10^{TH} MATHS GEOMETRY

SIMILAR TRIANGLE

Note : Construction No Need Important

1. Construct a triangle similar to a given triangle **PQR** with its sides equal to $\frac{2}{3}$ of the corresponding sides of the triangle **PQR** (**Scale Factor** $\frac{2}{3} < 1$).

Solution:

Given
(Scale Factor $\frac{2}{3} < 1$)

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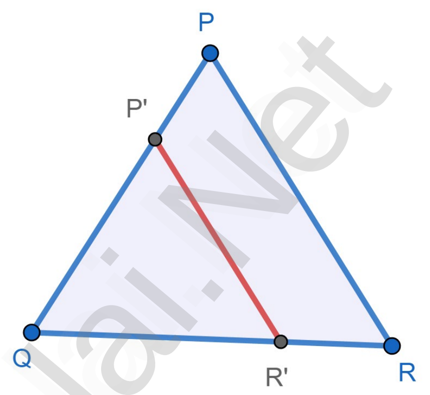
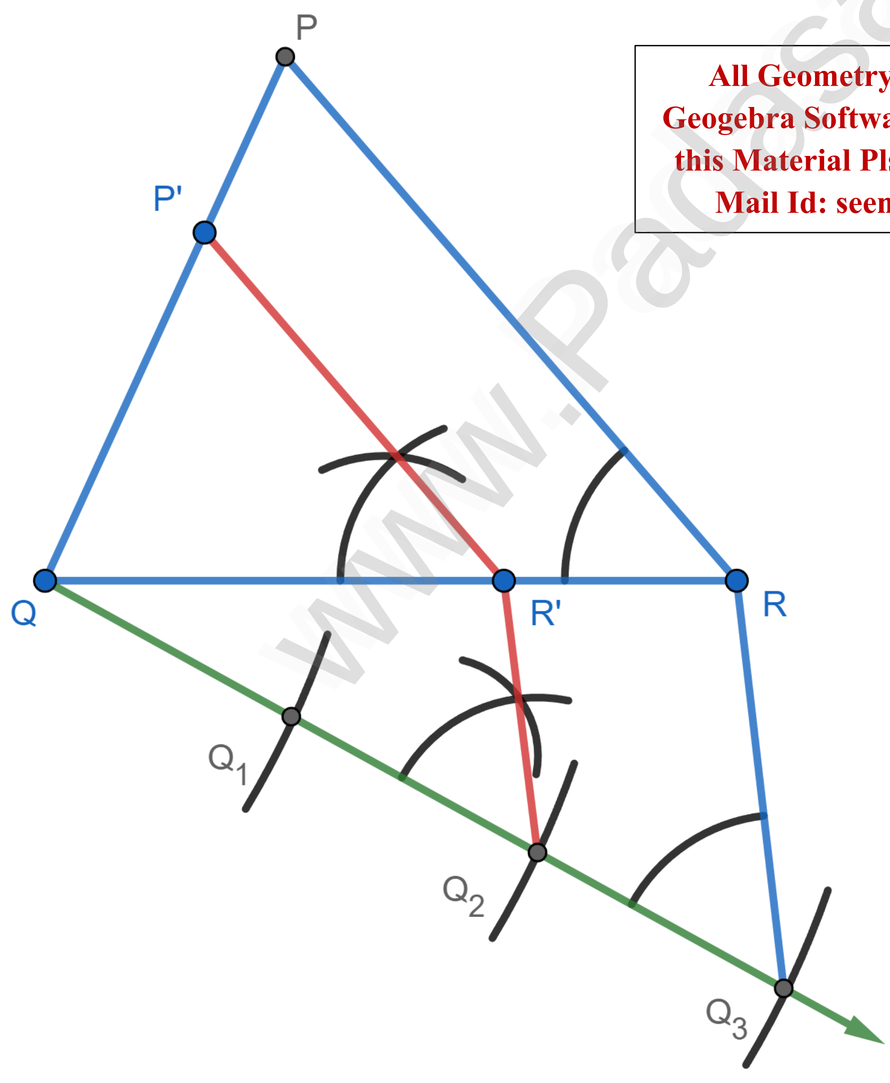
Rough Diagram



Fair Diagram



All Geometry and Graph Drawing by Geogebra Software. If Any doubt or error in this Material Pls Contact Me: 8489880553. Mail Id: seenivasan1101@gmail.com

Construction:

❖ Construct a ΔPQR with any measurement.

❖ Draw a ray QX making acute angle with QR on the side opposite to vertex P.

❖ Locate 3 (greater of 2 and 3 in $\frac{2}{3}$) points. Q_1, Q_2, Q_3, on QX . $Q Q_1 = Q_1 Q_2 = Q_2 Q_3$.

❖ Join Q_3R and draw a line through Q_2 (2 being smaller and 3 in $\frac{2}{3}$) parallel to Q_3R to intersect QR at R'.

❖ Draw line through R' parallel to the line RP to intersect QP at P'.

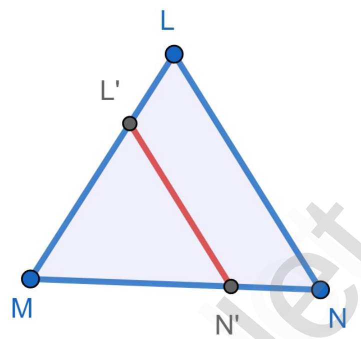
❖ $\Delta P'QR'$ is the required triangle of $\frac{2}{3}$ of the corresponding sides of ΔPQR.

2. Construct a triangle similar to a given triangle **LMN** with its sides equal to $\frac{4}{5}$ of the corresponding sides of the triangle **LMN** (**Scale Factor** $\frac{4}{5} < 1$).

Solution:

Given (Scale Factor $\frac{4}{5} < 1$)

Rough Diagram



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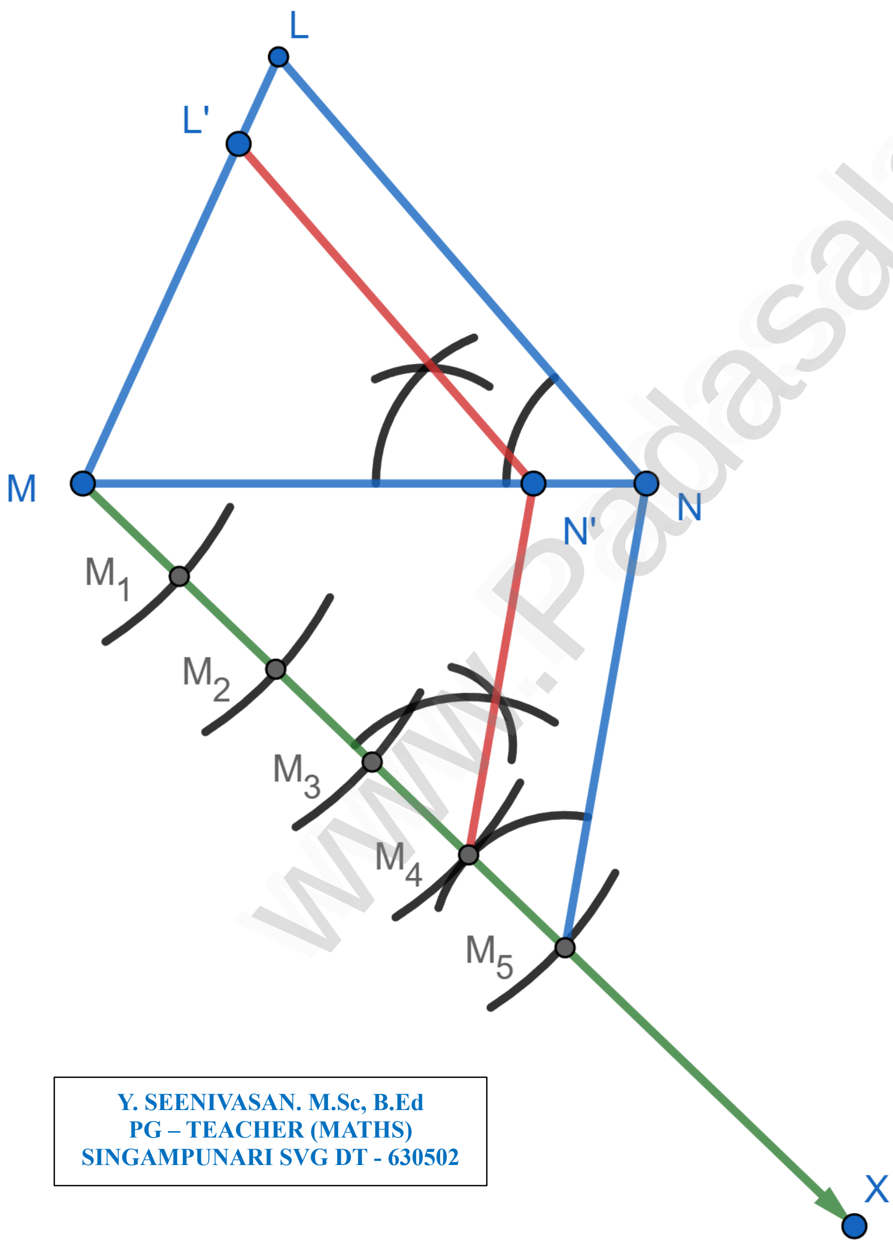

Construction:

❖ Construct a $\Delta\, LMN$ with any measurement.

❖ Draw a ray QX making acute angle with MN on the side opposite to vertex L.

❖ Locate 5 (greater of 4 and 3 in $\frac{4}{5}$) points. M_1, M_2, M_3, on MX. So $M M_1 = M_1 M_2 = M_2 M_3 = M_3 M_4 = M_4 M_5$.

❖ Join M_5 R and draw a line through M_4 (4 being smaller of 4 and 5 in $\frac{4}{5}$) parallel to M_4 N to intersect MN at N'.

❖ Draw line through N' parallel to the line NL to intersect ML at L'.

❖ $\Delta\, L'MN'$ is the required triangle of $\frac{4}{5}$ of the corresponding sides of $\Delta\, LMN$.

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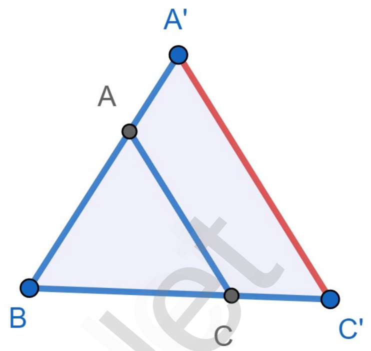
3. Construct a triangle similar to a given triangle **ABC** with its sides equal to $\frac{6}{5}$ of the corresponding sides of the triangle **ABC** (**Scale Factor** $\frac{6}{5} > 1$).

Solution:

Given
(Scale Factor $\frac{6}{5} > 1$)

Rough Diagram



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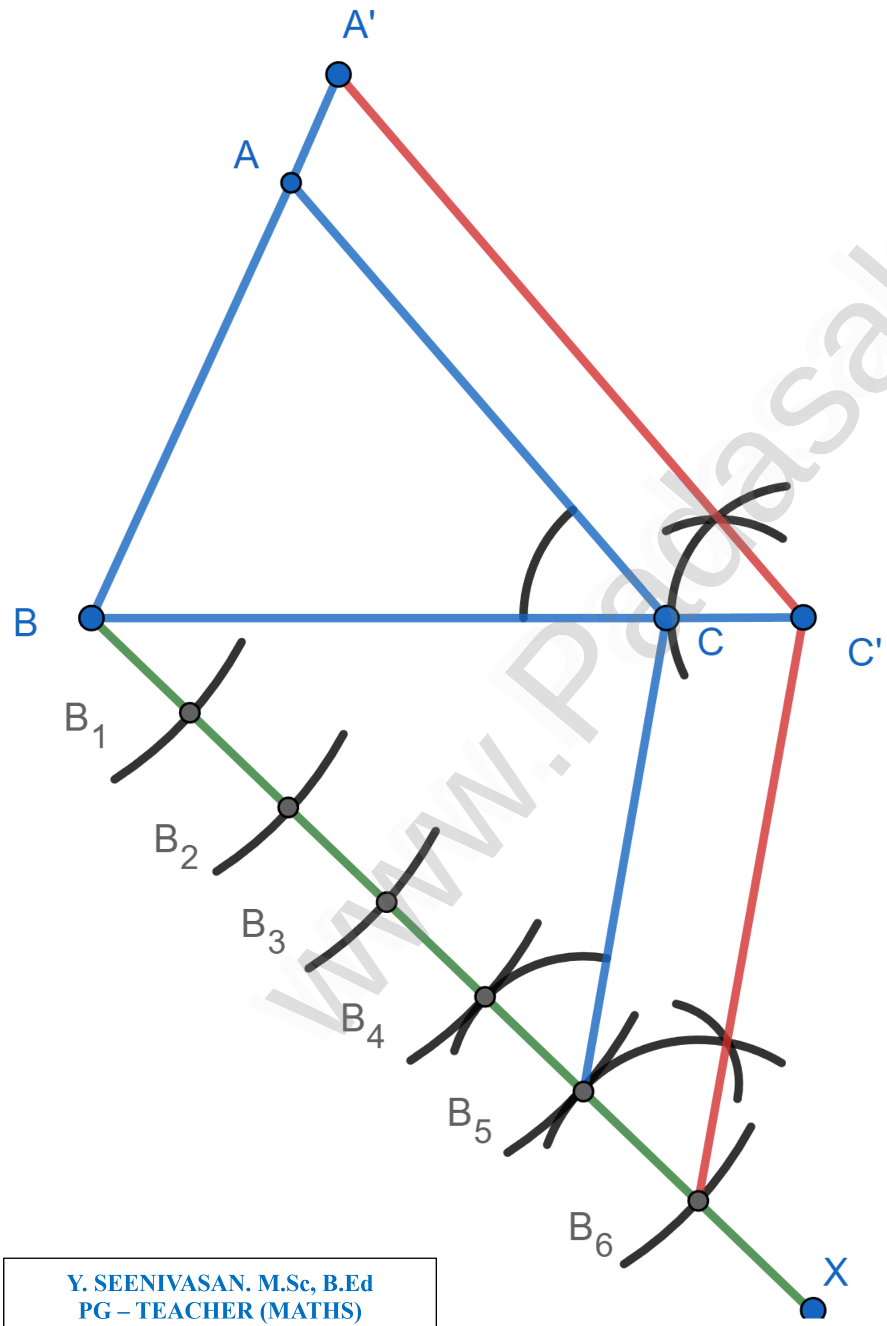

Construction:

❖ Construct a $\Delta ABRC$ with any measurement.

❖ Draw a ray BX making acute angle with BC on the side opposite to vertex A.

❖ Locate 6 (greater of 6 and 5 in $\frac{6}{5}$) points. B_1, B_2, B_3, on BX. So $B B_1 = B_1 B_2 = B_2 B_3 = B_3 B_4 = B_4 B_5 = B_5 B_6$.

❖ Join B_5C and draw a line through B_5 (5 being smaller of 5 and 6 in $\frac{6}{5}$) parallel to B_6C to intersecting the extended line segment BC at C'.

❖ Draw line through C' parallel to the line CA to intersecting the extended line segment BA at A'.

❖ $\Delta A'BC'$ is the required triangle of $\frac{6}{5}$ of the corresponding sides of ΔABC.

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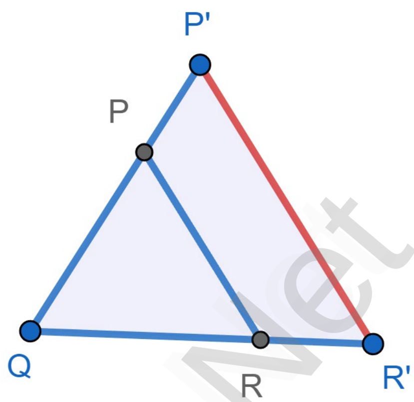
4. Construct a triangle similar to a given triangle **PQR** with its sides equal to $\frac{7}{3}$ of the corresponding sides of the triangle **PQR** (**Scale Factor** $\frac{7}{3} > 1$).

Solution:

Given
(Scale Factor $\frac{7}{3} > 1$)

Rough Diagram



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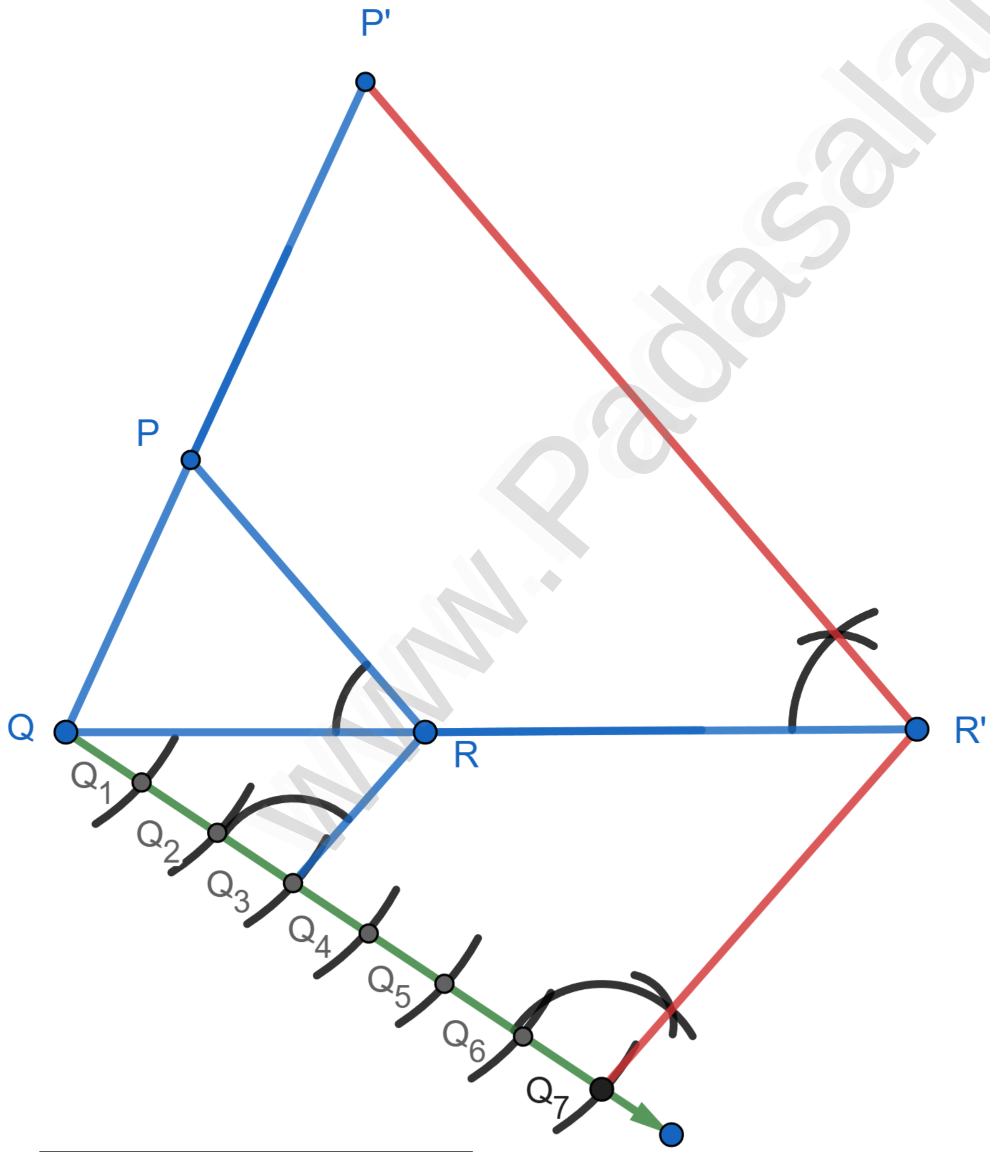

Construction:

- Construct a ΔPQR with any measurement.
- Draw a ray QX making acute angle with QR on the side opposite to vertex P.
- Locate 7 (greater of 7 and 3 in $\frac{7}{3}$) points. $Q_1, Q_2, Q_3, Q_4, Q_5, Q_6, Q_7$, on QX. So $QQ_1 = Q_1Q_2 = Q_2Q_3 = Q_3Q_4 = Q_4Q_5 = Q_5Q_6 = Q_6Q_7$.
- Join Q_3R and draw a line through Q_3 (3 being smaller of 3 and 7 in $\frac{7}{3}$) parallel to Q_3R to intersecting the extended line segment QR at R'.
- Draw line through R' parallel to the line RP to intersecting the extended line segment QP at P'.
- $\Delta P'QR'$ is the required triangle of $\frac{7}{3}$ of the corresponding sides of ΔPQR.

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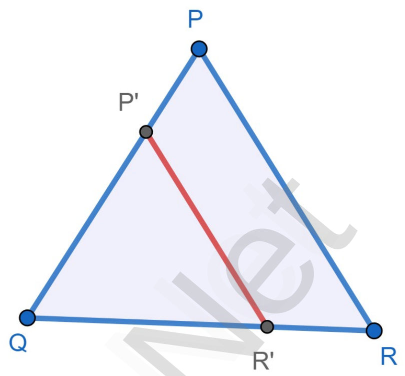
Example : 4.10.

Construct a triangle similar to a given triangle **PQR** with its sides equal to $\frac{3}{5}$ of the corresponding sides of the triangle **PQR** (**Scale Factor** $\frac{3}{5} < 1$).

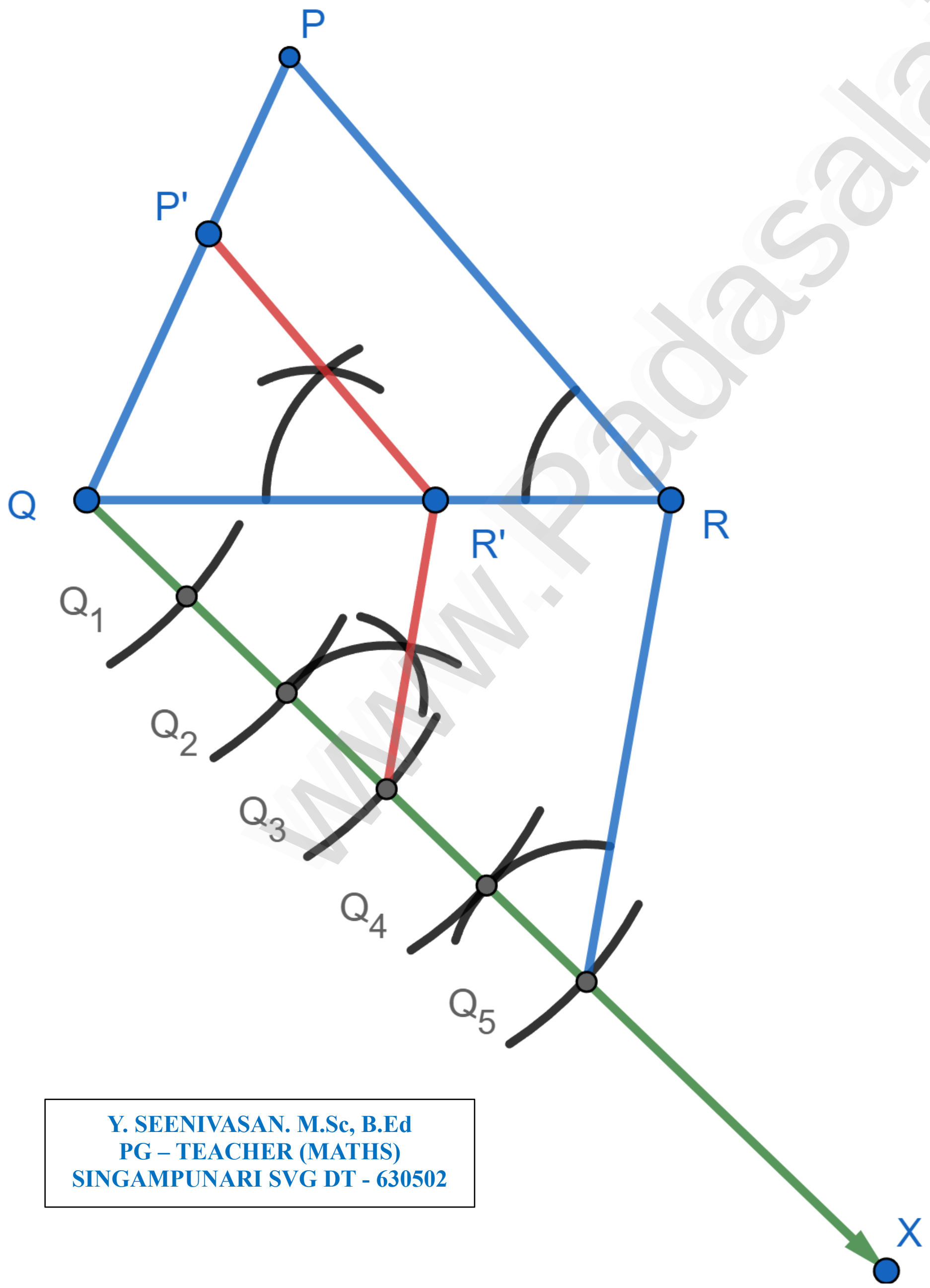
Solution:

Given
(Scale Factor $\frac{3}{5} < 1$)

Rough Diagram



Fair Diagram



Construction:

- ❖ Construct a $\Delta\, PQR$ with any measurement.
- ❖ Draw a ray QX making acute angle with QR on the side opposite to vertex P.
- ❖ Locate 5 (greater of 3 and 5 in $\frac{3}{5}$) points. Q_1, Q_2, Q_3, Q_4, Q_5, on QX . So $Q\,Q_1 = Q_1\,Q_2 = Q_2\,Q_3 = Q_3\,Q_4 = Q_4\,Q_5$.
- ❖ Join Q_5R and draw a line through Q_3 (3 being smaller and 5 in $\frac{3}{5}$) parallel to $Q_5\,R$ to intersect QR at R'.
- ❖ Draw line through R' parallel to the line RP to intersect QP at P'.
- ❖ $\Delta\, P'QR'$ is the required triangle of $\frac{3}{5}$ of the corresponding sides of $\Delta\, PQR$.

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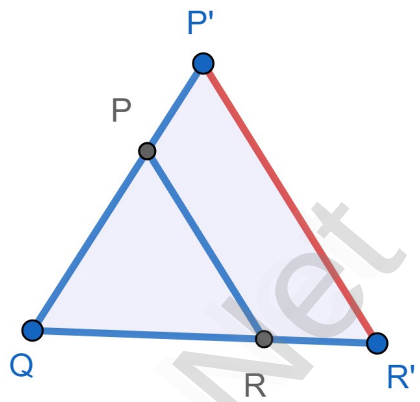
Example : 4.11.

Construct a triangle similar to a given triangle **PQR** with its sides equal to $\frac{7}{4}$ of the corresponding sides of the triangle **PQR** (**Scale Factor** $\frac{7}{4} > 1$).

Solution:

Given
(Scale Factor $\frac{7}{4} > 1$**)**

Rough Diagram



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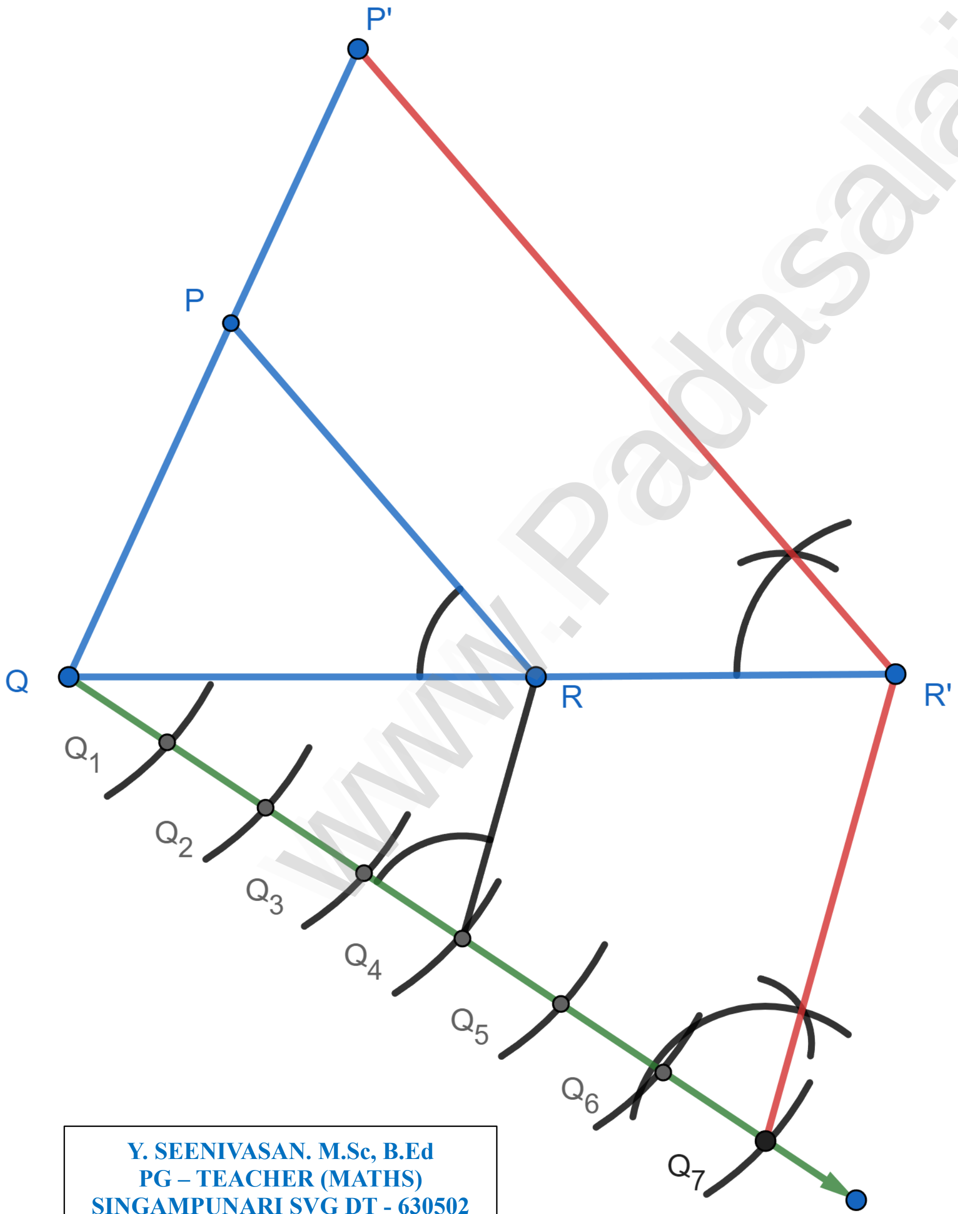

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Construction:

- Construct a $\Delta\, PQR$ with any measurement.
- Draw a ray QX making acute angle with QR on the side opposite to vertex P.
- Locate 7 (greater of 7 and 4 in $\frac{7}{4}$) points. Q_1, Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, on QX. So $Q\,Q_1 = Q_1\,Q_2 = Q_2\,Q_3 = Q_3\,Q_4 = Q_4\,Q_5 = Q_5\,Q_6 = Q_6\,Q_7$.
- Join Q_4R and draw a line through Q_4 (4 being smaller of 4 and 7 in $\frac{7}{4}$) parallel to Q_4 R to intersecting the extended line segment QR at R'.
- Draw line through R' parallel to the line RP to intersecting the extended line segment QP at P'.
- $\Delta\, P'QR'$ is the required triangle of $\frac{7}{4}$ of the corresponding sides of $\Delta\, PQR$.

