CHAPTER-11
PRACTICAL GEOMETRY

Students Learning Outcomes

After studying this chapter, students will be able to:

- Divide a line segment into a given number of equal segments.
- Divide a line segment internally in a given ratio.
- Construct a triangle when perimeter and ratio among the lengths of sides are given.
- Construct an equilateral triangle when
  - base is given
  - altitude is given
- Construct an isosceles triangle when
  - base and a base angle, are given,
  - vertex angle and altitude are given,
  - altitude and a base angle are given.
- Construct a parallelogram when
  - two adjacent sides and. their included angle are given,
  - two adjacent sides and a diagonal are given.
- Verify practically that the sum of
  - measures of angles of a triangle is 180°
  - measures of angle of a quadrilateral is 360°

SOLVED EXERCISE 11.1

1. Divide a line segment of length 6cm into 3 congruent parts.

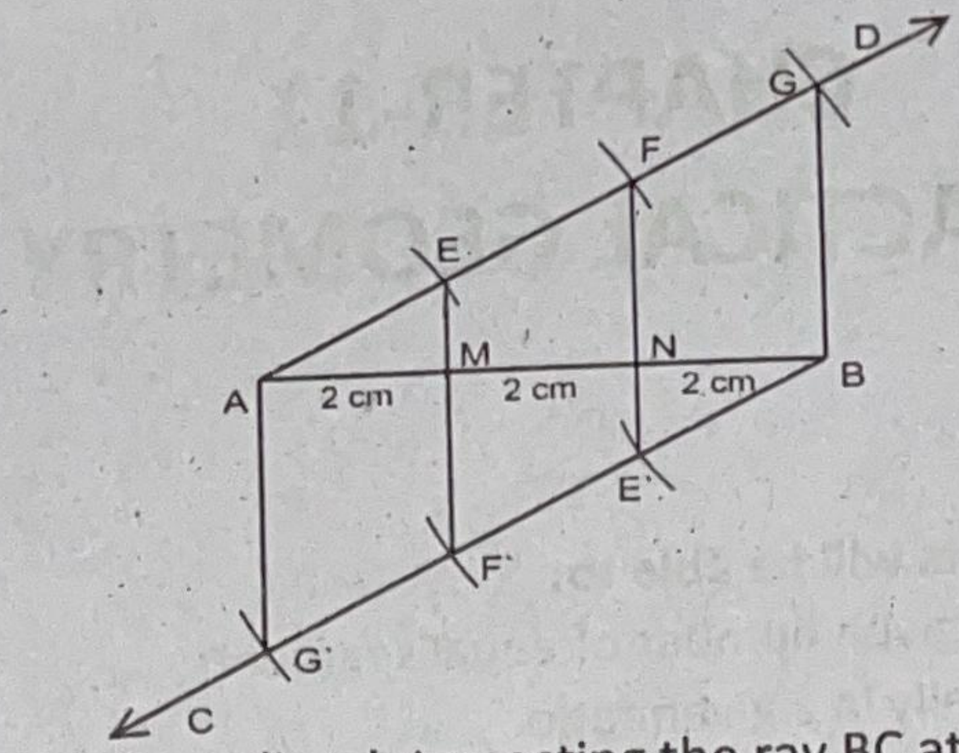
Ans: Steps of Construction:

(i) Draw a line segment AB of length 6cm, using a ruler.

(ii) Draw a ray AD making an acute angle with a line segment AB, (using protractor and rules.)

(iii) Draw another ray BC making the same acute angle.

(iv) Draw 3 arcs of suitable radius, intersecting the ray AD at points E, F and G respectively.



(v) Similarly draw 3 arcs of same radius, intersecting the ray BC at point E', F' and G' respectively.

(vi) Draw line segments AG', EF', FE' and GB', intersecting line segment AB at points M and N.

2. Divide a line segment of length 7.5cm respectively into 5 congruent parts.

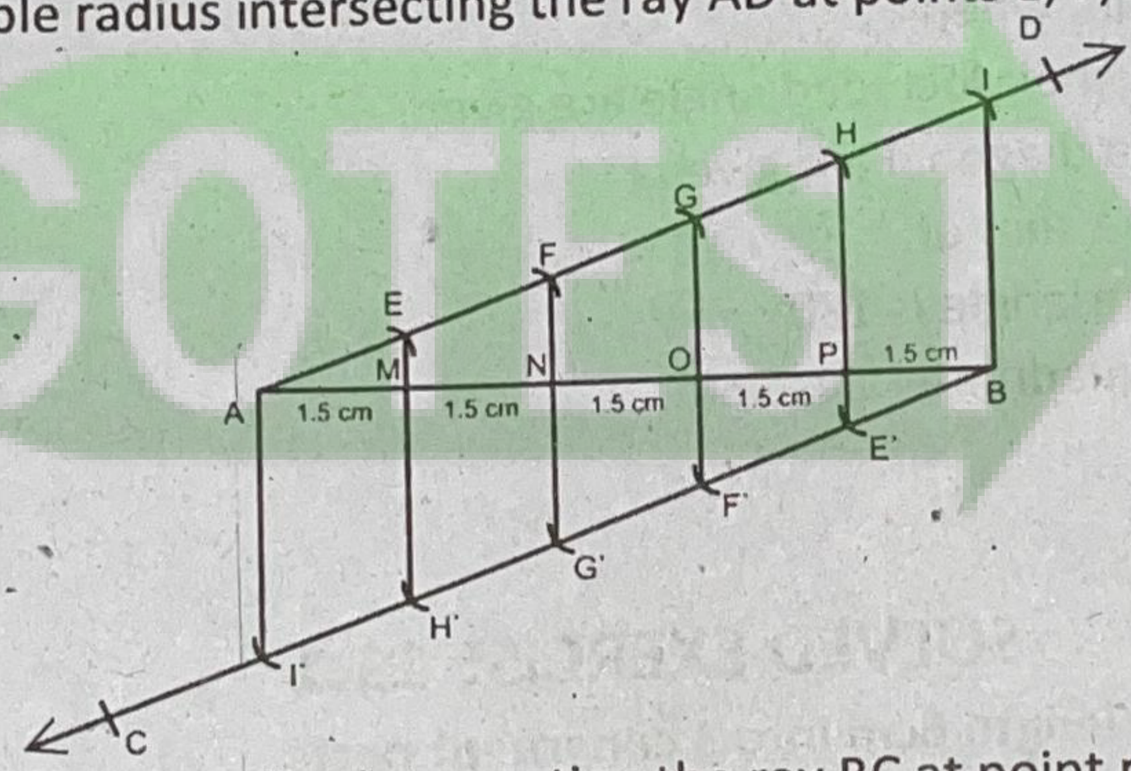
Ans: Steps of Construction:

(i) Draw a line segment AB of length 7.5 cm, using a ruler.

(ii) Draw a ray AD making an acute angle with a line segment AB, using protractor and ruler.

(iii) Draw another ray BC making the same acute angle.

(iv) Draw 5 arcs of suitable radius intersecting the ray AD at points E, F, G, H, I respectively.



(v) Similarly draw arcs of same radius intersecting the ray BC at point respectively.

(vi) Draw line segments AI', EH', FG', GF', HE' and IB, intersecting the line segment AB at point, M, N, O and P respectively.

3. Draw a line segment of length 10.8cm and divide it into 6 congruent parts.

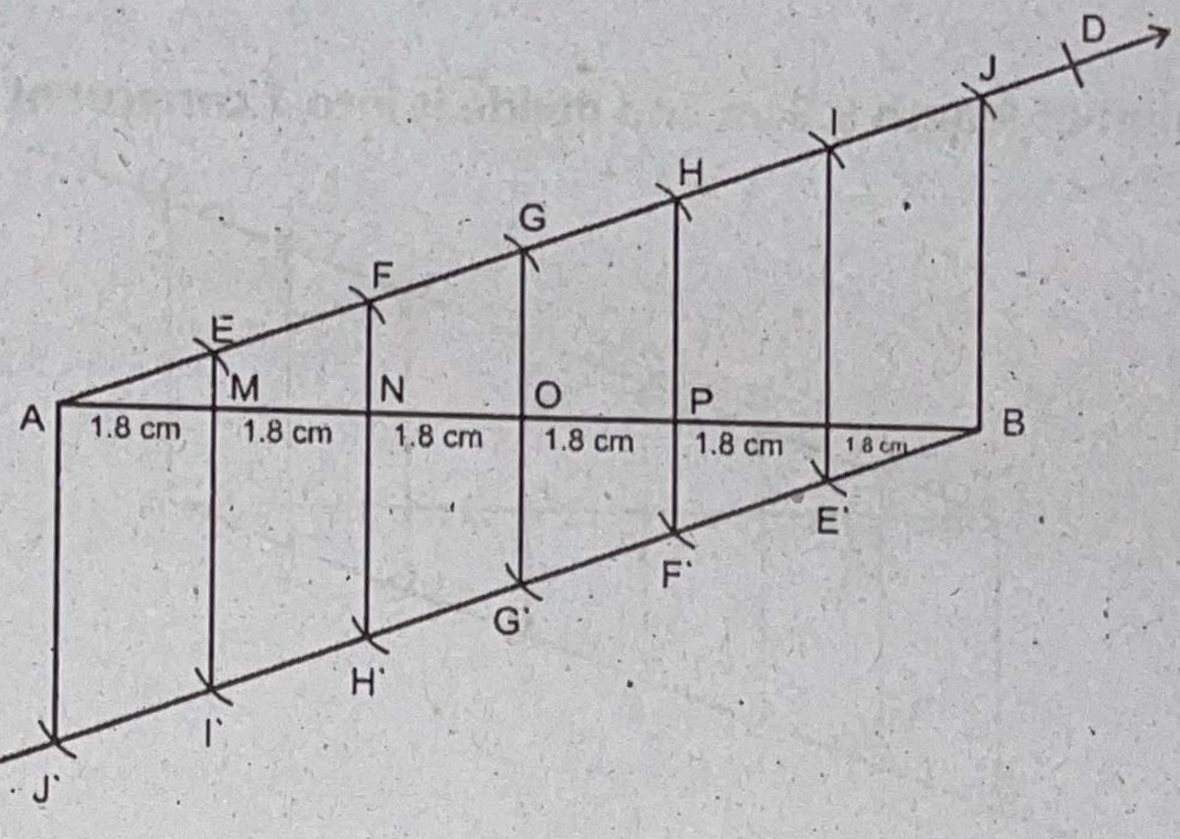
Ans: Steps of Construction:

(i) Draw a 10.8cm long line segment AB (use a ruler).

(ii) Draw a ray AD making an acute angle with the line segment AB.

(iii) Draw another ray BC making the same acute angle with the line segment AB.

(iv) Draw arc of suitable radius intersecting the ray AD at points E, F, G, H, I, J respectively.



(v) Similarly draw 6 arcs of same radius intersecting the ray BC at points E' F' G' H', I' and J' respectively.

(vi) Draw line segments *AJ', EI', FH', GG', HF', IE'* and JB. These line segments intersect line segment AB at points M, N, O, P, Q respectively.

4. **Divide a line segment of length 10cm. into 5 congruent parts.**

Ans: **Steps of construction:**

(i) Draw a 10cm long line segment AB (use a ruler).

