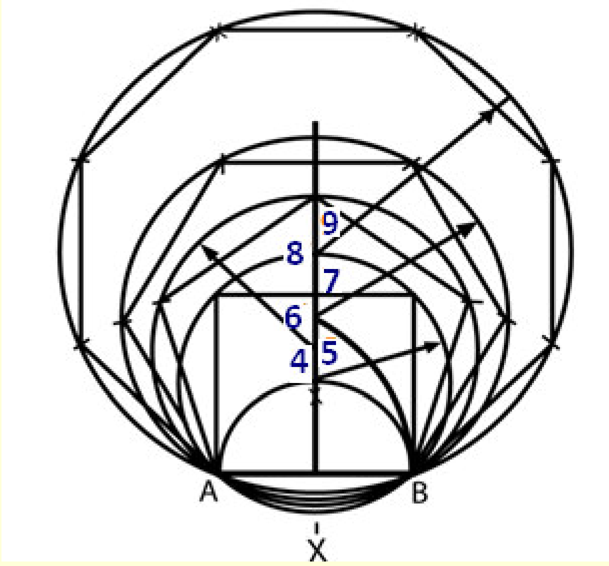
Draw Straight line AP

With center B and radius AB, draw arc AP.

The perpendicular bisector of AB meets st. line AP and arc AP in 4 and 6 respectively.

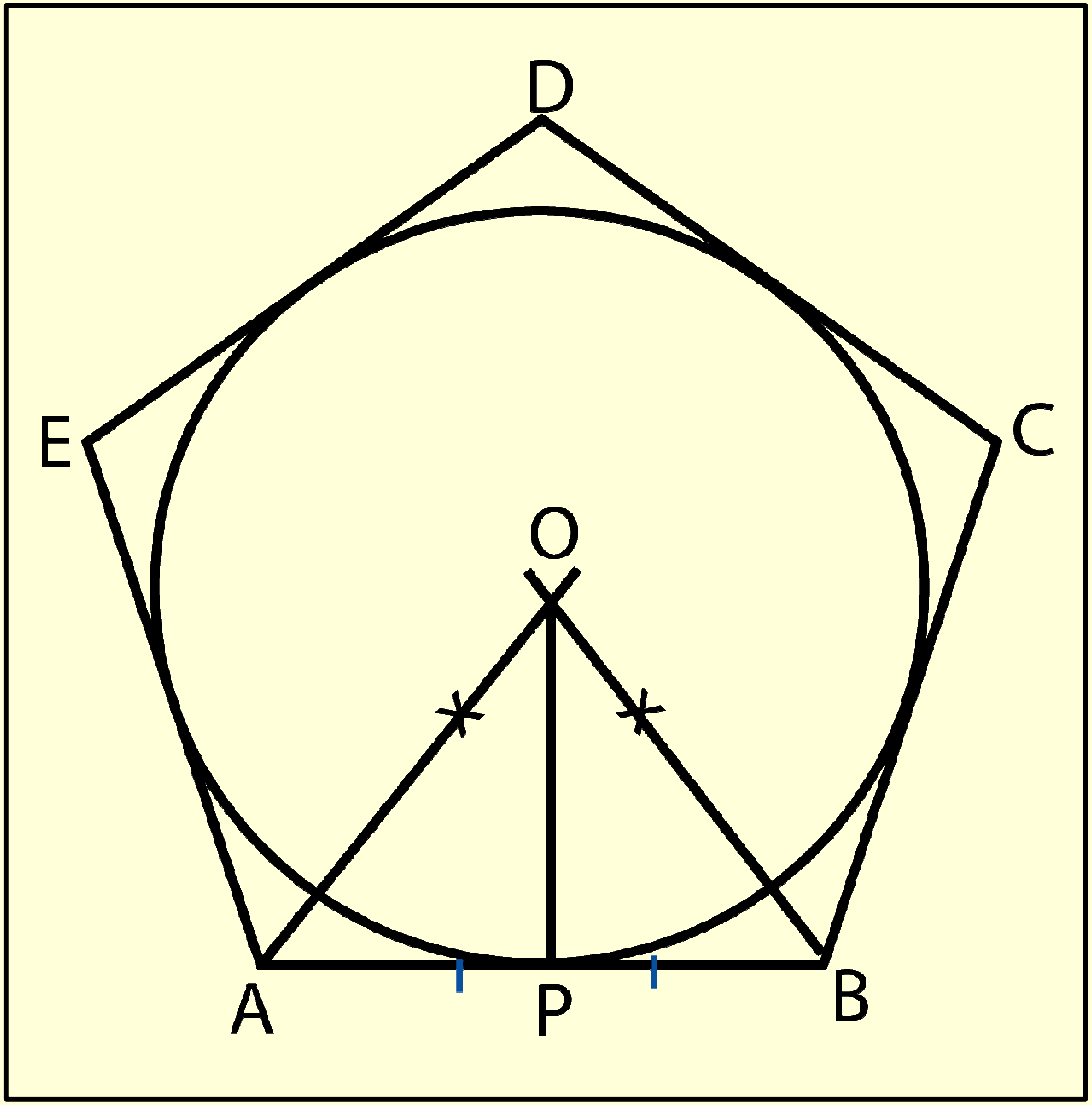
Draw circles with centers as 4, 5,&6 and radii as 4B, 5B, & 6B and inscribe a square, pentagon, & hexagon in the respective circles.

