

# NTSE

NCERT Solutions for Class 10

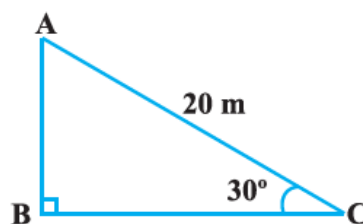
MATHS – Some Applications of Trigonometry



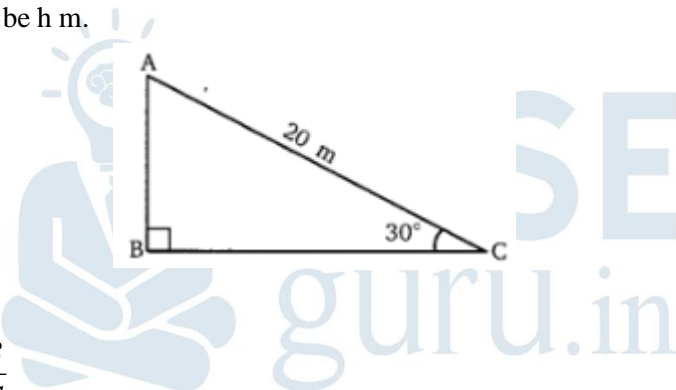
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1. A circus artist is climbing a 20 m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the height of the pole, if the angle made by the rope with the ground level is  $30^\circ$  (see Figure).



- Sol.** **Given :** Length of the rope (AC) = 20 m, and  $\angle ACB = 30^\circ$   
Let height AB of pole be h m.



Then in right  $\triangle ABC$ ,

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

$$\Rightarrow \frac{1}{2} = \frac{h}{20} \quad \left[ \because \sin 30^\circ = \frac{1}{2} \right]$$

$$\Rightarrow h = \frac{20}{2} = 10 \text{ m}$$

Hence, height of the pole = 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  $30^\circ$  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.

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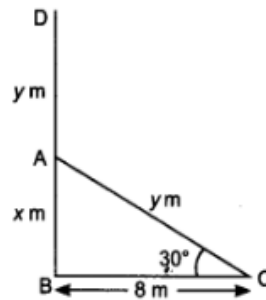


**Sol.** Let DB is a tree and AD is the broken part of it which touches the ground at C.

**Given :**  $\angle ACB = 30^\circ$  and  $BC = 8$  m

Let  $AB = xm$  and  $AD = ym$

$\therefore$  Now, length of the tree  $= (x + y)m$



In  $\triangle ABC$ ,

$$\frac{AB}{BC} = \tan 30^\circ \Rightarrow \frac{x}{8} = \frac{1}{\sqrt{3}} \Rightarrow x = \frac{8}{\sqrt{3}} \quad \dots\dots(i)$$

and  $\frac{AB}{AC} = \sin 30^\circ \Rightarrow \frac{x}{y} = \frac{1}{2}$

$$\Rightarrow y = 2x$$

$$\Rightarrow y = 2 \times \frac{8}{\sqrt{3}} = \frac{16}{\sqrt{3}} \quad [\text{From equation (i)}]$$

Hence, total height of the tree

$$x + y = \frac{8}{\sqrt{3}} + \frac{16}{\sqrt{3}} = \frac{24}{\sqrt{3}} = \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{24\sqrt{3}}{3} = 8\sqrt{3} \text{ m}$$

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  $30^\circ$  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  $60^\circ$  to the ground. What should be the length of the slide in each case?

**Sol.** Let the length of slide for children below the age of 5 years be  $x$  m and length of the slide for elder children be  $y$  m.

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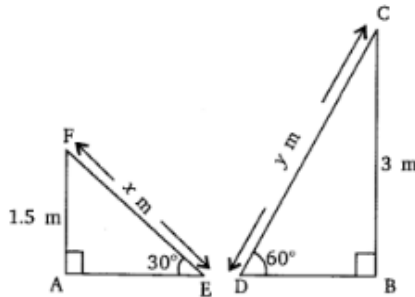
*I still wonder how one man has such a deep understanding of an examination. It becomes the truth what ever Vipin Sir says about NTSE.*

