Chapter 2

Using drawing tools & applied geometry




Contents

- Preparation of tools
- Using of tools
- Applied Geometry
  (or geometrical constructions)
- Problem solving steps

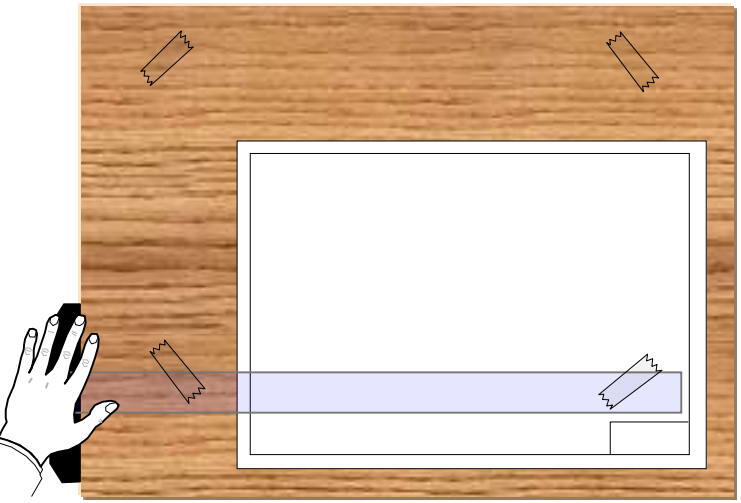
Preparation of Tools

Contents

Tools to be prepared

1. Paper	Fastening a sheet to a drafting board
2. Pencils	Sharpening the lead
3. Compass	Sharpening the lead

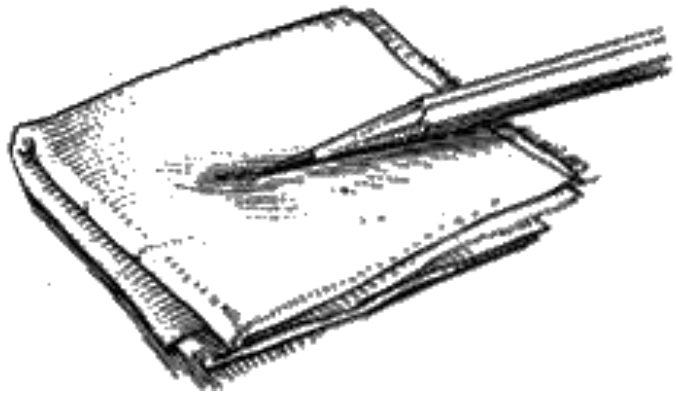
Paper



1. Place a paper close to the left edge of a table where a drafter can work conveniently.
2. Place a T-square.
3. Move the paper until its lower edge lies close to the top edge of a T-square.
4. Align the top edge of the paper with T-square blade.
5. Attach the paper’s corners with tape.
6. Move T-square down to smooth the paper.
7. Attach the remaining paper’s corners with tape.

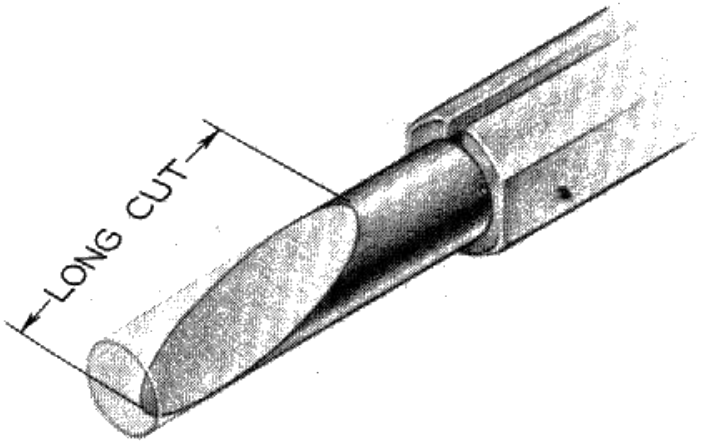
Pencil

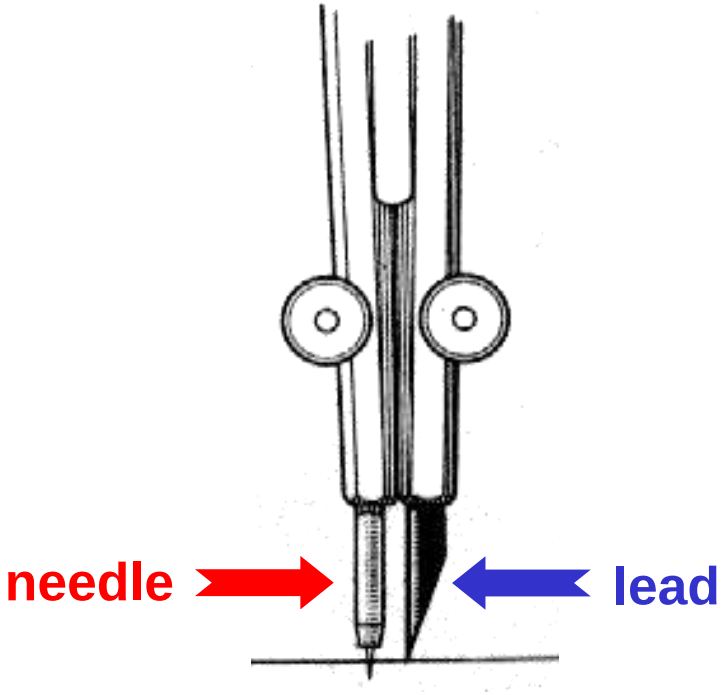
1. Remove the wood with penknife while expose a lead about 8-10 mm.
2. Polish the lead into a conical shape with a sandpaper.
3. Clean the lead with tissue paper.



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

Contents

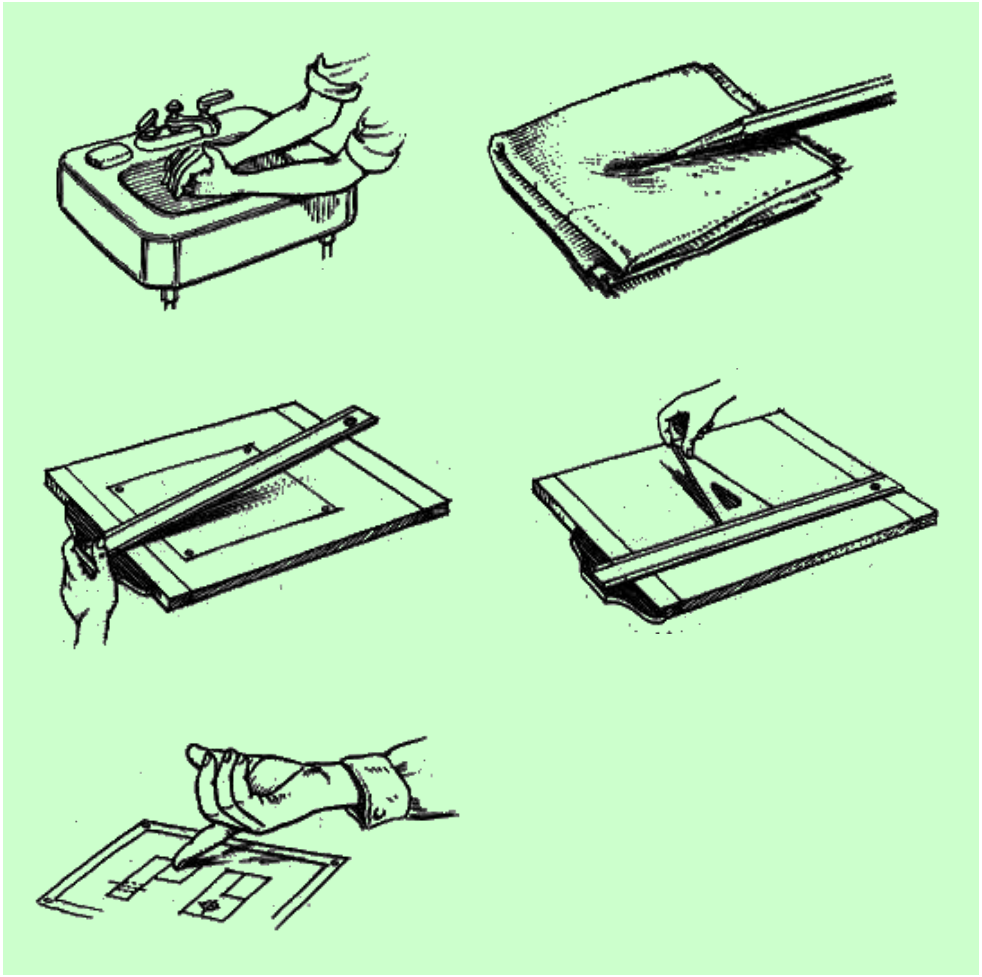
Function of the tools

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

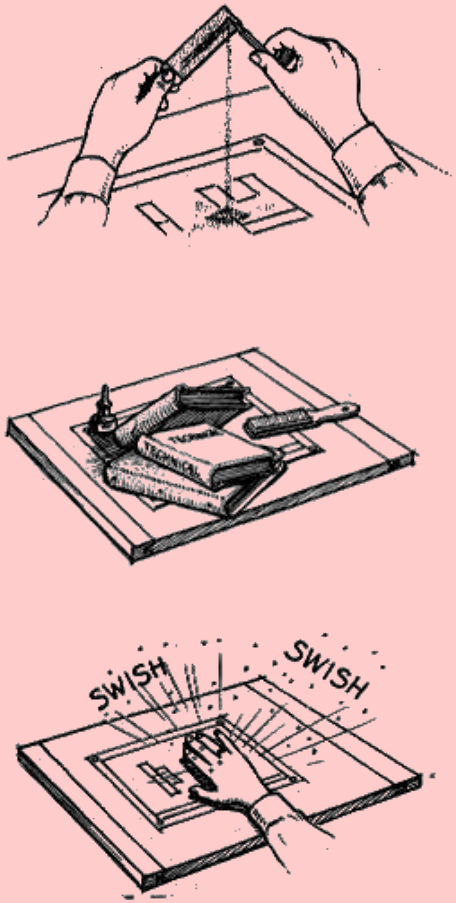
T-square and triangles can be used together to draw an inclined line with 15^o increment, i.e. 15^o, 30^o, 45^o, 60^o, 75^o, 90^o, 105^o, 120^o, 135^o, 150^o, 165^o, 180^o etc.

To keep your drawing clean

Do



Don’t



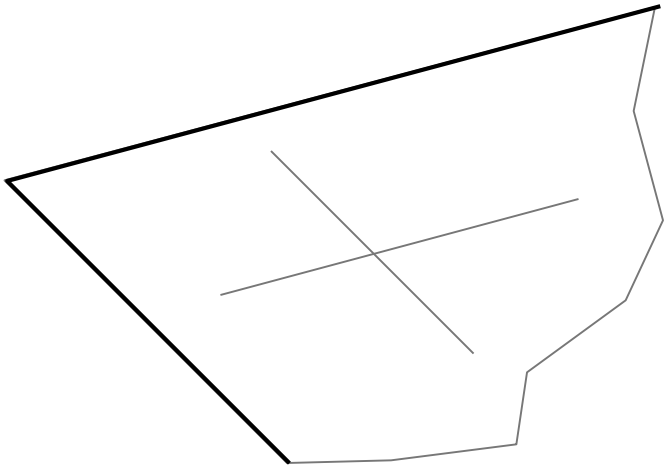
Using a compass

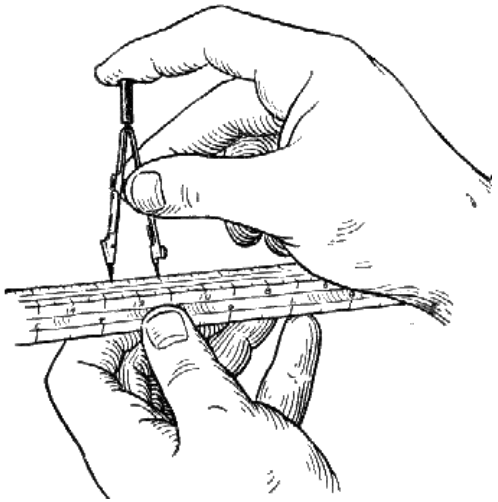
1. Locate the center of the circle to be drawn.

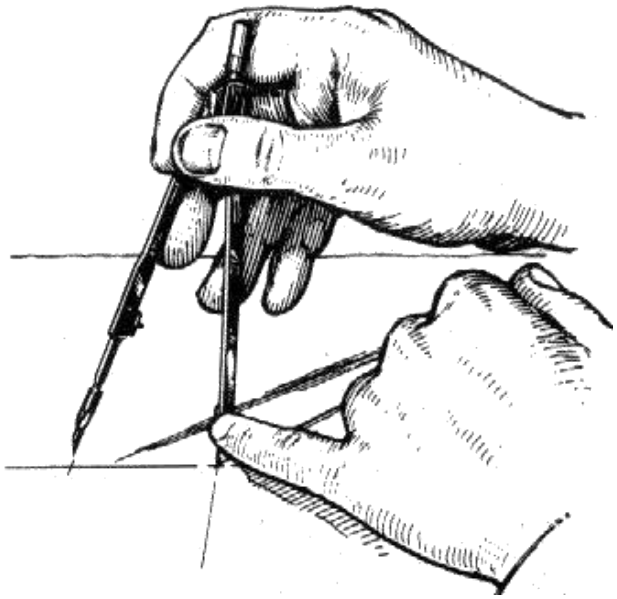
   Draw two intersecting lines.

