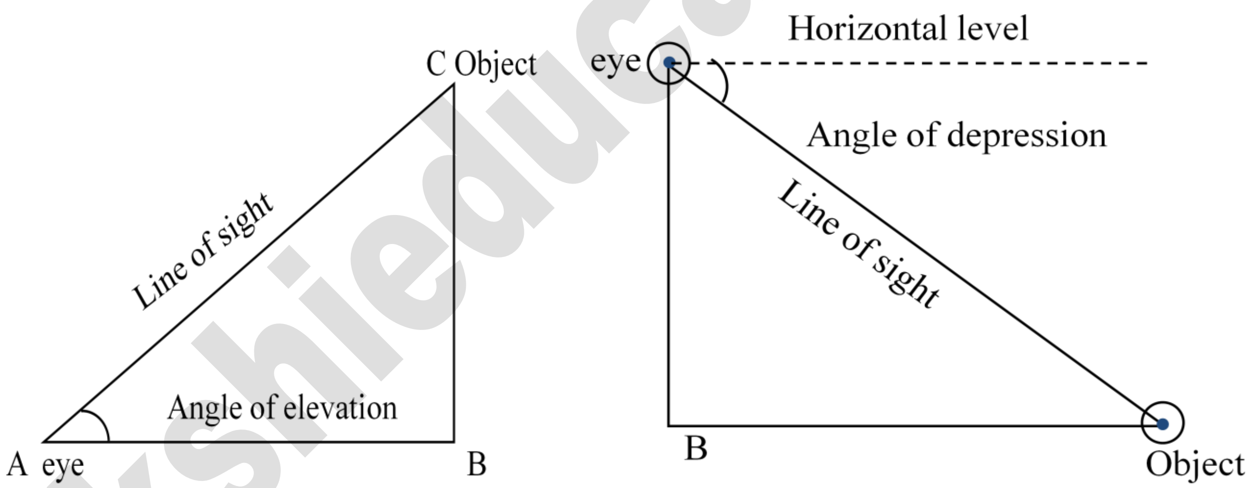
Applications of Trigonometry

The height or length of an object or the distance between two distant objects can be determined with the help of trigonometric ratios.

- **The Line of sight** is the line drawn from the eye of an observer to the point in the object viewed by the observer.
- **The angle of elevation** of an object viewed is the angle formed by the line of sight with the horizontal when it is above the horizontal level i.e. the case when we raise our head to look at the object.
- **The angle of depression** of an object viewed is the angle formed by the line of sight with the horizontal when it is below the horizontal level i.e. the case when lower our head to look at the object.



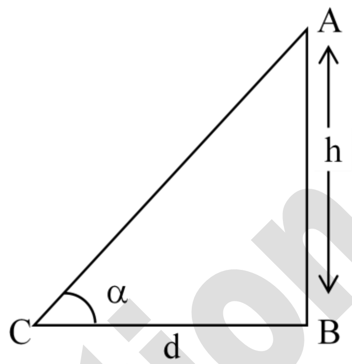
- Trigonometry has been used by surveyors for centuries. They use **Theodolites** to measure angles of elevation or depression in the process of survey.
- When we want to solve the problems of heights and distances, we should consider the following.
    - i) All the objects such as tower, trees, buildings, ships, mountains etc. Shall be considered as linear for mathematical convenience

ii) The angle of elevation or angle of depression is considered with reference to the horizontal line.

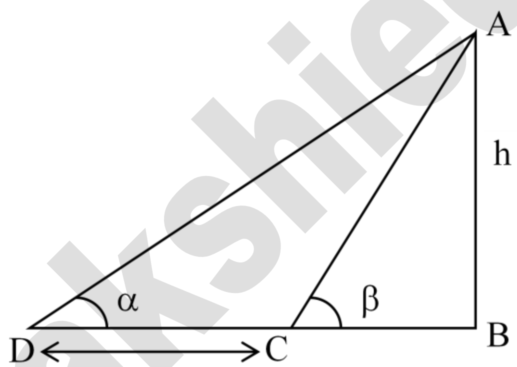
iii) The height of the observer is neglected, if it is not given in the problem.

- The angle of elevation of a tower from a distance ‘d’ m from its foot is $\propto°$ and hight of the tower is ‘h’ m then

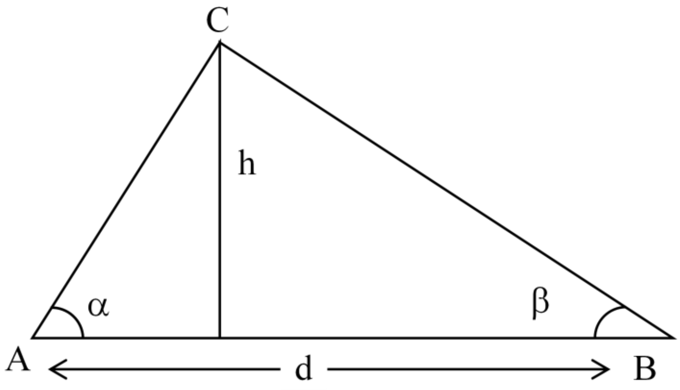
$$\tan\alpha = \frac{h}{d}$$



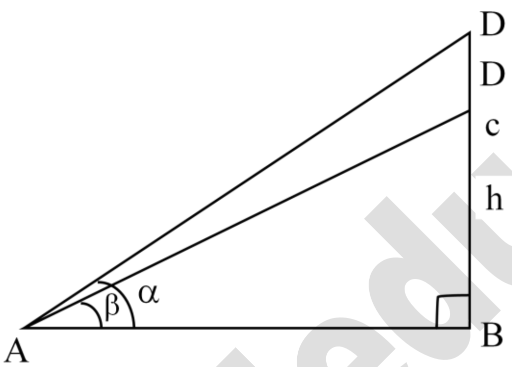
- The angle of elevation of the top of a tower as observed from a point on the ground is ‘$\propto$’ and on moving ‘d’ meters towards the tower, the angle of elevation is ‘β’, then the height of the tower $h = \frac{d}{\cot\alpha - \cot\beta}$