*M. Pareek*

An  
**NTSE Scholar**  
IIT-JEE (Adv.) AIR-3

Mukesh Pareek





**Given :**

$AF = 1.5\text{ m}$ ,  $BC = 3\text{ m}$ ,  $\angle FEA = 30^\circ$  and  $\angle CDB = 60^\circ$

In right  $\triangle FAE$ ,

$$\sin 30^\circ = \frac{AF}{EF} = \frac{1.5}{x}$$

$$\Rightarrow \frac{1}{2} = \frac{1.5}{x} \Rightarrow x = 3\text{ m}$$

In right  $\triangle CBD$ ,

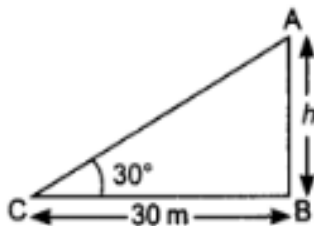
$$\sin 60^\circ = \frac{BC}{CD} = \frac{3}{y}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{3}{y} \Rightarrow y = \frac{3 \times 2}{\sqrt{3}} = 2\sqrt{3}\text{ m}.$$

Hence, the length of slide for children below the age of 5 years is 3 m and the length of slide for elder children is  $2\sqrt{3}\text{ m}$ .

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  $30^\circ$ . Find the height of the tower.

**Sol.** Let  $h$  be the height of the tower



$$\text{In } \triangle ABC, \quad \frac{AB}{BC} = \tan 30^\circ \Rightarrow \frac{h}{30} = \frac{1}{\sqrt{3}}$$

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

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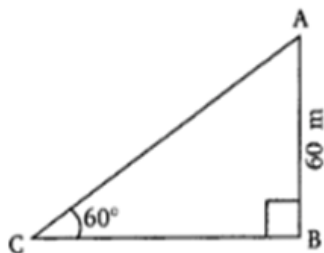
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5. A kite is flying at a height of 60 m above the ground. The string attached to the kite is temporarily tied to a point on the ground. The inclination of the string with the ground is  $60^\circ$ . Find the length of the string, assuming that there is no slack in the string.

**Sol.** Given :  $AB = 60m$  and  $\angle ACB = 60^\circ$



Let AC be the length of the string.

Then in right  $\triangle ABC$ ,

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

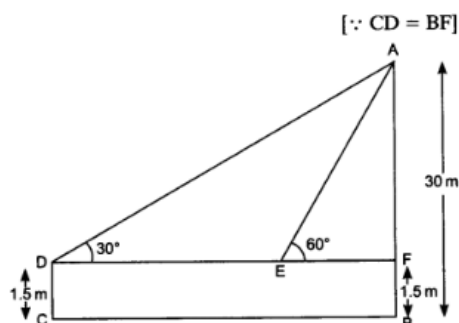
$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{60}{AC}$$

$$\Rightarrow AC = \frac{60 \times 2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{120 \times \sqrt{3}}{3} = 40\sqrt{3} m.$$

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

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  $30^\circ$  to  $60^\circ$  as he walks towards the building. Find the distance he walked towards the building.

**Sol.** Let AB = height of the building



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Given :  $\angle ADF = 30^\circ, \angle AEF = 60^\circ$

$$\begin{aligned} AF &= AB - FB \\ &= 30\text{ m} - 1.5\text{ m} = 28.5\text{ m} \end{aligned}$$

In  $\triangle AFE$ ,

$$\begin{aligned} \frac{AF}{EF} &= \tan 60^\circ \\ \Rightarrow \frac{28.5}{EF} &= \sqrt{3} \\ \Rightarrow EF &= \frac{28.5}{\sqrt{3}}\text{ m} \end{aligned}$$

In  $\triangle AFD$ ,

$$\begin{aligned} \frac{AF}{DF} &= \tan 30^\circ \\ \Rightarrow \frac{28.5}{DF} &= \frac{1}{\sqrt{3}} \\ \Rightarrow DF &= 28.5\sqrt{3}\text{ m} \end{aligned}$$

The distance walked by the boy towards building

$$\begin{aligned} DE &= DF - EF \\ &= 28.5\sqrt{3} - \frac{28.5}{\sqrt{3}} = \frac{28.5 \times 3 - 28.5}{\sqrt{3}} = \frac{28.5(3-1)}{\sqrt{3}} \\ &= \frac{28.5 \times 2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{57\sqrt{3}}{3} = 19\sqrt{3}\text{ m} \end{aligned}$$

7. The angle of elevation of the top of a building from the foot of the tower is  $30^\circ$  and the angle of elevation of the top of the tower from the foot of the building is  $60^\circ$ . If the tower is 50 m high, find the height of the building.