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

3. Set the needle point at the circle's center.

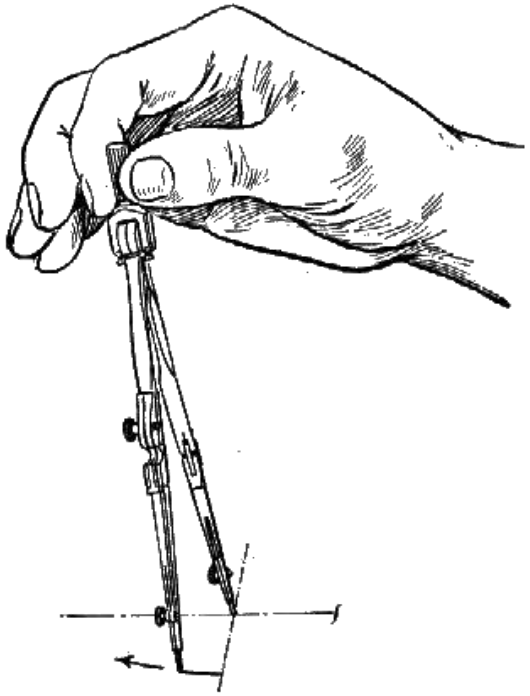


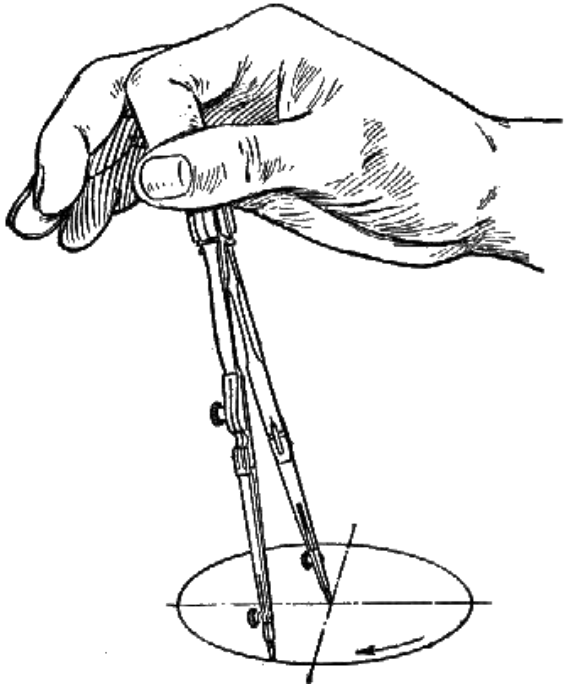




Using a compass

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

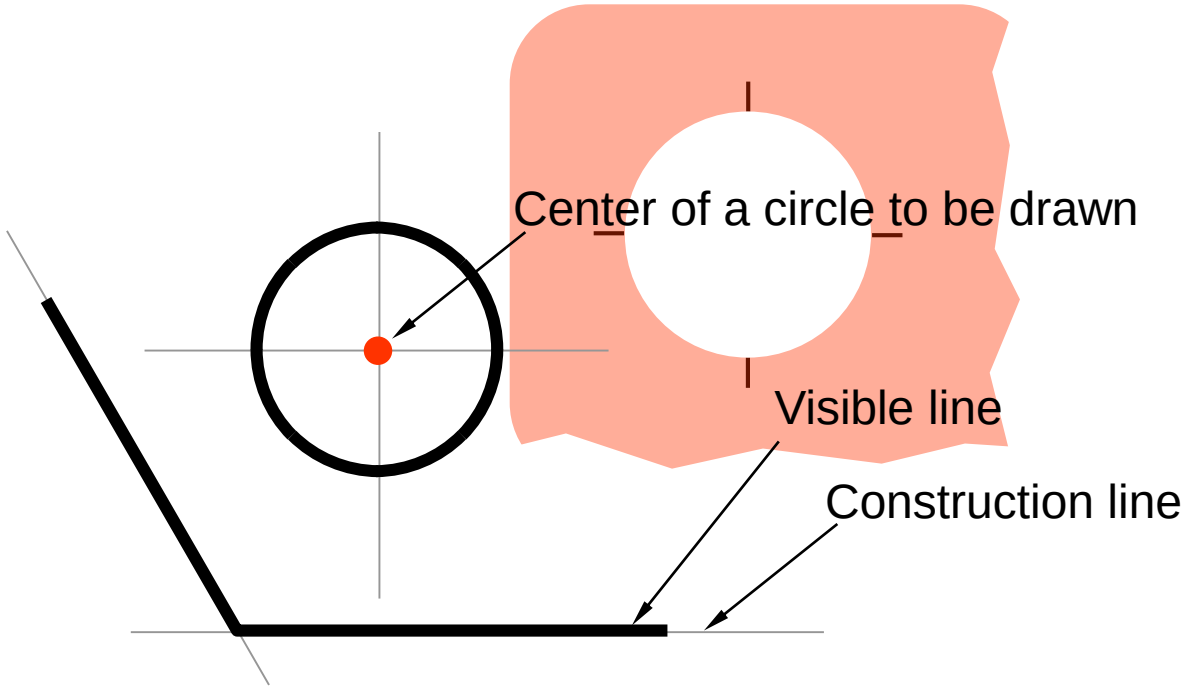




Using a template

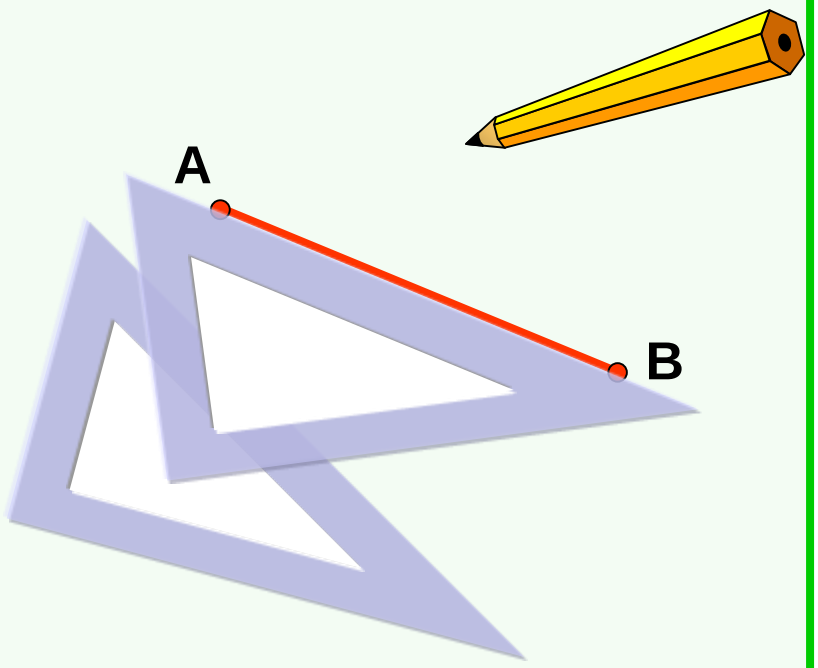
1. Draw two perpendicular lines that pass through center of a circle to be drawn.
2. Align all markings on template with the center lines.
3. Tracing the circle.

Given



Draw a line through the given points

Given



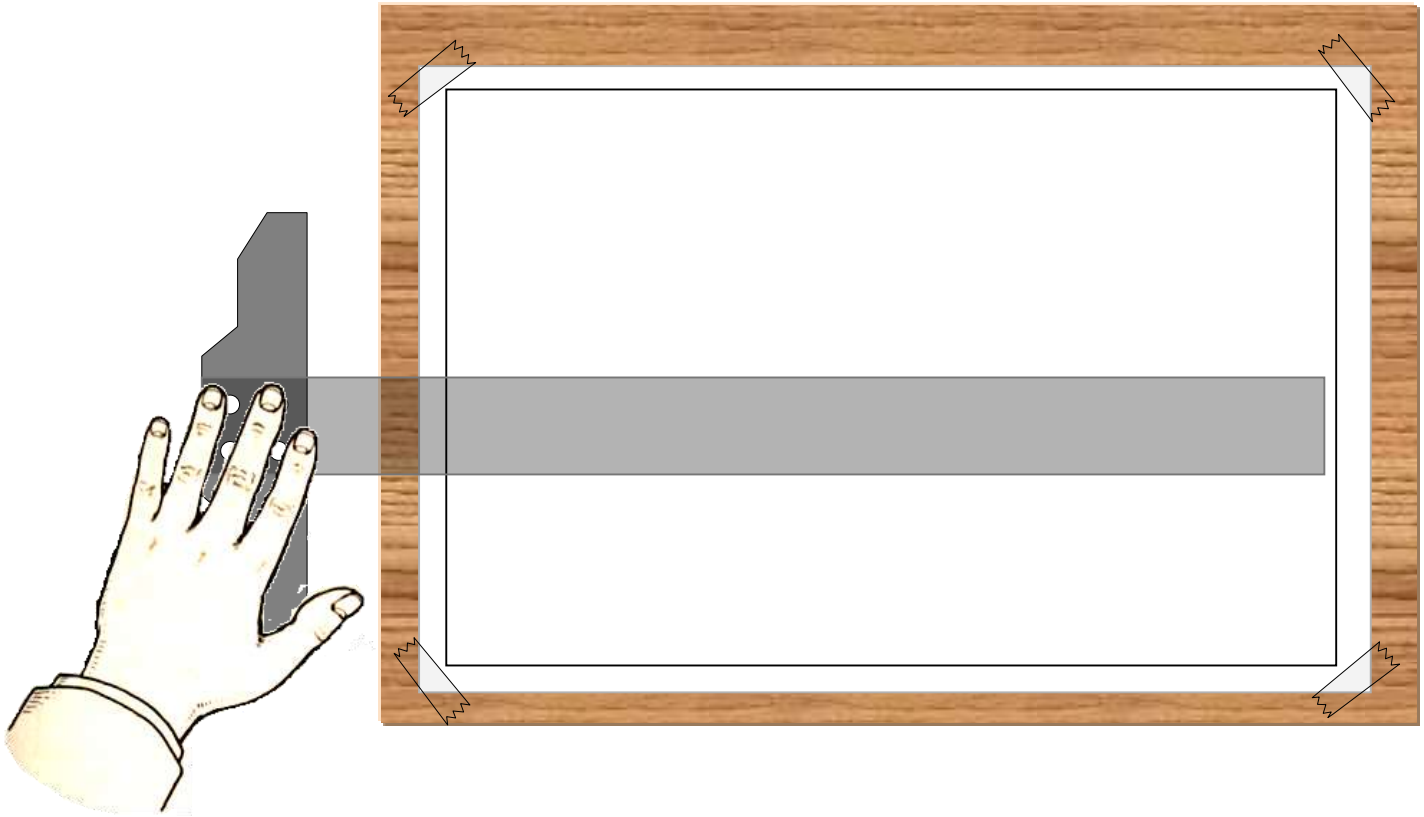
play

Explanations

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

Draw a horizontal line

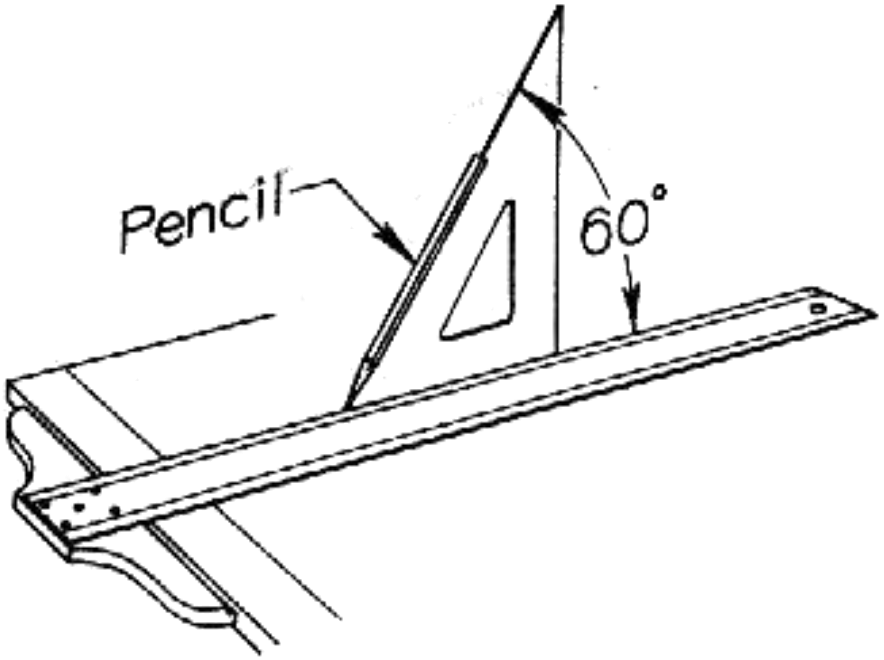
1. Press the T-square head against the left edge of the table.
2. Smooth the blade to the right.

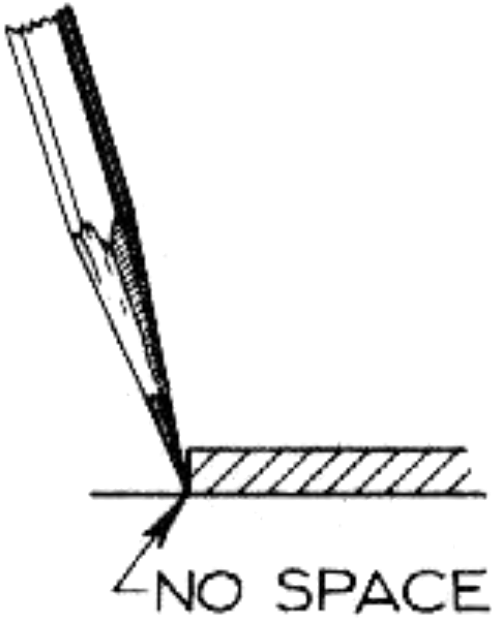


Draw a horizontal line

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

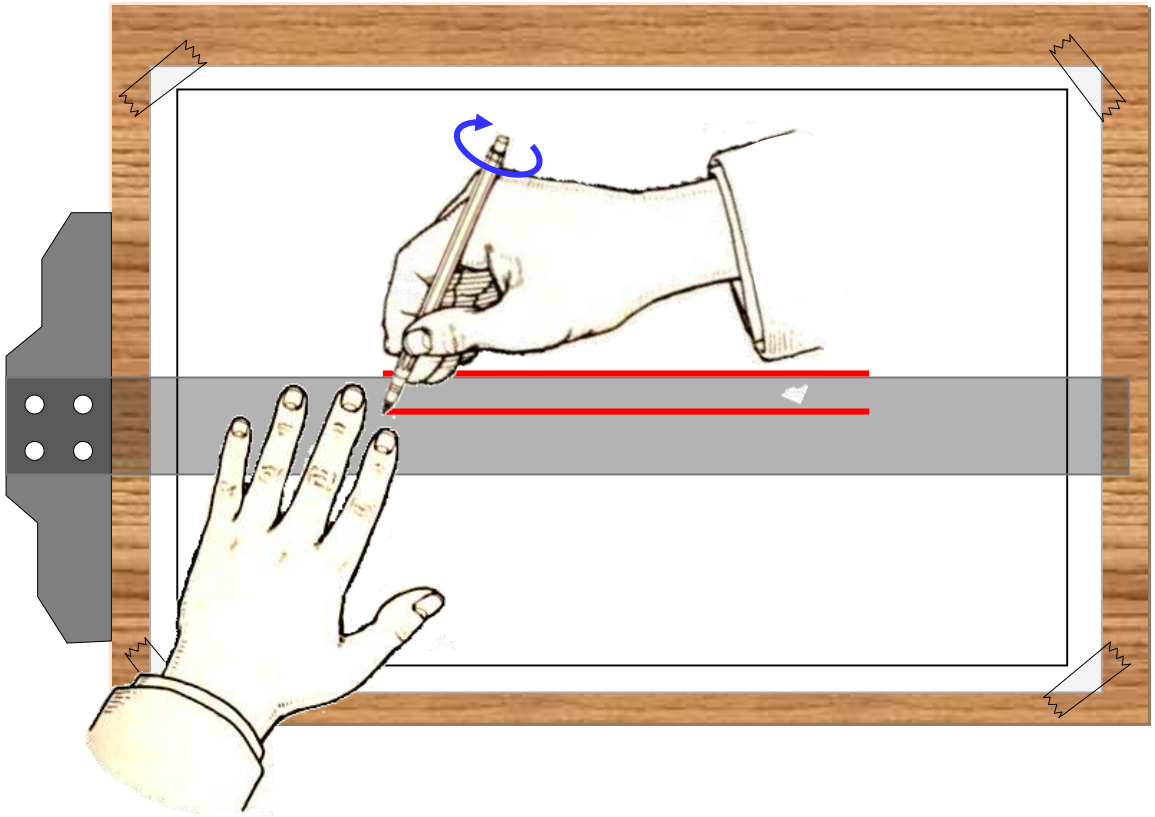
4. Rotate the pencil slowly while moving the pencil from left to right.