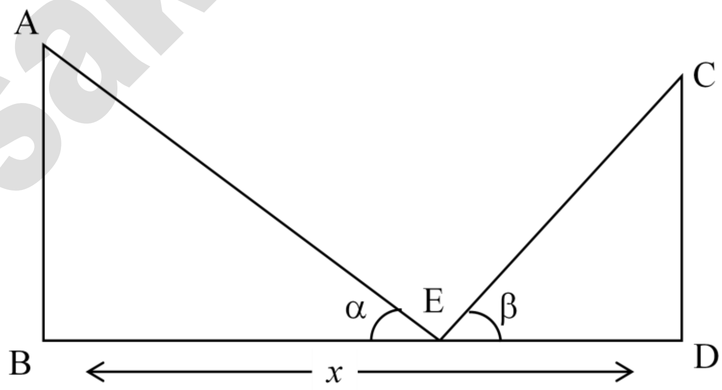
- Two men on either side of the tower and in the same straight line with its base notice the angle of elevation of top of the tower to be $\propto$ and β. If the height of the tower is ‘h’ m, then the distance between the two men $d = \frac{h\sin(\alpha+\beta)}{\sin\alpha . sin\beta}$



- A statue 'd' m tall stands on the top of a pedestal which is the height of 'h' m. From a point on the ground, the angle of elevation of the top of the statue is $\propto$ and from the same point the angle of elevation of the top of the pedestal is β, then the height of the statue is $d = \frac{h(\cot\alpha - \cot\beta)}{\cot\beta}$



- Two poles of equal height are standing opposite each other on either side of the road, which is x m wide. From a point between them on the road, the of the poles are $\propto$ and β respectively, then the height of the pole $h = \frac{x\tan\alpha.\tan\beta}{\tan\alpha + \tan\beta}$



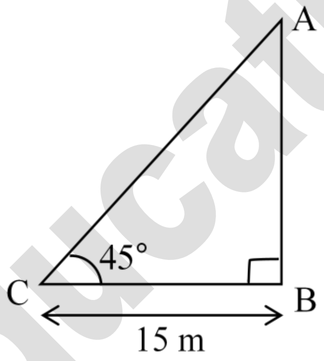
And the length of BE $=\dfrac{x\tan\beta}{\tan\alpha+\tan\beta}$

The length of DE $=\dfrac{x\tan\alpha}{\tan\alpha+\tan\beta}$

Exercise 12.1

1. A tower stands vertically on the ground. From a point which is 15 meter away from the foot of the tower, the angle of elevation of the top of the tower is 45°. What is the height of the tower?

Sol: Let the light of the tower = AB



Distance between foot of the tower and observation point 'C' is BC = 15 mts.

Angle of elevation of the top of tower $\angle$C = 45°

Form Δ ABC, tan C $=\dfrac{AB}{BC}$

$$\tan 45° = \frac{AB}{BC}$$

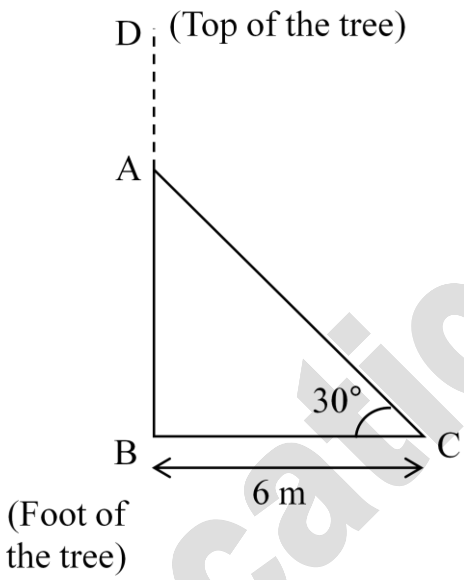
$$\Rightarrow 1 = \frac{AB}{15}$$

$$\Rightarrow AB = 15 \text{ mts.}$$

$\therefore$ Height of the tower AB = 15m.

2. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground by making 30°angle with the ground. The distance between the foot of the tree and the top of the tree on the ground is 6m. Find the height of the tree before falling down.

Sol: In right triangle ABC,



$$\text{Cos } 30° = \frac{BC}{AC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{6}{AC}$$

$$\Rightarrow AC = \frac{12}{\sqrt{3}} m.$$

$$\text{lly} \quad \tan 30° = \frac{AB}{BC}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{6} \Rightarrow AB = \frac{6}{\sqrt{3}} m.$$

$\therefore$ Height of the tree = AB + AC

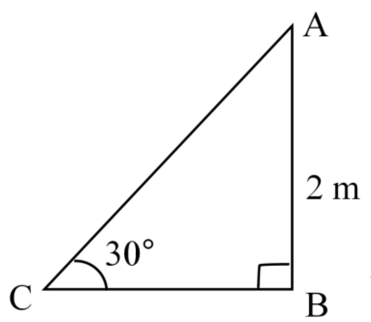
$$= \left(\frac{12}{\sqrt{3}} + \frac{6}{\sqrt{3}}\right)m$$

$$= \frac{18}{\sqrt{3}}m = 6\sqrt{3}$$

$\therefore$ The height of the tree before falling down is = $6\sqrt{3}$m.