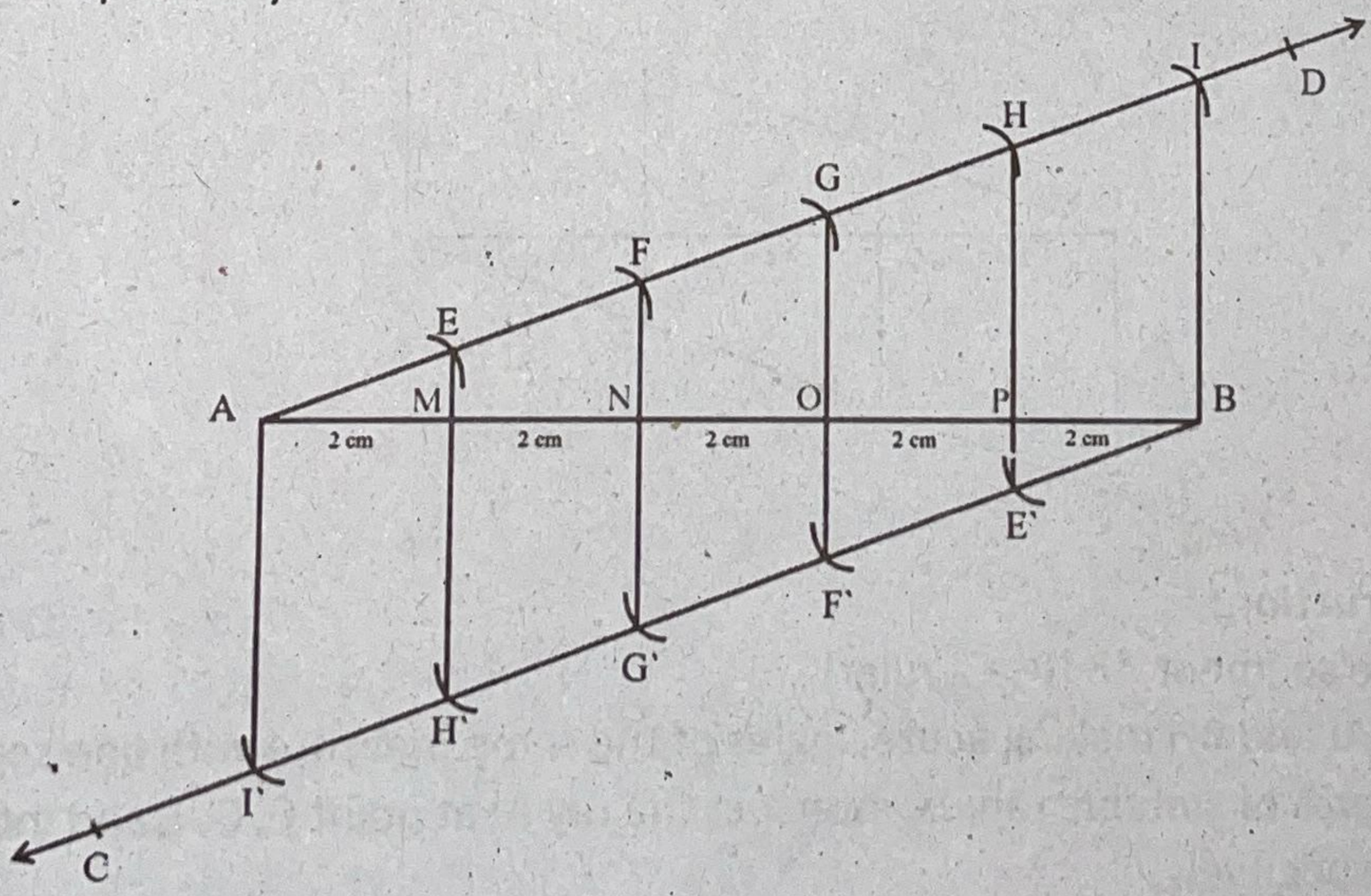
(ii) Draw a ray AD making an acute angle with the line segment AB.

(iii) Draw another ray BC making the same acute angle with the line segment AB.

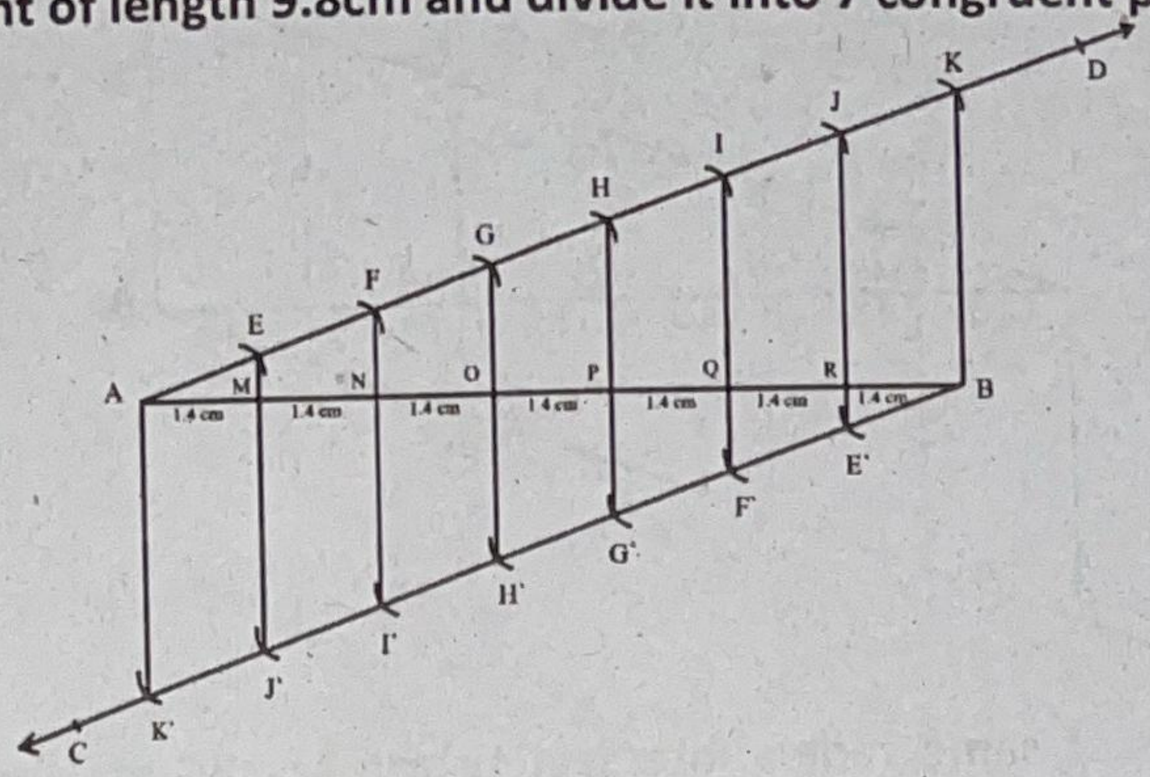
(iv) Draw 5 arcs of suitable radius intersecting the ray AD at points E, F, G, H, I, respectively.

(v) Similarly draw 5 arcs of same radius intersecting the ray BC at point E', F', G', H' and I' respectively.

(vi) Draw line segment, AI', EH', FG', GF', HE', and IB'. These line segments intersect line segment AB at point, M, N, O, P respectively.



5. Draw a line segment of length 9.8cm and divide it into 7 congruent parts.



Ans: Steps of Construction:

(i) Draw a 9.8cm long line segment AB (use a ruler).

(ii) Draw a ray AD making an acute angle with a line segment AB.

(iii) Draw another ray BC making the same angle.

(iv) Draw 7 arcs of suitable radius intersecting the ray AD at points E, F, G, H, I, J, K respectively.

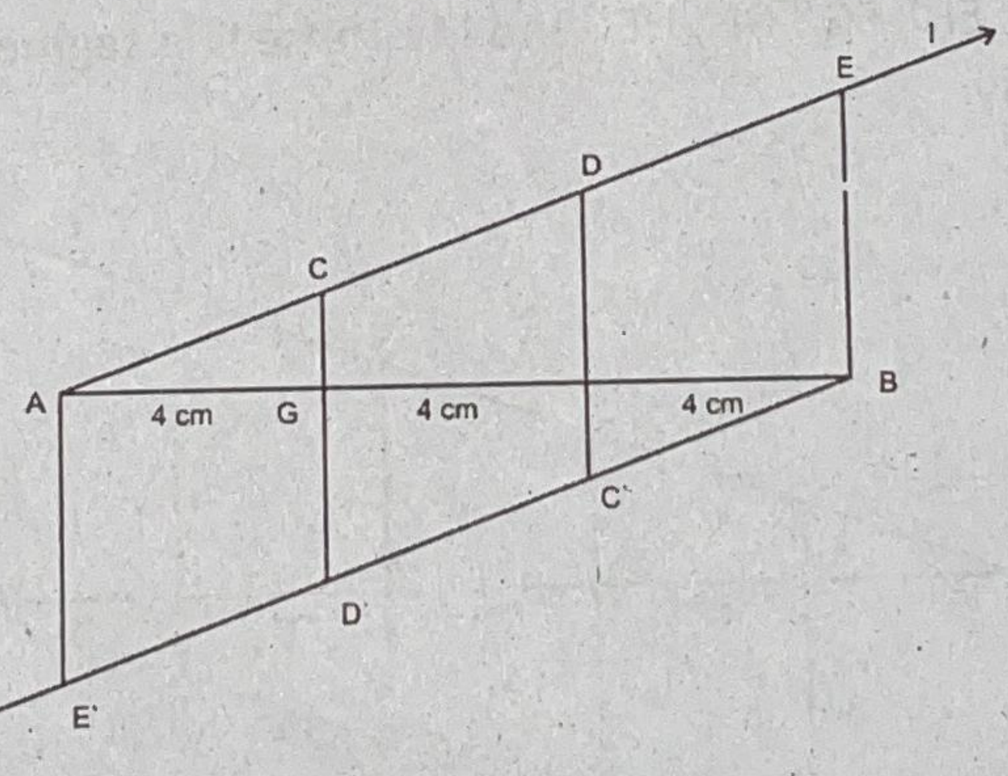
(v) Similarly draw 7 arcs of same radius intersecting the ray BC at point E', F', G', H', I', J' and K' respectively.

(vi) Draw line segment, AK', EJ', FI', GH', HG', IF', JE' and KB'. These line segments intersect line segment AB at points M, N, O, P, Q, R respectively.

6. Divide the line segment:

a. $\overline{AB}$ of length 4cm in the ratio 1:2.

1 : 2 ⇒ 1 + 2 = 3



Ans: Steps of Construction:

(i) Draw a 4cm line segment AB (use a ruler)

(ii) Draw two rays AI and BH making acute angles of the same measure with line segment AB.

(iii) Draw 1 + 2 = 3 arcs of suitable radius, intersect the ray AI at point C, D, E and intersect the ray BH at point C′, D′, E′ respectively.