Draw a horizontal line

5. Move T-square up or down to draw another horizontal line.

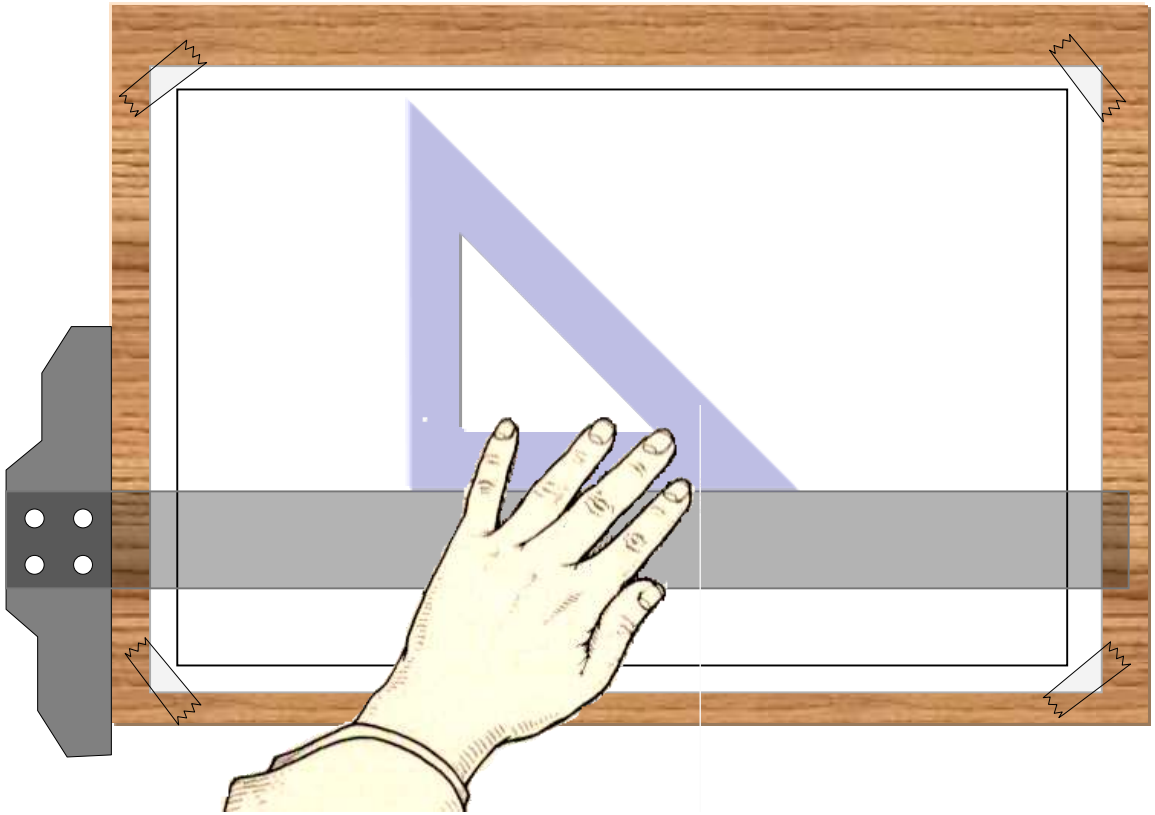


Draw a vertical line

1. Set T-square as before.

   Place any triangle on T-square edge.

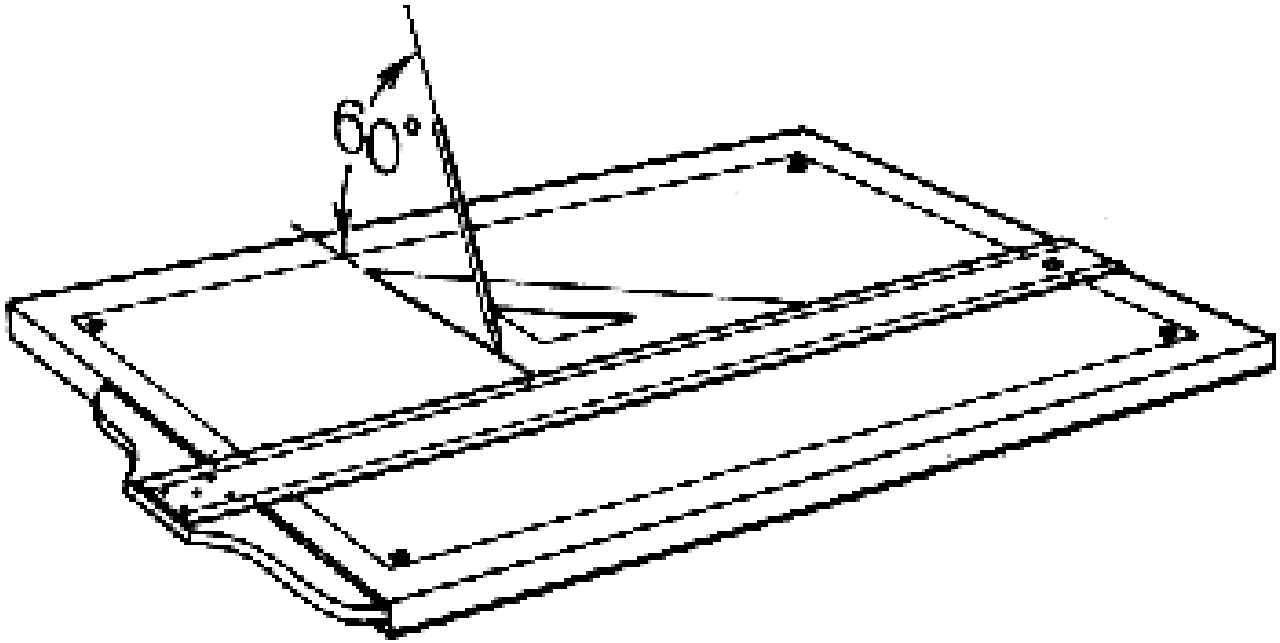
2. Use your left hand to hold both T-square and triangle in position.



Draw a vertical line

3. Lean the pencil to the triangle.

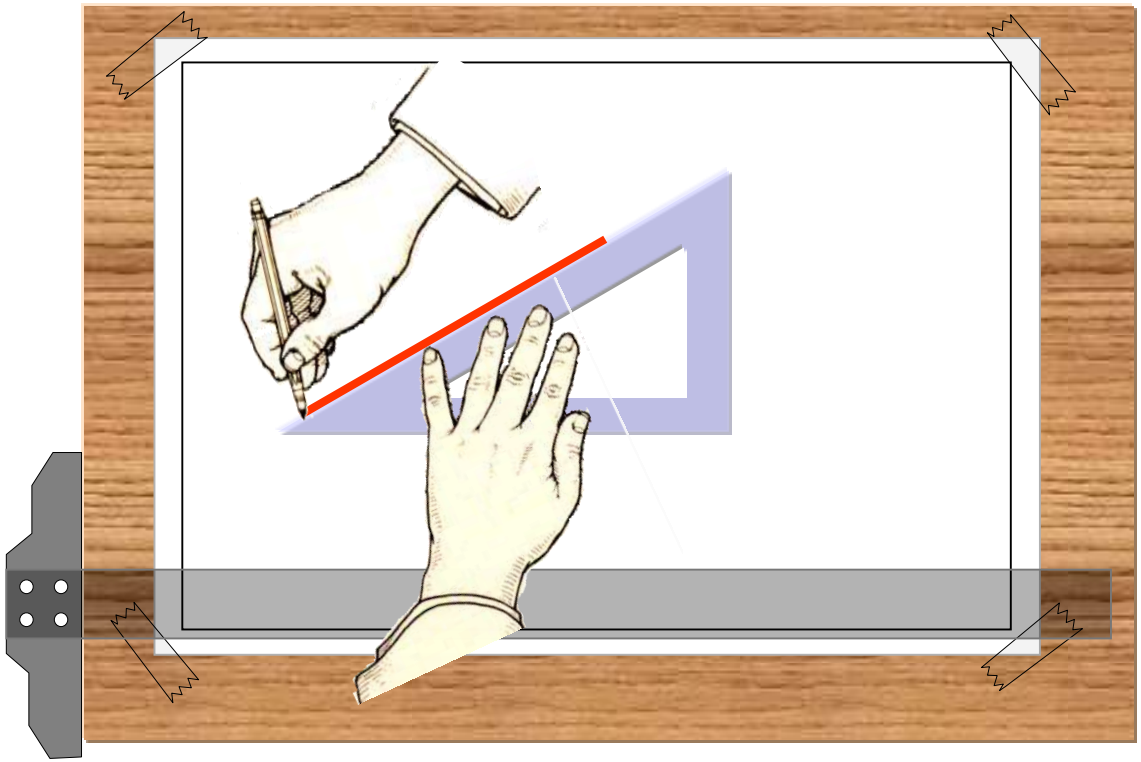
4. Draw the line upward while rotating the pencil slowly.



Draw a line at 30º with horizontal

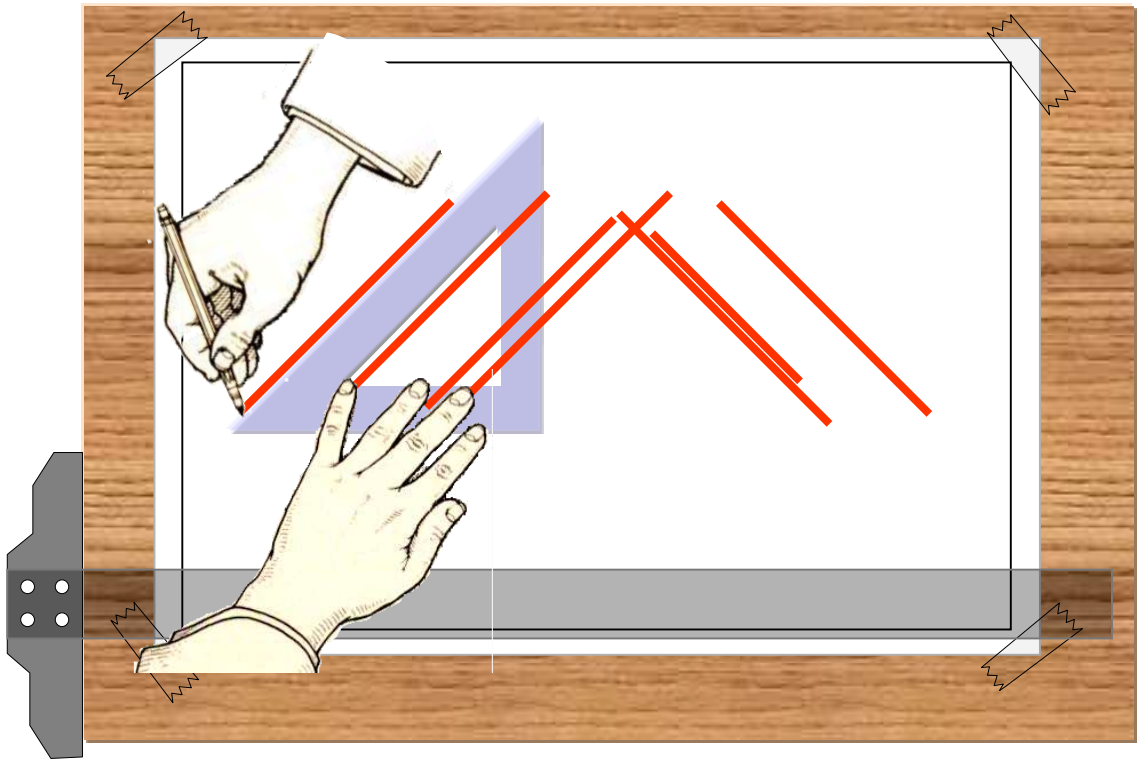
1. Place 30º-60º triangle on the T-square edge and press them firmly against the paper.

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



Draw a line at 45º with horizontal

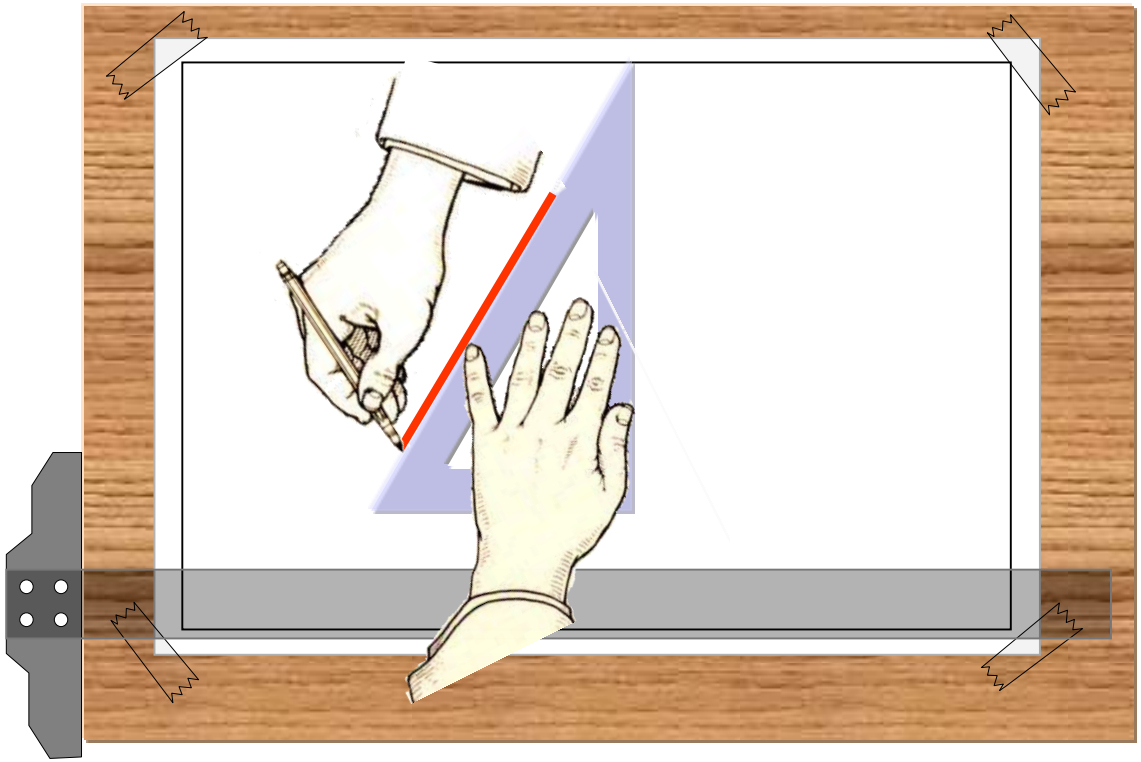
1. Place 45º triangle on the T-square edge and press them firmly against the paper.
2. Draw the line in the direction as shown below.



