CBSE NCERT Solutions for Class 9 Mathematics Chapter 11

Back of Chapter Questions

Exercise: 11.1

1. Construct an angle of 90^{o} at the initial point of a given ray and justify the construction.

Solution:

Steps of construction:

(i) Draw a ray OA.

(ii) Taking O as center and any radius,

draw an arc cutting OA at B.

(iii) Now, taking B as center and with the same radius as before,

draw an arc intersecting the previously drawn arc at point C.

(iv) With C as center and the same radius,

draw an arc cutting the arc at D

(v) With C and D as centers and radius more than $\frac{1}{2}$ CD,

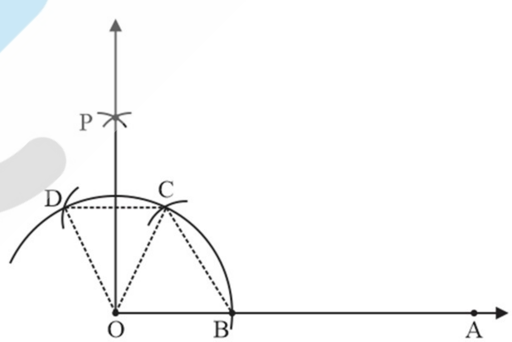
draw two arcs intersecting at P.

(vi) Join OP.

Thus, $\angle AOP = 90^{o}$

Justification

We need to prove $\angle AOP = 90^{o}$



Join OC and BC

Thus,

$OB = BC = OC$ (Radius of equal arcs−By Construction)

$\therefore \Delta OCB$ is an equilateral triangle

$BOC = 60^o$

Join OD, OC and CD

Thus, $OD = OC =\ DC$ (Radius of equal arcs-By Construction)

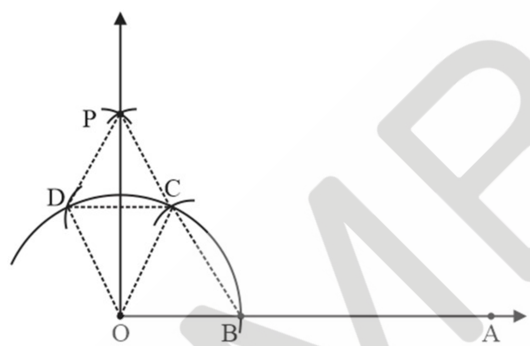
$\therefore \Delta DOC$ is an equilateral triangle

$DOC = 60^o$

Join PD and PC

Now,

In ΔODP and ΔOCP



$OD - OC$ (Radius of some arcs)

$DP = CP$ (Arc of same radii)

$OP = OP$ (Common)

$\therefore \Delta ODP \cong \Delta OCP$ (SSS Congruency)

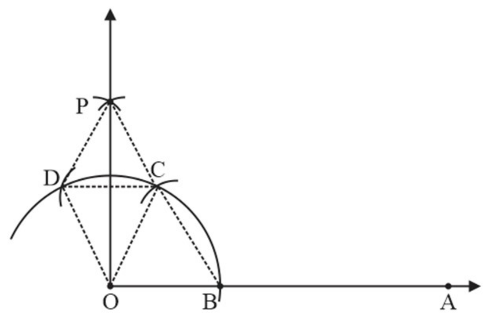
$\therefore \angle DOP = \angle COP$ (CPCT)

So, we can say that

$$\angle DOP = \angle COP = \frac{1}{2}\angle DOC$$

$\angle DOP = \angle COP = \frac{1}{2} \times 60^o = 30^o$ (We proved earlier that $\angle DOC = 60^o$)

Now,



$\angle AOP = \angle BOC + \angle COP$

$\angle AOP = 60^o + 30^o$

$\angle AOP = 90^o$

Hence justified

2. Construct an angle of 45^o at the initial point of a given ray and justify the construction.

Solution:

Steps of construction:

(i) Draw a ray OA.

(ii) Taking O as center and any radius,

draw an arc cutting OA at B.

(iii) Now, taking B as center and with the same radius as before,

draw an arc intersecting the previously drawn arc at point C.

(iv) With C as center and the same radius,

Draw two arcs intersecting at P

(v) With C and D as centers and radius more than $\frac{1}{2}$ CD,

Draw two arcs intersecting at P.

