

CONSTRUCTION OF ANGLES

(Using ruler and compass)

19.1 RULER AND COMPASS CAN BE USED :

- (i) To copy a given angle.
- (ii) To bisect a given angle.
- (iii) To construct certain angles from a given point.
- (iv) To bisect a given line segment by drawing its perpendicular bisector.
- (v) To drop a perpendicular on to a line from a given exterior point.
- (vi) To draw a perpendicular at a point on a given line.

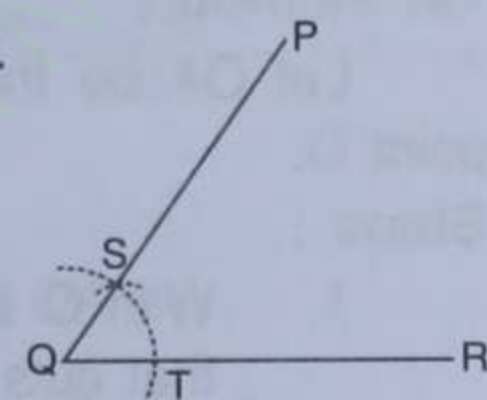
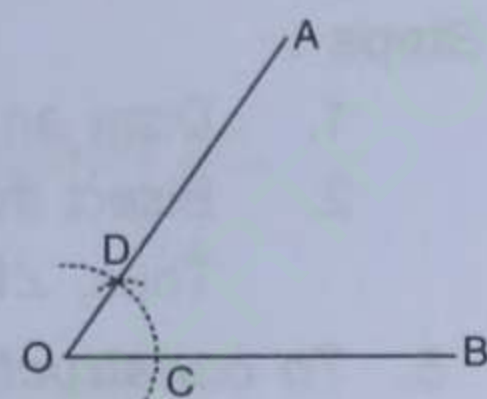
1. Copying a given angle

[To draw an angle equal to the given angle].

Let $\angle AOB$ be the given angle of certain size, that we have to copy at a given point Q.

Steps :

1. At point Q, draw line segment QR of any suitable length.
2. With O as centre, draw an arc of any suitable radius, to cut the arms of the angle at C and D.
3. With Q as centre, draw an arc of the same radius as drawn for C and D.
Let this arc cut the line segment QR at point T.
4. In your compasses, take the distance equal to the distance between C and D, and then, with T as centre, draw an arc of the radius equal to distance between C and D. Let this arc cut the first arc at point S.
5. Join QS and extend up to a suitable point P.
 $\angle PQR$ so obtained is equal to the given $\angle AOB$.

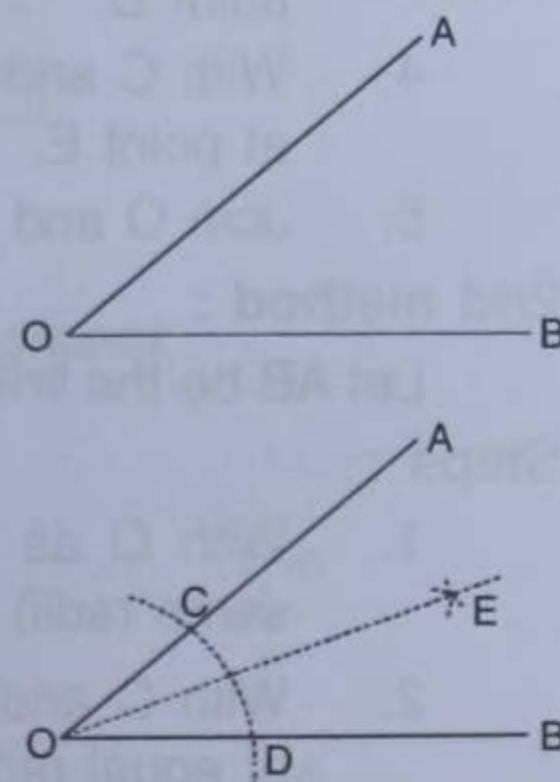


2. To bisect a given angle.

Let $\angle AOB$ be the angle to be bisected.

Steps :

1. With O as centre, draw an arc of any suitable measure that cuts the two arms AO and BO at points C and D, respectively.
2. Taking C and D as centres, draw arcs of equal radii (plural of radius) to cut each other at point E.
3. Join O and E.
The line OE bisects $\angle AOB$ i.e. $\angle AOE = \angle BOE$



The radius of each arc in step 2 must be of more than half the distance between C and D.