Draw a line at 60º with horizontal

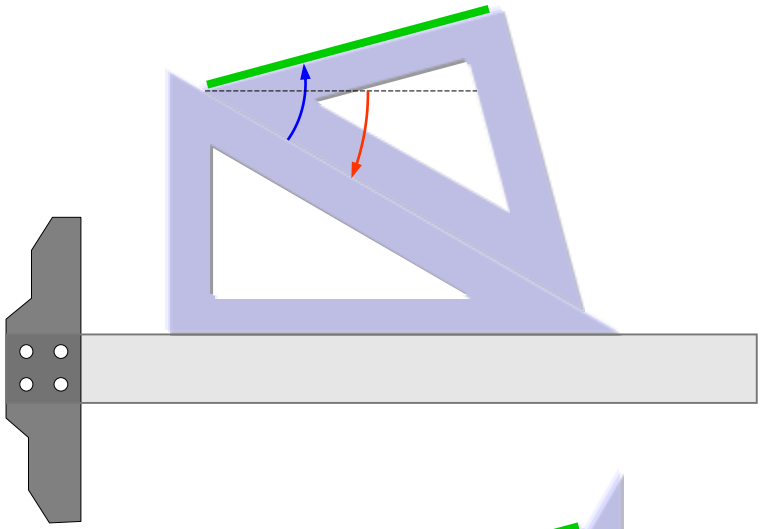
1. Place 30º-60º triangle on the T-square edge and press them firmly against the paper.

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



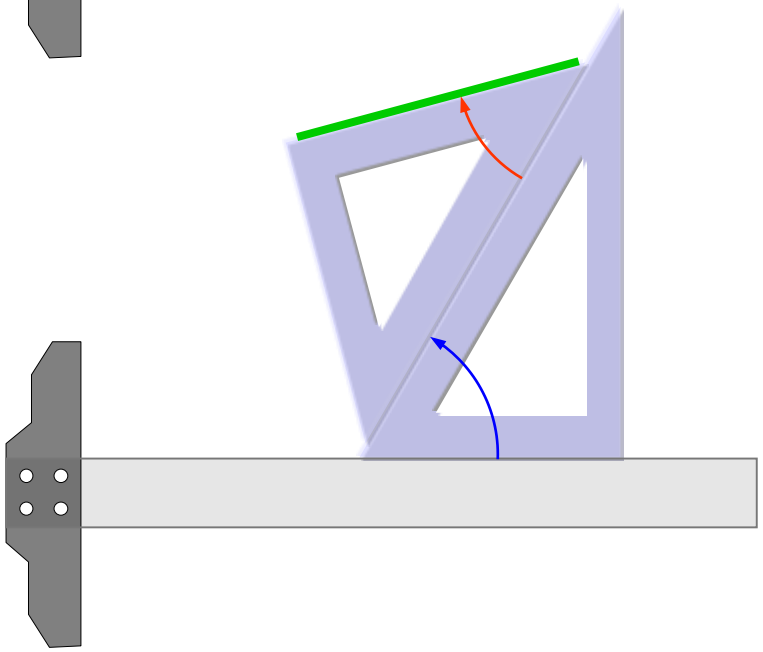
Draw a line at 15º with horizontal

1



-30º + 45º = 15º CCW

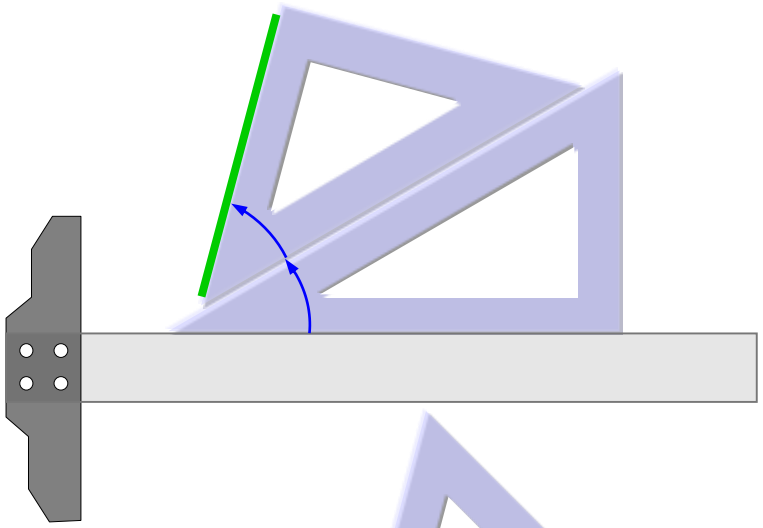
2



60º + (-45º) = 15º CCW

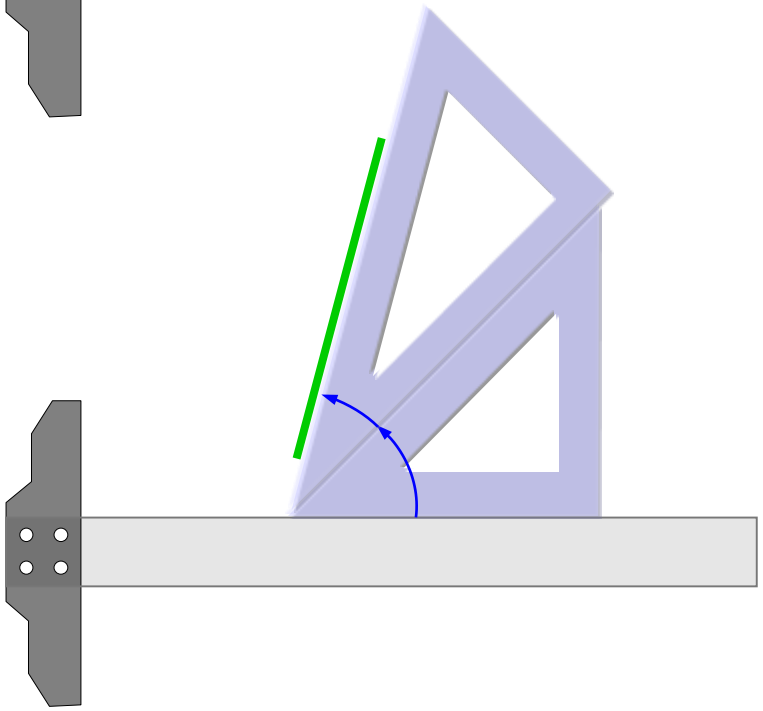
Draw a line at 75º with horizontal

1



30º + 45º = 75º CCW

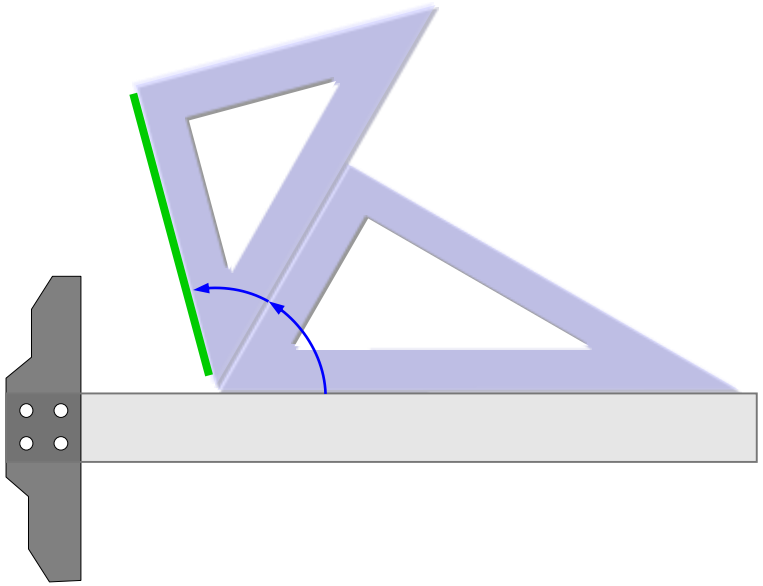
2



45º + 30º = 75º CCW

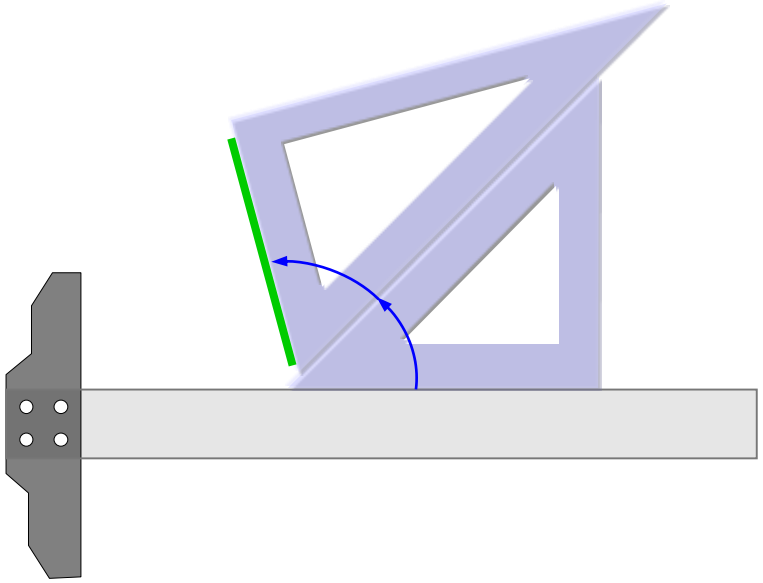
Draw a line at 105º with horizontal

1



$60^o + 45^o = 105^o$ CCW

2



$45^o + 60^o = 105^o$ CCW

Practice by Yourself

Arrange the triangles to draw a line at

a) 120^{o}

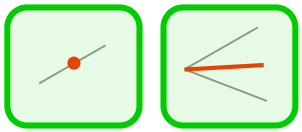
b) 135^{o}

c) 150^{o}

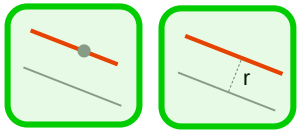
with a horizontal.

