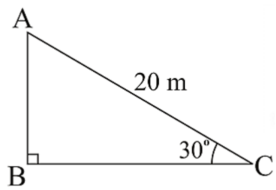
CBSE NCERT Solutions for Class 10 Mathematics Chapter 9

Back of Chapter Questions

1. 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.).

Solution:



Solution:

AB represents the height of the pole.

In ΔABC,

$\sin 30^{\circ} = \frac{AB}{AC}$

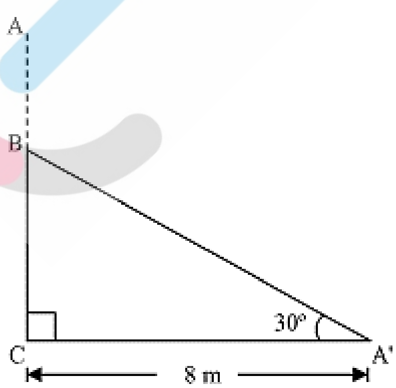
$\Rightarrow \frac{1}{2} = \frac{AB}{20}$

$\Rightarrow AB = 10$

Hence, the height of pole is 10 m

2. 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.

Solution:



Let AC be the original tree and A′B be the broken part which makes an angle of 30^o with the ground.

In $\Delta A'BC$,

$\tan 30^o = \frac{BC}{A'C}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{BC}{8}$

$\Rightarrow BC = \frac{8}{\sqrt{3}}$

Again, $\cos 30^o = \frac{A'C}{A'B}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{8}{A'B}$

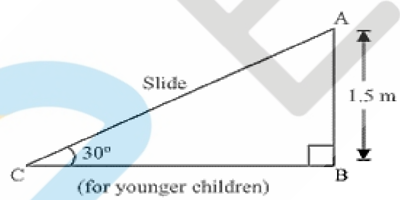
$\Rightarrow A'B = \frac{16}{\sqrt{3}}$

Hence, height of tree $= A'B + BC = \frac{16}{\sqrt{3}} + \frac{8}{\sqrt{3}} = \frac{24}{\sqrt{3}} = 8\sqrt{3}$ m

3. 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^o 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^o to the ground. What should be the length of the slide in each case?

Solution:

In the two figures, AC represent slide for younger children and PR represent slide for elder children

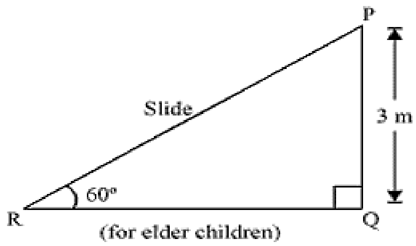


In ΔABC,

$\sin 30^o = \frac{AB}{AC}$

$\Rightarrow \frac{1}{2} = \frac{1.5}{AC}$

$\Rightarrow AC = 3$ m



In ΔPQR,

$\sin 60^{o} = \frac{PQ}{PR}$

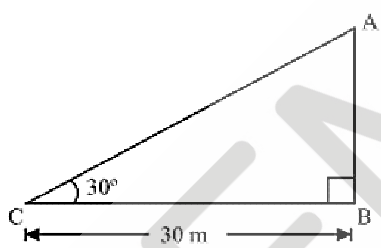
$\Rightarrow \frac{\sqrt{3}}{2} = \frac{3}{PR}$

$\Rightarrow PR = \frac{6}{\sqrt{3}} = 2\sqrt{3}$ m

Hence, the length of the two slides are 3 m and $2\sqrt{3}$ m.

4. 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^{o}. Find the height of the tower.

Solution:



Let AB represents the tower.

In ΔABC,

$\tan 30^{o} = \frac{AB}{BC}$

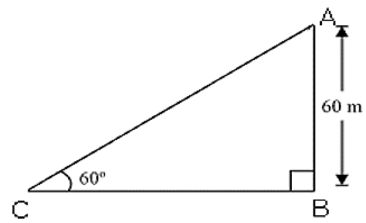
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{30}$

$\Rightarrow AB = \frac{30}{\sqrt{3}} = 10\sqrt{3}$ m

Hence, the height of the tower is $10\sqrt{3}$ m

5. 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^{o}. Find the length of the string, assuming that there is no slack in the string.