**Sol.** Given : height of the tower  $AB = 50\text{ m}$ ,

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Let  $h$  m be the height of the building

Then in right  $\triangle ABQ$ ,

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

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BQ}$$

$$\Rightarrow BQ = h\sqrt{3} \quad \dots\dots\dots(i)$$

In right  $\triangle PQB$ ,

$$\tan 60^\circ = \frac{PQ}{BQ}$$

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

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

$$\Rightarrow h\sqrt{3} \times \sqrt{3} = 50 \quad [\text{From (i)}]$$

$$\Rightarrow 3h = 50$$

$$\Rightarrow h = \frac{50}{3} = 16\frac{2}{3} \text{ m.}$$

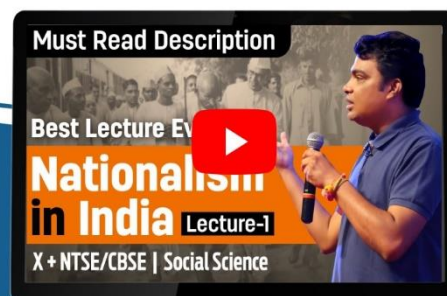
Hence, the height of the building is  $16\frac{2}{3}$  m.

8. 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  $60^\circ$  and  $30^\circ$ , respectively. Find the height of the poles and the distances of the point from the poles.

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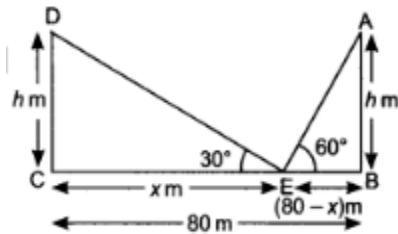
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**Sol.** Let  $AB = CD = h$  m  
Given :  $BC = 80$  m

[Height of the poles]  
[Width of the road]



Let  $CE = x$  m

$\therefore BE = (80 - x)$  m

In  $\triangle CDE$ ,  $\frac{CD}{CE} = \frac{h}{x} = \tan 30^\circ$

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

$$\Rightarrow x = \sqrt{3} h \quad \dots(i)$$

In  $\triangle ABE$ ,  $\frac{AB}{BE} = \tan 60^\circ \Rightarrow \frac{h}{80 - x} = \sqrt{3}$

$$\Rightarrow h = 80\sqrt{3} - \sqrt{3}x$$

$$\Rightarrow \sqrt{3}x = 80\sqrt{3} - h$$

$$\Rightarrow x = \frac{80\sqrt{3} - h}{\sqrt{3}} \quad \dots(ii)$$

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

$$\sqrt{3}h = \frac{80\sqrt{3} - h}{\sqrt{3}} \Rightarrow 3h = 80\sqrt{3} - h \Rightarrow 4h = 80\sqrt{3} \Rightarrow h = 20\sqrt{3}$$

Substituting  $h$  in equation (i),

$$x = h\sqrt{3} = 20\sqrt{3} \times \sqrt{3} = 60 \text{ m}$$

Hence, position of the point is at a distance of 60 m from pole CD and 20 m from pole AB.

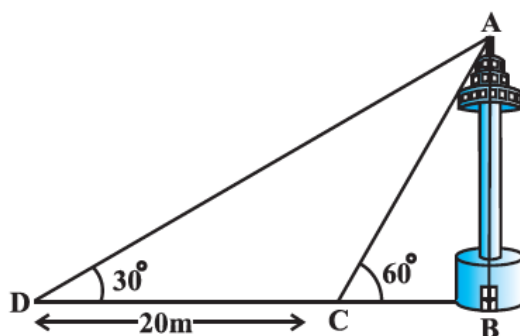
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9. A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is  $60^\circ$ . From another point 20 m away from this point on the line join this point to the foot of the tower, the angle of elevation of the top of the tower is  $30^\circ$  (see Figure). Find the height of the tower and the width of the canal.



