Grade 11 - Mathematics

23. Constructions

Content *-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)*

Prepared by *-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)*

R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

By learning this lesson, you will be able to…

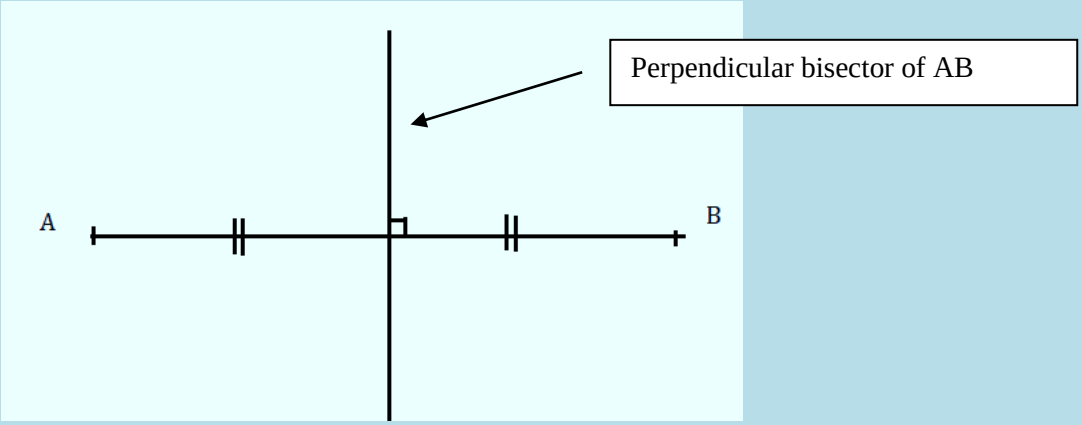
- Construct a perpendicular bisector to a straight line, an angle bisector, a perpendicular through a given point on the line, a perpendicular from an external point to a given straight line using a ruler and a pair of compasses,
- Construct the circumscribed circle,
- Identify the point where the circumcentre lies in a right angled triangle,
- Identify the point where the circumcentre lies in an acute angled triangle,
- Identify the point where the circumcentre lies in an obtuse angled triangle,
- Construct the inscribed circle,
- Construct the escribed circle,
- Construct a tangent to a circle through a point on the circle,
- Construct a tangent to a circle from an external point,
- Verify the characteristics of the tangent theorems using above constructions.

Content ***-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)***

Prepared by ***-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)***
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

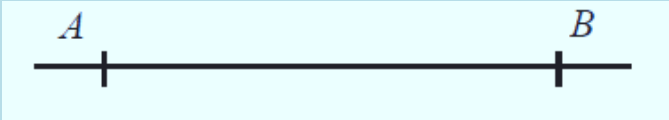
(1) The perpendicular bisector of a straight line segment.

❖ The perpendicular bisector of a straight line segment is the line drawn perpendicular to the straight line segment through its mid-point.

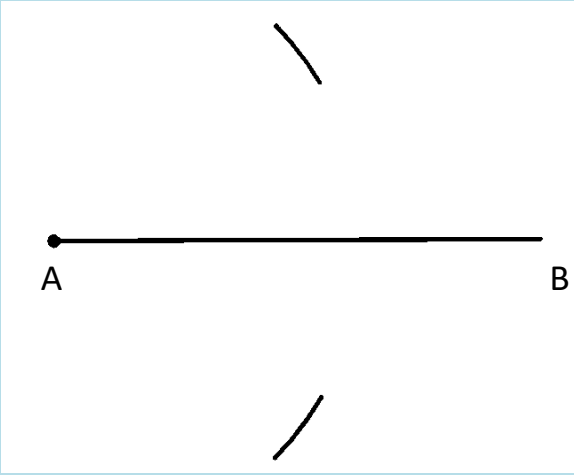


Constructing the perpendicular bisector of a straight line segment.

Step 1: Draw a straight line segment and name it as AB.



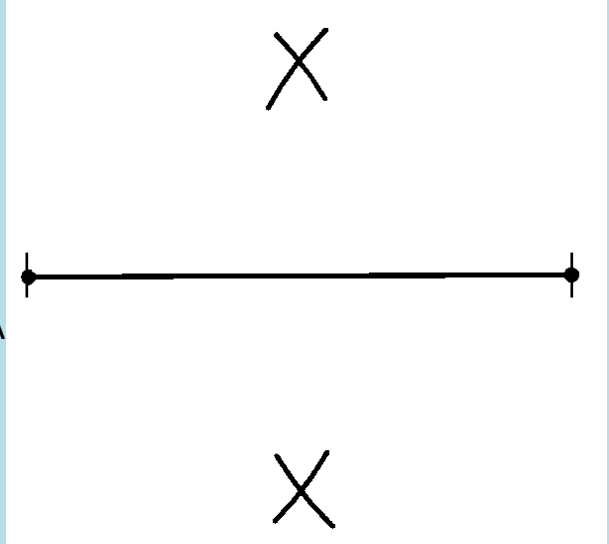
Step 2: Take a length a little more than half the length of AB onto the pair of compasses. Taking A as the centre, draw two arcs above and below the straight line segment.



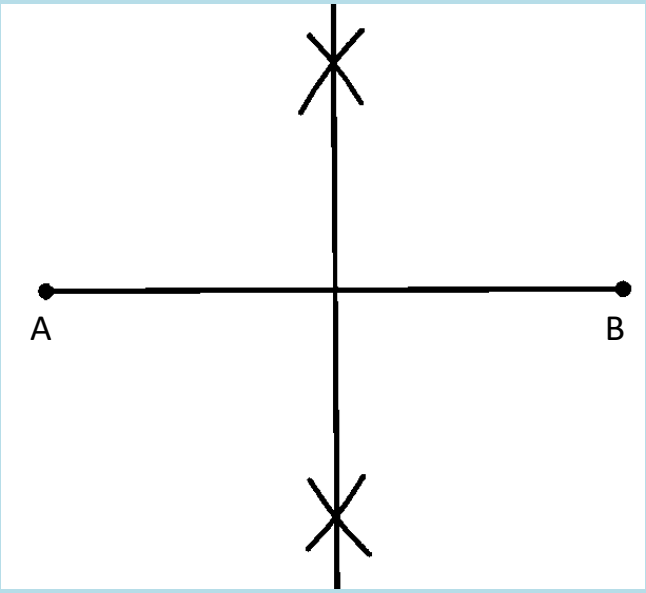
Content *-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)*

Prepared by *-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)*
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Step 3: Using the same length (i.e., without altering the pair of compasses) and taking B as the centre, draw another two arcs such that they intersect the two arcs drawn earlier.



