

## DAY 2

### When two angles are given:

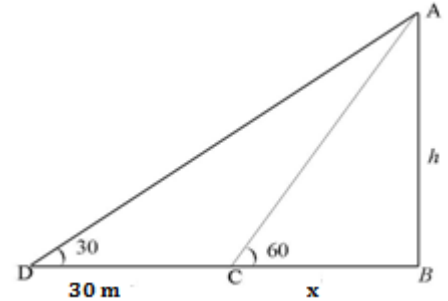
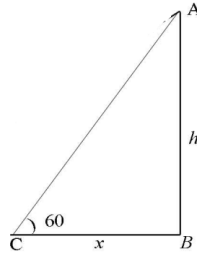
In last section, we have discussed problems related to one angle. In this section, we shall discuss problems when two angles are given.

1. The angle of elevation of the top of a tower from a point on the ground is  $60^\circ$ . After walking 30m towards the tower, the angle of elevation becomes  $60^\circ$ . What is the height of the tower?

**Sol:-** Let  $AB = h$  be the height of the tower and  $BC = x$ .

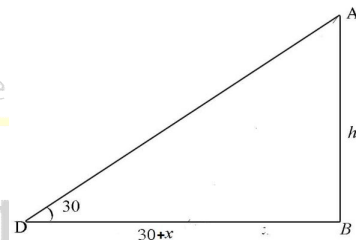
In right  $\triangle ABC$ ,

$$\begin{aligned}\frac{P}{B} &= \tan 60^\circ \\ \Rightarrow \frac{h}{x} &= \sqrt{3} \\ \Rightarrow h &= \sqrt{3}x \dots \dots \dots i)\end{aligned}$$



and In right  $\triangle ABD$ ,

$$\begin{aligned}\frac{P}{B} &= \tan 30^\circ \\ \Rightarrow \frac{h}{30+x} &= \frac{1}{\sqrt{3}} \Rightarrow \sqrt{3}h = 30 + x \\ \Rightarrow \sqrt{3}(\sqrt{3}x) &= 30 + x \quad \text{\{by i)\}} \\ \Rightarrow 3x &= 30 + x \Rightarrow 3x - x = 30 \\ \Rightarrow 2x &= 30 \Rightarrow x = \frac{30}{2} = 15\end{aligned}$$



From i):  $h = 15\sqrt{3} \text{ m}$

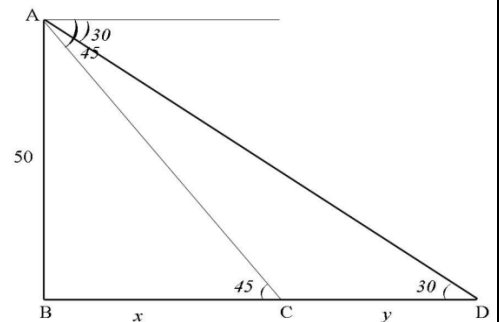
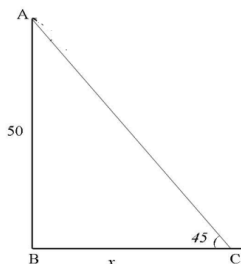
$\therefore$  Height of the tower =  $h = 15\sqrt{3} \text{ m}$

2. A straight highway leads to the foot of building of height 50 m. from the top of the building, the angles of depressions of two cars standing on the highway are  $45^\circ$  and  $30^\circ$ . What is the distance between the two cars?

**Sol:-** Let  $BC = x$  and  $CD = y$  be distance between two cars.

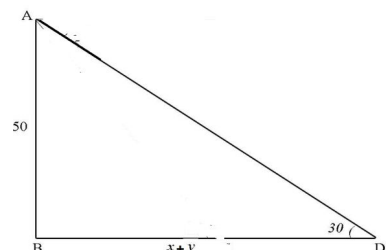
In right  $\triangle ABC$ ,

$$\begin{aligned}\frac{P}{B} &= \tan 45^\circ \\ \Rightarrow \frac{50}{x} &= 1 \\ \Rightarrow x &= 50 \dots \dots \dots i)\end{aligned}$$



and In right  $\triangle ABD$ ,

$$\frac{P}{B} = \tan 30^\circ$$



$$\Rightarrow \frac{50}{x+y} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow 50\sqrt{3} = x + y$$

$$\Rightarrow 50\sqrt{3} = 50 + y \quad \{\text{by i)}\}$$

$$\Rightarrow y = 50\sqrt{3} - 50 = 50(\sqrt{3} - 1) \text{ m}$$

$\therefore$  Distance between two cars =  $y = 50(\sqrt{3} - 1) \text{ m}$

3. From a point P on the ground the angle of elevation of the top of a 10 m tall building is  $30^\circ$ . A flag is hoisted at the top of the building and the angle of elevation of the top of the flagstaff from P is  $45^\circ$ . Find the length of the flagstaff and the distance of the building from the point P. (Use  $\sqrt{3} = 1.73$ ) [Example 4]