3.A contractor wants to set up a slide for the children to play in the park, He wants to set it up at the height of 2m and by making an angle of 30° with the ground. What should be the length of the slide

Sol: height of the slide = 2m



Length of the slide = ?

In right triangle ABC

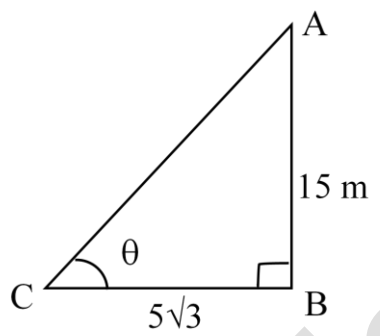
$$sin 30° = \frac{AB}{AC}$$

$$\Rightarrow \frac{1}{2} = \frac{2}{AC}$$

$\therefore$ The length of the slide AC = 4m.

4.Length of the shadow of a 15 meter high pole is 5√3 meters at 7 'o' clock in the morning. Then, what is the angle of elevation of the sun rays with the ground at the time?

Sol: Height of the pole AB = 15m



Length of the shadow of the pole BC = 5√3m

Let the angle of elevation of sunrays with ground is ∠ACB = θ say.

From right triangle ABC,

$$\tan\theta = \frac{AB}{BC} = \frac{15}{5\sqrt{3}} = \frac{3}{\sqrt{3}} = \sqrt{3}$$

$\Rightarrow \tan\theta = \sqrt{3}$

$\Rightarrow \tan\theta = \tan 60°$ $(\because \tan 60° = \sqrt{3})$

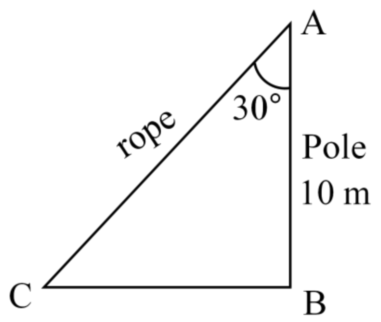
$\therefore \theta = 60°$

$\therefore \angle ACB = 60°$

$\therefore$ The angle of elevation = 60°.

5. You want to erect a pole of height 10m with the support of three ropes. Each rope has to make an angle 30° with the pole. What should be the length of the rope?

Sol: Height of the pole AB = 10m



Let the length of rope to erect the pole = AC

Angle made by the rope with the pole = 30°

From right triangle cos A $= \frac{AB}{AC}$

$\Rightarrow$ cos 30° $= \frac{10}{AC}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{10}{AC}$

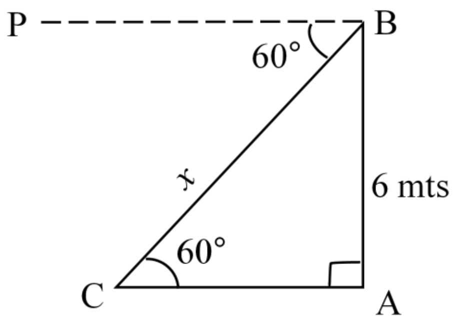
$\Rightarrow AC = \frac{20}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{20\sqrt{3}}{3} = \frac{20 \times 1.732}{3}$

$\Rightarrow$ AC = 11.55m

$\therefore$ Length of the rope = 11.55m.

6. Suppose you are shooting an arrow from the top of a building at a height of 6m to a target on the ground at an angle of depression of 60°. What is the distance between you and the object.

Sol: Height of a building AB = 6m



Angle of depression from top of a building 'B' to a target 'C' is 60°

$\angle PBC = \angle BCA = 60°$ ($\because$ PB//AC, they are alternate angles)

The distance between me and the object BC = x say.

From right triangle ABC

$$Sin\,60° = \frac{AB}{BC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{6}{BC}$$

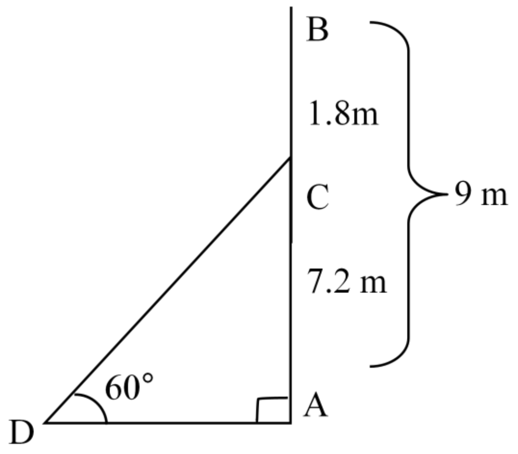
$$\Rightarrow BC = \frac{12}{\sqrt{3}} = \frac{12\sqrt{3}}{\sqrt{3}.\sqrt{3}} = \frac{12\sqrt{3}}{3}$$

$= 4\sqrt{3}$m

$\therefore$ The distance between me and the object is $4\sqrt{3}$m.

7. An electrician wants to repair an electric connection on a pole of height 9m. He needs to reach 1.8m below the top of the pole to do repair works. What should be the length of the ladder which he should use, when he climbs it at an angle of 60° with the ground? What will be the distance between foot of the ladder and foot of the pole?

Sol: Height of electric pole AB = 9m.



Length of a ladder = CD say.