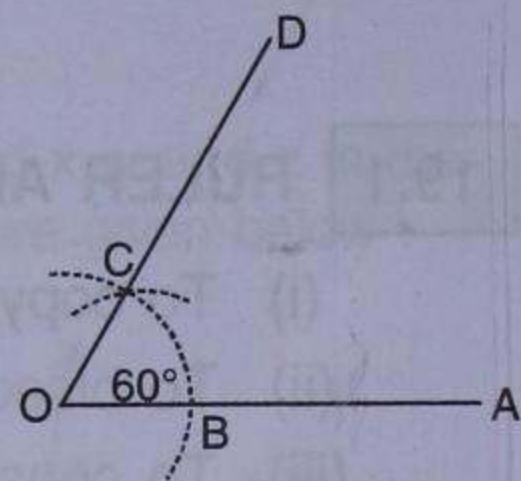
19.2 CONSTRUCTION OF PARTICULAR ANGLES :

Such as : 60° , 30° , 90° , 45° , 120° , 135° , 75° , 105° , 15° , 165° , etc.

3. To construct an angle of 60° .

Steps :

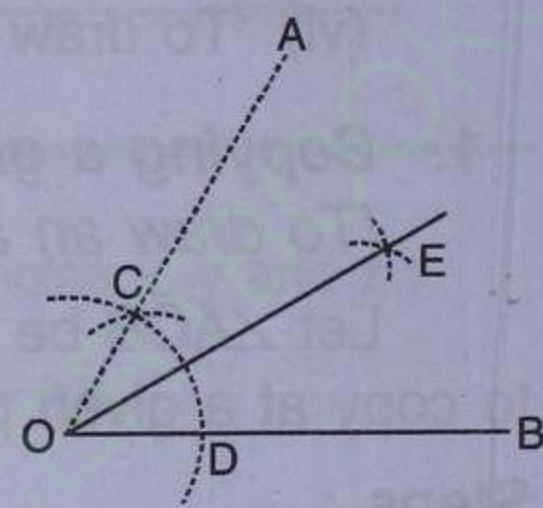
1. Draw a line segment OA of any suitable length.
 2. With O as centre, draw an arc of any suitable radius that cuts OA at point B.
 3. With B as centre, draw an arc of same size to cut the first arc at point C.
 4. Join OC and extend upto a suitable point D.
- Then, $\angle DOA = 60^\circ$.



4. To construct an angle of 30° .

Steps :

1. Draw an angle AOB of 60° , as explained above.
 2. Bisect this angle to get two angles of 30° each.
- Thus, $\angle EOB = 30^\circ$.



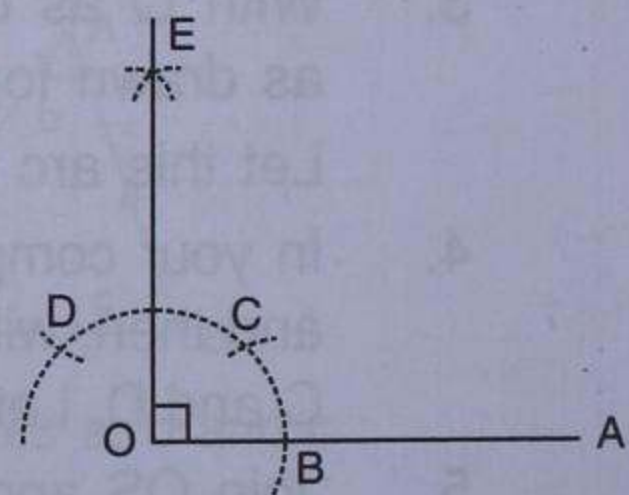
5. To construct an angle of 90° .

1st method :

Let OA be the line segment on which an angle of 90° is to be constructed at point O.

Steps :

1. With O as centre, draw an arc of a suitable radius that cuts OA at point B.
2. With B as centre, draw an arc (with the same radius, as taken in step 1) that cuts the first arc at point C.
3. Again, with C as centre and with the same radius, draw one more arc so that it cuts the first arc at point D.
4. With C and D as centres, draw two arcs of equal radii so that they intersect at point E.
5. Join O and E. Then, $\angle AOE = 90^\circ$.