Step 4: Draw a straight line using a ruler by joining the intersection points of the arcs. That line is the perpendicular bisector of the AB line.



Content ***-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)***

Prepared by ***-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)***
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

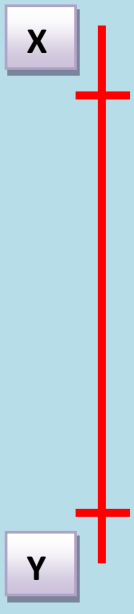
Exercise 01

Construct the perpendicular bisector of each of the following straight line segment.

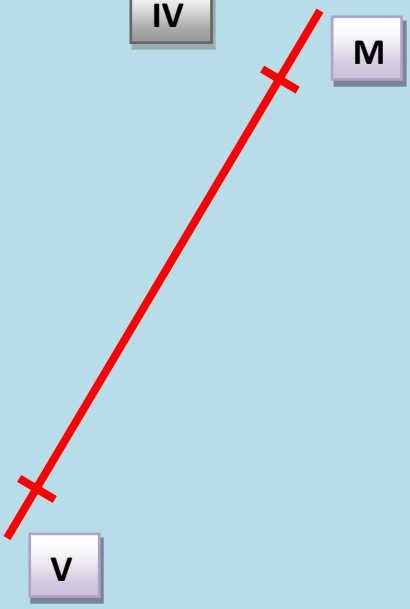
I

II

III



IV

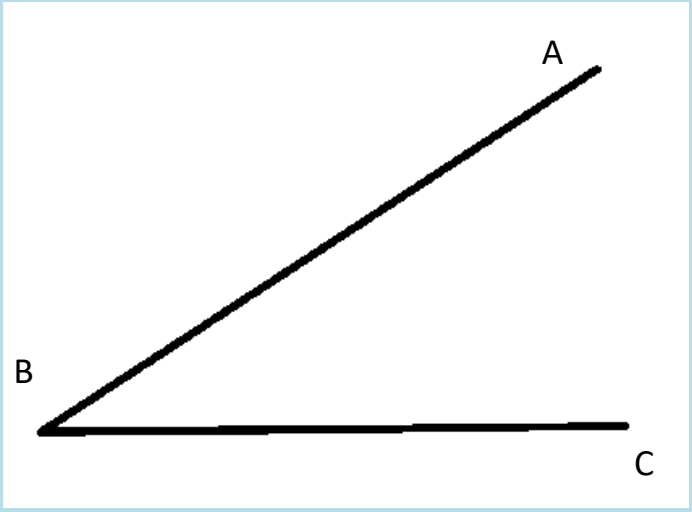


Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

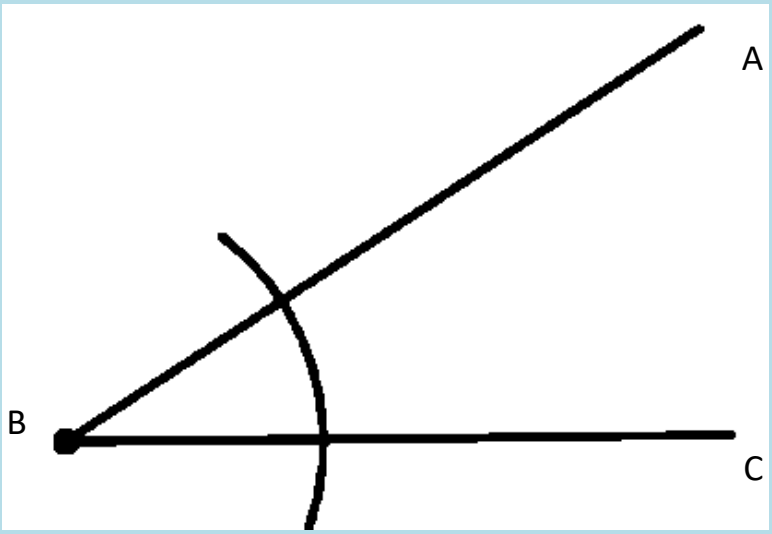
Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(02) Constructing the angle bisector of an angle

Step 1: Draw an angle and name it as $A\hat{B}C$



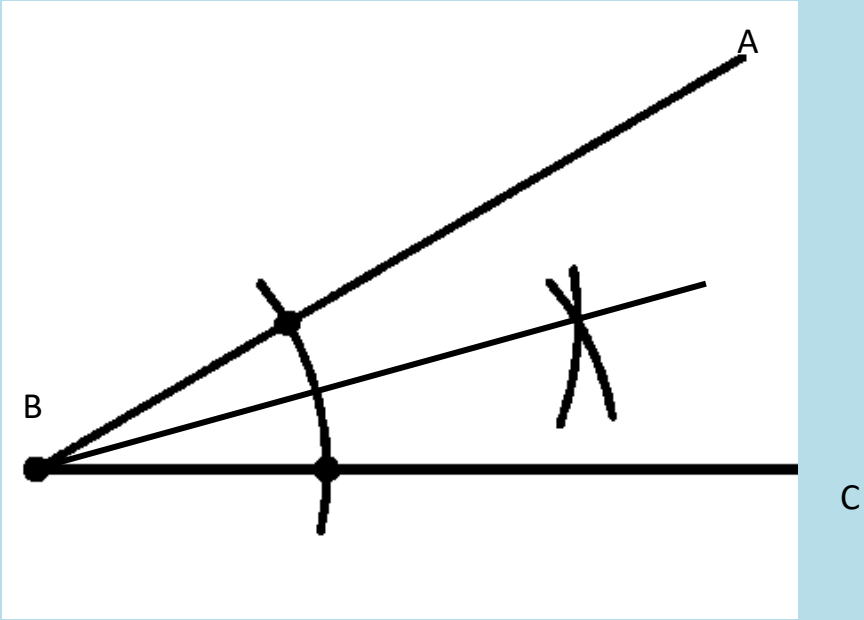
Step 2: Take a length which is less than BA and BC onto the pair of compasses. Taking B as the centre, draw an arc such that it intersects both BA and BC.



