CHAPTER
12

X CLASS-2023-24
APPLICATIONS OF TRIGONOMETRY

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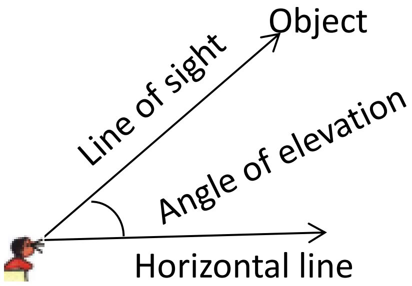
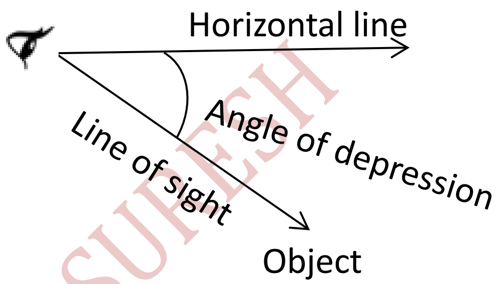
1. The line of sight is the line drawn from the eye of an observer to the point in the object viewed by the observer.
2. “The line of sight is above the horizontal line and angle between the line of sight and the horizontal line is called angle of elevation”.
3. “The line of sight is below the horizontal line and angle between the line of sight and the horizontal line is called angle of depression”.





4. Theodolites are used to measure angles of elevation or depression in the process of survey.

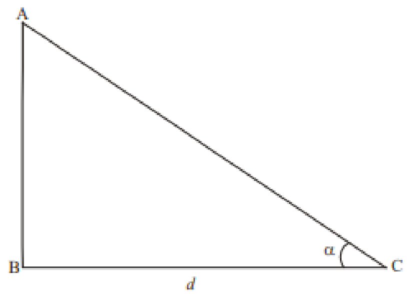
Example-1. The top of a clock tower is observed at angle of elevation of α and the foot of the tower is at the distance of d meters from the observer. Draw the diagram for this data.

Sol: Height of clock tower=AB

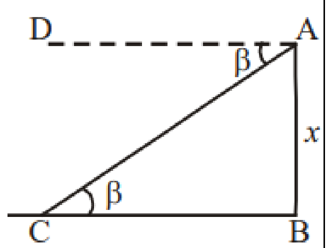
Observer point=C

Distance between foot of the tower and observer=BC=d m

Angle of elevation$=\angle ACB = \alpha$



Example-2. Rinky observes a flower on the ground from the balcony of the first floor of a building at an angle of depression β^{o}. The height of the first floor of the building is x meters. Draw the diagram for this data.



Solution :

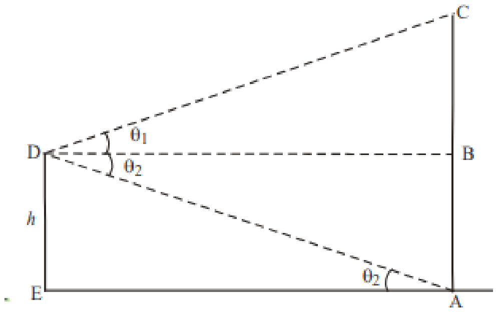
The height of the first floor of the building=AB$=x\ m$

Flower point=C, Angle of depression$=\angle DAC = \beta$

$\angle DAC = \angle ACB = \beta$(Alternate interior angles)

Example-3. A large balloon has been tied with a rope and it is floating in the air. A person has observed the balloon from the top of a building at angle of elevation of θ_1 and foot of the rope at an angle of depression of θ_2 . The height of the building is h feet. Draw the diagram for this data.

Solution:



Length of rope=AC

Building height=DE=$h\ feet$

Angle of elevation=$\angle BDC = \theta_1$

Angle of depression=$\angle ADB = \theta_2$

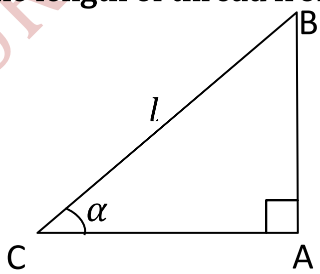
$\angle ADB = \angle DAE = \theta_2$(Alternate interior angles)

Do This

1. Draw diagram for the following situations:

(i) **A person is flying a kite at an angle of elevation α and the length of thread from his hand to kite is '*l*'.**

Sol:

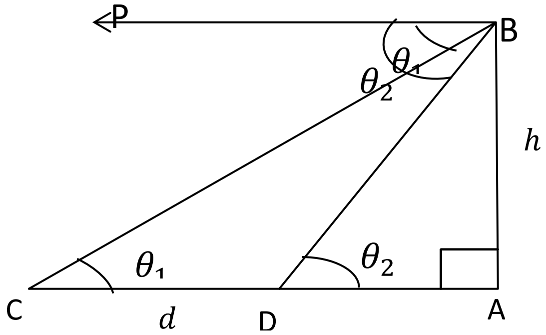


Length of thread=BC=l

Angle of elevation=$\angle ACB = \alpha$

(ii) **A person observes two banks of a river at angles of depression θ_1 and θ_2 ($\theta_1 < \theta_2$) from the top of a tree of height h which is at a side of the river. The width of the river is 'd'.**