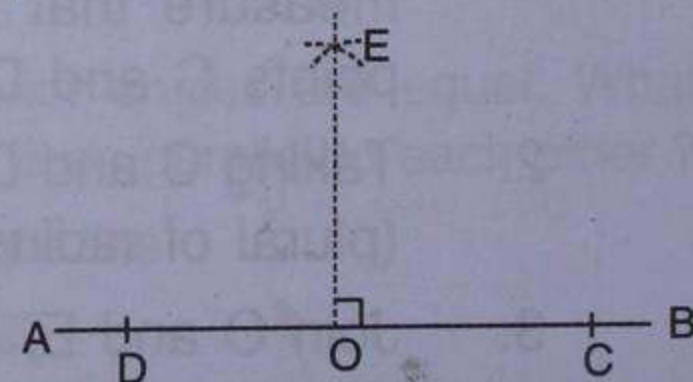


2nd method :

Let AB be the line segment and O the point where an angle of 90° is to be drawn.

Steps :

1. With O as centre, draw two arcs (both of the same radii) to cut AB at points C and D.
2. With C and D as centres, draw two more arcs of equal radii so that they intersect at point E.
3. Join points O and E. Then, $\angle AOE = 90^\circ$ and $\angle BOE = 90^\circ$.



In both the constructions discussed above, OE is said to be **perpendicular** to line segment OA at point O.

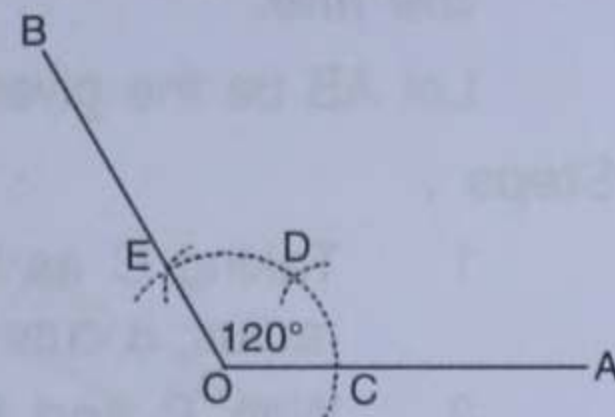
6. To construct an angle of 45° .

Draw an angle of 90° and bisect it. Each angle so obtained will be 45° .

7. To construct an angle of 120° .

Steps :

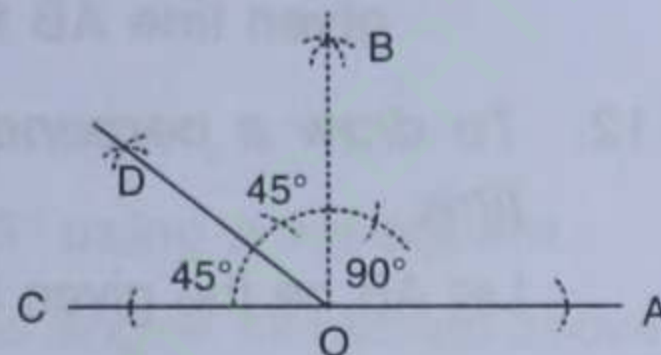
1. With centre O on the line segment OA, draw an arc to cut OA at point C.
2. With C as centre, draw one more arc with the same radius so that it cuts the first arc at point D.
3. With D as centre, draw one more arc of the same radius so that it cuts the first arc at E.
4. Join OE and extend it up to a suitable point B.
Then, $\angle AOB = 120^\circ$.



8. To construct an angle of 135° .

Steps :

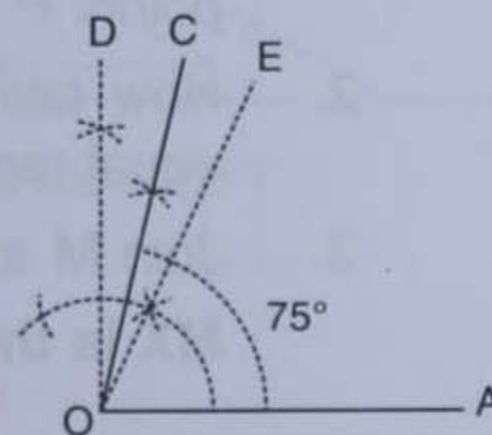
1. Draw an angle $BOA = 90^\circ$ at point O of the given line segment AC.
2. Bisect the angle BOC (clearly, angle BOC is also 90°).
Thus, $\angle BOD = \angle COD = 45^\circ$
And, $\angle AOD = 90^\circ + 45^\circ = 135^\circ$.



9. To construct an angle of 75° .

Steps :

1. Draw an angle $AOD = 90^\circ$ at point O of the line segment OA.
2. At the same point O, draw angle $AOE = 60^\circ$.
3. Bisect $\angle DOE$ so that
 $\angle EOC = \angle DOC = 15^\circ$
Thus, $\angle AOC = \angle AOE + \angle EOC = 60^\circ + 15^\circ = 75^\circ$.