Mark point 7, 8, etc with 6-7,7-8,etc. = 4-5 to get the centers of circles of heptagon and octagon, etc.



Inscribe a circle inside a regular polygon

- Bisect any two adjacent internal angles of the polygon.
- From the intersection of these lines, draw a perpendicular to any one side of the polygon (say OP).
- With OP as radius, draw the circle with O as center.



Inscribe a regular polygon of any number of sides (say n = 5), in a circle

Draw the circle with diameter AB.

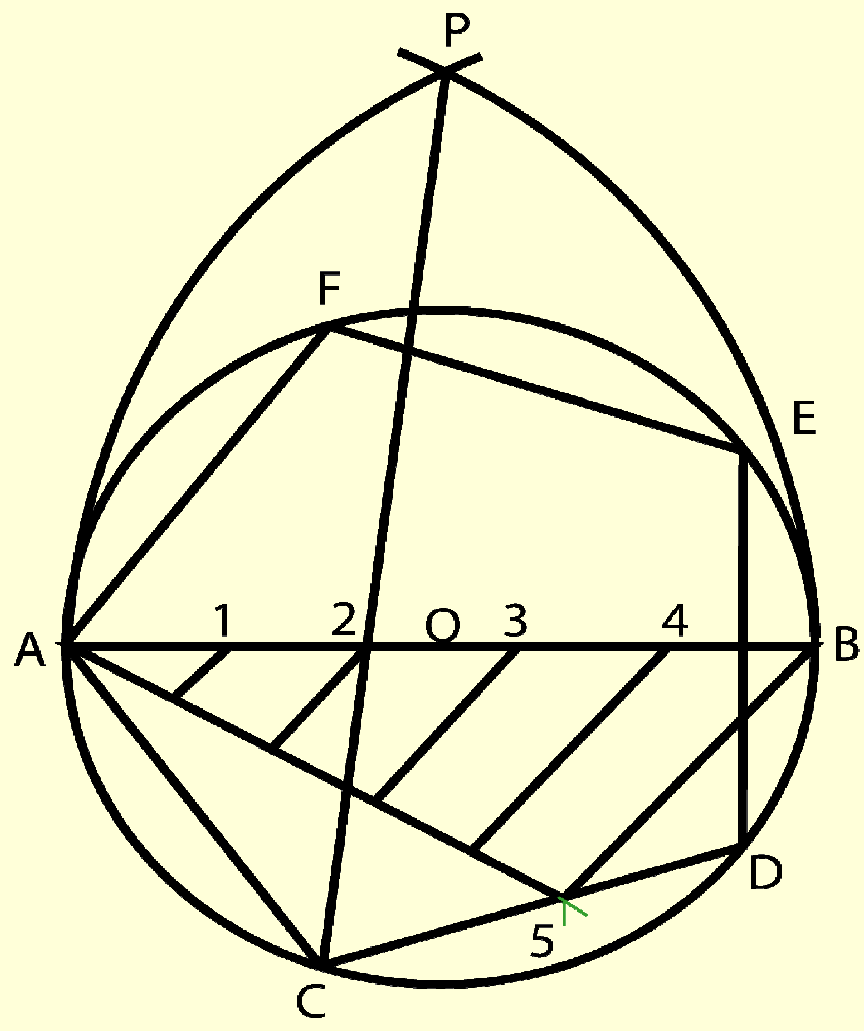
Divide AB in to “n” equal parts

Number them.