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TWO TANGENT AND TANGENT

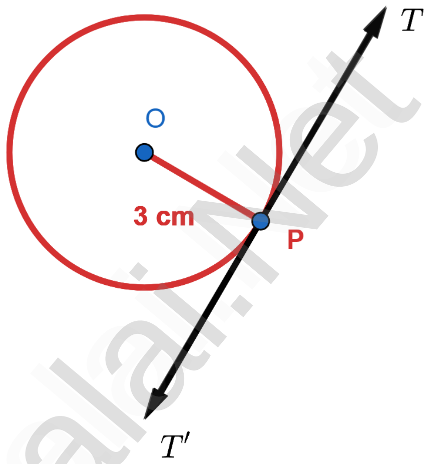
Example 4.29

Draw a circle of **radius 3 cm**. Take a point P on this circle and draw **a tangent at P**.

Solution:

Given
Radius $r = 3\ cm$

Rough Diagram



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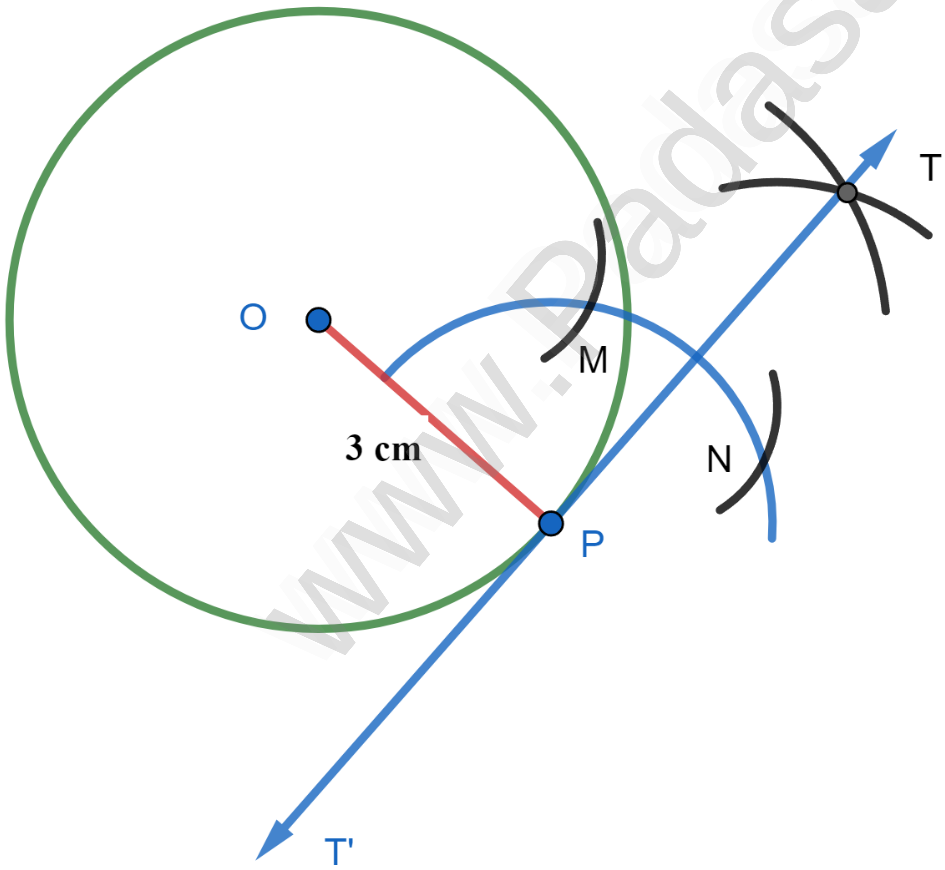

Construction:

- Draw a circle with centre at O of radius 3 cm.
- Take a point P on the circle. Join OP.
- Draw perpendicular line to OP which passes through P.
- TT' is the required tangent.

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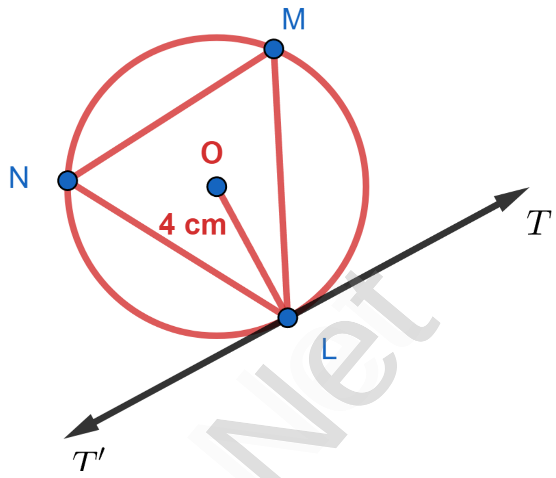
Example 4.30

Draw a circle of **radius 4 cm**. At a point L on it draw a **tangent** to the circle using the **alternate segment**.

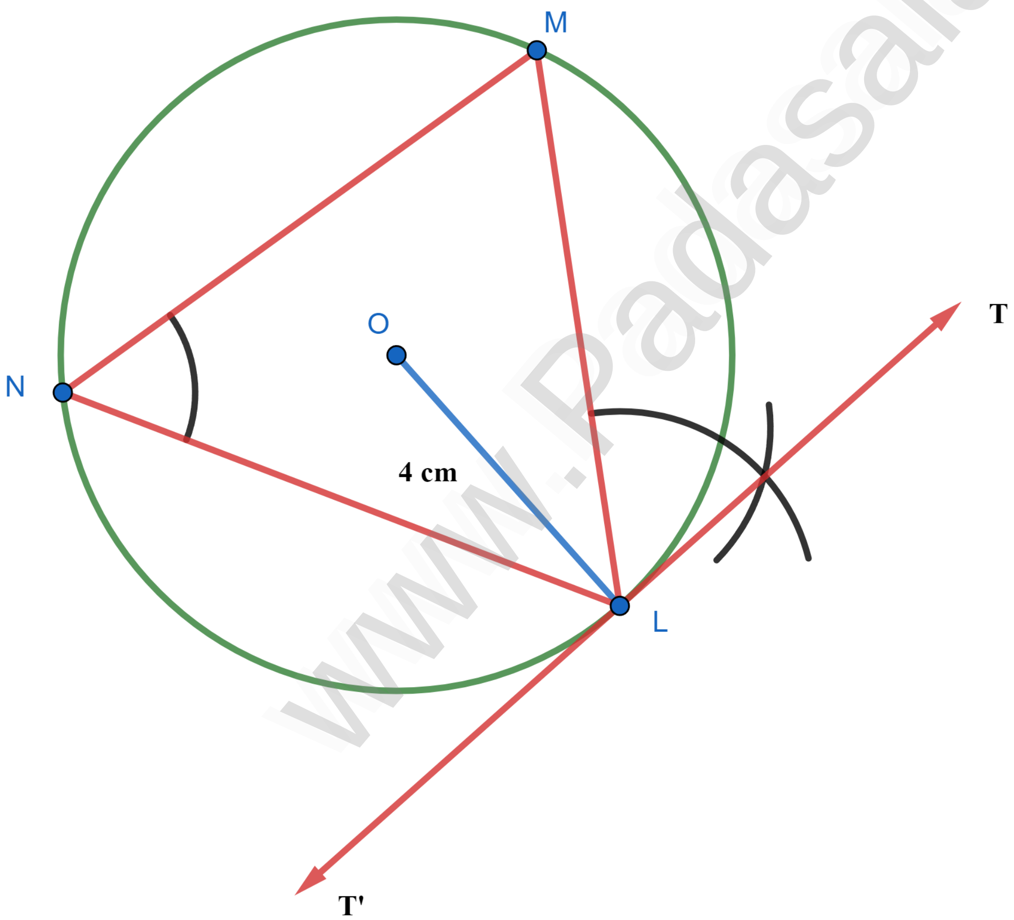
Solution:

Given
Radius $r = 4\ cm$

Rough Diagram



Fair Diagram



Construction:

❖ With O as the centre, draw a circle of radius 4 cm.

❖ Take a point L on the circle. Through L draw any chord LM.

❖ Take a point N distinct from L and M on the circle, so that L, M and N are in anti-clockwise direction. Join LN and NM.

❖ Through L draw a tangent TT' such that $\angle TLM = \angle MNL$.

❖ TT' is the required tangent.

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Example 4.31

Draw a circle of **diameter 6 cm** from a point P, which is **8 cm** away from its centre. Draw the **two tangents PA** and **PB** to the circle and measure their lengths.

Solution:

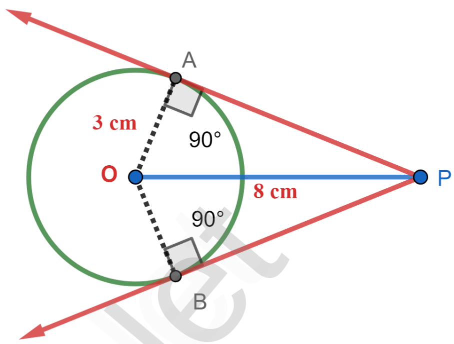
Given, $d = 6$ cm

Radius, $R = \frac{d}{2}$

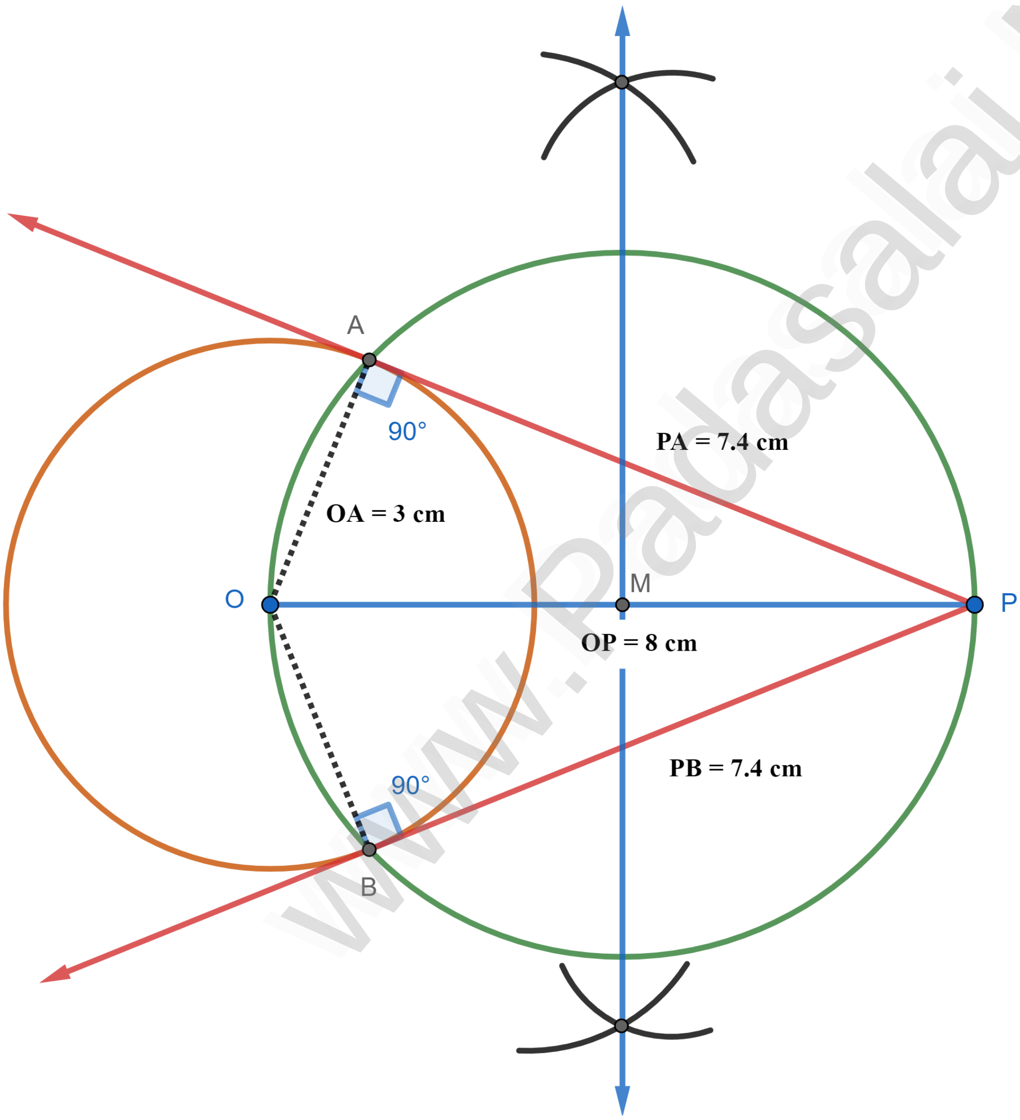
$= \frac{6}{2}$

Radius $r = 3\ cm$

Rough Diagram



Fair Diagram



Construction:

❖ With centre at O, draw a circle of radius 3 cm.

❖ Draw a line OP of length 8 cm.

❖ Draw a perpendicular bisector of OP, which cuts OP at M.

❖ With M as centre and MO as radius, draw a circle which cuts previous circle at A and B.

❖ Join AP and BP. AP and BP are the required tangents. Thus length of the tangents are PA = PB = 7.4 cm.

Verification:

In the Right Angle triangle OAP,

$$PA^2 = OP^2 - OA^2$$
$$= 8^2 - 3^2$$
$$= 64 - 9$$
$$= 55$$
$$PA = \sqrt{55} = 7.4\ cm\ (approximately)$$

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1. Draw a tangent at any point R on the circle of **radius 3.4 cm** and centre at **P**?.

Solution:

Given
Radius $r = 3.4\ cm$

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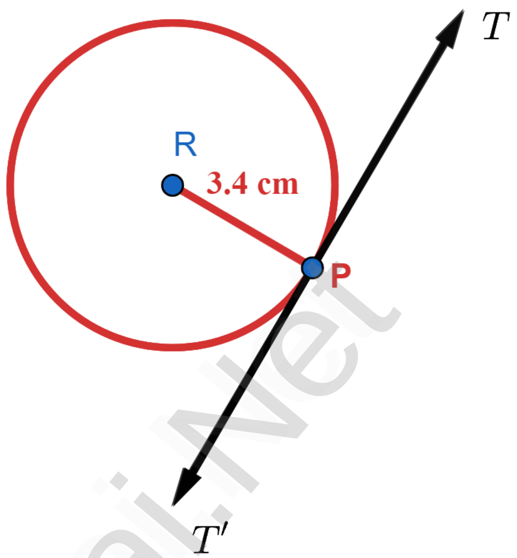
Rough Diagram



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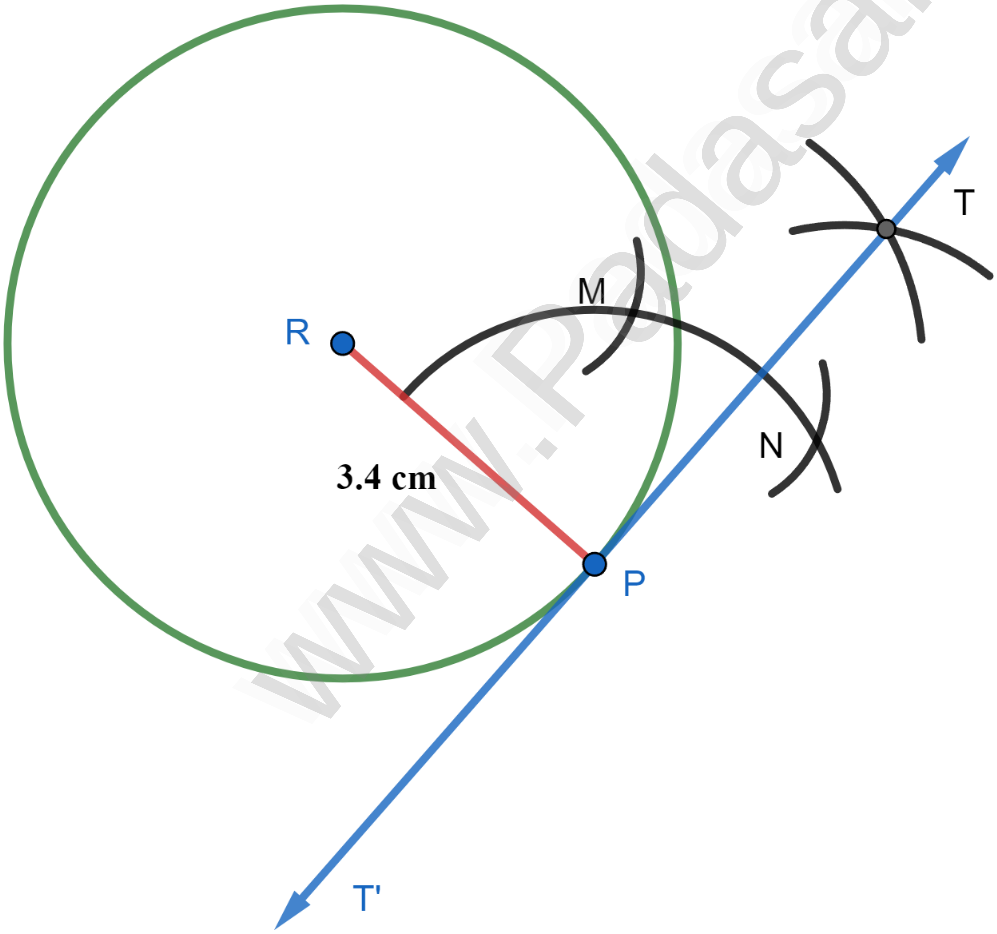

Construction:

- Draw a circle with centre at O of radius 3.4 cm.
- Take a point P on the circle. Join OP.
- Draw perpendicular line to OP which passes through P.
- TT' is the required tangent.

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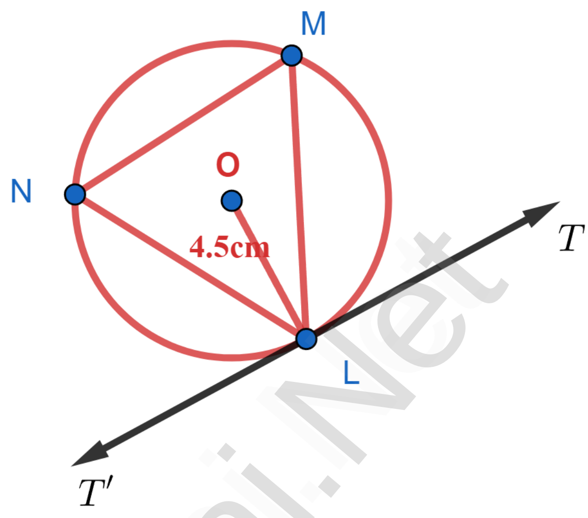
2. Draw a circle of **radius 4.5 cm** . Take a point on the circle. Draw the tangent at that point using the **Alternate Segment Theorem.**

Solution:

Given
Radius $r = 4.5\ cm$

Rough Diagram



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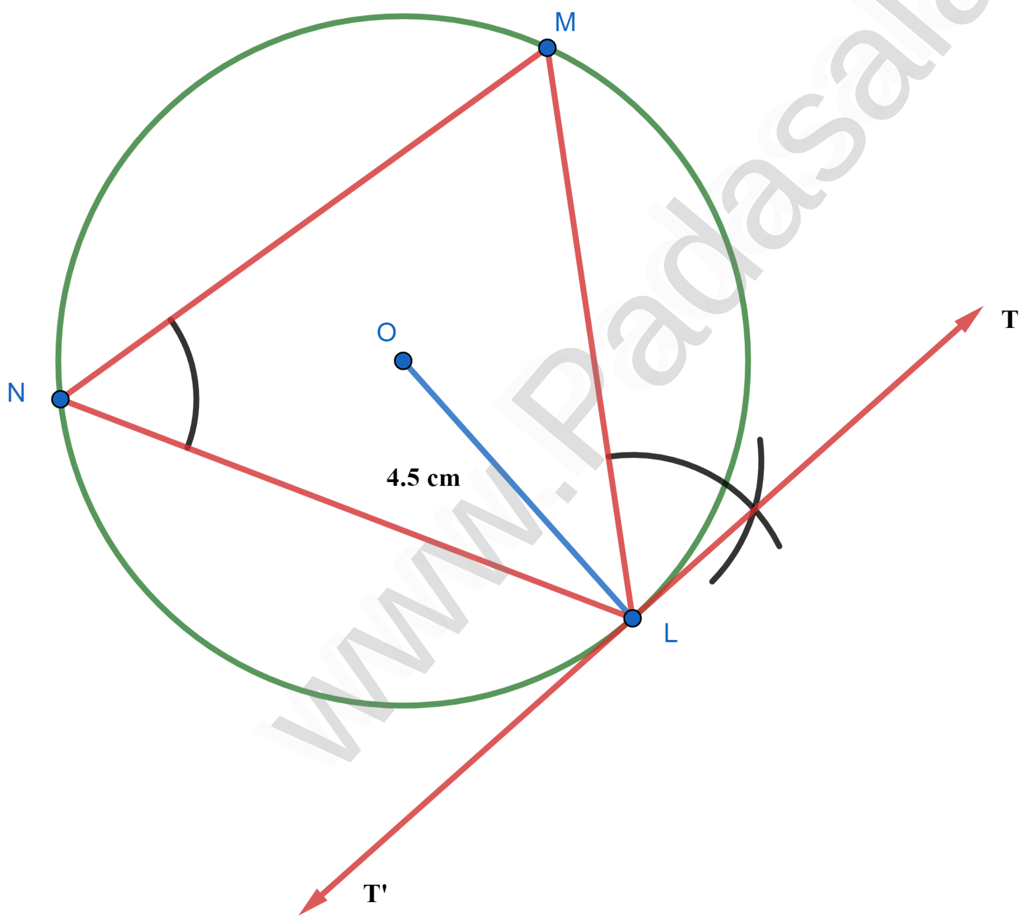

Construction:

❖ With O as the centre, draw a circle of radius 4.5 cm.

❖ Take a point L on the circle. Through L draw any chord LM.

❖ Take a point N distinct from L and M on the circle, so that L, M and N are in anti-clockwise direction. Join LN and NM.

❖ Through L draw a tangent TT' such that $\angle TLM = \angle MNL$.

❖ TT' is the required tangent.

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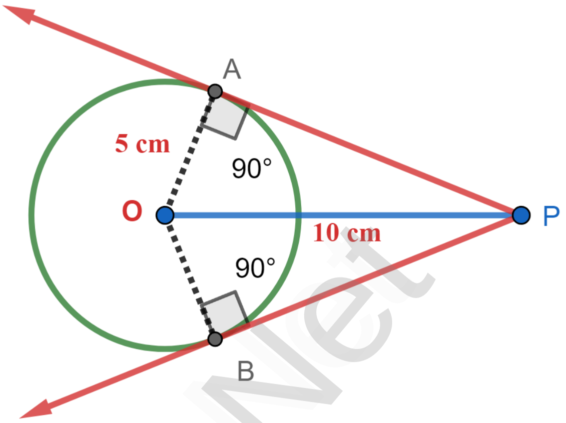
3. Draw the two tangents from a point which is **10 cm** away from the centre of a circle of **radius 5 cm**. Also, measure the lengths of the tangents.

Solution:

Given,
Radius $r = 5\ cm$

Rough Diagram



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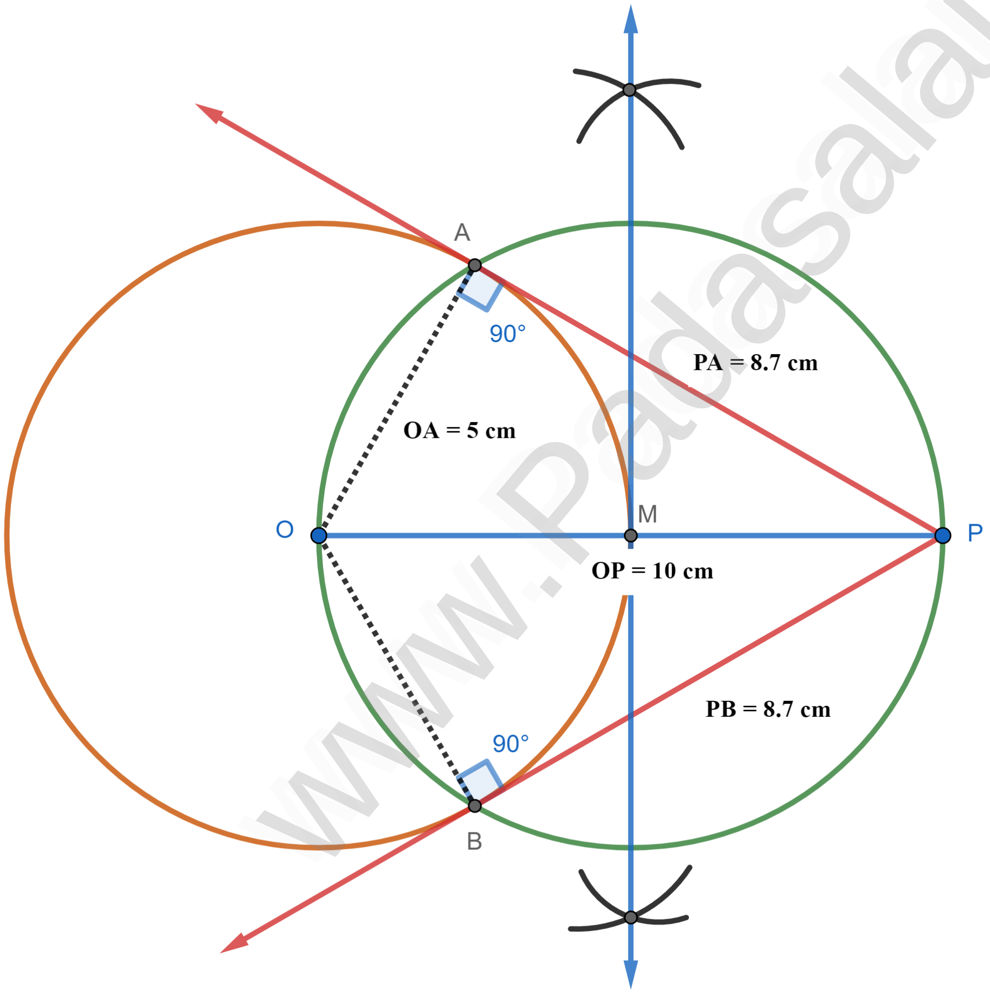

Construction:

- With centre at O, draw a circle of radius 5 cm.
- Draw a line OP of length 10 cm.
- Draw a perpendicular bisector of OP, which cuts OP at M.
- With M as centre and MO as radius, draw a circle which cuts previous circle at A and B.
- Join AP and BP. AP and BP are the required tangents. Thus length of the tangents are PA = PB = 8.7 cm.

Verification:

In the Right Angle triangle OAP,

$$PA^2 = OP^2 - OA^2$$
$$= 10^2 - 5^2$$
$$= 100 - 25$$
$$= 75$$
$$PA = \sqrt{75} = 8.7\ cm\ (approximately)$$

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4. Take a point which is **11 cm** away from the centre of a circle of **radius 4 cm** and draw the **two tangents** to the circle from that point.

Solution:

Given,
Radius $r = 4\ cm$

Rough Diagram

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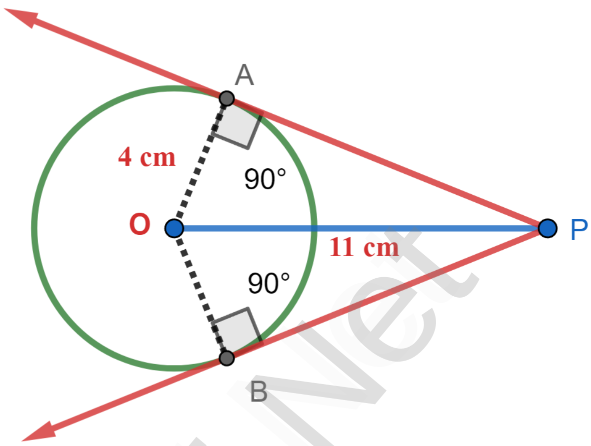
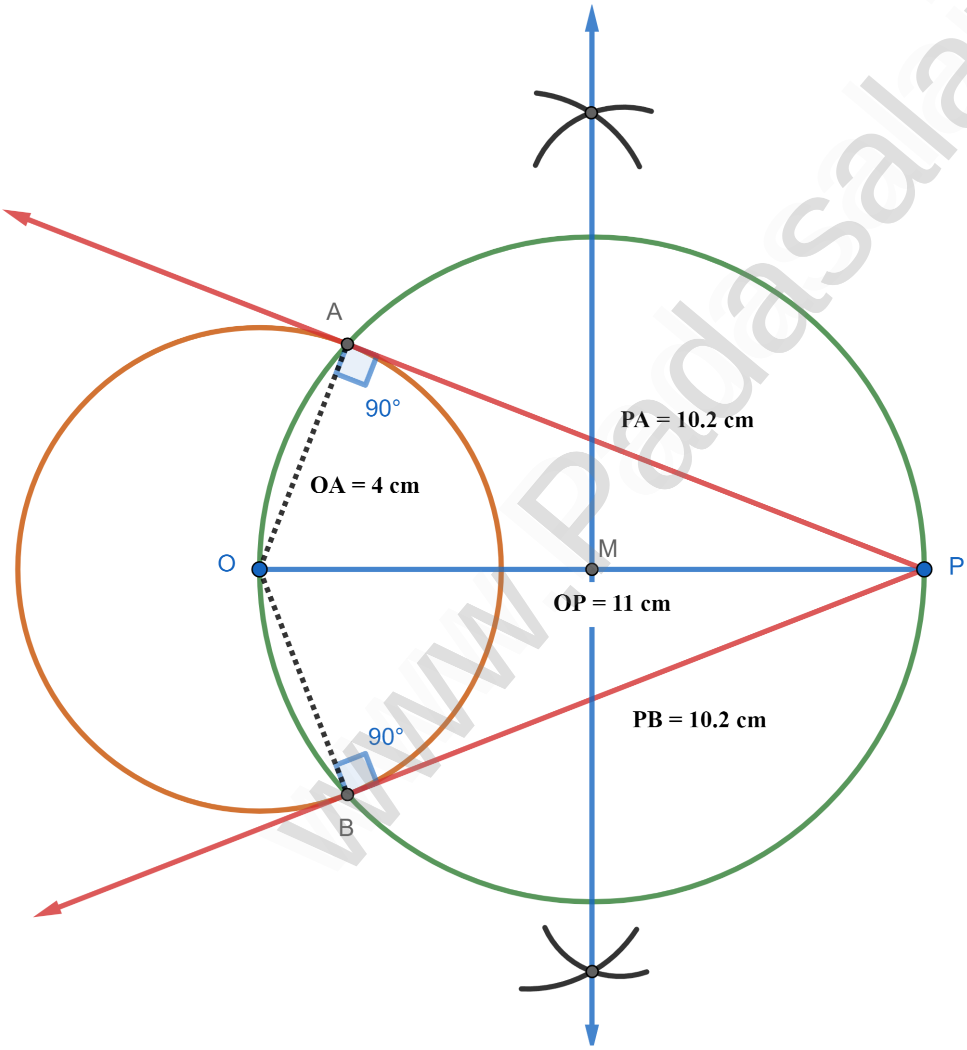


Fair Diagram



Construction:

- With centre at O, draw a circle of radius 4 cm.
- Draw a line OP of length 11 cm.
- Draw a perpendicular bisector of OP, which cuts OP at M.
- With M as centre and MO as radius, draw a circle which cuts previous circle at A and B.
- Join AP and BP. AP and BP are the required tangents. Thus length of the tangents are PA = PB = **10.2 cm**.