Solution:



Let A represents the position of the kite and the string is tied to point C on the ground.

In ΔABC,

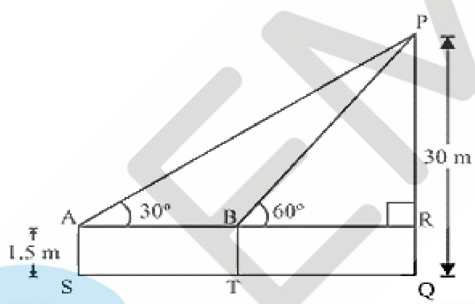
$\sin 60^{o} = \frac{AB}{AC}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{60}{AC}$

$\Rightarrow AC = \frac{120}{\sqrt{3}} = 40\sqrt{3}\text{ m}$

6. 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^{o} to 60^{o} as he walks towards the building. Find the distance he walked towards the building.

Solution:



Let initially boy was standing at S. After walking towards the building, he reached at point T.

In the figure, PQ = height of the building = 30 m

$AS = BT = RQ = 1.5\text{ m}$

$PR = PQ - RQ = 30\text{ m} - 1.5\text{ m} = 28.5\text{ m}$

In ΔPAR,

$\tan 30^{o} = \frac{PR}{AR}$

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

$\Rightarrow \text{AR} = 28.5\sqrt{3}$

In ΔPRB,

$\tan 60^o = \frac{\text{PR}}{\text{BR}}$

$\Rightarrow \sqrt{3} = \frac{28.5}{\text{BR}}$

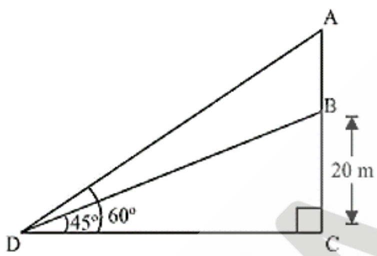
$\Rightarrow \text{BR} = \dfrac{28.5}{\sqrt{3}} = 9.5\sqrt{3}$

$\text{ST} = \text{AB} = \text{AR} - \text{BR} = 28.5\sqrt{3} - 9.5\sqrt{3} = 19\sqrt{3}$

Hence, distance the boy walked towards the building $= 19\sqrt{3}$ m

7. 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^o and 60^o respectively. Find the height of the tower.

Solution:



Let BC represents the building, AB represents the transmission tower, and D is the point on the ground from where elevation angles are to be measured.

In ΔBCD

$\tan 45^o = \dfrac{\text{BC}}{\text{CD}}$

$\Rightarrow 1 = \frac{20}{\text{CD}}$

$\Rightarrow \text{CD} = 20 \text{ m}$ ...(i)

In ΔACD,

$\tan 60^o = \frac{\text{AC}}{\text{CD}}$

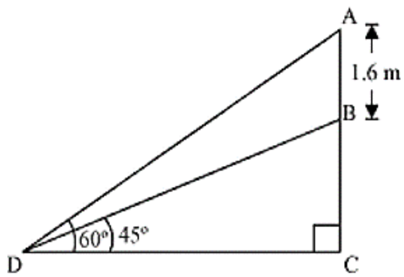
$\Rightarrow \sqrt{3} = \frac{\text{AB}+\text{BC}}{\text{CD}}$

$\Rightarrow \sqrt{3} = \frac{\text{AB}+20}{20}$ [From(i)]

$\Rightarrow \text{AB} = 20\sqrt{3} - 20 = 20(\sqrt{3} - 1)\text{m}$

8. 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.

Solution:



Let AB represents the statue,BC represents the pedestal and D be the point on ground from where elevation angles are to be measurd.