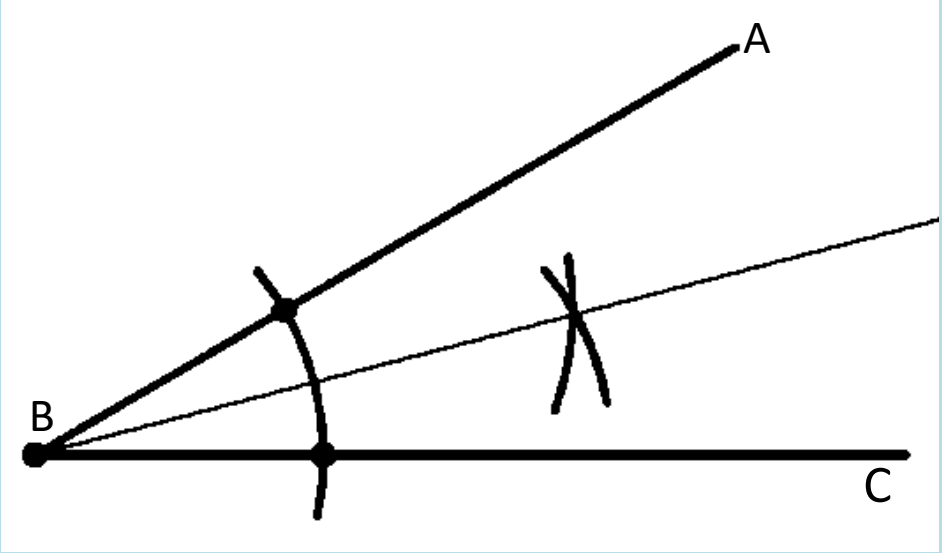
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Step 3: By taking the two intersection points of BC and BA by the arc, as the centres, draw two arcs with same radius which intersect.



Step 4: Join the centre B and the intersection point of the previously drawn two arcs. That is the angle bisector of $A\hat{B}C$



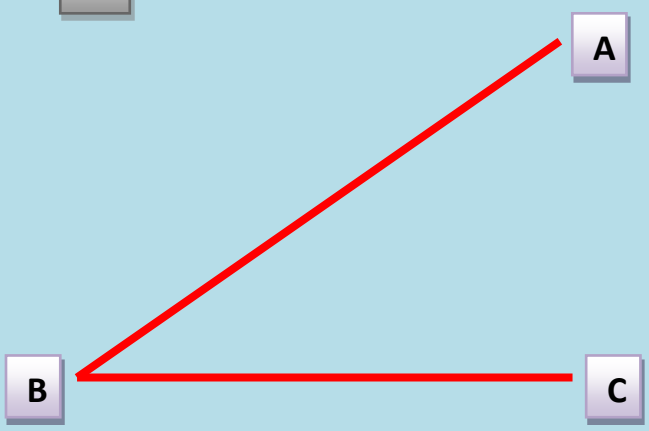
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

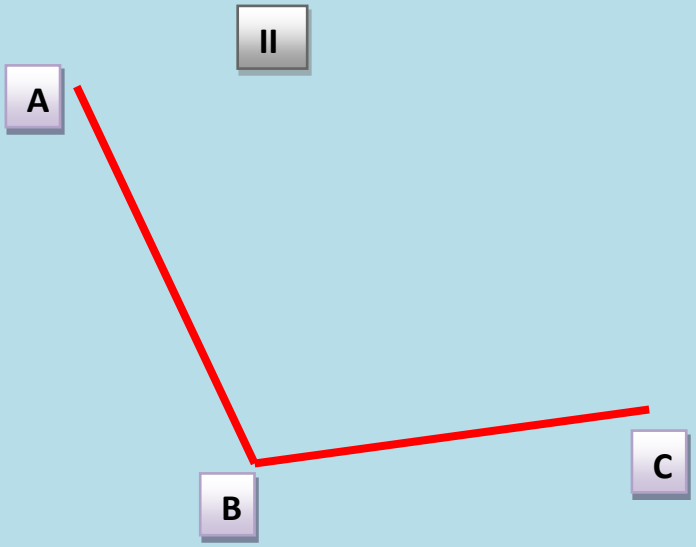
Exercise 02

Construct the angle bisector of each of the given angles below.

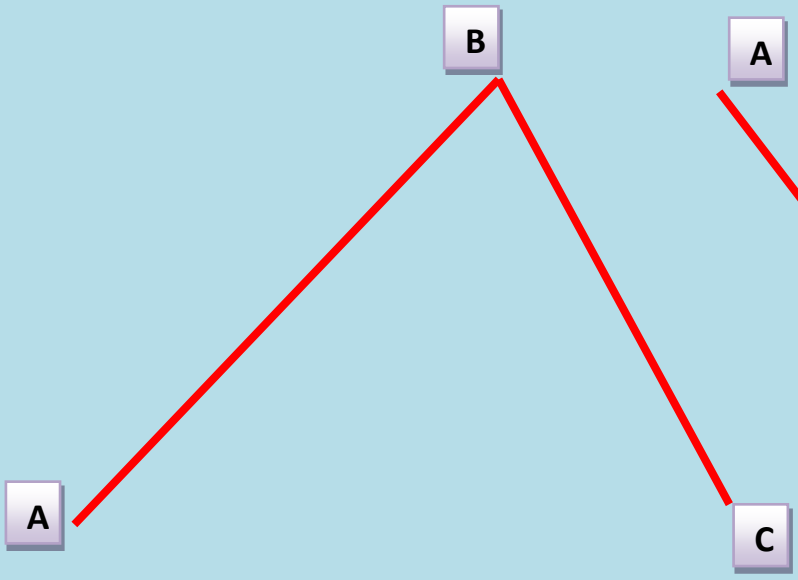
I



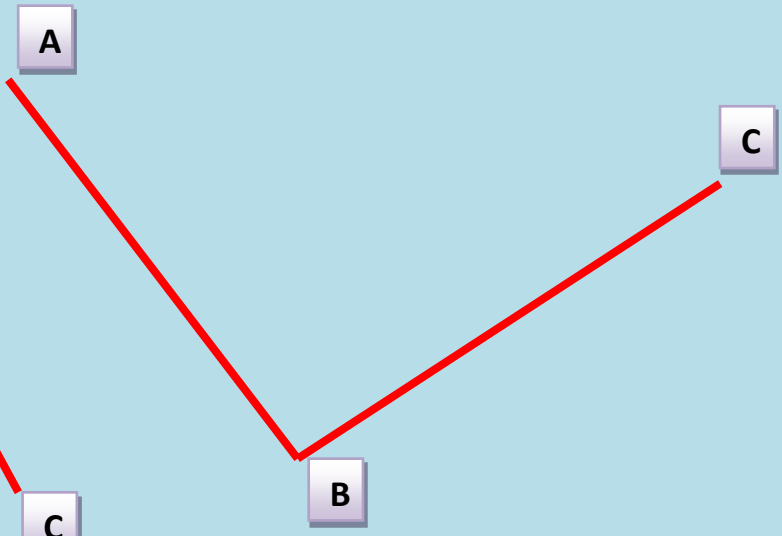
II



III



IV



Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

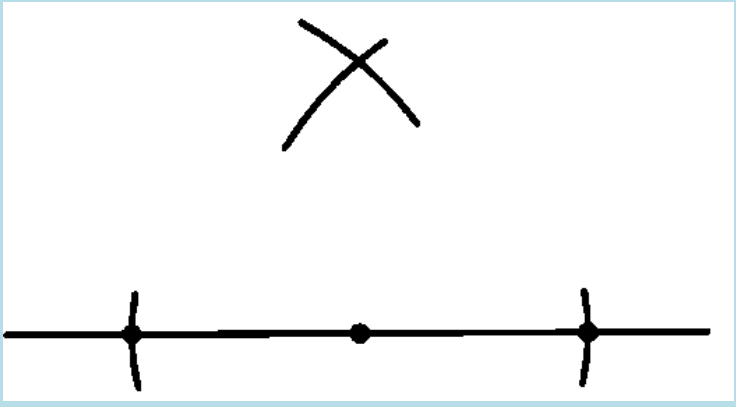
Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(03) Constructing a perpendicular to a straight line through a point on the line.