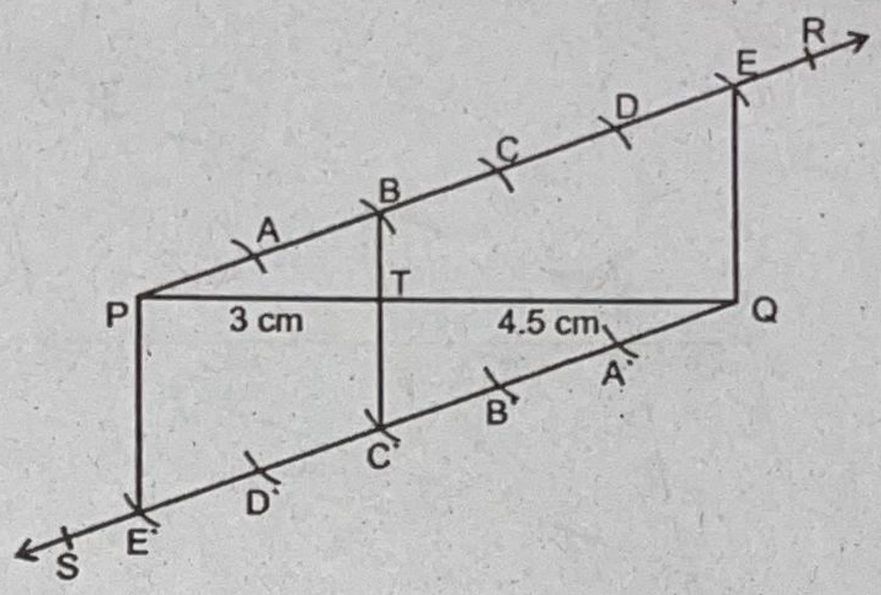
(iv) Draw line segments AE', CD', DC' and EB'.

(v) The line segment CD' intersects $\overline{AB}$ at G.

(vi) The line segments AG, GB are two parts of line segment AB such that $|\overline{AB}|:|\overline{GB}|=1:2$

b. $\overline{PQ}$ of length 7.5cm in the ratio 2:3.

$2:3 \Rightarrow 2+3=5$



Ans: Steps of Construction:

(i) Draw a 7.5cm line segment PQ (use a ruler).

(ii) Draw two rays PR and QS making acute angles of the same measure with line segment PQ.

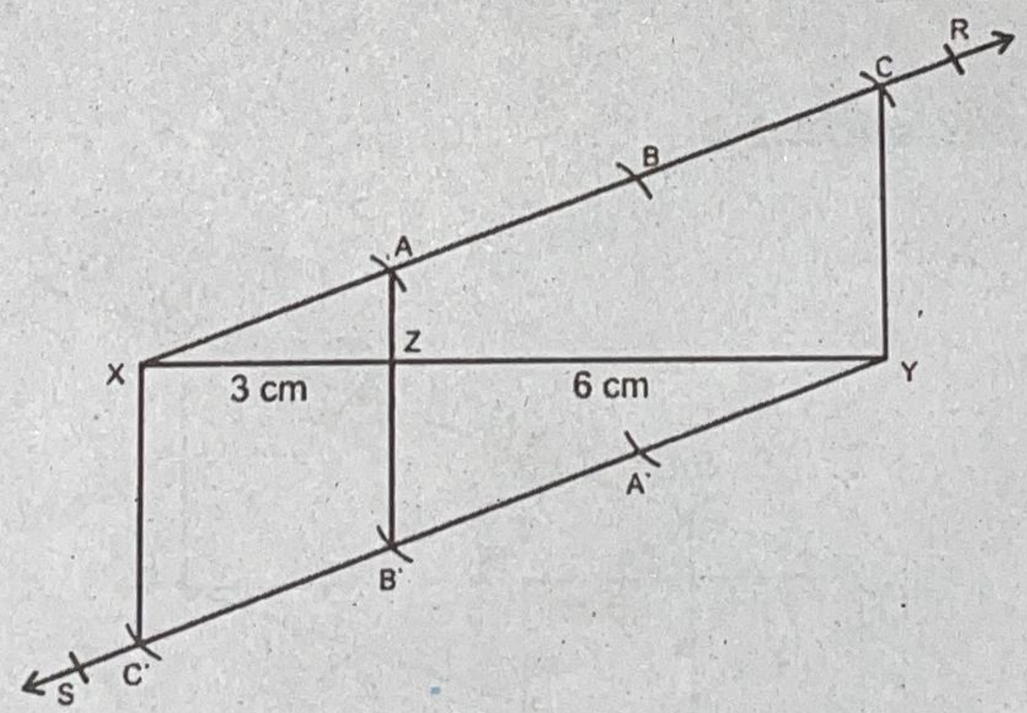
(iii) Draw 2 + 3 = 5 arcs of suitable radius, intersect the ray PR at points A, B, C, D, E and intersect the ray QS at point A′, B′, C′, D′, E′.

(iv) Draw line segments PE′, BC′, and EQ intersect PQ at point T.

(v) The line segments PT, TQ are two parts of line segment PQ such that $|\overline{PT}|:|\overline{TQ}|=2:3$

c. $\overline{XY}$ of length 9cm in the ratio 2:4.

$2:4 \Rightarrow 1:2 \Rightarrow 1+2=3$



Ans: Steps of Construction:

(i) Draw a 9cm line segment XY (use a ruler)

(ii) Draw two rays XR and YS making an acute angle with line segment xy.

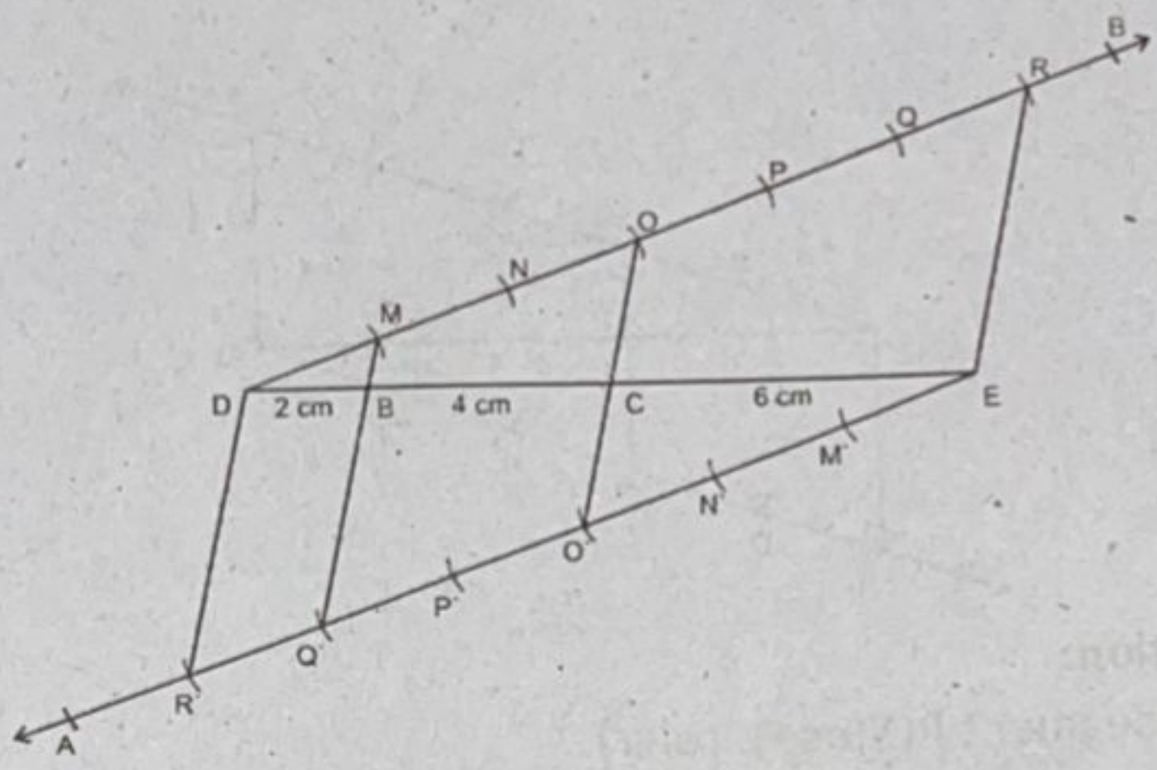
(iii) Draw 1 + 2 = 3 arcs of suitable radius, intersect the ray XR at points A, B, and C and intersect the ray Y′S at points A′, B′ and C′.

(iv) Draw line segments XC', AB', and Cy. The line segment AB'intersects the line segment XY at point Z.

(v) The line segments XZ, and ZY are two parts of line segment XY such that $|\overline{XZ}|:|\overline{ZY}|=1:2$

d. $\overline{DE}$ of length 6cm in the ratio 1:2:3.

$1:2:3 \Rightarrow 1+2+3=6$



Ans: Steps of Construction:

(i) Draw a 6cm line segment DE (use a ruler)

(ii) Draw two rays DB and EA making acute angles of the same measure with line segment DE.

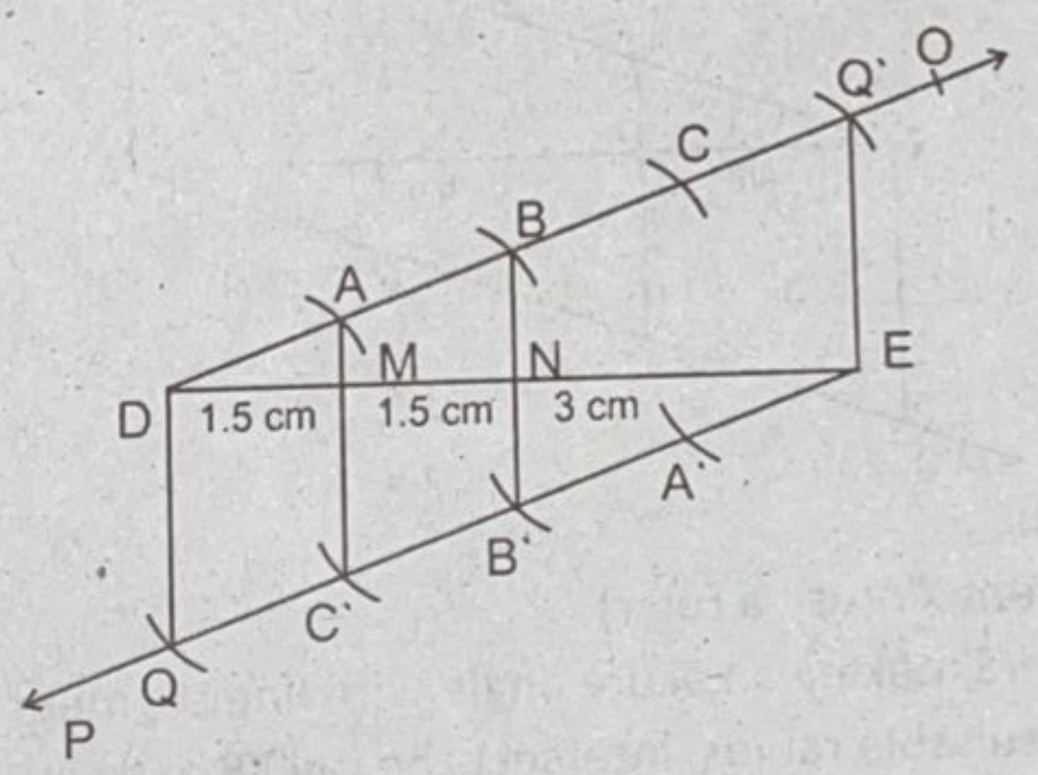
(iii) Draw 1 + 2 + 3 = 6 arcs of suitable radius, intersecting the ray DB at points M, N, O, P, Q, R and intersecting the ray EA at points M', N', O', P', Q', R'.

(iv) Draw line segments DR', MQ', OO', and RE. The line segments MQ', OO' intersect the line segment DE at points B and C.

