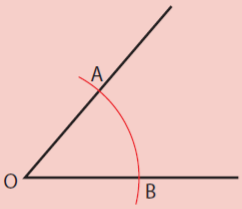
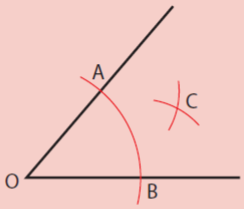
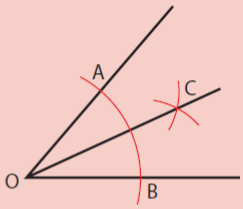
1. Bisector of a given angle using only compass and straightedge



To bisect the given angle, place the point of the compass at O and draw an arc to cut both arms of the angle at A and B.

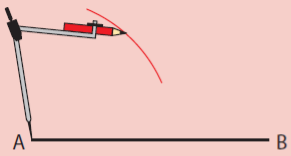


With the point of the compass at A and with the same radius, draw an arc between the arms of the angle. Repeat at B, cutting the first arc at C.

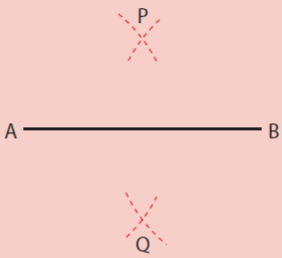


Join the point O to C. OC is the bisector of the angle AOB.

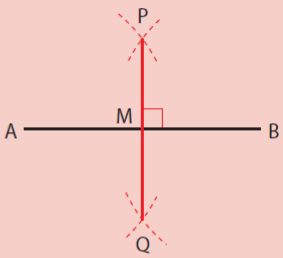
2. How to construct the perpendicular bisector of a line segment



Set your compass to over half the length of [AB]. With A as centre, draw an arc above and below the line.



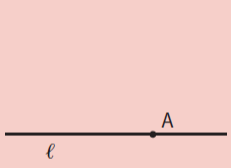
Keep your compass with the same radius. With B as centre, draw two more arcs. These arcs intersect the first two arcs at P and Q.



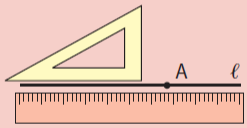
Join P and Q.
PQ is the perpendicular bisector of [AB].
M is the midpoint of [AB].

3. Line perpendicular to a given line ℓ, passing through a given point on ℓ

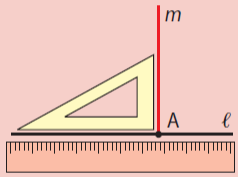
(i) Using a set square and straightedge



Given a line ℓ and the point A on ℓ.



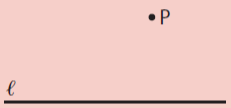
Place the ruler along the line ℓ and place the set square on the ruler.



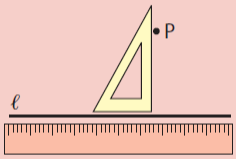
Move the set square along the ruler until it reaches the point A. Draw the line m through A.
m is perpendicular to ℓ.

4. Line perpendicular to a given line ℓ, passing through a given point not on ℓ

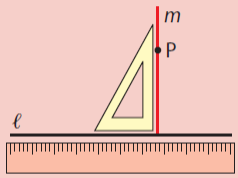
(i) Using a straightedge and set square



Given a line ℓ and a point P not on ℓ.

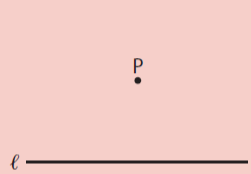


Place the ruler along the line ℓ and place the set square on the ruler.

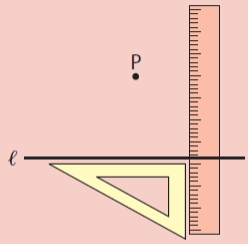


Move the set square along the ruler until it reaches the point P. Draw the line m through P.
m is perpendicular to ℓ and contains P.

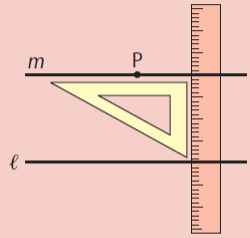
5. How to draw a line parallel to a given line, through a given point



Given a line ℓ and a point P.