In ΔBCD,

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

$\Rightarrow 1 = \frac{BC}{CD}$

$\Rightarrow BC = CD \quad \ldots(i)$

In ΔACD,

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

$\Rightarrow \sqrt{3} = \frac{AB+BC}{BC} \quad [From(i)]$

$\Rightarrow 1.6 + BC = BC\sqrt{3}$

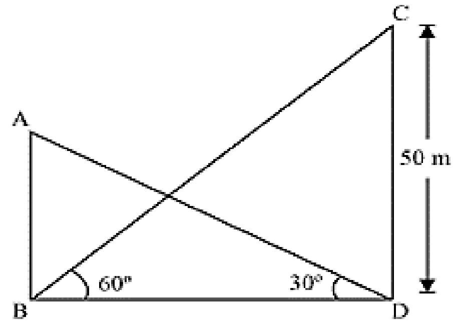
$\Rightarrow BC = \frac{(1.6)(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$

$= \frac{1.6(\sqrt{3}+1)}{2} = 0.8(\sqrt{3}+1)$

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

9. 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.

Solution:



In ΔCDB,

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

$\Rightarrow \sqrt{3} = \frac{50}{BD}$

$\Rightarrow BD = \frac{50}{\sqrt{3}}$

In ΔABD,

$\tan 30^{o} = \frac{AB}{BD}$

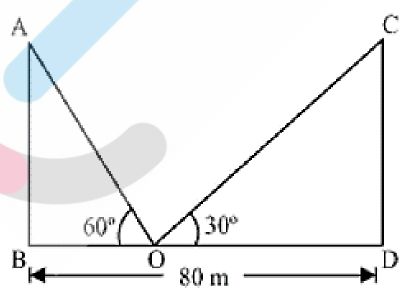
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{BD}$

$\Rightarrow AB = \frac{50}{\sqrt{3}} \times \frac{1}{\sqrt{3}} = \frac{50}{3} = 16\frac{2}{3}$ m

Hence, height of the building $= 16\frac{2}{3}$ m

10. 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.

Solution:



Let AB and CD represent the poles and O is the point on the road.

In ΔABO,

$\tan 60^{o} = \frac{AB}{BO}$

$\Rightarrow \sqrt{3} = \frac{AB}{BO}$

$\Rightarrow BO = \frac{AB}{\sqrt{3}}$ ...(i)

In ΔCDO,

$\tan 30^{o} = \frac{CD}{DO}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{CD}{80-BO}$

$\Rightarrow 80 - BO = CD\sqrt{3}$

$\Rightarrow CD\sqrt{3} = 80 - \frac{AB}{\sqrt{3}}$ [From (i)]

$\Rightarrow CD\sqrt{3} + \frac{AB}{\sqrt{3}} = 80$

$\Rightarrow CD\left[\sqrt{3} + \frac{1}{\sqrt{3}}\right] = 80$ (Since, $AB = CD$)

$\Rightarrow CD\left(\frac{3+1}{\sqrt{3}}\right) = 80$

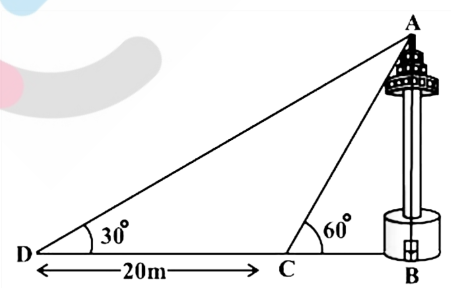
$\Rightarrow CD = 20\sqrt{3}$

$BO = \frac{AB}{\sqrt{3}} = \frac{CD}{\sqrt{3}} = \frac{20\sqrt{3}}{\sqrt{3}} = 20$ m

$DO = BD - BO = 80$ m $- 20$ m $= 60$ m

Hence, the height of the poles is $20\sqrt{3}$ m and distance of the point from the poles is 20 m and 60 m.

11. 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^{o}. 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^{o} (see Fig.). Find the height of the tower and the width of the canal.