Many more angles can be drawn with such combinations.

e.g. : (i) $105^\circ = 90^\circ + 15^\circ$

(ii) $150^\circ = 90^\circ + 60^\circ$ or $150^\circ = 120^\circ + 30^\circ$ and so on.

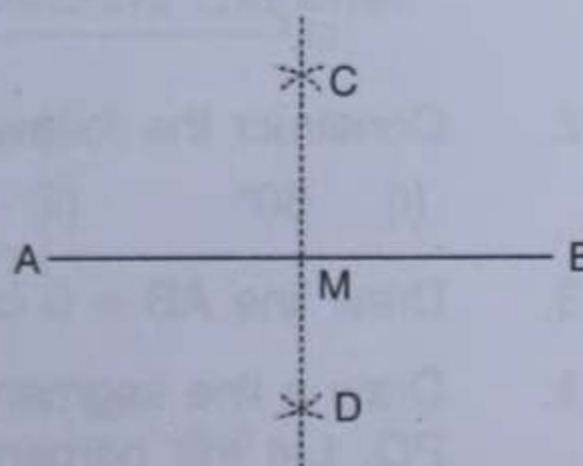
19.3 PERPENDICULARS :

10. To draw the perpendicular bisector of a given line segment.

Let AB be the given line segment.

Steps :

1. With A and B as centres, draw arcs of equal radii on both the sides of AB. The radii of these arcs must be more than half the length of AB.
2. Let these arcs cut each other at points C and D.



3. Join CD, which cuts AB at M.

Then, $AM = BM$. And $\angle AMC = 90^\circ$

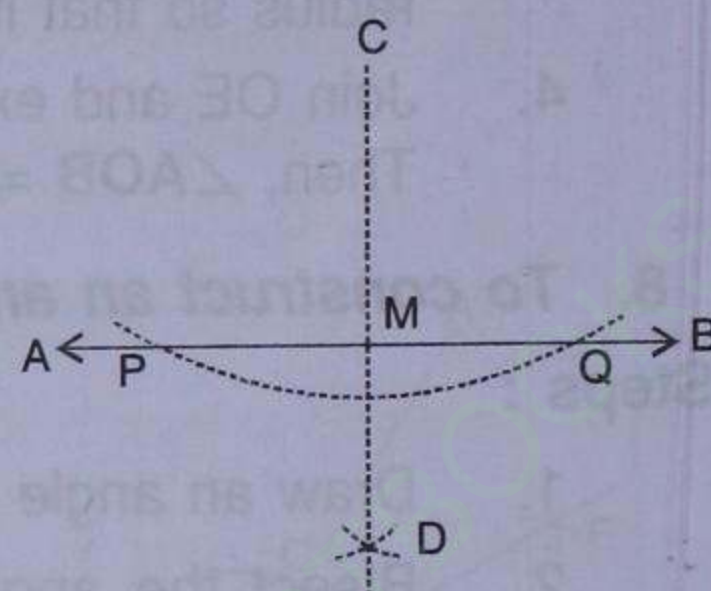
Thus, the line segment CD is the perpendicular bisector of AB as it bisects AB at M and is also perpendicular to AB.

11. To draw a perpendicular on to a given line from a given point outside the line.

Let AB be the given line and C the given point lying outside the line AB.

Steps :

1. Taking C as centre, draw an arc of a suitable radius; it cuts AB at the two points P and Q.
2. With P and Q as centres, draw two arcs of equal radii intersecting at point D on the other side of AB.
3. Join C and D. Let CD cut line AB at point M.
CM is the required perpendicular on to the given line AB from the exterior point C.

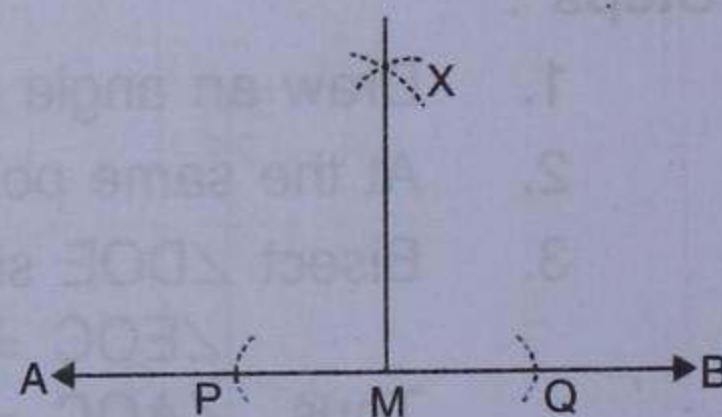


12. To draw a perpendicular on to a line through a given point on the given line.

Let AB be the given line and let M be a point on the line AB.