Applied Geometry

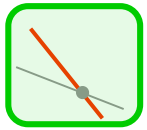
Bisecting



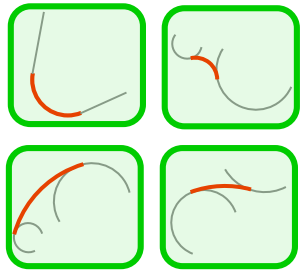
Parallel line



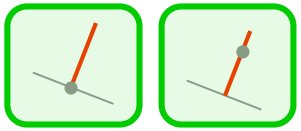
Inclined line



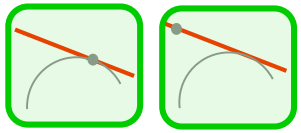
Tangent arc



Perpendicular line



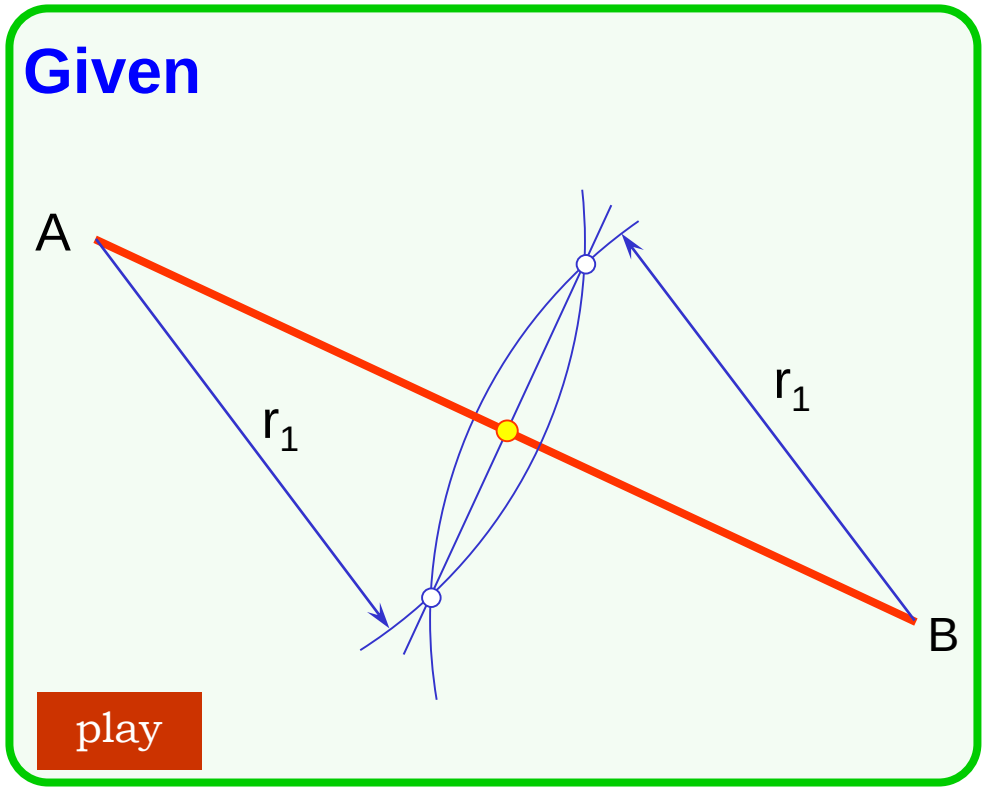
Tangent line



Contents

Bisecting a line and an angle

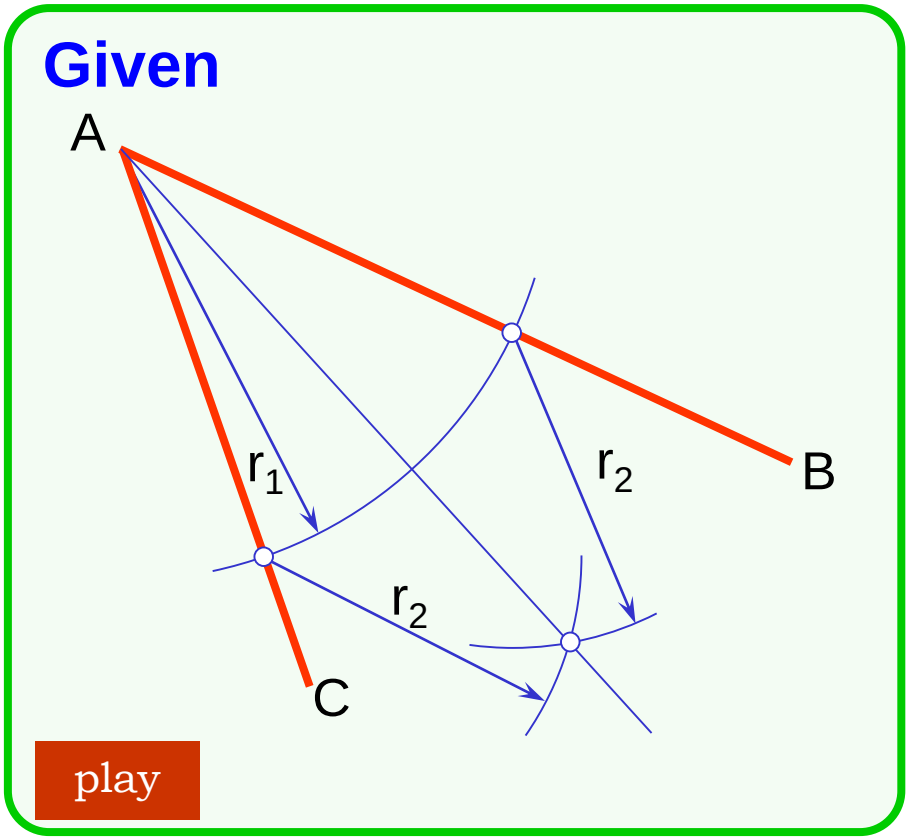
To bisect a given line



Explanations

1. Swing two arcs having a 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.

To bisect a given angle



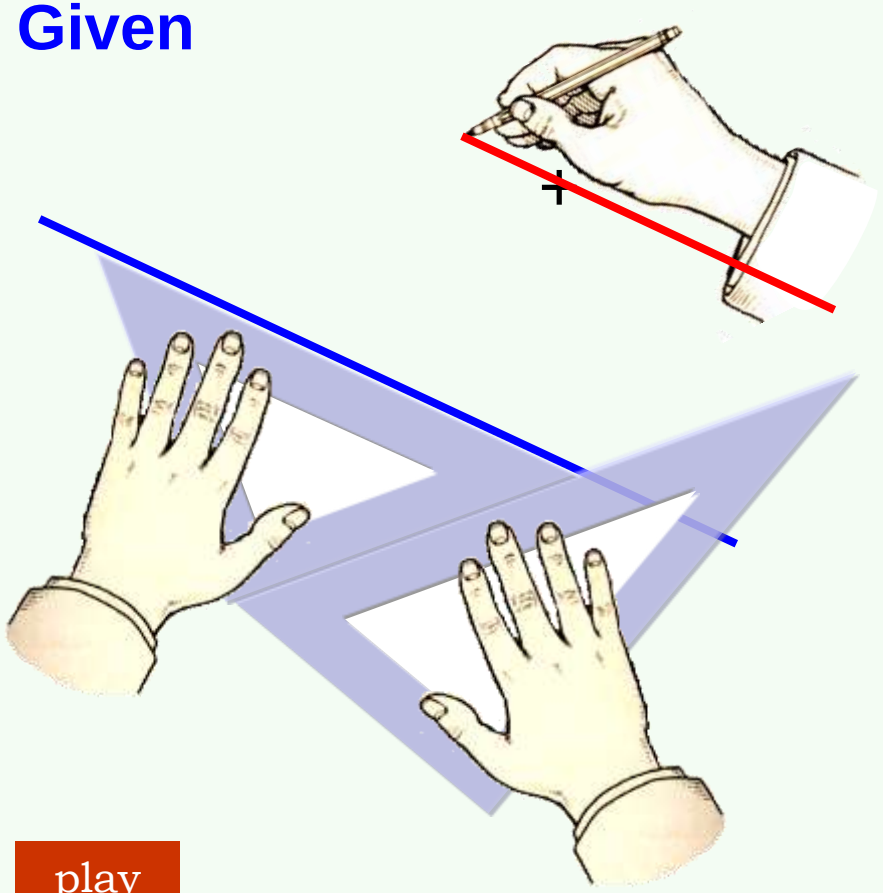
Explanations

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.

Drawing a parallel line

Line parallel to a given line through a given point

Given



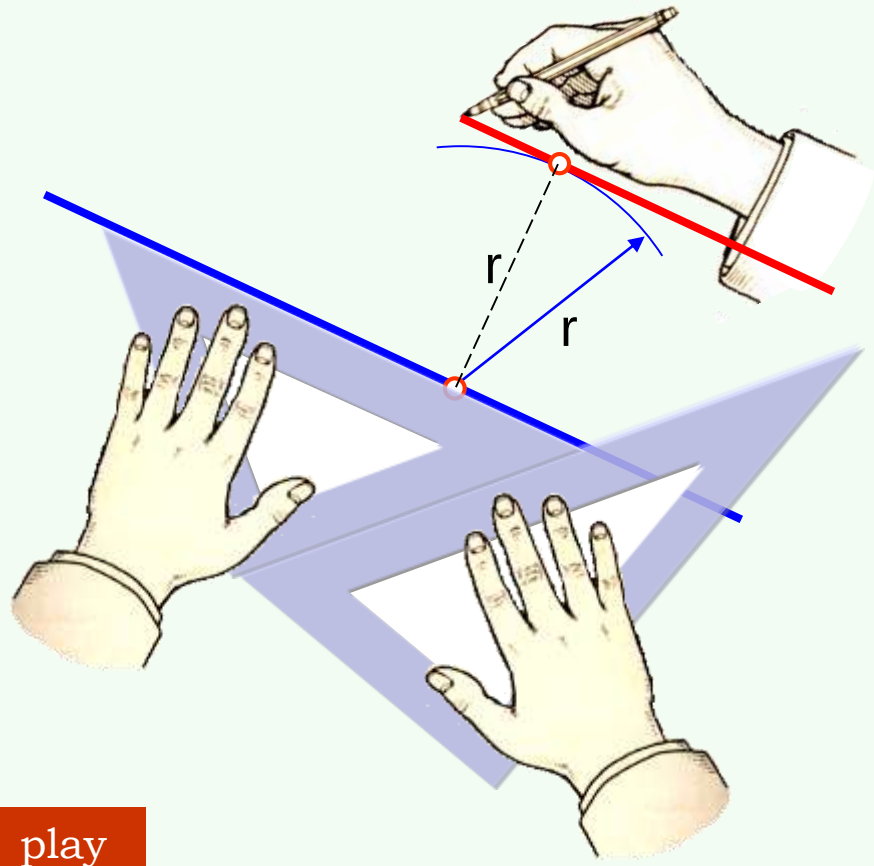
play

Explanations

1. Line an edge of a triangle up to a given line.
2. Support the triangle with another one.
3. Slide the first triangle until its edge passes through the given point.
4. Draw a line.

Line parallel to a given line at a given distance

Given



play

Explanations

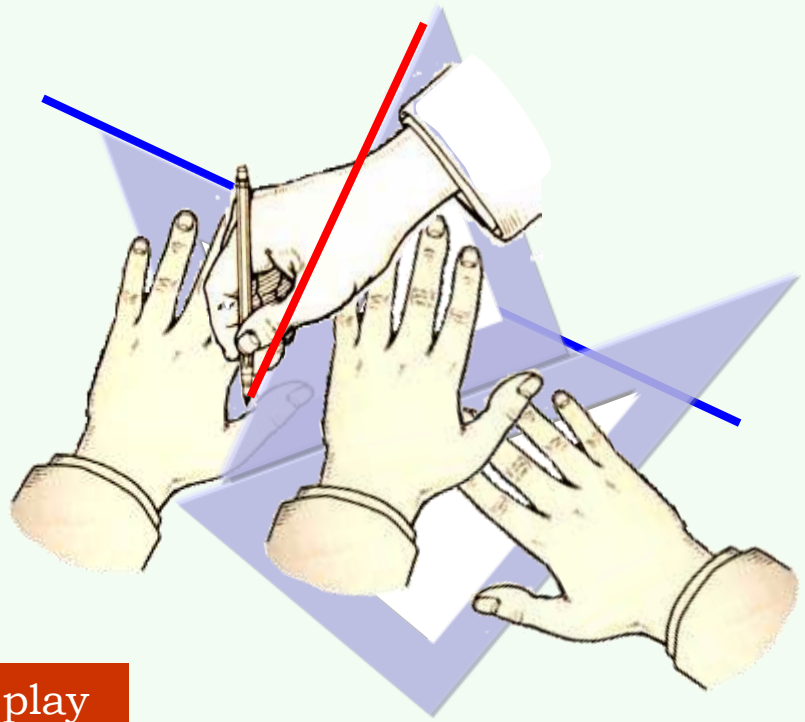
1. Choose a convenient point on a given line.
2. Use that point as center of an arc with a radius equal to a given distance.
3. Draw a line parallel to a given line and tangent to the arc.

Drawing a perpendicular line

Line perpendicular to a point in a line

Revolve method

Given



play

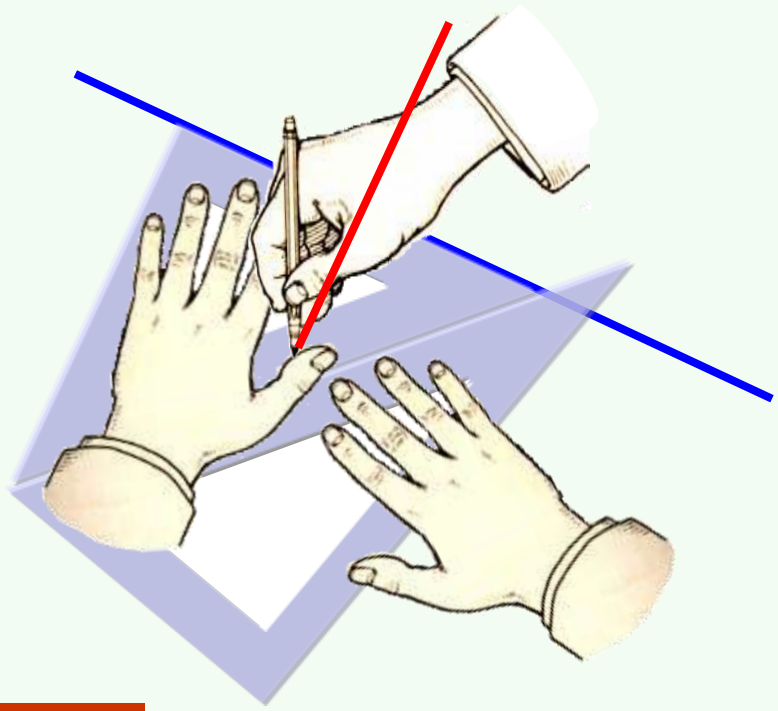
Explanations

1. Line an opposite edge of a 45^{o} triangle up to a given line.
2. Support the triangle with another one.
3. Flip the first triangle and slide until its edge passes through the given point.
4. Draw a line.

Line perpendicular to a point in a line

Adjacent-sides method

Given



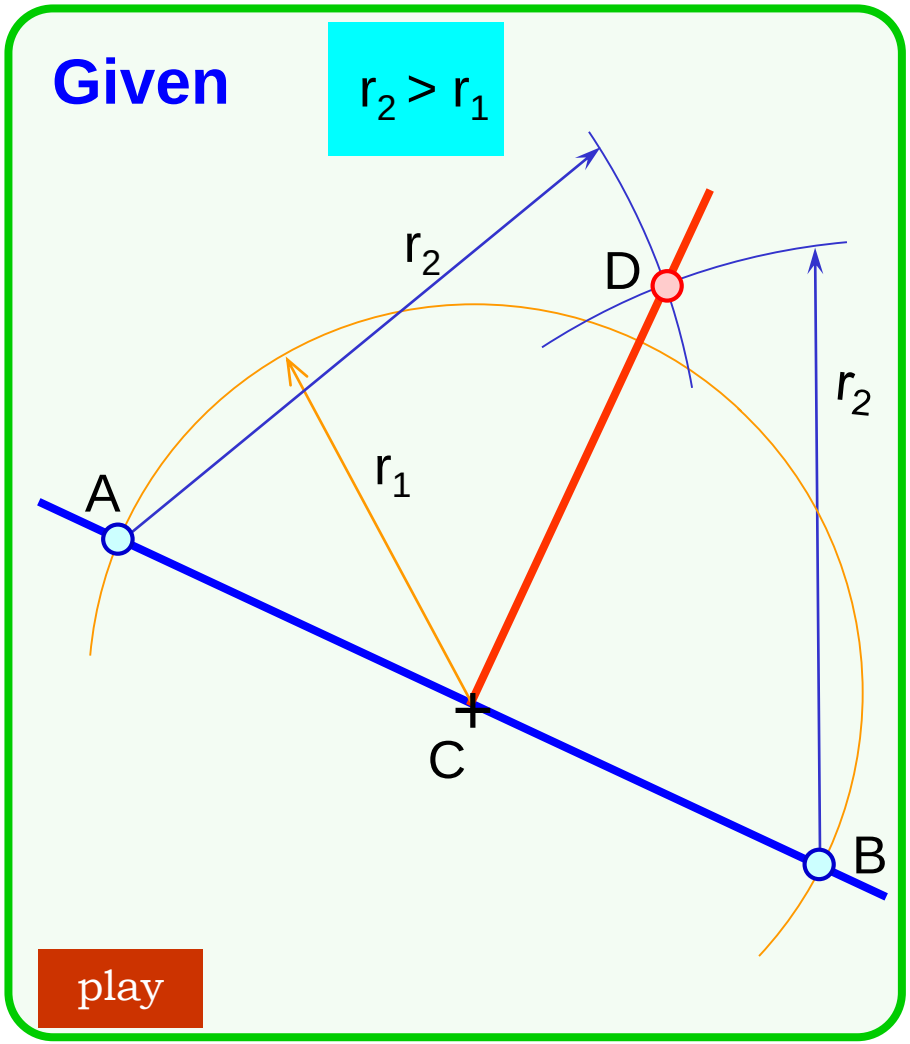
play

Explanations

1. Line an adjacent edge of a 45^{o} triangle up to a given line.
2. Support the triangle with another one.
3. Slide the first triangle until another adjacent edge passes through the given point.
4. Draw a line.