Step 1: Draw a straight line segment and mark a point P on the line.

Step 2: Take a suitable length onto the pair of compasses and taking P as the centre, draw two arcs that intersect the straight line on either side of P.

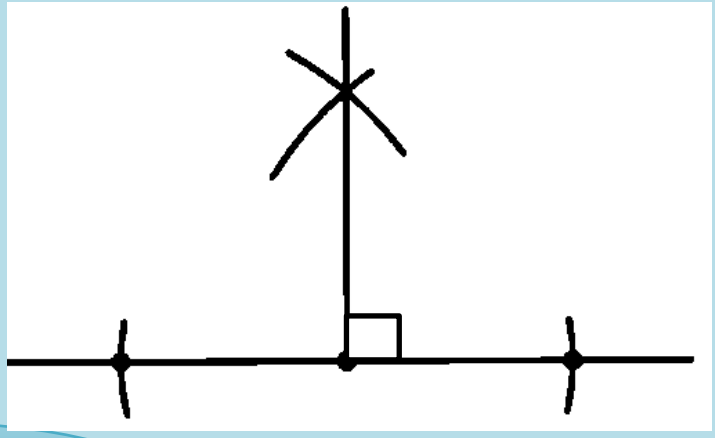
Step 3: By taking the two intersection points of the straight line by arcs as centres, draw two arcs with the same radius which intersect on one side of the straight line.



Content *-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)*

Prepared by *-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)*
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

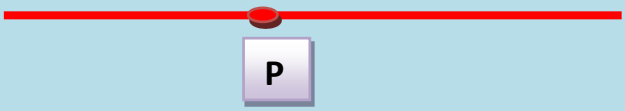
Step 4: Join the intersection points of the two arcs and point P. That line is perpendicular to the given straight line.



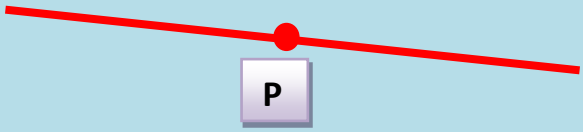
Exercise 04

Construct perpendiculars to the given lines through the point P.

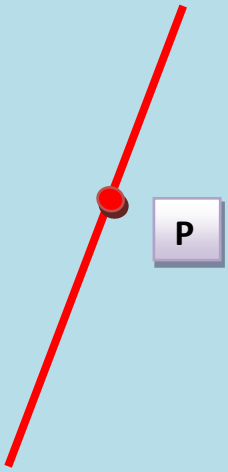
I



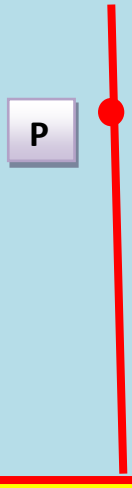
II



III



IV

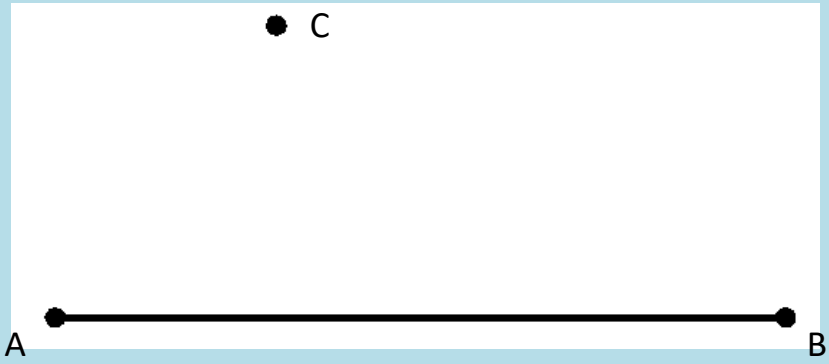


Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

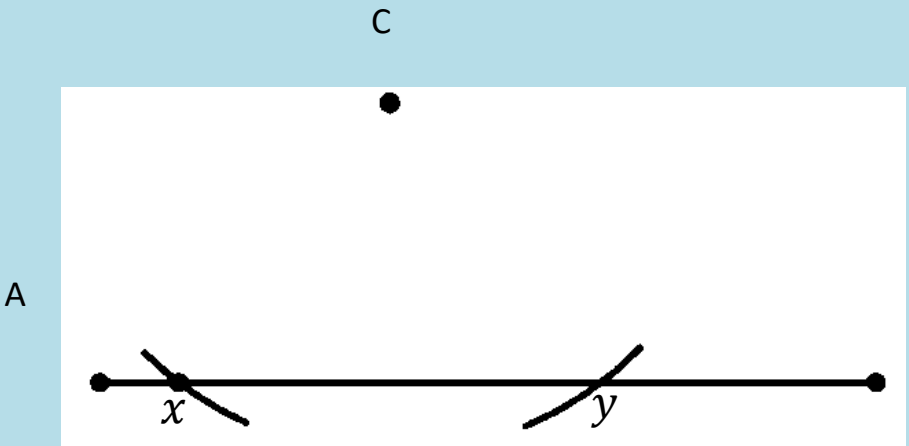
Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(04).Constructing a perpendicular to a straight line from an external point.

Step 1: Draw a straight line segment AB and mark an external point C.



