NCERT Solutions for Class 10 Maths Chapter 9 Some Applications of Trigonometry Excercise: 9.1

Q1 A circus artist is climbing a 20 m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the height of the pole, if the angle made by the rope with the ground level is 30° (see Fig. 9.11).

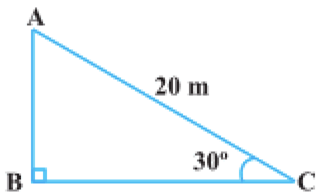


Fig. 9.11

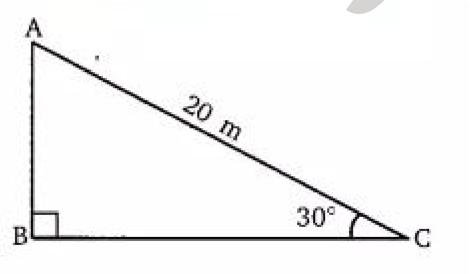
Answer:

Given that,

The length of the rope (AC) = 20 m. and $\angle ACB = 30^o$

Let the height of the pole (AB) be h

So, in the right triangle ΔABC



By using the Sin rule

$$\sin\theta = \frac{P}{H} = \frac{AB}{AC}$$

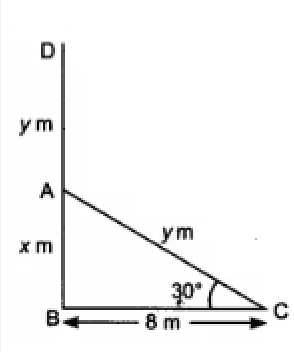
$$\sin 30^o = \frac{h}{20}$$

$h = 10$ m.

Hence the height of the pole is 10 m.

Q2 A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle 30° with it. The distance between the foot of the tree to the point where the top touches the ground is 8 m. Find the height of the tree.

Answer:



Suppose DB is a tree and the AD is the broken height of the tree which touches the ground at C.

GIven that,

$\angle ACB = 30^o$, BC = 8 m

let AB = x m and AD = y m

So, AD+AB = DB = $x + y$

In right angle triangle ΔABC ,

$\tan\theta = \frac{P}{B} = \frac{x}{8}$

$\tan 30^o = \frac{x}{8} = \frac{1}{\sqrt{3}}$

So, the value of x = $8/\sqrt{3}$

Similarily,

$\cos 30^o = \frac{BC}{AC} = \frac{8}{y}$

the value of y is $16/\sqrt{3}$

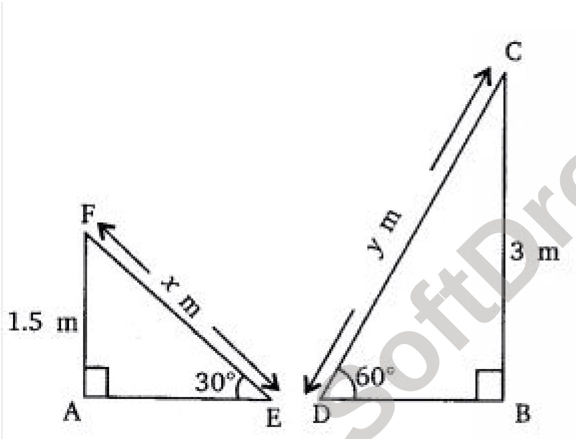
So, the total height of the tree is-

$$x+y=\frac{24}{\sqrt{3}}=8\sqrt{3}$$

= 8 (1.732) = 13.856 m (approx)

Q3 A contractor plans to install two slides for the children to play in a park. For the children below the age of 5 years, she prefers to have a slide whose top is at a height of 1.5 m, and is inclined at an angle of 30° to the ground, whereas for elder children, she wants to have a steep slide at a height of 3m, and inclined at an angle of 60° to the ground. What should be the length of the slide in each case?

Answer:



Suppose x m is the length of slides for children below 5 years and the length of slides for elders children be y m.