(v) The line segments DB, BC and CE are parts of line segment DE which divide the line segment DE in the ratio 1 : 2 : 3.

e. $\overline{DE}$ of length 6cm in the ratio 1:1:2.

$1:1:2 \Rightarrow 1+1+2=4$



Ans: Steps of Construction:

(i) Draw a 6cm line segment DE (use a ruler)

(ii) Draw two rays DO and EP making acute angles of the same measure with line segment DE.

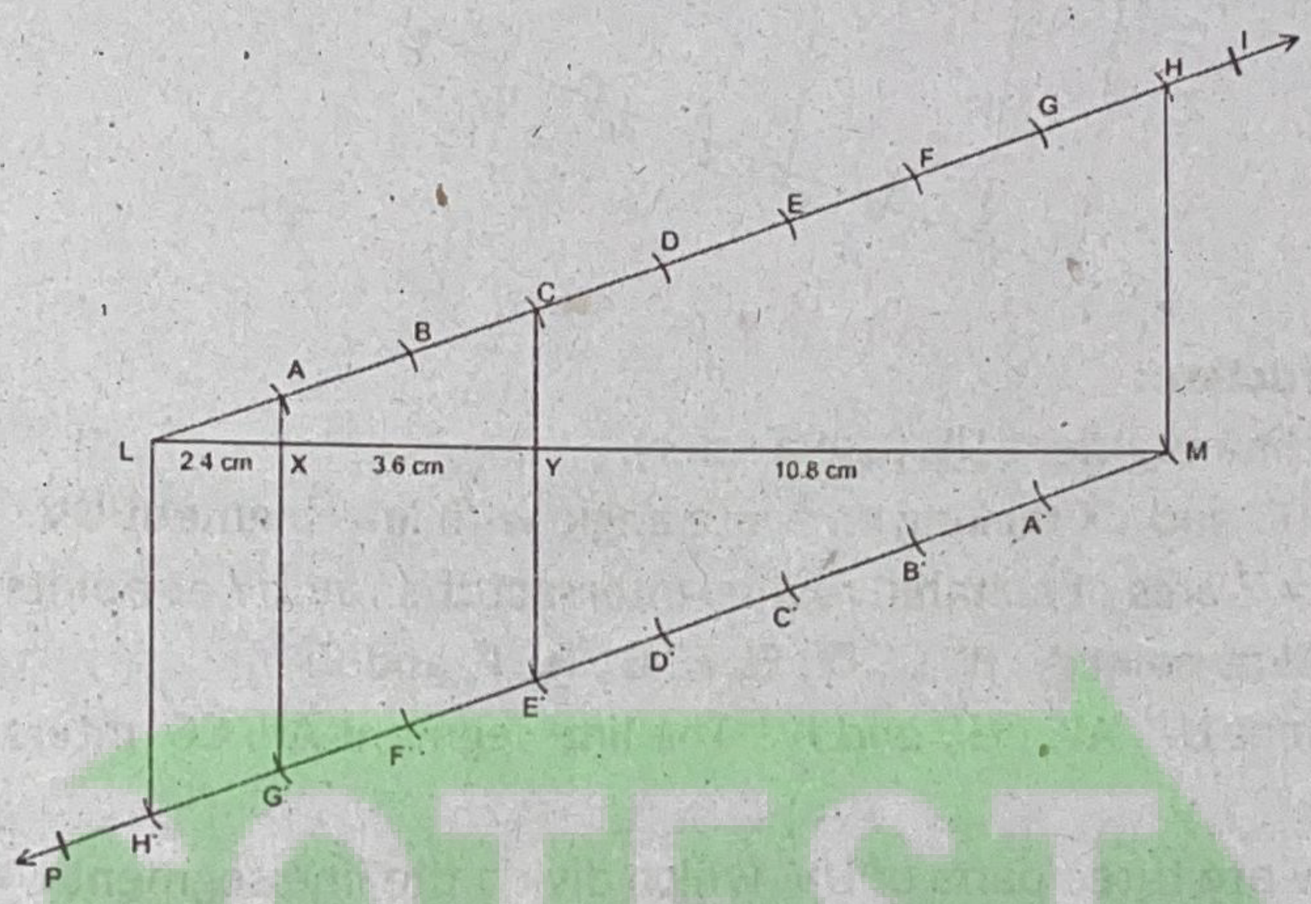
(iii) Draw 1 + 1 + 2 = 4 arcs of suitable radius, intersect the ray DO at points A, B, C, Q, and intersect the ray EP at points A′,B′,C′,Q′ respectively.

(iv) Draw line segments DQ′, AC′, BB′ and QE. The line segments AC′ and BB′ intersect the line segment DE at points M and N.

(v) The line segments DM, MN and NE divided the line segment DE in the ratio 1 : 1 : 2.

f. $\overline{LM}$ of length 10.8cm in the ratio 2:3:4.

2 : 3 : 4 ⇒ 2 + 3 + 4 = 9



Ans: Steps of Construction:

(i) Draw a 10.8cm line segment LM (use a ruler).

(ii) Draw two rays LO and MP making acute angles of the same measure with line segment LM.

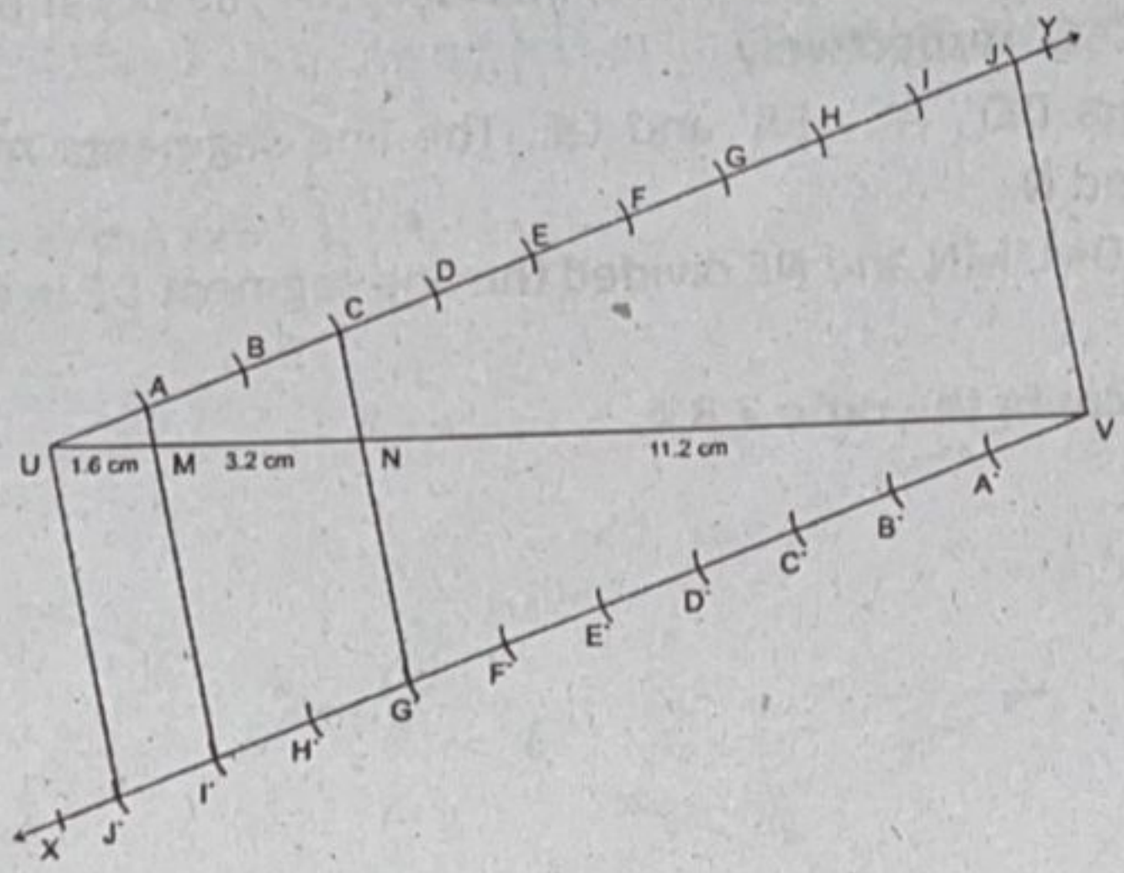
(iii) Draw 2 + 3 + 4 = 9 arcs of suitable radius, intersect the ray LO at point A, B, C, D, E, F, G, H and intersect the ray MP at points A′, B′, C′, D′, E′, F′, G′, H′.

(iv) Draw line segments LH′, AG′, CE′ and HM. The line segments AG′ and CE′ intersect the line segments HM at X and Y.

(v) LX, XY and YM are three parts of LM which divide the line segment LM in the ratio 2:3:4.

g. $\overline{UV}$ of length 11.2cm in the ratio 1:2:4.

1 : 2 : 4 ⇒ 1 + 2 + 4 = 7



Ans: Steps of Construction:

(i) Draw a 11.2cm line segment UV (use a ruler).

(ii) Draw two rays UY and VX making an acute angle with line segment UV.

(iii) Draw 1 + 2 + 4 = 7 arcs of suitable radius, intersect the ray UY at points A, B, C, D, E, F, G, H, I, J and intersect the ray VX at point A′, B′, C′, D′, E′, F′, G′, H′, I′, and J′.

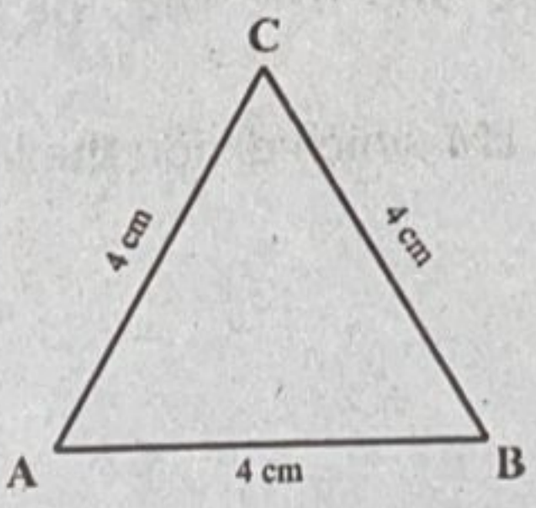
(iv) Draw line segment UJ′, AI′, CG′, *and* JV′. The line segment AI′, CG′ intersect the line segment UV at points M and N.

(v) UM, MN and NV are three parts of UV, which divide the line segment UV in the ratio 1:2:4.

SOLVED EXERCISE 11.2

1. Construct the equilateral triangles of given measures.

(a) base = 4cm



Ans: Steps of Construction:

(i) Draw a line segment of length 4cm using a ruler. Label its end points A and B.

