Mathematics

Chapter 14: Practical Geometry

PRACTICAL GEOMETRY

Practical geometry is an important branch of geometry which deals with the study of the size, positions, shapes as well as dimensions of objects.

Geometrical Instruments

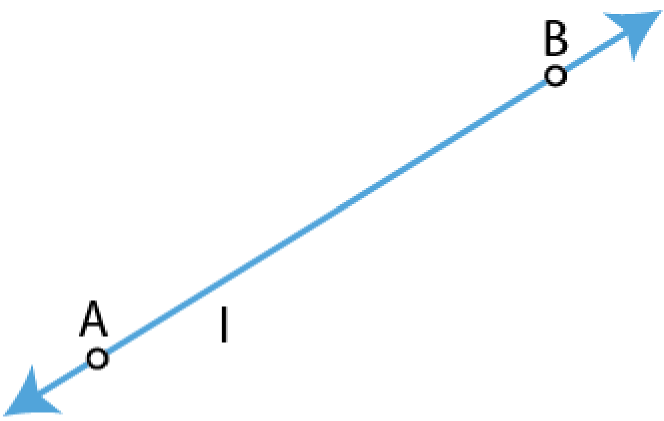
Whether you have to draw a line segment or measure it, draw a circle or arcs, draw an angle, etc. it can easily be possible with the help of geometrical tools. Let us discuss the various geometrical instruments used in practical geometry.

Name of Geometrical tool	Use of Geometrical tool
Divider	Comparing lengths.
Protractor	Measure as well as draw angles.
Set Squares	To draw parallel and perpendicular lines.
Compass	To draw circles, arcs, and to mark equal lengths.
Ruler	To measure lengths of the line segment and to draw a line segment.

Points and Lines

Point: It is a location.

Line: Collection of points in a linear manner that extends infinitely in two directions.



Tools of Construction

Tools used for construction:

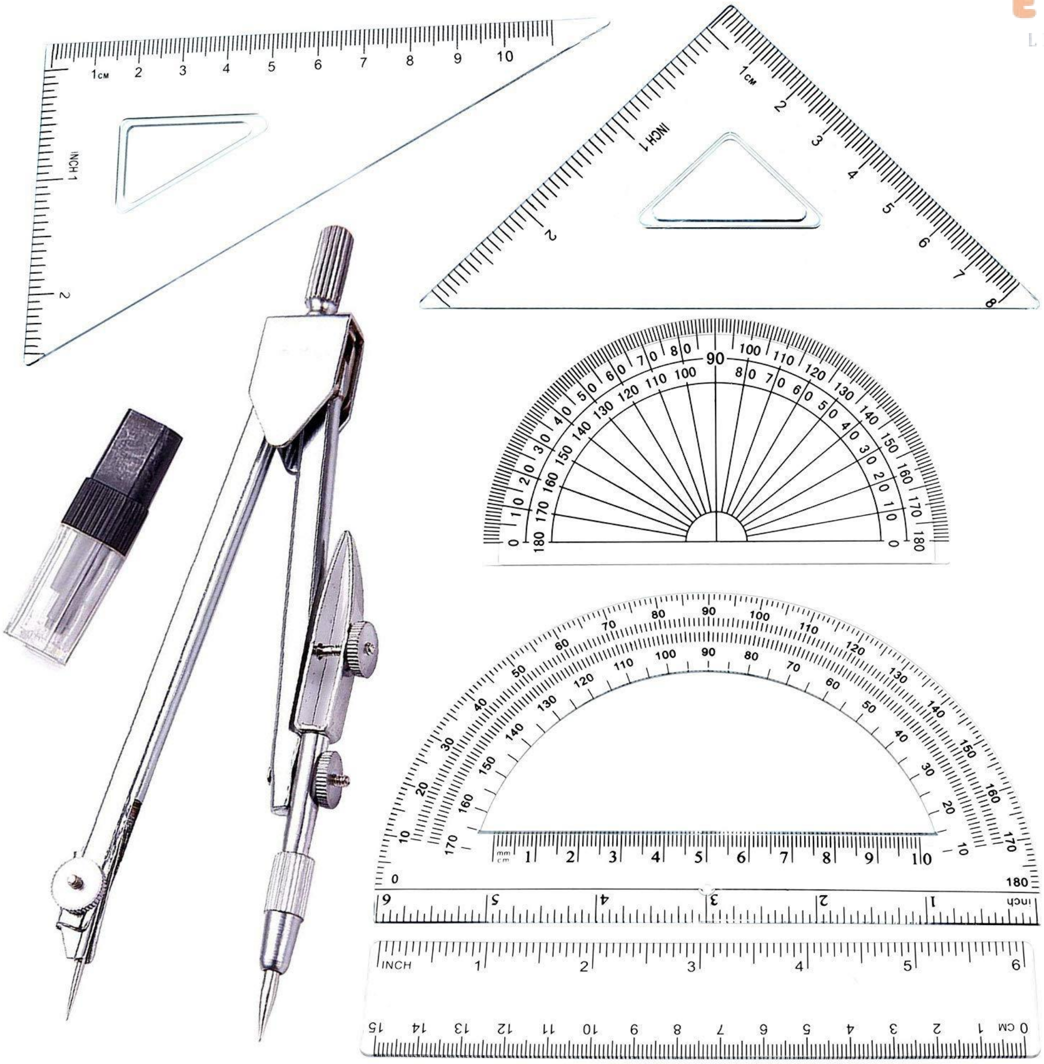
Ruler: An instrument used to draw line segments and measure their lengths.