Solution:

In ΔABC,

$\tan 60^o = \frac{AB}{BC}$

$\Rightarrow \sqrt{3} = \frac{AB}{BC}$

$\Rightarrow BC = \frac{AB}{\sqrt{3}}$ ... (i)

In ΔABD,

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

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{\frac{AB}{\sqrt{3}}+20}$ [From(i)]

$\Rightarrow \frac{AB\sqrt{3}}{AB+20\sqrt{3}} = \frac{1}{\sqrt{3}}$

$\Rightarrow 3AB = AB + 20\sqrt{3}$

$\Rightarrow 2AB = 20\sqrt{3}$

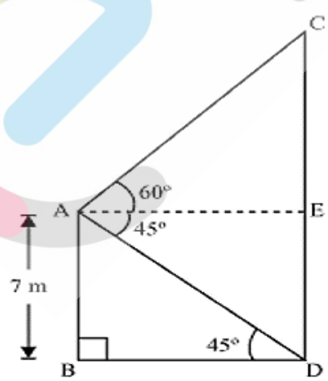
$\Rightarrow AB = 10\sqrt{3}$

$\Rightarrow BC = \frac{AB}{\sqrt{3}} = \frac{10\sqrt{3}}{\sqrt{3}} = 10$

Hence, the height of the tower is $10\sqrt{3}$ m and width of the canal is 10 m

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

Solution:



Let AB represents the building and CD represents a cable tower.

In ΔABD,

$\tan 45^{o} = \frac{AB}{BD}$

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

$\Rightarrow BD = 7$

Hence, $AE = BD = 7$

In ΔACE,

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

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

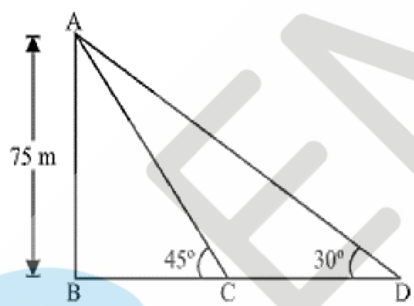
$\Rightarrow CE = 7\sqrt{3}$

So, $CD = CE + ED = \left(7\sqrt{3} + 7\right)m = 7(\sqrt{3} + 1)m$

Hence, the height of the cable tower $= 7\left(\sqrt{3} + 1\right)m$

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

Solution:



Let AB represents the lighthouse and the two ships are at point C and D respectively.

In ΔABC,

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

$\Rightarrow 1 = \frac{75}{BC}$

$\Rightarrow BC = 75$

In ΔABD,

$\tan 30^{o} = \frac{AB}{BD}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{BC+CD}$

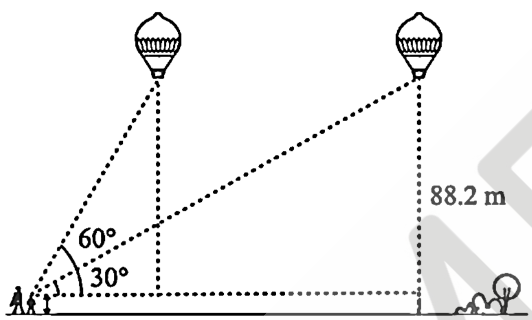
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{75+CD}$

$\Rightarrow 75\sqrt{3} = 75 + CD$

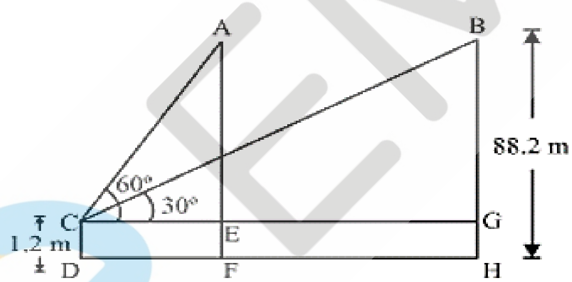
$\Rightarrow CD = 75(\sqrt{3} - 1)$

Hence, the distance between the two ships $= 75(\sqrt{3} - 1)$m

14. 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.). Find the distance travelled by the balloon during the interval.