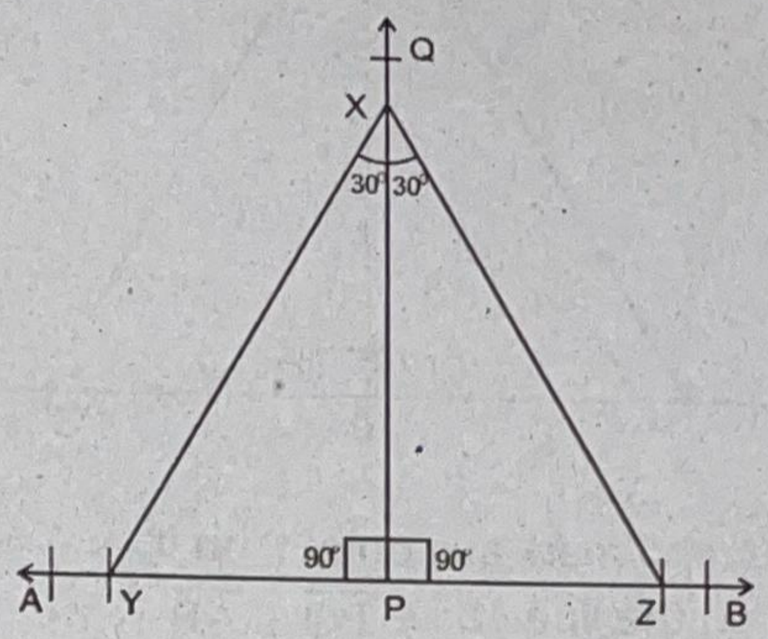
(ii) Place the needle of the compasses at point A and Open it so that the tip of the pencil touches the point B.

(iii) Draw an arc of radius $\overline{AB}$ with center A.

(iv) Draw another arc of radius $\overline{AB}$ with center B. This arc will intersect the first arc at one point. Name the common point of two arcs as C.

(v) Joint 'C' with 'A' and 'B'. ΔABC is the required triangle.

(b) **altitude = 6cm**



Ans: Steps of Construction:

(i) Draw a line AB using a ruler and mark any point P on it.

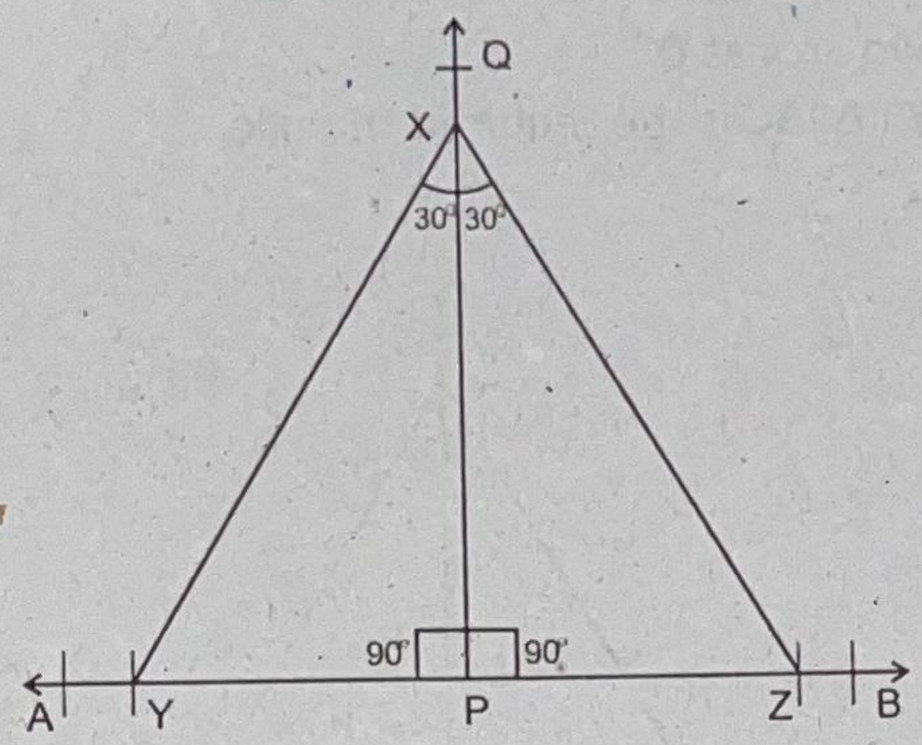
(ii) Draw a perpendicular $\overrightarrow{PQ}$ on the line AB i.e $\overrightarrow{PQ} \perp \overline{AB}$

(iii) From point P draw an arc of measure 6cm. This arc will cut the perpendicular $\overrightarrow{PQ}$ at any point X as shown.

(iv) Since the vertex angle is 60° and the altitude bisects it. So perpendicular will make angles of 30° on both sides of $\overline{PX}$.

(v) Draw two angles of measure 30° with perpendicular PX on both sides. These arms cut the base line at Points Y and Z. ΔXYZ in the required triangle.

(c) altitude = 5.5cm



Ans: Steps of Construction:

(i) Draw a line AB using a ruler and mark any point P on it.

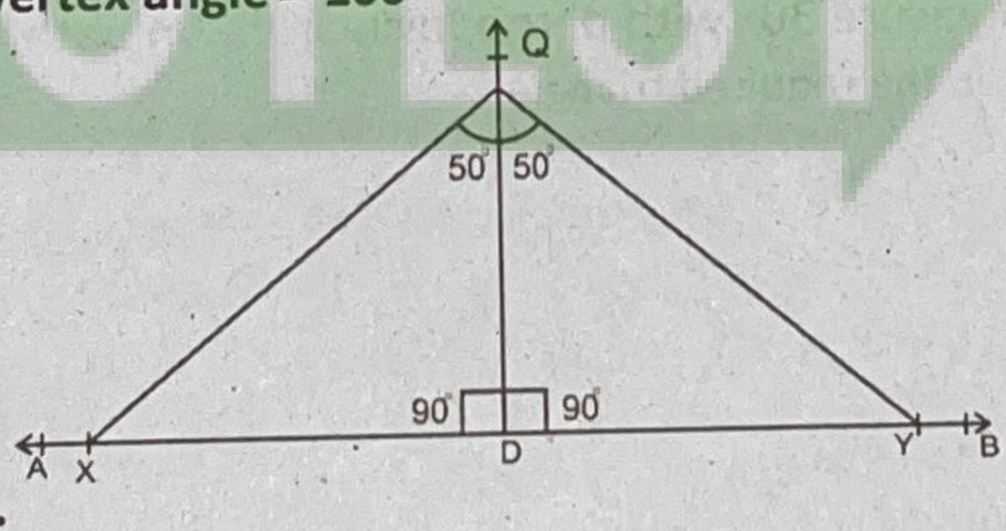
(ii) Draw a perpendicular $\overline{PQ}$ on the line AB i.e $\overline{PQ} \perp \overline{AB}$

(iii) From the point P draw an arc of measure 5.5cm. This are will out $\overline{PQ}$ at points X as shown.

(iv) Since the vertex angle is 60° and the altitude bisects it. So perpendicular will make angles of 30° on both sides of $\overline{PX}$.

(v) Draw two arms making angles of 30° with perpendicular $\overline{PX}$ on both sides. These arms cut the base line at points 'Y' and 'Z'. ΔXYZ is the required triangle.

(d) altitude = 3.5cm and vertex angle = 100°



Ans: Steps of Construction:

(i) Draw a line XY and choose any point D on it.

(ii) Draw a perpendicular $\overline{DG}$ above the base line, i:e $\overline{DG} \perp \overline{XY}$

(iii) From point D, draw an arc of radius 3.5cm to cut this perpendicular at point C.

(iv) Since the vertex angle is 100° and an altitude bisects it. So, perpendicular will make angles of 50° on both sides of $\overline{DC}$.

(v) Draw two arms making angles of 50° with perpendicular $\overline{DC}$, on its both sides and these arms cut the base line at points A and B. ΔABC is the required triangle.

(e) base = 5cm and base angle = 65°

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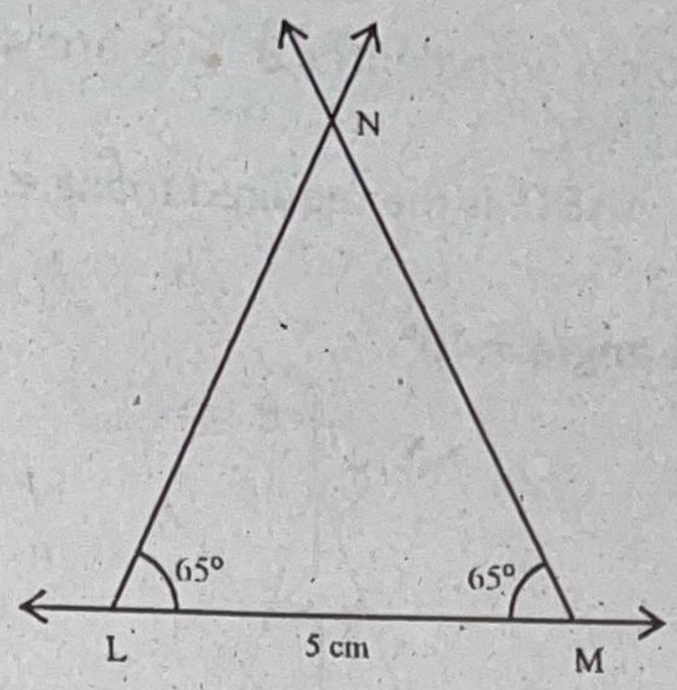


Ans: Steps of Construction:

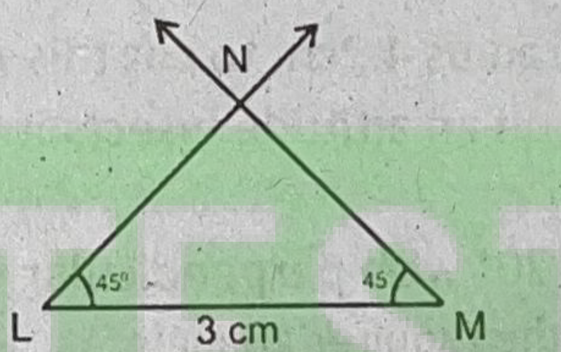
(i) Draw a line segment LM of length 5cm using a ruler.

(ii) Construct an angle of 65° at the point L.

(iii) Construct another angle of 65° at points M. The arms of these angles intersect each other at point 'N'. ΔLMN is the required triangle .

2. Construct an isosceles triangle whose:

(a) base = 3cm and base angle = 45°



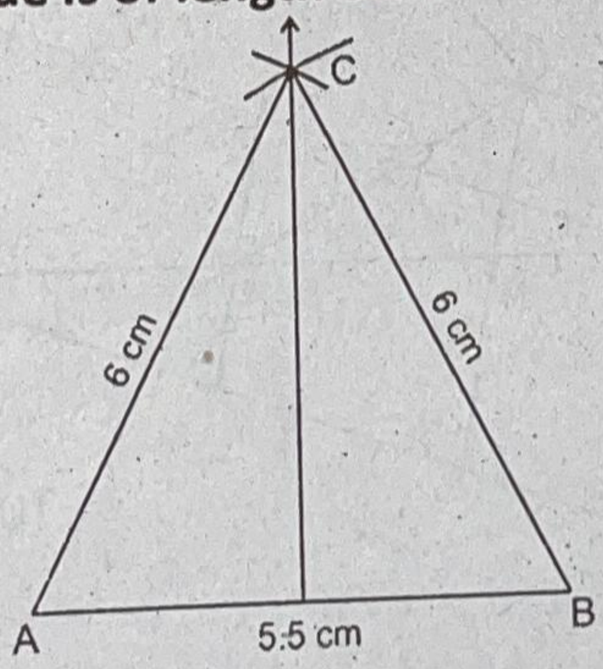
Ans: Steps of Constructions:

(i) Draw a line segment LM of length 3cm using a ruler.

(ii) Construct an angle of 45° at the point L.