Verification:

In the Right Angle triangle **OAP**,

$$PA^2 = OP^2 - OA^2$$
$$= 11^2 - 4^2$$
$$= 121 - 16$$
$$= 105$$
$$PA = \sqrt{105} = 10.2\ cm\ (approximately)$$

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5. Draw the two tangents from a point which is **5 cm** away from the centre of a circle of **diameter 6 cm**. Also , measure the lengths of the tangents.

Solution:

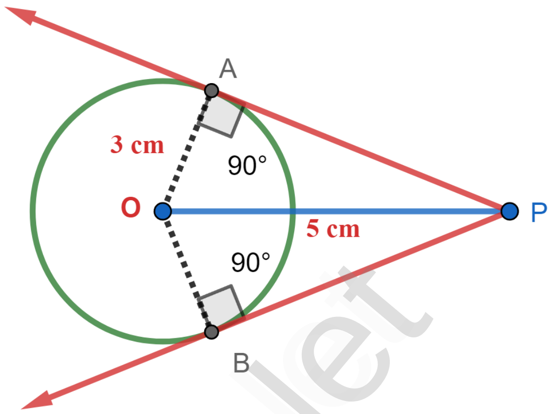
Given, **d = 6 cm**

Radius, $R = \frac{d}{2}$

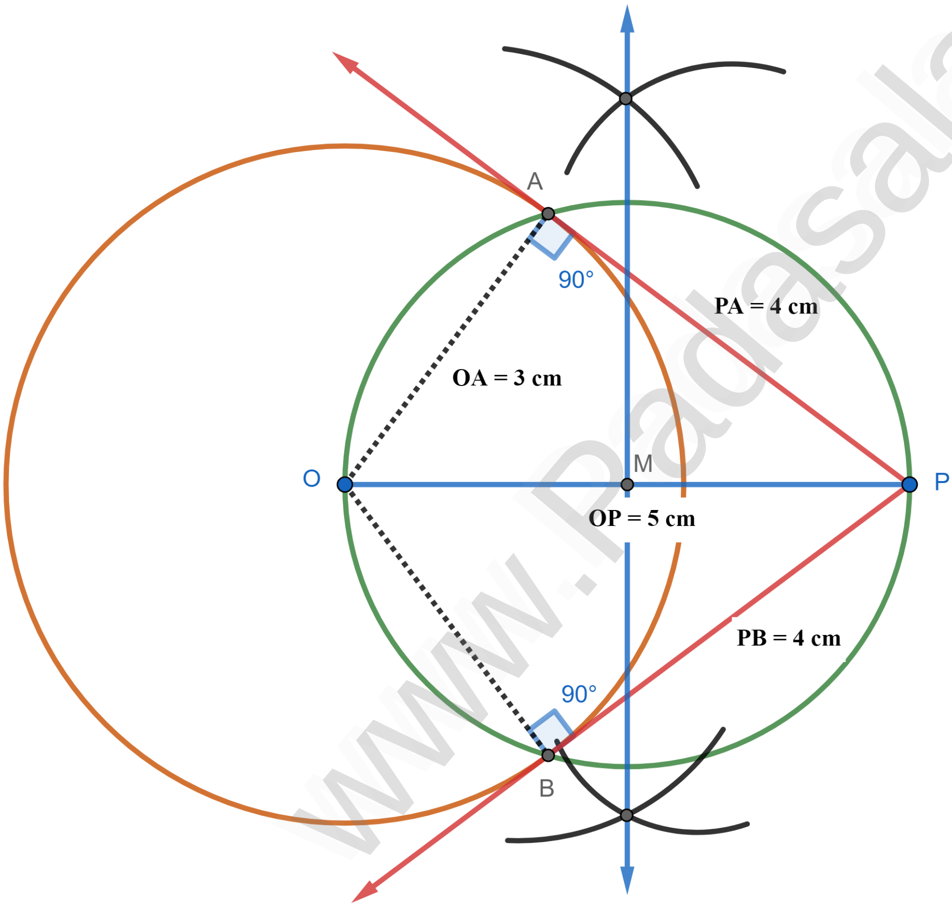
$= \frac{6}{2}$

Radius $r = 3\ cm$

Rough Diagram



Fair Diagram



Construction:

- With centre at O, draw a circle of radius 3 cm.
- Draw a line OP of length 5 cm.
- Draw a perpendicular bisector of OP, which cuts OP at M.
- With M as centre and MO as radius, draw a circle which cuts previous circle at A and B.
- Join AP and BP. AP and BP are the required tangents. Thus length of the tangents are **PA = PB = 4 cm**.

Verification:

In the Right Angle triangle **OAP**,

$$PA^2 = OP^2 - OA^2$$
$$= 5^2 - 3^2$$
$$= 25 - 9$$
$$= 16$$
$$PA = \sqrt{16} = 4\ cm\ (approximately)$$

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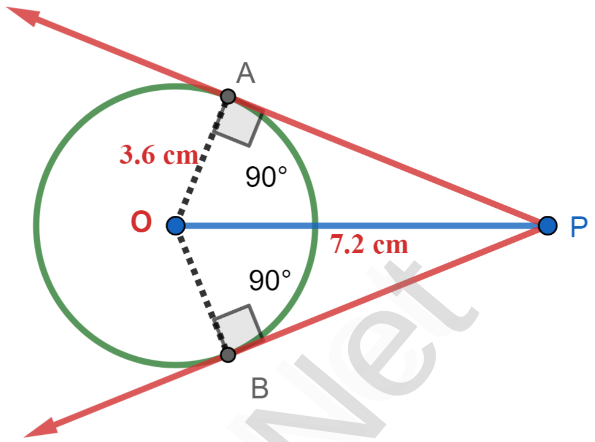
6. Draw a tangent to the circle from the point P having **radius 3.6 cm.** and centre O point P is at a **distance 7.2 cm** from the centre.

Solution:

Given,
Radius $\boldsymbol{r = 3.6\ cm}$

Rough Diagram



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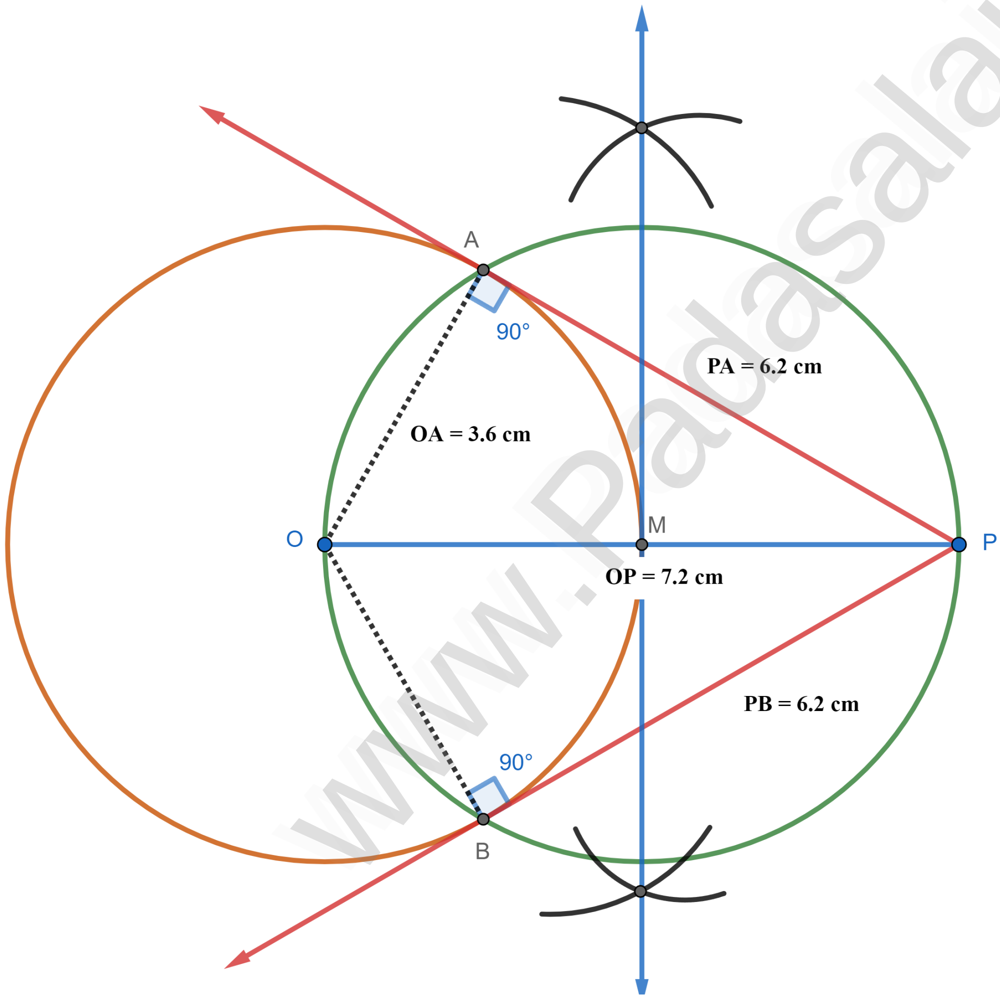

Construction:

- ❖ With centre at O, draw a circle of radius 3.6 cm.
- ❖ Draw a line OP of length 7.2 cm.
- ❖ Draw a perpendicular bisector of OP, which cuts OP at M.
- ❖ With M as centre and MO as radius, draw a circle which cuts previous circle at A and B.
- ❖ Join AP and BP. AP and BP are the required tangents. Thus length of the tangents are **PA = PB = 6.2 cm**.

Verification:

In the Right Angle triangle **OAP**,

$$\boldsymbol{PA^2 = OP^2 - OA^2}$$
$$= 7.2^2 - 3.6^2$$
$$= 51.84 - 12.96$$
$$= 38.88$$
$$\boldsymbol{PA = \sqrt{38.88} = 6.2\ cm\ (approximately)}$$

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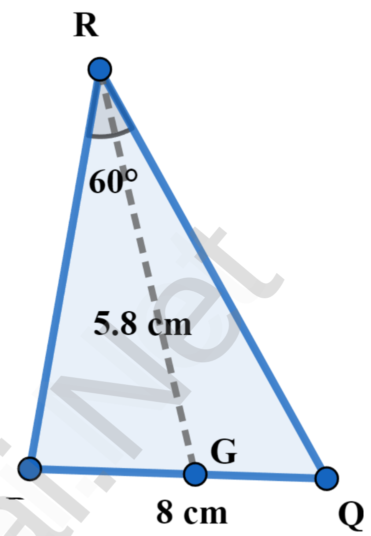
Construction of a Triangle

Example : 4.17

Construct a $\Delta\, PQR$ in which $PQ = 8$ **cm**, $\angle R = 60^{\circ}$ and the **Median RG** from R to **PQ is 5.8 cm**. Find the length of the **altitude from R to PQ**.

Solution:

Rough Diagram



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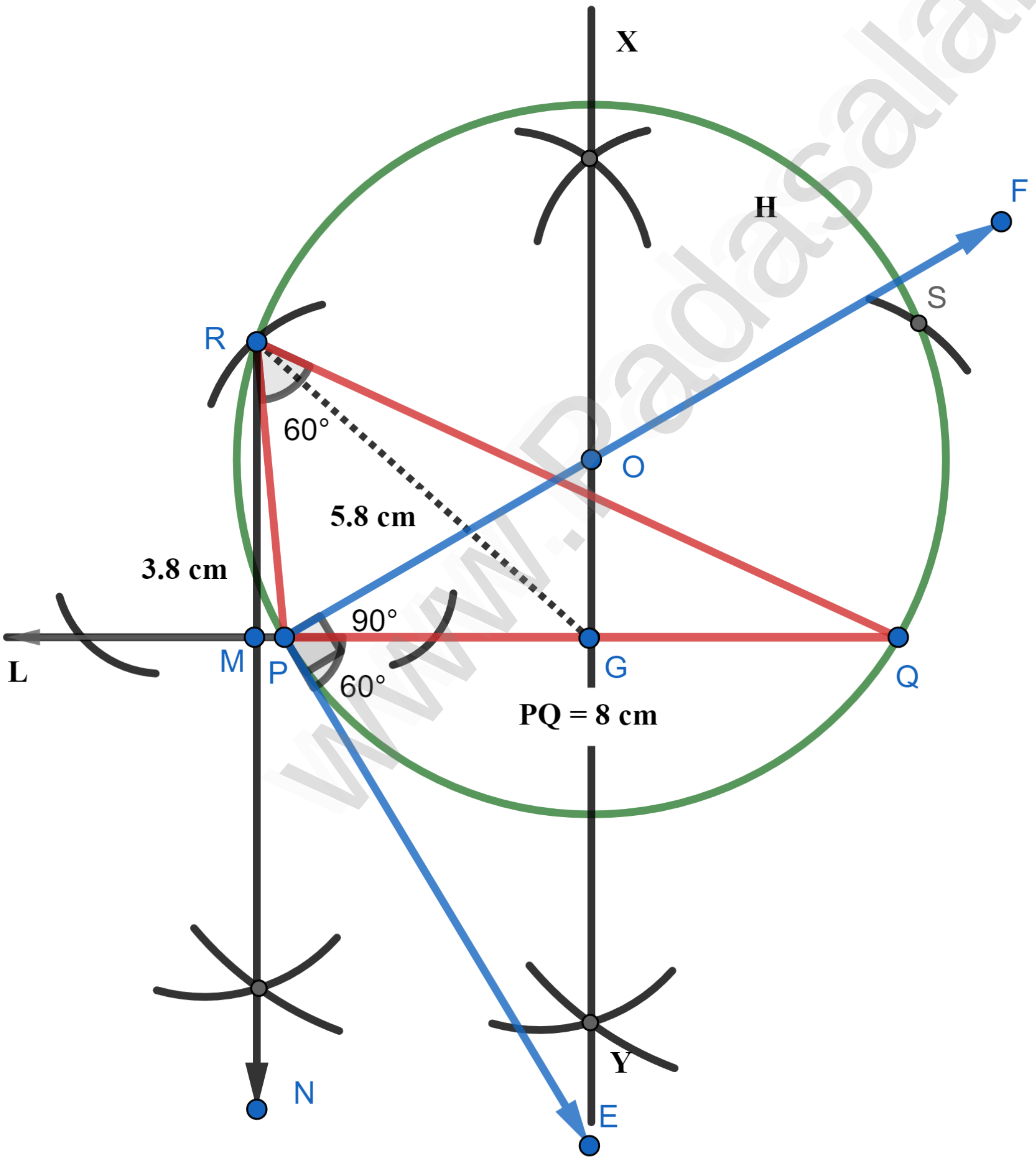
Fair Diagram



Construction:

- Draw a line segment **PQ = 8 cm**. At P, draw PE such that $\angle QPE = 60°$. At P, draw PF such that $\angle EPF = 90°$.
- Draw the perpendicular bisector to PQ, which intersects PF at O and PQ at G.
- With O as centre and OP as radius draw a circle.
- From G mark arcs of **radius 5.8 cm** on the circle. Mark them as R and S.
- Join PR and RQ. Then $\Delta\, PQR$ is the required triangle.
- From R draw a line RN perpendicular to LQ. LQ meets RN at M.
- The length of the altitude is **RM = 3.8 cm.**

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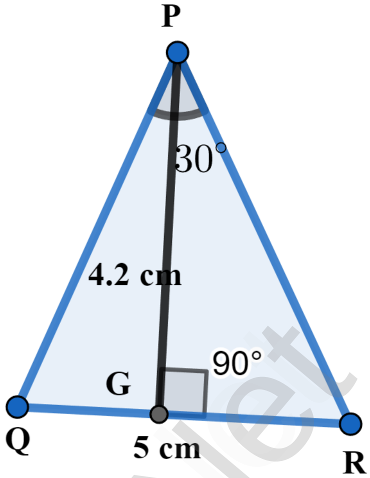
Example : 4.17

Construct a $\Delta\, PQR$ in which such that $QR = 5$ **cm**, $\angle P = 30^{\circ}$ and the **Altitude** from P to **QR is of length 4.2 cm**.

Solution:

Rough Diagram



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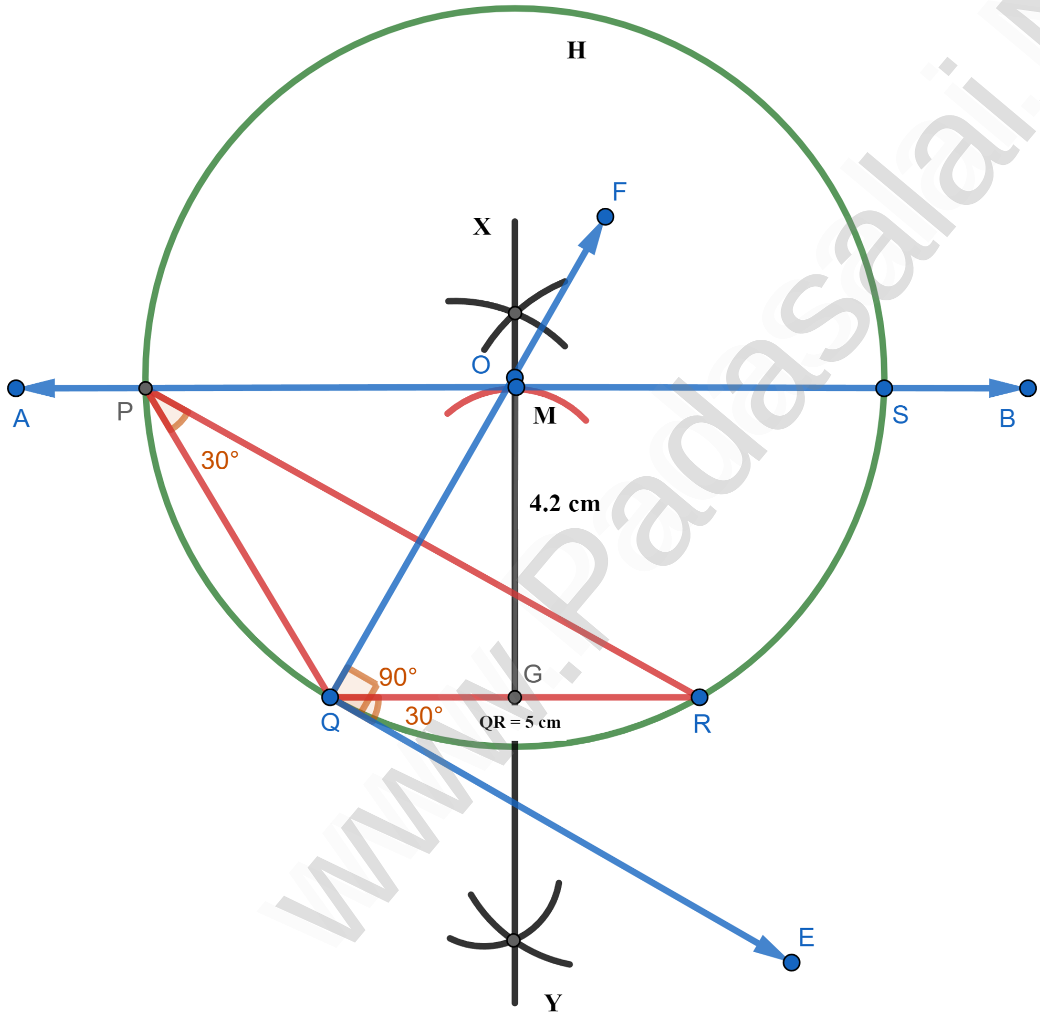
Fair Diagram



Construction:

❖ Draw a line segment QR = 8 cm. At Q draw QE such that $\angle RQE = 30°$. At Q draw QF such that $\angle EQF = 90°$.

❖ Draw the perpendicular bisector XY to QR which intersects QF at O and QR at G.

❖ With O as centre and OQ as radius draw a circle.

❖ From G mark arcs in the line XY at M Such that **GM = 4.2 cm.**

❖ Draw AB through M which is parallel to QR.

❖ AB meets the circle at P and S.

❖ Join QP and RR. Then $\Delta\, PQR$ is the required triangle.

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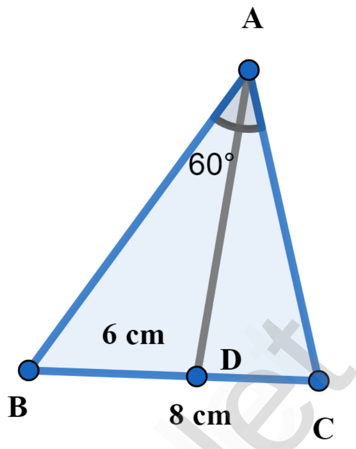
Example : 4.17

Draw a triangle $\Delta\, ABC$ of base $BC = 8$ **cm**, $\angle A = 60^{\circ}$ and the **Bisector** of $\angle A$ meets BC at D such that **BD = 6 cm.**

Solution:

Rough Diagram



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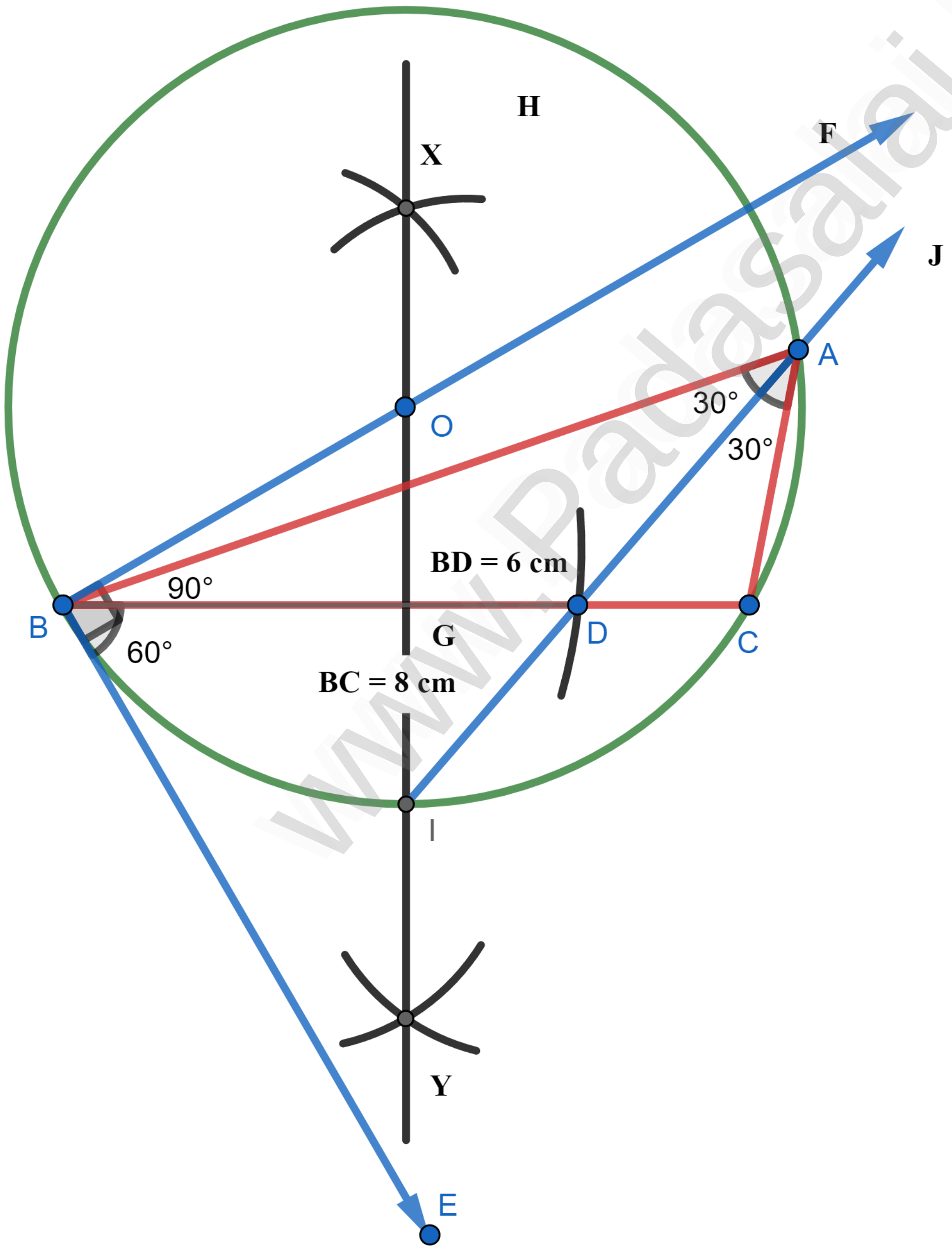
Fair Diagram



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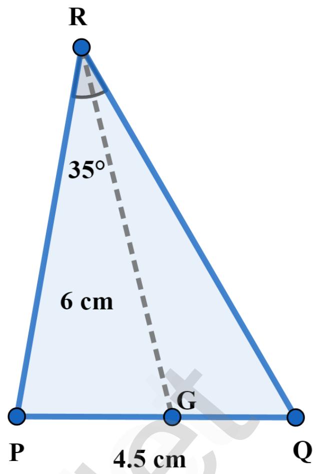
Construction:

- Draw a line segment BC = 8 cm. At B draw BE such that $\angle CBE = 60°$. At B draw BF such that $\angle EBF = 90°$.
- Draw the perpendicular bisector XY to BC which intersects BF at O and BC at G.
- With O as centre and OB as radius draw a circle.
- From B mark arc of 6 cm on BC at D.
- The perpendicular bisector intersects the circle at I. Joint ID.
- ID produced meets the circle at A. Now join AB and AC. Then $\Delta\, ABC$ is the required triangle.

1. Construct a $\Delta\, PQR$ in which base $PQ = 4.5$ **cm**, $\angle R = 35^{\circ}$ and the **Median RG** from R to **PQ is 6 cm**.

Solution:

Rough Diagram



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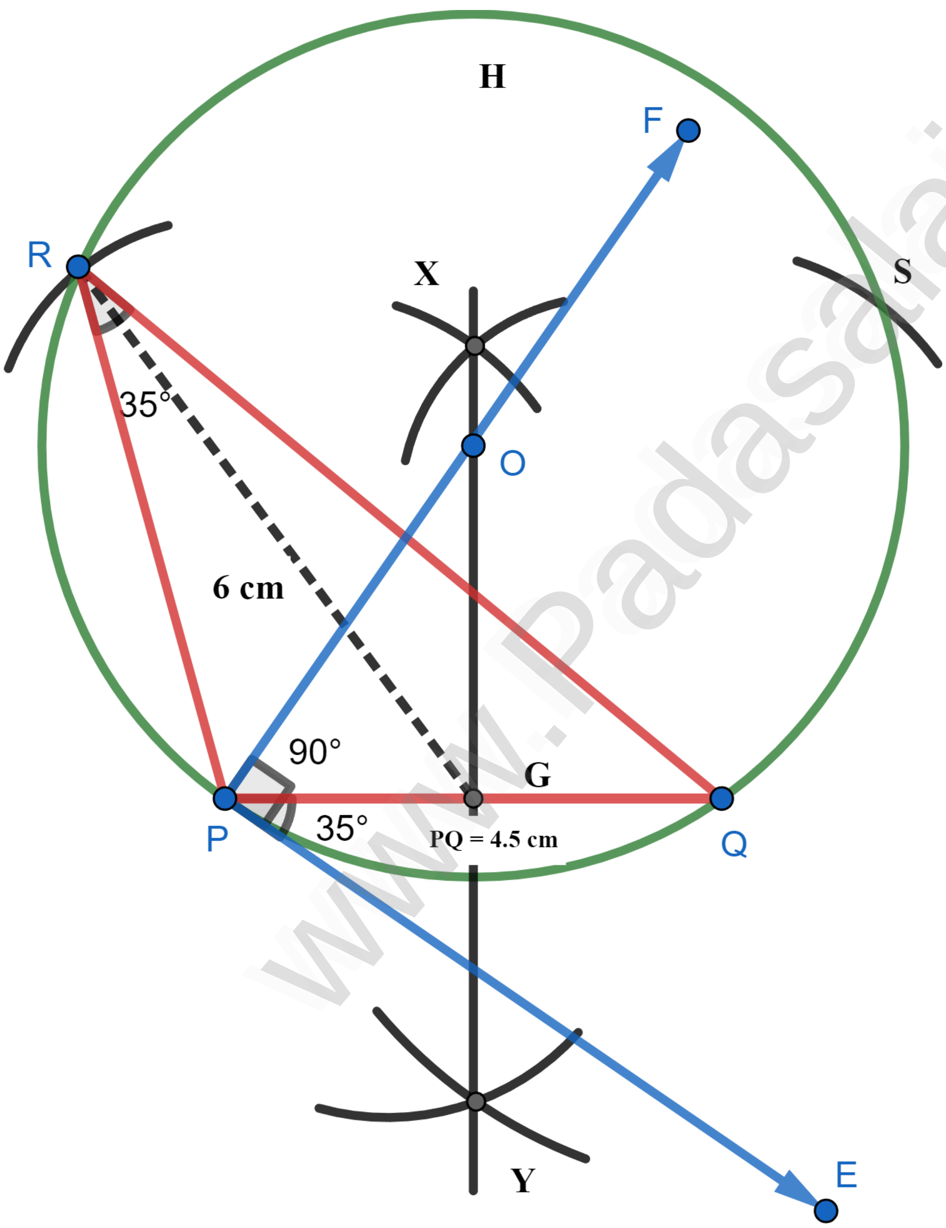

Construction:

- Draw a line segment **PQ = 4.5 cm**. At P, draw PE such that $\angle QPE = 35°$. At P, draw PF such that $\angle EPF = 90°$.
- Draw the perpendicular bisector to PQ, which intersects PF at O and PQ at G.
- With O as centre and OP as radius draw a circle.
- From G mark arcs of **radius 6 cm** on the circle. Mark them as R and S.
- Join PR and RQ. Then $\Delta\, PQR$ is the required triangle.

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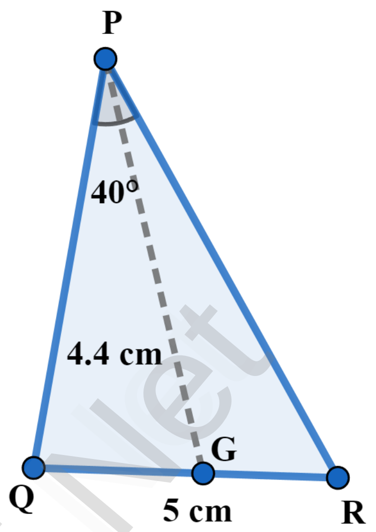
2. Construct a $\Delta\, PQR$ in which $QR = 5$ cm, $\angle P = 40^\circ$ and the **Median PG** from P to **QR is 4.4 cm**. Find the length of the Altitude from P to QR.