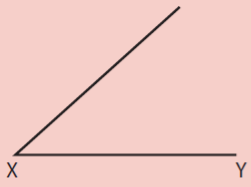


Place one side of the set square along the line ℓ. Place the ruler along the other side and hold firmly.

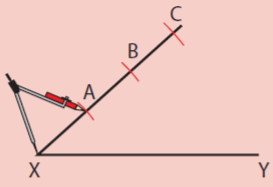


Slide the set square along the ruler up to the point P. Draw a line m through P. The line m is parallel to ℓ.

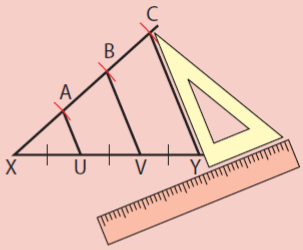
6. Division of a line segment into three equal parts



Draw a line segment [XY]. Draw a line through X making an acute angle with [XY].



Use a compass with X as centre and draw an arc crossing the line at A. With A as centre and with the same radius, draw another arc crossing the line. Mark this point B. Repeat the process at point B and mark the new point C.

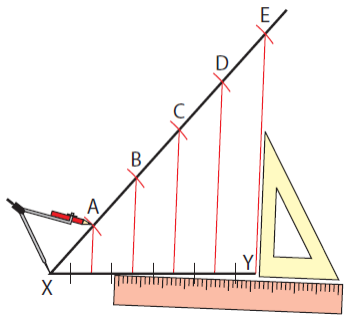


Join C to Y.
Using a set square and ruler, draw lines through B and A parallel to CY.
These lines meet [XY] at the points V and U, respectively.
U and V divide [XY] into three equal parts.

7. Division of a line segment into any number of equal segments, without measuring it

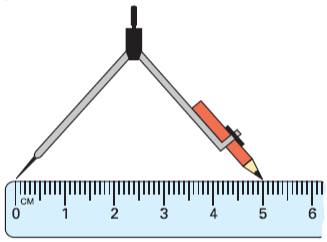
The method shown in 6 above can be used to divide a line segment into any number of equal parts.

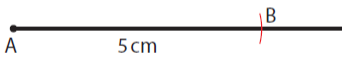
In the given figure, the line XE is divided into 5 equal parts.
Join EY.
Using a set square and straightedge, draw lines through D, C, B and A parallel to EY.
The line segment [XY] is divided into 5 equal parts.



8. Line segment of a given length on a given ray

We use a compass, ruler and straightedge to draw a line segment of a given length on a given ray.



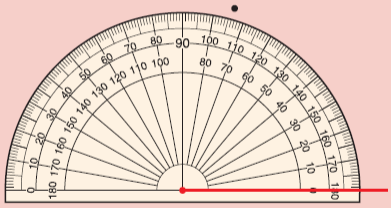


To draw a line segment of 5 cm, we use a compass and ruler to get a radius of 5 cm.
We now place the compass at the point A and without changing the radius, draw an arc intersecting the line at B.
[AB] is 5 cm in length.

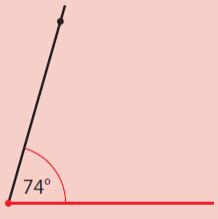
9. Angle of a given number of degrees with a given ray as one arm

We use a protractor to measure angles and draw angles of given sizes. The diagrams below show how to draw an angle of 74°.

Draw a line.
Mark the vertex of the angle.



Position the protractor as if you were measuring an angle.
Mark a dot at 74°.

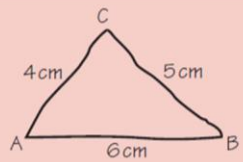


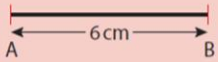
Draw a line from the vertex through the dot.

Triangle given lengths of the three sides

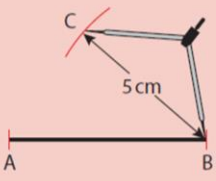
Make an accurate drawing of triangle ABC with $|AB| = 6$ cm, $|BC| = 5$ cm and $|CA| = 4$ cm.

Make a rough sketch first, to get an idea of what your finished drawing should be like.