Given that,

AF = 1.5 m, BC = 3 m, $\angle AEF=30^o$ and $\angle BDC=60^o$

In triangle Δ EAF,

$$\sin\theta=\frac{AF}{EF}=\frac{1.5}{x}$$

$$\sin 30^o=\frac{1.5}{x}$$

The value of x is 3 m.

Similarily in Δ CDB,

$\sin 60^o = \frac{3}{y}$

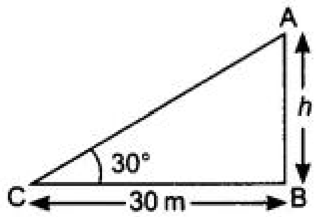
$\frac{\sqrt{3}}{2} = \frac{3}{y}$

the value of y is $2\sqrt{3}$ = 2(1.732) = 3.468

Hence the length of the slide for children below 5 yrs. is 3 m and for the elder children is 3.468 m.

Q4 The angle of elevation of the top of a tower from a point on the ground, which is 30 m away from the foot of the tower, is 30°. Find the height of the tower.

Answer:



Let the height of the tower AB is h and the angle of elevation from the ground at point C is $\angle ACB = 30^o$

According to question,

In the right triangle ΔABC ,

$\tan\theta = \frac{AB}{BC} = \frac{h}{30}$

$\tan 30^o = \frac{1}{\sqrt{3}} = \frac{h}{30}$

the value of h is $10\sqrt{3}$ = 10(1.732) = 17.32 m

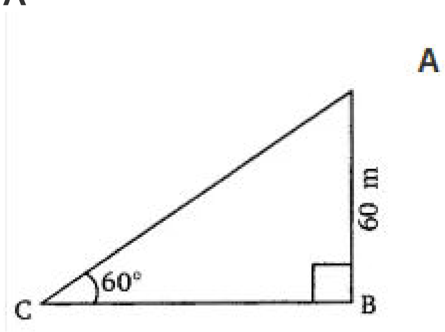
Thus the height of the tower is 17.32 m

Q5 A kite is flying at a height of 60 m above the ground. The string attached to the kite is temporarily tied to a point on the ground. The inclination of the string with the

[ground is 60°. Find the length of the string, assuming that there is no slack in the string.]

Answer:

A



Given that,

The length of AB = 60 m and the inclination of the string with the ground at point C is $\angle ACB = 60^o$.

Let the length of the string AC be l .

According to question,

In right triangle Δ CBA,

$$\sin 60^o = \frac{AB}{AC} = \frac{60}{l}$$

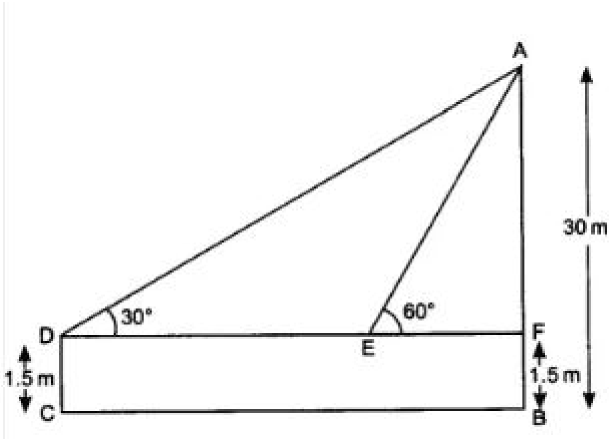
$$\frac{\sqrt{3}}{2} = \frac{60}{l}$$

The value of length of the string (l) is $40\sqrt{3}$ = 40(1.732) = 69.28 m

Hence the length of the string is 69.28 m.

Q6 [A 1.5 m tall boy is standing at some distance from a 30 m tall building. The angle of elevation from his eyes to the top of the building increases from 30° to 60° as he walks towards the building. Find the distance he walked towards the building.]

Answer:



Given that,

The height of the tallboy (DC) is 1.5 m and the height of the building (AB) is 30 m.