Solution:

Rough Diagram



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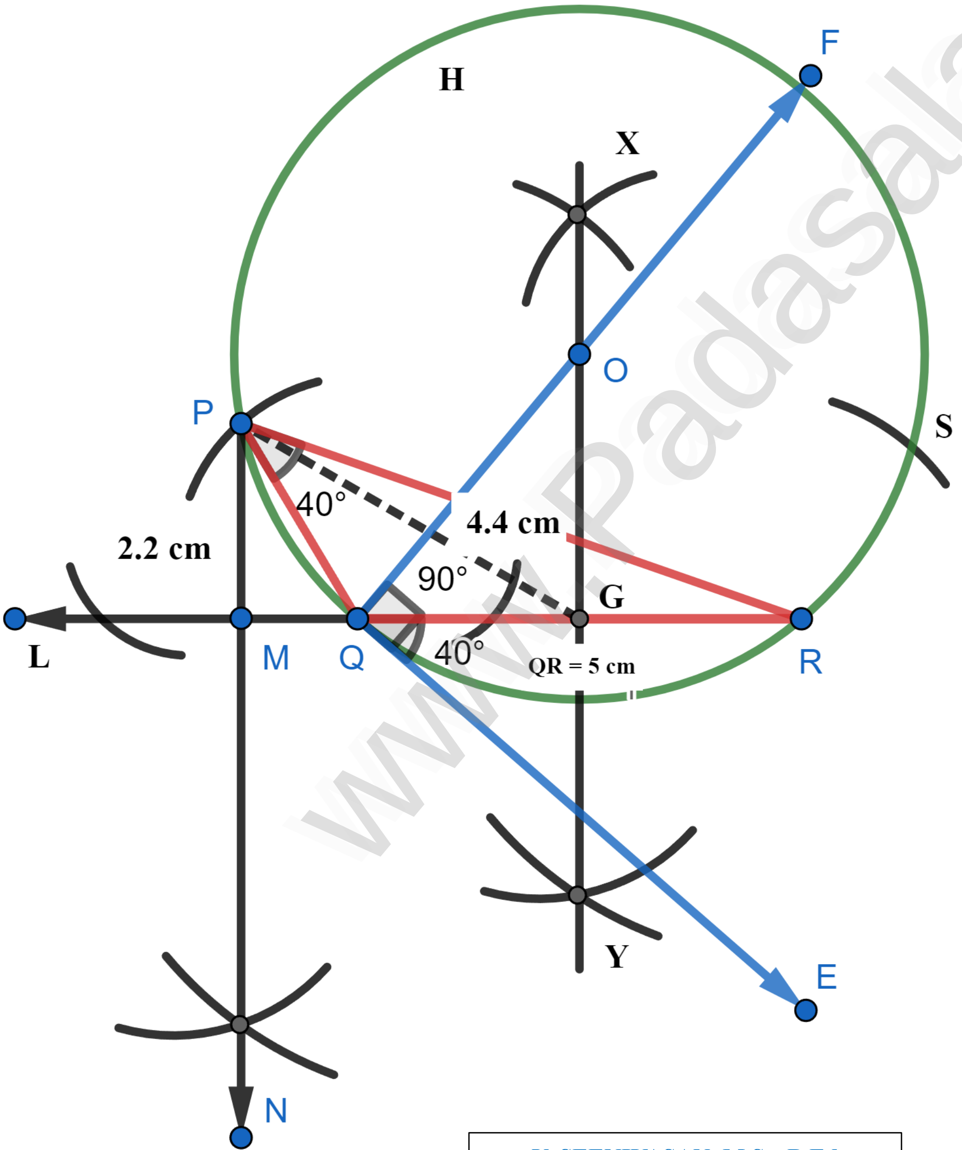
Fair Diagram



Construction:

- ❖ Draw a line segment **QR = 5 cm**. At P, draw PE such that $\angle QPE = 40°$. At P, draw PF such that $\angle EPF = 90°$.
- ❖ Draw the perpendicular bisector to PQ, which intersects PF at O and PQ at G.
- ❖ With O as centre and OP as radius draw a circle.
- ❖ From G mark arcs of **radius 4.4 cm** on the circle. Mark them as R and S.
- ❖ Join PR and RQ. Then $\Delta\, PQR$ is the required triangle.
- ❖ From P draw a line PN perpendicular to LQ. LQ meets PN at M.
- ❖ The length of the altitude is **PM = 2.2 cm.**

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3. Construct a $\Delta\, PQR$ in which such that $QR = 6.5$ **cm**, $\angle P = 60^{\circ}$ and the **Altitude** from P to **QR is of length 4.5 cm**.

Solution:

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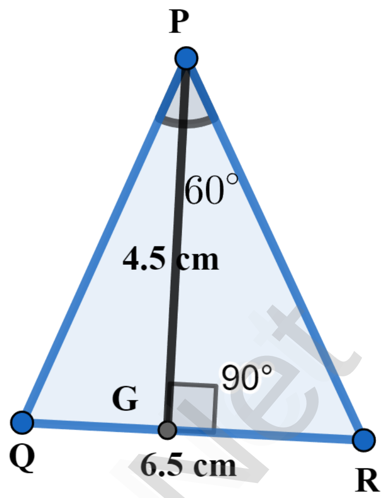
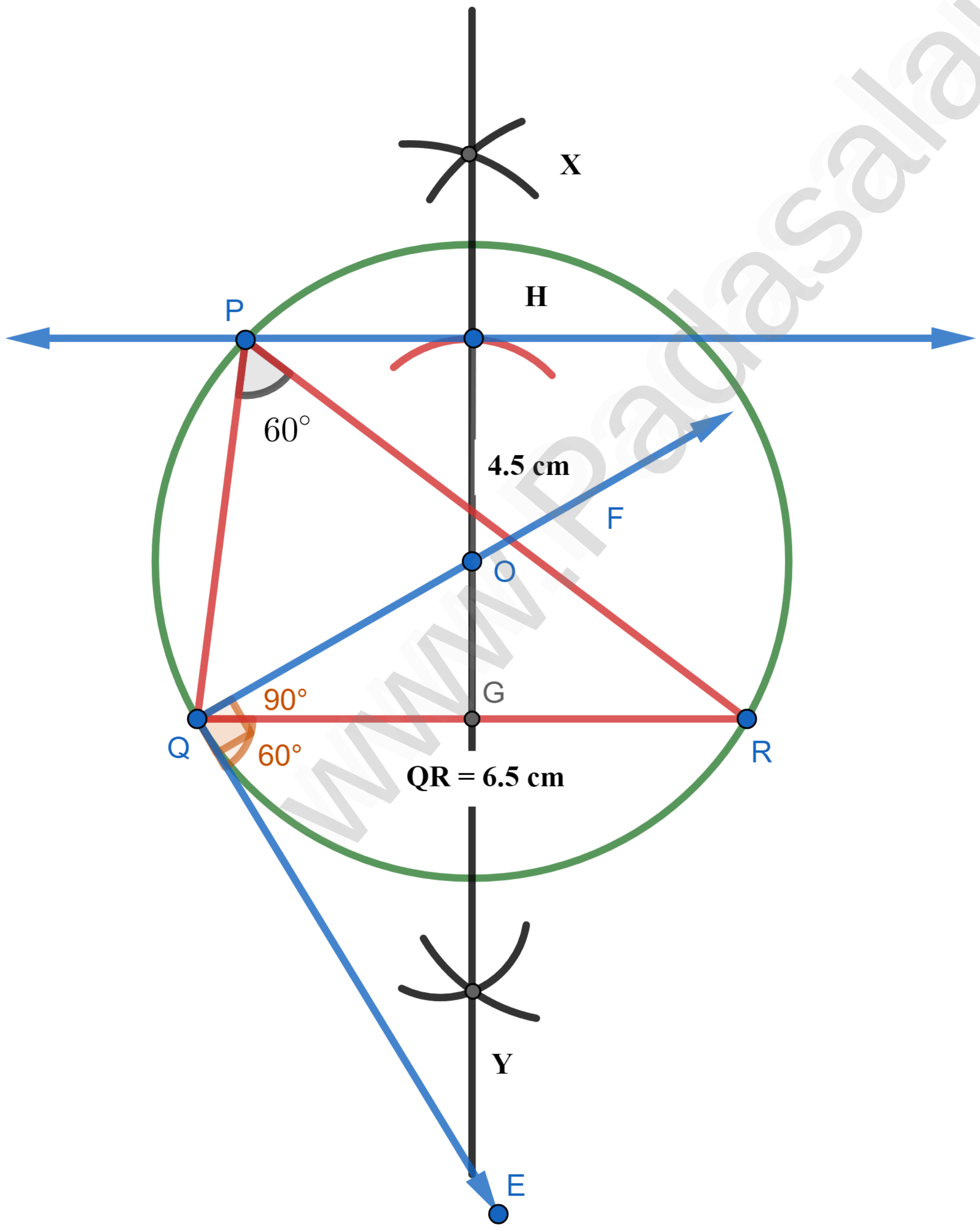
Rough Diagram



Fair Diagram



Construction:

- ❖ Draw a line segment QR = 6.5 cm. At Q draw QE such that $\angle RQE = 60°$. At Q draw QF such that $\angle EQF = 90°$.
- ❖ Draw the perpendicular bisector XY to QR which intersects QF at O and QR at G.
- ❖ With O as centre and OQ as radius draw a circle.
- ❖ From G mark arcs in the line XY at M Such that **GM = 4.5 cm.**
- ❖ Draw AB through M which is parallel to QR.
- ❖ AB meets the circle at P and S.
- ❖ Join QP and PR. Then $\Delta\, PQR$ is the required triangle.

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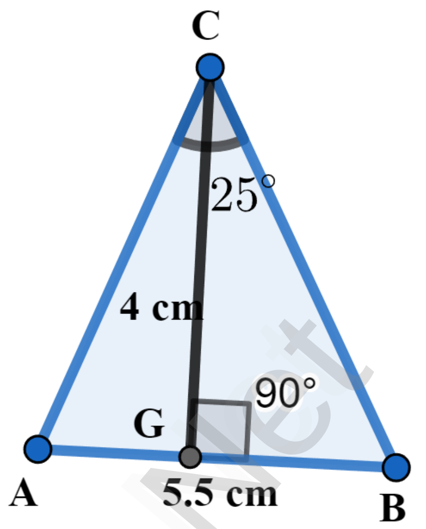
4. Construct a $\Delta\, \boldsymbol{PQR}$ in which such that $\boldsymbol{QR = 6.5}$ **cm**, $\angle \boldsymbol{P} = \boldsymbol{60^\circ}$ and the **Altitude** from P to **QR is of length 4.5 cm**.

Solution:

Rough Diagram



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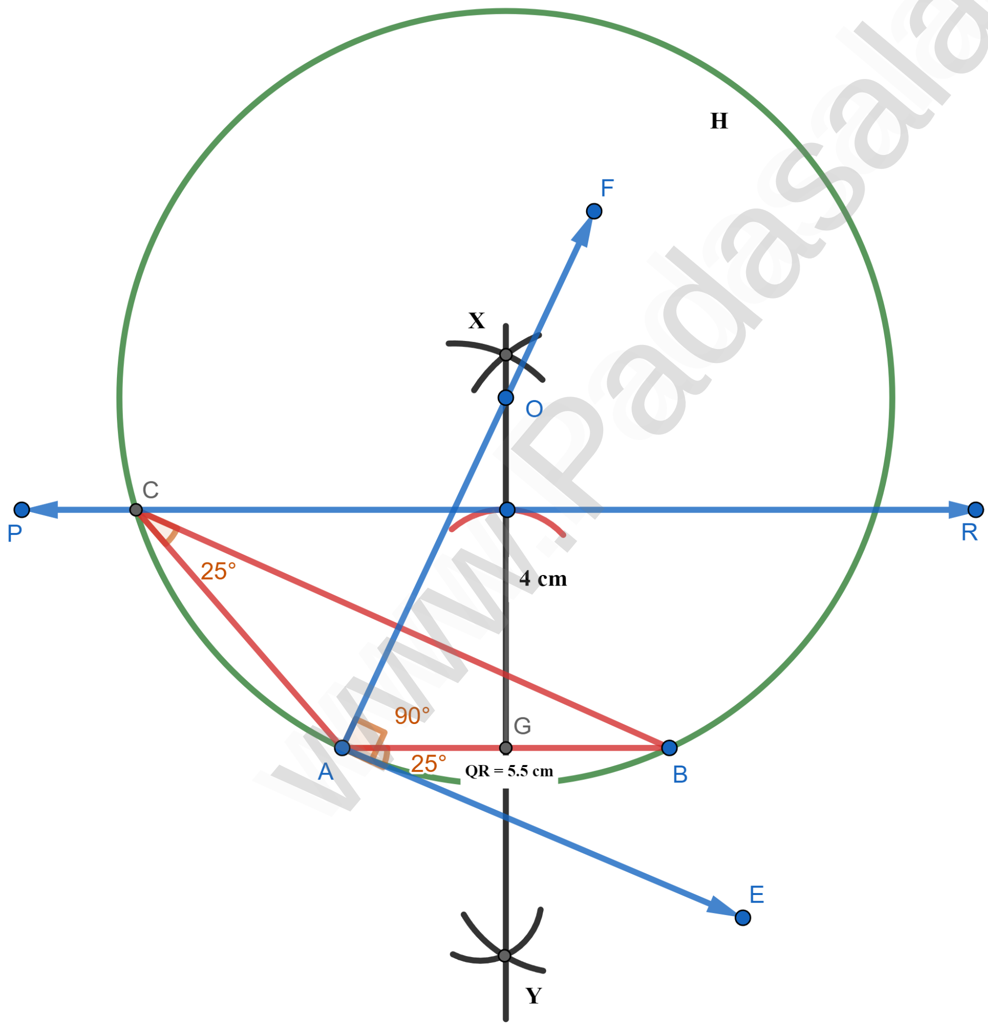

Construction:

❖ Draw a line segment AB = 5.5 cm. At A draw AE such that $\angle BAE = 25°$. At B draw BF such that $\angle EBF = 90°$.

❖ Draw the perpendicular bisector XY to QR which intersects QF at O and QR at G.

❖ With O as centre and OQ as radius draw a circle.

❖ From G mark arcs in the line XY at M Such that **GM = 4 cm.**

❖ Draw PR through M which is parallel to BC.

❖ AB meets the circle at P and S.

❖ Join AC and CB. Then $\Delta\, ABC$ is the required triangle.

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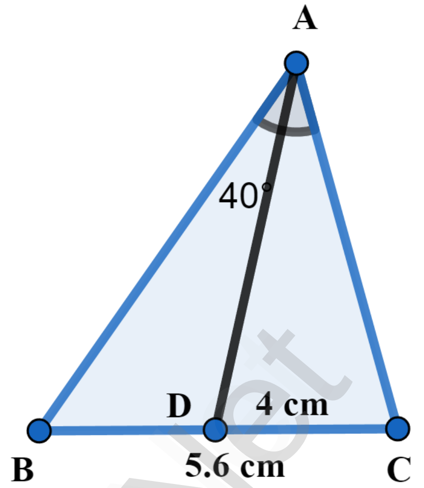
5. Draw a triangle $\Delta\, ABC$ of base $BC = 5.6$ **cm**, $\angle A = 40^{\circ}$ and the **Bisector** of $\angle A$ meets BC at D such that **BD = 4 cm.**

Solution:

Rough Diagram



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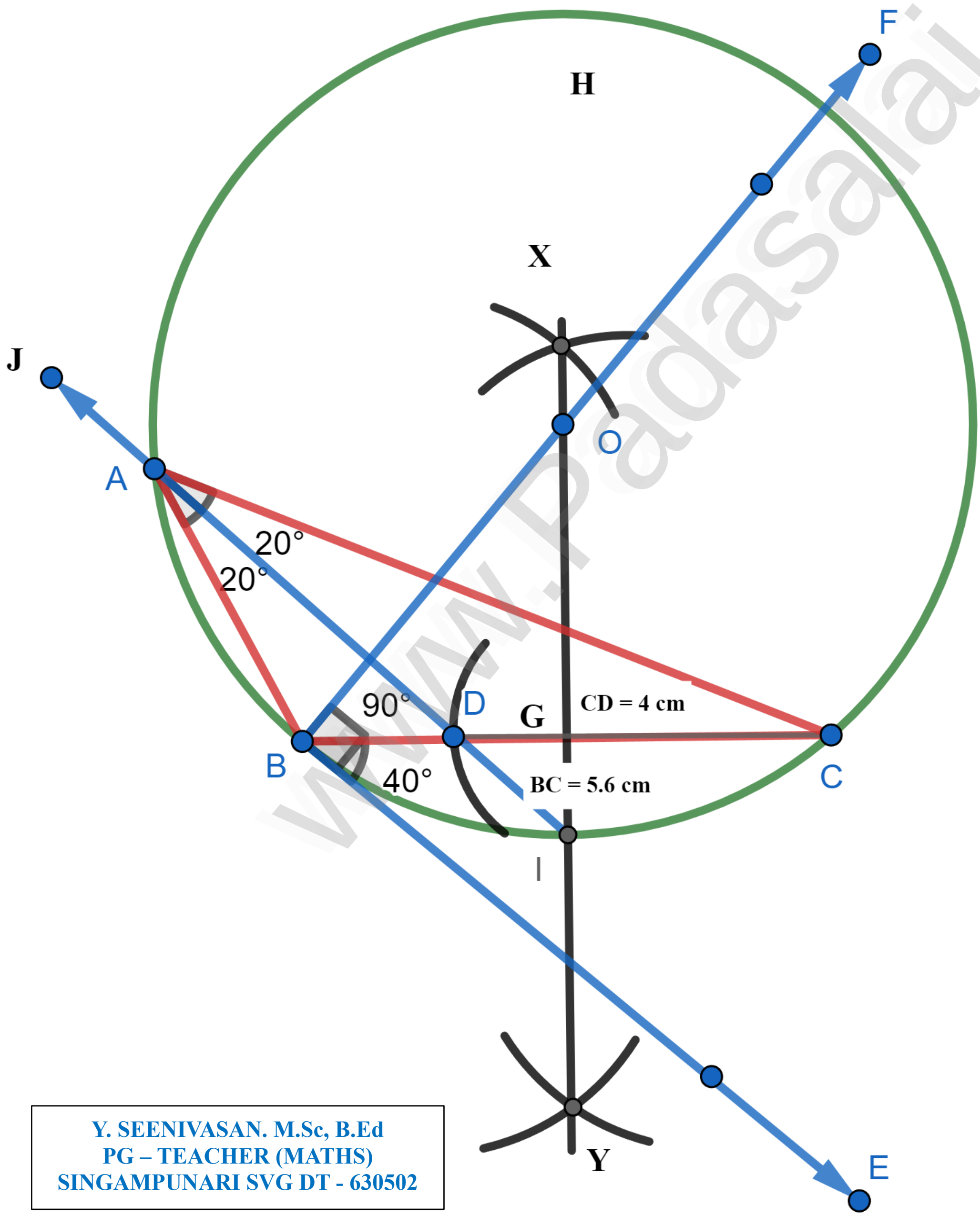

Construction:

- ❖ Draw a line segment BC = 5.6 cm. At B draw BE such that $\angle CBE = 40°$. At B draw BF such that $\angle EBF = 90°$.
- ❖ Draw the perpendicular bisector XY to BC which intersects BF at O and BC at G.
- ❖ With O as centre and OB as radius draw a circle.
- ❖ From C mark arc of 4 cm on CD at B.
- ❖ The perpendicular bisector intersects the circle at I. Joint ID.
- ❖ ID produced meets the circle at A. Now join AB and AC. Then $\Delta\, ABC$ is the required triangle.

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6. Draw a triangle $\Delta\, PQR$ such that $PQ = 6.8$ **cm**, **vertical angle** is 50° and the **Bisector** of vertical angle meets the base at D where **PD = 5.2 cm.**

Solution:

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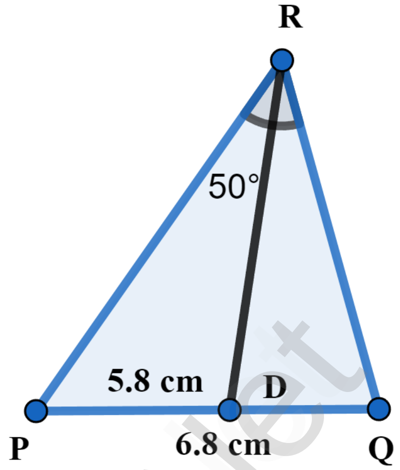
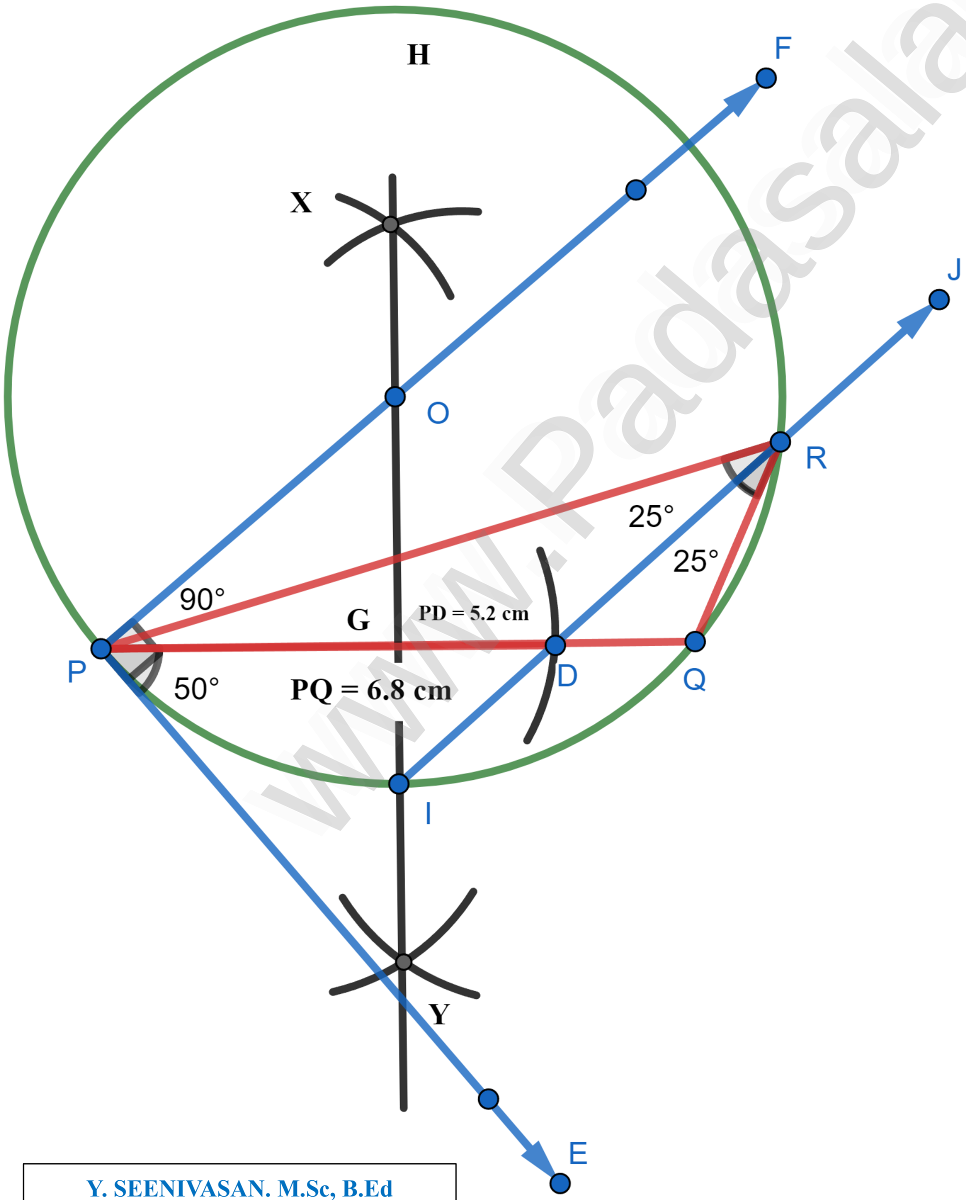
Rough Diagram



Fair Diagram



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Construction:

- ❖ Draw a line segment PQ = 6.8 cm. At P draw PE such that $\angle QPE = 50°$. At B draw BF such that $\angle EPF = 90°$.
- ❖ Draw the perpendicular bisector XY to PQ which intersects PF at O and PQ at G.
- ❖ With O as centre and OP as radius draw a circle.
- ❖ From P mark arc of 5.2 cm on PD at Q.
- ❖ The perpendicular bisector intersects the circle at I. Joint ID.
- ❖ ID produced meets the circle at A. Now join PQ and QR. Then $\Delta\, PQR$ is the required triangle.

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10^{TH} MATHS GRAPH OF VARIATION SOLUTION

GRAPH OF VARIATION EM NEW (2024 - 2025)

Example: 3.47 Varshika drew 6 circles with different sizes. Draw a graph for the relationship between the diameter and circumference (approximately related) of each circle as shown in the table and use it to find the circumference of a circle when its diameter is 6 cm.

Diameter (x) cm	1	2	3	4	5
Circumference (y) cm	3.1	6.2	9.3	12.4	15.5

Solution:

From the table **x increases** and **y** also **increases**. Thus, the variation is **Direct variation**.

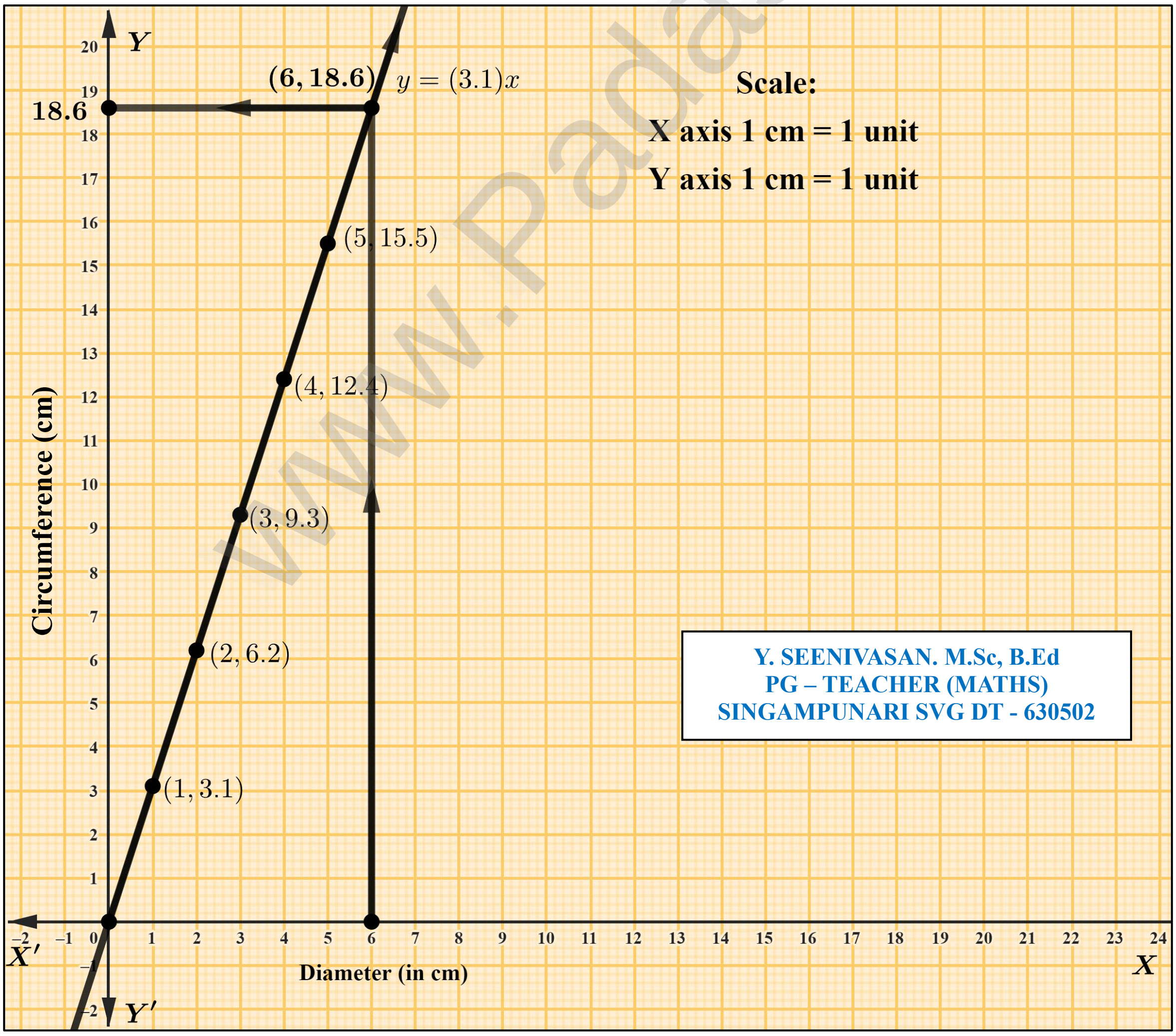
Let $\boldsymbol{y = kx},\ \boldsymbol{k} = \frac{y}{x}, k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = \frac{3.1}{1} = \frac{6.2}{2} = \frac{9.3}{3} = \frac{12.4}{4} = \cdots = \mathbf{3.1}.\ k = 3.1\ and\ \boldsymbol{y} = (\mathbf{3.1})\boldsymbol{x}.$

Plot the Points (1, 3.1), (2, 6.2), (3, 9.3), (4, 12.4), (5, 15.5).

∴ From the graph, when diameter is **6 cm**, its circumference is **18.6 cm**.

(**Verify** : $y = (3.1) \times 6 = \mathbf{18.6}$).



Example: 3.48 A bus is travelling at a uniform speed of 50 km / hr. Draw the distance time graph and hence find

(i) The constant of variation.
(ii) How far will it travel in 90 minutes or 1 ½ hrs?.
(iii)The time required to cover a distance of 300 km from the graph.

Solution:

Let x be the time taken (in Mins) and y be the distance travelled (in km).

Time taken x (in minutes)	60	120	180	240
Distance y (in km)	50	100	150	200

From the table **x increases** and **y** also **increases**. Thus, the variation is **Direct variation**.

Let $\boldsymbol{y = kx}$, $\boldsymbol{k} = \frac{y}{x}, k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = \frac{50}{60} = \frac{100}{120} = \frac{150}{180} = \frac{200}{240} = \cdots = \frac{5}{6}$. $k = \frac{5}{6}$ *and* $\boldsymbol{y} = \frac{5}{6}\boldsymbol{x}$.

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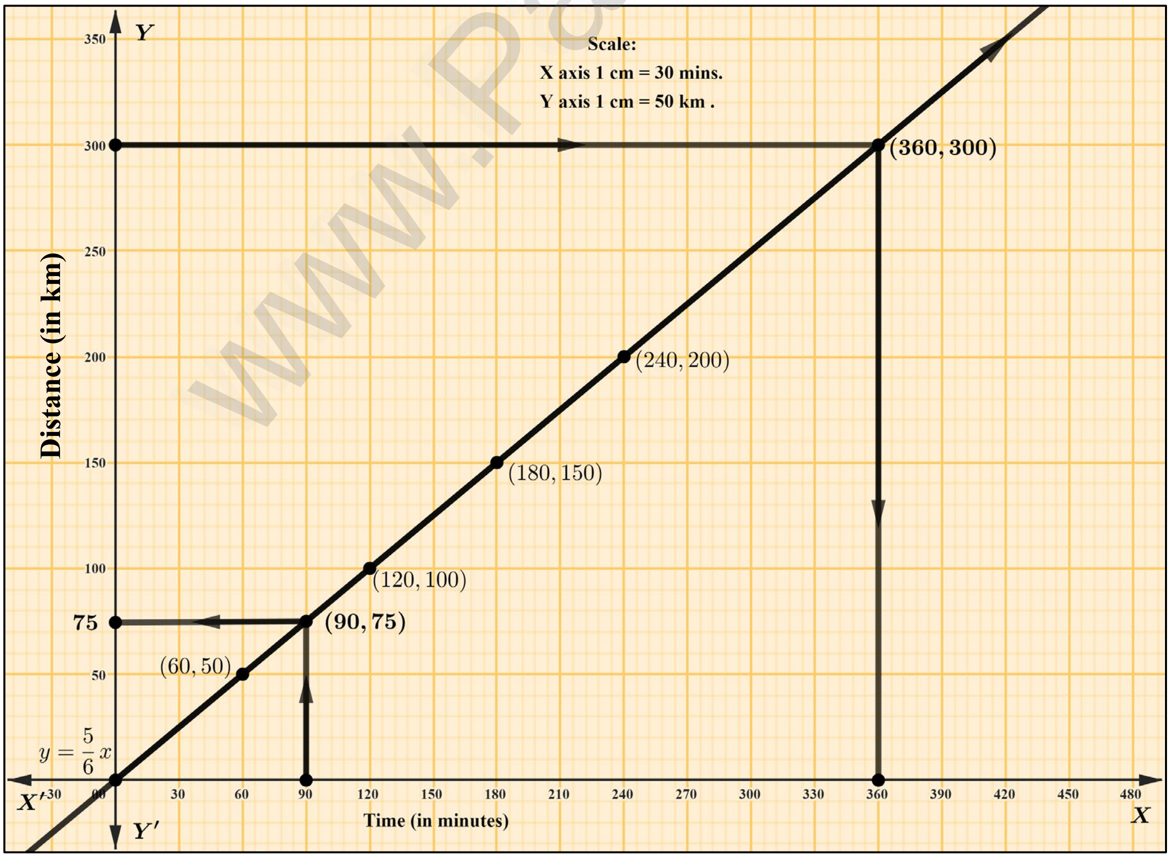
Plot the Points (60, 50), (120, 100), (180, 150), (240, 200).