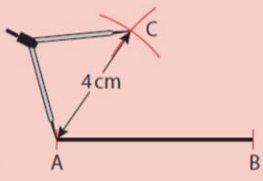




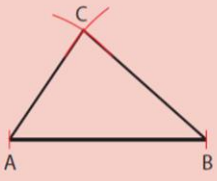
Start with the longest side. Using a ruler, draw a line segment 6 cm long and label its ends A and B.



Set your compass to a radius of 5 cm. Put the point at B and draw an arc.



Set your compass to 4 cm. Put the point at A and draw a second arc. Point C is where the two arcs cross.

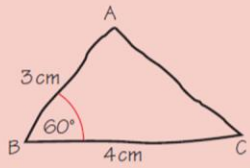


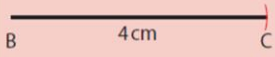
Join C to A and B to complete the triangle.

Triangle given side, angle and side measurements

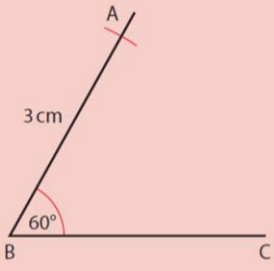
Construct a triangle ABC with [BC] as base, where $|BC| = 4$ cm, $|AB| = 3$ cm and $|\angle ABC| = 60°$. Measure the side [AC].

A rough sketch is shown on the right.

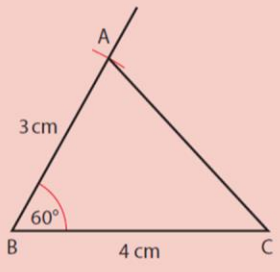




Draw a horizontal line and use your compass to mark off 4 cm. This gives the base [BC] = 4 cm.



Use your protractor to measure $\angle CBA = 60°$ and draw the line BA. Place the point of your compass at B and draw an arc using a radius of 3 cm. The point where the arc cuts the line BA gives us the required point A.

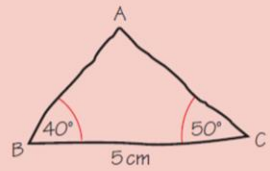


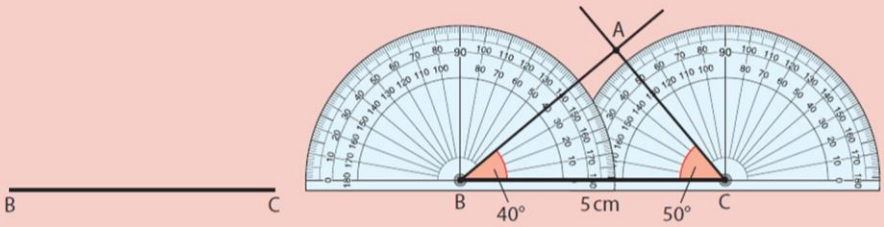
Join A to C. ABC is the required triangle. If we measure |AC|, we get 3.6 cm.

Triangle given angle, side, angle measures

Construct a triangle ABC with $|BC| = 5$ cm, $|\angle ABC| = 40°$ and $|\angle ACB| = 50°$.

A rough sketch is shown.





Draw a line segment [BC], 5 cm in length.

Use a protractor to make $|\angle ABC| = 40°$ and $|\angle BCA| = 50°$

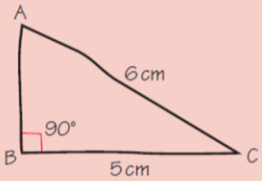
The lines meet at the point A.

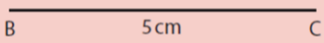
ABC is the required triangle.

Right-angled triangle, given the length of the hypotenuse and one other side

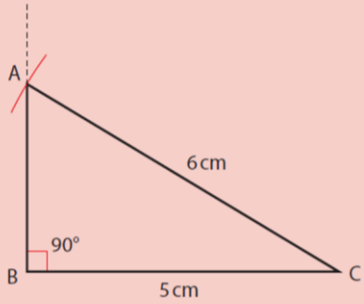
Construct the triangle ABC so that $|\angle ABC| = 90°$, $|BC| = 5$ cm and $|AC| = 6$ cm.

A rough sketch of the triangle is shown.





Draw a line segment [BC], 5 cm in length.