(vi) Join OP

Thus, $\angle AOP = 90^o$

Now we draw bisector of $\angle AOP$

(vii) Let OP intersect the original arc at point Q

(viii) Now, taking B and Q as centers, and the radius greater than $\frac{1}{2}$ BQ,

Draw two arcs intersecting at R.

(ix) Join OR.

Thus, $\angle AOR = 45^o$

Justification

We need to prove $\angle AOR = 45^o$

Join OC & OB

Thus,

$OB = BC = OC$

$\therefore$ ΔOCB is an equilateral triangle

$\therefore \angle BOC = 60^o$

Join OD, OC and CD

Thus, $OD = OC = DC$

$\therefore$ ΔDOC is an equilateral triangle

$\therefore \angle DOC = 60^o$

Join PD and PC

Now,

In ΔODP and ΔOCP

$OD = OC$ (Radius of same arcs)

$DP = CP$ (Arc of same radii)

$OP = OP$ (Common)

$\therefore \Delta ODP \cong \Delta OCP$ (SSS Congruency)

$\therefore \angle DOP = \angle COP$ (CPCT)

So, we can say that

$$\angle DOP = \angle COP = \frac{1}{2}\angle DOC$$

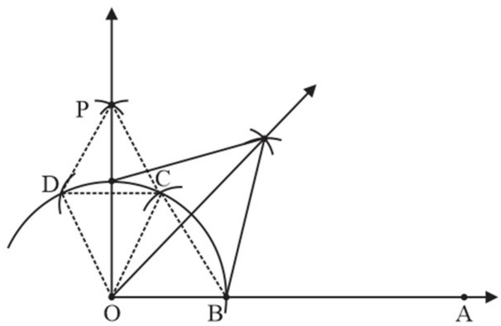
$\angle DOP = \angle COP = \frac{1}{2} \times 60^o = 30^o$ (We proved earlier that $\angle DOC = 60^o$)

Now,

$\angle AOP = \angle BOC + \angle COP$

$\angle AOP = 60^o + 30^o$

$= 90^o$



Now,

Join ΔOQR and ΔOBR

$OQ = OR$ (Radius of same arcs)

$OQ = BR$ (Arc of same radii)

$OQ = OR$ (Common)

$\therefore \Delta OQR \cong \Delta OBR$ (SSS Congruency)

$\therefore \angle OQR = \angle BOR$ (CPCT)

$\angle OQR = \angle BOR = \frac{1}{2}\angle AOP$

$\angle DOP = \angle COP = \frac{1}{2} \times 90^o$

$= 45^o$

Thus, $\angle AOR = 45^o$

Hence justified

3. Construct the angles of the following measurements:

(1) 30^o

(2) $22\frac{1}{2}^o$

(3) 15^o

Solution:

(1) 30^o

First we make 60^o,

And then its bisector

Steps of construction:

(i) Draw a ray OA.

(ii) Taking O as center and any radius,

Draw an arc cutting OA to B.

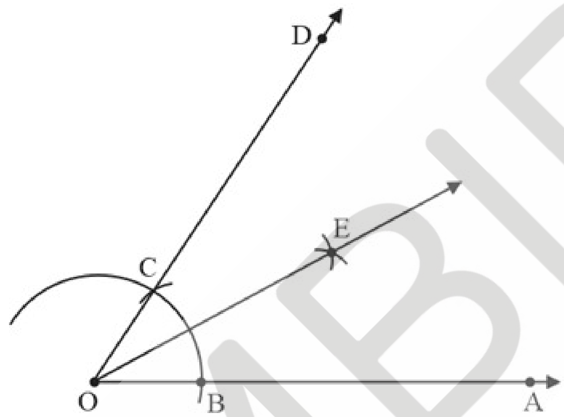
(iii) Now, taking B as center and with the same radius as before,

Draw an arc intersecting the previously drawn arc at point C.

(iv) Draw the ray OD passing trough C

Thus, $\angle AOD = 60^{o}$

Now we draw bisector of $\angle AOD$



(v) Taking C and D as center,

With radius more than $\frac{1}{2}$CD, draw arcs intersecting at E.

(vi) Join OE

Thus $\angle AOE = 30^{o}$

(2) $22\frac{1}{2}^{o}$

$$22\frac{1}{2} = \frac{45}{2}$$

So, we make 45^{o} and then its bisector

Steps of construction:

(i) Draw a ray OA.

