Mathematics

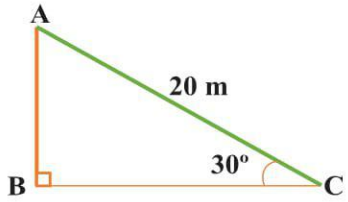
(www.tiwariacademy.in)
(Chapter – 9) (Some Applications of Trigonometry)
(Class 10)

Exercise 9.1

Question 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 Figure).

Answer 1:



In the given figure, AB is pole and AC is rope.
In ΔABC,

$$\frac{AB}{AC} = \sin 30° \quad \Rightarrow \frac{AB}{20} = \frac{1}{2} \quad \Rightarrow AB = \frac{20}{2} = 10$$

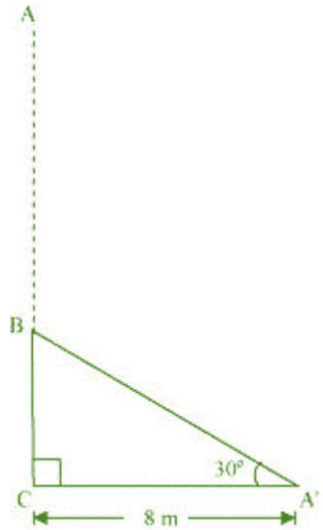
Hence, the height of the pole is 10 m.

Question 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.

Answer 2:

Let AC is the tree which break at B and the broken part AB become A'B.



In ΔA'BC,

$$\frac{BC}{A'C} = \tan 30°$$

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

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

and $$\frac{A'C}{A'B} = \cos 30°$$

$$\Rightarrow \frac{8}{A'B} = \frac{\sqrt{3}}{2} \quad \Rightarrow A'B = \frac{16}{\sqrt{3}}$$

Height of the tree

$$= AC = AB + BC = A'B + BC$$

$$= \frac{16}{\sqrt{3}} + \frac{8}{\sqrt{3}} = \frac{24}{\sqrt{3}} = \frac{24\sqrt{3}}{3} = 8\sqrt{3}$$

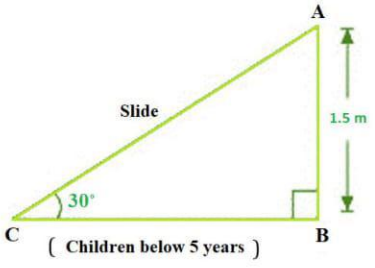
Hence, the height of the tree $8\sqrt{3}$ m.

Question 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?

Answer 3:

Let AC be the slide for the children below the age of 5 years. The height of this slide is 1.5 m inclined at 30°.

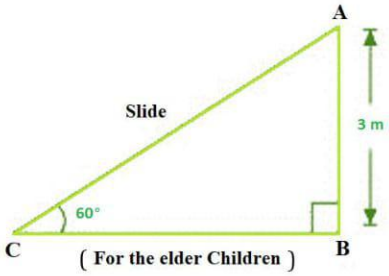


In ΔABC,

$$\frac{AB}{AC} = \sin 30°$$

$$\Rightarrow \frac{1.5}{AC} = \frac{1}{2} \quad \Rightarrow AC = 3$$

Let AC be the slide for the childern above 5 years which is 3 m high and inclined at 60° with the horizontal.



In ΔABC,

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

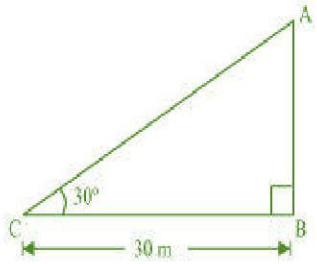
$$\Rightarrow AC = \frac{6}{\sqrt{3}} = \frac{6\sqrt{3}}{3} = 2\sqrt{3}$$

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

Question 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.

Answer 4:



Let AB is tower and C is the point 30 m away from the foot of the tower.