With center A & B and radius AB, draw arcs to intersect at P.

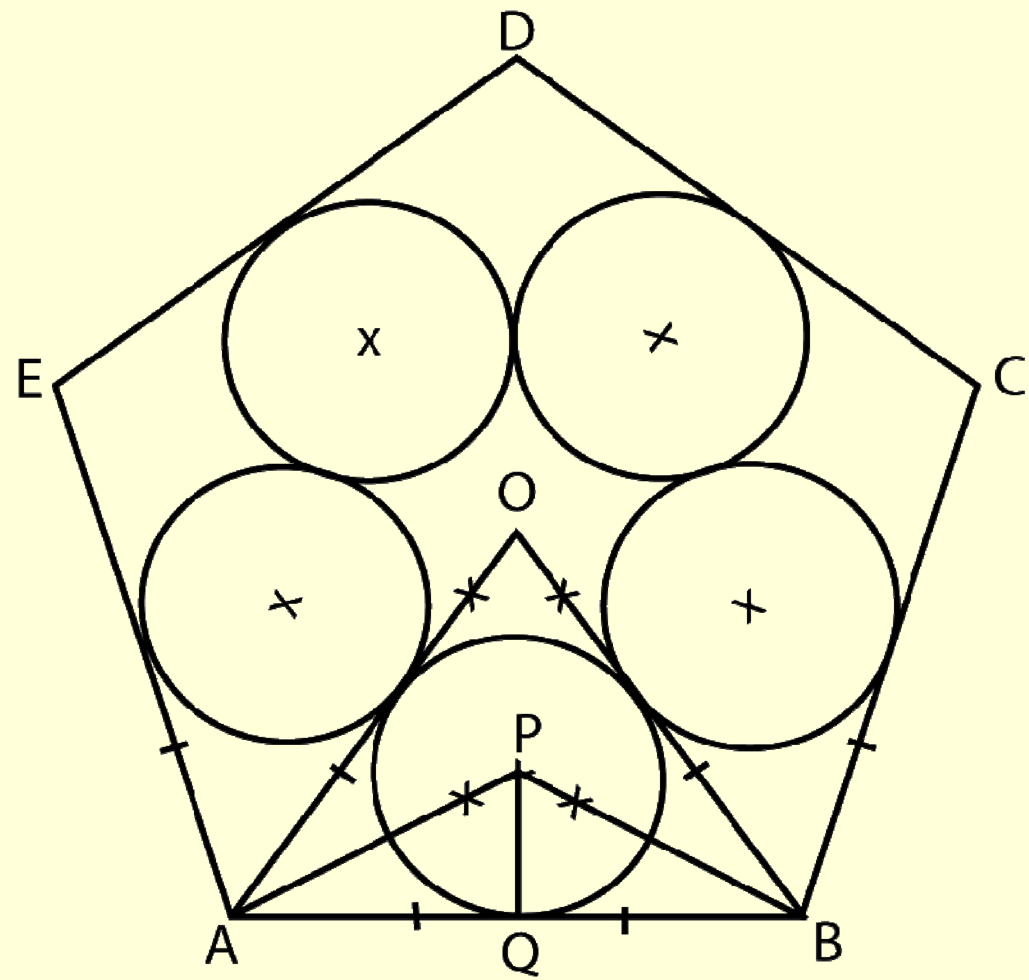
Draw line P2 and produce it to meet the circle at C.

AC is the length of the side of the polygon.