(ii) Taking O as center and any radius, draw an arc cutting OA at B.

(iii) Now, taking B as center and with the same before, draw an arc intersecting the previously drawn arc at point C.

(iv) With C as center and the same radius, Draw an arc cutting the arc at D

(v) With C and D as centers and radius more than $\frac{1}{2}$CD,

Draw two arcs intersecting at P.

(vi) Join OP.

Thus, $\angle AOP = 90^o$

(vii) Let OP intersect the original arc at point Q

(viii) Now, taking B and Q as centers, and radius greater than $\frac{1}{2}$BQ

Draw two arcs intersecting at R.

(ix) Join OR.

Thus $\angle AOR = 45^o$

Now we draw bisector of $\angle AOR$

(x) Mark point S where ray OR intersects the arc

(xi) Now, taking B and S as centers, and radius greater than $\frac{1}{2}$BS,

Draw two arcs intersecting at T.

(xii) Join OT.

Thus, $\angle AOT = 22\frac{1}{2}^o$

(3) 15^o

First we make 30^o,

And then its bisector

Steps of construction:

(i) Draw a ray OA.

(ii) Taking O as center and any radius,

Draw an arc cutting OA and B.

(iii) Now, taking B as center and with the same radius as before,

Draw an arc intersecting the previously drawn arc at point C.

(iv) Draw the ray OD passing through C

Thus, $\angle AOD = 60^o$

Now we draw bisector of $\angle AOD$

(v) Taking C and D as center,

With radius more than $\frac{1}{2}$CD draw arcs intersecting at E.

(vi) Join OE

Thus $\angle AOE = 30^o$

Now we know draw bisector of $\angle AOD$

(vii) Taking P and B as center,

With radius more than $\frac{1}{2}$PB, draw arcs intersecting at F.

(viii) Taking P and B as center,

With radius more than $\frac{1}{2}$PB, draw arcs intersecting at F.

(ix) Join OF

Thus,$\angle AOF = 15^o$

4. Construct the following angles and verify by measuring them by a protractor:

(1) 75^o

(2) 105^o

(3) 135^o

Solution:

(1) 75^o

$75^o = 60^o + 15^o$

$75^o = 60^o + \frac{30^o}{2}$

So, to we make 75^o, we make 60^o and then bisector of 30^o

Step of construction

(i) Draw a ray OA.

(ii) Taking O as center and any radius, draw an arc cutting OA at B.

(iii) Now, with B as center, and same radius as before,

Draw another arc intersecting the previously drawn arc at point C.

(iv) Now, with C as center, and same radius,

Draw another arc intersecting the previously drawn arc at point D

(v) Draw ray OE passing through C and ray OF passing through D

Thus, $\angle AOE = 60^o$

And $\angle EOF = 60^o$

Now we bisect $\angle EOF$ twice

$60^o \to 30^o \to 15^o$

(vi) Taking C and D as center, with radius more than $\frac{1}{2}$ CD,

draw arcs intersecting at P.

(vii) Join OP

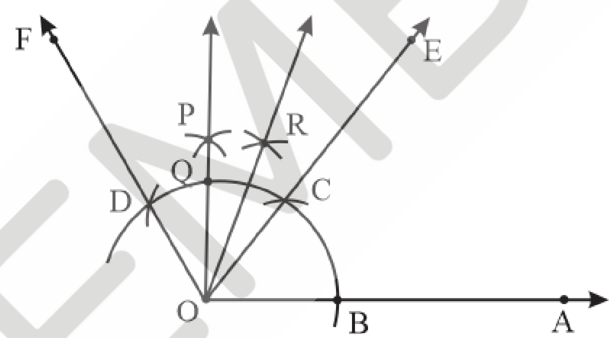
(viii) Thus $\angle EOP = 30^o$

Now we bisect $\angle EOP$ i.e.$\frac{30^o}{2} = 15^o$

(vii) Mark point Q where OP intersects the arc

(viii) Taking Q and as center, with radius more than $\frac{1}{2}$ QC,

Draw arcs intersecting at R.



Thus, $\angle AOR = 75^o$

On measuring the $\angle AOR$ by protractor, we can find that find that$\angle AOR = 75^o$

Thus, the construction is verified

(2) 105^o

$105^o = 90^o + 15^o$

$$105^o = 90^o + \frac{30^o}{2}$$

So, to make 105^o, we make 90^o and then bisector of 30^o

Steps of constructions

(i) Draw a ray OA.