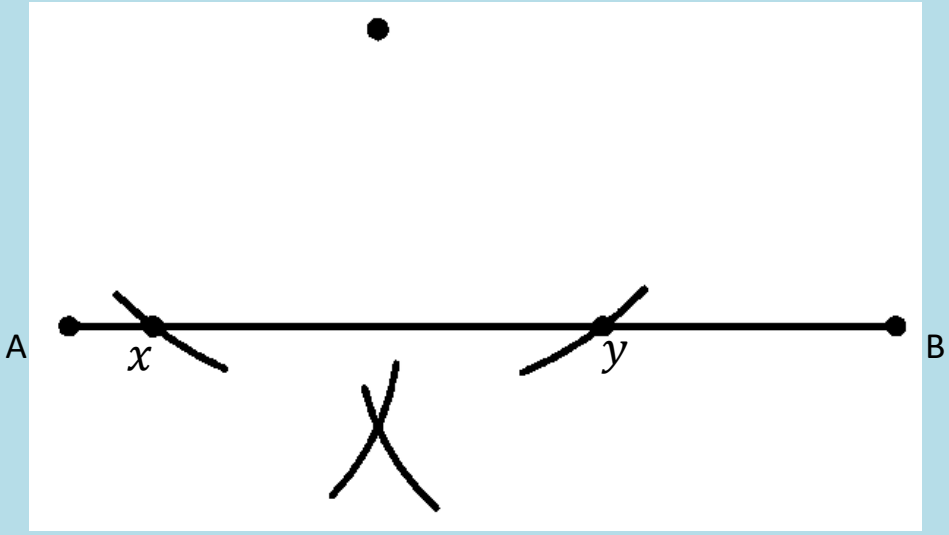
Step 2: Take a length which is a little more than the distance from C to AB onto the pair of compasses. Taking C as the centre, draw two arcs which intersect AB. Name the two intersection points as X and Y.



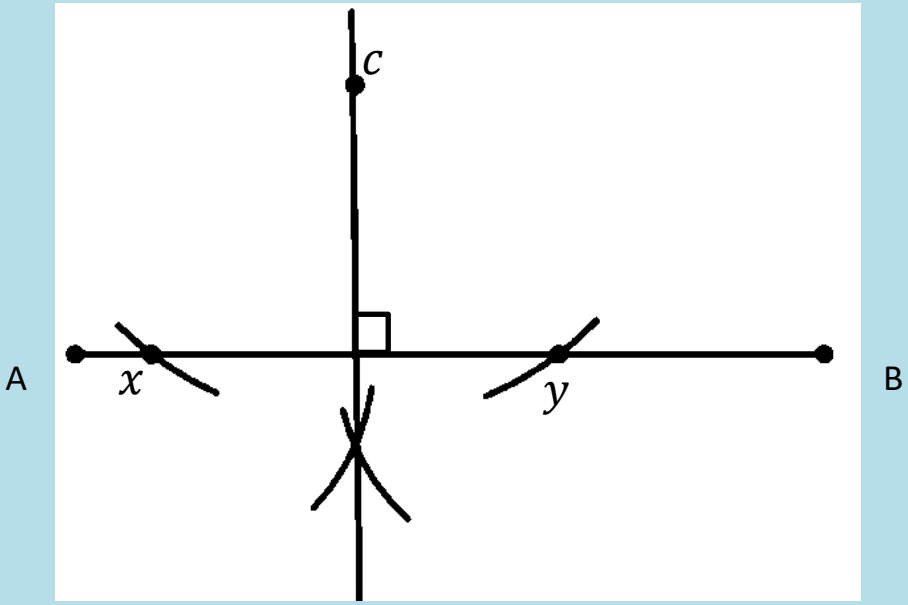
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Step 3: Taking the same radius, draw two intersecting arcs taking X and Y as the centres, on the side of AB opposite to that on which C lies.



Step 4: Join the intersection point of the two arcs and point C.



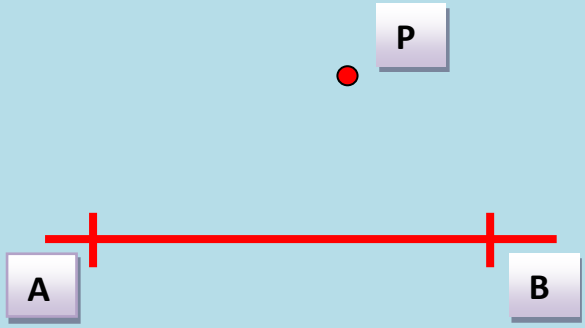
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

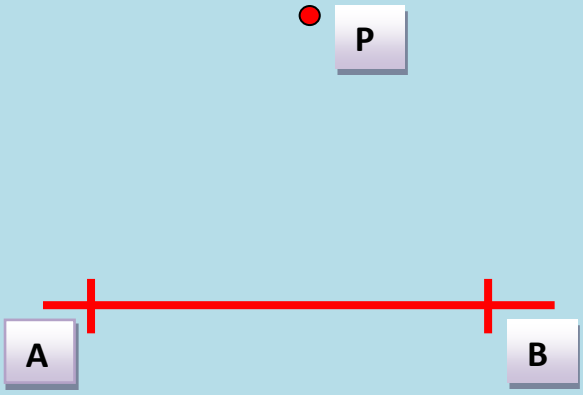
Exercise 04

Construct perpendiculars to the given straight lines through the given external points.

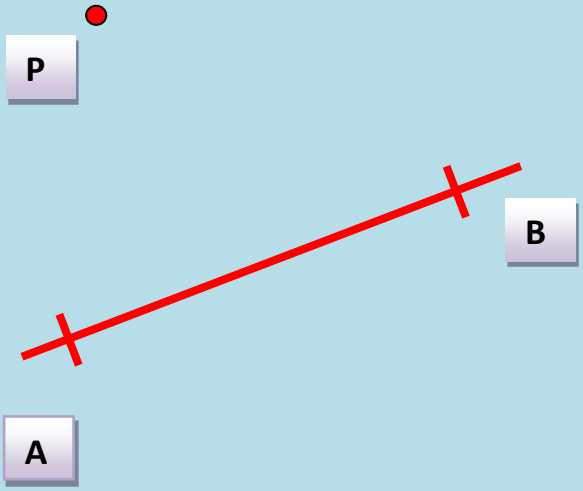
I



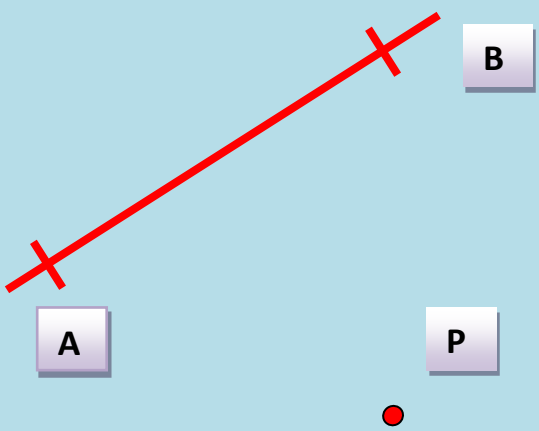
II



III



IV



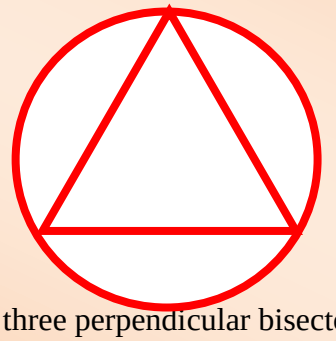
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(05).Constructing the circumscribed circle of a triangle.