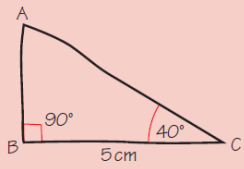


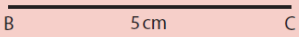
Use a protractor to make an angle of 90° at B.
Draw a vertical line BA.
Set your compass to a radius of 6 cm.
With C as centre, draw an arc cutting the vertical line.
Mark this point A and join AC.
ABC is the required triangle.

Right-angled triangle, given one side and one angle.

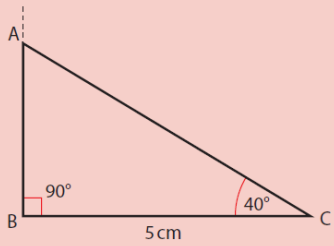
Construct the triangle ABC so that the base [BC] = 5 cm, $|\angle ABC| = 90°$ and $|\angle ACB| = 40°$.

A rough sketch is shown.





Draw a line segment [BC], 5 cm in length.

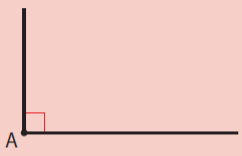


Use a protractor to make an angle of 90° at B.
Draw a vertical line BA.
Now use your protractor to make an angle of 40° at C.
Mark the point A where the arm of the angle meets the vertical line.
ABC is the required triangle.

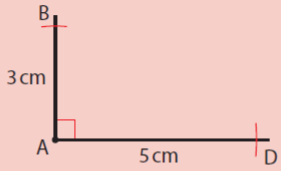
Other example

How to construct a rectangle of given sides.

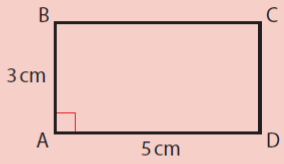
Construct a rectangle of sides 5 cm and 3 cm in length.



Draw a horizontal line and mark a point A on it.
Use a set square or protractor to draw a line perpendicular to given line at A.

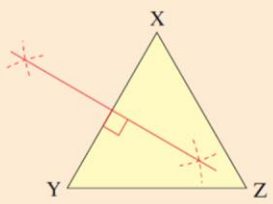


Use a compass to measure 5 cm on the horizontal line and 3 cm on the vertical line.
Mark the points D and B, respectively.

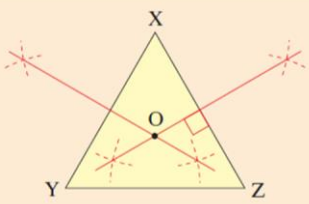


Draw a line through B parallel to AD.
Draw a line through D parallel to AB.
These lines meet at the point C.
ABCD is the required rectangle.

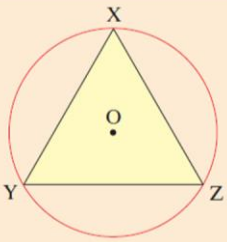
How to construct the circumcircle of a given triangle.



Construct the perpendicular bisector of [XY].



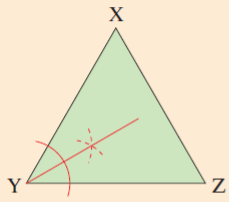
Construct the perpendicular bisector of [XZ]. The two bisectors meet at the point O, as shown.
O is the circumcentre.



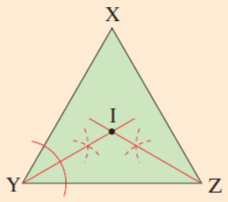
With O as centre and |OX| as radius, draw a circle through X, Y and Z.
This is the circumcircle of the triangle.

How to construct the incircle of a given triangle.

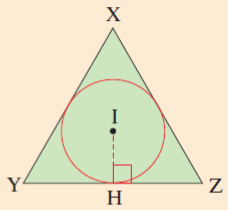
The construction of the incircle of a triangle involves constructing the bisector of an angle which is given on the previous page.



Construct the bisector of ∠XYZ, as shown.

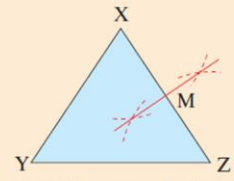


Now construct the bisector of ∠XZY. The two bisectors meet at the point I.
I is the incentre.