Height of electric pole to do repair work AC = AB – BC

= 9 – 1.8 = 7.2

Distance between foot of ladder and the pole = AD

Angle made by ladder with ground at D = 60°

$\therefore$ from right triangle ACD

$$\sin 60^\circ = \frac{AC}{CD}$$

$$\frac{\sqrt{3}}{2} = \frac{7.2}{CD}$$

$$\Rightarrow CD = \frac{7.2\times 2}{\sqrt{3}} = \frac{14.4}{\sqrt{3}}\times\frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{14.4\times\sqrt{3}}{3} = 4.8\times 1.732$$

= 8.3136 m.

lly tan 60° $= \frac{AC}{AD}$

$$\sqrt{3} = \frac{7.2}{AD}$$

$$\Rightarrow AD = \frac{7.2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{7.2 \times 1.732}{3}$$

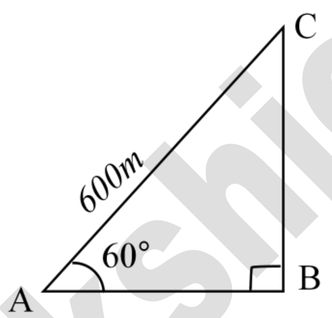
= 2.4 × 1.732

= 4.1568m.

∴ The distance between foot of the ladder and foot of the pole = 4.1568m.

8. A boat has to cross a river. It crosses the river by making an angle of 60° with the bank of the river due to the stream of the river and travels a distance of 600 m to reach the another side of the river. What is the width of the river?

Sol: Let the width of a river is AB.



Making angle with the bank of river ∠CAB = 60°

Travel of boat from A to C, AC = 600m.

From right triangle ABC

$$\cos 60° = \frac{AB}{AC}$$

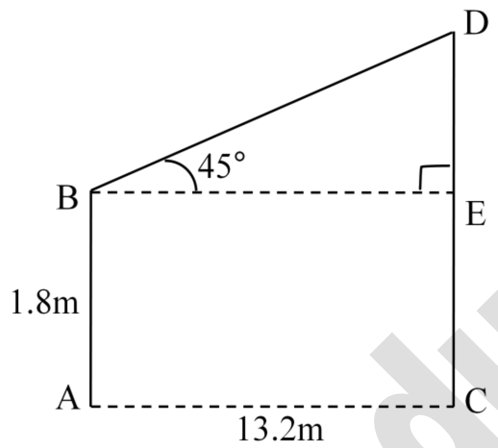
$$\Rightarrow \frac{1}{2} = \frac{AB}{600}$$

$$\Rightarrow AB = \frac{600}{2} = 300m.$$

$\therefore$ The width of the river = 300m.

9. An observer of height 1.8m is 13.2 m away from a palm tree. The angle of elevation of the top of the tree from his eyes is 45°. What is the height of the palm tree?

Sol: Height of the observer AB = 1.8m.



Height of the palm tree = CD say.

Distance between the palm tree and observer

AC is 13.2m.

From figure we observed that AC = BE and

AB = CE = 1.8m.

$\therefore$ From right triangle Δ DBE, we get

$$\tan 45° = \frac{DE}{BE}$$

$$\Rightarrow 1 = \frac{DE}{AC} \qquad (\because BE = AC = 13.2m)$$

$$\Rightarrow 1 = \frac{DE}{13.2}$$

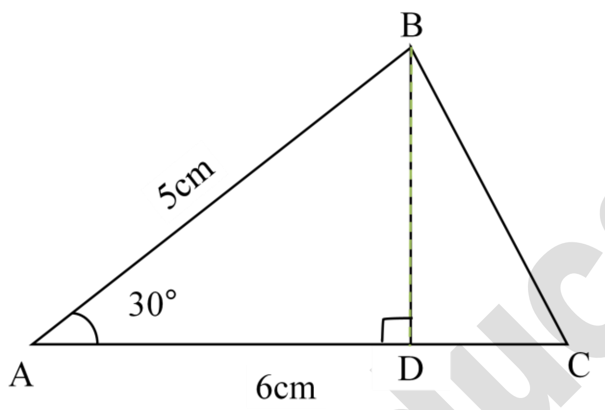
$\Rightarrow$ DE = 13.2m

Length of the palm tree CD = CE + ED

= 1.8 + 13.2

= 15m.

10. in the adjacent figure AC = 6 cm, AB = 5cm and ∠BAC = 30°. Find the area of the triangle?



Sol: From the triangle we get $\sin 30° = \frac{BD}{AB} = \frac{BD}{5}$

$$\Rightarrow \frac{1}{2} = \frac{BD}{5} \Rightarrow BD = \frac{5}{2} = 2.5cm.$$

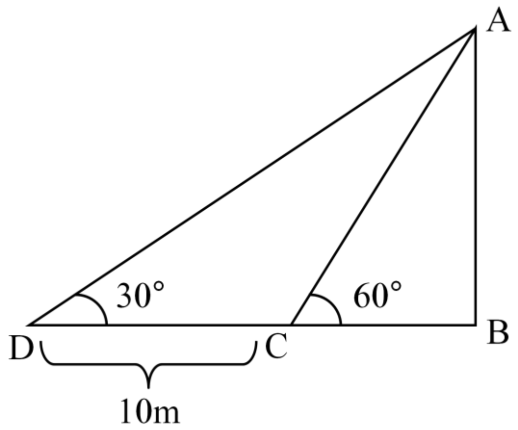
$\therefore$ Area of Δ ABC = $\frac{1}{2} \times AC \times BD$

$$= \frac{1}{2} \times 6 \times 2.5 = 7.5cm^2$$

$\therefore$ Area of Δ ABC = 7.5 sq.cm.

11. A TV tower stands vertically on the side of a road. From a point on the other side directly opposite to the tower, the angle of elevation of the top of tower is 60°. From another point 10m away from this point, on the tower, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the road?

Sol: Height of the tower is AB say



Width of the road is BD say

Distance between two observation points C and D is CD = 10m.