Introduction.

- The circle which goes through the three vertices of a triangle is known as the circumcircle.

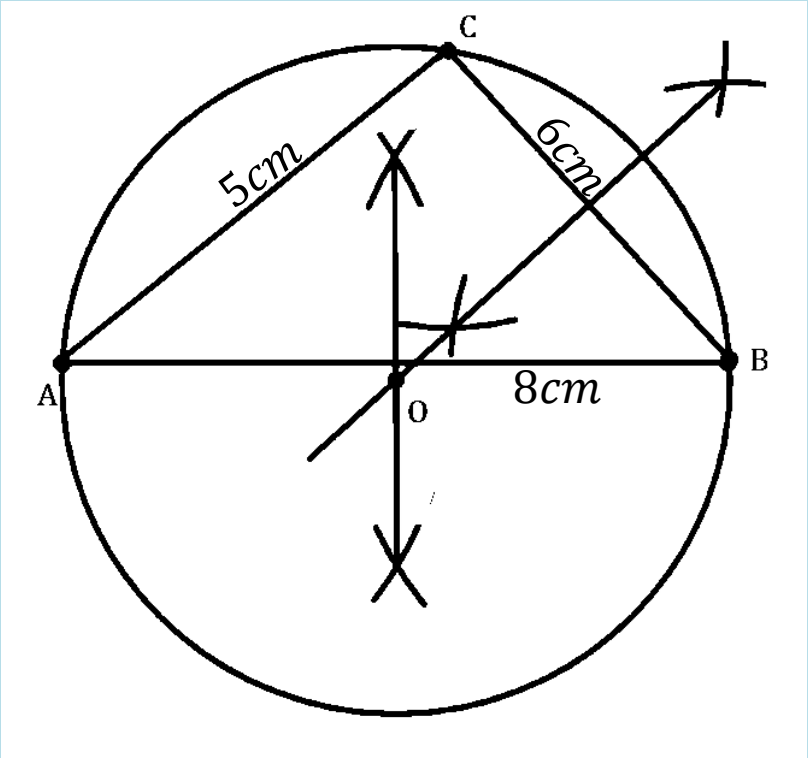


- The point where the three perpendicular bisectors of the sides of the triangle meet, is the centre of the circumcircle. (circumcenter)
- The length from the circumcenter to any vertex of the triangle is the radius of the circumcrcle.

Question 01

Construct the circumcircle of the triangle ABC where AB=8 cm, BC= 6 cm and AC=5 cm.

Answer



Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

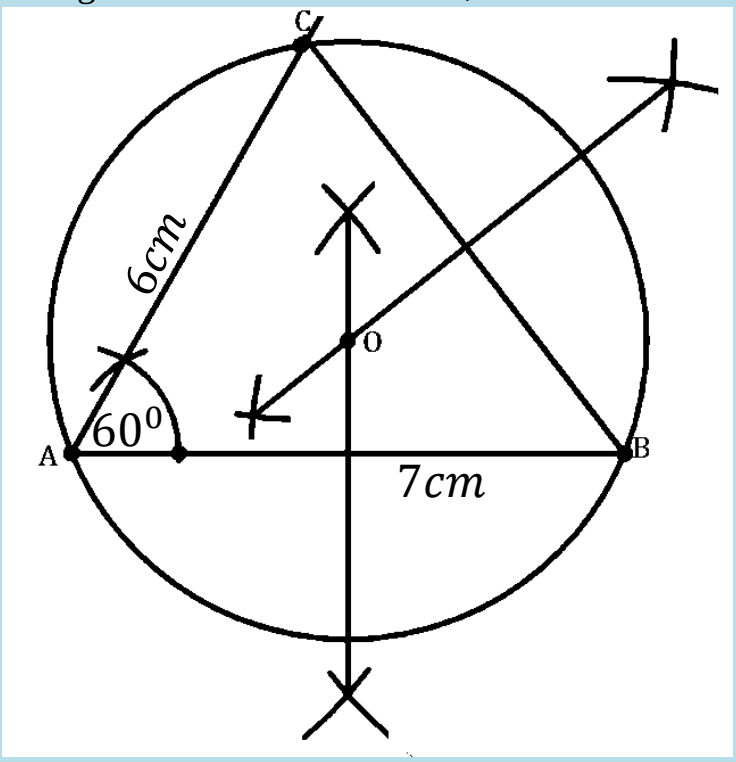
Steps of the construction

1. Constructing ABC triangle.
2. Constructing the perpendicular bisector of AB side.
3. Constructing the perpendicular bisector of BC side.
4. Constructing the circle by taking the intersection point of perpendicular bisectors as the centre and the length to any vertex as the radius.

Question 02

Construct the circumcircle of the triangle ABC where AB=7 cm, AC=6 cm and $B\hat{A}C = 60^0$

Answer



Steps of the construction

1. Constructing the side AB.
2. Constructing angle $B\hat{A}C$.
3. Constructing side AC.
4. Joining B and C.
5. Constructing the perpendicular bisector of the side AB.
6. Constructing the perpendicular bisector of the side BC.
7. Constructing the circle by taking the intersection point of perpendicular bisectors as the centre and the length to any vertex as the radius.

Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Exercise 05

01)(i) Construct the PQ line segment such that PQ=7cm.

(ii) Construct a perpendicular to PQ line at P.

(iii) Mark the point R on the above constructed perpendicular such that PR=5cm.

(iv) Complete the PQR triangle.

(v) Construct the perpendicular bisector of PQ side.

(vi) Construct the perpendicular bisector of PR side.

(vii) Mark the intersection point of the above drawn perpendicular bisectors as O.

(viii) Construct a circle by taking O as the centre and OP as the radius.

(ix) Does the constructed circle go through P, Q and R? If not, start the construction again.

02)(i) Construct the AB line segment such that AB=7cm.

(ii) Construct an angle of 60^0 taking B as the vertex and BA as the arm.

(iii) Construct an angle of 60^0 taking A as the vertex and AB as the arm and bisect it.

(iv) Construct the ABC triangle such that $A\hat{B}C = 60^0$ and $B\hat{A}C = 30^0$

(v) Construct the circumcircle of ABC triangle.

03)(i) Construct the XYZ triangle such that XY=6cm, $X\hat{Y}Z$=120^0 and YZ=5cm.