Solution:



Height of tree=AB=h

Width of river=CD=d

Think - Discuss

1. **You are observing top of your school building at an angle of elevation α from a point which is at d meter distance from foot of the building. Which trigonometric ratio would you like to consider to find the height of the building?**

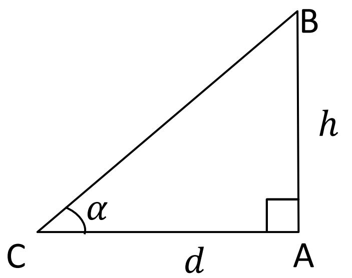
Sol: Height of the building=AB=h m

Distance from foot of the building to observing point=AC=d m

We have adjacent side .We want opposite side

So we consider **tangent** ratio

$\tan\alpha = \frac{AB}{AC} = \frac{h}{d} \Rightarrow h = d \times tan\,\alpha$



2. A ladder of length x meter is leaning against a wall making angle θ with the ground. Which trigonometric ratio would you like to consider to find the height of the point on the wall at which the ladder is touching?

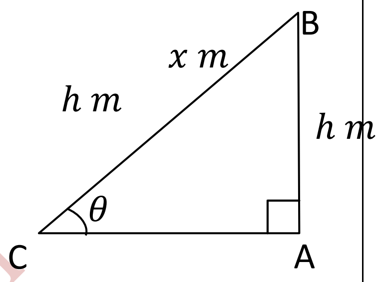
Sol: Length of ladder=BC=$x\ m$

The height of the point on the wall at which the ladder is touching=

We have hypotenuse . We want opposite side

So we consider sine ratio

$\sin\theta = \frac{h}{x} \Rightarrow h = x \times sin\,\theta$



Example-4. A boy observed the top of an electric pole at an angle of elevation of 60º when the observation point is 8 meters away from the foot of the pole. Find the height of the pole

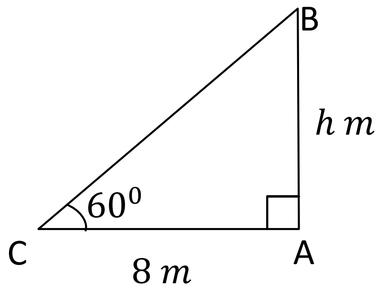
Sol: Height of electric pole=AB=$h\ m$

Observation point from the foot of the pole=AC= $8\ m$

Angle of elevation=$\angle ACB = 60^0$

$\tan 60^0 = \frac{AB}{AC}$

$\sqrt{3} = \frac{h}{8} \Rightarrow h = 8\sqrt{3}\ m$



Example-5. Rajender observes a person standing on the ground from a helicopter at an angle of depression 45º. If the helicopter flies at a height of 50 meters from the ground, what is the distance of the person from Rajender?

Sol: Height of helicopter flies from the ground=AB=50 m

$\angle PBC = \angle ACB = 45^0$ (Alternate interior angles)

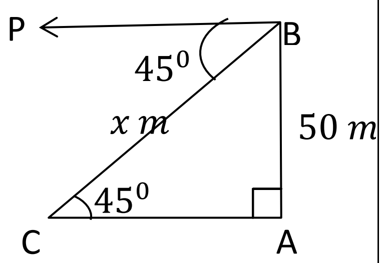
distance of the person from Rajender =BC=$x\ m$

$\sin 45^0 = \frac{\mathrm{AB}}{\mathrm{BC}}$

$\frac{1}{\sqrt{2}} = \frac{50}{x}$

$x = 50\sqrt{2}$

The distance from the person to Rajendar is $50\sqrt{2}\ m$



EXERCISE - 12.1

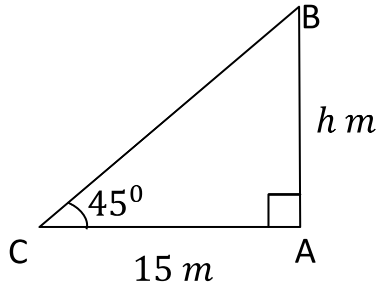
1. A tower stands vertically on the ground. From a point which is 15 meter away from the foot of the tower, the angle of elevation of the top of the tower is 45º. What is the height of the tower?

Sol: Height of the tower=AB=$h\ m$

Observing point=C

AC= 15 m

Angle of elevation=$\angle ACB = 45^0$



$$\tan 45^0 = \frac{AB}{AC}$$

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

The height of the tower=15 m

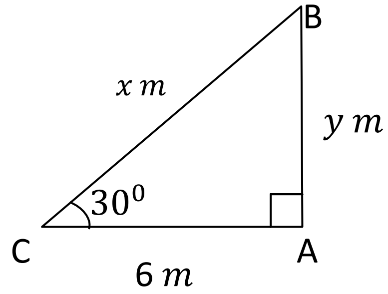
2. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground by making 30º angle with the ground. The distance between the foot of the tree and the top of the tree on the ground is 6m. Find the height of the tree before falling down.