(ii) Taking O as center and any radius, drawn an arc cutting OA to B.

(iii) Now with B as center and same radius as before,

Draw an arc intersecting the previously drawn arc at point D

(iv) Draw ray OE passing through C

And ray OF passing through D

Thus, $\angle AOE = 60^o$

And $\angle EOF = 60^o$

Now we bisects $\angle EOF$ twice

$60^o \rightarrow 30^o \rightarrow 15^o$

(v) Taking C and D as center, with radius more than $\frac{1}{2}$CD,

Draw arcs intersecting at P.

(vi) Join OP

Thus,$\angle AOP = 90^o$

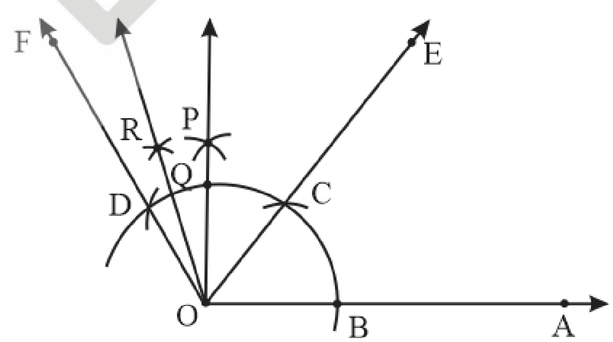
And $\angle POD = 30^o$

Now, we bisects $\angle POD$ i.e. $\frac{30^o}{2} = 15^o$

(vii) Mark point Q where OP intersects the arc

(viii) Taking Q and C as center, with radius more than $\frac{1}{2}$QC, draw arcs intersecting at R.

(ix) Join OR



Thus $\angle AOR = 105^o$

On measuring the $\angle AOR$ by protractor, we find that $\angle AOR = 105^o$

Thus, the construction is verified

(3) 135^o

$135^o = 90^o + 45^o$

So, make 135^o, we make 90^o and then 45^o

Step of construction

(i) Draw a line OAA'

(ii) Taking O as center and any radius draw an arc cutting OA at B.

(iii) Now, with B as center and same radius as before,

Draw an arc intersecting the previously drawn arc at point C.

(vi) With C as center and then same radius,

Draw an arc cutting the arc at D.

(v) With C and D as centers and radius more than $\frac{1}{2}CD$, draw two arcs intersecting at P.

Draw two arcs intersecting at P.

Thus, $\angle AOP = 90^o$

Also, $\angle A'OP = 90^o$

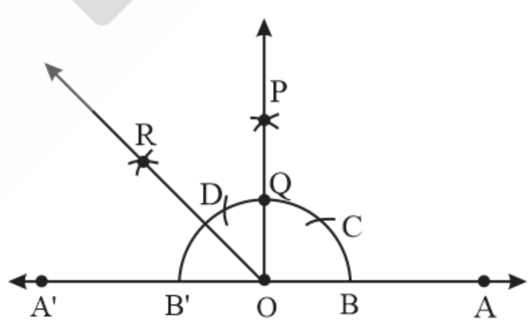
So, we bisect $\angle A'OP$

(vi) Mark point Q where OP intersects the arc

(vii) With B′ and Q as centers and radius more than $\frac{1}{2}B'Q$,

Draw two arcs intersecting at R.

(viii) Join OR.



$\therefore \angle POR = 45^o$

Thus,

$\angle AOR = \angle AOP + \angle POR$

$= 90^o + 35^o$

$= 135^o$

$\therefore \angle AOR = 135^o$

5. Construct an equilateral triangle, given its side and justify the construction.

Solution:

Pt us construct an equilateral triangle, each of whose side = 3 cm (say).

Steps of construction:

Step I:

Draw $\overline{OA}$.

Step II:

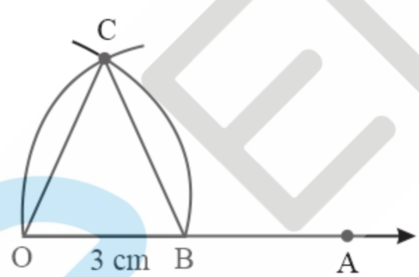
Taking O as centre and radius equal to 3 cm, draw an arc to cut $\overline{OA}$ at B such that $OB = 3$ cm

Step III:

Taking B as centre and radius equal to OB, draw an arc to intersect the previous arc at C.