$\angle ADF = 30^o$ and $\angle AEF = 60^o$

According to question,

In right triangle AFD,

$\Rightarrow \tan 30^o = \dfrac{AF}{DF} = \dfrac{28.5}{DF}$

$\Rightarrow \dfrac{1}{\sqrt{3}} = \dfrac{28.5}{DF}$

So, DF = $(28.5)\sqrt{3}$

In right angle triangle ΔAFE,

$\tan 60^o = \dfrac{AF}{FE} = \dfrac{28.5}{EF}$

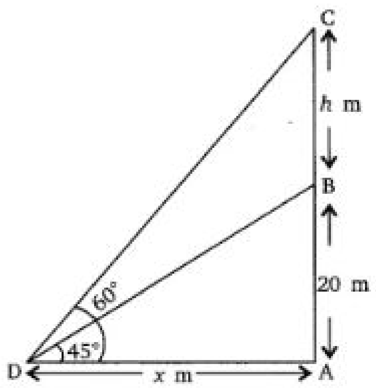
$\sqrt{3} = \dfrac{28.5}{EF}$

EF = $9.5\sqrt{3}$

So, distance walked by the boy towards the building = DF - EF = $19\sqrt{3}$

Q7 From a point on the ground, the angles of elevation of the bottom and the top of a transmission tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

Answer:



Suppose BC = h is the height of transmission tower and the AB be the height of the building and AD is the distance between the building and the observer point (D).

We have,

AB = 20 m, BC = h m and AD = x m

$\angle CDA = 60^o$ and $\angle BDA = 45^o$

According to question,

In triangle $\triangle$ BDA,

$$\tan 45^o = \frac{AB}{AD} = \frac{20}{x}$$

So, x = 20 m

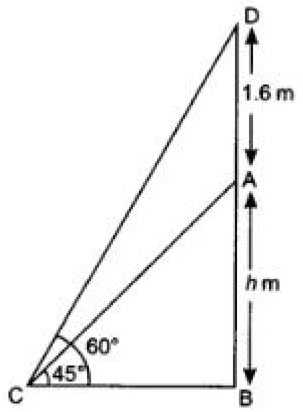
Again,

In triangle $\triangle$ CAD,

Answer- the height of the tower is 14.64 m

Q8 A statue, 1.6 m tall, stands on the top of a 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 the pedestal is 45°. Find the height of the pedestal.

Answer:



Let the height of the pedestal be h m. and the height of the statue is 1.6 m.

the angle of elevation of the top of the statue and top of the pedestal is($\angle DCB = 60^o$)and($\angle ACB = 45^o$) respectively.

Now,

In triangle ΔABC ,

$$\tan 45^o = 1 = \frac{AB}{BC} = \frac{h}{BC}$$

therefore, BC = h m

In triangle ΔCBD ,

$$\Rightarrow \tan 60^o = \frac{BD}{BC} = \frac{h + 1.6}{h}$$

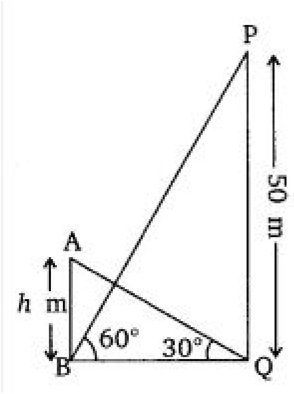
$$\Rightarrow \sqrt{3} = 1 + \frac{1.6}{h}$$

the value of h is $0.8(\sqrt{3} + 1)$ m

Hence the height of the pedestal is $0.8(\sqrt{3} + 1)$ m

Q9 The angle of elevation of the top of a building from 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 50 m high, find the height of the building.