From right triangle ΔABC we get

$$\tan 60° = \frac{AB}{BC} \Rightarrow AB = BC\sqrt{3} \longrightarrow (1)$$

lly in ΔABD, $\tan 30° = \frac{AB}{BD}$

$$\frac{1}{\sqrt{3}} = \frac{AB}{BC + CD}$$

$$\Rightarrow AB = \frac{BC + CD}{\sqrt{3}} \longrightarrow (2)$$

From (1) & (2), we get

$$\sqrt{3}.BC = \frac{BC + CD}{\sqrt{3}}$$

$\Rightarrow 3\ BC = BC + CD$

$\Rightarrow 3\ BC - BC = CD$

$\Rightarrow 2\ BC = CD$

$$BC = \frac{CD}{2}$$

$$BC = \frac{10}{2} = 5 \qquad (\because \text{we know that } CD = 10m)$$

$\therefore$ width of the road $BD = BC + CD$

$= 5 + 10 = 15m.$

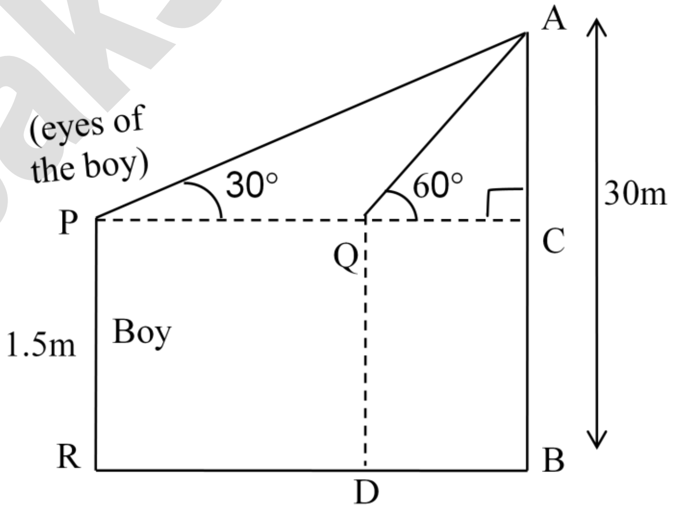
Height of the tower $AB = \sqrt{3}.BC$

$= \sqrt{3}.5 = 5\sqrt{3}m.$

12. A 1.5m tall boy is looking at the top of a temple which is 30 meter in height from a point at certain distance. The angle of elevation from his eye to the top of the crown of the temple increases from 30° to 60° as he walks towards the temple. Find the distance he walked towards the temple.

Sol: height of the temple AB = 30m.

Height of the Boy PR = 1.5m.



The angle of elevation from his eye to the top of the temple is $\angle APC = 30°$.

From figure we observed AC = AB – BC

(∵ BC = PR)

= AB – PR

= 30 – 1.5

AC = 28.5m

In right triangle ACQ, we get

$$\tan 60° = \frac{AC}{QC} = \frac{28.5}{QC}$$

$$\Rightarrow \sqrt{3} = \frac{28.5}{QC}$$

$$\Rightarrow QC = \frac{28.5}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{28.5 \times \sqrt{3}}{3}$$

∴ QC = $9.5\sqrt{3}$.

In right triangle APC, we get

$$\tan 30° = \frac{AC}{PC} = \frac{28.5}{PC}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{28.5}{PC}$$

⇒ PC = $28.5\sqrt{3}$.

∴ The distance walked towards the temple is PQ

∴ PQ = PC – QC

= $28.5\sqrt{3} - 9.5\sqrt{3}$

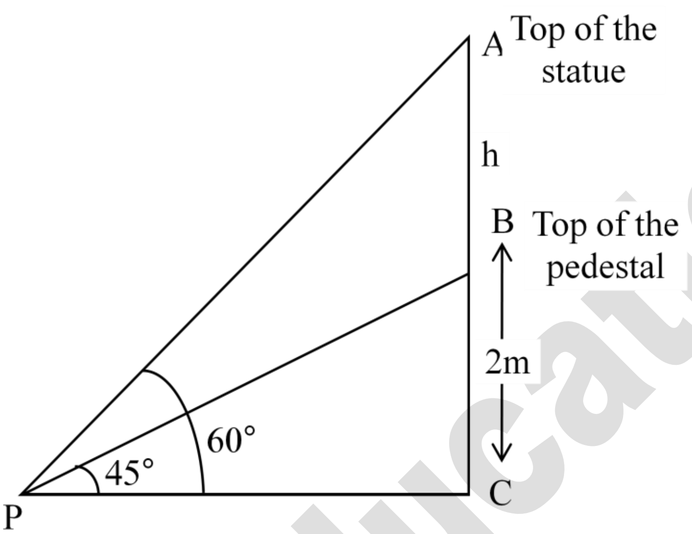
= $(28.5 - 9.5) \times \sqrt{3}$

$= 19 \times 1.732$

$= 32.908m.$

13. A statue stands on the top of a 2m tall pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and from the same point, the angle of elevation of the top of pedestal is 45°. Find the height of the statue.

Sol: Let the height of the statue AB = h say.



