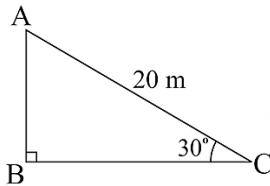


CBSE NCERT Solutions for Class 10 Mathematics Chapter 9**Back of Chapter Questions**

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 $\triangle ABC$,

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

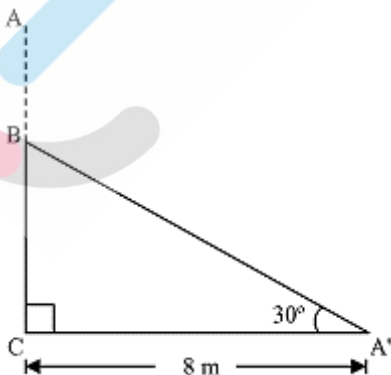
$$\Rightarrow \frac{1}{2} = \frac{AB}{20}$$

$$\Rightarrow AB = 10$$

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° with the ground.

In $\Delta A'BC$,

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

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

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

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

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

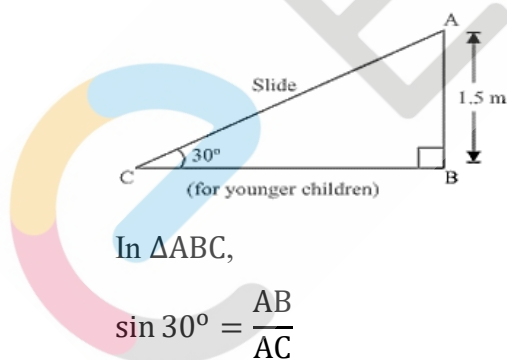
$$\Rightarrow A'B = \frac{16}{\sqrt{3}}$$

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

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° 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?

Solution:

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

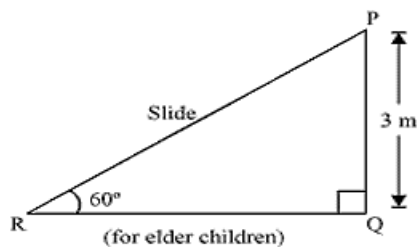


In ΔABC ,

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

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

$$\Rightarrow AC = 3 \text{ m}$$



In ΔPQR ,

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

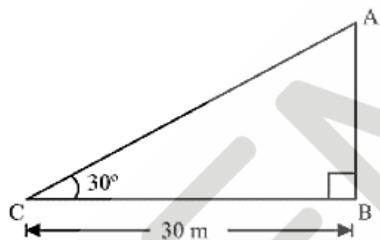
$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{3}{PR}$$

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

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° . Find the height of the tower.

Solution:



Let AB represents the tower.

In ΔABC ,

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

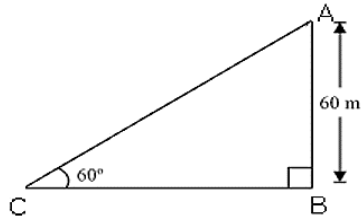
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{30}$$

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

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° . 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 $\triangle ABC$,

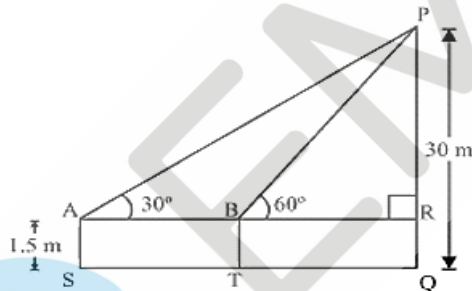
$$\sin 60^\circ = \frac{AB}{AC}$$

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

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

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° to 60° 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 $= 30 \text{ m}$

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

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

In $\triangle PAR$,

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

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

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

In ΔPRB ,

$$\tan 60^\circ = \frac{PR}{BR}$$

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

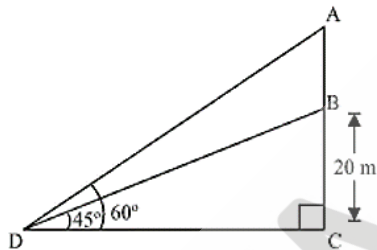
$$\Rightarrow BR = \frac{28.5}{\sqrt{3}} = 9.5\sqrt{3}$$

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

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° and 60° 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

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

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

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

In ΔACD ,

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

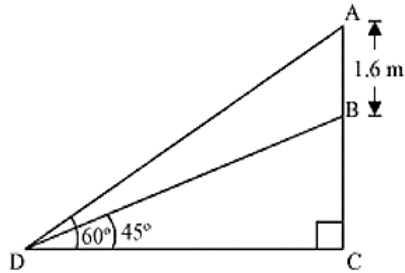
$$\Rightarrow \sqrt{3} = \frac{AB+BC}{CD}$$

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

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

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 measured.