Compass: Instrument having a pointer on one end and a pencil on the other end. It is used to mark equal lengths and to draw circles and arcs.

Divider: Instrument having a pair of pointers. It is used to compare lengths.

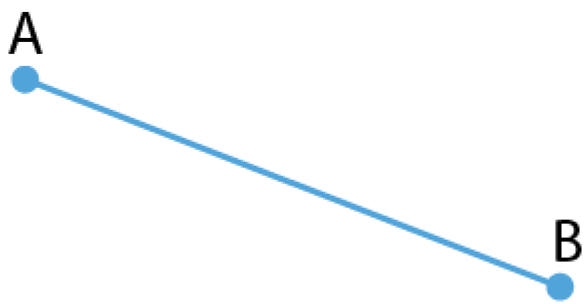
Set- Squares: Two triangular pieces – One of them has 45°, 45°, 90° and the other has 30°, 60°, 90° angles at the vertices. It is used to draw parallel and perpendicular lines.

Protractor: A semicircular instrument graduated into 180° parts. It is used to draw and measure angles.



Line Segment

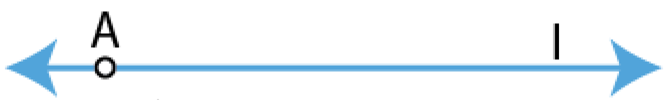
Line Segment: Part of a line that is bounded by two distinct endpoints.



Constructing a Line Segment for a given Length

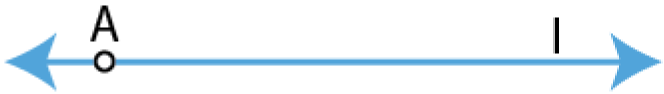
Steps for constructing a line segment of a given length ‘a’:

(i) Draw a line l and mark a point A on it.



(ii) Place the compass on the initial point of the ruler. Open it to place pencil point up to the 'a' mark.

(iii) Place the pointer on A and draw an arc to cut l at B. AB is the required line segment.



Constructing Copy of a Line Segment

Steps for constructing a copy of a given line segment using ruler and compass together:

(i) Given AB whose length is unknown.

(ii) Fix compass' pointer on A and pencil end on B. The opening of the instrument now gives the length of AB.

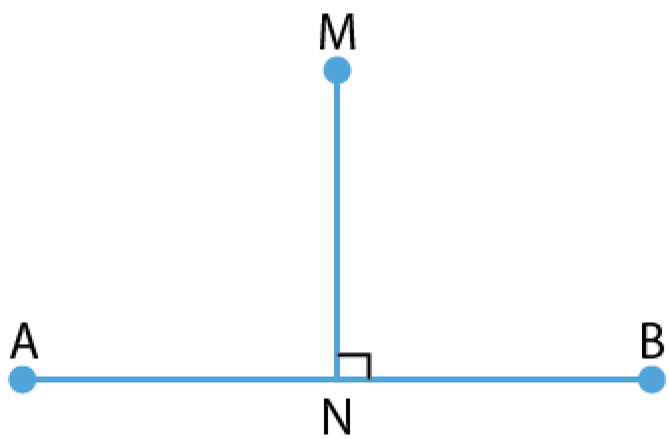
(iii) Draw any line l.

(iv) Placing the pointer on C, draw an arc that cuts l at a point say D. Then, CD = AB.

To know more about Constructing a Copy of a Line Segment, visit here.

Perpendiculars and Parallels

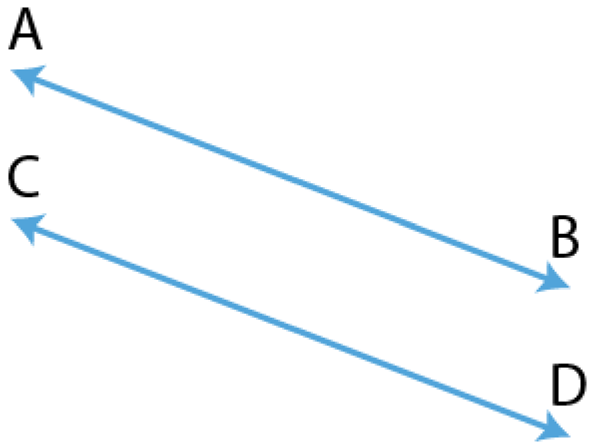
A line MN meeting another line AB at the right angle is said to be the perpendicular to the line AB.



$AB \perp MN$

If two lines are non-intersecting and are always the same distance apart, then they are said to be parallel lines.

As shown in the figure, AB || CD.