Steps :

1. Taking M as centre, draw two arcs of the same radii. Let these arcs cut AB at points P and Q.
2. Now taking P and Q as centres, draw arcs of equal radii intersecting at point X.
3. Join M and X.

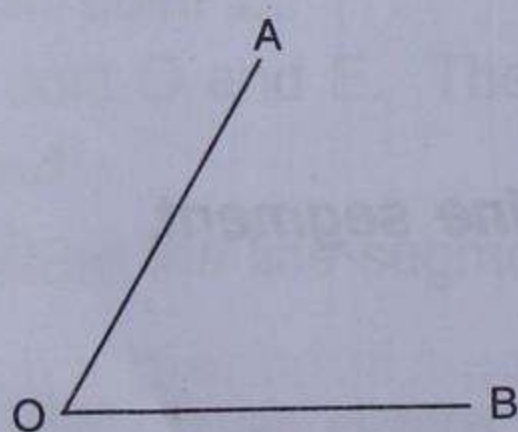


MX is the required perpendicular on to the line AB through point M on it.

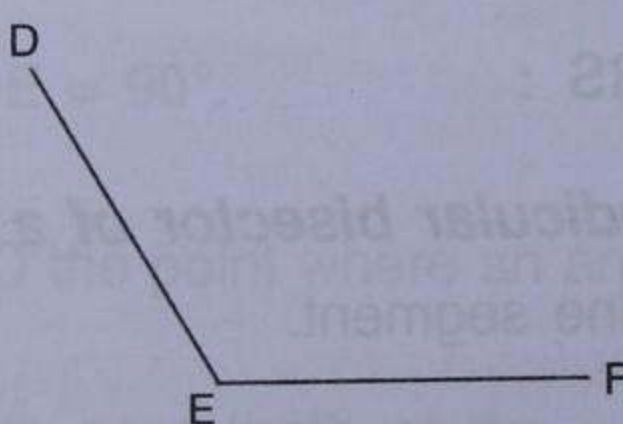
EXERCISE 19(A)

1. In your note-book, copy the following angles using ruler and compasses only.

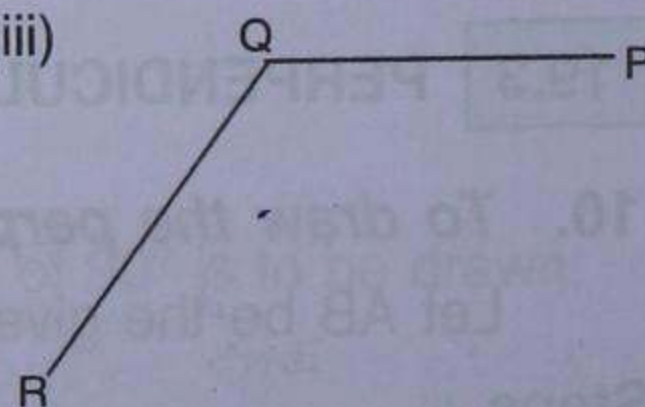
(i)



(ii)



(iii)



2. Construct the following angles, using ruler and compass only

(i) 60°

(ii) 90°

(iii) 45°

(iv) 30°

(v) 120°

(vi) 135°

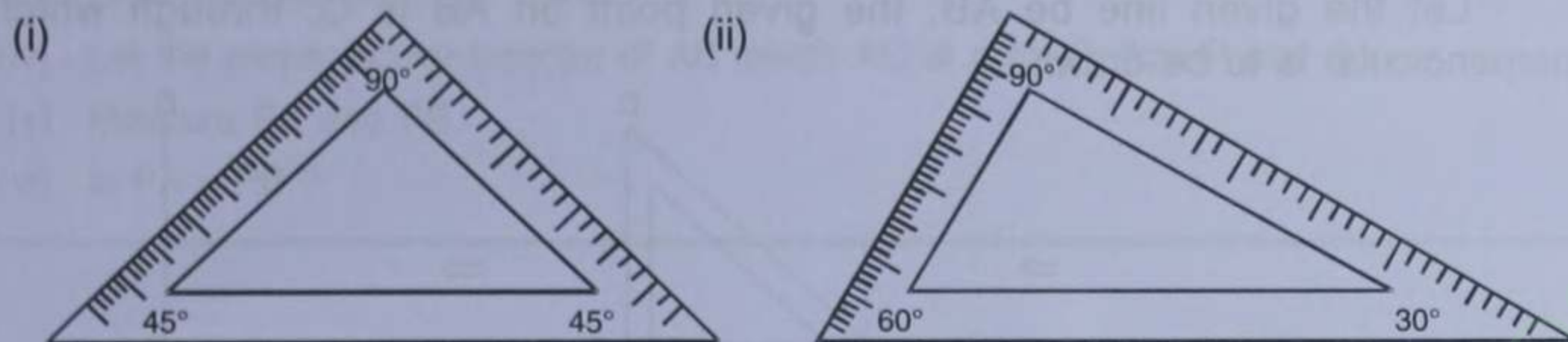
3. Draw line $AB = 6$ cm. Construct angle $ABC = 60^\circ$. Then draw the bisector of angle ABC.