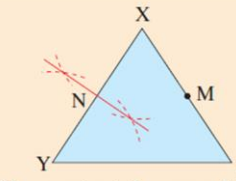


Use a set square to draw a perpendicular from I to the line YZ. The perpendicular meets YZ at H.
With |IH| as radius, draw a circle to touch the three sides.
This is the incircle of the triangle XYZ.

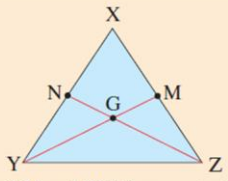
How to construct the centroid of a given triangle.



Construct the perpendicular bisector of [XZ], as shown. M is the midpoint of [XZ].



Now construct the perpendicular bisector of [XY]. N is the midpoint of [XY].

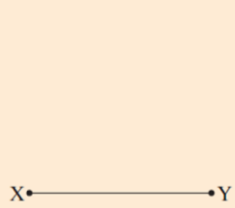


Join YM and ZN. They meet at the point G. G is the centroid of the triangle.

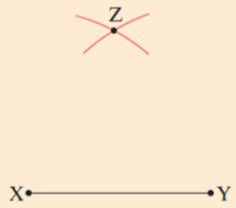
How to construct an angle of 60°.

Each angle in an equilateral triangle is 60°. We will now use this information to draw an angle of 60°.

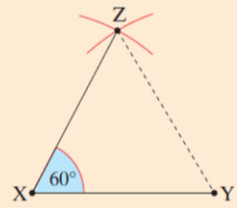
In an equilateral triangle, all the sides are equal in length.



Draw a line segment [XY].



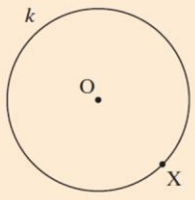
Set the compass to a radius of |XY|.
With X as centre and radius |XY| draw an arc.
Repeat at Y.
The arcs meet at Z.



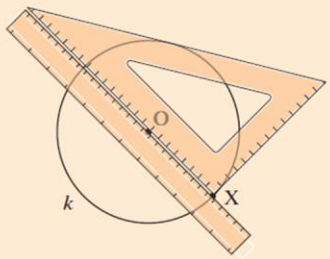
Join XZ.
$|\angle ZXY| = 60°$.

The triangle XYZ is equilateral.

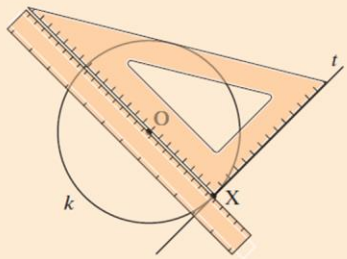
How to construct ta tangent to a circle at a given point.



Given a circle k and a point X on it. O is the centre of the circle.

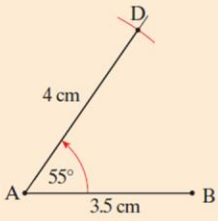


Join X to O, the centre of the circle.
Place a ruler along OX and slide set square along the ruler until it reaches X.

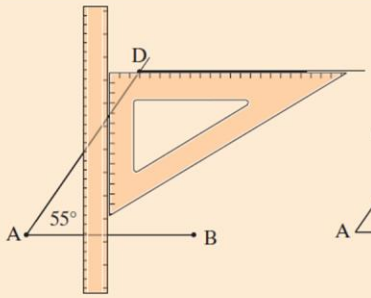


Draw a line *t* through X perpendicular to OX.
t is a tangent to the circle k.

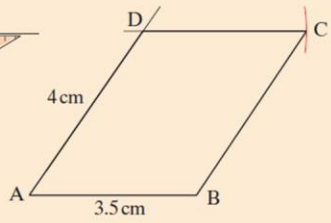
How to construct a parallelogram.



Draw a horizontal line [AB] = 3.5 cm. Use a protractor to measure an angle of 55° at A. Draw a line through A and measure |AD| = 4 cm.



Place set square along the line AB. Use a ruler to slide the set square up to the point D. Draw a line through D parallel to AB.



Use a compass with a radius of 3.5 cm (the same as |AB|) to draw an arc on the line. |DC| = 3.5 cm. Join BC. ABCD is the required parallelogram.