(iii) Construct another angle of 45° at point M. The arms of these angles intersect each other at point 'N'. LMN is the required triangle.

(b) base = 5.5cm and each other side is of length 6cm.



Ans: Steps of Construction:

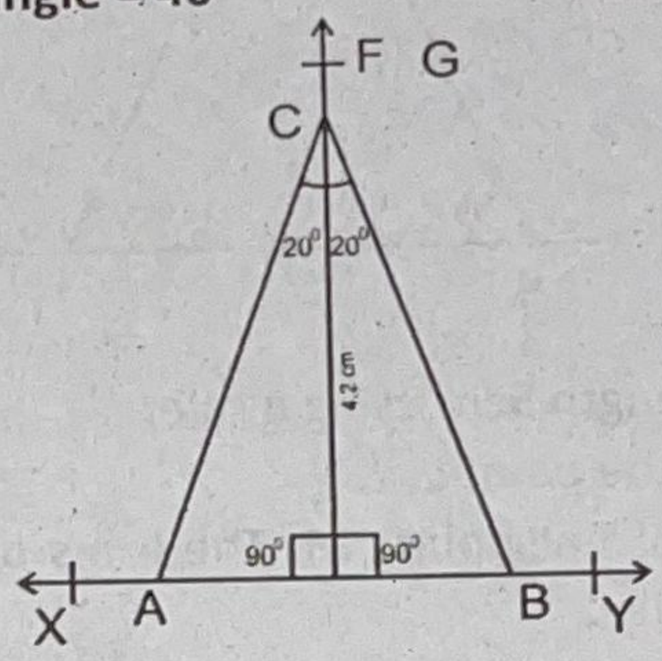
(i) Draw a line segment of length 5.5cm (using ruler). Label its end points as A and B.

(ii) Draw an arc of radius 6 cm with center A.

(iii) Draw another arc of radius 6 cm with center B. This arc will intersect the first area at one point. Name the common point of two arcs as C.

(iv) Join C to the points A and B. ΔABC is the required triangle.

(c) altitude = 4.2cm and vertex angle = 40°



Ans: Steps of Construction:

(i) Draw a line xy and choose any point D on it.

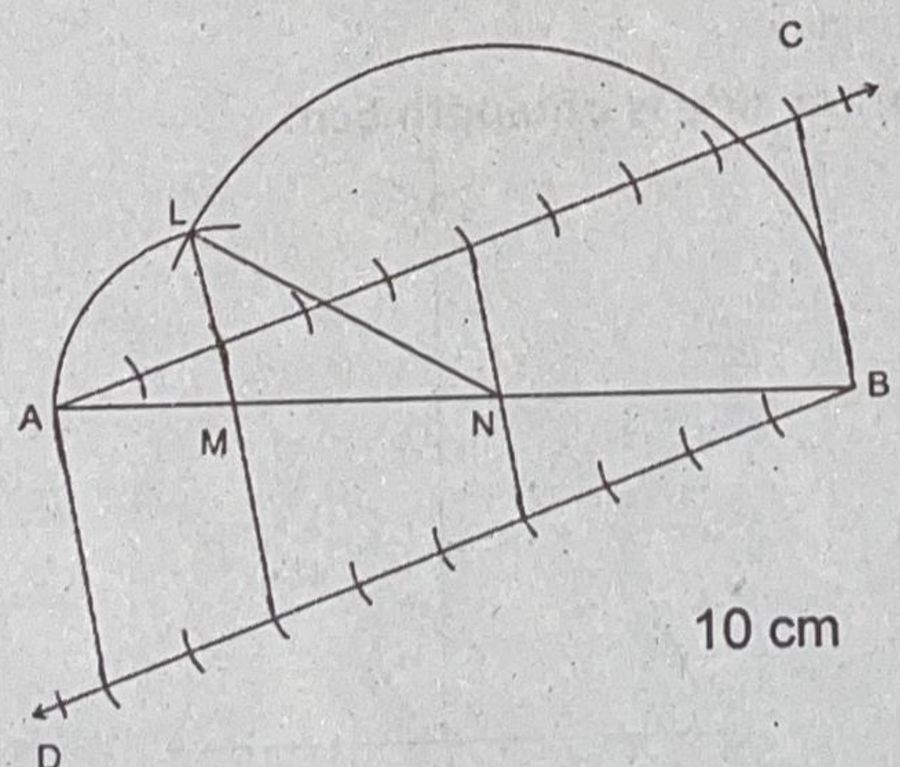
(ii) Draw a perpendicular $\overline{DF}$ above the baseline.

(iii) From point D, draw an arc of radius 4.2cm to cut this perpendicular at point C.

(iv) Since the vertex angle is 40° and an altitude bisects it. So, perpendicular will make the angle 20° on both sides.

(v) Draw two arms making angle 20° with perpendicular CD, on both sides and these arms cut the base line at points A and B. ΔABC is the required triangle.

3. Construct a triangle ΔLMN whose ratio among the lengths of its sides is 2:3:4 and perimeter is 10cm.



Ans: Steps of Construction:

(i) Draw a line segment AB of length 10cm.

(ii) Divide the line segment AB in given ratio 2:3:4.

(iii) Consider the point M as center and draw an arc by using the length of AM as radius.

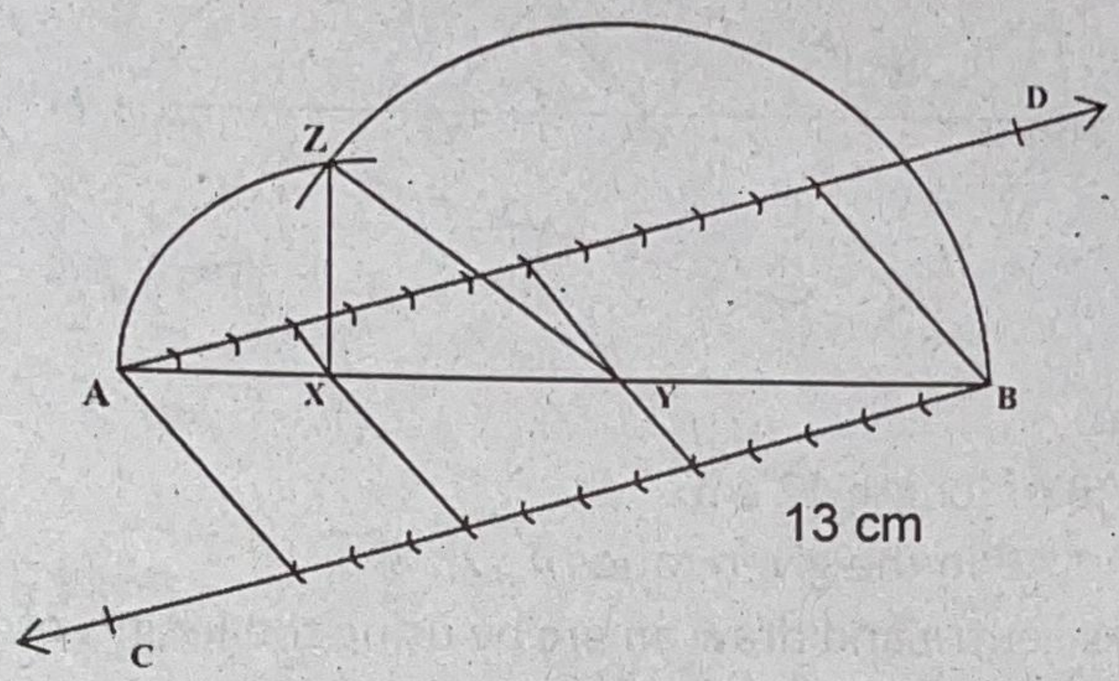
(iv) Again consider the point N as center and draw another arc by using the length of NB as radius.

(v) Label the point of intersections of two arcs as L.

(vi) Join the point L with M and N. ΔLMN is the required triangle.

4. Construct a triangle *ΔXYZ* whose perimeter is 13cm and 3:4:5 is the ratio among the length of its sides.

3:4:5 = 3 + 4 + 5 ⇒ 12



Ans: Steps of Construction:

(i) Draw a line segment AB of length 13cm.

(ii) Divide the line segment AB in the given ratios 3:4:5.

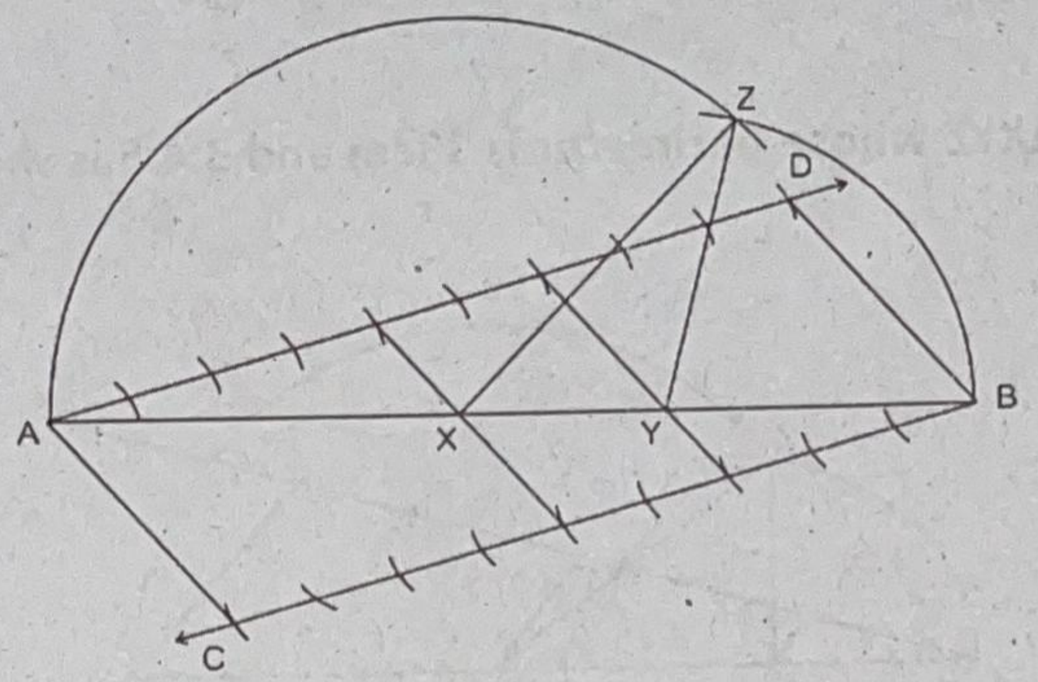
(iii) Consider the point x as center and draw an arc by using the length of AX as radius.

(iv) Again consider the point Y as center and draw another arc by using by using the length of YB as radius.

(v) Label the point of intersection of two arcs as Z.

(vi) Join the point Z with X and Y. ΔXYZ is the required triangle.

5. The perimeter of a ΔXYZ *is* 12cm and the ratio among the lengths of its sides is 4:2:3. Construct the triangle ΔXYZ.



Ans: Steps of Construction:

(i) Draw a line segment AB of length 12 cm.

(ii) Divide the line segment AB in the given ratios 4 : 2 : 3.

(iii) Consider the point X as centre and draw an arc by using the length of AX as radius.

(iv) Again consider the point Y as centre and draw another arc by using the length of YB as radius.

(v) Label the point of intersection of two arcs as Z.