Line perpendicular to a point in a line

Compass method



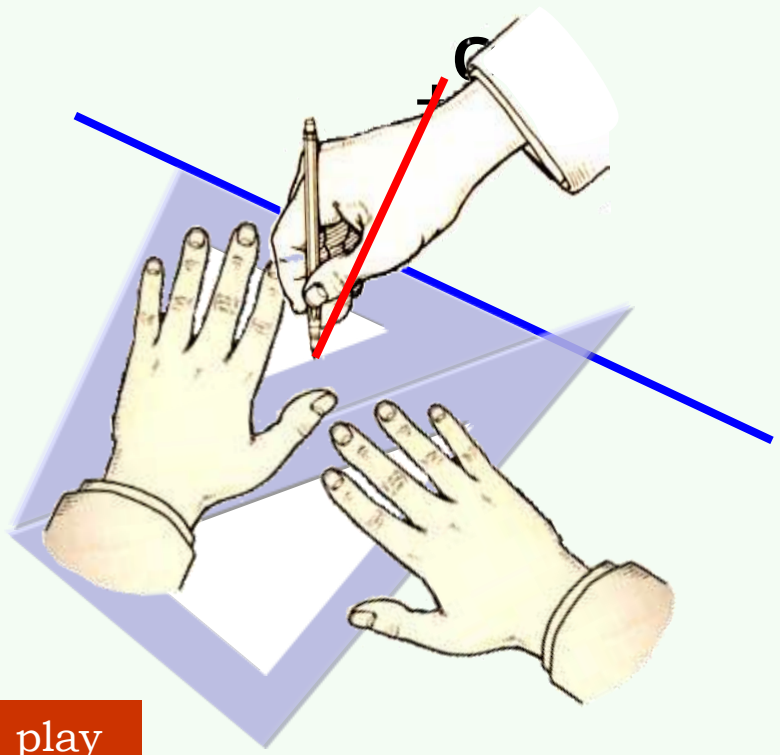
Explanations

1. Use a given point as center, draw the arc with any radius.
2. Bisect the distance between the intersection points between an arc and a given line.
3. Draw a line.

Line perpendicular to a given line through a point outside the line

Adjacent-sides method

Given



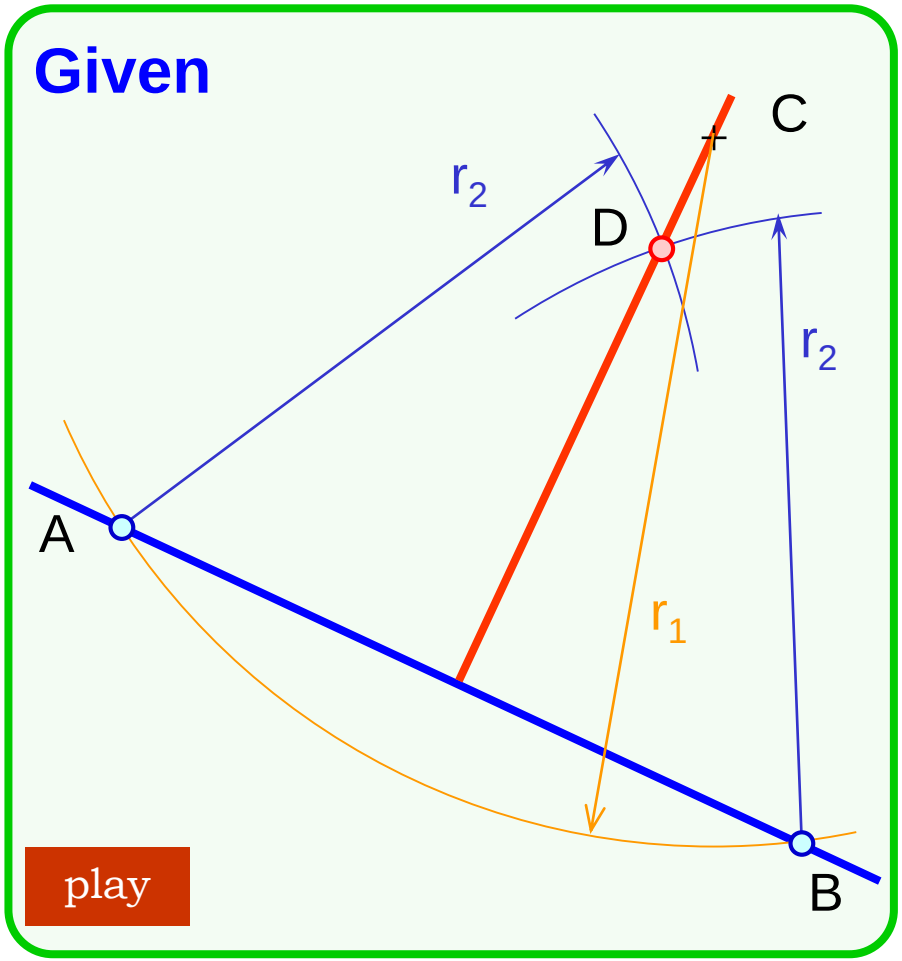
play

Explanations

1. Line an adjacent edge of a 45^{o} triangle up to a given line.
2. Support the triangle with another one.
3. Slide the first triangle until another adjacent edge passes through the given point.
4. Draw a line.

Line perpendicular to a given line through a point outside the line

Compass method



Explanations

1. Use a given point as a center, draw the arc with any radius that intersect the given line.
2. Bisect the distance between the intersection points between an arc and a given line.
3. Draw a line.

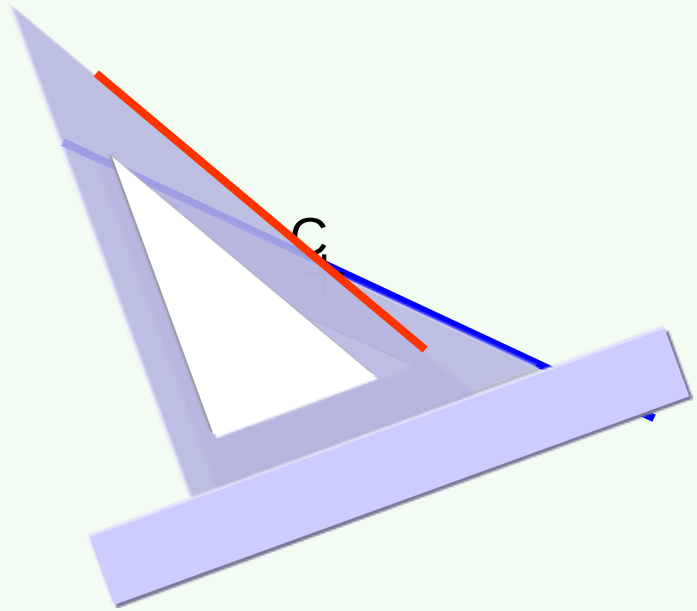
Practice by Yourself

Draw a line perpendicular to a given line and pass through a point lies outside using *revolved* method.

Drawing an inclined line

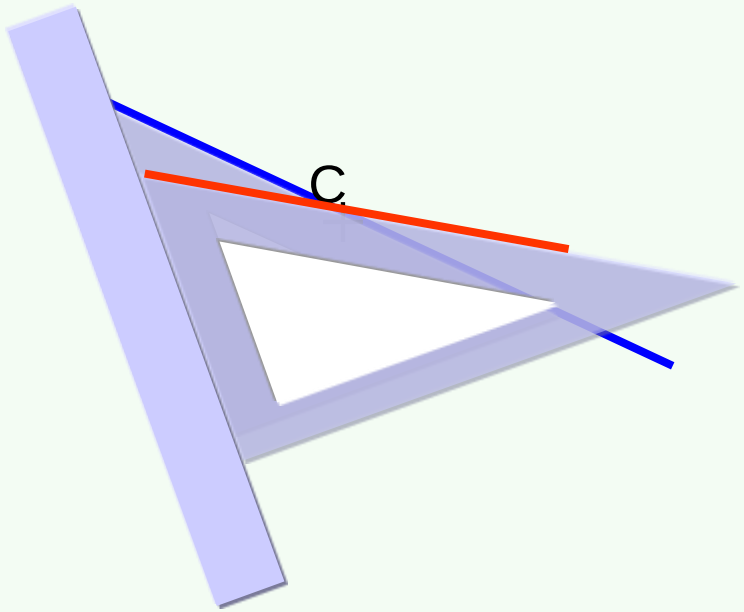
Line making 15º with a given line through a given point

Given



play

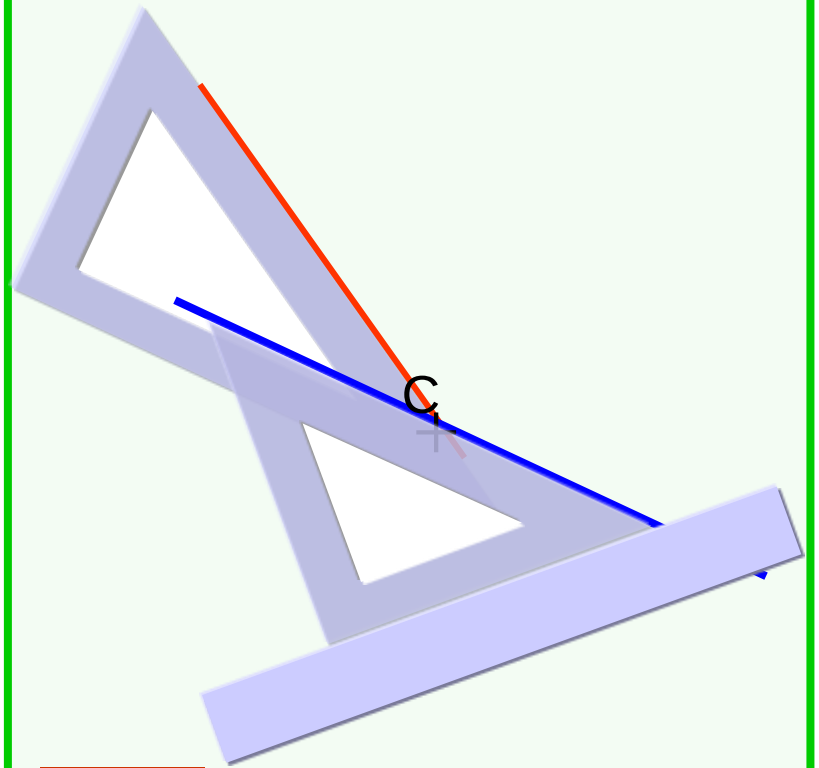
Given



play

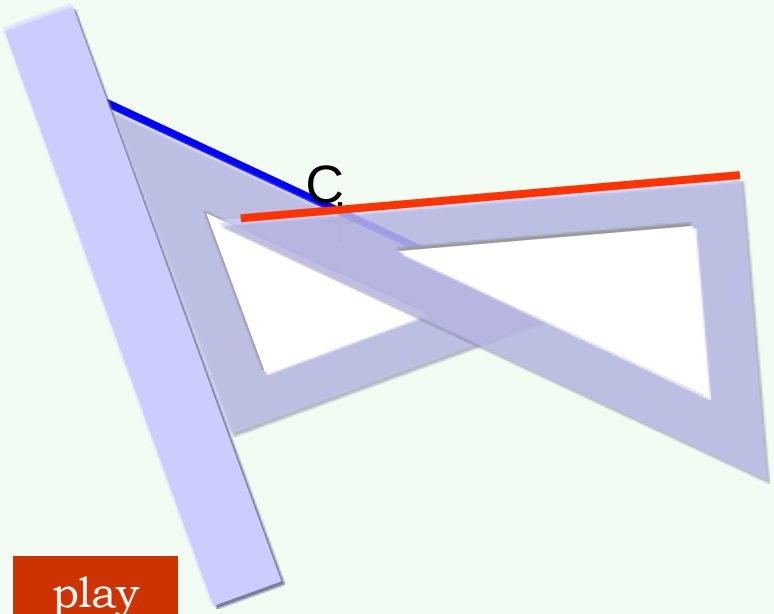
Line making 30º with a given line through a given point

Given



play

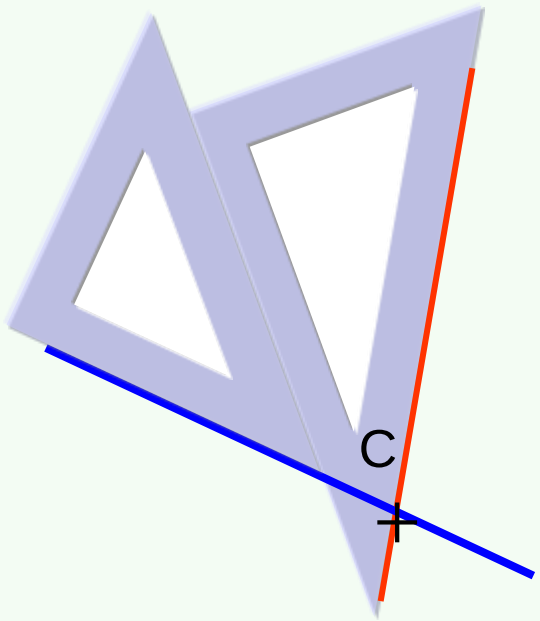
Given



play

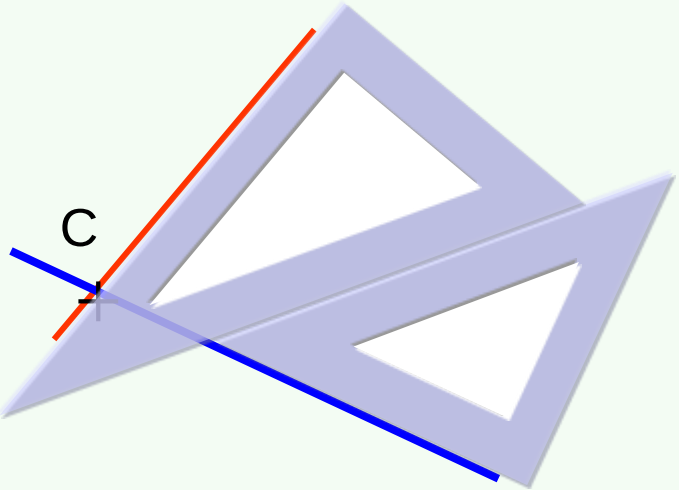
Line making 75º with a given line through a given point