**Sol.** Let the height of the tower AB be  $h$  m and  $x$  m be the width of the canal BC. Then in right  $\triangle ABD$ ,

$$\begin{aligned}\tan 30^\circ &= \frac{AB}{BD} = \frac{AB}{DC + CB} \\ \Rightarrow \frac{1}{\sqrt{3}} &= \frac{h}{20 + h} \\ \Rightarrow 20 + x &= h\sqrt{3} \\ \Rightarrow x &= h\sqrt{3} - 20 \quad \dots(i)\end{aligned}$$

In right  $\triangle ABC$ ,  $\tan 60^\circ = \frac{AB}{BC}$

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

From equations (i) and (ii), we get:

$$\begin{aligned}h\sqrt{3} - 20 &= \frac{h}{\sqrt{3}} \\ \Rightarrow h\sqrt{3} - \frac{h}{\sqrt{3}} &= 20 \quad \Rightarrow h\left(\frac{3-1}{\sqrt{3}}\right) = 20 \\ \Rightarrow h &= \frac{20\sqrt{3}}{2} = 10\sqrt{3}\end{aligned}$$

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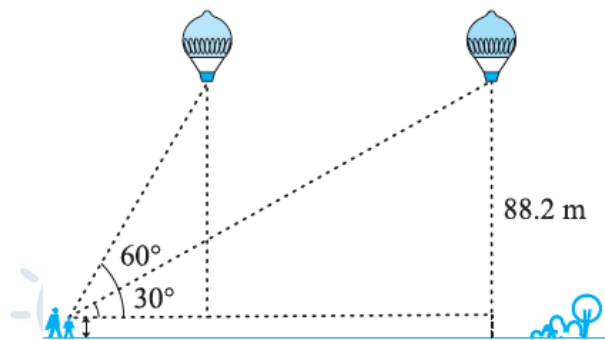


Putting the value of  $h = 10\sqrt{3}$  in equation (ii), we get:

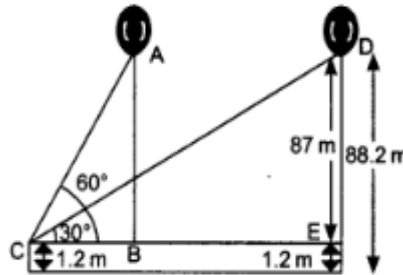
$$x = \frac{h}{\sqrt{3}} = \frac{10\sqrt{3}}{\sqrt{3}} = 10 \text{ m.}$$

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

10. 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  $60^\circ$ . After some time, the angle of elevation reduces to  $30^\circ$  (see Figure). Find the distance travelled by the balloon during the interval.



**Sol.** Let the first position of the balloon is A and after sometime it will reach to the point D.



The vertical height  $ED = AB = (88.2 - 1.2) \text{ m} = 87 \text{ m}$ .

In  $\triangle ABC$ ,  $\frac{AB}{BC} = \tan 60^\circ$

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

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

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In  $\triangle DEC$ ,  $\frac{DE}{CE} = \tan 30^\circ$

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

$$\Rightarrow CE = 87\sqrt{3} \text{ m}$$

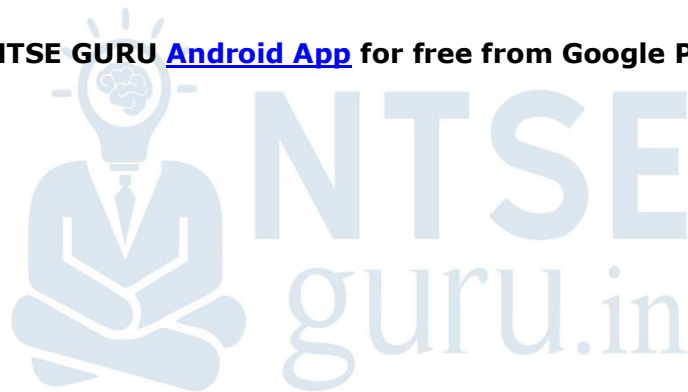
Distance travelled by the balloon from A to D is BE.

So,  $BE = CE - CB$   
 $= 87\sqrt{3} - 29\sqrt{3} = 58\sqrt{3} \text{ m}$

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