∴ From the graph, The distance travelled for **90 minutes or 1 ½** hrs is **75 km**.

(**Verify** : $y = \frac{5x}{6}, if\ x = 90, y = \frac{5x}{6} = \frac{5}{6} \times 90 = \boldsymbol{75\ km}$.)

∴ From the graph, The time taken to cover **300 km** is **360 minutes or 6** hrs.

(**Verify** : $y = \frac{5x}{6}, if\ y = 300\ , x = \frac{6x}{5} = \frac{6}{5} \times 300 = \boldsymbol{360\ mins}$.)



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Example: 3.49 A Company initially started with 40 workers to complete the work by 150 days. Later it decided to fasten up the work increasing the number of workers as shown below.

Number of workers (x)	40	50	60	75
Number of days (y)	150	120	100	80

(i) Graph the above data and identify the type of variation.
(ii) From the graph, find the number of days required to complete the work if the company decides to opt for 120 workers?.
(iii)If the work has to be completed by 200 days, how many workers are required?.

Solution:

From the table **x increases** and **y decreases**. Thus, the variation is an **indirect variation**.

Let $\boldsymbol{y} = \frac{k}{x}$, $\boldsymbol{k} = \boldsymbol{xy}$, $k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = 40 \times 150 = 50 \times 120 = 60 \times 100 = 75 \times 80 = \cdots = \mathbf{6000}$. $\boldsymbol{xy} = \mathbf{6000}$ *and* $\boldsymbol{y} = \frac{6000}{x}$.

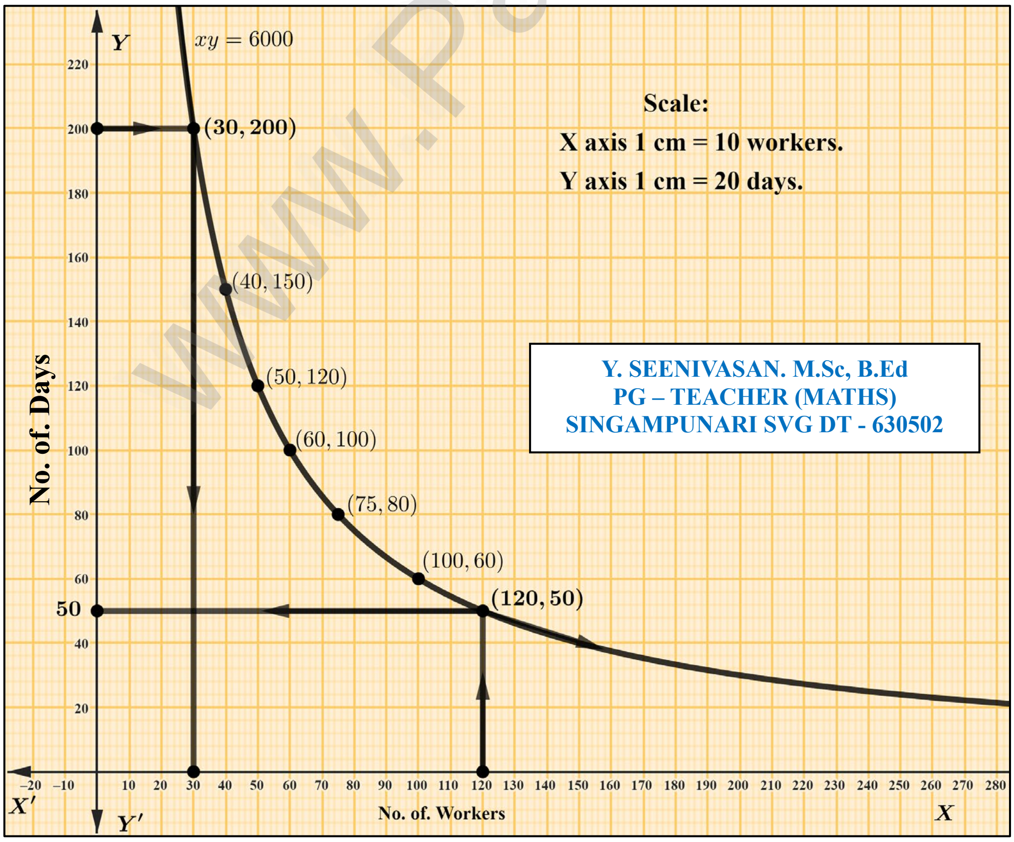
Plot the Points (40, 150), (50, 120), (60, 100), (75, 80).

∴ From the graph , the required number of days to complete the work when the company decides to work with **120** workers is **50 days**.

(**Verify** : $\boldsymbol{xy} = \mathbf{6000}$, $if\ x = 120, y = \frac{6000}{120} = \mathbf{50}$).

∴ From the graph , if the work has to be completed by **200 days**, the number of workers required is **30**.

(**Verify** : $\boldsymbol{xy} = \mathbf{6000}$, $if\ y = 200, y = \frac{6000}{200} = \mathbf{30}$).



Example: 3.48 Nishanth is the winner in a Marathon race 12 km distance. He ran at the uniform speed of 12 km / hr and reached the destination in 1 hour. He was followed by Aradhana, Jeyanth, Sathya and Swetha with their respective speed of 6 km / hr, 4 km / hr, 3 km / hr and 2 km / hr. And, they covered the distance in 2 hrs, 3 hrs, 4 hrs and 6 hours respectively.

Draw the Speed- time graph and use it to find time taken to Kaushik with his speed 2.4 km / hr.

Solution:

Let x be the Speed (in km / hr) and y be the time (in hours).

Speed x (in km / hr)	12	6	4	3	2
Time y (in Hours)	1	2	3	4	6

From the table **x decreases** and **y increases**. Thus, the variation is **Indirect variation**.

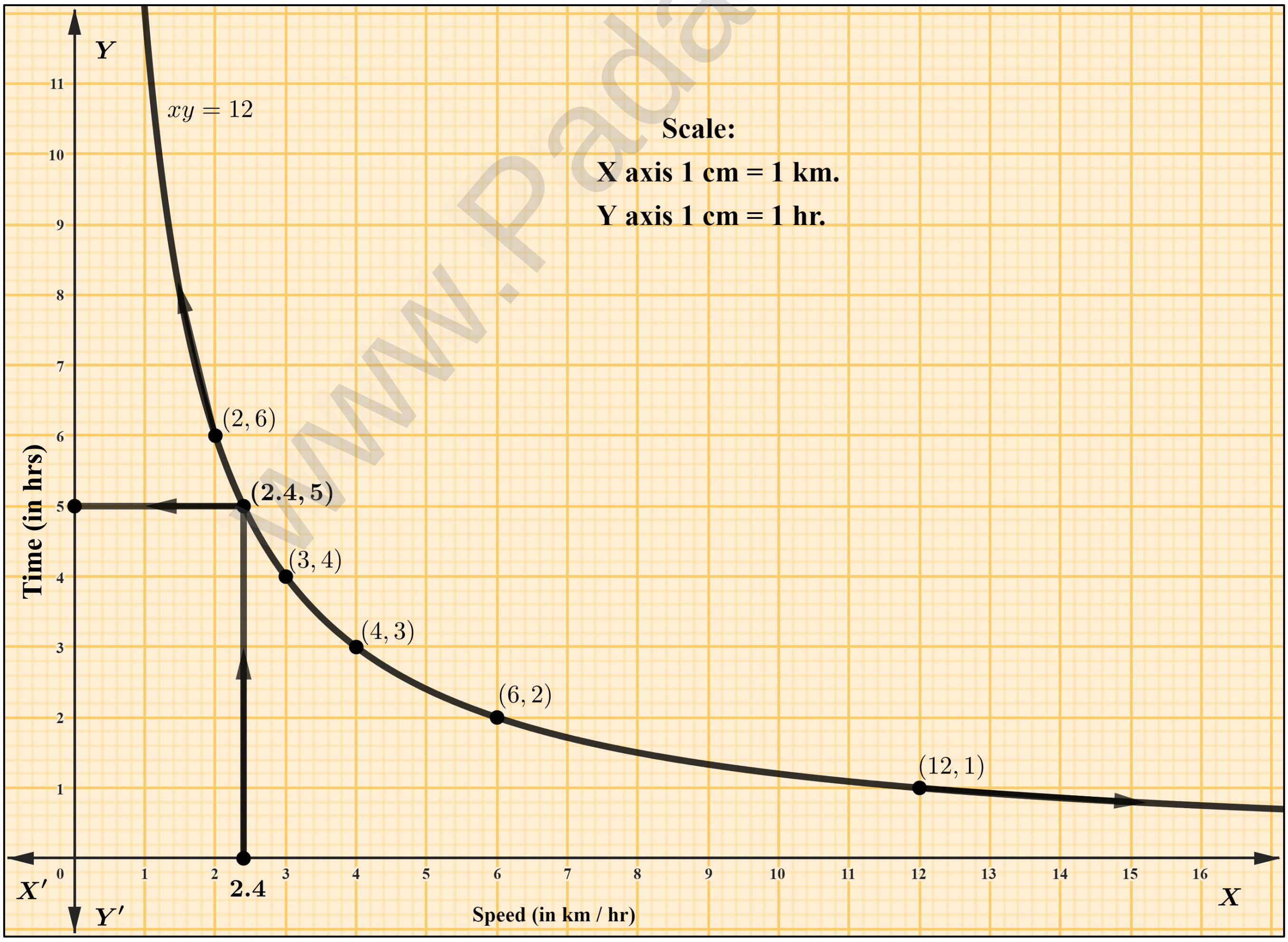
Let $\boldsymbol{y} = \frac{k}{x}$, $\boldsymbol{k} = \boldsymbol{xy}$, $k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = 12 \times 1 = 6 \times 2 = 4 \times 3 = 3 \times 4 = \cdots = \mathbf{24}$. $\boldsymbol{xy} = \mathbf{24}$ *and* $\boldsymbol{y} = \frac{\mathbf{24}}{x}$.

Plot the Points (12, 1), (6, 2), (4, 3), (3, 4), (2, 6).

∴ From the graph, Kaushik Takes **5 hrs** with a speed of **2.4 km / hr**.

(**Verify** : $y = \frac{24}{x}, if\ x = 5, y = \frac{24}{5} = \mathbf{2.4}$.)



Exercise : 3.15) 1) A garment shop announces a flat 50 % discount on every purchase of items for their customers. Draw the graph for the relation between the Marked Price and the Discount. Hence find

(i) The marked price when a customer gets a discount of ₹ 3250 (from graph).
(ii) The discount when the marked price is ₹ 2500.

Solution:

Let x be the Marked Price (in ₹) and y be the Discount (in ₹).

Marked Price x (in ₹)	1000	1500	2000	2500	3000
Discount y (in ₹)	500	750	1000	1250	1500

From the table **x increases** and **y** also **increases**. Thus, the variation is **Direct variation**.

Let $\boldsymbol{y = kx},\ \boldsymbol{k} = \frac{y}{x}, k > 0$. where **k** is a constant of variation.

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$\boldsymbol{k} = \frac{500}{1000} = \frac{750}{1500} = \frac{1000}{2000} = \frac{1250}{2500} = \cdots = \frac{\mathbf{1}}{\mathbf{2}}.\ k = \frac{1}{2}\ and\ \boldsymbol{y} = \frac{\mathbf{1}}{\mathbf{2}}\boldsymbol{x}.$

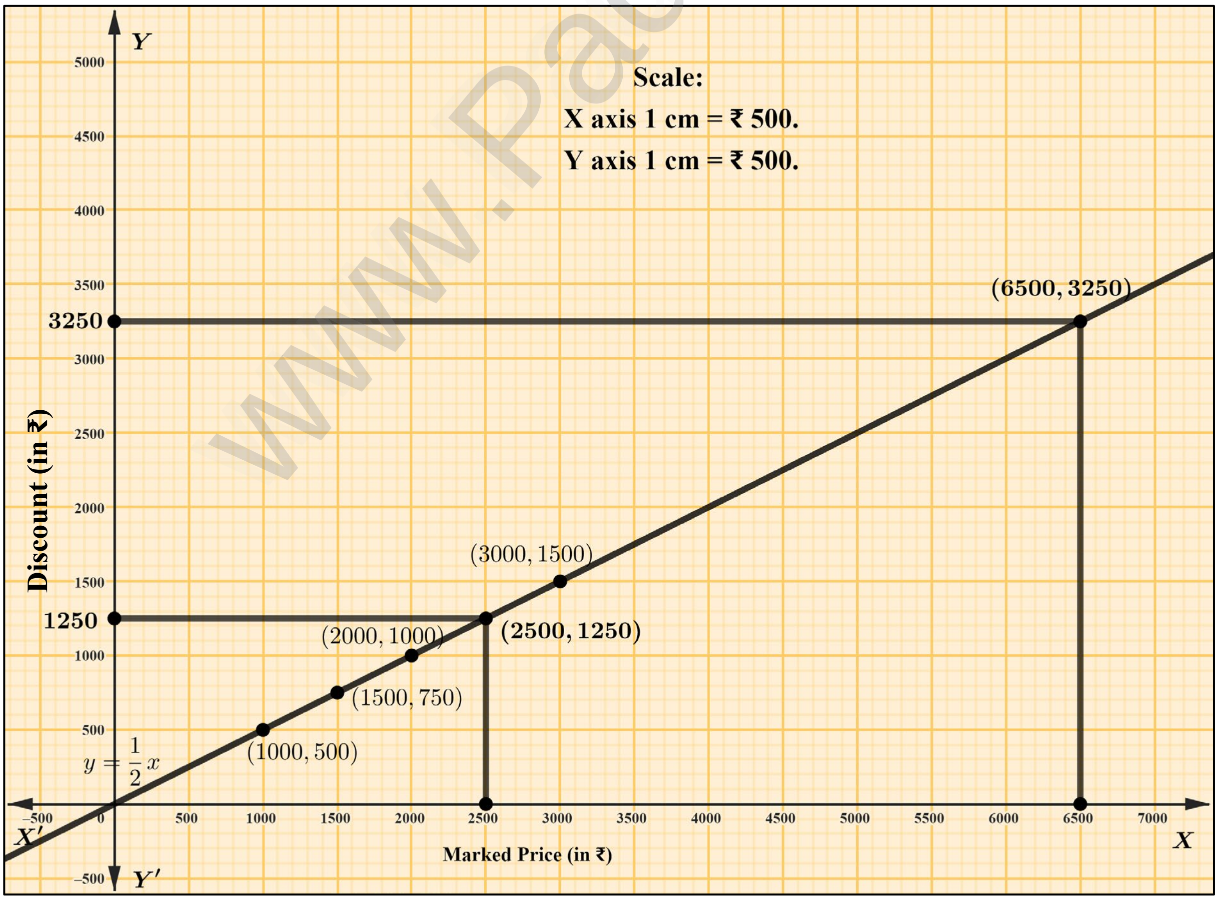
Plot the Points (1000, 500), (1500, 750), (2000, 1000), (2500, 1250), (3000, 1500).

∴ From the graph, when a customer gets a discount of **₹ 3250** the marked price is **₹ 6500**.

(**Verify** : $y = \frac{x}{2}, if\ y = 3250,\ 3250 = \frac{x}{2} = 3250 \times 2 =$ ₹ **6500**.)

∴ From the graph, when the marked price is **₹ 2500** the discount is **₹ 1250**.

(**Verify** : $y = \frac{x}{2}, if\ x = 2500, y = \frac{1}{2} \times 2500 = 1250 =$ ₹ **1250**)



Exercise: 3.15) 2) Draw the graph of $xy = 24, x, y > 0$. Using the graph find,

(i) y when $x = 3$ and (ii) x when $y = 6$.

Solution: $xy = 24$ (take multiple of 24 two point)

x	1	2	3	4	6	8	12	24
y	24	12	8	6	4	3	2	1

From the table **x increases** and **y decreases**. Thus, the variation is **Indirect variation**.

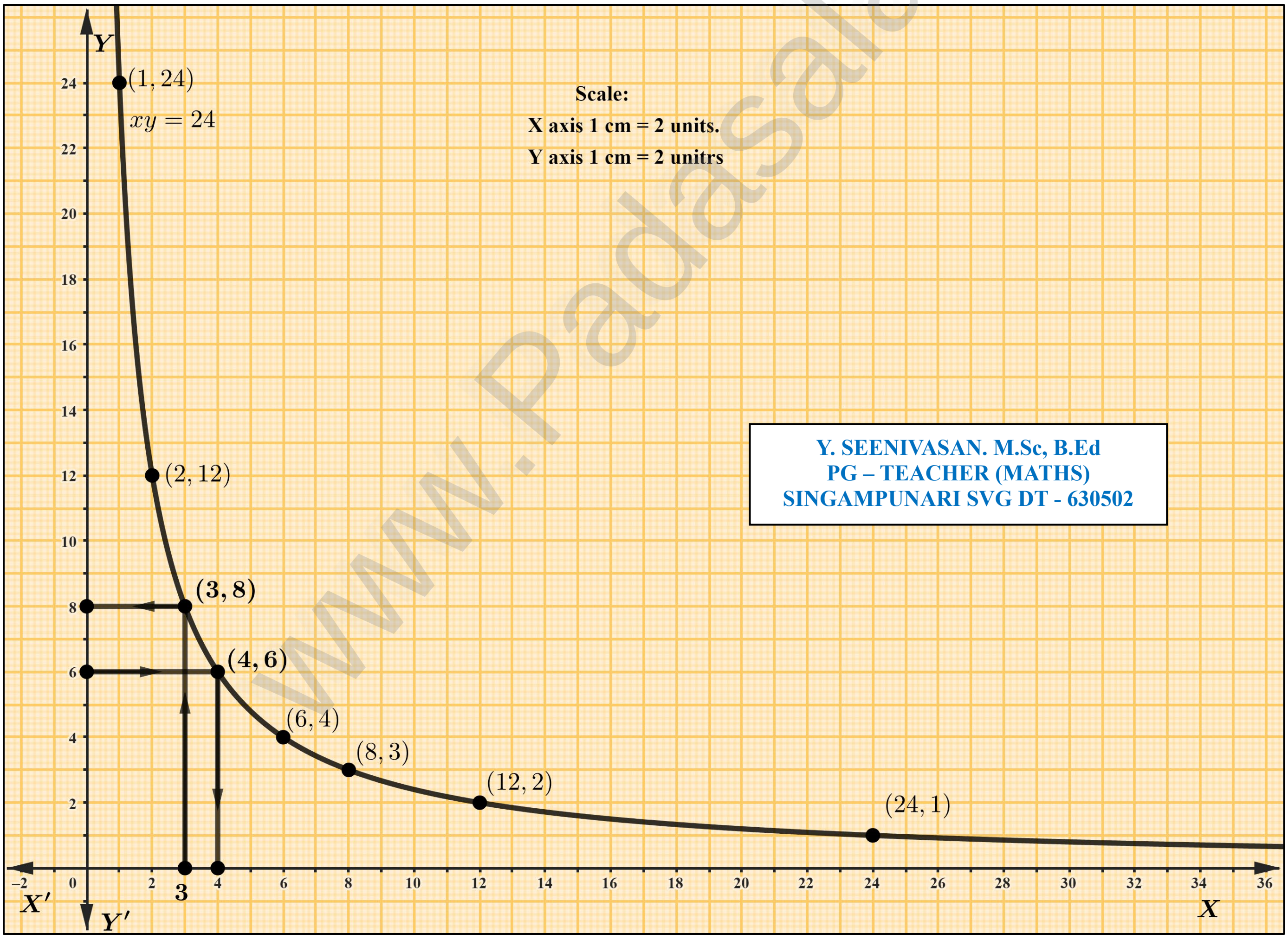
Let $\boldsymbol{y} = \frac{\boldsymbol{k}}{\boldsymbol{x}}$, $\boldsymbol{k} = \boldsymbol{xy}$, $k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = 1 \times 24 = 2 \times 12 = 3 \times 8 = 4 \times 6 = \cdots = \mathbf{24}$. $\boldsymbol{xy} = \mathbf{24}$ *and* $\boldsymbol{y} = \frac{\mathbf{24}}{\boldsymbol{x}}$.

Plot the Points (1, 24), (2, 12), (3, 8), (4, 6), (6, 4), (8, 3), (12, 2), (24, 1).

∴ From the graph, when $\boldsymbol{x} = \mathbf{3}$, then $\boldsymbol{y} = \mathbf{8}$. (**Verify** : $y = \frac{24}{x}, if\ x = 3, y = \frac{24}{3} = \mathbf{8}$.)

∴ From the graph, when $\boldsymbol{y} = \mathbf{6}$, then $\boldsymbol{x} = \mathbf{4}$. (**Verify** : $y = \frac{24}{x}, if\ y = 6, y = \frac{24}{6} = \mathbf{4}$.)



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Exercise: 3.15) 3) Graph the following linear function $y = \frac{1}{2}x$. Identify the constant of variation and verify it with the graph. Also find

(i) y when $x = 9$ and (ii) x when $y = 7.5$.

Solution: $y = \frac{1}{2}x$ (take even number divisible by 2)

x	2	4	6	8	10	12
y	1	2	3	4	5	6

From the table **x increases** and **y** also **increases**. Thus, the variation is **Direct variation**.

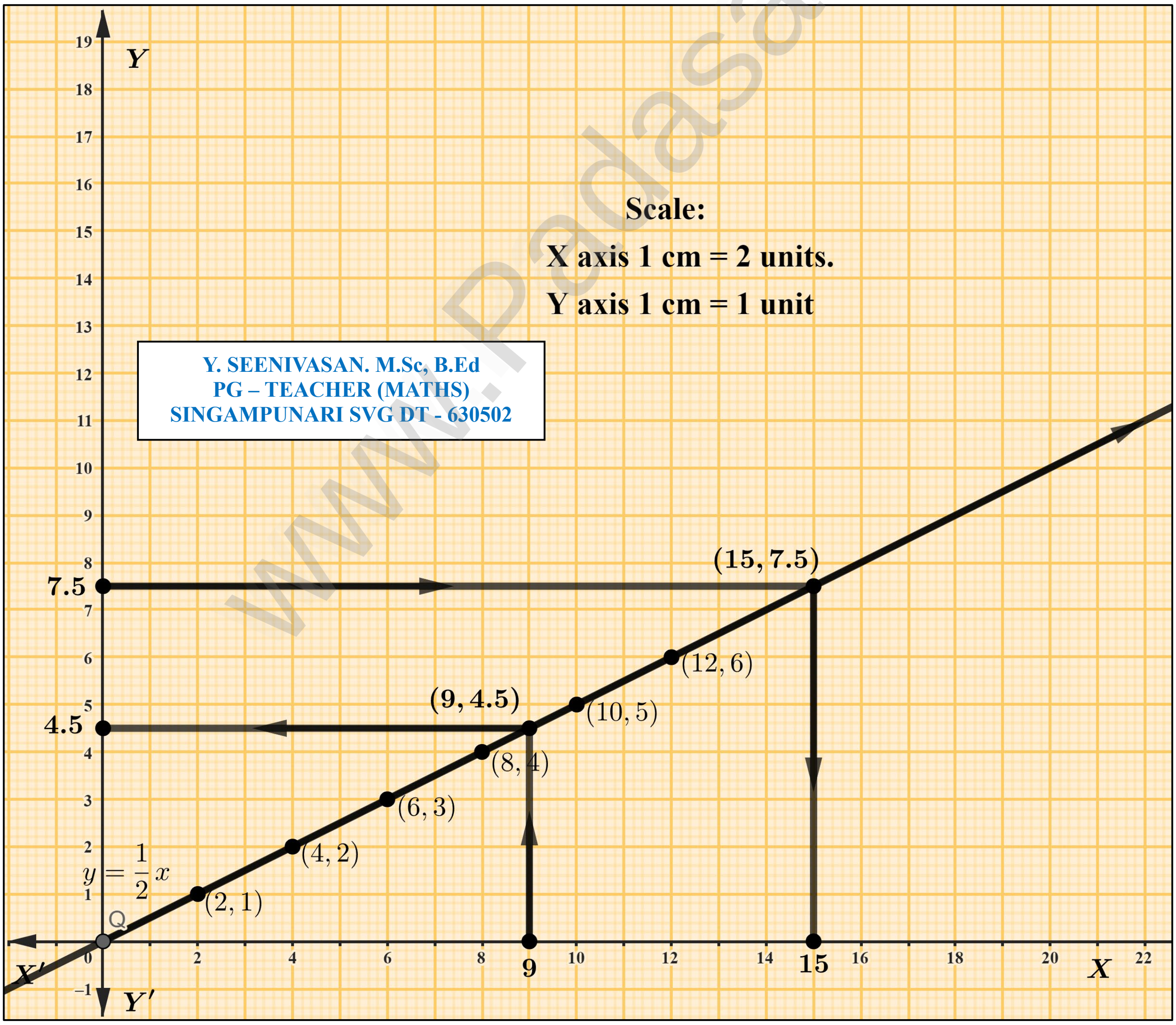
Let $\boldsymbol{y = kx}$, $\boldsymbol{k} = \frac{y}{x}$, $k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = \frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \cdots = \frac{\mathbf{1}}{\mathbf{2}}$. $\boldsymbol{k} = \frac{\mathbf{1}}{\mathbf{2}}$ *and* $\boldsymbol{y} = \frac{1}{2}x$.

Plot the Points (2, 1), (4, 2), (6, 3), (8, 4), (10, 5), (12, 6).

∴ From the graph, when $\boldsymbol{x = 9}$, then $\boldsymbol{y = 4.5}$. (**Verify** : $y = \frac{x}{2}, if\ x = 9, y = \frac{9}{2} = \mathbf{4.5}$.)

∴ From the graph, when $\boldsymbol{y = 7.5}$, then $\boldsymbol{x = 15}$. (**Verify** : $y = \frac{x}{2}, if\ y = 7.5,\ 7.5 = \frac{x}{2} = \mathbf{15}$.)



Exercise: 3.15) 4) The following table shows the data about the number of pipes and the time taken to fill the same tank.

No. of. pipes x	2	3	6	9
Time Taken y (in mins)	45	30	15	10

Draw the graph for the above data and hence

(i) Find the time taken to fill the tank when five pipes are used.

(ii) Find the number of pipes when the time is 9 minutes.

Solution:

From the table **x increases** and **y decreases**. Thus, the variation is **Indirect variation**.

Let $\boldsymbol{y = \frac{k}{x}}$, $\boldsymbol{k = xy}$, $k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = 2 \times 45 = 3 \times 30 = 6 \times 15 = 9 \times 10 = \cdots = \mathbf{90}$. $\boldsymbol{xy} = \mathbf{90}$ *and* $\boldsymbol{y} = \frac{\mathbf{90}}{x}$.

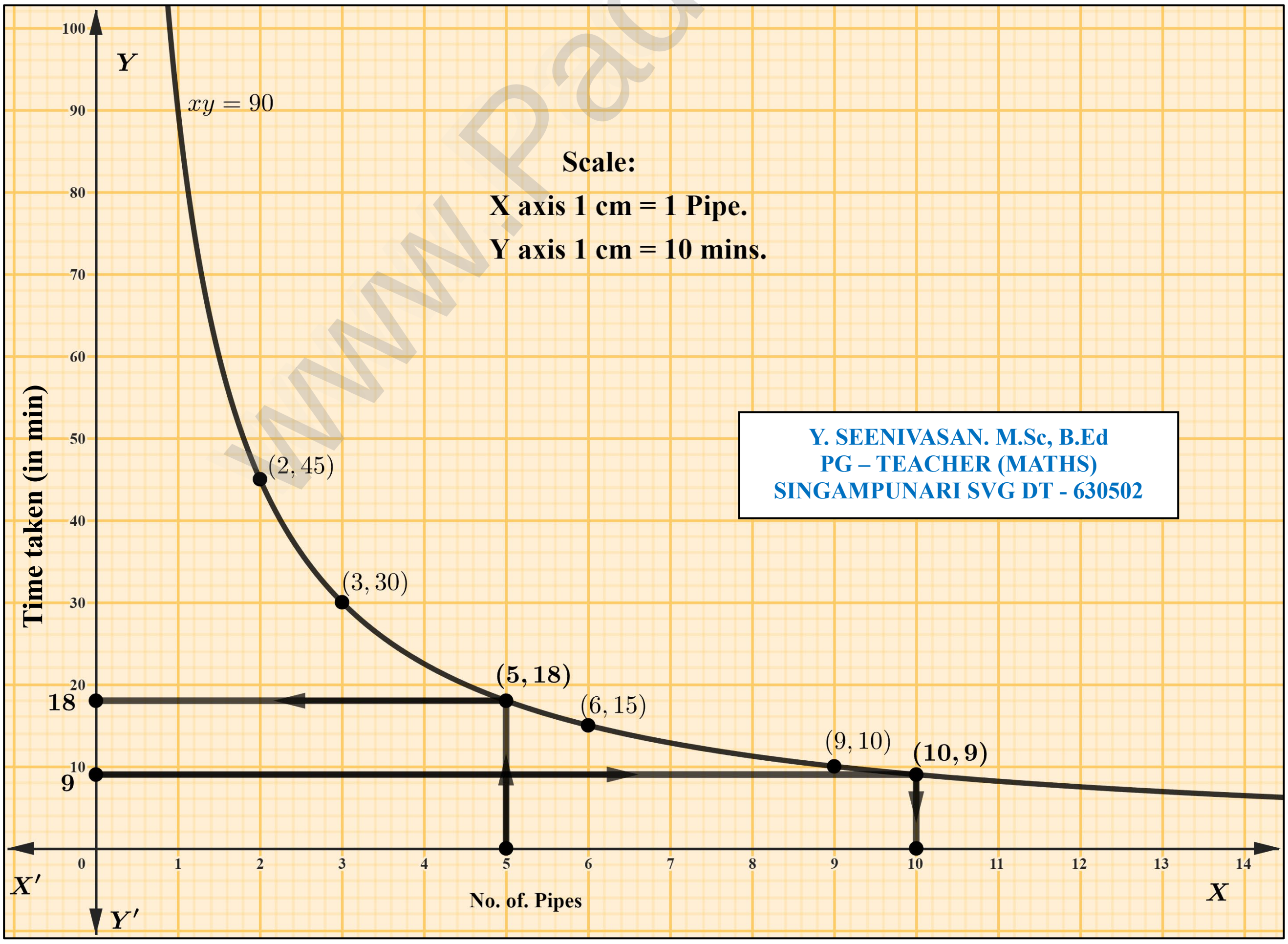
Plot the Points (2, 45), (3, 30), (6, 15), (9, 4).

∴ From the graph, when five or **5 pipes** are used time taken to fill the tank is **18 minutes**.

(**Verify** : $y = \frac{90}{x}, if\ x = 5, y = \frac{90}{5} = \mathbf{18}$.)