Height of the pedestal BC = 2m

In right triangle BCP, we get

$\tan 45° = \frac{BC}{PC}$ (point on the ground)

$\Rightarrow 1 = \frac{BC}{PC} \Rightarrow PC = 2m \longrightarrow (1)$

lly in right triangle ACP, we get

$\tan 60° = \frac{AC}{PC}$

$\Rightarrow \sqrt{3} = \frac{AC}{2} \Rightarrow AC = 2\sqrt{3}.$

∴ The height of the statue AB = AC – BC

$= 2\sqrt{3} - 2$

$= 2(\sqrt{3} - 1)$

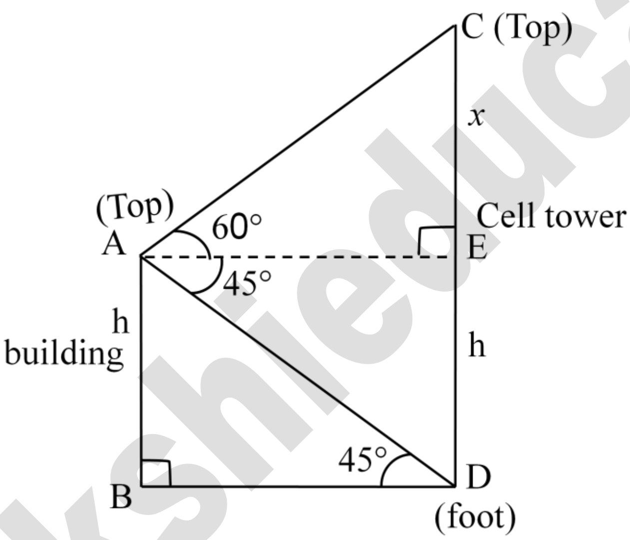
$= 2(1.732 - 1)$

$= 2 \times 0.732$

$= 1.464$m.

14. From the top of a Building, the angle of elevation of the top of a cell tower is 60° and the angle of depression to its foot is 45°. If distance of the building from the tower is 7m then find the height of the tower.

Sol: Height of the building AB = h say.



Let AB = DE = h

CE = x say.

The distance between the tower and building BD = 7m.

From the figure BD = AE = 7m.

From right triangle ACE $\tan 60° = \dfrac{CE}{AE}$

$$\sqrt{3} = \frac{CE}{7} \Rightarrow CE = 7\sqrt{3}$$

$$x = 7\sqrt{3}m.$$

From right triangle ABD, we get

$$\tan 45° = \frac{AB}{BD}$$

$$1 = \frac{AB}{7} = \frac{h}{7}$$

$\therefore$ h = 7m. and AB = ED = 7m.

$\therefore$ The height of cell tower CD = CE + ED

= $7\sqrt{3} + 7$

= $7(\sqrt{3} + 1)$

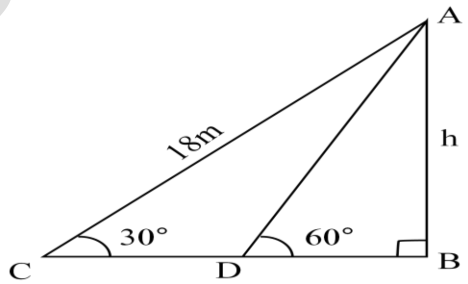
= 7 (1.732 + 1)

= 7 (2.732)

= 19.124m.

15. A wire of length 18m had been tied with electric pole at an angle of elevation 30° with the ground. Because it was conversing a long distance, it was cut and tied at an angle of elevation 60° with ground. How much length of the wire was cut?

Sol: Height of electric pole = AB = h say.



Length of a wire = AC = 18m.

From figure

In right triangle ACB, we get

sin 30° = $\frac{AB}{AC} = \frac{h}{18}$

$$\Rightarrow \frac{1}{2} = \frac{h}{18} \Rightarrow h = \frac{18}{2} = 9m \longrightarrow (1)$$

lly from triangle ADB, we get

$$\sin 60° = \frac{AB}{AD} = \frac{h}{AD}$$

From (1) h = 9m

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{9}{AD}$$

$$\Rightarrow AD = \frac{18}{\sqrt{3}} = \frac{18}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{18\sqrt{3}}{3} = 6\sqrt{3}m.$$

$\therefore$ The length of the remaining wire after cutting

= 18 – 6√3 = (18 – 6 × 1.732)

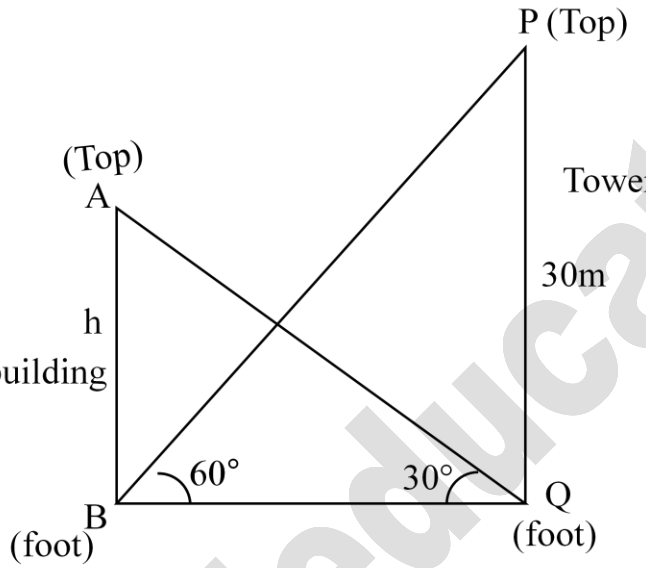
= 18 – 10.392

= 7.608m.

16. The angle of elevation of the top of a building form the foot of the tower is 30° and the angle of elevation of the top of the tower from the foot of the building is 60°. If the tower is 30m high, find the height of the building.

Sol: Let the height of the building be AB = hm
say
The height of the tower PQ = 30m.