Sol: Let length of remaining part =AB=$y\ m$

Length of broken part=BC=$x\ m$

AC=6m

Angle of elevation=$\angle ACB = 30^0$



$$\cos 30^0 = \frac{AC}{BC}$$

$$\frac{\sqrt{3}}{2} = \frac{6}{x} \Rightarrow x \times \sqrt{3} = 6 \times 2 \Rightarrow x = \frac{12}{\sqrt{3}} = \frac{12 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = \frac{12 \times \sqrt{3}}{3} = 4\sqrt{3}$$

$$\tan 30^0 = \frac{AB}{AC}$$

$$\frac{1}{\sqrt{3}} = \frac{y}{6} \Rightarrow y \times \sqrt{3} = 6 \times 1 \Rightarrow y = \frac{6}{\sqrt{3}} = \frac{6 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = \frac{6 \times \sqrt{3}}{3} = 2\sqrt{3}$$

$$x + y = 4\sqrt{3} + 2\sqrt{3} = 6\sqrt{3}$$

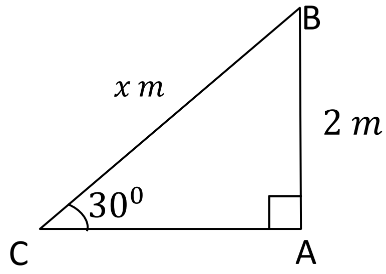
The height of the tree before falling down=$6\sqrt{3}\ m$

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 2 m and by making an angle of 30º with the ground. What should be the length of the slide?

Sol: Height of slide=AB=2 m

Length of slide=BC=$x\ m$

Angle of elevation$=\angle ACB = 30^0$

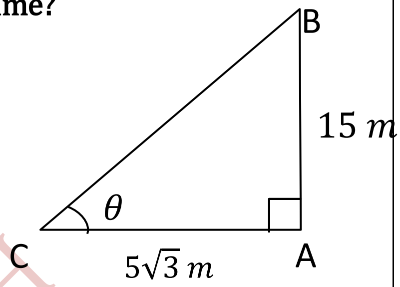


$\sin 30^0 = \dfrac{\text{AB}}{\text{BC}}$

$\dfrac{1}{2} = \dfrac{2}{x} \Rightarrow x = 2 \times 2 = 4$

The length of slide=4 m

4. Length of the shadow of a 15 meter high pole is 5 $\sqrt{3}$ 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=15 m

Length of shadow=AC=$15\sqrt{3}m$

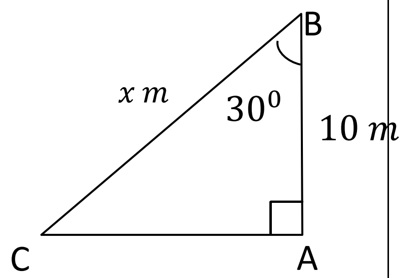
Let the angle of elevation $= \angle ACB = \theta$

$\tan\theta = \dfrac{AB}{AC} = \dfrac{15}{5\sqrt{3}} = \dfrac{3}{\sqrt{3}} = \sqrt{3}$

$\Rightarrow \theta = 60^0$

The angle of elevation of the Sun rays with the ground$=60^0$

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



Sol: Height of pole=AB=10 m

Let length of each rope=BC=$x\ m$

Angle made by the rope with the pole$=30^0$

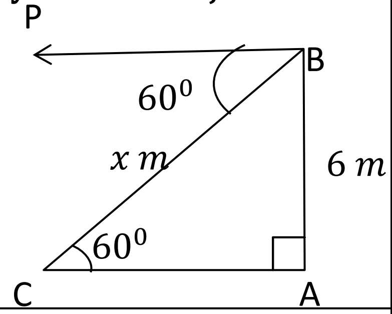
$\cos 30^0 = \dfrac{\text{AB}}{\text{BC}}$

$\dfrac{\sqrt{3}}{2} = \dfrac{10}{x} \Rightarrow \sqrt{3} \times x = 2 \times 10 \Rightarrow x = \dfrac{20}{\sqrt{3}}$

The length of each rope $= \dfrac{20}{\sqrt{3}}\ m$

Required length of rope $= 3 \times \dfrac{20}{\sqrt{3}} = \sqrt{3} \times \sqrt{3} \times \dfrac{20}{\sqrt{3}} = 20\sqrt{3}m$

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



Sol: Height of building=AB=6 m

Target place=C

Angle of depression$=60^0$

$\angle PBC = \angle ACB = 60^0$ $(Alternate\ interior\ angles)$

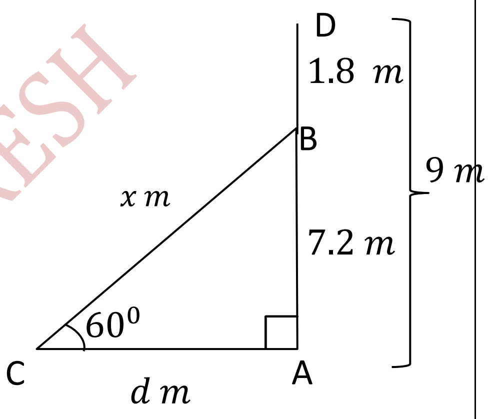
$$\sin 60^0 = \frac{AB}{BC}$$

$$\frac{\sqrt{3}}{2} = \frac{6}{x}$$

$$\Rightarrow x = \frac{12}{\sqrt{3}} = \frac{12}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{12 \times \sqrt{3}}{3} = 4\sqrt{3}$$