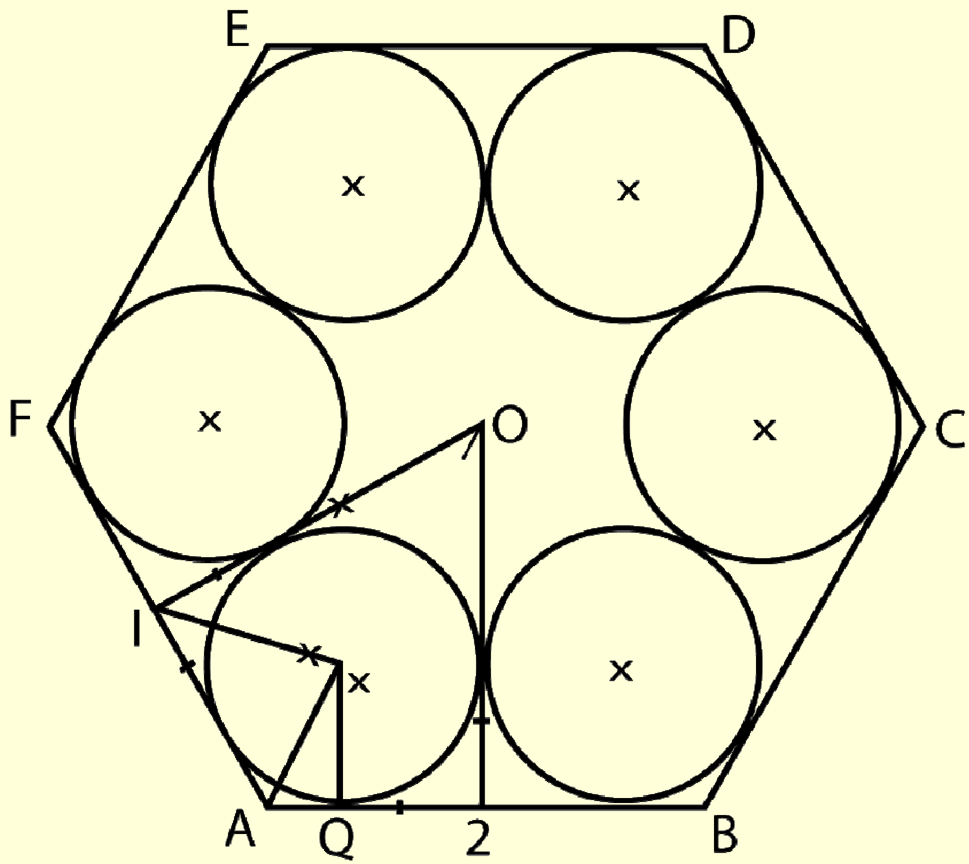
Inside a regular polygon, draw the same number of equal circles as the side of the polygon, each circle touching one side of the polygon and two of the other circles.

- **Draw bisectors of all the angles of the polygon, meeting at O, thus dividing the polygon into the same number of triangles.**
- **In each triangle inscribe a circle.**