Constructing a Perpendiculars Using a Compass and Ruler

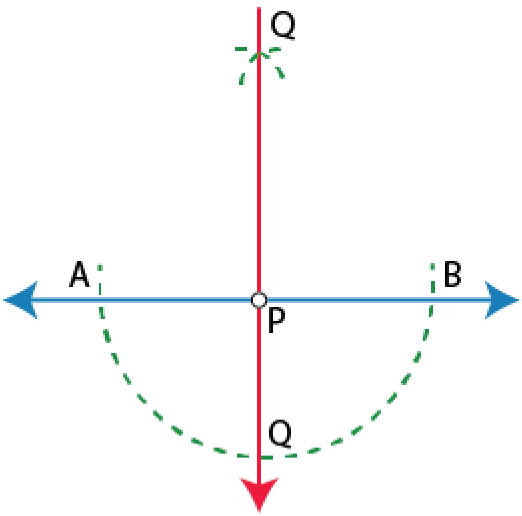
Steps for constructing perpendiculars using compass and rulers:

(i) Given a line l and a point P not on it.

(ii) With P as the centre, draw an arc which intersects line l at two points A and B.

(iii) Using the same radius and with A and B as centres, construct two arcs that intersect at a point, say Q, on the other side.

(iv) Join PQ. Thus, $\overline{PQ}$ is the perpendicular to l.



Constructing Perpendicular to a Line through a Point on the Line

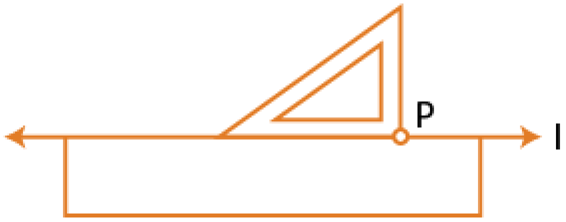
Steps to construct a perpendicular to a line through a point on the line:

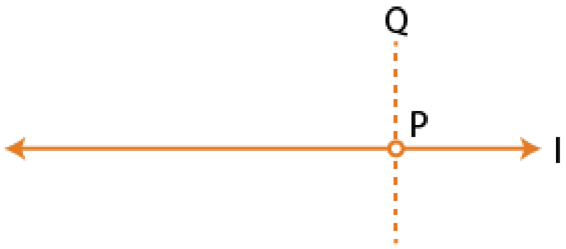
(i) Place a ruler along a given line l such that one of its edges is along l.

(ii) Place a set square with one of its edges along the already aligned edge of the ruler.

(iii) Slide the set square such that its right-angled corner coincides with the Point P.

(iv) Draw PQ and PQ are perpendicular to l.





Paper Folding Construction

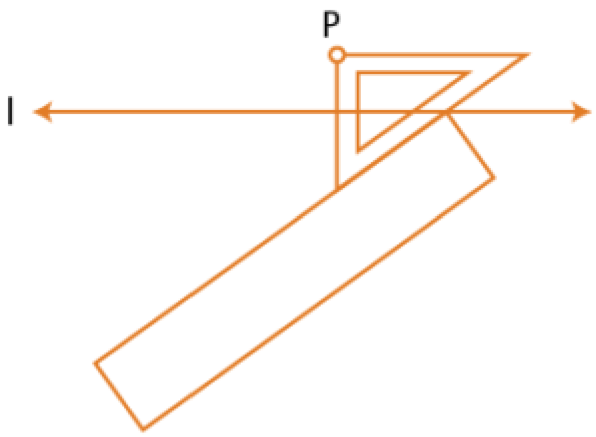
Paper folding method to make perpendiculars:

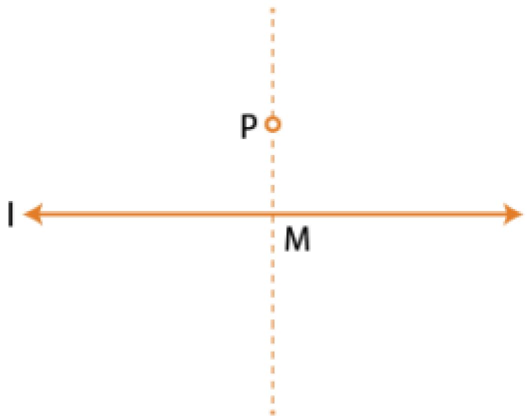
(i) Let l be the given line and P be a point outside l.

(ii) Place a set-square on l such that one arm of its right angle aligns along l.

(iii) Place a ruler along the edge opposite to the right angle of the set-square.

(iv) Slide the set-square along the ruler till the point P touches the other arm of the set-square.





Circle

A circle is a set of all points in a plane that are equidistant from a point i.e. centre of the circle.

To know more about Circles,

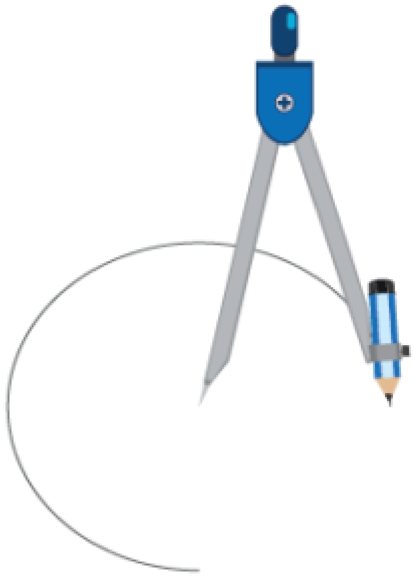
Construction of a Circle for a given Radius

Steps for constructing a circle using a compass:

(i) Open compass for the required radius.

(ii) Place pointer of the compass on O.

(iii) Rotate the compass slowly to draw the circle.