(ii) Construct the circumcircle of XYZ triangle.

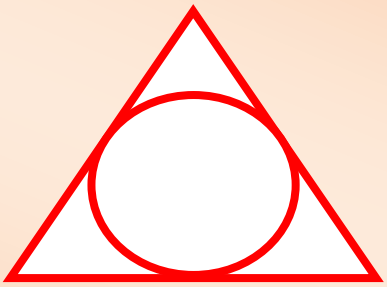
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(06).Constructing the inscribed circle of a triangle

Introduction

- The circle which touches the three sides of a triangle internally, is known as the incircle .

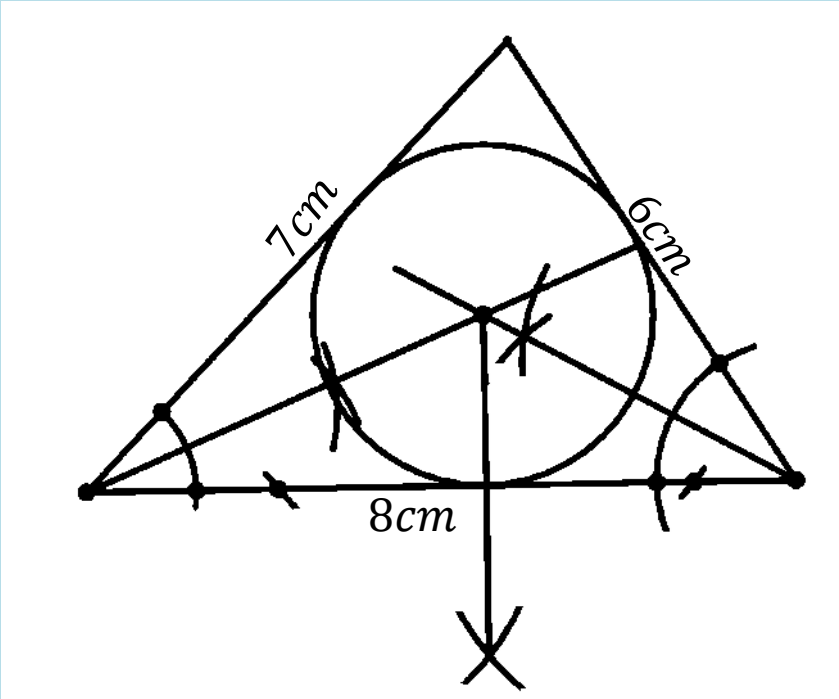


- The point where the angle bisectors of the internal angles of the triangle meet, is the centre of the incircle. (incentre)
- The perpendicular length from the incentre to any side of the triangle is the radius of the incircle.

Question 01

Construct the incircle of the triangle ABC where AB=8cm, AC=7cm and BC=6cm.

Answer



Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Steps of the construction

1. Constructing the ABC triangle.
2. Constructing the angle bisector of $B\hat{A}C$
3. Constructing the angle bisector of $A\hat{B}C$
4. Constructing a perpendicular to side AB from the intersection point of the two angle bisectors.
5. Constructing the incircle by taking the intersection point of the two angle bisectors as the centre and the length of the perpendicular from that intersection point to the side AB as the radius.

Exercise 06

01) (i) Construct the ABC triangle such that AB=8cm, $B\hat{A}C$=90^0 and AC=5cm.
(ii) Construct the angle bisector of $A\hat{B}C$
(iii) Construct the angle bisector of $B\hat{A}C$
(iv) Mark the intersection point of the two angle bisectors as O.
(v) Construct a perpendicular to AB from O and mark the point that it meets AB as P.
(vi) Construct the incircle by taking O as the centre and OP as the radius.

02) (i) Construct the XYZ triangle such that XY=7.5cm, $X\hat{Y}Z$=60^0 and $Y\hat{X}Z$=60^0
(ii) Construct the incircle of the XYZ triangle.

03) Construct the PQR triangle such that PQ=5cm, $P\hat{Q}R$=90^0 and QR=4cm and construct the incircle.

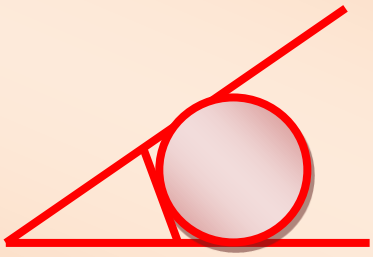
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(07).Constructing the excircle of a triangle.

Introduction

- The circle which touches the three sides of a triangle externally, is known as the excircle.

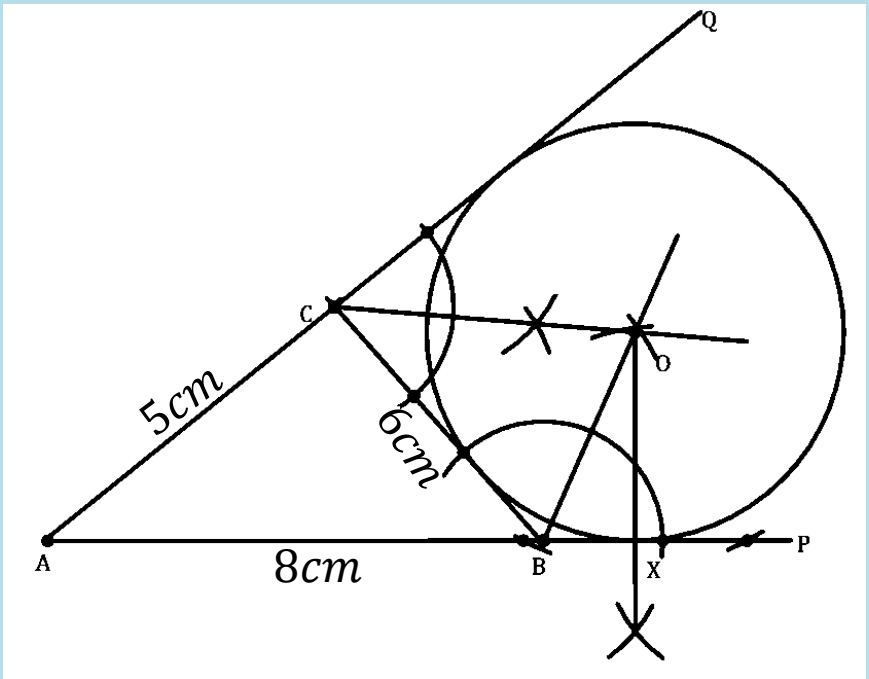


- The point where the angle bisectors of two external angles of the triangle meet, is the centre of the excircle. (excentre)
- The perpendicular length from the excentre to a side of the triangle is the radius of the excircle.
- Three excircles can be constructed to one triangle.