4. Draw a line segment $PQ = 8$ cm. Construct the perpendicular bisector of the line segment PQ. Let the perpendicular bisector drawn meets PQ at point R. Measure the lengths of PR and QR. Is $PR = QR$?

5. Draw a line segment $AB = 7$ cm. Mark a point P on AB such that $AP = 3$ cm. Draw perpendicular on to AB at point P .
6. Draw a line segment $AB = 6.5$ cm. Locate a point P that is 5 cm from A and 4.6 cm from B . Through the point P , draw a perpendicular on to the line segment AB .

19.4 USING SET-SQUARES :

A set-square is a triangular piece of plastic or metal.

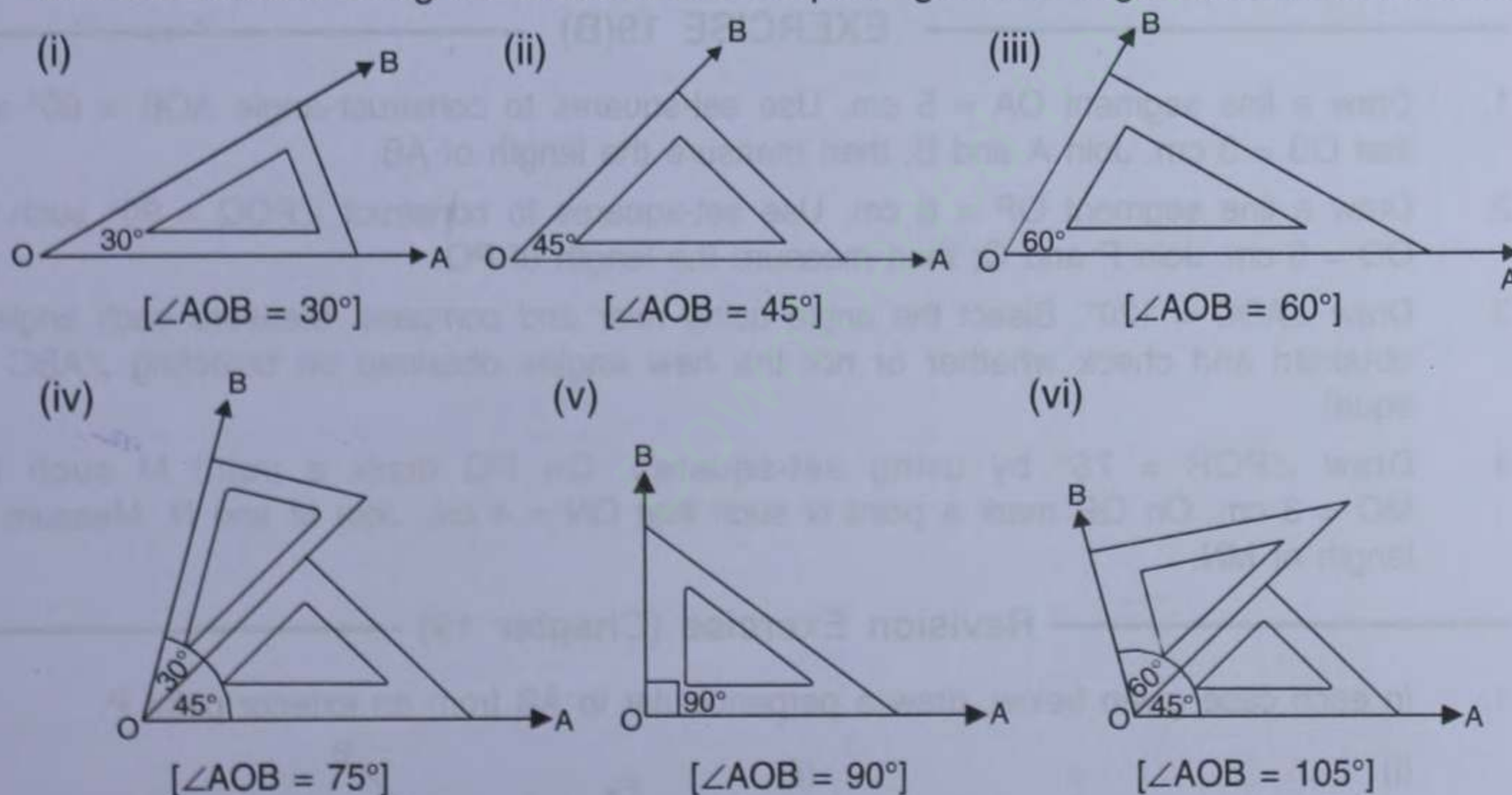


In general, set-squares are of two types :

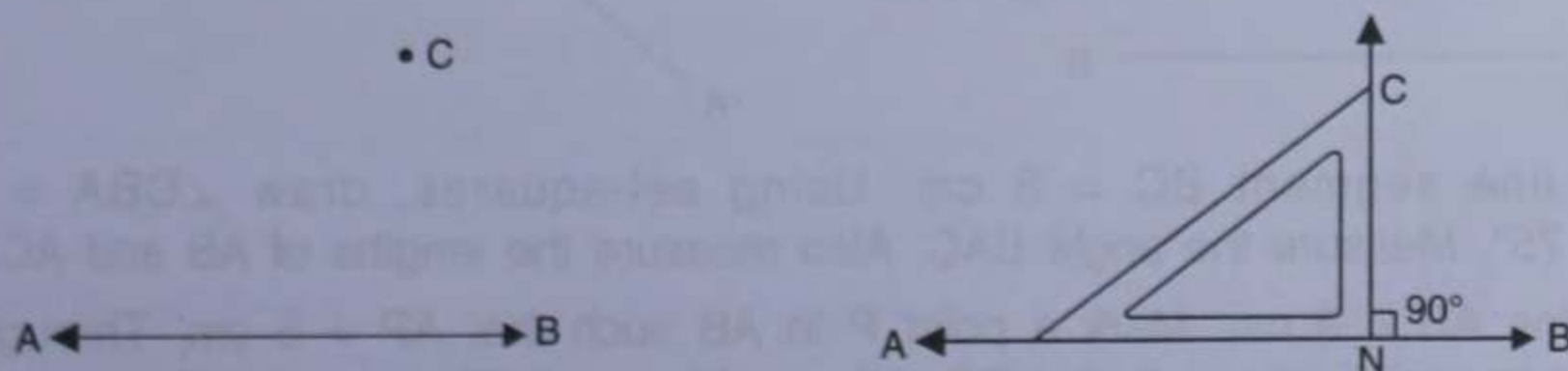
- (i) a set-square with angles 45° , 90° and 45° .
- (ii) a set-square with angles 60° , 90° and 30° .

1. To draw the angles of 30° , 45° , 60° , 75° , 90° and 105° using a set-square.

The lines drawn along the sides of a set-square give the angles mentioned above.