Angle Bisector and Its Construction

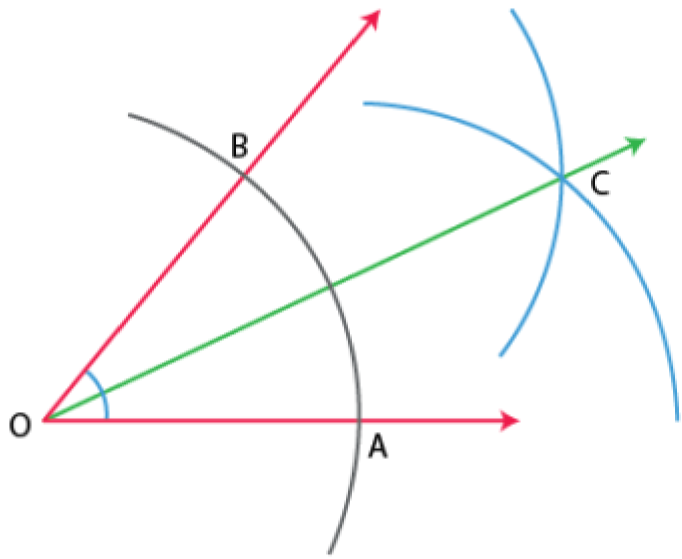
Steps to construct angle bisectors of a given angle:

(i) With O as the centre, draw an arc that cuts both rays at A and B.

(ii) With B as the centre, draw an arc whose radius is more than half of the length of AB.

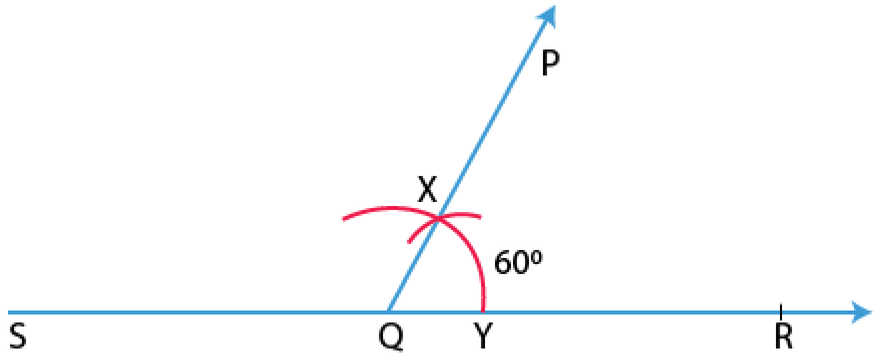
(iii) With A as the centre, with the same radius, cut an arc in the interior of ∠BOA

(iv) Mark point of intersection as C. Then, OC is the angle bisector.

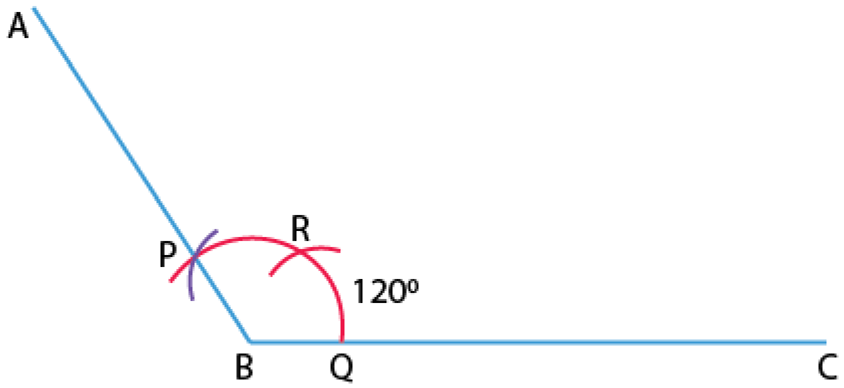


Construction of 30°, 60°, 90°and 120°Angles

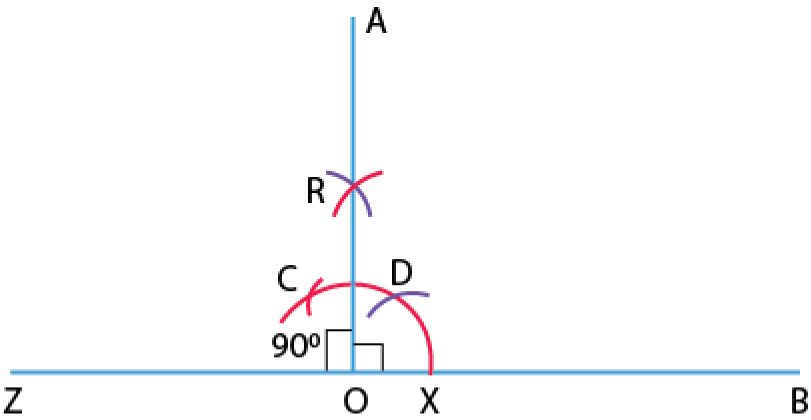
(i) Construction of 60° angle:



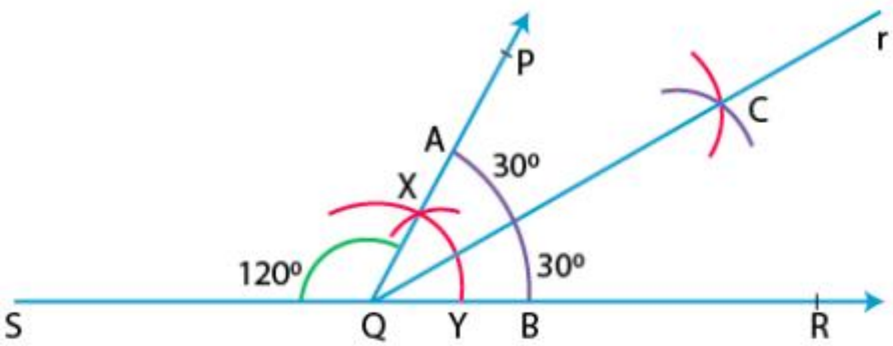
(ii) Construction of 120°angle:



(iii) Construction of 90° angle:



(iv) Construction of 30° angle:



Constructing of an Angle with Unknown Measurement

Steps for constructing a copy of an angle with unknown measurement:

(i) Draw a line l and choose a point P on it.

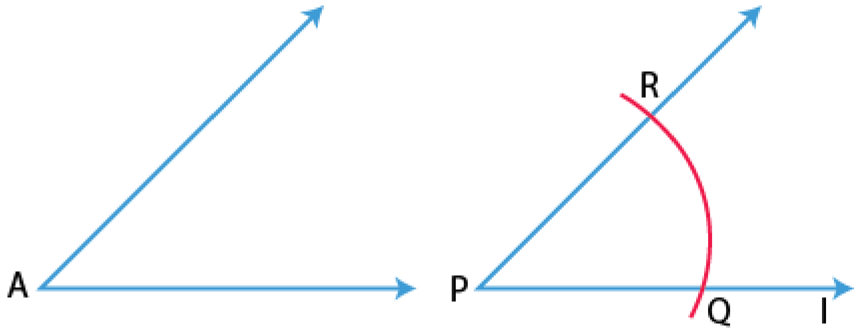
(ii) Place compass' pointer at A and draw an arc to cut the rays of ∠A at B and C.

(iii) Draw an arc with P as the centre, cutting /at Q.

(iv) Set your compasses to length BC with the same radius.

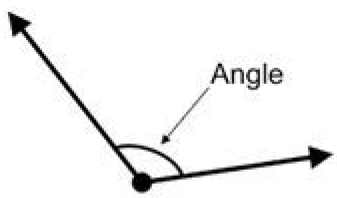
(v) Place the compasses pointer at Q and draw an arc to cut the arc drawn earlier in R.

(vi) Join PR. This gives ∠P=∠A



Angles

Angles: Formed by two rays sharing a common endpoint.



MIND MAP : LEARNING MADE SIMPLE

CHAPTER-14

Practical Geometry

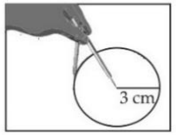
Geometrical construction

Process of drawing geometrical figures

Tools

Tools
Scale
Campass
Divider
Protactor
Set Squares

Circle



Step 1 : Open the compass for the required radius of 3 cm.
Step 2 : Mark a point with sharp pencil.
Step 3 : Place the pointer of compass on 0.
Step 4 : Turn the compass draw the circle.

Constructing line segment

Step 1 : Draw a line 'l' mark a point 'A' on 'l'.
Step 2 : Place the compass point on zero mark and open pencil point upto 5 cm mark.
Step 3 : Place the pointer on A and swing an arc to cut 'l' at 'B'.
Step 4 : AB is a line segment of 5 cm.

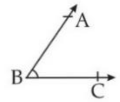
Construction of 60° angle

Step 1 : Take A as centre draw arc intersecting AB.
Step 2 : With O as centre and same radius, draw arc intersecting same arc.
Step 3 : Draw AC passing through X thus $\angle CAB = 60°$.

Perpendicular bisector

Step 1 : With A and B as length and radius $> \frac{1}{2}$AB, draw intersecting arcs on both sides of line segment
Step 2 : Join PQ. Thus PQ is the required line segment.

Angle Bisector



Step 1 : Take B as centre, draw arcs intersecting AB and BC (of any radius).
Step 2 : D and E as centres and radius $\frac{1}{2}$ DE, draw two arcs and join B to it.
Step 3 : BF is the required bisector.

Important Questions

Multiple Choice Questions:

Question 1. A line segment $\overrightarrow{TP}$ is bisected at I. What is the measure of $\overrightarrow{TI}$?

(a) $\frac{1}{2}\overrightarrow{TP}$

(b) $\overrightarrow{IP}$

(c) $\overrightarrow{TP}$

(d) $\frac{1}{3}\overrightarrow{TP}$

Question 2. Which of the following can be drawn on a piece of paper?

(a) A line

(b) A line segment

(c) A ray

(d) A plane

Question 3. At 7 a.m. the angle between the Sun's ray and the ground at a point is 43°. What would be the angle at 10 a.m.?

(a) 40°

(b) 90°

(c) Between 43° and 90°

(d) Greater than 90°

Question 4. Identify the uses of a ruler.

(a) To draw a line segment of a given length

(b) To draw a copy of a given segment.

(c) To draw a diameter of a circle.

(d) All the above.