From figure in right triangle ΔPBQ



We get $\tan 60° = \frac{PQ}{BQ}$

$$\sqrt{3} = \frac{30m}{BQ}$$

$$\Rightarrow BQ = \frac{30}{\sqrt{3}} m \longrightarrow (1)$$

In right triangle ΔAQB, we get1

$$\tan 30 = \frac{AB}{BQ} = \frac{h}{BQ}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BQ}$$

$$\Rightarrow BQ = h\sqrt{3} \longrightarrow (2)$$

From (1) & (2) we get

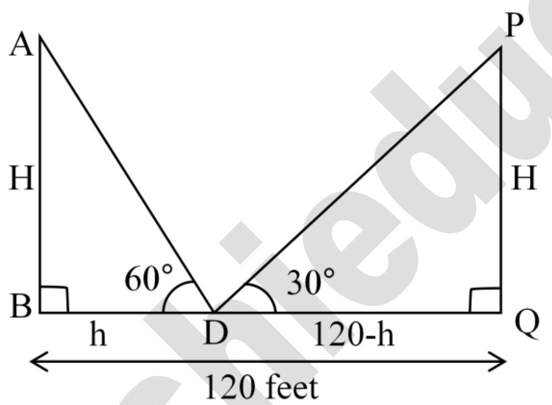
$$h\sqrt{3} = \frac{30}{\sqrt{3}}$$

$$h = \frac{30}{\sqrt{3} \times \sqrt{3}} = \frac{30}{3} = 10m.$$

$\therefore$ The height of the Building is 10m.

17. Two poles of equal heights are standing opposite to each other on either side of the road. Which is 120 feet wide from a point between them on the road, the angles of elevation of the top of the poles are 60° and 30° respectively. Find the height of the poles and the distances of the point from the poles.

Sol: The two poles of equal heights are AB and PQ say. Where AB = PQ = H say.



The distance between the two poles AB and PQ is 120 feet.

Take 'D' is a point between them and let BD = h m

From figure in right ΔABD we get then DQ = (120 - h) m

$$\tan 60° = \frac{AB}{BD}$$

$$\sqrt{3} = \frac{AB}{h}$$

$$\Rightarrow AB = h\sqrt{3} \Rightarrow H = h\sqrt{3} \longrightarrow (1)$$

lly in right triangle PQD, we get

$$\tan 30^\circ = \frac{PQ}{DQ} = \frac{H}{120-h}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{H}{120-h}$$

$$\Rightarrow H = \frac{120-h}{\sqrt{3}} \longrightarrow (2)$$

From (1) & (2) we get

$$h\sqrt{3} = \frac{120-h}{\sqrt{3}}$$

$\Rightarrow h\sqrt{3} \times \sqrt{3} = 120 - h$

$\Rightarrow 3h + h = 120 \Rightarrow 4h = 120 \Rightarrow h = \frac{120}{4} = 30$

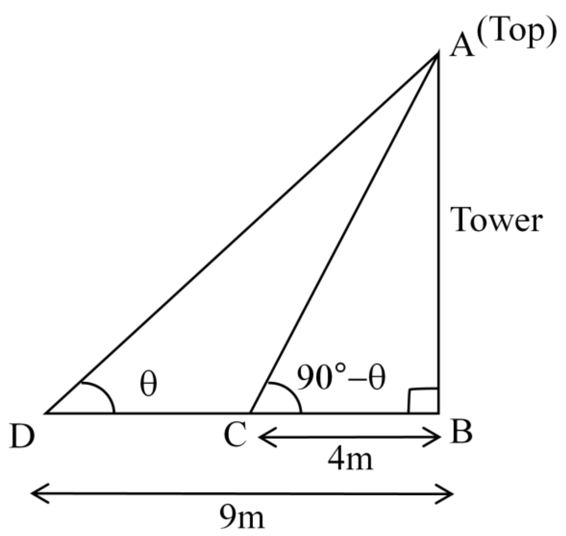
From (1) $H = 30\sqrt{3}$ m.

And also $120 - h = 120 - 30 = 90$.

$\therefore$ The heights of the poles are $30\sqrt{3}$ feet each and the distances of the point form the poles are 30 feet and 90 feet.

18. The angles of elevation of the top of a tower from two points at a distance of 4m and 9m. Find the height of the tower from the base of the tower and in the same straight line with it are complementary.

Sol: Height of the tower is AB say



Let ∠ADB = θ.

Then ∠ACB = 90 – θ (∵ given) (∵ ∠ABD and ∠ACB are Complementary)

In right triangle ABD

$$\tan\theta = \frac{AB}{DB} = \frac{AB}{9} \longrightarrow (1)$$

In right triangle ΔABC

$$\tan(90° - \theta) = \frac{AB}{4} \longrightarrow (2)$$

$$\cot\theta = \frac{AB}{4}$$

Multiplying (1) and (2), we get

$$\frac{AB}{9} \times \frac{AB}{4} = \tan\theta \times \cot\theta$$

$$\frac{AB^2}{36} = \tan\theta \times \frac{1}{\tan\theta} = 1$$

$\Rightarrow AB^2 = 36$

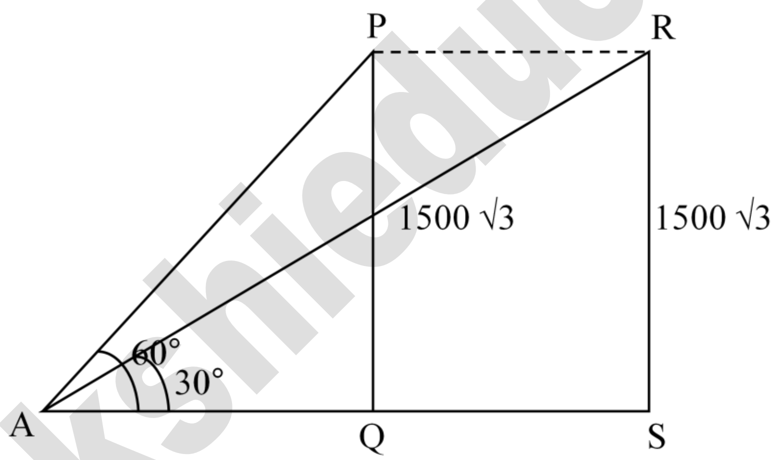
$\Rightarrow$ AB = 6m

$\therefore$ The right of the tower is 6m.