In $\triangle BCD$,

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

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

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

In $\triangle ACD$,

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

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

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

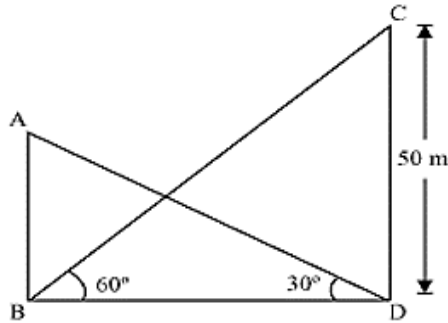
$$\Rightarrow BC = \frac{(1.6)(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$$

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

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 $\triangle CDB$,

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

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

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

In $\triangle ABD$,

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

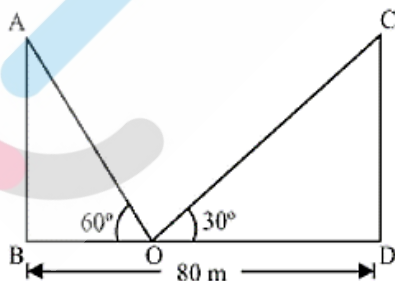
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{BD}$$

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

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 $\triangle ABO$,

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

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

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

In $\triangle CDO$,

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

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

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

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

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

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

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

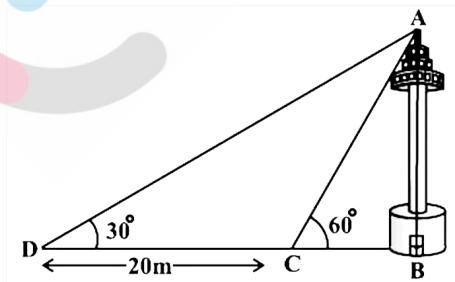
$$\Rightarrow CD = 20\sqrt{3}$$

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

$$DO = BD - BO = 80 \text{ m} - 20 \text{ m} = 60 \text{ m}$$

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° . 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.). Find the height of the tower and the width of the canal.



Solution:

In $\triangle ABC$,

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

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

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

In $\triangle ABD$,

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

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

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

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

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

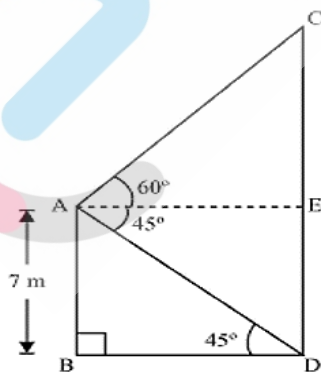
$$\Rightarrow AB = 10\sqrt{3}$$

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

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 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.

Solution:



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

In $\triangle ABD$,

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

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

$$\Rightarrow BD = 7$$

Hence, $AE = BD = 7$

In $\triangle ACE$,

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

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

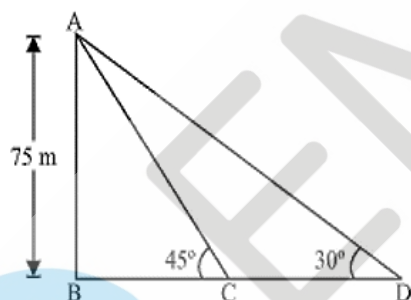
$$\Rightarrow CE = 7\sqrt{3}$$

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

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

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° and 45° . 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 $\triangle ABC$,

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

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

$$\Rightarrow BC = 75$$

In $\triangle ABD$,

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

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

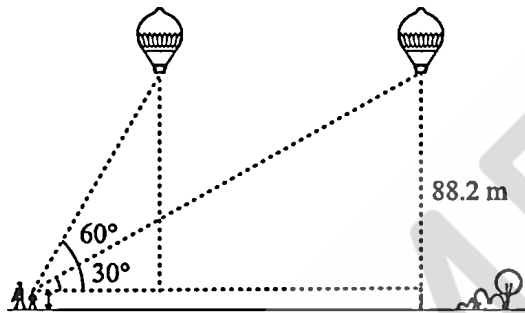
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{75+CD}$$

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

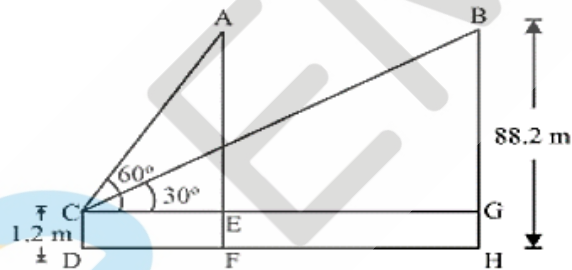
$$\Rightarrow CD = 75(\sqrt{3} - 1)$$

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 $\triangle ACE$,

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

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

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

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

In $\triangle BCG$,

$$BG = AE = 87$$

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

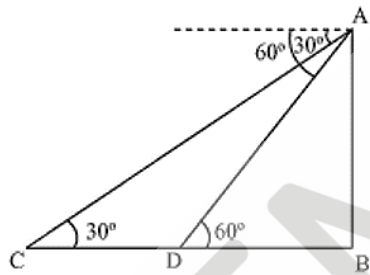
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{87}{CG}$$

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

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° , 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.

Solution:



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

in $\triangle ADB$,

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

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

$$\Rightarrow DB = \frac{AB}{\sqrt{3}} \quad \dots(i)$$

In $\triangle ABC$,

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

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

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

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

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

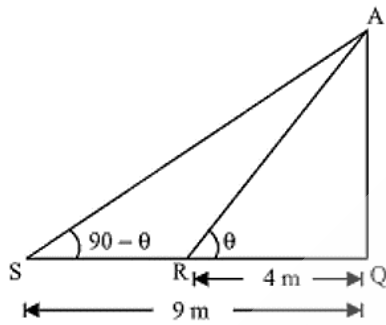
Since, time taken by car to travel distance $DC \left(= \frac{2AB}{\sqrt{3}}\right) = 6$ seconds

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 $\angle ASQ = 90^\circ - \theta$

(Since, the angles are complementary)

In ΔAQR ,

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

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

In ΔAQS ,

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

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

Multiplying equations (i) and (ii),

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

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

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

Hence, height of the tower is 6 m

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