Answer:



It is given that, the height of the tower (AB) is 50 m. $\angle AQB = 30^o$ and $\angle PBQ = 60^o$

Let the height of the building be h m

According to question,

In triangle PBQ,

$$\tan 60^o = \frac{PQ}{BQ} = \frac{50}{BQ}$$

$$\sqrt{3} = \frac{50}{BQ}$$

$$BQ = \frac{50}{\sqrt{3}}$$ ....(i)

In triangle ABQ,

$$\tan 30^o = \frac{h}{BQ}$$

$$BQ = h\sqrt{3}$$ ....(ii)

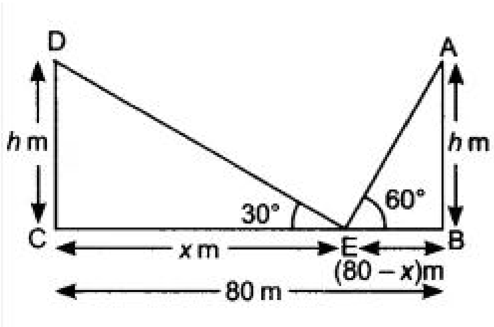
On equating the eq(i) and (ii) we get,

$$\frac{50}{\sqrt{3}} = h\sqrt{3}$$

therefore, h = 50/3 = 16.66 m = height of the building.

Q10 Two poles of equal heights are standing opposite each other on either side of the road, which is 80 m 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.

Answer:



Given that,

The height of both poles are equal DC = AB. The angle of elevation of of the top of the poles are $\angle DEC = 30^o$ and $\angle AEB = 60^o$ resp.

Let the height of the poles be h m and CE = x and BE = 80 - x

According to question,

In triangle DEC,

..............(i)

In triangle AEB,

..................(ii)

On equating eq (i) and eq (ii), we get

$$\sqrt{3}h = 80 - \frac{h}{\sqrt{3}}$$

$$\frac{h}{\sqrt{3}} = 20$$

$h = 20\sqrt{3}$ m

So, x = 60 m

Hence the height of both poles is ($h = 20\sqrt{3}$)m and the position of the point is at 60 m from the pole CD and 20 m from the pole AB.

Q11 A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60°.

From another point 20 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 30° (see Fig. 9.12). Find the height of the tower and the width of the canal.

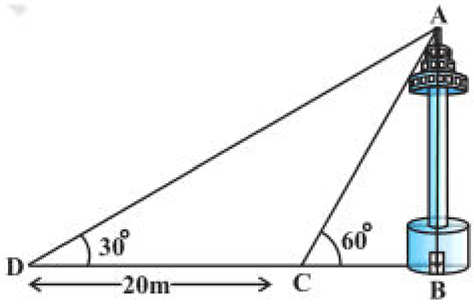
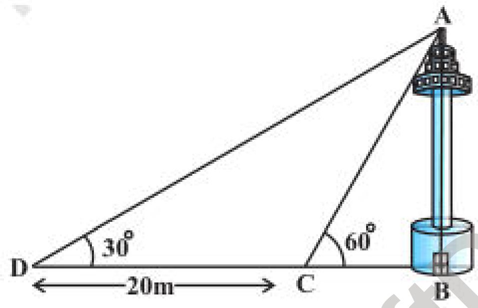


Fig. 9.12

Answer:



Suppose the h is the height of the tower AB and BC = x m

It is given that, the width of CD is 20 m,

According to question,

In triangle ΔADB ,

............(i)

In triangle ACB,

$\Rightarrow \tan 60^o = \frac{h}{x} = \sqrt{3}$

$\Rightarrow x = \frac{h}{\sqrt{3}}$ ....(ii)

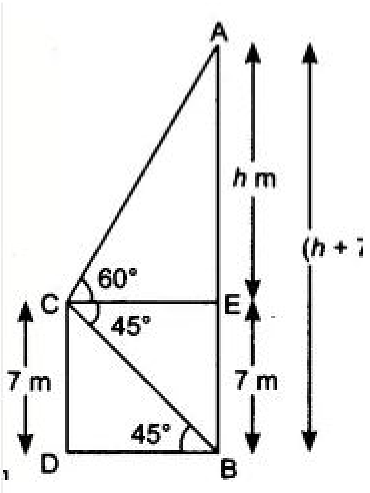
On equating eq (i) and (ii) we get:

$$h\sqrt{3} - 20 = \frac{h}{\sqrt{3}}$$

from here we can calculate the value of $h = 10\sqrt{3} = 10(1.732) = 17.32\ m$ and the width of the canal is 10 m.