Required distance= $4\sqrt{3}\ m$

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



Sol: Height of pole=AD=9 m

Electrician reached point=B

$BD = 1.8\text{ m}$ and $AB = 9 - 1.8 = 7.2\text{ m}$

Let length of ladder=BC=$x\ m$ and

Required distance=AC= $d\ m$

$$\sin 60^0 = \frac{AB}{BC}$$

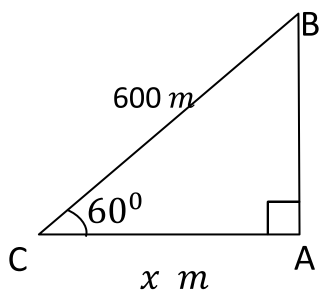
$$\frac{\sqrt{3}}{2} = \frac{7.2}{x}$$

$$\Rightarrow x = \frac{7.2 \times 2}{\sqrt{3}} = \frac{7.2 \times 2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{7.2 \times 2 \times \sqrt{3}}{3} = 2.4 \times 2 \times \sqrt{3} = 4.8 \times 1.732 = 8.3136m$$

$$\tan 60^0 = \frac{AB}{AC} \Rightarrow \sqrt{3} = \frac{7.2}{d}$$

$$\Rightarrow d = \frac{7.2}{\sqrt{3}} = \frac{7.2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{7.2 \times \sqrt{3}}{3} = 2.4\sqrt{3} = 2.4 \times 1.732 = 4.1568\ m$$

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



Sol: Let width of the river=AC=$x\ m$

Distance travelled by boat=BC=600 m

Angle made by boat=$\angle ACB = 60^0$

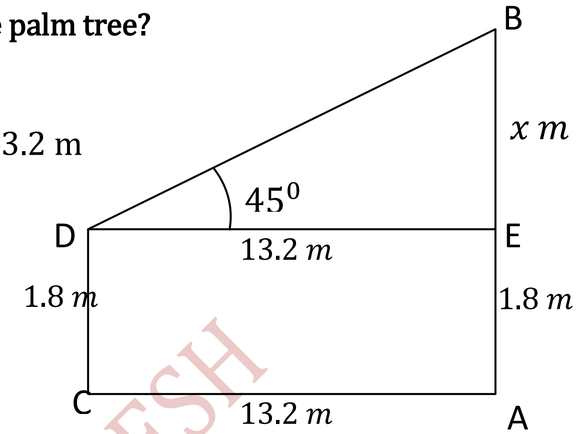
$$\cos 60^0 = \frac{AC}{BC}$$

$$\frac{1}{2} = \frac{x}{600}$$

$$\Rightarrow x = \frac{600}{2} = 300$$

The width of the river =300 m

9. An observer of height 1.8 m is13.2 m away from a palm tree. The angle of elevation of the top of the tree from his eyes is 45º. What is the height of the palm tree?



Sol: Height of observer=CD=AE=1.8 m

Distance of observer from palm tree=AC=DE=13.2 m

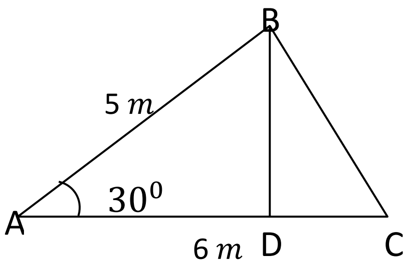
$$\tan 45^0 = \frac{BE}{DE}$$

$$1 = \frac{x}{13.2}$$

$$\Rightarrow x = 13.2$$

The height of the palm tree=AB=$x + 1.8 = 13.2 + 1.8 = 15\ m$

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



Sol: Let $BD \perp AC$

From ΔADB

$$\sin 30^0 = \frac{BD}{AB}$$

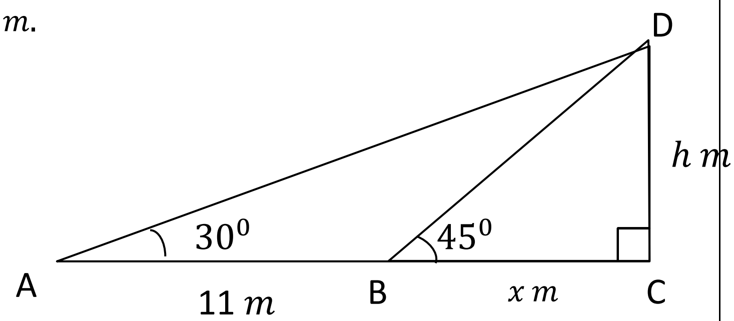
$$\frac{1}{2} = \frac{BD}{5}$$

$$BD = \frac{5}{2}\ m$$

$$Area\ of\ \Delta ABC = \frac{1}{2} \times AC \times BD = \frac{1}{2} \times 6 \times \frac{5}{2} = \frac{30}{4} = 7.5\ m^2$$

Solution for Two Triangles

Ex: Suppose you are observing the top of the palm tree at an angle of elevation 45º. The angle of elevation changes to 30º when you move 11 m away from the tree. Find height of the tree.