Question 5. $\overrightarrow{XY}$ bisects ∠AXB. If ∠YXB = 37.5∘, what is the measure of ∠AXB?

(a) 37.5°

(b) 74°

(c) 64°

(d) 75°

Question 6. X and Y are two distinct points in a plane. How many lines can be drawn passing through both X and Y?

(a) 0

(b) 1

(c) Only 2

(d) Infinitely many

Question 7. Lines a, b, p, q, m, n and x have a point P common to all of them. What is the name of P?

(a) Point of concurrence

(b) Point of intersection

(c) Common point

(d) Distinct point

Question 8. If two lines have only one point in common, what are they called?

(a) Parallel lines

(b) Intersecting lines

(c) Perpendicular lines

(d) Transversal

Question 9. Two lines are said to be perpendicular to each other when they meet at ____angle.

(a) 180°

(b) 90°

(c) 60°

(d) 360°

Question 10. How do you draw a 90° angle?

(a) By drawing a perpendicular to a line from a point lying on it.

(b) By bisecting a 120° angle.

(c) By bisecting a 60° angle.

(d) By drawing multiples of 45° angle.

Question 11. Angles of set squares are 45, 90 and ____.

(a) 60

(b) 75

(c) 30

(d) 90

Question 12. A ________ is the longest chord of a circle.

(a) diameter

(b) radius

(c) None of these

(d) chord

Question 13. If the radius of a circle is 8.5 cm, then the diameter of the circle is _____.

(a) 17 cm

(b) 12 cm

(c) 8.5 cm

(d) None of these

Question 14. If the radius of a circle is 3 cm, then the diameter of the circle is _____.

(a) 1.5 cm

(b) 6 cm

(c) 3 cm

(d) None of these

Question 15. If the radius of a circle is 5.5 cm, then the diameter of the circle is _____.

(a) 11 cm

(b) 5.5 cm

(c) 12 cm

(d) None of these

Match The Following:

	Column I		Column II
1.	The line which divides a line segment into two equal halves and perpendicular to it is called	**A.**	perpendicular lines
2.	The line which divides an angle into two equal angles is called	**B.**	parallel lines
3.	The lines which intersect each other at 90o are called	**C.**	perpendicular bisector
4.	Two lines which are parallel to the same line are called	**D.**	angle bisector

Fill in the blanks:

1. The image of points A and B in the line l are P and Q respectively then $\overline{PQ}$ = _________.
2. To bisect a line segment of length 5cm, the opening of the compass

should be more than half of ________.

3. If an angle of measure 90° is bisected twice the angle so obtained measures __________.

4. In an isosceles ΔPQR, the bisector of ∠Q and ∠R meet at O. If ∠QOR = 140°, then ∠P = ______.

True /False:

1. Two line segments are compared in terms of their lengths.
2. When a ray makes one complete rotation, the measure of angle formed is 90°.
3. With the help of compasses we can draw 80°.
4. To construct an angle of $37\frac{1}{2}^{\circ}$, we can bisect 75°.

Very Short Questions:

1. If an angle of 110° is bisected, find the measure of each angle formed.
2. Draw two line segments which are perpendicular to each other using set squares.
3. Construct an angle of 60° using compass and ruler.
4. Construct $\overline{PQ}$ of length 6cm. From this cut off $\overline{PR}$ of length $\overline{PR}$ of length 4.5cm. Measure $\overline{QR}$.
5. Draw any circle and mark points A, B and C such that:

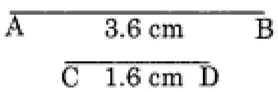
(i) A is on the circle.

(ii) B is the interior of the circle.

(iii) C is the exterior of the circle

Short Questions:

1. If AB = 3.6 and CD = 1.6 cm, construct a line segment equal to $\overrightarrow{AB} + \overrightarrow{CD}$ and measure the total length.



2. Construct a perpendicular to a given line segment at point on it.

3. Construct an angle of 60° and bisect it.

4. Draw an angle of 120° and hence construct an angle of 105°.

5. Using compasses and ruler, draw an angle of 75° and hence construct an angle of $37\frac{1}{2}^{\circ}$.

Long Questions:

1. With $\overline{PQ}$ of length 6.1cm as diameter draw a circle.
2. Draw a circle with center C and radius 3.4cm. Draw any chord $\overline{AB}$. Construct the perpendicular bisector of $\overline{AB}$ and examine, if it passes through C.
3. Draw ΔABC. Draw perpendiculars from A, B and C respectively on the sides BC, CA and AB. Are there perpendicular concurrent? (passing through the same points).

Assertion and Reason Questions:

1) Assertion (A): In a triangle D ABC, if ∠B=90°,then it is a right angled triangle.

Reason(R): If any one of the angles of a triangle is right angle, then it is a right angled triangle.

a) Both A and R are individually true and R is the correct explanation of A:

b) Both A and R are individually true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

2) Assertion (A): In an equilateral triangle, if one angle equals 60°, then rest of the two are 150° each.

Reason (R): In an equilateral triangle, all three angles are equal.

a) Both A and R are individually true and R is the correct explanation of A:

b) Both A and R are individually true but R is not the correct explanation of A.

c) A is true but R is false

d) A is false but R is true.