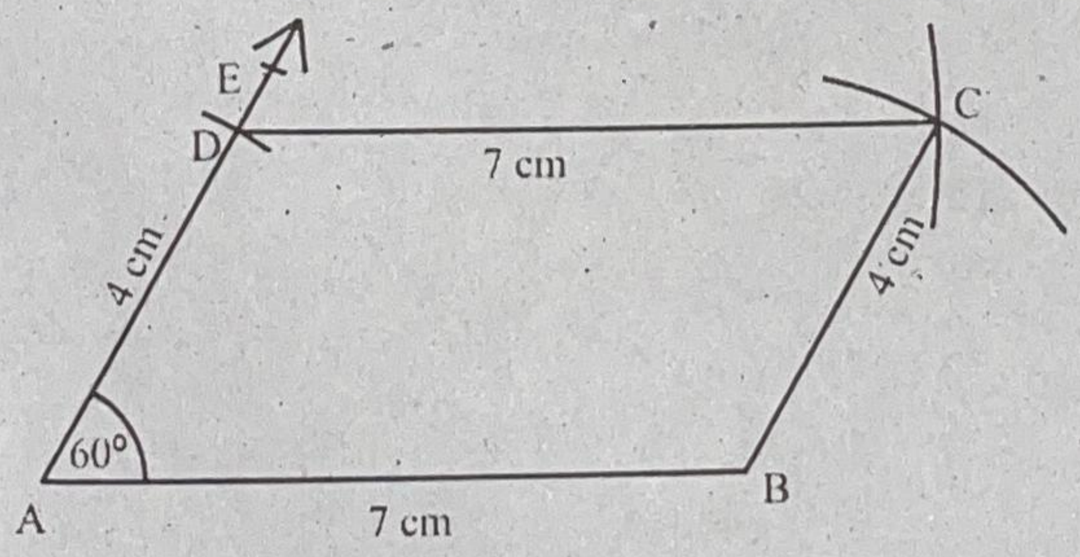
(vi) Join the point Z with X and Y. ΔXYZ is the required triangle.

SOLVED EXERCISE 11.3

1. Construct the parallelogram *ABCD* where

$m\overline{AB} = 7cm$ $m\overline{BC} = 4cm$

$m\angle BAC = 60^\circ$



Ans: Steps of Construction:

(i) Draw $\overline{AB}$ 7cm long.

(ii) Construct an angle of 60° at point A i.e $\angle A = 60^\circ$

(iii) Draw an arc of radius 4cm intersecting $\overline{AE}$ at the point D.

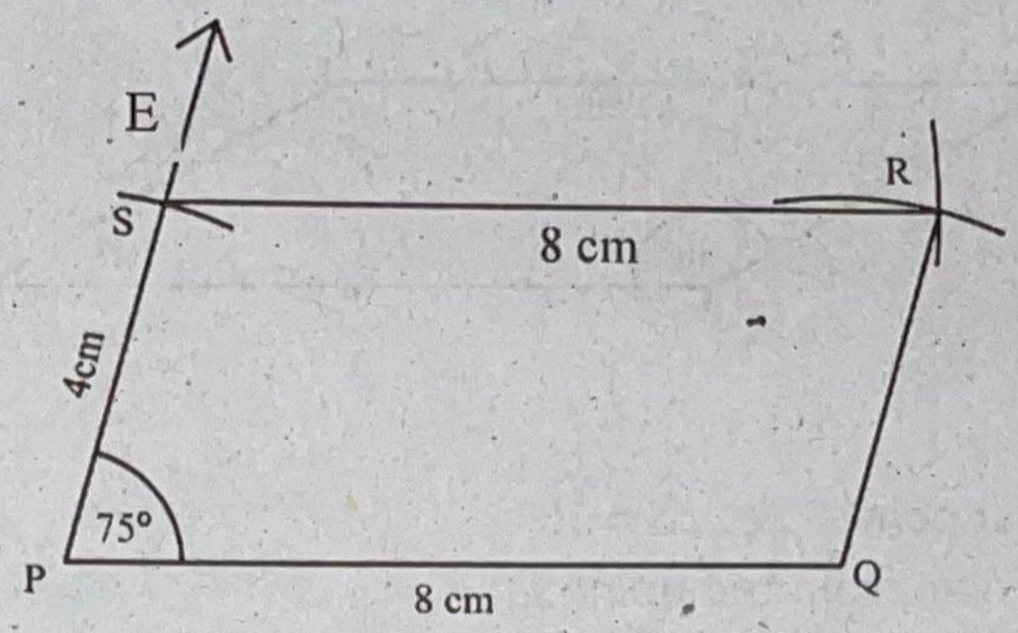
(iv) Now take point B as centre and draw another arc of radius 4cm.

(v) Now again consider the point D as centre and draw an arc of radius 7cm. This arc will intersect the previous arc on the point C.

(vi) Join point C with point D and point B. ABCD is the required parallelogram.

2. Construct the parallelogram PQRS where.

$m\overline{PQ} = 8cm$ $m\overline{QR} = 4cm$ $m\angle P = 75°$



Ans: Steps of Construction:

(i) Draw $\overline{PQ}$ 8cm long.

(ii) Construct an angle 75° at point P i.e. $\angle P$.

(iii) Draw an arc of radius 4cm intersecting $\overrightarrow{PE}$ at the point S.

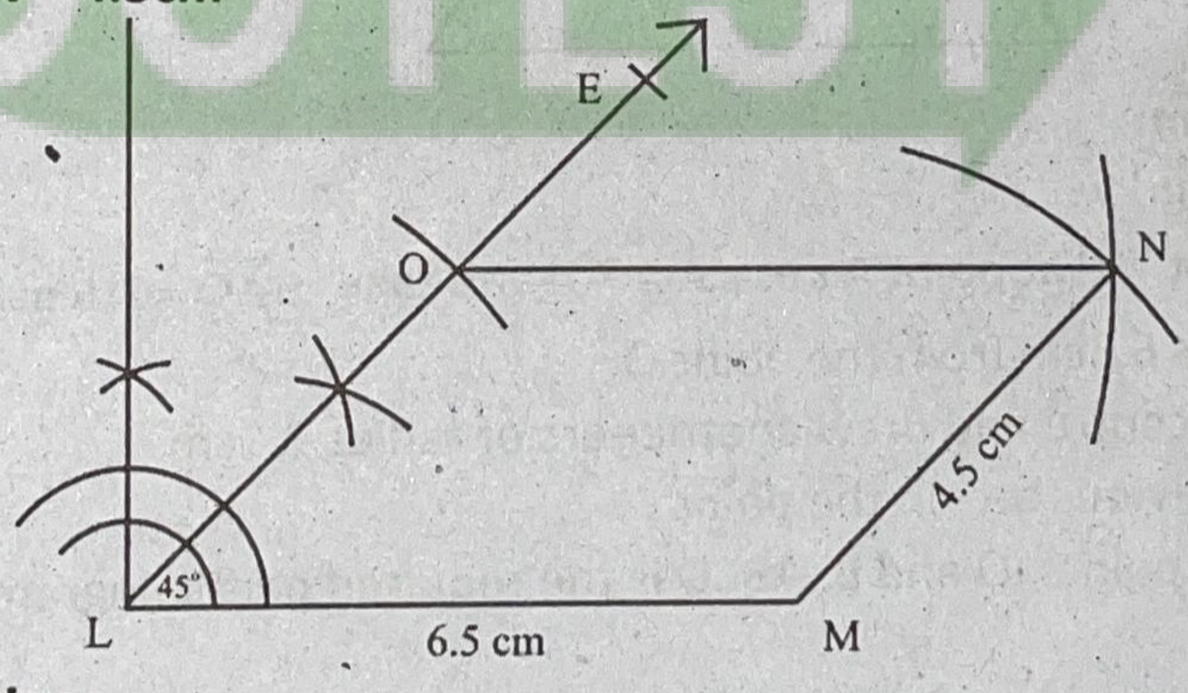
(iv) Now take the point Q as centre and draw another arc of radius 4cm.

(v) Now again consider the point S as centre and draw an arc of radius 8cm. This arc will intersect the previous arc on the point R.

(vi) Join the point R with point, S and Q, PQRS is the required parallelogram.

3. Construct the parallelogram *LMNO* where

***mLM* = 6.5cm** ***mMN* = 4.5cm**



Ans: Steps of Construction:

(i) Draw $\overline{LM}$ 6.5cm long.

(ii) Construct an angle 45° at point L i.e. $\angle L = 45°$.

(iii) Draw an arc of radius 4.5cm intersecting $\overrightarrow{LE}$ at the point O.

(iv) Now take the point M as centre and draw another arc of radius 4.5cm.

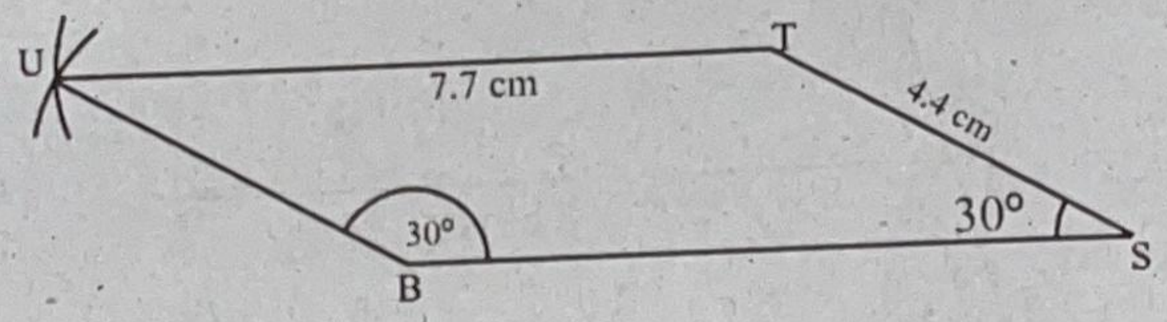
(v) Now again consider the point O as centre and draw an arc of radius 6.5cm. This arc will intersect the previous arc on the point N.

(vi) Join the point N with point O and M, LMNO is the required parallelogram.

4. Construct the parallelogram *BSTU* where

$m\overline{BS} = 7.7cm$ $m\overline{ST} = 4.4cm$

$m\angle BST = 30°$



Ans: Steps of Construction:

(i) Draw $\overline{BS}$ 7.7cm long.

(ii) Construct an angle 30° at point S i.e. $\angle S = 30°$.

(iii) Draw an arc of radius 4.4cm from the point S.

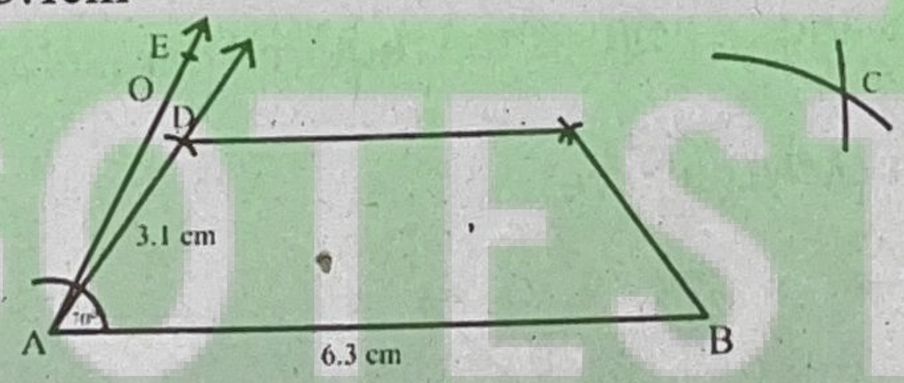
(iv) Now take point B as centre and draw another arc of radius 4.4cm.