Solution:



Let A is the initial position of the balloon and B is the final position after some time and CD represents the girl.

In ΔACE,

$AE = AF - EF = 88.2 - 1.2 = 87$

$\tan 60^\circ = \frac{AE}{CE}$

$\Rightarrow \sqrt{3} = \frac{87}{CE}$

$\Rightarrow CE = \frac{87}{\sqrt{3}} = 29\sqrt{3}$

In ΔBCG,

$BG = AE = 87$

$\tan 30^{o} = \frac{BG}{CG}$

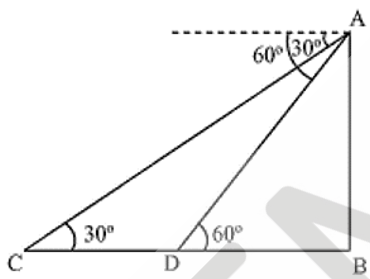
$\Rightarrow \frac{1}{\sqrt{3}} = \frac{87}{CG}$

$\Rightarrow CG = 87\sqrt{3}$

Hence, distance travelled by balloon $= AB = EG = CG - CE = 87\sqrt{3} - 29\sqrt{3} = 58\sqrt{3}$ m

15. 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^{o}, 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^{o}. Find the time taken by the car to reach the foot of the tower from this point.

Solution:



Let AB represents the tower. C is the initial position of the car and D is the final position after six seconds.

in ΔADB,

$\tan 60^{o} = \frac{AB}{DB}$

$\Rightarrow \sqrt{3} = \frac{AB}{DB}$

$\Rightarrow DB = \frac{AB}{\sqrt{3}}$ ….(i)

In ΔABC,

$\tan 30^{o} = \frac{AB}{BC}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{BD+DC}$

$\Rightarrow AB\sqrt{3} = BD + DC$

$\Rightarrow AB\sqrt{3} = \frac{Ab}{\sqrt{3}} + DC\ [From(i)]$

$\Rightarrow DC = AB\sqrt{3} - \frac{AB}{\sqrt{3}} = AB\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right) = \frac{2AB}{\sqrt{3}}$

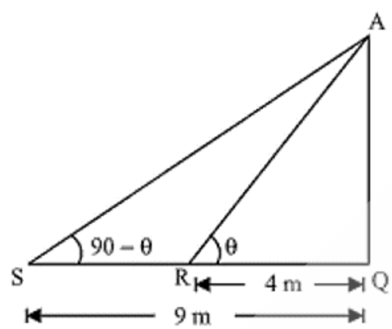
Since, time taken by car to travel distance DC $\left(= \frac{2AB}{\sqrt{3}}\right) = 6$ seconds

Hence, time taken by car to travel distance DB $\left(= \frac{AB}{\sqrt{3}}\right) = \frac{6}{\frac{2AB}{\sqrt{3}}} \times \frac{AB}{\sqrt{3}} = 3$ seconds

(Since, speed is uniform)

16. 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.

Solution:



Let AQ represents the tower and R, S are the points which are 4m, 9m away from base of the tower respectively.

Let $\angle ARQ = \theta$, then $\angle ASQ = 90^o - \theta$

(Since, the angles are complementary)

In ΔAQR,

$\tan\theta = \frac{AQ}{QR}$

$\Rightarrow \tan\theta = \frac{AQ}{4}$ ...(i)

In ΔAQS,

$\tan(90^0 - \theta) = \frac{AQ}{SQ}$

$\Rightarrow \cot\theta = \frac{AQ}{9}$ .... (ii)

Multiplying equations (i) and (ii),

$\left(\frac{AQ}{4}\right)\left(\frac{AQ}{9}\right) = (\tan\theta).(\cot\theta)$

$\Rightarrow \frac{AQ^2}{36} = 1$

$\Rightarrow AQ = \sqrt{36} = 6$

Hence, height of the tower is 6 m

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