Sol: Let the height of the tree=CD=$h\ m$, $BC = x\ m$.

Observer places=A,B

$AB = 11m$, $AC = (x + 11)m$

From ΔBCD

$$\tan 45^0 = \frac{CD}{BC}$$

$$1 = \frac{h}{x} \Rightarrow x = h \rightarrow (1)$$

$From\ \Delta ACD$

$$\tan 30^0 = \frac{CD}{AC}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{11+x}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{11+h} \quad (from\ (1)\ x = h)$$

$$\Rightarrow \sqrt{3}h = 11 + h$$

$$\Rightarrow \sqrt{3}h - h = 11$$

$$\Rightarrow h(\sqrt{3}-1) = 11$$

$$\Rightarrow h = \frac{11}{\sqrt{3}-1}$$

$$The\ height\ of\ the\ palm\ tree = \frac{11}{\sqrt{3}-1} m$$

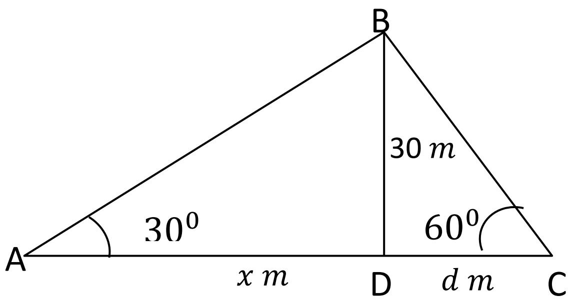
Example-6. Two men on either side of a temple of 30 meter height observe its top at the angles of elevation 30º and 60º respectively. Find the distance between the two men.

Sol: Height of the temple=BD=30 m

Observers places=A,C

$\angle BAD = 30^0, \angle BCD = 60^0$

Let $AD = x\ m\ \ and\ \ CD = d\ m$



$From\ \Delta BAD$

$$\tan 30^0 = \frac{BD}{AD}$$

$$\frac{1}{\sqrt{3}} = \frac{30}{x}$$

$$x = 30\sqrt{3}$$

$From\ \Delta BCD$

$$\tan 60^0 = \frac{BD}{CD}$$

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

$$d = \frac{30}{\sqrt{3}} = \frac{30\times\sqrt{3}}{\sqrt{3}\times\sqrt{3}} = \frac{30\times\sqrt{3}}{3} = 10\sqrt{3}$$

Distance between the persons=$x + d = 30\sqrt{3} + 10\sqrt{3} = 40\sqrt{3}\ m$

Example-7. A straight highway leads to the foot of a tower. Ramaiah standing at the top of the tower

observes a car at an angle of depression 30º. The car is approaching the foot of the tower with a uniform speed. Six seconds later, the angle of depression of the car is found to be 60º. Find the time taken by the car to reach the foot of the tower from this point

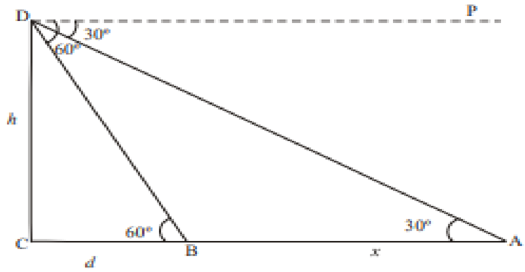
Sol: Let the distance travelled by the car in 6 seconds =

AB = x meters

Heights of the tower =CD = h meters

The remaining distance to be travelled by the car =BC

= d meters



$AC = (x + d)m$

∠PDA = ∠DAC = 30^0 (Alternate interior angles)

∠PDB = ∠DBC = 60^0 (Alternate interior angles)

From ΔBCD

$$\tan 60^0 = \frac{CD}{BC}$$

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

$$h = \sqrt{3}d \rightarrow (1)$$

From ΔBCD

$$\tan 30^0 = \frac{CD}{AC}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{x+d}$$

$$h = \frac{x+d}{\sqrt{3}} \rightarrow (2)$$

From (1)&(2)

$$\sqrt{3}d = \frac{x+d}{\sqrt{3}}$$

$$\sqrt{3} \times \sqrt{3}d = x + d$$

$$3d = x + d$$

$$3d - d = x$$

$$2d = x$$

$$d = \frac{x}{2}$$

Time taken to travel 'x' meters = 6 seconds.