(v) Now again consider the point T as centre and draw an arc of radius 7.7cm. This arc will intersect the previous arc on the point U.

(vi) Join the point U with points T and B with points T and B. BSTU is the required parallelogram.

5. Construct the parallelogram ABCO where

$m\overline{OA} = 6.3cm$ $m\overline{AB} = 3.1cm$ $m\angle A = 70°$



Ans: Steps of Construction:

(i) Draw $\overline{AB}$ 6.3cm long.

(ii) Construct an angle of 70° at point A i.e. $\angle A = 70°$ and take $m\overline{AO} = 3.1cm$ from $\overrightarrow{AE}$.

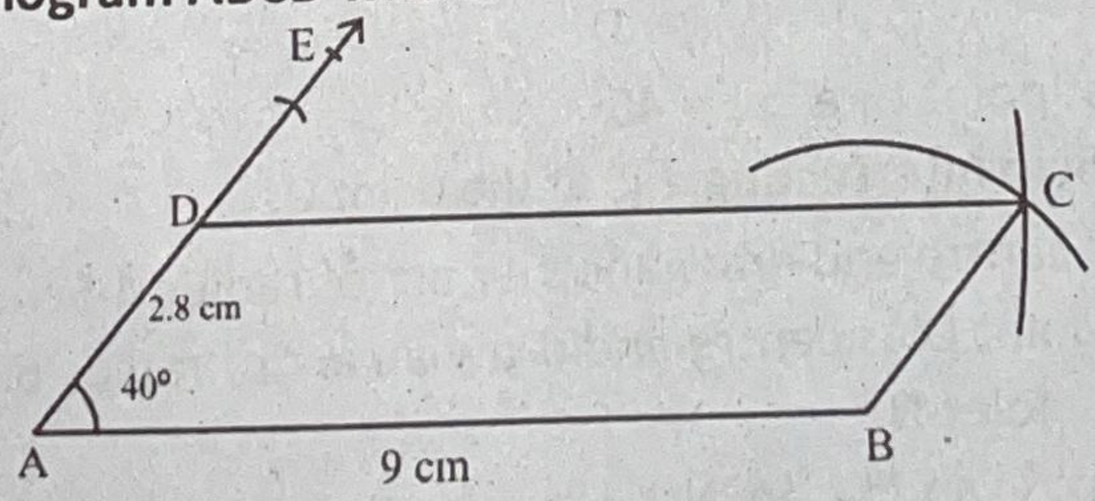
(iii) Draw an arc of radius 6.3cm from the point O.

(iv) Now take point B as centre and draw another arc of radius 3.1cm.

This arc will intersect the previous arc on the point C.

(v) Join the point C with points, O and B, ABCO is the required parallelogram.

6. Construct the parallelogram ABCD where



Ans: Steps of Construction:

(i) Draw $\overline{AB}$ 9cm long.

(ii) Construct an angle 40° at point A i.e. $\angle A = 40°$.

(iii) Draw an arc of radius 2.8cm from A and take $m\overline{AD} = 2.8cm$ from $\overrightarrow{AE}$.

(iv) Now take point B as centre and draw an arc of radius 2.8cm.

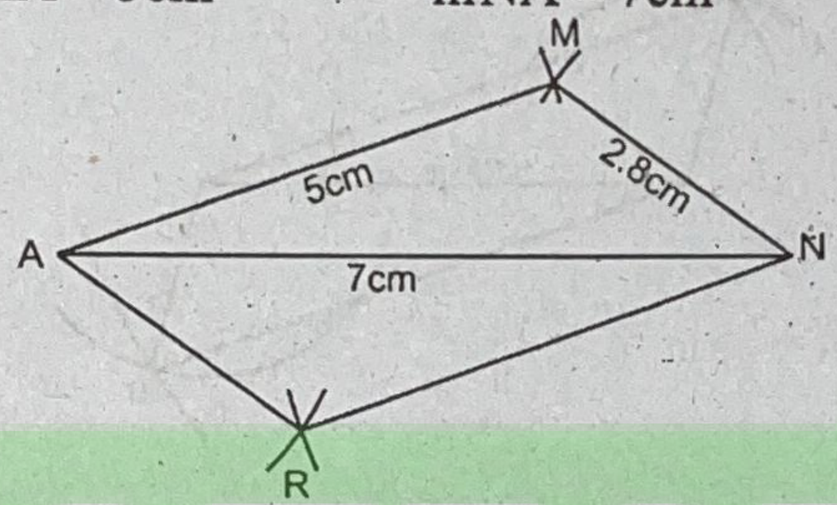
(v) Now again consider the point D as centre and draw an arc of radius 9cm. This arc will intersect the previous arc on the point C.

(vi) Join the point C with points D and B. ABCD is the required parallelogram.

SOLVED EXERCISE 11.4

1. Construct the parallelogram MNRA where

$m\overline{MN} = 2.8cm$ $m\overline{MA} = 5cm$ $m\overline{NA} = 7cm$



Ans: Steps of Construction:

(i) Draw a line segment AN of 7cm.

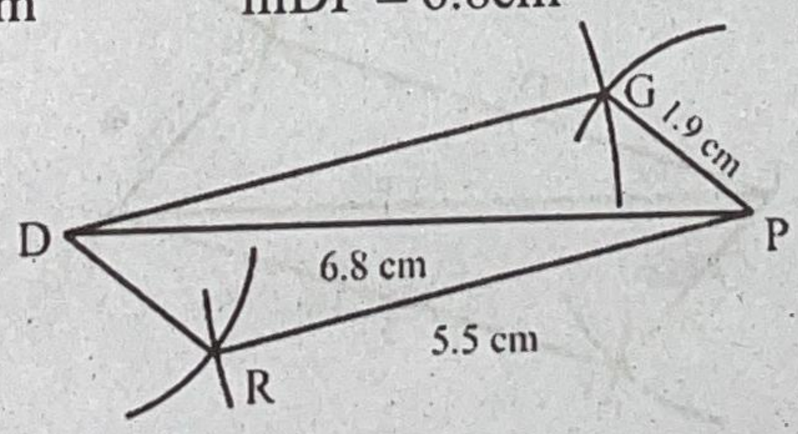
(ii) Consider the Point A as centre and draw an arc of radius 5cm on the upper side of line segment AN and draw another arc of radius 2.8cm on the lower side of line segment AN.

(iii) Now consider the point N as centre and draw an arc of radius 2.8cm on the upper side of line segment AN and draw another arc of radius 5cm on the lower side of line segment AN (These arcs intersect at point M and R).

(iv) Finally join the points M and R with the point A and then the point N. MNRA is the required parallelogram.

2. Construct the parallelogram GPRD where

$m\overline{DG} = 5.5cm$ $m\overline{GP} = 1.9cm$ $m\overline{DP} = 6.8cm$



Ans: Steps of Construction:

(i) Draw a line segment $\overline{DP}$ of 6.8cm.

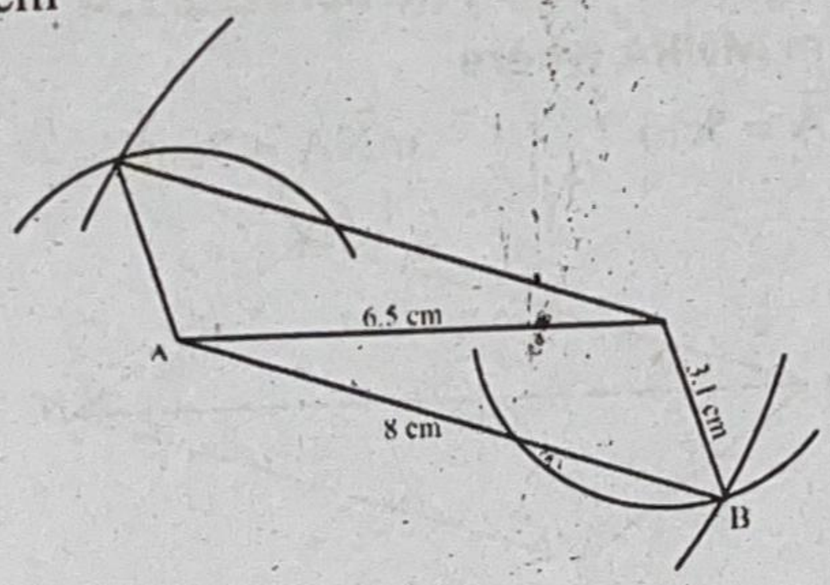
(ii) Consider the Point D as centre and draw an arc of radius 5.5cm on the upper side of line segment DP and draw another arc of radius 1.9cm on the lower side of line segment DP.

(iii) Now consider the point P as centre and draw an arc of radius 1.9cm on the upper side of line segment DP and draw another arc of radius 5.5cm on the lower side of line segment DP. (These arcs intersect at point G and R).

(iv) Finally join the points G and R with the point D and then the point P. GPRD is the required parallelogram.

3. Construct the parallelogram *ACBD* where

$m\overline{AC} = 3.1cm$ $m\overline{AB} = 6.5cm$ $m\overline{CB} = 8cm$



Ans: Steps of Construction:

(i) Draw a line segment AB = 6.5cm.

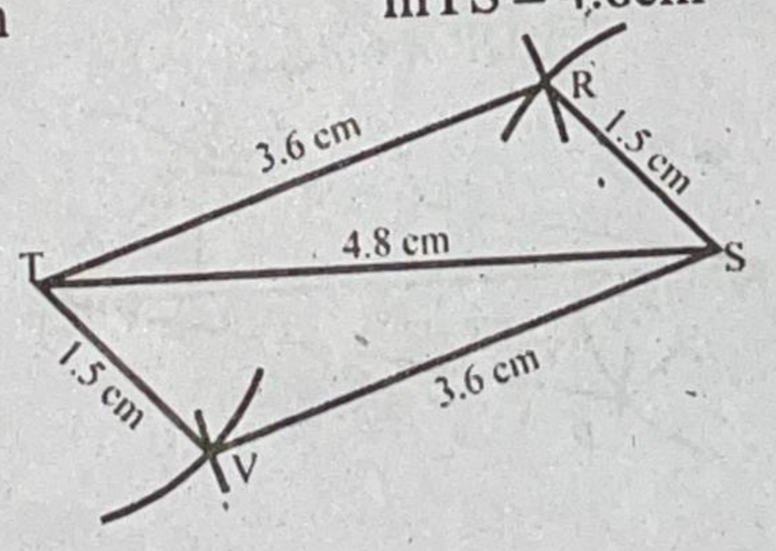
(ii) Consider the Point A as center and draw an arc of radius 3.1cm on the upper side of line Segment AB and draw another arc of radius 8cm on the lower side of line segment AB.

(iii) Now consider the point B as center and draw an arc of radius 8cm on the upper side of line segment AB and draw another arc of radius 3.1cm on the lower side of line segment AB. (These arcs intersect at point C and D).

(iv) Finally join the points C and D with the point A and then the point B. ACBD is the required parallelogram.

4. Construct the parallelogram RSVT where

$m\overline{SR} = 1.5cm$ $m\overline{RT} = 3.6cm$ $m\overline{TS} = 4.8cm$



Ans: Steps of Construction:

(i) Draw a line segment $m\overline{TS} = 4.8cm$.