Q12 From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 45°. Determine the height of the tower.

Answer:



Let the height of the cable tower be (AB = $h + 7$)m

Given,

The height of the building is 7 m and angle of elevation of the top of the tower $\angle ACE = 60^o$, angle of depression of its foot $\angle BCE = 45^o$.

According to question,

In triangle ΔDBC ,

$$\tan 45^o = \frac{CD}{BD} = \frac{7}{BD} = 1$$

$$BD = 7\ m$$

since DB = CE = 7 m

In triangle ΔACE ,

$$\tan 60^o = \frac{h}{CE} = \frac{h}{7} = \sqrt{3}$$
$$\therefore h = 7\sqrt{3}\ m$$

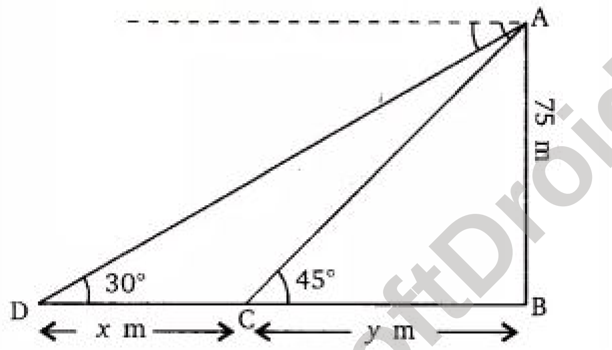
Thus, the total height of the tower equal to $h + 7 = 7(1+\sqrt{3})m$

Q13 As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships.

Answer:

Given that,

The height of the lighthouse (AB) is 75 m from the sea level. And the angle of depression of two different ships are $\angle ADB = 30^0$ and $\angle ACB = 45^0$ respectively



Let the distance between both the ships be x m.

According to question,

In triangle ΔADB ,

$$\tan 30^0 = \frac{AB}{BD} = \frac{75}{x+y} = \frac{1}{\sqrt{3}}$$
$\therefore x + y = 75\sqrt{3}$ ....(i)

In triangle ΔACB ,

$$\tan 45^0 = 1 = \frac{75}{BC} = \frac{75}{y}$$
$\therefore y = 75\ m$ ....(ii)

From equation (i) and (ii) we get;

$x = 75(\sqrt{3} - 1) = 75(0.732)$

$x = 54.9 \simeq 55\ m$

Hence, the distance between the two ships is approx 55 m.

Q14 A 1.2 m tall girl spots a balloon moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the eyes of the girl at any instant is 60°. After some time, the angle of elevation reduces to 30° (see Fig. 9.13). Find the distance traveled by the balloon during the interval.

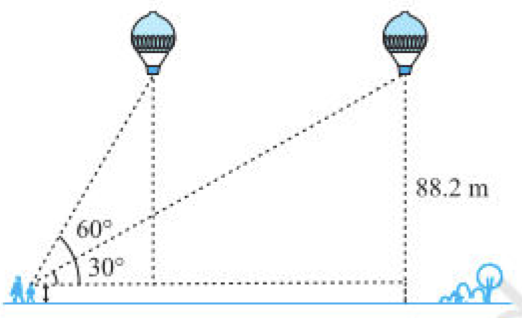
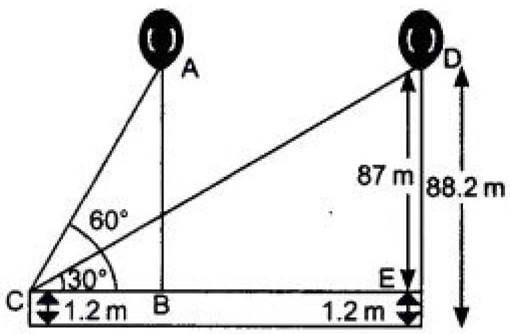


Fig. 9.13

Answer:

Given that,

The height of the girl is 1.2 m. The height of the balloon from the ground is 88.2 m and the angle of elevation of the balloon from the eye of the girl at any instant is ($\angle ACB = 60^0$) and after some time $\angle DCE = 30^0$.