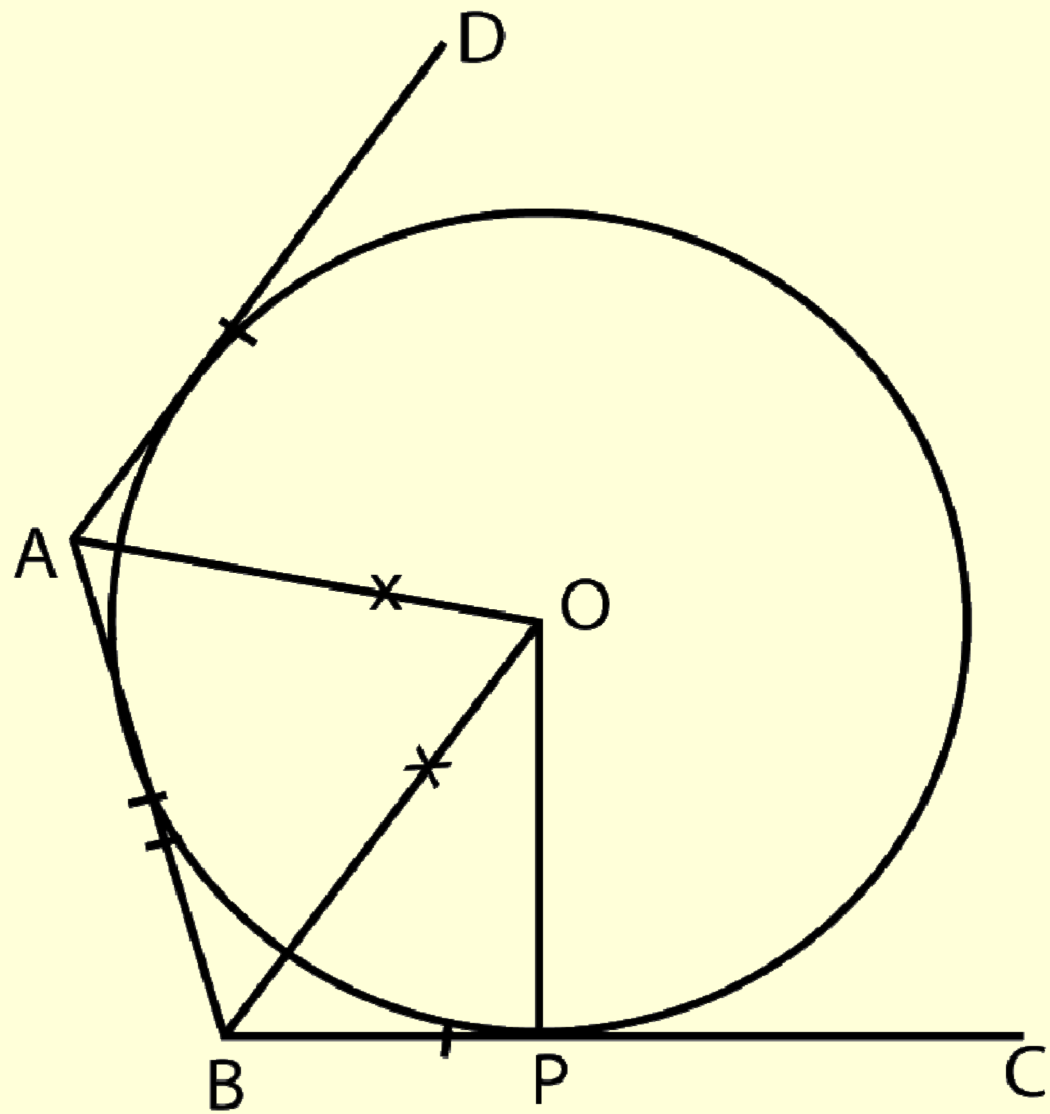
Inside a regular polygon, draw the same number of equal circles as the side of the polygon, each circle touching two adjacent sides of the polygon and two of the other circles.

- **Draw the perpendicular bisectors of the sides of the polygon to obtain same number of quadrilaterals as the number of sides of the polygon.**
- **Inscribe a circle inside each quadrilateral.**