2. To draw a perpendicular on to a line through a point outside the line.

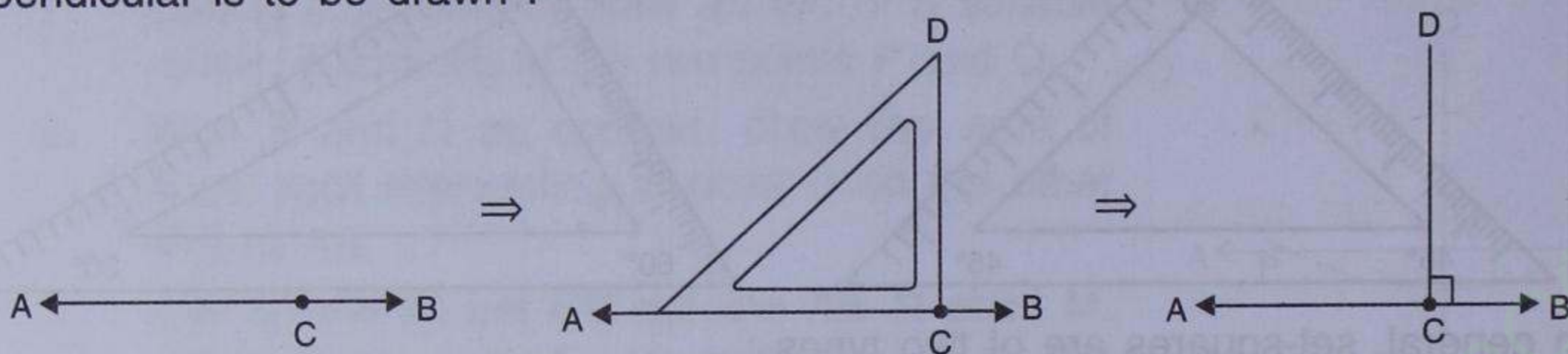


Let AB be the given line and C the given point outside the line AB . Place the suitable set-square in such a way that one of its edges, i.e. the one containing angle 90° , coincides with line AB and the other edge with point C (see the figure given above). Then, through point C , draw a line along the edge of the set-square such that it meets the given line AB at point N .

$\therefore$ **CN is the required perpendicular on to AB through the external point C .**

3. To construct a perpendicular on to a line at a point on the line.

Let the given line be AB ; the given point on AB is C , through which the perpendicular is to be drawn :



Place the suitable set-square at point C in such a way that one edge of it, i.e. the one containing 90° , coincides with line AB . Now, through C , draw a line segment CD along the other edge of the set-square containing 90° .

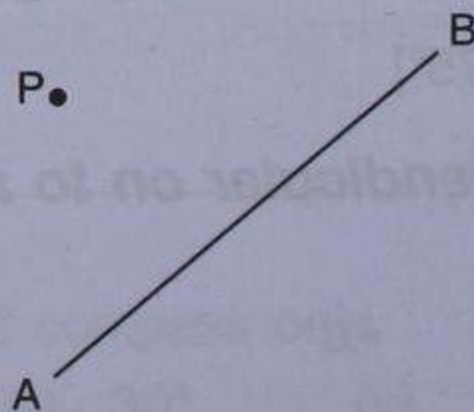
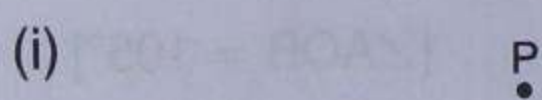
$\therefore$ **CD is the required perpendicular on to AB through point C on the line AB .**

EXERCISE 19(B)

1. Draw a line segment $OA = 5$ cm. Use set-squares to construct angle $AOB = 60^\circ$ such that $OB = 3$ cm. Join A and B ; then measure the length of AB .
2. Draw a line segment $OP = 8$ cm. Use set-squares to construct $\angle POQ = 90^\circ$ such that $OQ = 6$ cm. Join P and Q ; then measure the length of PQ .
3. Draw $\angle ABC = 120^\circ$. Bisect the angle using ruler and compass. Measure each angle so obtained and check whether or not the new angles obtained on bisecting $\angle ABC$ are equal.
4. Draw $\angle PQR = 75^\circ$ by using set-squares. On PQ mark a point M such that $MQ = 3$ cm. On QR mark a point N such that $QN = 4$ cm. Join M and N . Measure the length of MN .

Revision Exercise (Chapter 19)

1. In each case given below, draw a perpendicular to AB from an exterior point P .



2. Draw a line segment $BC = 8$ cm. Using set-squares, draw $\angle CBA = 60^\circ$ and $\angle BCA = 75^\circ$. Measure the angle BAC . Also measure the lengths of AB and AC .
3. Draw a line $AB = 9$ cm. Mark a point P in AB such that $AP = 5$ cm. Through P draw (using set-squares) perpendicular $PQ = 3$ cm. Measure BQ .

4. Draw a line segment $AB = 6$ cm. Without using set squares, draw angle $OAB = 60^\circ$ and angle $OBA = 90^\circ$. Measure angle AOB and write this measurement.
 5. Without using set squares, construct angle $ABC = 60^\circ$ in which $AB = BC = 5$ cm. Join A and C and measure the length of AC.
 6. Use a protractor to construct angle $MON = 80^\circ$. Bisect the angle MON .
 7.
 - (i) Draw $AB = 7$ cm.
 - (ii) Construct angle $ABC = 60^\circ$.
 - (iii) Draw the perpendicular bisector of AB.
 - (iv) Let the perpendicular bisector of AB meets AC at point P. Join P and A.
 - (v) Measure PA and PB.
 - (vi) Is $PA = PB$?
-