∴ From the graph, when the time is **9 minutes** the number pipes required **10**.

(**Verify** : $y = \frac{90}{x}, if\ y = 9, 9 = \frac{90}{x} = \mathbf{10}$.)



Exercise: 3.15) 5) A School announces that for a certain competitions, the cash price will be distributed for all the participants equally as show below

No. of. Participants (x)	2	4	6	8	10
Amount for each Participants y (in ₹)	180	90	60	45	36

(i) Find the constant of variation.

(ii) Graph the above data and hence, find how will each participants get if the number of participants are 12.

Solution:

From the table **x increases** and **y decreases**. Thus, the variation is **Indirect variation**.

Let $y = \frac{k}{x}$, $k = xy$, $k > 0$. where **k** is a constant of variation.

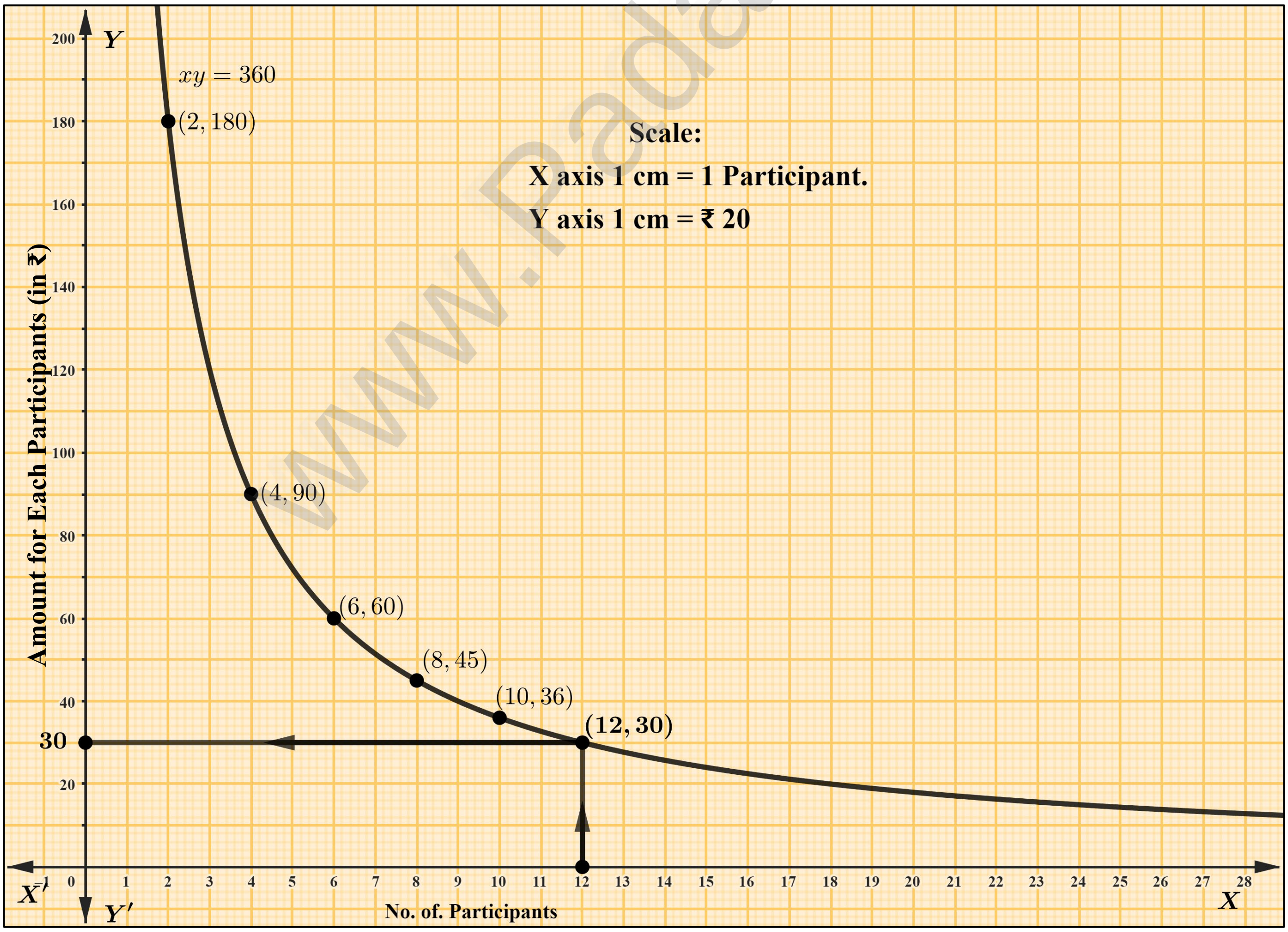
$k = 2 \times 180 = 4 \times 90 = 6 \times 60 = 8 \times 45 = \cdots = 360$. $xy = 360$ *and* $y = \frac{360}{x}$.

Plot the Points (2, 180), (4, 90), (6, 60), (8, 45), (10, 36).

(i) Constant of variation $k = 360$.

∴ From the graph, the **12** number of participants will get the amount of each participants is **₹ 30**.

(**Verify** : $y = \frac{360}{x}, if\ x = 12, y = \frac{360}{12} = 30$.)



Exercise: 3.15) 6) A two wheeler parking zone near bus stand charges as below.

Time x (in hours)	4	8	12	24
Amount y (in ₹)	60	120	180	360

Check if the amount charged are in direct variation or in inverse variation to the parking time. Graph the data. Also

(i) Find the amount to be paid when parking time is 6 hrs.

(ii) Find the parking duration when the amount paid is ₹ 150.

Solution:

From the table **x increases** and **y** also **increases**. Thus, the variation is **Direct variation**.

Let $\boldsymbol{y = kx},\ \boldsymbol{k} = \frac{y}{x}, k > 0$. where **k** is a constant of variation.

$\boldsymbol{k} = \frac{60}{4} = \frac{120}{8} = \frac{180}{12} = \frac{360}{24} = \cdots = \mathbf{15}.\ k = 15\ and\ \boldsymbol{y} = \mathbf{(15)}\boldsymbol{x}.$

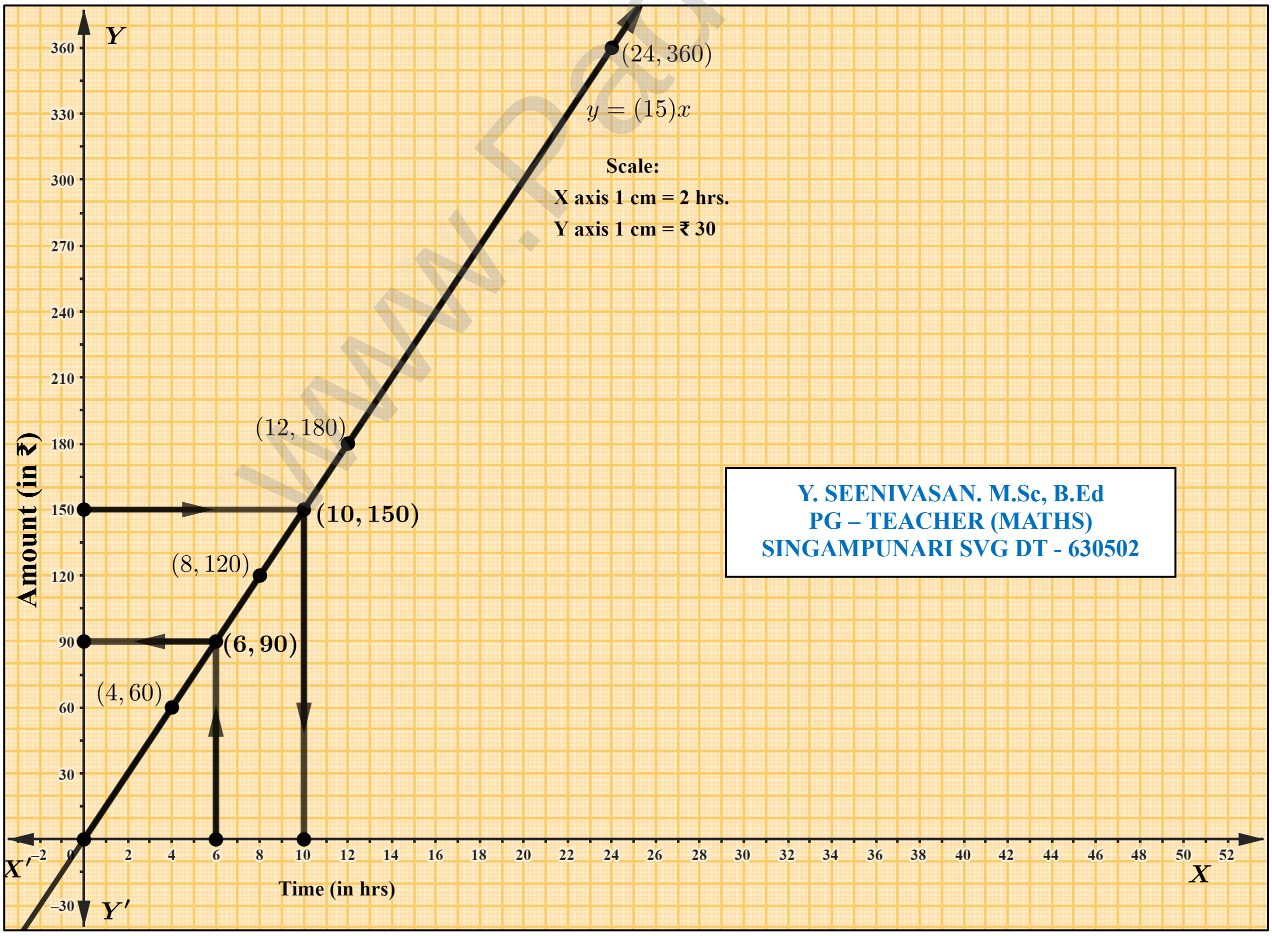
Plot the Points (4, 60), (8, 120), (12, 9180), (24, 360).

∴ From the graph, when parking time is **6 hrs** the amount to be paid is **₹ 90**.

(**Verify** : $y = (15)x,\ if\ x = 6,\ y = (15) \times 6 =$ ₹ **90**).

∴ From the graph, when the amount paid is **₹ 150** the parking duration is **10 hrs**.

(**Verify** : $y = (15)x,\ if\ y =$ ₹ $150,\ x = \frac{150}{15} = \mathbf{10}$).



10^{TH} MATHS QUADRATIC GRAPH SOLUTION

QUADRATIC GRAPH EM NEW (2024 - 2025)

Example: 3.51 Discuss the nature of solutions of the following quadratic equations.

(i) $x^2 + x - 12 = 0$ (ii) $x^2 - 8x + 16 = 0$ (iii) $x^2 + 2x + 5 = 0$

Solution:

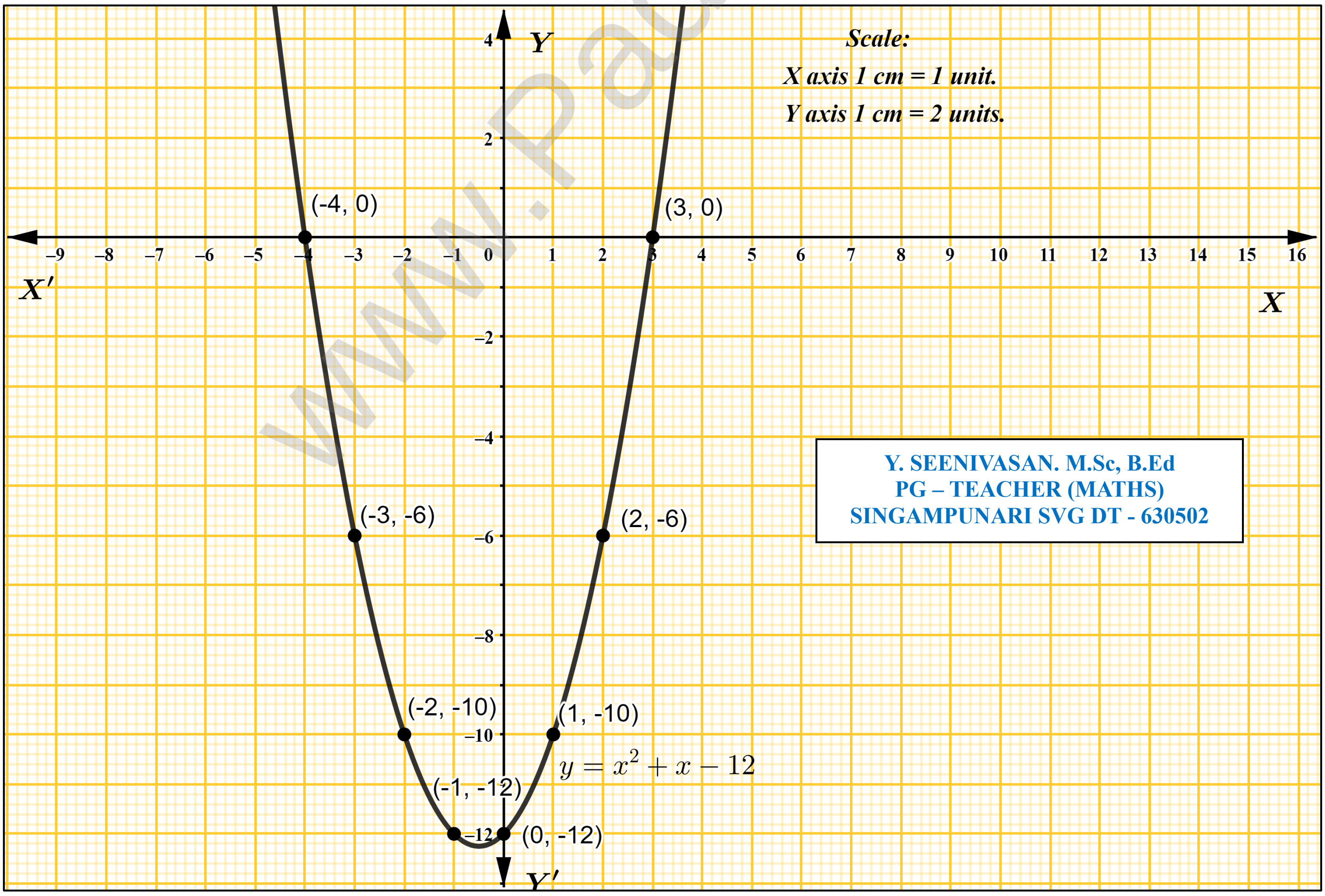
(i) $y = x^2 + x - 12 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-1}{2} = -\mathbf{0.5}$ (between **-1 to 0** take left 3 point right 3 point)

x	- 4	- 3	- 2	- 1	0	1	2	3
x^2	16	9	4	1	0	1	4	9
+ x	- 4	- 3	- 2	-1	0	1	2	3
- 12	- 12	- 12	- 12	- 12	- 12	- 12	- 12	- 12
y	0	- 6	- 10	- 12	- 12	- 10	-6	0

Plot the points : (-4, 0), (-3, -6), (-2, -10), (-1, -12), (0, -12), (1, -10), (2, -6), (-4, 0), (3, 0).

∴ The Quadratic Equation $x^2 + x - 12 = 0$ has **Real** and **Unequal Roots**.



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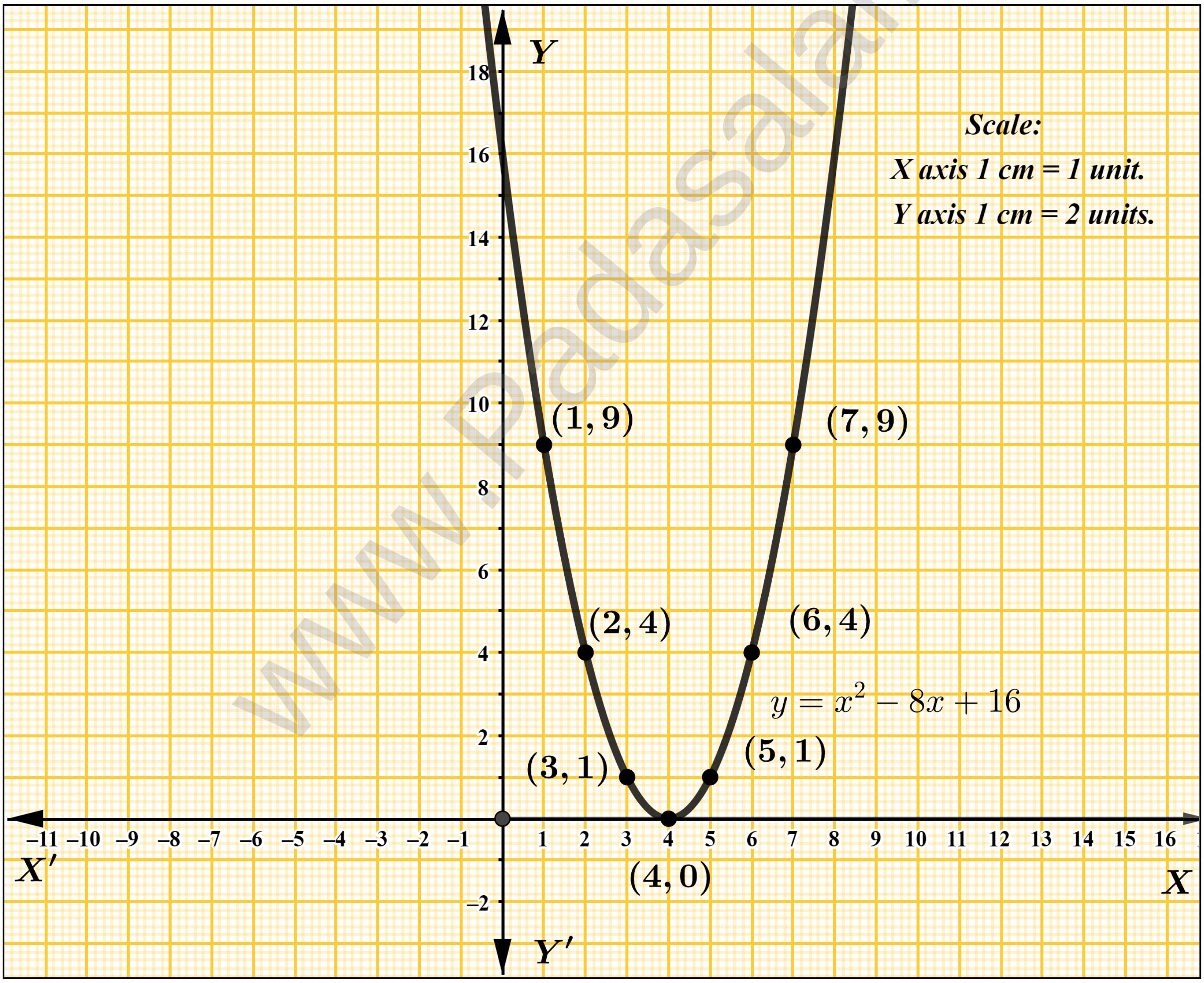
(ii) $y = x^2 - 8x + 16 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-8)}{2} = \mathbf{4}$ (between **4** Left 3 Point and Right 3 point)

x	1	2	3	4	5	6	7
x^2	1	4	9	16	25	36	49
-8x	-8	-16	-24	-32	-40	-48	-56
+16	16	16	16	16	16	16	16
y	9	4	1	0	1	4	9

Plot the points : (1, 9), (2, 4), (3, 1), (4, 0), (5, 1), (6, 4), (7, 9).

∴ The Quadratic Equation $x^2 - 8x + 16 = 0$ has **Real** and **Equal Roots**.



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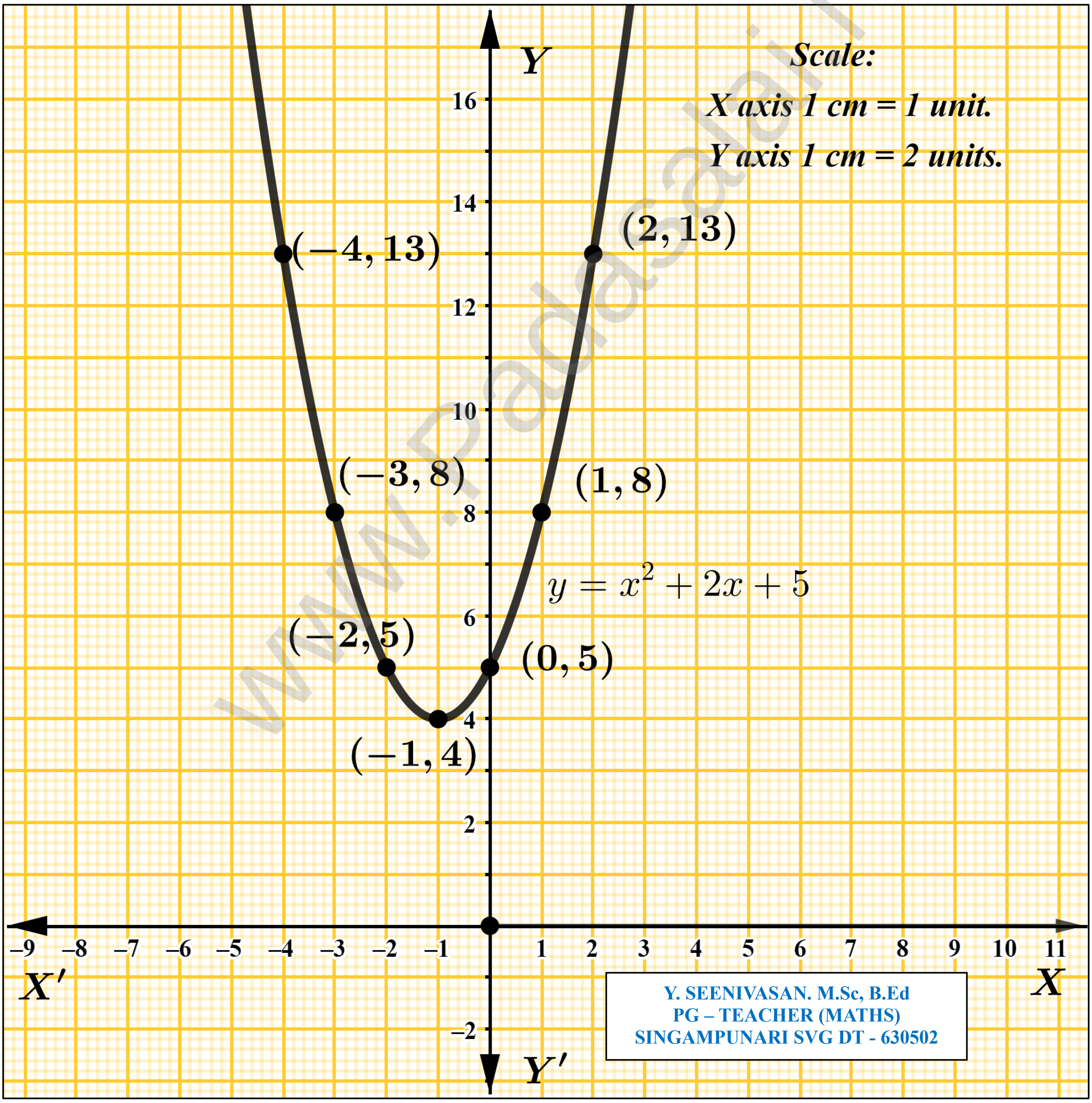
(iii) $y = x^2 + 2x + 5 = 0 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-2}{2} = \mathbf{-1}$ (between **-1** Left 3 Point and Right 3 point)

x	-4	-3	-2	-1	0	1	2
x^2	16	9	4	1	0	1	4
+2x	-8	-6	-4	-2	0	2	4
+5	5	5	5	5	5	5	5
y	13	8	5	4	5	8	13

Plot the points : (-4, 13), (-3, 8), (-2, 5), (-1, 4), (0, 5), (1, 8), (2, 13).

∴ The Quadratic Equation $x^2 - 8x + 16 = 0$ has **No Real Roots**.



Example: 3.52 Draw the graph of $\boldsymbol{y = 2x^2}$ and hence solve $\boldsymbol{2x^2 - x - 6 = 0}$.

Solution:

Given, $\boldsymbol{y = 2x^2} \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{0}{2} = \mathbf{0}$ (between **0** Left 3 Point and Right 3 point)

x	-3	-2	-1	0	1	2	3
x^2	9	4	1	0	1	4	9
$Y = 2x^2$	18	8	2	0	2	8	18

Plot the points : (-3, 18), (-2, 8), (-1, 2), (0,0), (1, 2), (2, 8), (3, 18)

Solve :

$y = 2x^2$

$0 = 2x^2 - x - 6$

(-) (+) (+)

$\boldsymbol{y = \quad x + 6}$

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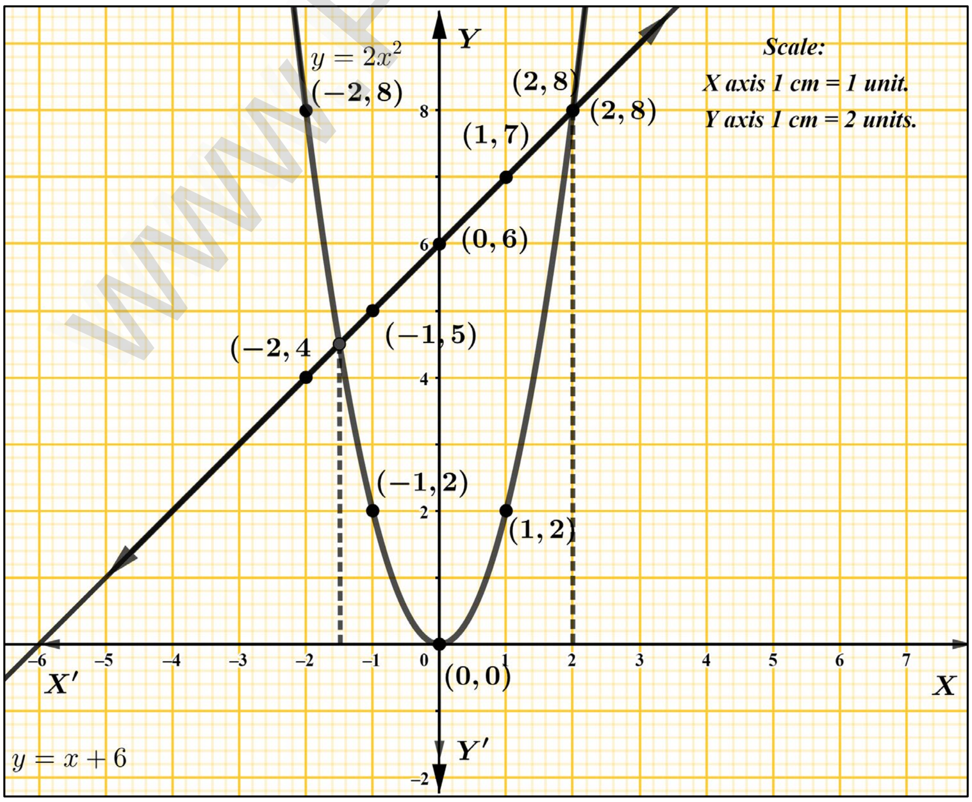
$\boldsymbol{y = x + 6}$

x	-3	-2	-1	0	1	2	3
+6	6	6	6	6	6	6	6
Y = x + 6	3	4	5	6	7	8	9

Plot the Points : (-3, 3), (-2, 4), (-1, 5), (0,6), (1, 7), (2, 8), (3, 9)

∴ The solution set of Equation $\boldsymbol{2x^2 - x - 6 = 0}$ has $\{\mathbf{-1.5, 2}\}$.



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Example: 3.53 Draw the graph of $y = x^2 + 4x + 3$ and hence solve $x^2 + x + 1 = 0$.

Solution:

Given, $y = x^2 + 4x + 3 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-4}{2} = -2$ (between **-2** Left 3 Point and Right 3 point)

x	-5	-4	-3	-2	-1	0	1
x^2	25	16	9	4	1	0	1
+ 4x	-20	-16	-12	-8	-4	0	4
+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3
y	8	3	0	-1	0	3	8

Plot the points : (-5, 8), (-4, 3), (-3, 0), (-2,-1), (-1, 0), (0, 3), (1, 8)

Solve :

$y = x^2 + 4x + 3$

$0 = x^2 + x + 1$

(-) (-) (-)

$y = 3x + 2$

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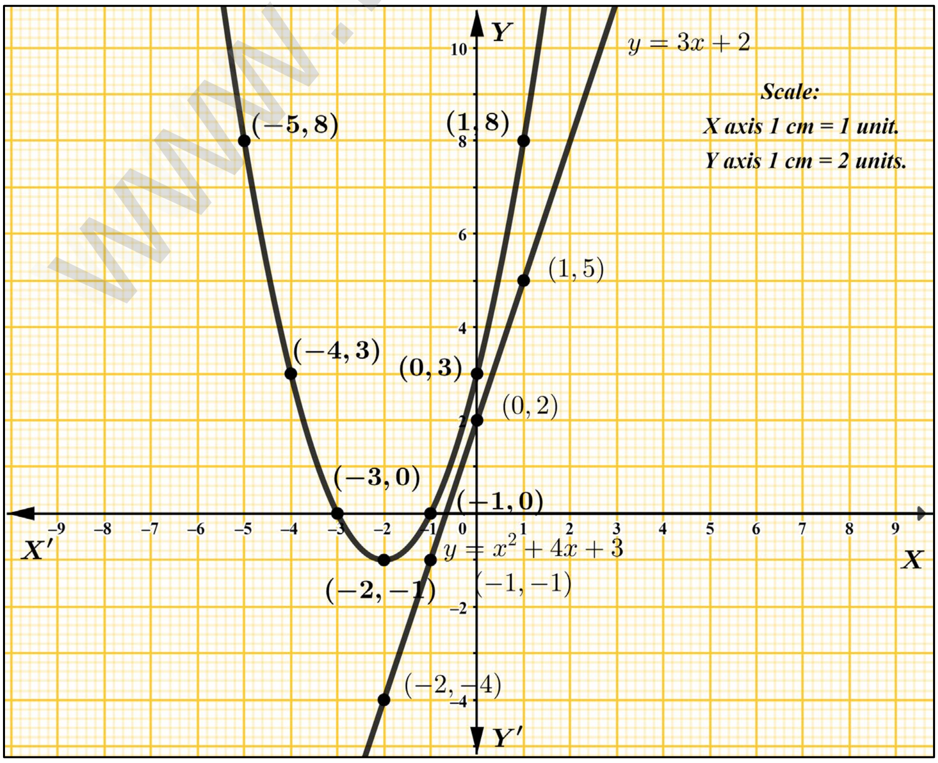
$y = 3x + 2$

x	-4	-3	-2	-1	0	1
3x	-12	-9	-6	-3	0	3
+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2
y	-10	-7	-4	-1	2	5

Plot the Points : (-4, -10), (-3, -7), (-2, -4), (-1,-1), (0, 2), (1, 5).

∴ The solution set of Equation $x^2 + x + 1 = 0$. has **No Real Roots.**



Example: 3.54 Draw the graph of $y = x^2 + x - 2$ and hence solve $x^2 + x - 2 = 0$.