Step IV:

Join OC and BC.



Thus ΔOBC is the required equilateral triangle.

Justification

$\because$ The arcs OC and BC are drawn with the same radius

$\because OC = BC$

$\Rightarrow OC = BC$ [Chords corresponding to equal to arcs are equal]

$\because OC = OB = BC$

$\therefore$ OBC is an equilateral triangle.

Exercise: 11.2

1. Construct a triangle ABC in which BC = 7cm, $\angle B = 75^o$ and AB + AC = 13 cm

Solution:

Steps of constructions:

(i) Draw base BC of length 7 cm

(ii) Now, let's draw $B = 75^o$

Let the ray be BX

(iii) Open the compass to length AB + AC = 13 cm.

From point B as center, cut an arc on ray BX.

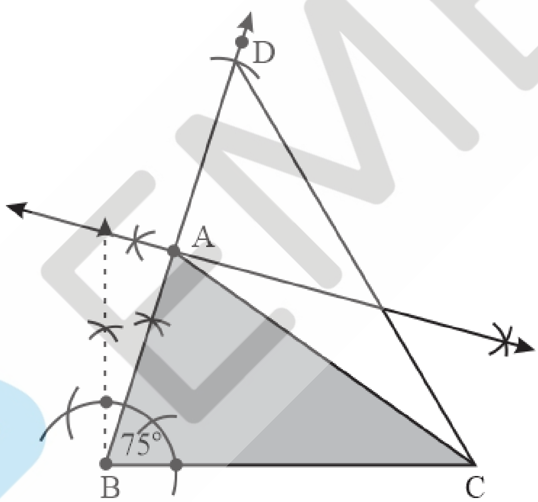
Let the arc intersect BX at D

(iv) Join CD

(v) Now, we will draw perpendicular bisector of CD

(vi) Mark point A where perpendicular bisector intersects BD

(vii) Join AC



$\therefore$ ΔABC is the required triangle

2. Construct a triangle ABC in which BC = 8 cm, $\angle B = 45^o$ and AB − AC = 3.5 cm.

Solution:

Steps of construction:

(i) Draw base BC of length 8 cm

(ii) Now let's draw $\angle B = 45^o$

Let the ray be BX

(iii) Open the compass to length $AB - AC = 3.5$ cm

Note:

Since $AB - AC = 3.5$ cm is positive So, BD will be above line BC

From point B as center, cut an arc on ray BX.

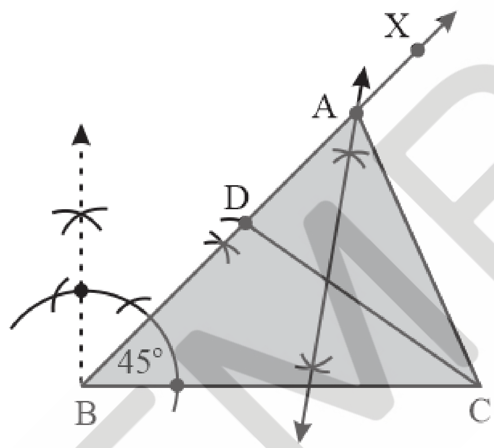
Let the arc intersect BX at D

(iv) Join CD

(v) Now, we will draw perpendicular bisector of CD

(vi) Mark point A where perpendicular bisector intersects BD

(vii) Join AC



$\therefore$ ΔABC is the required triangle

3. Construct a triangle PQR in which $QR = 6$ cm, $\angle Q = 60^o$ and $PR - PQ = 2$ cm.

Solution:

Steps of construction:

(i) Draw base QR of length 6 cm

(ii) Now, let's draw $\angle Q = 60^o$

Let the ray ne QX

(iii) Open the compass to length $PR - PQ = 2$ cm.

Note:

Since $PR - PQ = 2$ cm,

$(PQ - PR)$ is negative

So, QD will be below line QR

From point Q as center, cut an arc on ray QX. (opposite side of QR).