Let the x distance travelled by the balloon from position A to position D during the interval.

AB = ED = 88.2 - 1.2 =87 m

Now, In triangle ΔBCA ,

$$\tan 60^0 = \sqrt{3} = \frac{AB}{BC} = \frac{87}{BC}$$
$$\therefore BC = 29\sqrt{3}$$

In triangle ΔDCE ,

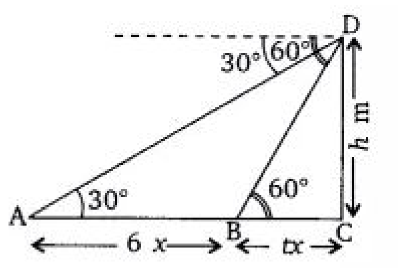
$$\tan 30^0 = \frac{1}{\sqrt{3}} = \frac{DE}{CE} = \frac{87}{CE}$$
$$\therefore CE = 87\sqrt{3}$$

Thus, distance traveled by the balloon from position A to D

$= CE - BC = 87\sqrt{3} - 29\sqrt{3} = 58\sqrt{3}$ m

Q15 A straight highway leads to the foot of a tower. A man standing at the top of the tower observes a car at an angle of depression of 30°, which 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 60°. Find the time taken by the car to reach the foot of the tower from this point.

Answer:



Let h be the height of the tower (DC) and the speed of the car be $x\ ms^{-1}$.

Therefore, the distance (AB)covered by the car in 6 seconds is 6 x m. Let t time required to reach the foot of the tower. So, BC = $x\,t$

According to question,

In triangle ΔDAC ,

$\tan 30^0 = \frac{1}{\sqrt{3}} = \frac{h}{6x + xt}$

$x(6+t) = h\sqrt{3}$ ....(i)

In triangle ΔBCD ,

$\tan 60^0 = \sqrt{3} = \frac{h}{xt}$

$\therefore h = 3.xt$ ....(ii)

Put the value of h in equation (i) we get,

$x(6+t) = (\sqrt{3}.\sqrt{3})xt$

$6x + xt = 3xt$

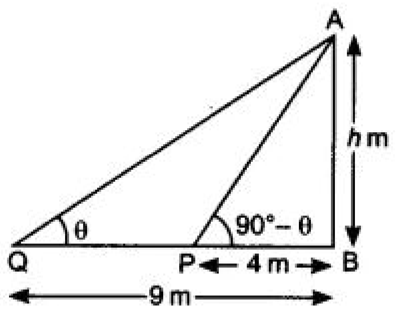
$6x = 2xt$

$t = 3$

Hence, from point B car take 3 sec to reach the foot of the tower.

Q16 The angles of elevation of the top of a tower from two points at a distance of 4 m and 9 m from the base of the tower and in the same straight line with it are complementary. Prove that the height of the tower is 6 m.

Answer:



Let the height of the tower be h m.

we have PB = 4m and QB = 9 m

Suppose $\angle BQA = \theta$, so $\angle APB = 90 - \theta$

According to question,

In triangle ΔABQ ,

$$\tan\theta = \frac{h}{9}$$
$$\therefore h = 9\tan\theta$$ ....(i)

In triangle ΔABP ,

$$\tan(90-\theta) = \cot\theta = \frac{h}{4}$$
$$\therefore h = 4\cot\theta$$ ....(ii)

multiply the equation (i) and (ii), we get

$$h^2 = 36$$
$$\Rightarrow h = 6m$$

Hence the height of the tower is 6 m.