ANSWER KEY -

Multiple Choice questions:

1. (b) $\overrightarrow{TP}$

2. (b) A line segment

3. (c) Between 43° and 90°

4. (d) All the above.

5. (d) 75°

6. (b) 1

7. (a) Point of concurrence

8. (b) Intersecting lines

9. (b) 90°

10. (a) By drawing a perpendicular to a line from a point lying on it.

11. (B) 75

12. (a) diameter

13. (b) 17 cm

14. (c) 6 cm

15. (d) 11 cm

Match The Following:

	Column I		Column II
1.	The line which divides a line segment into two equal halves and perpendicular to it is called	**C.**	perpendicular bisector
2.	The line which divides an angle into two equal angles is called	**D.**	angle bisector
3.	The lines which intersect each other at 90o are called	**A.**	perpendicular lines
4.	Two lines which are parallel to the same line are called	**B.**	parallel lines

Fill in the blanks:

1. The image of points A and B in the line l are P and Q respectively then $\overline{PQ}$ = $\underline{\overline{\boldsymbol{AB}}}$.

2. To bisect a line segment of length 5cm, the opening of the compass should be more than half of **5cm**.

3. If an angle of measure 90° is bisected twice the angle so obtained measures $22\frac{1}{2}^{\circ}$.

4. In an isosceles ΔPQR, the bisector of ∠Q and ∠R meet at O. If ∠QOR = 140°, then ∠P = **100˚**.

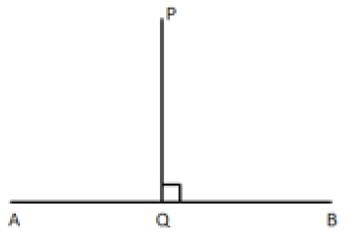
True /False:

1. True
2. False
3. False
4. True

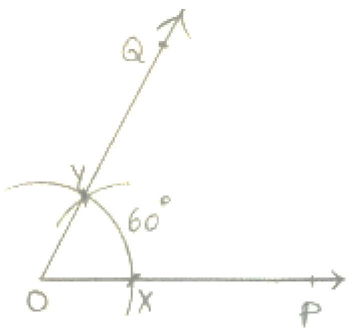
Very Short Answer:

1. If an angle of 110˚ is bisected (divided into two equal parts), then each angle would be $\frac{110^{\circ}}{2} = 55^{\circ}$

2.



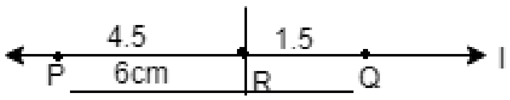
3.



Steps of Construction:

1. Draw a ray $\overrightarrow{OP}$.
2. With 'O' as centre and any radius, draw an arc. Cutting $\overrightarrow{OP}$ at x.
3. With x as centre and the same radius, draw another arc intersecting the first arc at y
4. Join O, Y and produce it to Q.
5. Hence, ∠POQ = 60˚ is the required angle.

4.

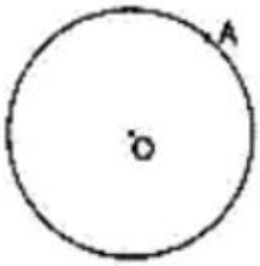


steps:-

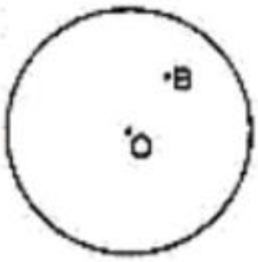
1. Place the zero mark of the ruler at ‘P’.
2. Mark a point ‘Q’ at a distance of 6cm from ‘P’.
3. Again mark a point ‘R’ at a distance of 4.5cm from ‘P’.
4. Hence by measuring $\overrightarrow{QR}$ we find $\overrightarrow{QR}$ = 6 – 4.5 = 1.5cm.

5.

i.



ii.



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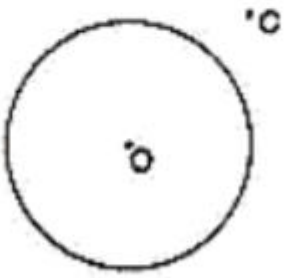
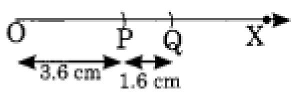


Short Answer:

1. Step I: Draw a ray OX.

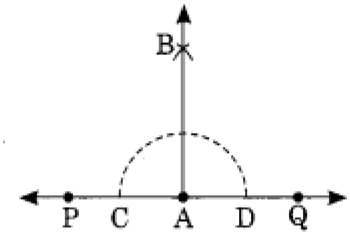
Step II: With centre 0 and radius equal to the length of AB (3.6 cm) mark a point P on the ray.



Step III: With centre P and radius equal to the length of CD (1.6 cm) mark another point Q on the ray.

Thus OQ is the required segment such that OQ = 3.6 cm + 1.6 cm = 5.2 cm.

2. Step I Draw a line $\overleftrightarrow{PQ}$ and take any point A on it.



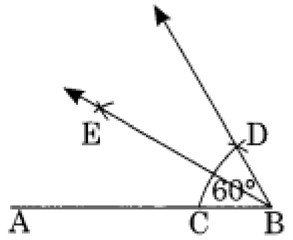
Step II: With centre A draw an arc which meets PQ at C and D.