19. The angle of elevation of a jet plane from a point A on the ground is 60°. After a flight of 15 seconds, the angle of elevation changes to 30°. If the jet plane is flying at a constant height of 1500 √3 meter, find the speed of the jet plane. (√3 = 1.732)

Sol: Let P, R be the two positions of the plane and A be the point of observation.

It is given that angles of elevation of the plane in A two positions P and R from point A are 60° and 30°. Respectively



$\Rightarrow \angle PAQ = 60°$ and $\angle RAS = 30°$.

And also given that plane is flying at a constant height PQ = Rs = 1500 √3.

Now, In Δ PAQ, we get

$$\tan 60° = \frac{PQ}{AQ} = \frac{1500\sqrt{3}}{AQ}$$

$$\Rightarrow \sqrt{3} = \frac{1500\sqrt{3}}{AQ}$$

$$\Rightarrow AQ = \frac{1500\sqrt{3}}{\sqrt{3}} = 1500m.$$

In ΔRAS, we get

$$\tan 30° = \frac{RS}{AS} = \frac{1500\sqrt{3}}{AS}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{1500\sqrt{3}}{AS}$$

$\Rightarrow$ AS = $1500\sqrt{3}\times\sqrt{3} = 1500 \times 3 = 4500$.

$\therefore$ Thus the distance which the plane travels PR = RS = AS – AQ

= 4500 – 1500 = 3000m.

$\therefore$ Speed of plane $= \frac{3000}{15} = 200\, m/\text{sec}$.

Multiple Choice Questions

1. If the angle of elevation of the top of a tower at a distance of 500 m from the foot is 30°. Then the height of the tower is _________ [ ]

   a) $250\sqrt{3}$m b) $500\sqrt{3}$m c) $\frac{500}{\sqrt{3}}m$ d) 250m

2. A pole 6m high casts a shadow $2\sqrt{3}$m long on the ground, then sun's elevation is _____ [ ]

   a) 60° b) 45° c) 30° d) 90°

3. The height of the tower is 100m. When the angle of elevation of sun is 30°, then shadow of the tower is _______ [ ]

   a) $100\sqrt{3}$m b) 100m c) $100(\sqrt{3} - 1)$m d) $\frac{100}{\sqrt{3}}m$

4. If the height and length of the shadow of a man are the same, then the angle of elevation of the sun is ____________ [ ]

   a) 30° b) 60° c) 45° d) 15°

5. The angle of elevation of the top of a tower, whose height is 100m, at a point whose distance from the base of the tower is 100 m is ___ [ ]

   a) 30° b) 60° c) 45° d) none of these

6. The angle of elevation of the top of a tree height 2003 m at a point at distance of 200m from the base of the tree is _________ [ ]

   a) 30° b) 60° c) 45° d) None of these

7. A lamp post $5\sqrt{3}$ m high casts a shadow 5m long on the ground. The sun's elevation at this moment is _________ [ ]

   a) 30° b) 45° c) 60° d) 90°

8. Find the length of shadow of 10m high tree if the angle of elevation of the sun is 30°

a) 10m b) $\frac{10}{\sqrt{3}}m$ c) 10√3 m d) 20 m [ ]

9. If the angle of elevation of a bird sitting on the top of a tree as seen from the point at a distance of 20m from the base of the tree is 60°. Then the height of the tree is _______ [ ]

a) 20√3m b) 10√3m c) 20m d) 10m

10. The tops of two poles of height 20m and 14m are connected by a wire. If the wire makes an angle of 30° with horizontal, then the length of the wire is ____ [ ]

a) 6m b) 8m c) 10m d) 12m

Key:

1) C; 2) A; 3) A; 4) C; 5) C; 6) C; 7) C; 8) C; 9) A; 10) D.

Fill in the Blanks

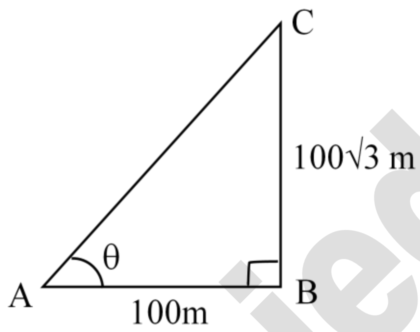
1. The ratio of the length of a tree and its shadow is $1:\frac{1}{\sqrt{3}}$. The angle of the sun's elevation is ________ degrees

2. If two towers of height h_1 and h_2 subtend angles of 60 and 30 respectively at the mid-point of the line joining their feet, then $h_1 : h_2$ is ________

3. The line drawn from the eye of an observer to the object viewed is called ________

4. If the angle of elevation of the sun is 30°, then the ratio of the height of a tree with its shadow is ______

5. From the figure θ = _____________



6. The angle of elevation of the sun is 45°. Then the length of the shadow of a 12m high tree is _______

7. When the object is below the horizontal level, the angle formed by the line of sight with the horizontal is called _______

8. When the object is above the horizontal level, the angle formed by the line of sight with the horizontal is called _______

9. The angle of depression of a boat is 60m high bridge is 60°. Then the horizontal distance of the boat from the bridge is ____

10. The height or length of an object can be determined with help of _____

Key

1) 60°; 2) 3 : 1; 3) Line of sight; 4) 1: $\sqrt{3}$; 5) 60°; 6) 12m;

7) angle of depression; 8) angle of elevation; 9) $20\sqrt{3}$m; 10) Trigonometric ratios.