Solution:

Given, $y = x^2 + x - 2 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-1}{2} = -0.5$ (between **-1 to 0** Left 3 Point and Right 3 point)

x	-4	-3	-2	-1	0	1	2	3
x^2	16	9	4	1	0	1	4	9
+ x	-4	-3	-2	-1	0	1	2	3
- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2	- 2
y	10	4	0	-2	-2	0	4	10

Plot the points : (-4, 10), (-3, 4), (-2, 0), (-1,-2), (0, -2), (1, 0), (2, 4), (3, 10)

Solve :

$y = x^2 + x - 2$

$0 = x^2 + x - 2$

(-) (-) (+)

$y = 0$

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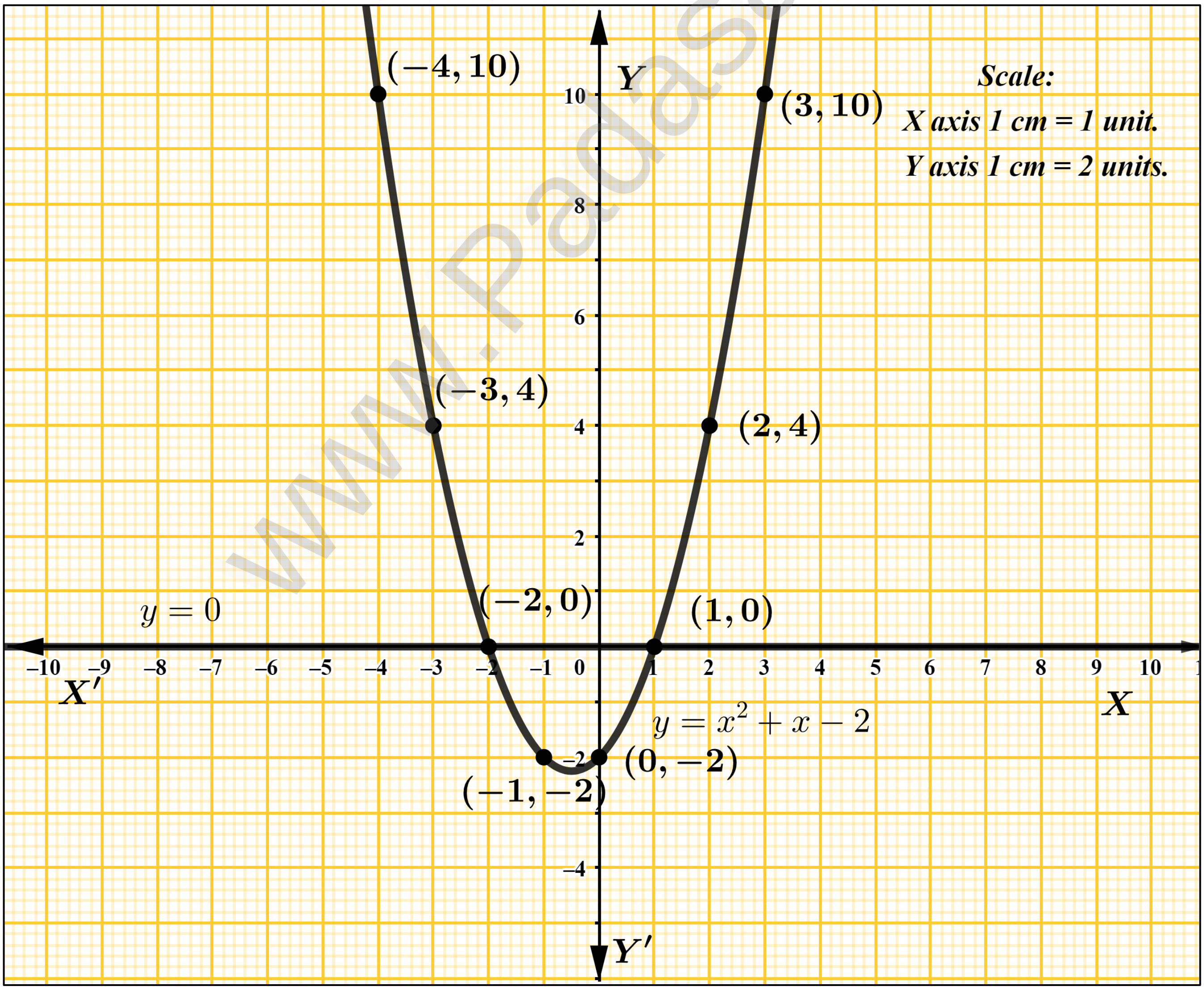

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Example: 3.55: Draw the graph of $y = x^2 - 4x + 3$ and hence solve $x^2 - 6x + 9 = 0$.

Solution:

Given, $y = x^2 - 4x + 3 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-4)}{2} = \mathbf{2}$ (between **2** Left 3 Point and Right 3 point)

x	-1	0	1	2	3	4	5
x^2	1	0	1	4	9	16	25
- 4x	4	0	-4	-8	-12	-16	-20
+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3
y	8	3	0	-1	0	3	8

Plot the points : (-1, 8), (0, 3), (1, 0), (2,-1), (3, 0), (4, 3), (5, 8)

Solve :

$$y = x^2 - 4x + 3$$
$$0 = x^2 - 6x + 9$$
(-) (+) (-)

$$y = 2x - 6$$

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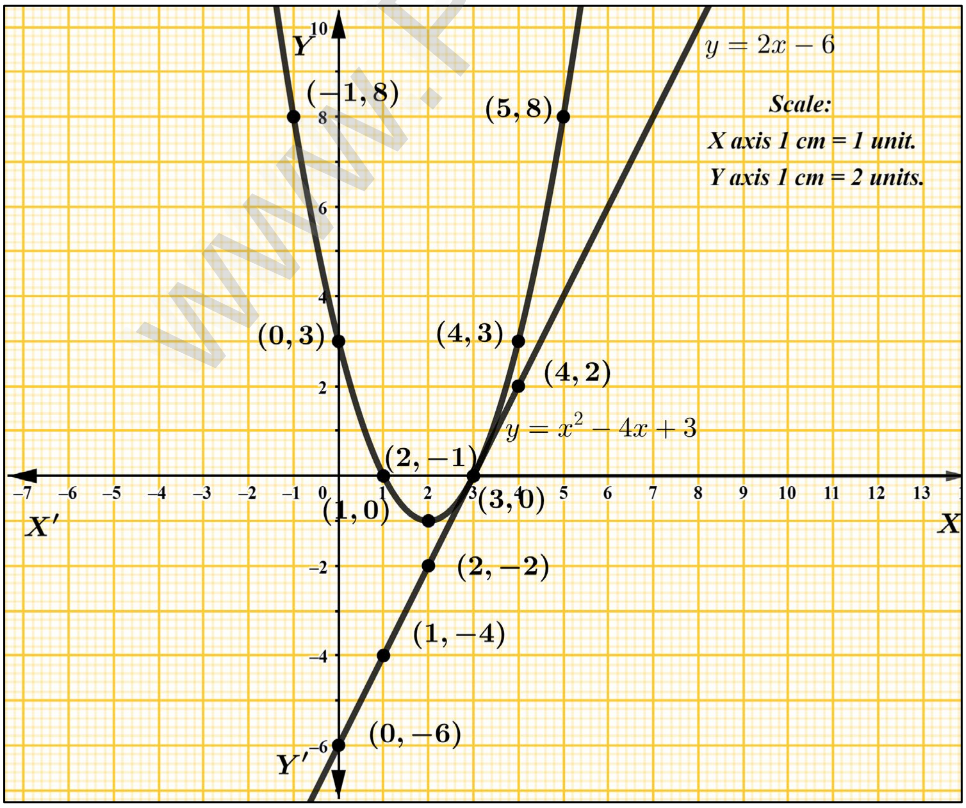
$y = 2x - 6$

x	-1	0	1	2	3	4
2x	-2	0	2	4	6	8
- 6	- 6	- 6	- 6	- 6	- 6	- 6
y	-8	-6	-4	-2	0	2

Plot the Points : (-1, -8), (0, -6), (1, -4), (2,-2), (3, 0), (4, 2).

∴ The solution set of Equation $x^2 - 6x + 9 = 0$ has {3} only **.**



Exercise: 3.16 Graph the following quadratic equations and state the nature of solutions.
(i) $x^2 - 9x + 20 = 0$ (ii) $x^2 - 4x + 4 = 0$ (iii) $x^2 + x + 7 = 0$ (iv) $x^2 - 9 = 0$
(v) $x^2 - 6x + 9 = 0$ (vi) $(2x - 3)(x + 2) = 0$

Solution:

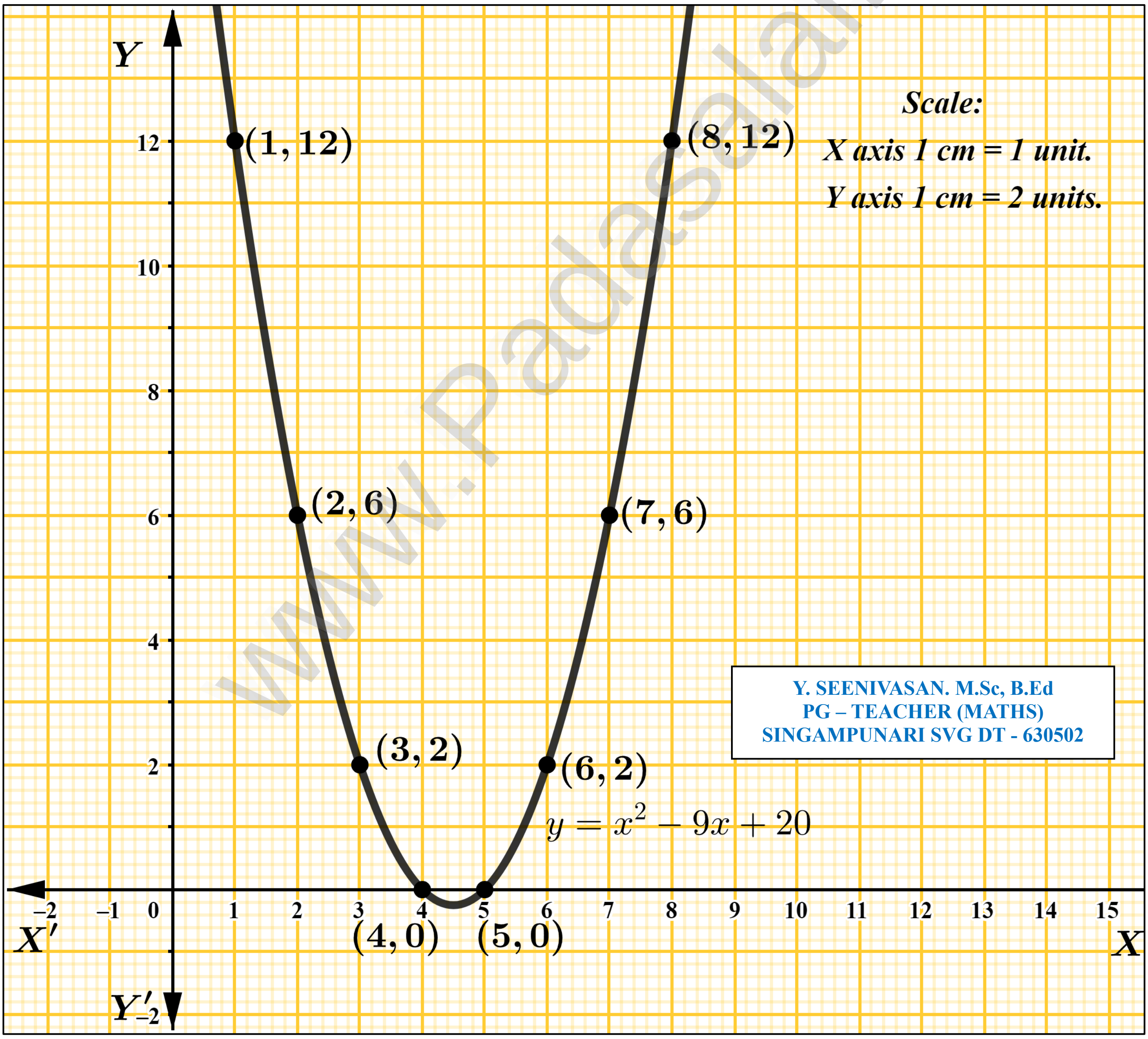
(i) $y = x^2 - 9x + 20 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-9)}{2} = \mathbf{4.5}$ (between **4 to 5** take left 3 point right 3 point)

x	1	2	3	4	5	6	7	8
x^2	1	4	9	16	25	36	49	64
- 9x	-9	-18	-27	-36	-45	-54	-63	-72
+ 20	+ 20	+ 20	+ 20	+ 20	+ 20	+ 20	+ 20	+ 20
y	12	6	2	0	0	2	6	12

Plot the points : (1, 12), (2, 6), (3, 2), (4, 0), (5, 0), (6, 2), (7, 6), (8, 12).

∴ The Quadratic Equation $x^2 - 9x + 20 = 0$ has **Real** and **Unequal Roots**.



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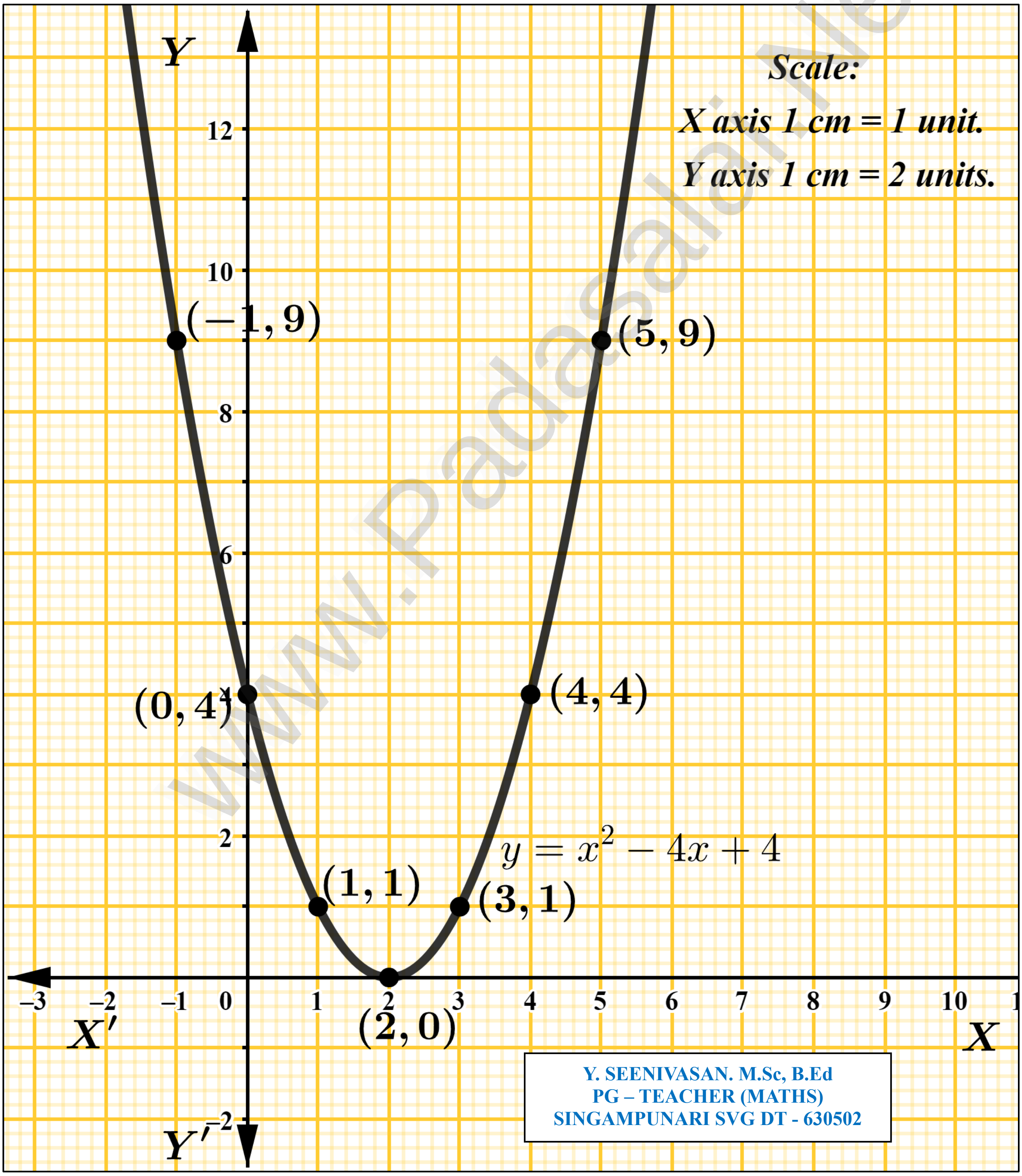
(ii) $y = x^2 - 4x + 4 = 0 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-4)}{2} =$ **2** (between **2** take left 3 point right 3 point)

x	-1	0	1	2	3	4	5
x^2	1	0	1	4	9	16	25
- 4x	4	0	-4	-8	-12	-16	-20
+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4	+ 4
y	9	4	1	0	1	4	9

Plot the points : (-1, 9), (0, 4), (1, 1), (2, 0), (3, 1), (4, 4), (5, 9).

∴ The Quadratic Equation $x^2 - 4x + 4 = 0$ has **Real** and **Equal Roots**.



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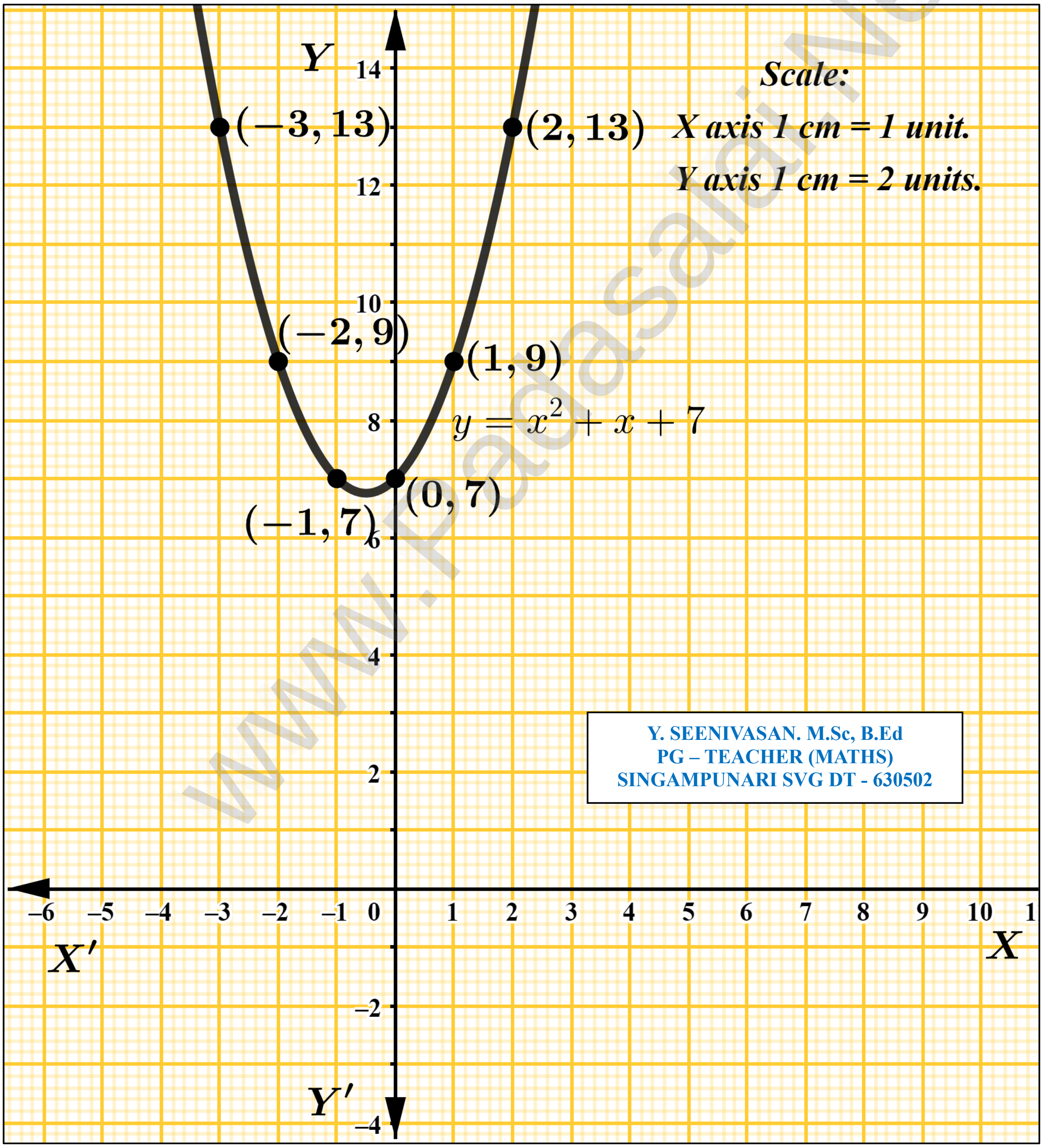
(iii) $y = x^2 + x + 7 = 0 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-1}{2} = \mathbf{-0.5}$ (between **-1 to 0** take left 3 point right 3 point)

x	-4	-3	-2	-1	0	1	2	3
x^2	16	9	4	1	0	1	4	9
+x	-4	-3	-2	-1	0	1	2	3
+7	+7	+7	+7	+7	+7	+7	+7	+7
y	19	13	9	7	7	9	13	19

Plot the points : (-4, 19), (-3, 13), (-2, 9), (-1, 7), (0, 7), (1, 9), (2, 13), (3,19).

∴ The Quadratic Equation $x^2 + x + 7 = 0$ has **No Real Roots**.



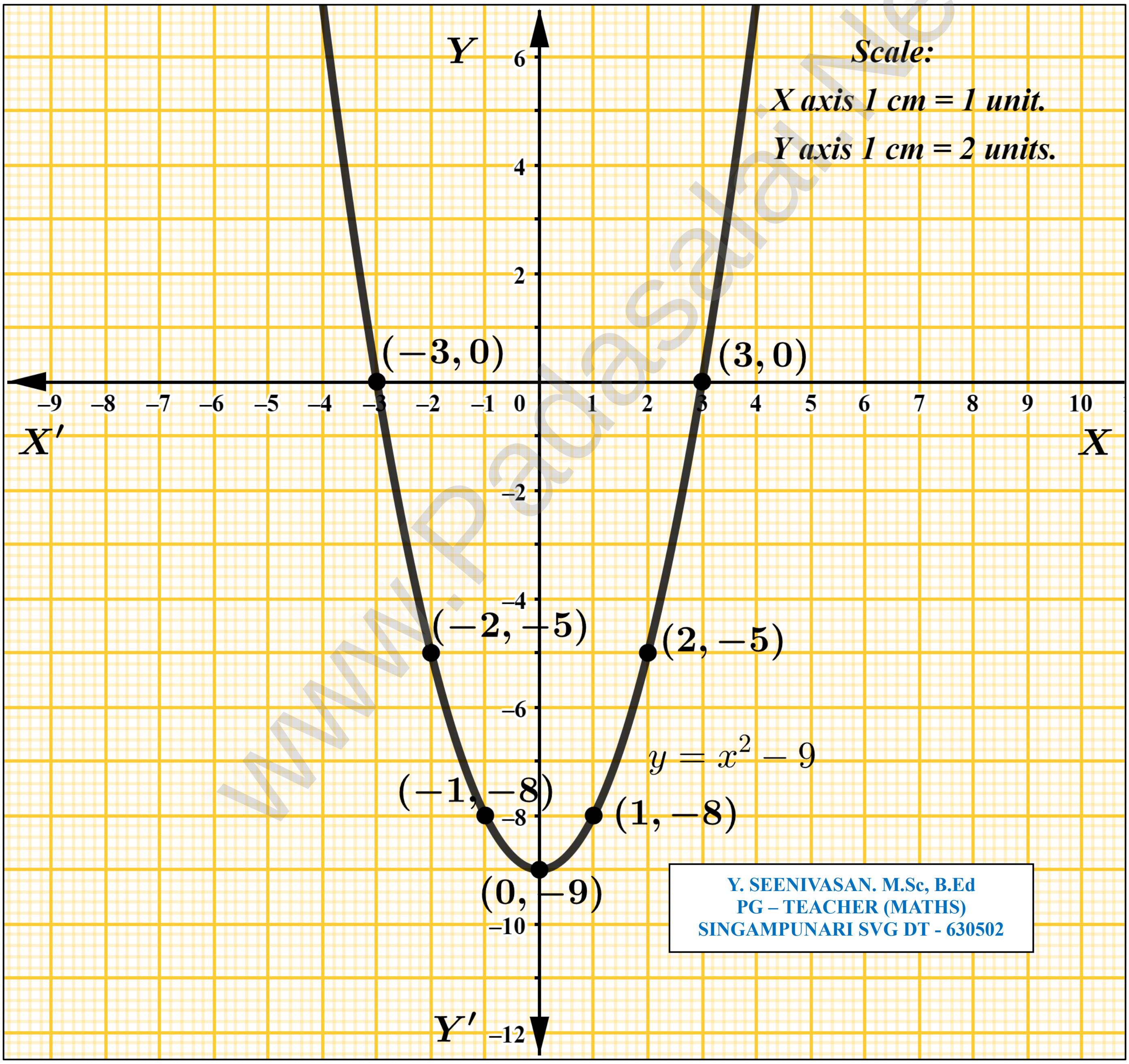
(iv) $y = x^2 - 9 = 0 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{0}{2} = \mathbf{0}$ (between **0** take left 3 point right 3 point)

x	-3	-2	-1	0	1	2	3
x^2	9	4	1	0	1	4	9
-9	-9	-9	-9	-9	-9	-9	-9
y	0	-5	-8	-9	-8	-5	0

Plot the points : (-3, 0), (-2, -5), (-1, -8), (0, -9), (1, -8), (2, -5), (3, 0).

∴ The Quadratic Equation $x^2 - 9 = 0$ has **Real and Unequal Roots**.



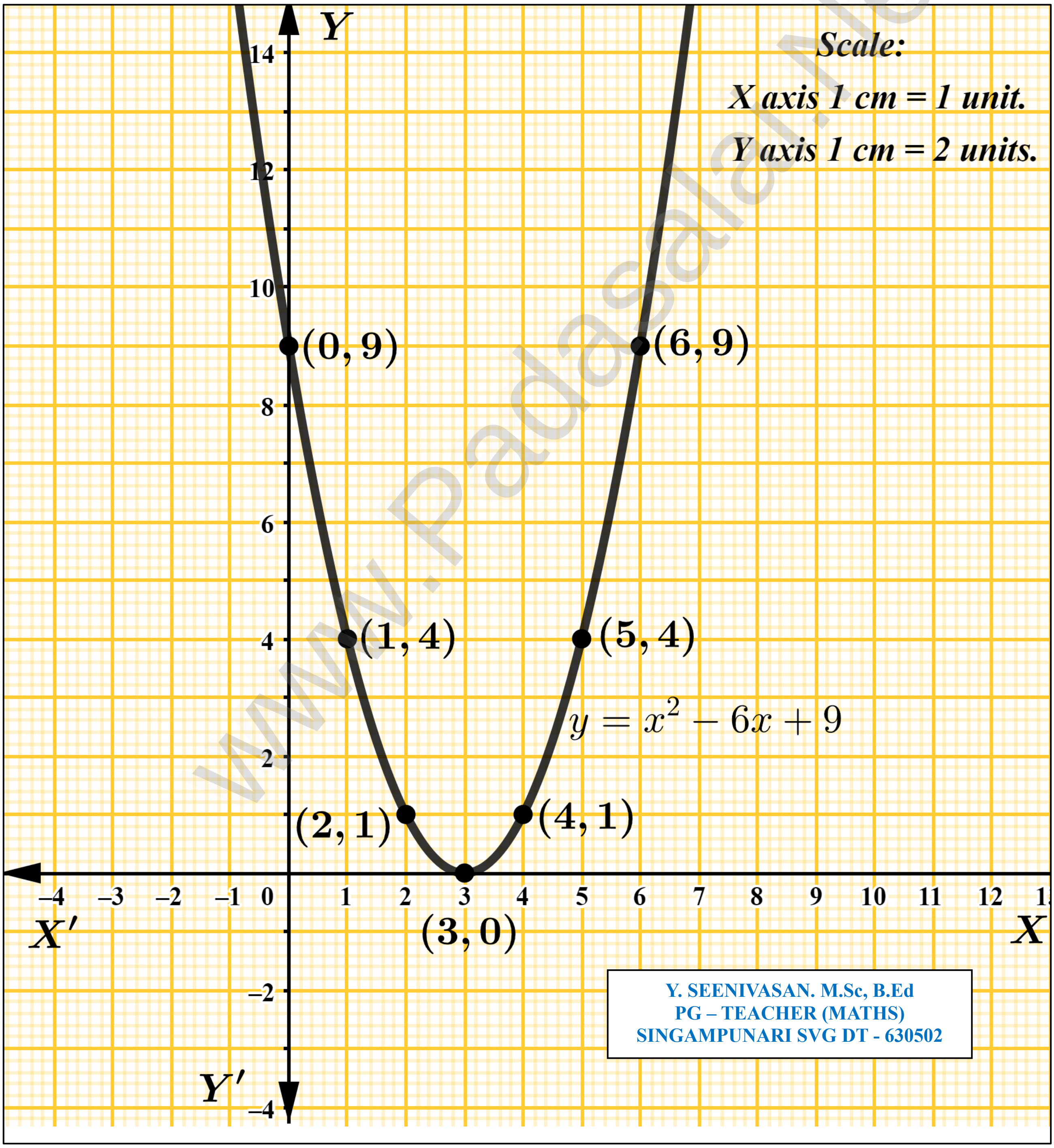
(v) $y = x^2 - 6x + 9 = 0 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-6)}{2} = \mathbf{3}$ (between **3** take left 3 point right 3 point)

x	0	1	2	3	4	5	6
x^2	0	1	4	9	16	25	36
-6x	0	-6	-12	-18	-24	-30	-36
+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9	+ 9
y	9	4	1	0	1	4	9

Plot the points : (0, 9), (1, 4), (2, 1), (3, 0), (4, 1), (5, 4), (6, 9).