Given



play

Given

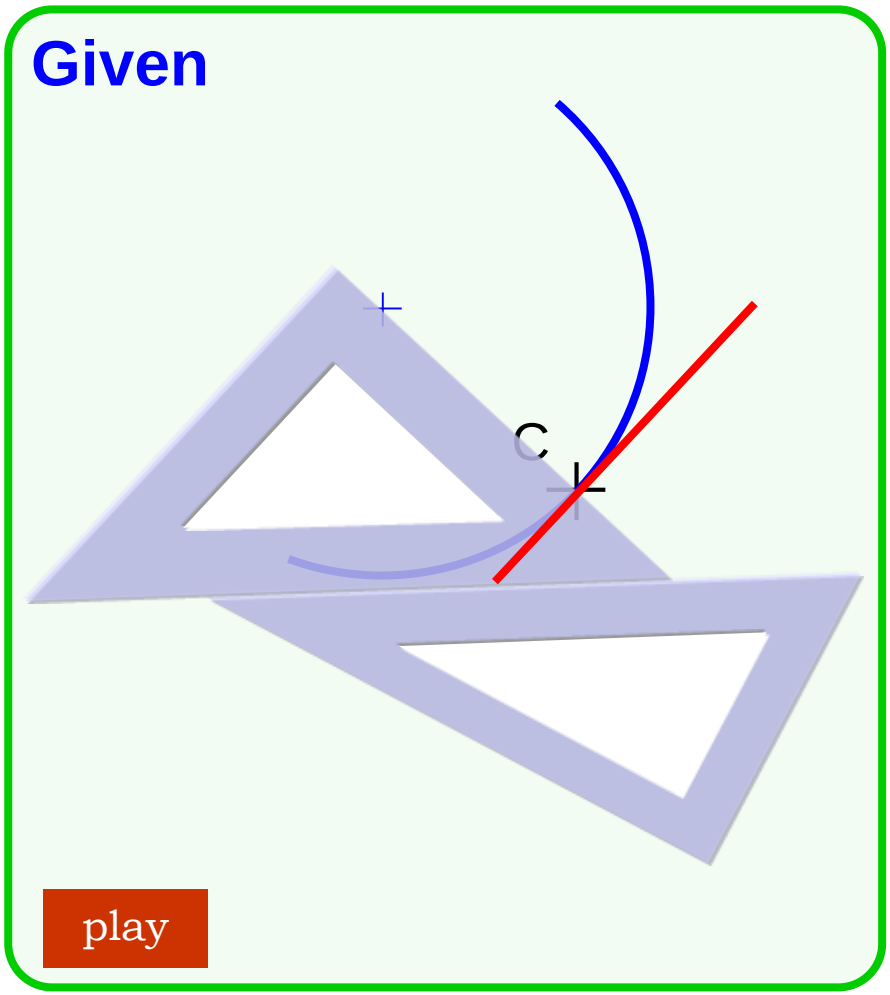


play

Drawing a Tangent line to an arc (or a circle)

Tangent line to a given arc (or circle)

Case 1 : A given point lies on an arc



Explanations

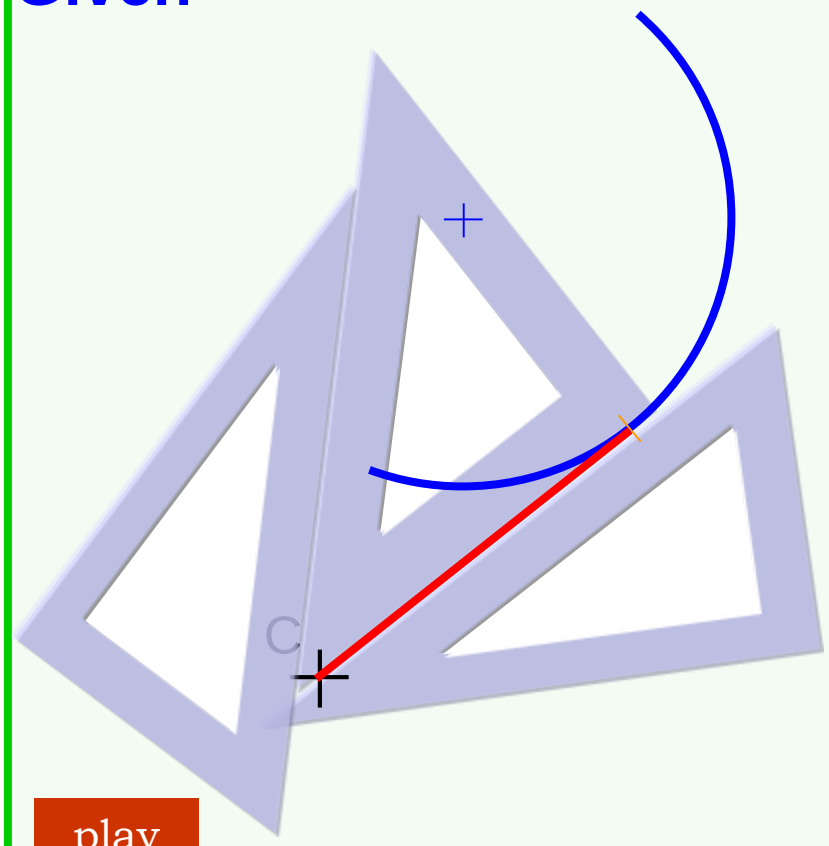
1. Line an adjacent edge of a 45^{o} triangle up to the center of an arc and a given given.
2. Support the triangle with another one.
3. Slide the first triangle until another adjacent edge passes through the given point.
4. Draw a line.

Tangent line to a given arc (or circle)

Case 2 : A given point lies outside an arc

Given

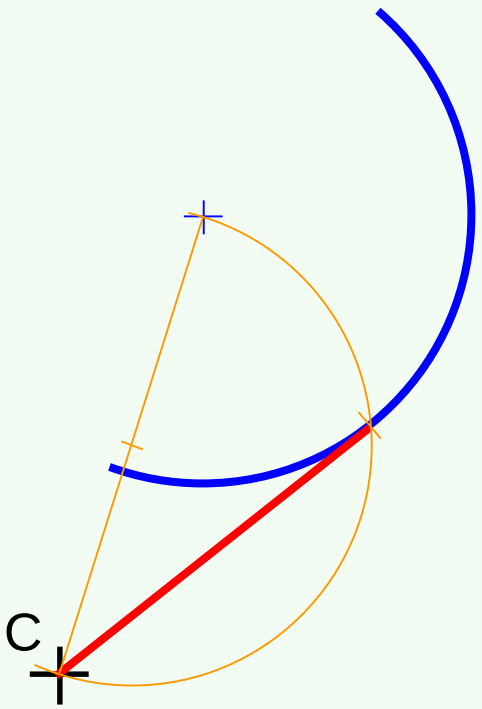
1st method



play

Given

2nd method



play

Drawing a tangent curve to the given lines

Key Concept

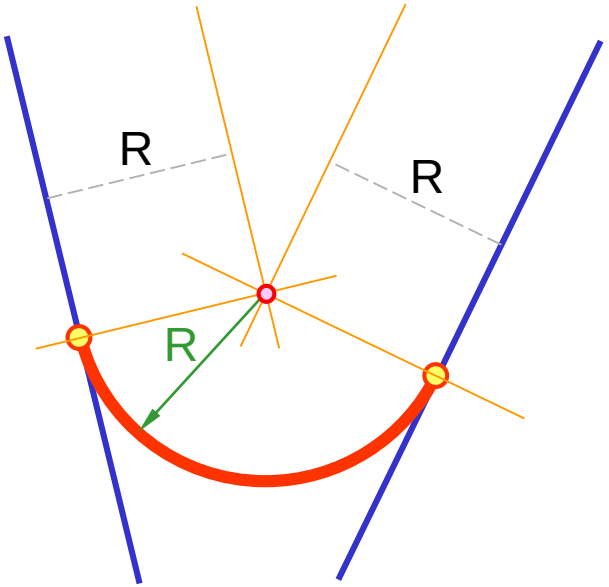
- To draw a tangent arc (of a specified radius, R), it is necessary to locate

  1. its center, C.

     It places outside a line for a distance equal to a radius of an arc.

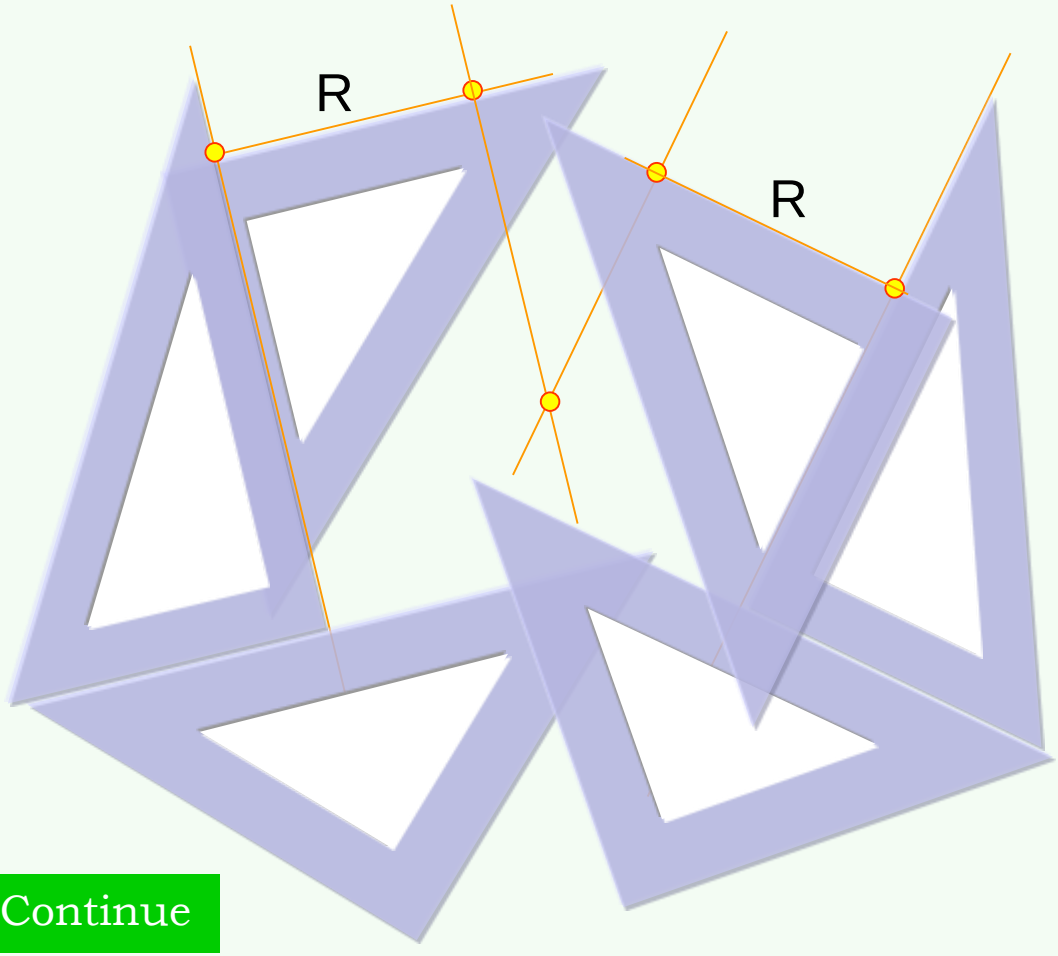
  2. the start and end points (or tangent points) of the arc.

     It lies on a given line in the way that the line passing through this point and the center of an arc be perpendicular to a given line.