Time taken to travel the distance of 'd' meter $= \frac{x}{2} = \frac{6}{2} = 3$ seconds

EXERCISE - 12.2

1. **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 60^0. From another point 10 m away from this point, on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30º. Find the height of the tower and the width of the road.**

Sol: Let the height of the tower=CD=$h\ m$

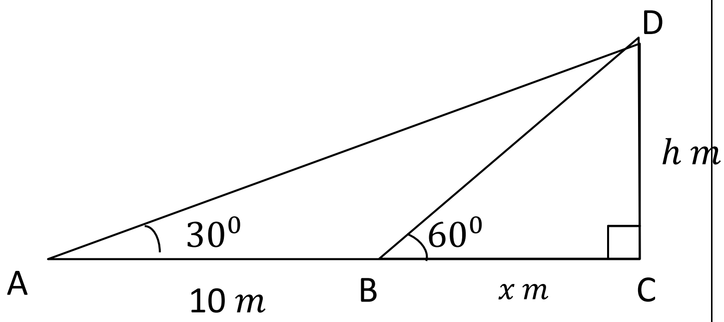
Width of the road=$x\ m$

Observation points=A,B

$AB = 10\ m$, $AC = (10 + x)m$

From ΔBCD

$$\tan 60^0 = \frac{\text{CD}}{\text{BC}}$$



$$\sqrt{3} = \frac{h}{x} \Rightarrow h = \sqrt{3}x \rightarrow (1)$$

From ΔACD

$$\tan 30^0 = \frac{CD}{AC}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{10+x} \Rightarrow h = \frac{10+x}{\sqrt{3}} \rightarrow (2)$$

From (1) & (2)

$$\sqrt{3}x = \frac{10+x}{\sqrt{3}}$$

$$\sqrt{3} \times \sqrt{3}x = 10 + x$$

$$3x = 10 + x$$

$$3x - x = 10$$

$$2x = 10$$

$$x = \frac{10}{2} = 5$$

From (1), $h = \sqrt{3}x = \sqrt{3} \times 5 = 5\sqrt{3}$

$\therefore$ The width of road $= 5\ m$

The height of tower $= 5\sqrt{3}m$

2. **A 1.5 m 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 30⁰ to 60⁰ as he walks towards the temple. Find the distance he walked towards the temple.**

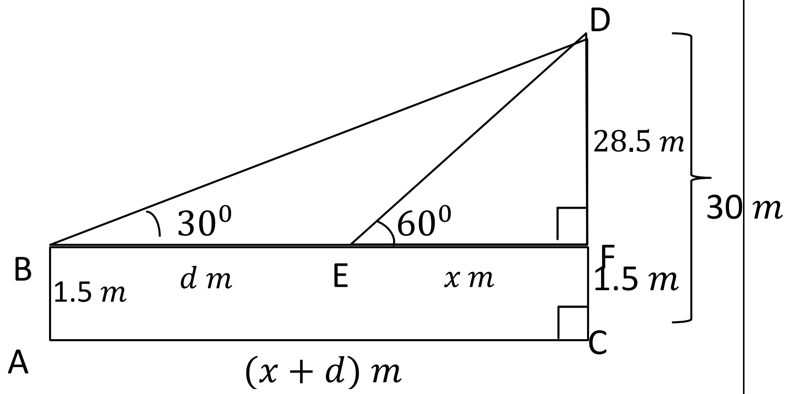
Sol: Height of the boy=AB=CF=1.5 m

Height of the temple=CD=30 m

Let the distance walked=BE=$d\ m$

$DF = 30 - 1.5 = 28.5m$

From ΔDEF



$$\tan 60^0 = \frac{DF}{EF}$$

$$\sqrt{3} = \frac{28.5}{x} \Rightarrow x = \frac{28.5}{\sqrt{3}} = \frac{28.5}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{28.5\sqrt{3}}{3} = 9.5\sqrt{3} \rightarrow (1)$$

From ΔBFD

$$\tan 30^0 = \frac{DF}{BF}$$

$$\frac{1}{\sqrt{3}} = \frac{28.5}{x+d}$$

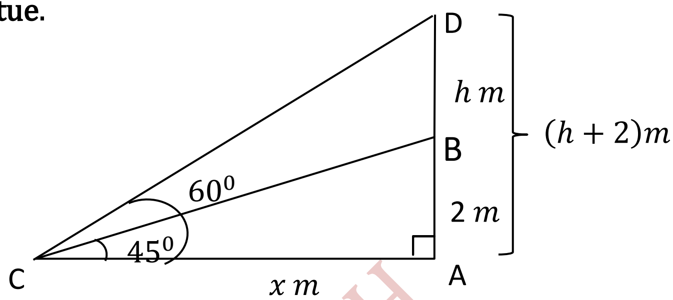
$\Rightarrow x + d = 28.5\sqrt{3}$

$\Rightarrow 9.5\sqrt{3} + d = 28.5\sqrt{3}$

$\Rightarrow d = 28.5\sqrt{3} - 9.5\sqrt{3} = 19\sqrt{3}$

Distance walked by the boy towards the temple$=19\sqrt{3} = 19 \times 1.732 = 32.908\ m$

3. **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 60ºand from the same point, the angle of elevation of the top of the pedestal is 45º. Find the height of the statue.**