In ΔABC,

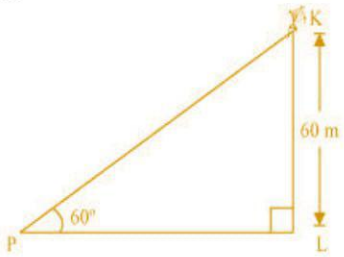
$$\frac{AB}{BC} = \tan 30° \Rightarrow \frac{AB}{30} = \frac{1}{\sqrt{3}} \quad \Rightarrow AB = \frac{30}{\sqrt{3}} = \frac{30\sqrt{3}}{3} = 10\sqrt{3}$$

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

Question 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.

Answer 5:



Let K be the kite and P is the point where the string is tied on the ground.

In ΔKLP,

$$\frac{KL}{KP} = \sin 60°$$

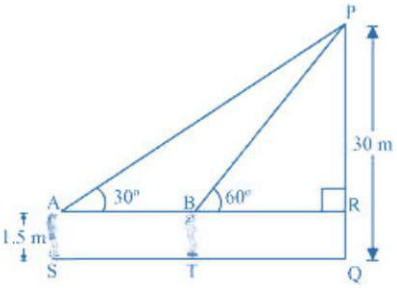
$$\Rightarrow \frac{60}{KP} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow AB = \frac{120}{\sqrt{3}} = \frac{120\sqrt{3}}{3} = 40\sqrt{3}$$

Hence, the length of the string is $40\sqrt{3}$ m.

Question 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.



Answer 6:

Let PQ is building and AS is a boy 1.5 m tall. He moves from S to T towards building.

Here, PQ = 30 m

Therefore, PR = PQ − RQ = (30 − 1.5) m = 28.5 m = 57/2 m

In ΔPAR,

$$\frac{PR}{AR} = \tan 30° \Rightarrow \frac{57/2}{AR} = \frac{1}{\sqrt{3}} \quad \Rightarrow AR = \frac{57\sqrt{3}}{2}$$

In ΔPRB,

$$\frac{PR}{BR} = \tan 60° \Rightarrow \frac{57/2}{BR} = \sqrt{3} \Rightarrow BR = \frac{57}{2\sqrt{3}} = \frac{57\sqrt{3}}{6} = \frac{19\sqrt{3}}{2}$$

Distanc walked towards the building

$$= ST = AB = AR - BR = \frac{57\sqrt{3}}{2} - \frac{19\sqrt{3}}{2} = \frac{38\sqrt{3}}{2} = 19\sqrt{3}$$

Hence, the distance walked towards the building is $19\sqrt{3}$ m.

Question 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.

Answer 7:

Let BC is building and AB is transmission tower.

In ΔBCD,

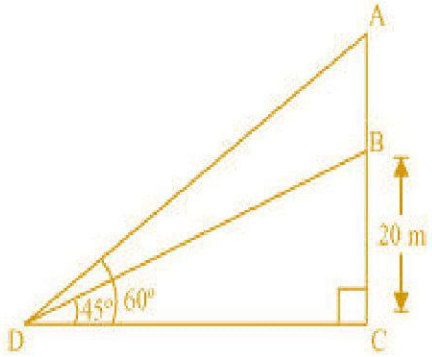
$$\frac{BC}{CD} = \tan 45° \Rightarrow \frac{20}{CD} = 1 \Rightarrow CD = 1$$

In ΔACD,

$$\frac{AC}{CD} = \tan 60° \Rightarrow \frac{AB + BC}{CD} = \sqrt{3} \Rightarrow \frac{AB + 20}{20} = \sqrt{3}$$

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

Hence, the height of the transmission towwer is $20(\sqrt{3} - 1)$ m.



Question 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.

Answer 8:

Let BC is pedestal and AB is 1.6 m high statue.

In ΔBCD,

$$\frac{BC}{CD} = \tan 45° \Rightarrow \frac{BC}{CD} = 1 \Rightarrow BC = CD$$

In ΔACD,

$$\frac{AB + BC}{CD} = \tan 60°$$

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

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

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

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

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

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

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