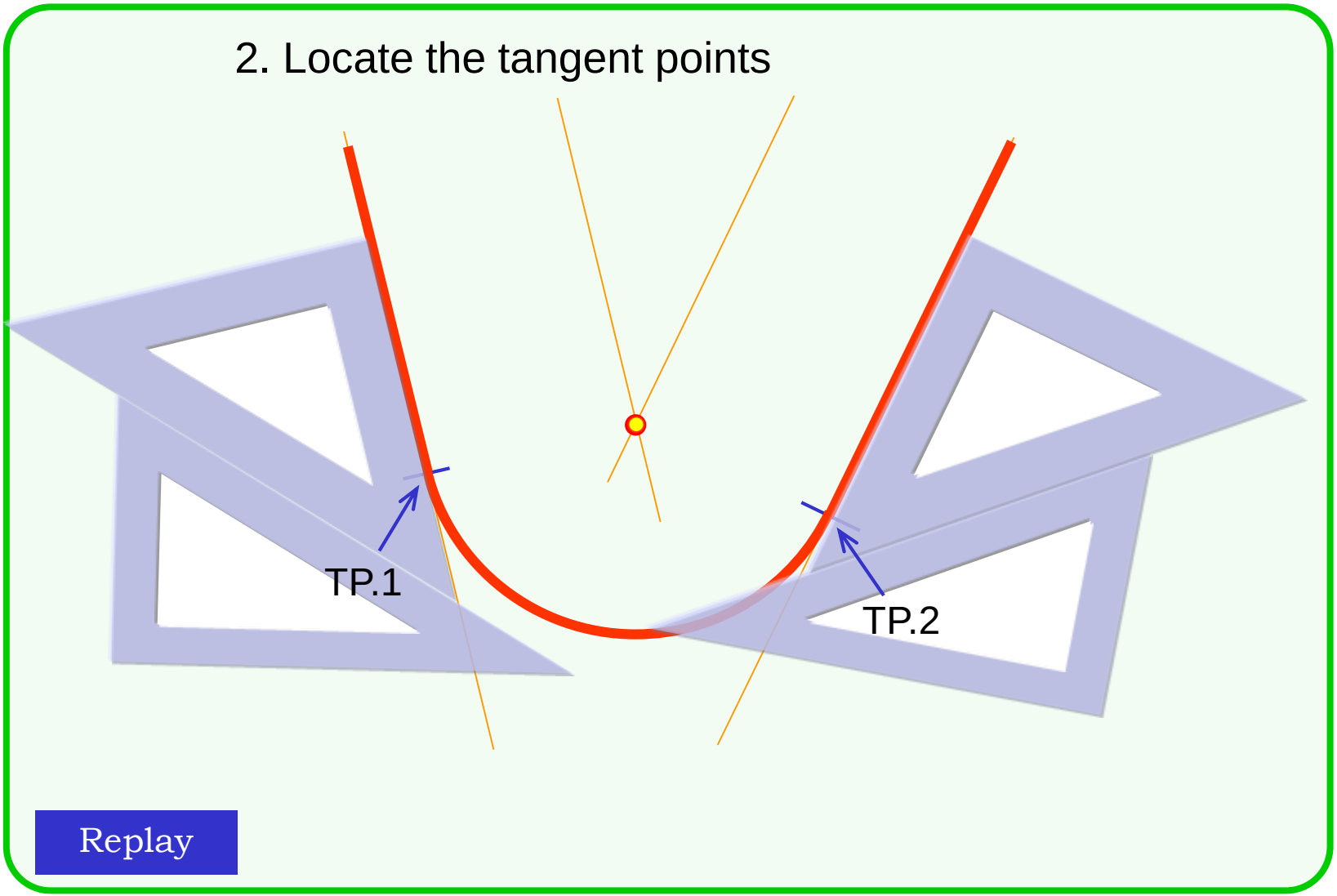
Tangent arc to the given lines

Given 1. Locate the center of an arc



play Continue

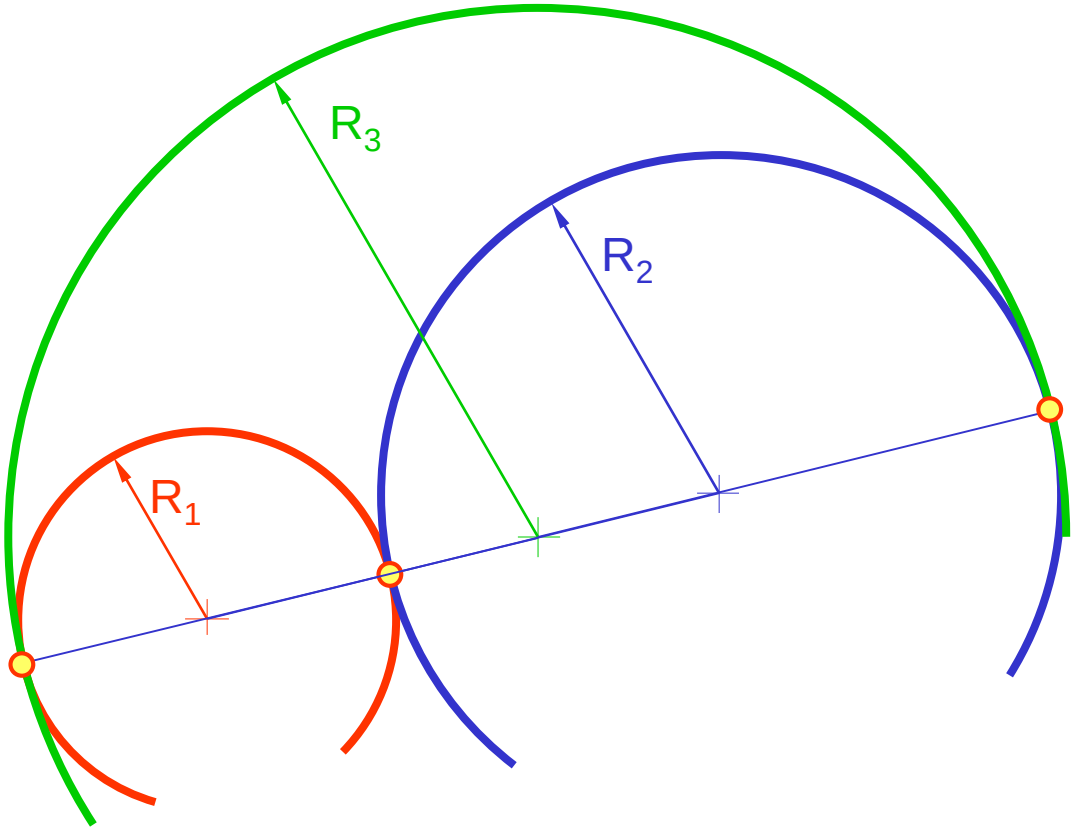
Tangent arc to the given lines



Drawing a tangent curve to the given curves

Key Concept

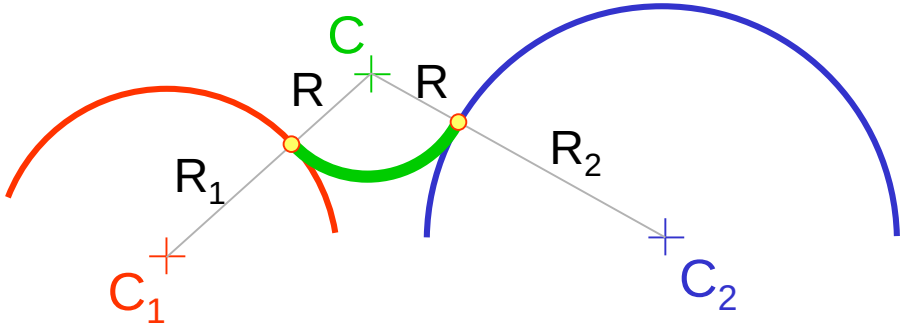
- Tangent point lies on the line passes through the centers of each arc (or circle).



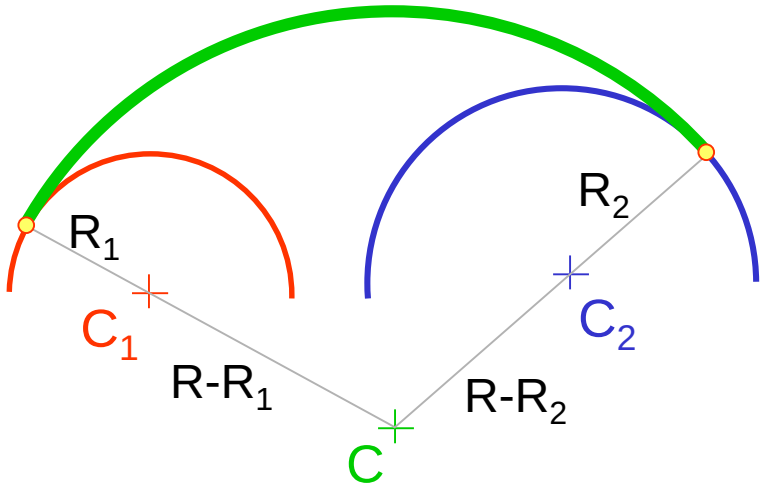
Tangent arc to a given arcs (or circles)

- To draw a tangent arc (of a specified radius, R),
  it is necessary to locate
  1. its center, C.
  2. the start and end points (or tangent points) of the arc.

Case 1 : External

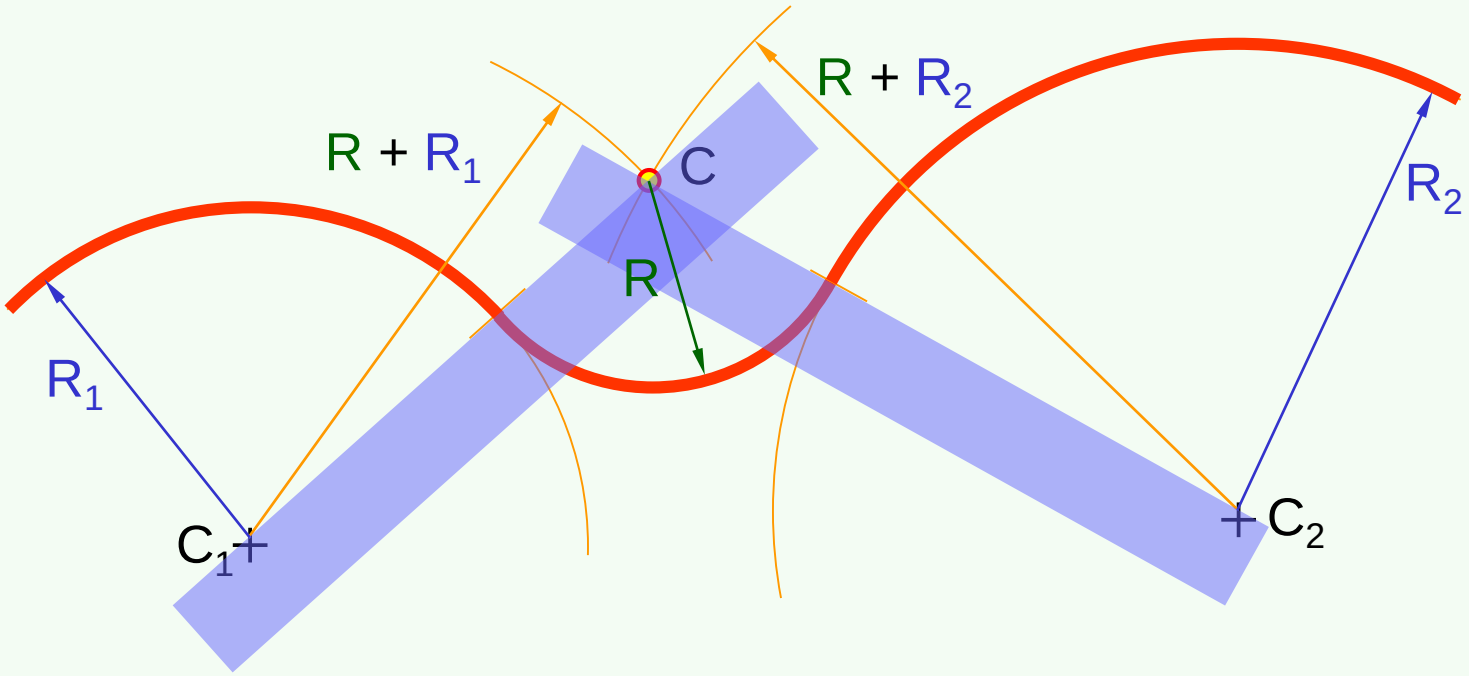


Case 2 : Internal



External tangent arc

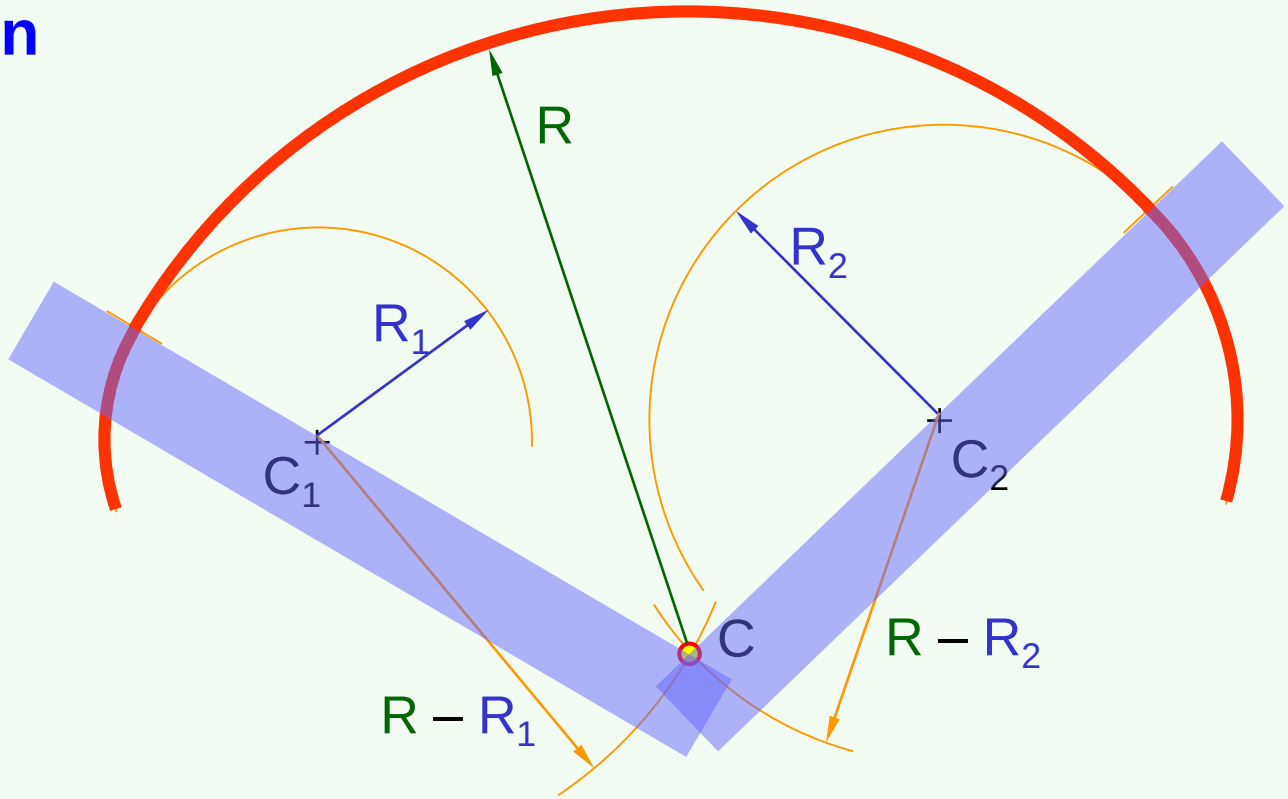
Given



play

Internal tangent arc (Type 1)

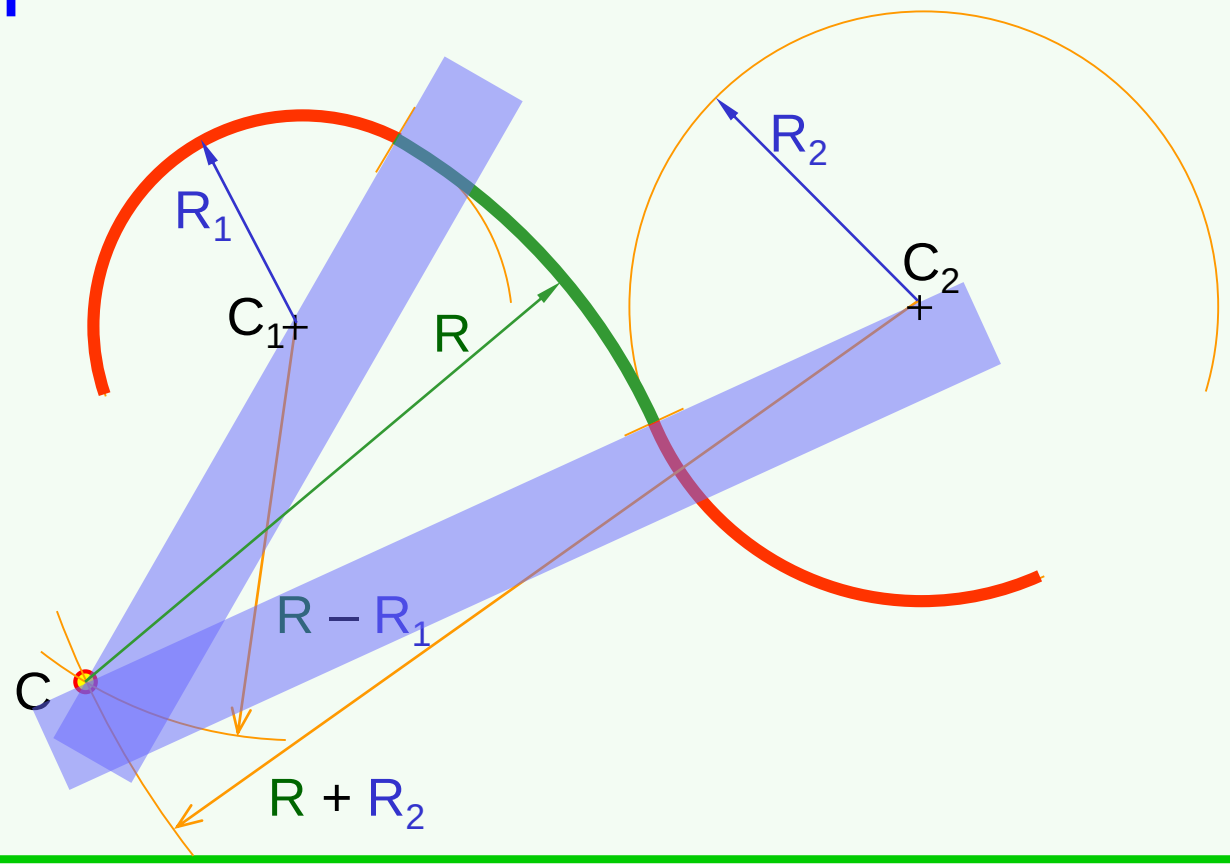
Given



play

Internal tangent arc (Type 2)

Given



play

Problem solving steps

1. Calculate the required space.
2. Layout the drawing steps.
3. Match the construction techniques to each drawing step.
4. Start drawing.

- Always use a construction line if the information to draw a line or a curve is incomplete.

Example

Drawing steps VDO