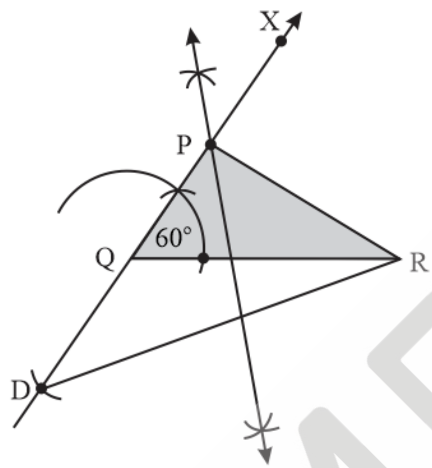
Let the arc intersect QX at D

(vi) Join RD

(v) Now, we will draw perpendicular bisector of RD

(vii) Mark Point P where perpendicular bisector intersects RD

(viii) Join PR



$\therefore$ ΔPQR is the required triangle

4. Construct a triangle XYZ in which $\angle Y = 30^o, \angle Z = 90^o$ and $XY + YZ + ZX = 11$ cm.

Solution:

Given $\angle Y = 30^o, \angle 90^o$ and $XY + YZ + ZX = 11$ cm.

Let's construct ΔXYZ

Steps of construction:

(i) Draw a line segment AB equal to $XY + YZ + ZX = 11$ cm

(ii) Make angle equal to $\angle Y = 30^o$ from the point A

Let the angle be $\angle LAB$.

(iii) Make angle equal to $\angle Z = 90^o$ from the B

Let the angle be $\angle MBA$

(vi) Bisect $\angle LAB$ and $\angle MBA$.

Let these bisector intersect at a point X.

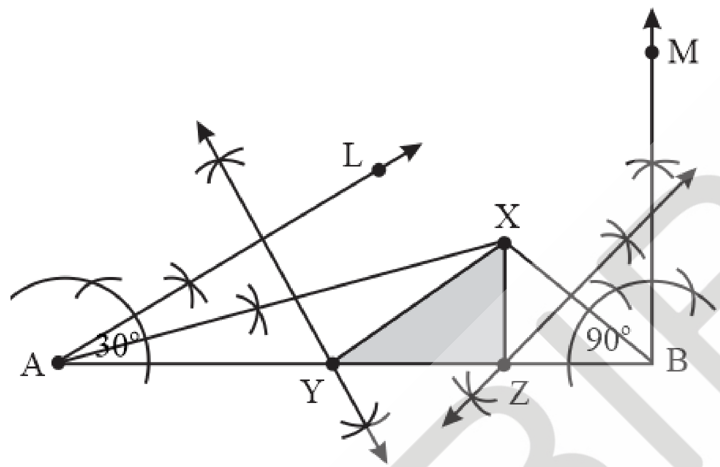
(v) Make perpendicular bisector of XA

Let it intersect AB at point Y

(vi) Make perpendicular bisector of XB

Let it intersect AB at the point Z

(vii) Join XY & YZ



∴ ΔXYZ is the required triangle

5. Construct a right triangle whose base is 12 cm and sum of its hypotenuse and other side is 18 cm.

Solution:

Let ΔABC be the right angle triangle

Where $BC = 12$ cm

$\angle B = 90^o$ and

$AC + AB = 18$ cm

Steps of construction:

(i) Draw base BC of length 12 cm

(ii) Now, let's draw $\angle B = 90^o$

Let the ray be BX

(iii) Open the compass to length $AB + AC = 18$ cm.

From point B as center, cut an arc on ray BX

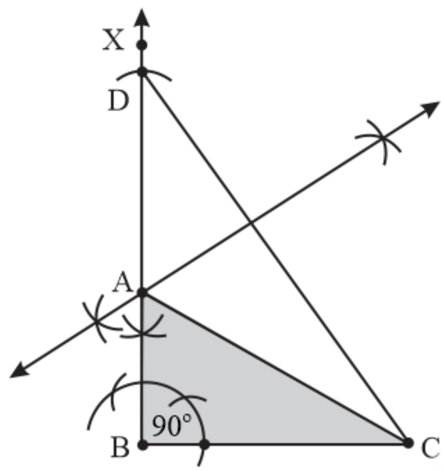
Let the arc intersects BX at D

(iv) Join CD

(v) Now we will draw perpendicular bisector of CD

(vi) Mark point A where perpendicular bisector intersects BD

(vii) Join AC



∴ ΔABC is the required triangle