Sol: Height of the pedestal=AB=2 m

Let the height of statue=BD=$h\ m$

$AD = (h+2)m$

The point of observation=C

Let AC=$x\ m$

From ΔABC

$\tan 45^0 = \frac{AB}{AC}$

$1 = \frac{2}{x}$

$\Rightarrow x = 2$

From ΔADC

$\tan 60^0 = \frac{AD}{AC}$

$\sqrt{3} = \frac{h+2}{x}$

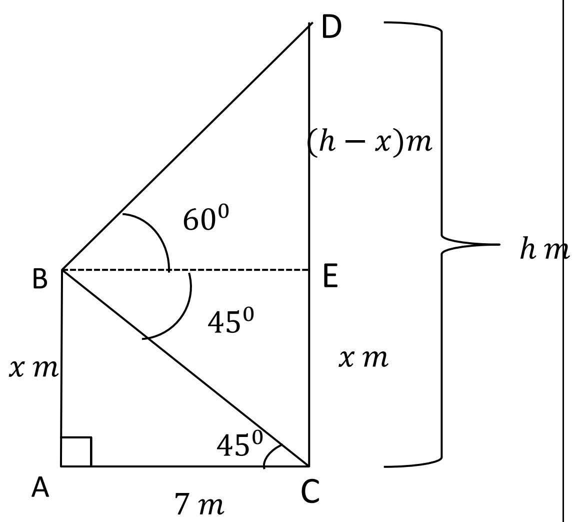
$\sqrt{3} = \frac{h+2}{2}$

$h + 2 = 2\sqrt{3}$

$h = 2\sqrt{3} - 2 = 2(\sqrt{3} - 1) = 2(1.732 - 1) = 2 \times 0.732 = 1.454\ m$

$\therefore$ The height of the statue $= 1.454\ m$

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



Sol: Let the height of building=AB=CE=$x\ m$

The height of tower=CD=$h\ m$

Distance between tower and building=AC=BE=7 m

$From\ \Delta ABC$

$\tan 45^0 = \frac{AB}{AC}$

$1 = \frac{x}{7} \Rightarrow x = 7$

From ΔBDE

$\tan 60^0 = \frac{DE}{BE}$

$$\sqrt{3} = \frac{h-x}{7}$$

$$h - x = 7\sqrt{3}$$

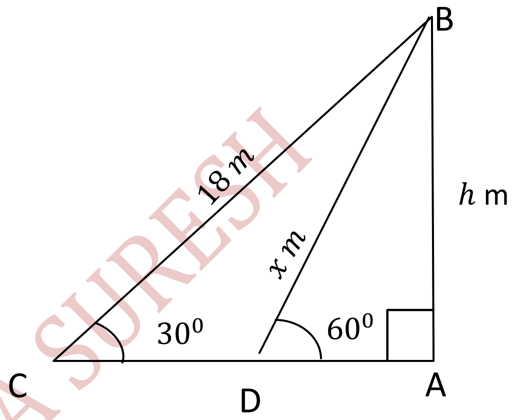
$$h - 7 = 7\sqrt{3}$$

$$h = 7\sqrt{3} + 7 = 7(\sqrt{3}+1) = 7(1.732+1) = 7 \times 2.732 = 19.124\, m$$

$\therefore$ The height of the tower $= 19.124\, m$

5. **A wire of length 18 m had been tied with electric pole at an angle of elevation 30º with the ground. As it is covering a long distance, it was cut and tied at an angle of elevation 60º with the ground. How much length of the wire was cut?**

Sol: Length of wire=18 m



Let height of the pole=AB=$h\, m$

From ΔBAC

$$\sin 30^0 = \frac{h}{18}$$

$$\frac{1}{2} = \frac{h}{18}$$

$$h = \frac{18}{2} = 9 \rightarrow (1)$$

From ΔBAD

$$\sin 60^0 = \frac{h}{x}$$

$$\frac{\sqrt{3}}{2} = \frac{h}{x}$$

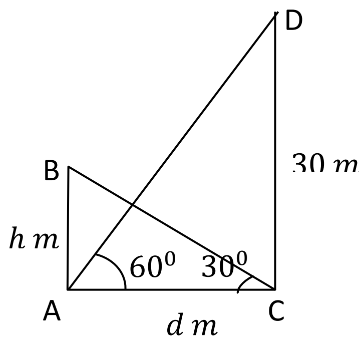
$$\frac{\sqrt{3}}{2} = \frac{9}{x}$$

$$x = \frac{18}{\sqrt{3}} = \frac{18}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{18\sqrt{3}}{3} = 6\sqrt{3} = 6 \times 1.732 = 10.392\, m$$

The length of the wire removed=$18 - x = 18 - 10.392 = 7.608\, m$

6. **The angle of elevation of the top of a building from the foot of the tower is 30º and the angle of elevation of the top of the tower from the foot of the building is 60º. If the tower is 30 m high, find the height of the building.**