Step III: Join AB and produce.

Step IV: With centres C and D and radius equal to half of the length of the previous arc, draw two arcs which meets each other at B.

Thus AB is the required perpendicular to $\overleftrightarrow{PQ}$.

3. Step I: Draw a line segment $\overrightarrow{AB}$.



Step II: With centre B and proper radius, draw an arc which meets AB at C.

Step III: With C as centre and the same radius as in step II, draw an arc cutting the previous arc at D.

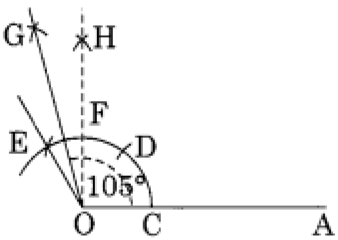
Step IV: Join B to D and produce.

Step V: Draw the bisector BE of ∠ABD.

Thus BE is the required bisector of ∠ABD.

4.

Step I: Draw a line segment $\overline{OA}$.



Step II: With centre O and proper radius, draw an arc which meets OA at C.

Step III: With centre C and radius same, mark D and E on the previous arc.

Step IV: Join O to E and produce.

Step V: ∠EOA is the required angle of 120°.

Step VI: Construct an angle of 90° which meets the previous arc at F.

Step VII: With centre E and F and proper radius, draw two arcs which meet each other at G.

Step VIII: Join OG and produce.

Thus ∠GOA is the required angle of 105°.

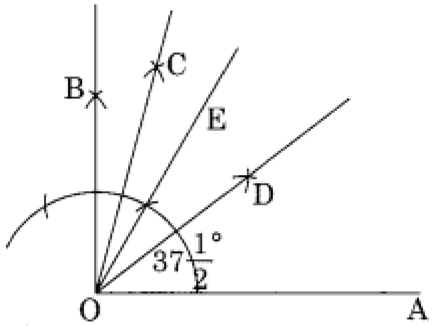
5. Step I: Draw a line segment OA.

Step II: Construct ∠BOA = 90° and ∠EOA = 60°

Step III: Draw OC as the bisector of ∠BOE , which equal to

$$\frac{60^\circ + 90^\circ}{2} = 75^\circ$$

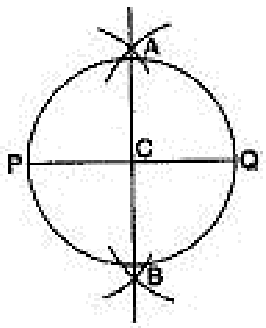
Step IV: Draw the bisector OD of ∠COA.



Thus ∠DOA is the required angle of $37\frac{1}{2}^\circ$.

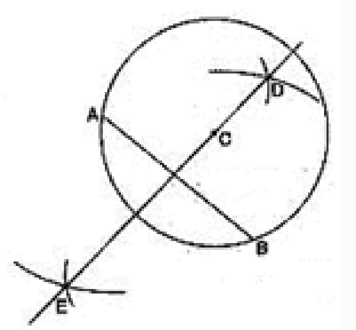
Long Answer:

1.



1. Draw a line segment P $\overline{PQ}$ of length 6.1cm.
2. With P as centre, using compasses, draw an arc. The radius of this arc should be more than half of the length of $\overline{PQ}$.
3. With the same radius and with Q as centre, draw another arc using compasses. Let it cut the previous arcs at A and B.
4. Join $\overline{AB}$. It cuts $\overline{PQ}$ at C. Then $\overline{AB}$ is the perpendicular bisector of the line segment $\overline{PQ}$.
5. Place the pointer of the compasses at C and open the pencil up to P.
6. Turn the compasses slowly to draw the circle

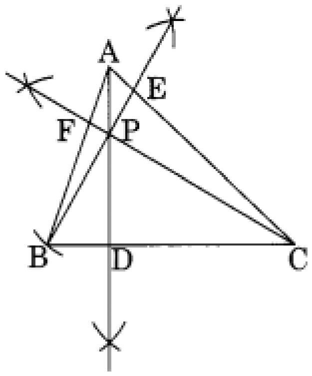
2.



1. Draw a point with a sharp pencil and mark it as C.
2. Open the compasses for the required radius 3.4cm, by putting the pointer on 0 and opening the pencil upto 3.4cm.
3. Place the pointer of the compasses at C.
4. Turn the compasses slowly to draw the circle.
5. Draw any chord $\overline{AB}$ of this circle.
6. With A as centre, using compasses, draw an arc. The radius of this arc should be more than half of the length of $\overline{AB}$.
7. With the same radius and with B as centre, draw another arc using compasses. Let it cut the previous arcs at D and E.
8. Join $\overline{DE}$. Then $\overline{DE}$ is the perpendicular bisector of the line segment $\overline{AB}$. On examinating, we find that it passes through C.

3. Step I: Draw any ΔABC.

Step II: Draw the perpendicular AD from A to BC.



Step III: Draw the perpendicular BE from B to AC.

Step IV: Draw the perpendicular CF from C to AB.

We observe that the perpendiculars AD, BE and CF intersect each other at P.

Thus, P is the point of intersection of the three perpendiculars.

Assertion and Reason Answers:

1) a) Both A and R are individually true and R is the correct explanation of A:

2) d) A is false but R is true.