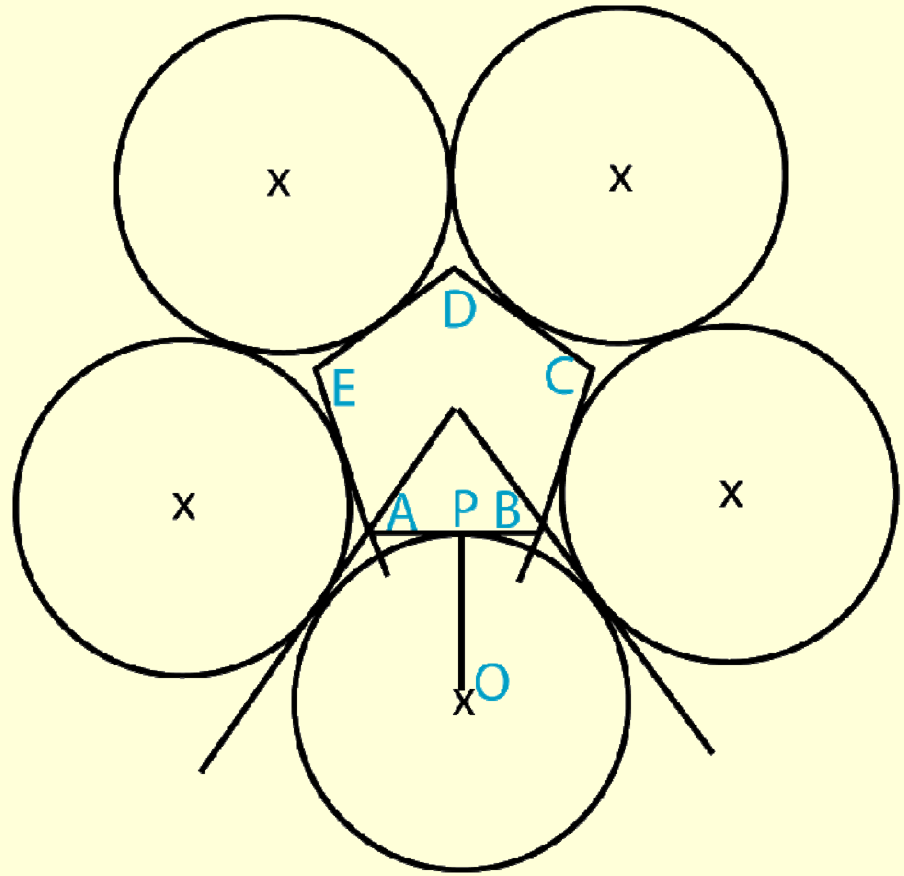
To draw a circle touching three lines inclined to each other but not forming a triangle.

- Let AB, BC, and AD be the lines.
- Draw bisectors of the two angles, intersecting at O.
- From O draw a perpendicular to any one line intersecting it at P.
- With O as center and OP as radius draw the desired circle.



Outside a regular polygon, draw the same number of equal circles as the side of the polygon, each circle touching one side of the polygon and two of the other circles.

- **Draw bisectors of two adjacent angles and produce them outside the polygon.**
- **Draw a circle touching the extended bisectors and the side AB (in this case) and repeat the same for other sides.**



Construction of an arc tangent of given radius to two given arcs

- **Given - Arcs of radii M and N. Draw an arc of radius AB units which is tangent to both the given arcs. Centers of the given arcs are inside the required tangent arc.**

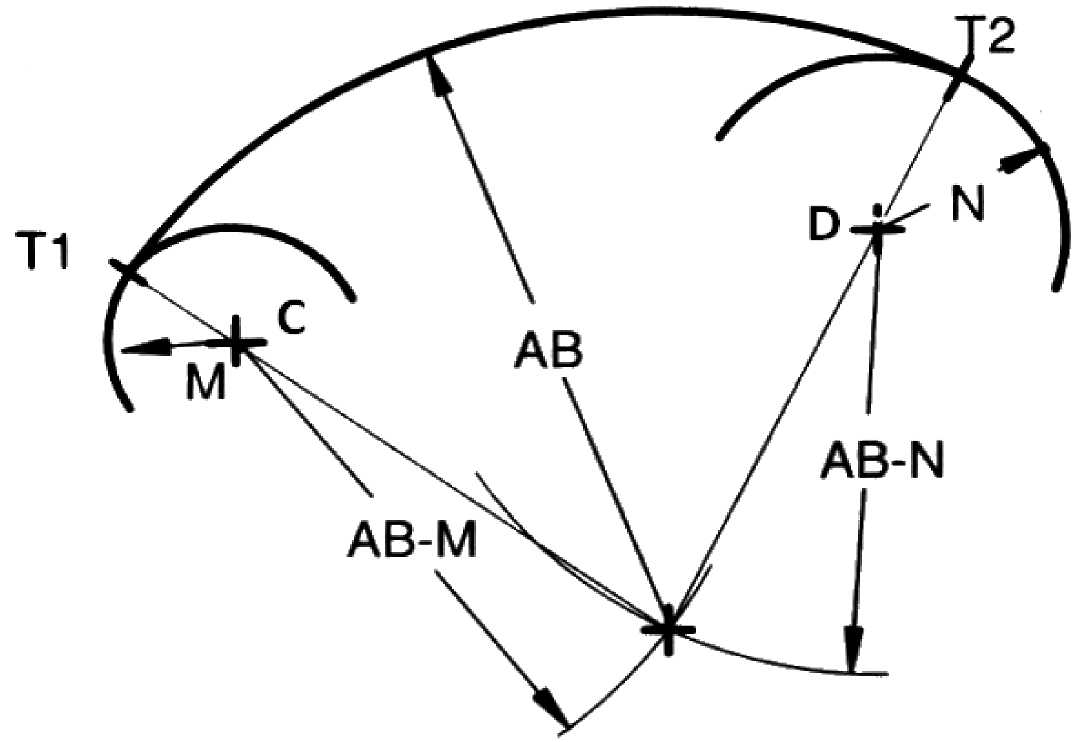
Steps:

From centers C and D of the given arcs, draw construction arcs of radii (AB – M) and (AB - N), respectively.

With the intersection point as the center, draw an arc of radius AB.

This arc will be tangent to the two given arcs.

Locate the tangent points T1 and T2.



Construction of line tangents to two circles (Open belt)

Given: Circles of radii R1 and R the centers O and P, respectively.

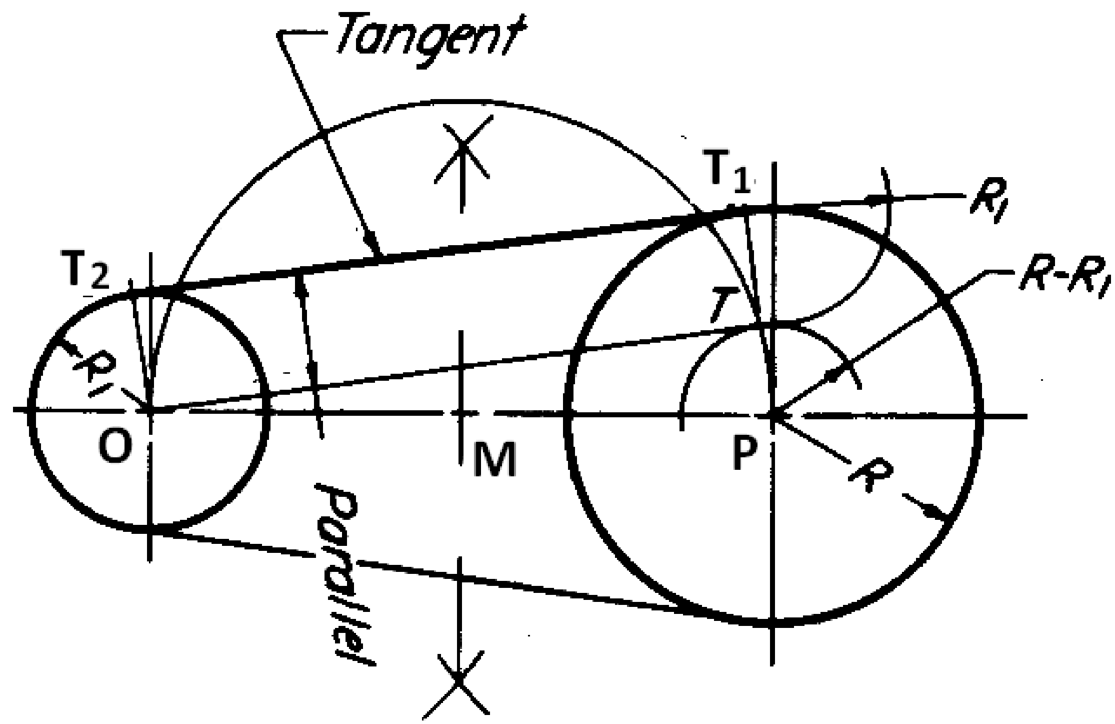
Steps:

With P as center and a radius equal to **(R-R1)** draw an arc.

Locate the midpoint of **OP** as perpendicular bisector of **OP** as "**M**".

With **M** as centre and **Mo** as radius draw a semicircle.

Locate the intersection point **T** between the semicircle and the circle with radius (**R-R1**).



draw a line **PT** and extend it to locate **T1**.