Question 01

Construct the excircle of the triangle ABC which touches the side BC and the extended sides AB and AC by taking AB=8cm, BC=6cm and AC=5cm.

Answer



Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Steps of the construction

1. Constructing the triangle ABC.
2. Extending the side AB up to P and side AC up to Q.
3. Constructing the angle bisector of $C\hat{B}P$
4. Constructing the angle bisector of $B\hat{C}Q$
5. Naming the intersection point of the two angle bisectors as O and constructing a perpendicular from O to side AB.
6. Constructing the excircle by taking O as the centre and OX perpendicular distance as the radius.

Exercise 07

01) (i) Construct the ABC triangle such that AB=5cm, $A\hat{B}C$=60^0 and BC=5cm.
(ii) Construct the angle bisector of the external angle formed by extending the AB side.
(iii) Construct the angle bisector of the external angle formed by extending the AC side.
(iv) Mark the intersection point of the two angle bisectors as O.
(v) Construct a perpendicular to AB from O and mark the point that it meets AB as P.
(vi) Construct the excircle by taking O as the centre and OP as the radius.

02) (i) Construct the XYZ triangle such that XY=4cm, $Y\hat{X}Z$=90^0 and XZ=5cm.
(ii) Construct the angle bisector of the external angle formed by extending the ZX side.
(iii) Construct the angle bisector of the external angle formed by extending the ZY side.
(iv) Mark the intersection point of the two angle bisectors as O and construct a perpendicular to XY from O.
(v) Construct the excircle by taking O as the centre and perpendicular length from O to XY as the radius.

03) Construct an equilateral triangle of side length 4cm and construct all the three excircles.

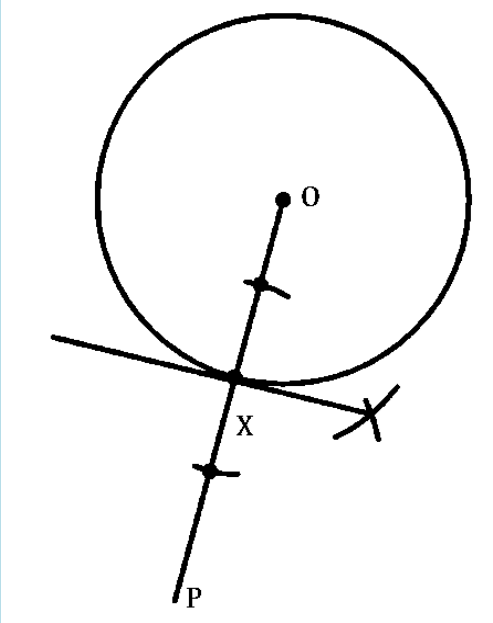
Content -: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)

Prepared by -: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(08). Constructing a tangent to a circle through a point on the circle.

Question: Construct a circle with centre O and mark any point on the circle as X. Construct a tangent to the circle at X

Answer



Steps of the construction

1. Constructing the circle with centre O.
2. Marking a point X on the circle.
3. Joining OX and extending upto P.
4. Constructing a perpendicular to OP at X.

Exercise 08

01) Construct a circle with radius 3cm and construct a tangent to the circle at any point on the circle.

02) Construct a circle with radius 4cm and construct a tangent to the circle at any point on the circle.

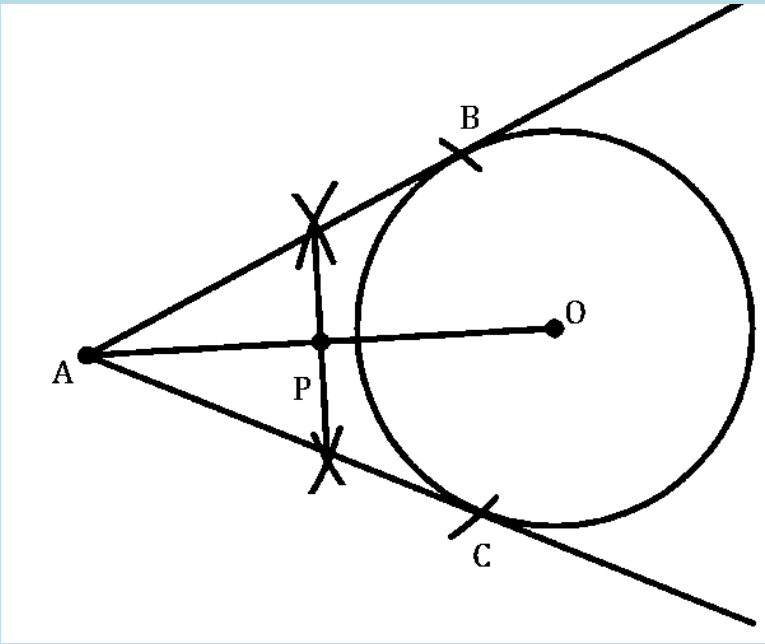
Content *-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)*

Prepared by *-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)*
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

(09).Constructing two tangents to a circle from an external point.

Question: Construct a circle with centre O and mark an external point A. Construct two tangents to the circle from A.

Answer



Steps of the construction

1. Construct a circle with centre O and mark an external point A.
2. Join AO and construct the perpendicular bisector of it.
3. Mark the point it intersects AO as P.
4. Draw two arcs on the circle by taking P as the centre and OP as radius.
5. Draw the two tangents AB and AC.

Content *-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)*

Prepared by *-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)*
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)

Exercise 09

01)(i) Construct a circle with radius 3cm and mark an external point P.
(ii) Mark the centre of the circle as O and join OP.
(iii) Construct the perpendicular bisector of OP and mark the point it intersects OP as X.
(iv) Construct two arcs that intersect the circle by taking X as the centre and XO as the radius and mark the two intersection points as A and B.
(v) Construct the two tangents PA and PB

02)Construct a circle with radius 3.5 cm and construct two tangents to the circle from an external point.

03)(i) Construct a circle with radius 3.7 cm and mark its centre as O.
(ii) Mark a point P on the circle.
(iii) Construct a tangent to the circle through P.
(iv) Mark any point on the tangent as X other than point P.
(v) Construct the other tangent to the circle from X.

❖ **Note**

➢ **Do the miscellaneous exercises 23.1/23.2/23.3 in your textbook.**

Content ***-: P.M.C.Senarath Bandara (ISA, Puttlam Education Zone)***

Prepared by ***-: M.V.D.P.T.K.Devapriya (Deputy Director,Provincial Education Department, NWP)***
R.S.S.Ranasinghe (Assistant Teacher, Athugalpura Prince College, NWP)