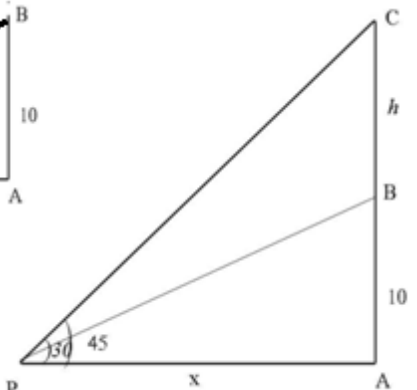
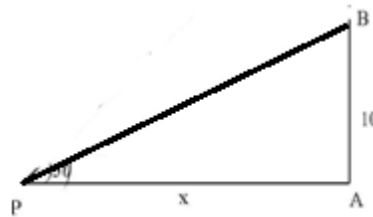
Sol:- Let  $BC = h$  be the length of flag staff and  $AP = x$

In right  $\angle d \triangle ABP$ ,

$$\frac{P}{B} = \tan 30^\circ$$

$$\Rightarrow \frac{10}{x} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow x = 10\sqrt{3} \dots \dots \dots \text{i)}$$



and In right  $\angle d \triangle PAC$ ,

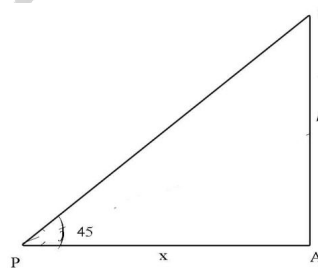
$$\frac{P}{B} = \tan 45^\circ$$

$$\Rightarrow \frac{h+10}{x} = 1$$

$$\Rightarrow h + 10 = x$$

$$\Rightarrow h + 10 = 10\sqrt{3} \quad \{\text{by i)}\}$$

$$\Rightarrow h = 10\sqrt{3} - 10 = 10(\sqrt{3} - 1) = 10(1.73 - 1) = 10 \times 0.73 = 7.3 \text{ m}$$



4. From a point on the bridge across a river, the angles of depression of the banks on the opposite sides of the river are  $30^\circ$  and  $45^\circ$  respectively. If the bridge is at a height of 3 m from the banks, find the width of the river. [Example 7]

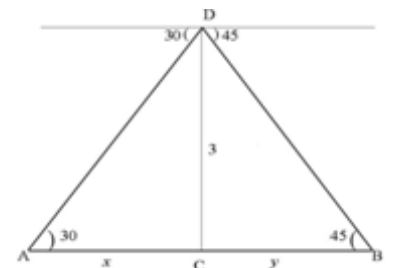
Sol:- Let  $AB = AC + CB = x + y$  be the width of the river

In right  $\angle d \triangle ACD$ ,

$$\frac{P}{B} = \tan 30^\circ$$

$$\Rightarrow \frac{3}{x} = \frac{1}{\sqrt{3}} \quad \Rightarrow x = 3\sqrt{3} \dots \dots \dots \text{i)}$$

and In right  $\angle d \triangle BCD$ ,



$$\frac{P}{B} = \tan 45^\circ$$

$$\Rightarrow \frac{3}{y} = 1 \quad \Rightarrow y = 3$$

$$\therefore \text{Width of the river} = x + y = 3\sqrt{3} + 3 = 3(\sqrt{3} + 1)m$$

### EXERCISE

1. The angle of elevation of the top of a tower from a point on the ground is  $30^\circ$ . After walking 40m towards the tower, the angle of elevation becomes  $45^\circ$ . What is the height of the tower?
2. A tree stands vertically on the bank of a river. From a point on the other bank directly opposite to the tree, the angle of elevation of the top of the tree is  $60^\circ$ . From a point 30 m behind this point on the same bank, the angle of elevation of the tree is  $30^\circ$ . Find the height of the tree and width of the river?
3. A straight highway leads to the foot of a building of height 100m. From the top of the building, the angles of depression of two cars standing on the highway are  $45^\circ$  and  $30^\circ$ . What is the distance between the two cars and how far is each car from the building?
4. Ex 9.1, Q 6,7,8,10,11,13

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