Draw **OT2** parallel to **PT1**.

The line **T1** to **T2** is the required tangent

Construction of line tangents to two circles (crossed belt)

Given: Two circles of radii R1 and R with centers O and P, respectively.

Steps:

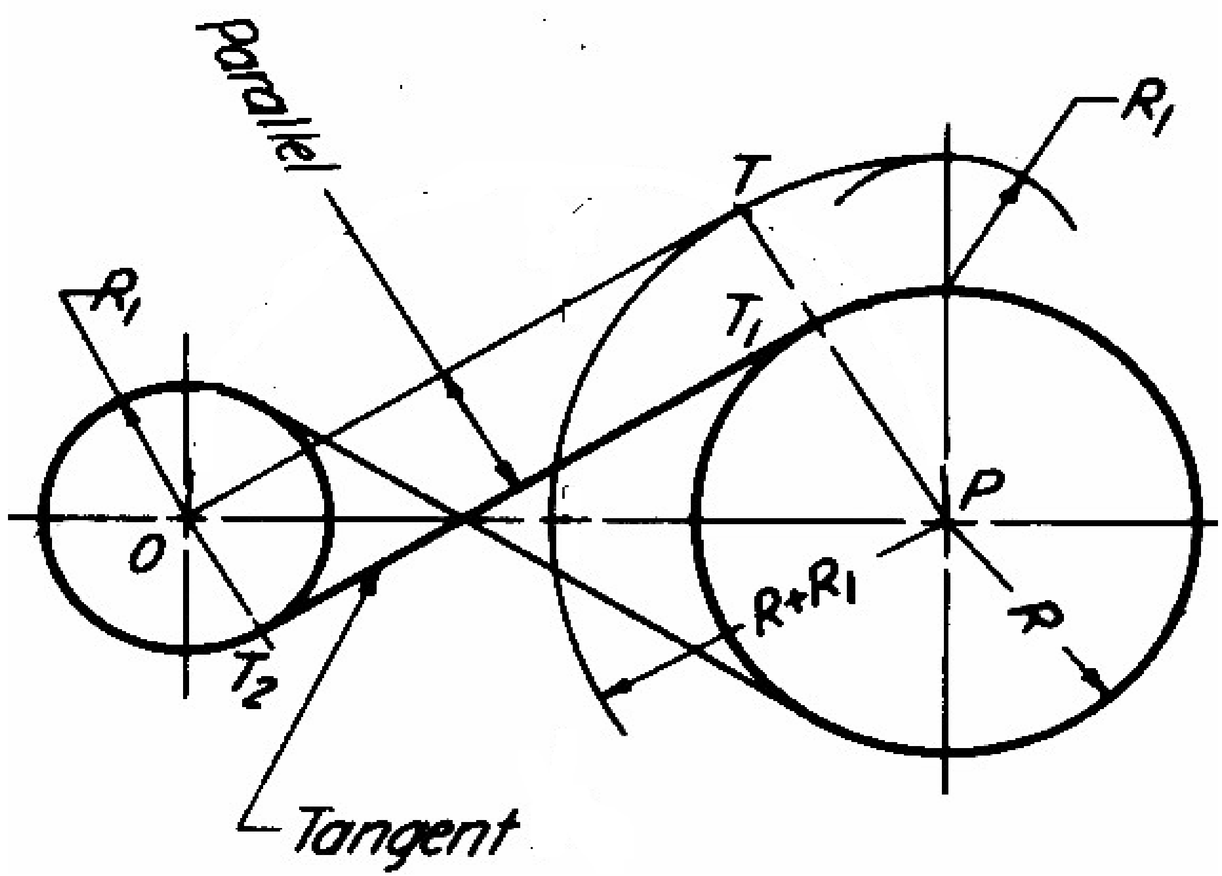
Using **P** as a center and a radius equal to **(R+ R1)** draw an arc.

Through **O** draw a tangent to this arc.

Draw a line PT cutting the circle at T_1

Through O draw a line OT_2 parallel to PT_1.

The line $\mathbf{T_1T_2}$ is the required tangent.



THANK YOU