∴ The Quadratic Equation $x^2 - 6x + 9 = 0$ has **Real and Equal Roots.**



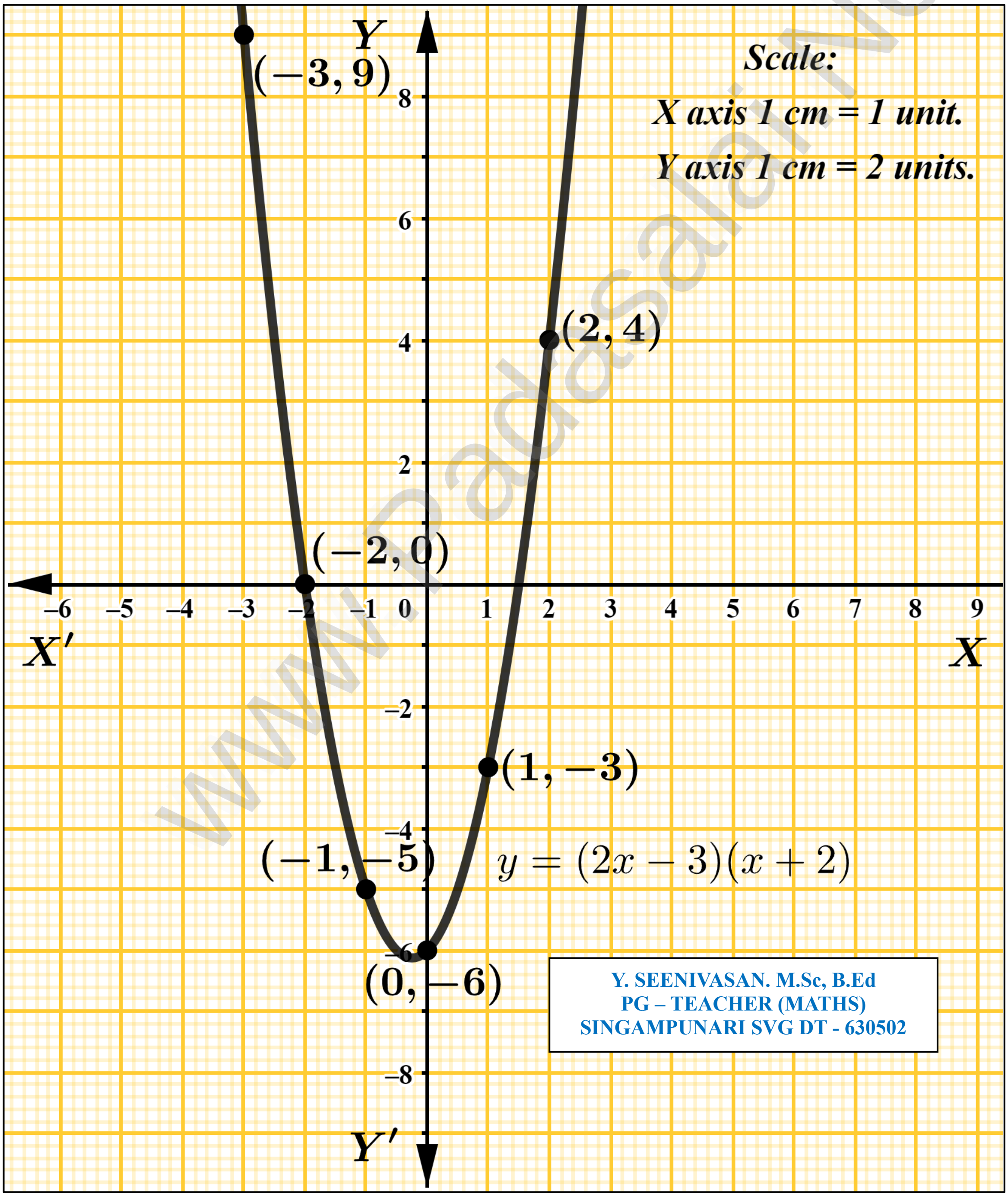
(vi) $y = (2x-3)(x+2) = 2x^2+4x-3x-6 = \mathbf{2x^2+x-6=0} \Rightarrow ax^2+bx+c=0$

$\frac{-b}{2a} = \frac{-1}{2\times 2} = \frac{-1}{4} = \mathbf{-0.25}$ (between **-1 to 0** take left 3 point right 3 point**).**

x	-4	-3	-2	-1	0	1	2	3
$2x^2$	32	18	8	2	0	2	8	18
+ x	-4	-3	-2	-1	0	1	2	3
- 6	- 6	- 6	- 6	- 6	- 6	- 6	- 6	- 6
y	22	9	0	-5	-6	-3	4	15

Plot the points : (-4, 22), (-3, 9), (-2, 0), (-1, -5), (0, -6), (1, -3), (2, 4), (3, 15).

∴ The Quadratic Equation $(2x-3)(x+2)=0$ has **Real and Unequal Roots.**



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Exercise: 3.16) 2) Draw the graph of $y = x^2 - 4$ and hence solve $x^2 - x - 12 = 0$.

Solution:

Given, $y = x^2 - 4 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{0}{2} = 0$ (between **0** Left 3 Point and Right 4 point)

x	-3	-2	-1	0	1	2	3
x^2	9	4	1	0	1	4	9
-4	-4	-4	-4	-4	-4	-4	-4
y	5	0	-3	-4	-3	0	5

Plot the points : (-3, 5), (-2, 0), (-1, -3), (0,-4), (1, -3), (2, 0), (3, 5)

Solve :

$y = x^2 - 4$

$0 = x^2 - x - 12$

(-) (+) (+)

$y = x + 8$

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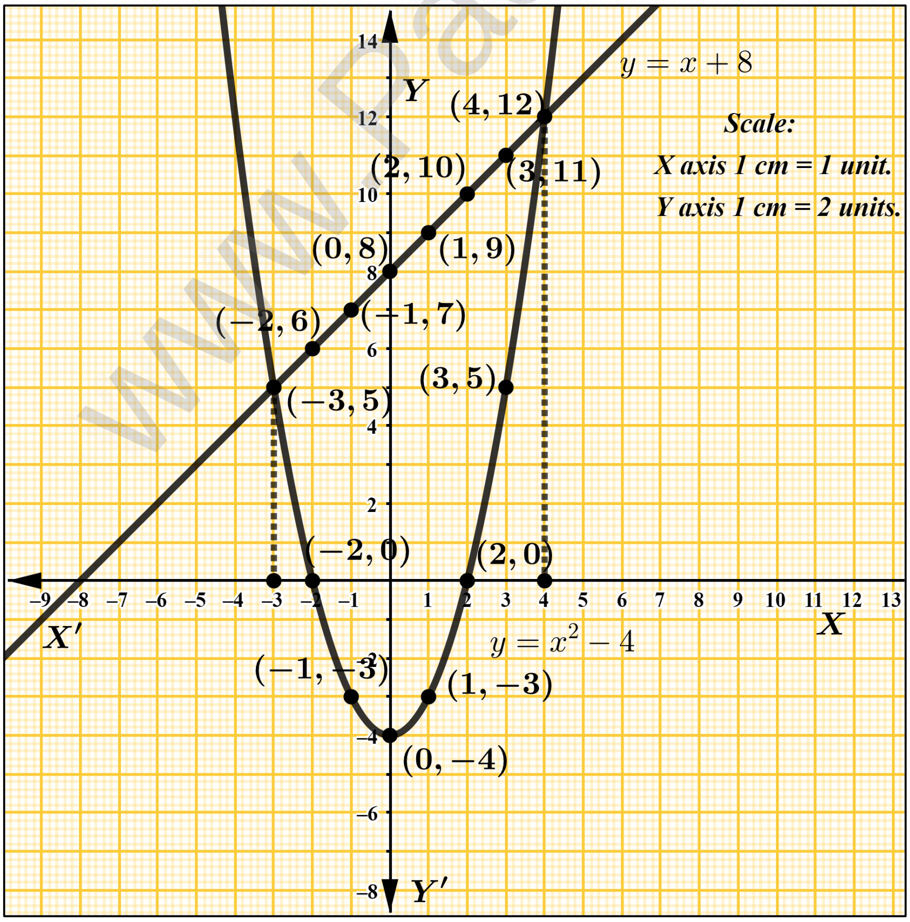
$y = x + 8$

x	-3	-2	-1	0	1	2	3	4
8	8	8	8	8	8	8	8	8
Y	5	6	7	8	9	10	11	12

Plot the Points : (-3, 5), (-2, 6), (-1, 7), (0,8), (1, 9), (2, 10), (3,11).

∴ The solution set of Equation $x^2 - x - 12 = 0$ has $\{-3, 4\}$.



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Exercise: 3.16) 3) Draw the graph of $\boldsymbol{y = x^2 + x}$ and hence solve $\boldsymbol{x^2 + 1 = 0}$.

Solution:

Given, $\boldsymbol{y = x^2 + x} \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-1}{2} = \boldsymbol{-0.5}$ (between **-1 to 0** Left 3 Point and Right 3 point)

x	-4	-3	-2	-1	0	1	2	3
x^2	16	9	4	1	0	1	4	9
+ x	-4	-3	-2	-1	0	1	2	3
y	12	6	2	0	0	2	6	12

Plot the points : (-4, 12), (-3, 6), (-2, 2), (-1,0), (0, 0), (1, 2), (2, 6), (3, 12).

Solve :

$$y = x^2 + x$$
$$0 = x^2 + 0x + 1$$
(-) (-) (-)

$$\boldsymbol{y = \quad x - 1}$$

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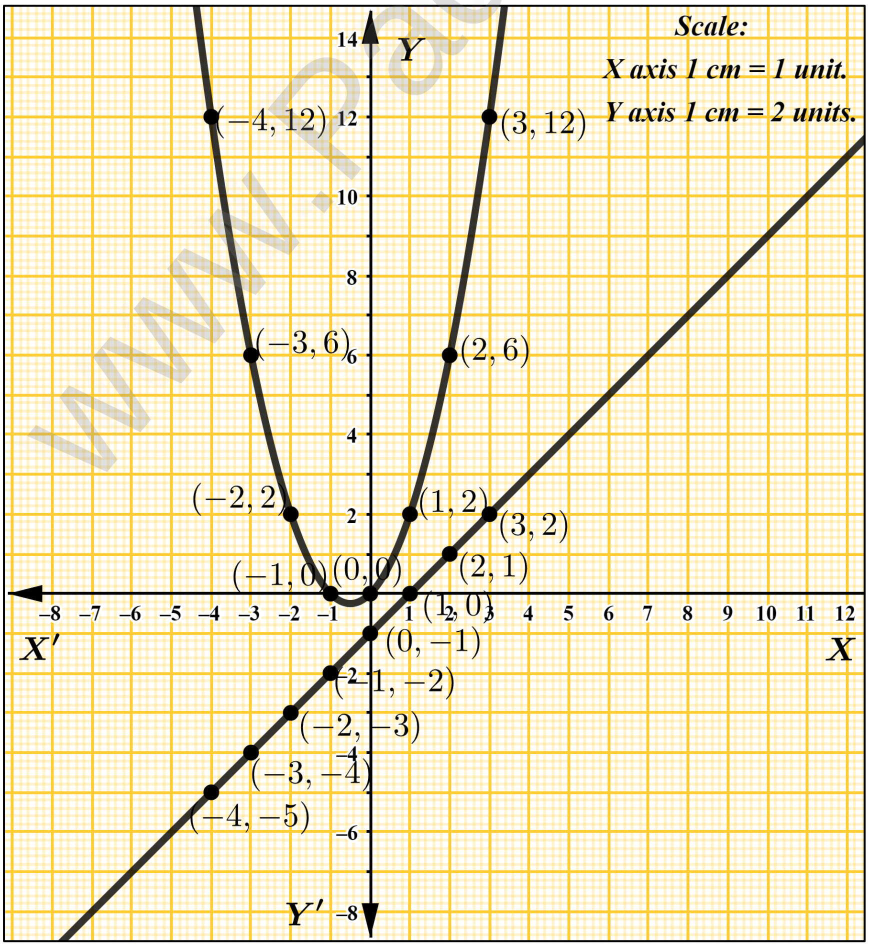
$\boldsymbol{y = \quad x - 1}$

x	-4	-3	-2	-1	0	1	2	3
-1	-1	-1	-1	-1	-1	-1	-1	-1
Y	-5	-4	-3	-2	-1	0	1	2

Plot the Points : (-4, -5), (-3, -4), (-2, -3), (-1,-2), (0, -1), (1, 0), (2,1), (3, 2).

∴ The solution set of Equation $\boldsymbol{x^2 + 1 = 0}$ has **No Real roots.**



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Exercise: 3.16) 4) Draw the graph of $y = x^2 + 3x + 2$ and hence solve $x^2 + 2x + 1 = 0$.

Solution:

Given, $y = x^2 + 3x + 2 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-3}{2} = -1.5$ (between **-2 to -1** Left 3 Point and Right 3 point)

x	-5	-4	-3	-2	-1	0	1	2
x^2	25	16	9	4	1	0	1	4
+3x	-15	-12	-9	-6	-3	0	3	6
+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2	+ 2
y	12	6	2	0	0	2	6	12

Plot the points : (-5, 12), (-4, 6), (-3, 2), (-2,0), (-1, 0), (0, 2), (1, 6), (2, 12).

Solve :

$y = x^2 + 3x + 2$

$0 = x^2 + 2x + 1$

(-) (-) (-)

$\mathbf{y = \quad x + 1}$

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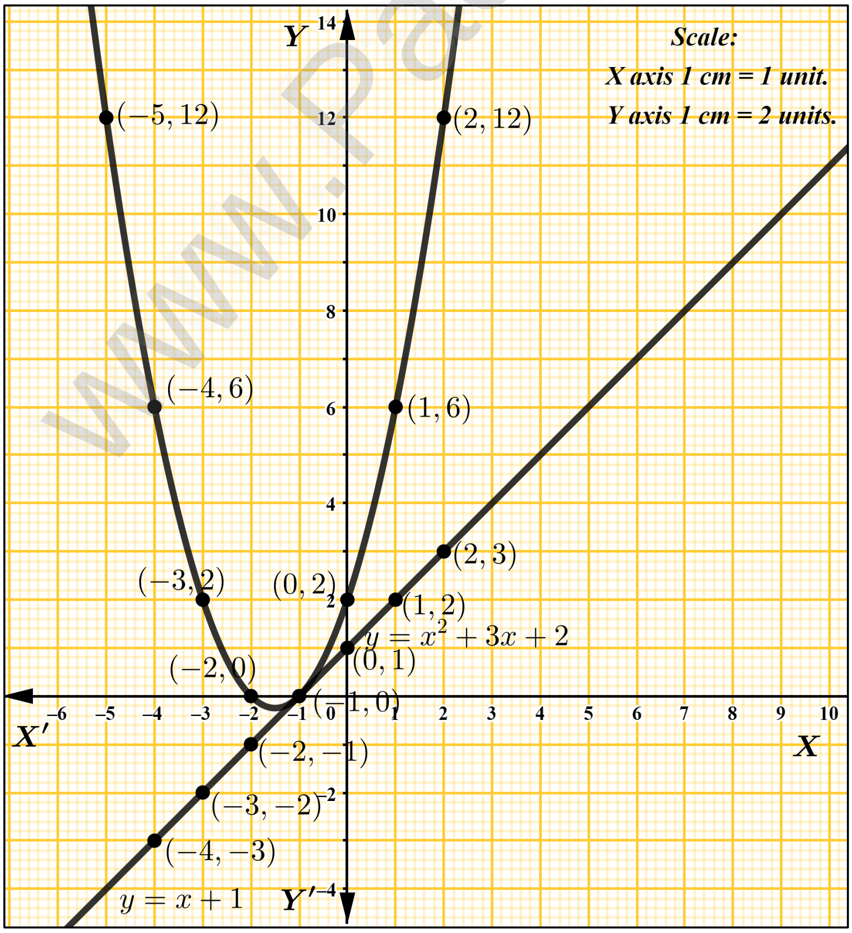
$\mathbf{y = \quad x + 1}$

x	-4	-3	-2	-1	0	1	2
+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1
Y	-3	-2	-1	0	1	2	3

Plot the Points : (-4, -3), (-3, -2), (-2, -1), (-1, 0), (0, 1), (1, 2), (2,3).

∴ The solution set of Equation $x^2 + 2x + 1 = 0$ has $\{-1\}$.



Exercise: 3.16) 5) Draw the graph of $y = x^2 + 3x - 4$ and hence solve $x^2 + 3x - 4 = 0$.

Solution:

Given, $y = x^2 + 3x - 4 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-3}{2} = -1.5$ (between **-2 to -1** Left 3 Point and Right 3 point)

x	-5	-4	-3	-2	-1	0	1	2
x^2	25	16	9	4	1	0	1	4
+3x	-15	-12	-9	-6	-3	0	3	6
-4	-4	-4	-4	-4	-4	-4	-4	-4
y	6	0	-4	-6	-6	-4	0	6

Plot the points : (-5, 6), (-4, 0), (-3, -4), (-2,-6), (-1, -6), (0, -4), (1, 0), (2, 6).

Solve :

$y = x^2 + 3x - 4$

$0 = x^2 + 3x - 4$

(-) (-) (+)

$y = 0$

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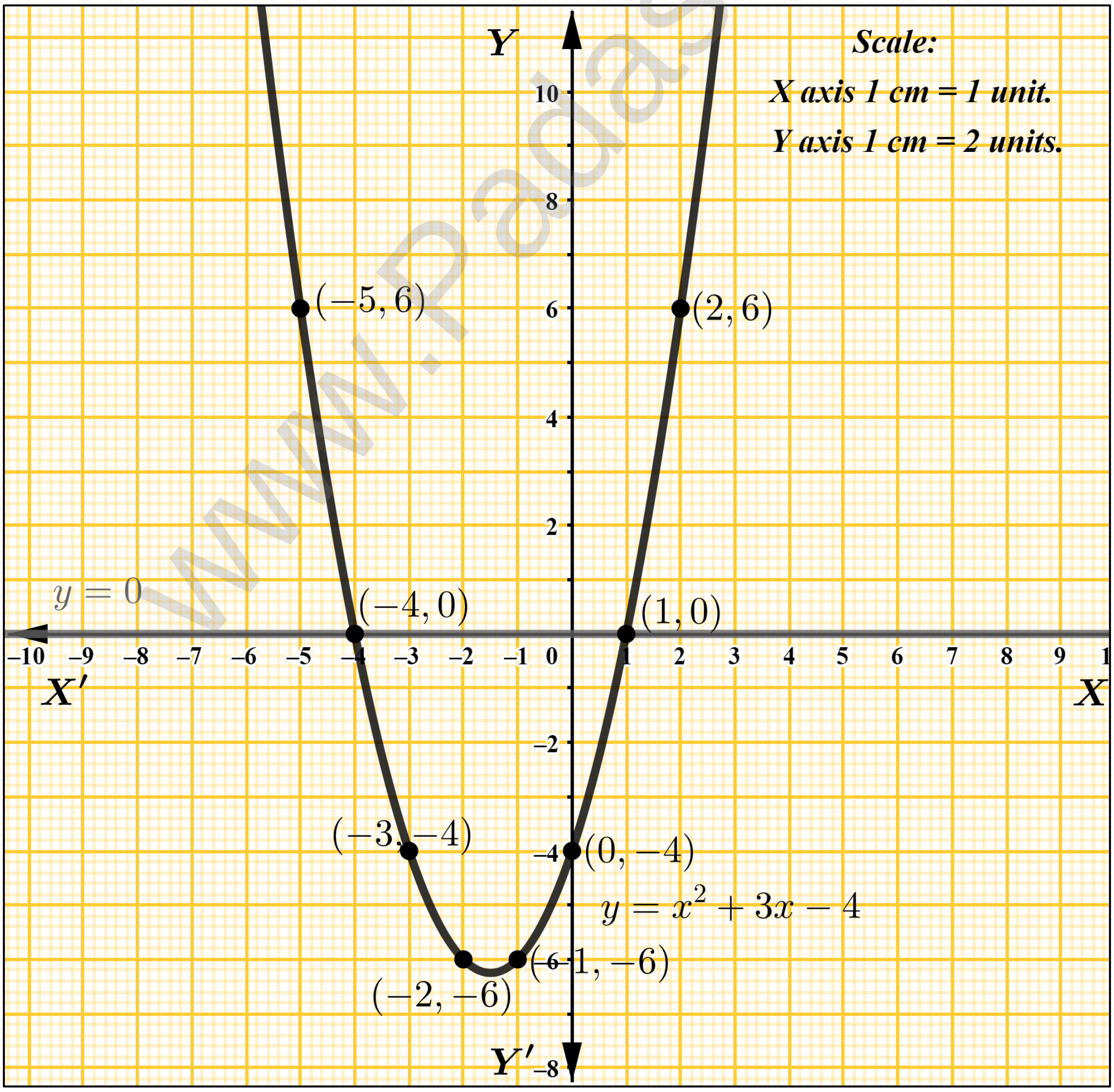
∴ The solution set of Equation $x^2 + 3x - 4 = 0$ has $\{-4, 1\}$.



Exercise: 3.16) 6) Draw the graph of $y = x^2 - 5x - 6$ and hence solve $x^2 - 5x - 14 = 0$.

Solution:

Given, $y = x^2 - 5x - 6 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-5)}{2} = 2.5$ (between **2 to 3** Left 4 Point and Right 4 point)

x	-2	-1	0	1	2	3	4	5	6	7
x^2	4	1	0	1	4	9	16	25	36	49
-5x	10	5	0	-5	-10	-15	-20	-25	-30	-35
-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
y	8	0	-6	-10	-12	-12	-10	-6	0	8

Plot the points : (-2, 8), (-1, 0), (0, -6), (1,-10), (2, -12), (3, -12), (4, -10), (5, -6),(6, 0), (7, 8).

Solve :

$$y = x^2 - 5x - 6$$
$$0 = x^2 - 5x - 14$$
$$(-) \quad (+) \quad (+)$$
$$y = 8$$

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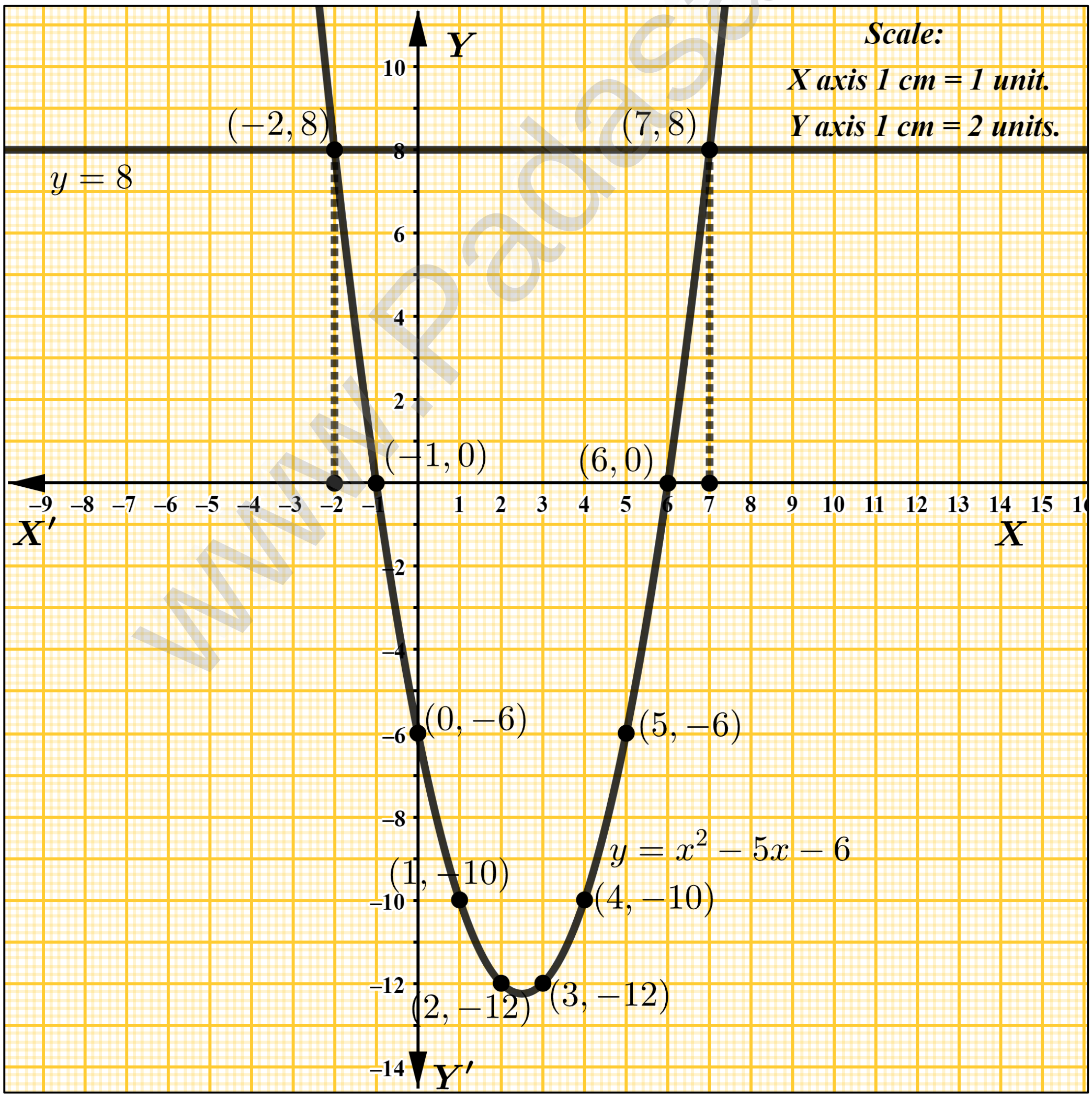
∴ The solution set of Equation $x^2 - 5x - 14 = 0$ has $\{-2, 7\}$.



Exercise: 3.16) 7) Draw the graph of $y = 2x^2 - 3x - 5$ and hence solve $2x^2 - 4x - 6 = 0$.

Solution:

Given, $y = 2x^2 - 3x - 5 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-(-3)}{2 \times 2} = \frac{3}{4} = 0.75$ (between **0 to 1** Left 3 Point and Right 3 point)

x	-2	-1	0	1	2	3	4	5
x^2	8	2	0	2	8	18	32	50
-3x	6	3	0	-3	-6	-9	-12	-15
-5	-5	-5	-5	-5	-5	-5	-5	-5
y	9	0	-5	-6	-3	4	15	30

Plot the points : (-2, 9), (-1, 0), (0, -5), (1,-6), (2, -3), (3, 4), (4, 15), (5, 30).

Solve :

$y = 2x^2 - 3x - 5$

$0 = 2x^2 - 4x - 6$

(-) (+) (+)

$y = x + 1$

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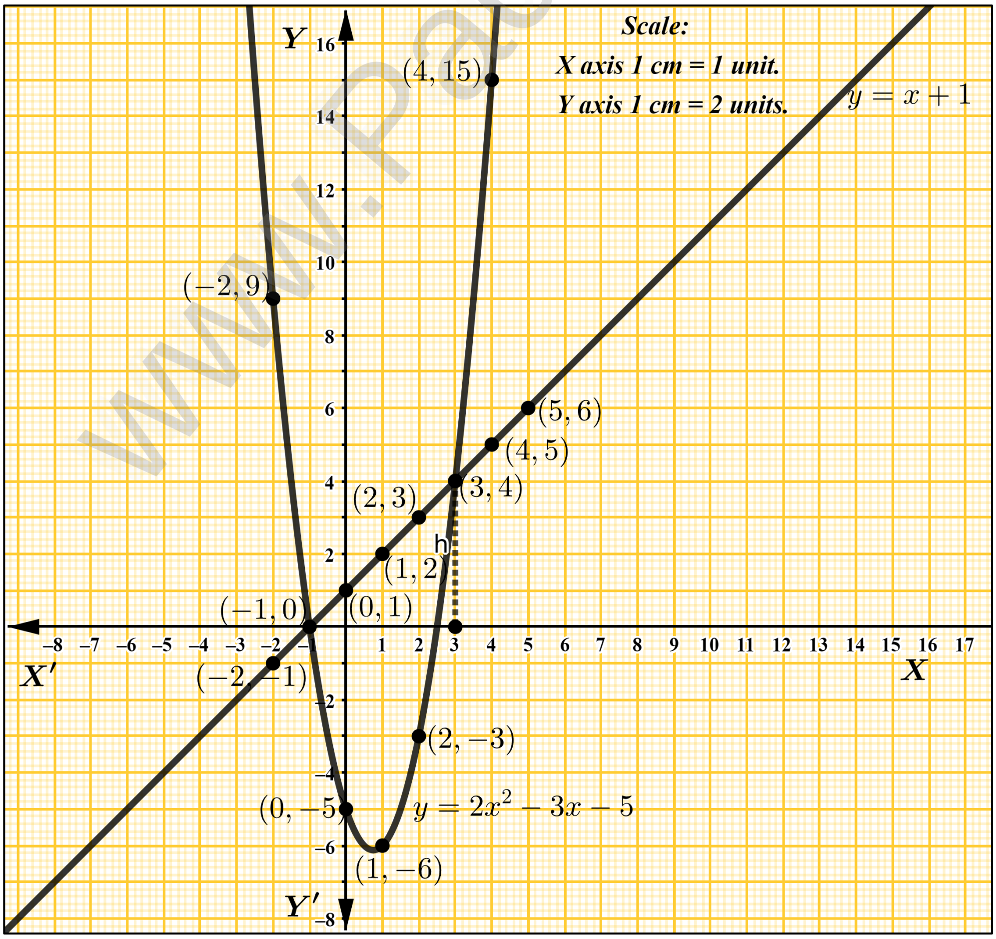
$y = x + 1$

x	-2	-1	0	1	2	3	4	5
+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1	+ 1
Y	-1	0	1	2	3	4	5	6

Plot the Points : (-2, -1), (-1, 0), (0, 1), (1, 2), (2, 3), (3, 4), (4,5), (5,6).

∴ The solution set of Equation $2x^2 - 4x - 6 = 0$ has $\{-1, 3\}$.



Exercise: 3.16) 8) Draw the graph of $y = (x-1)(x+3)$ and hence solve $x^2 - x - 6 = 0$.

Solution:

Given, $y = (x-1)(x+3) = x^2 + 3x - x - 3 = x^2 + 2x - 3 \Rightarrow ax^2 + bx + c = 0$

$\frac{-b}{2a} = \frac{-2}{2} = -1$ (between **1** Left 3 Point and Right 4 point)

x	-4	-3	-2	-1	0	1	2
x^2	16	9	4	1	0	1	4
+2x	-8	-6	-4	-2	0	2	4
- 3	- 3	- 3	- 3	- 3	- 3	- 3	- 3
y	5	0	-3	-4	-3	0	5

Plot the points : (-4, 5), (-3, 0), (-2, -3), (-1,-4), (0, -3), (1, 0), (2, 5).

Solve :

$y = x^2 + 2x - 3$

$0 = x^2 - x - 6$

(-) (+) (+)

$y = \quad 3x + 3$

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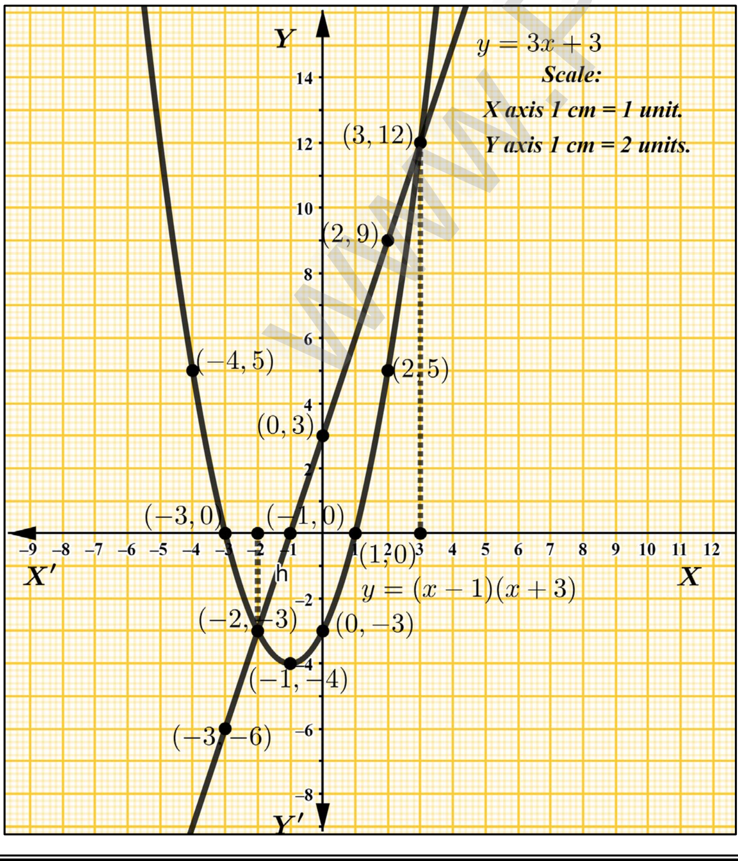
$y = \quad 3x + 3$

x	-4	-3	-2	-1	0	1	2	3
3x	-12	-9	-6	-3	0	3	6	9
+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3	+ 3
y	-9	-6	-3	0	3	6	9	12

Plot the Points : (-4, -9), (-3, -6), (-2, -3), (-1, 0), (0, 3), (1, 6), (2,9), (3,12).

$\therefore$ The solution set of Equation $x^2 - x - 6 = 0$ has $\{-2, 3\}$.



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