Sol: Let height of the building=AB=$h\, m$



The height of the tower=CD=30m

AC= d m

From ΔADC

$$\tan 60^0 = \frac{30}{d}$$

$$\sqrt{3} = \frac{30}{d} \Rightarrow d = \frac{30}{\sqrt{3}}$$

$From\ \Delta BAC$

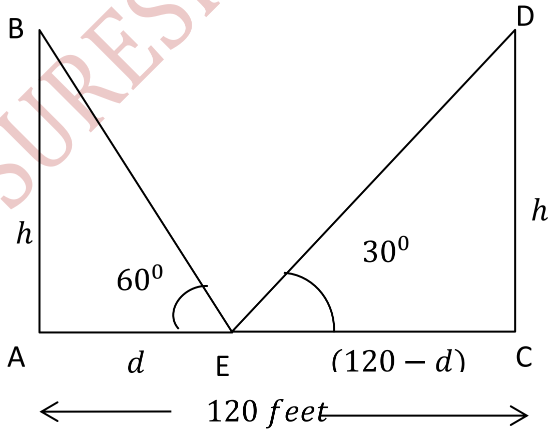
$$\tan 30^0 = \frac{h}{d}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{d}$$

$$h = d \times \frac{1}{\sqrt{3}} = \frac{30}{\sqrt{3}} \times \frac{1}{\sqrt{3}} = \frac{30}{3} = 10$$

$\therefore$ The height of the building $= 10\ m$

7. **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 60º and 30º respectively. Find the height of the poles and the distances of the point from the poles.**



Sol: Let height of the poles=AB=CD=$h\ feet$

Observation point=E

The distance between two poles=AC=120 $feet$

Let AE $=$ d feet then CE $= (120 - d) feet$

Fom ΔBAE

$$\tan 60^0 = \frac{h}{d}$$

$$\sqrt{3} = \frac{h}{d} \Rightarrow h = d\sqrt{3} \rightarrow (1)$$

$from\ \Delta DCE$

$$\tan 30^0 = \frac{h}{120 - d}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{120 - d} \Rightarrow h = \frac{120 - d}{\sqrt{3}} \rightarrow (2)$$

From (1) &(2)

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

$$d\sqrt{3} \times \sqrt{3} = 120 - d$$

$$3d = 120 - d$$

$$4d = 120$$

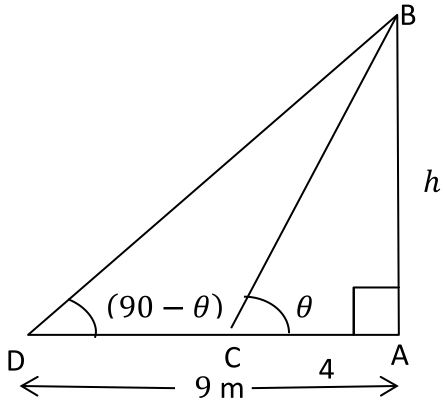
$$d = 30$$

$$h = d\sqrt{3} = 30\sqrt{3} = 30 \times 1.731 = 51.96$$

$\therefore$ The height of the pole $= 51.96\ feet$

The distances of the point from the poles=30 feet, 90 feet

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



Sol: Let the height of the tower=h

Observation points=C,D

AC=4 m, AD=9 m

Let $\angle ACB = \theta$ $then$ $\angle ADB = 90 - \theta$

From ΔBAC

$$\tan\theta = \frac{h}{4} \to (1)$$

From ΔBAD

$$\tan(90-\theta) = \frac{h}{9}$$

$$\cot\theta = \frac{h}{9} \Rightarrow \tan\theta = \frac{9}{h} \to (2)$$

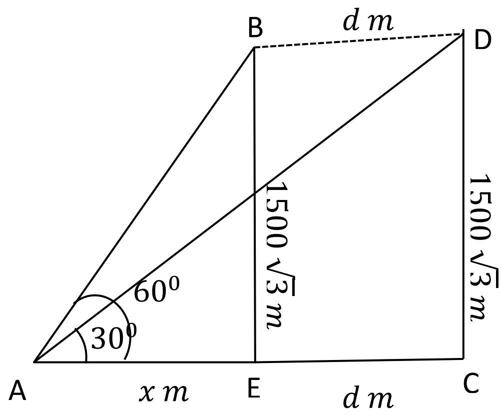
From (1) & (2)

$$\frac{h}{4} = \frac{9}{h} \Rightarrow h^2 = 36 \Rightarrow h = 6\,m$$

$\therefore$ The height of the tower $= 6\,m$

9. **The angle of elevation of a jet plane from a point A on the ground is 60º. After a flight of 15 seconds, the angle of elevation changes to 30º. If the jet plane is flying at a constant height of 1500 $\sqrt{3}$ meter, find the speed of the jet plane.($\sqrt{3} = 1.732$)**

Sol: Jet plane flying height from ground=BE=CD=$1500\sqrt{3}\,m$



From ΔABE

$$\tan 60^0 = \frac{BE}{AE}$$

$$\sqrt{3} = \frac{1500\sqrt{3}}{x}$$

$$x = 1500$$

From ΔACD

$$\tan 30^0 = \frac{CD}{AC}$$

$$\frac{1}{\sqrt{3}} = \frac{1500\sqrt{3}}{x+d}$$

$$x + d = 1500\sqrt{3} \times \sqrt{3} = 1500 \times 3 = 4500$$

$$1500 + d = 4500 \Longrightarrow d = 3000$$

The jet plane travels a distance of 3000 m in 15 seconds

$$\text{The speed of the jet plane} = \frac{\text{distance}}{\text{time}} = \frac{3000}{15} = 200\,m/s$$