Now, $h = 50\sqrt{3} \times \sqrt{3}$

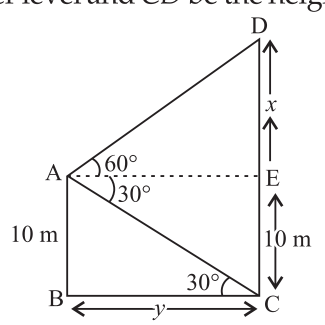
(from equations (i) & (ii))

$= 50 \times 3$

$= 150$ m

Q. 5. A man standing on the deck of a ship, which is 10 m above water level, observes the angle of elevation of the top of a hill as 60° and the angle of depression of the base of hill as 30°. Find the distance of the hill from the ship and the height of the hill. [CBSE OD, Term 2, Set 1, 2016]

Ans. Let AB be the height of deck of ship from the water level and CD be the height of hill.



Then,

In Δ ABC,

$$\tan 30° = \frac{10}{y}$$

$$\Rightarrow \quad y = 10\sqrt{3} \quad \text{...(i)}$$

In Δ ADE,

$$\tan 60° = \frac{x}{y}$$

$$\Rightarrow \quad y = \frac{x}{\sqrt{3}} \quad \text{...(ii)}$$

From (i) and (ii), we get

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

$$x = 10 \times 3 = 30 \text{ m}$$

∴ Distance of the hill from the ship is $10\sqrt{3}$ m and the height of the hill is $30 + 10 = 40$ m.

Q. 6. The angles of depression of the top and bottom of a 50 m high building from the top of a tower are 45° and 60° respectively. Find the height of the tower and the horizontal distance between the tower and the building. (use $\sqrt{3} = 1.73$) [CBSE Delhi, Term 2, Set 1, 2016]

Ans. Let AB and CD be the tower and high building, respectively.

Given, $CD = 50$ m

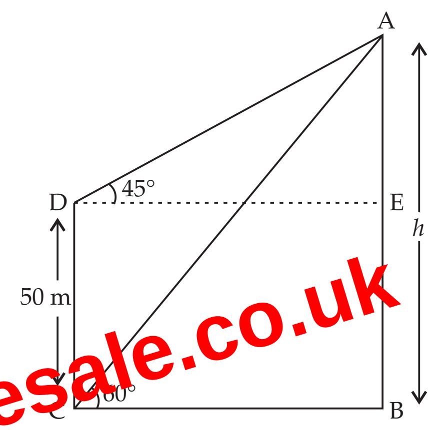
Let, $AB = h$ m

Then, in Δ ADE,

$$\tan 45° = \frac{AE}{DE}$$

$$\Rightarrow \quad 1 = \frac{h-50}{DE}$$

$$\Rightarrow \quad DE = h - 50 \quad \text{...(i)}$$



and, in Δ ACB,

$$\tan 60° = \frac{AB}{CB}$$

$$\Rightarrow \quad \sqrt{3} = \frac{h}{CB}$$

$$\Rightarrow \quad CB = \frac{h}{\sqrt{3}} \quad \text{...(ii)}$$

Now, $CB = DE$

then, from eq. (i) and (ii), we get

$$h - 50 = \frac{h}{\sqrt{3}}$$

$$\Rightarrow \quad h - \frac{h}{\sqrt{3}} = 50$$

$$\Rightarrow \quad \frac{(\sqrt{3}-1)}{\sqrt{3}} h = 50$$

$$\Rightarrow \quad h = \frac{50\sqrt{3}}{\sqrt{3}-1} = \frac{50\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

$$\Rightarrow \quad h = \frac{50\sqrt{3}\,(\sqrt{3}+1)}{3-1}$$

$$\Rightarrow \quad h = \frac{150 + 50\sqrt{3}}{2}$$

$$\Rightarrow \quad h = 75 + 25\sqrt{3}$$

$$\Rightarrow \quad h = 75 + 25\,(1.73)$$

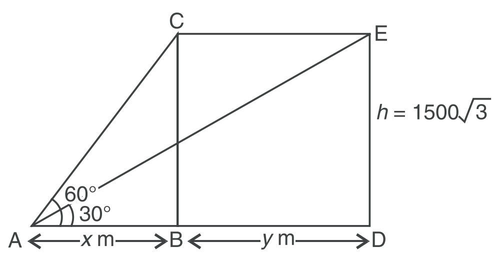
$$= 118.25 \text{ m}$$

Hence, the height of the tower is 118.25 m and the horizontal distance between the tower and the building is 68.25 m.

Q. 7. The angle of elevation of an aeroplane from point *A* on the ground is 60°. After flight of 15 seconds, the angle of elevation change to 30°. If the aeroplane is flying at a constant height of $1500\sqrt{3}$ m, find the speed of the plane in km/hr.

[CBSE OD, Term 2, Set 1, 2015]

Ans.



Let *BC* be the height at which the aeroplane flying.

Then, $BC = 1500\sqrt{3}$ m

In 15 seconds, the aeroplane moves from C to E and makes angle of elevation 30°.

Let $AB = x$ m, $BD = y$ m

So, $AD = (x + y)$ m

In $\Delta\, ABC$,

$$\tan 60° = \frac{BC}{AB}$$

$$\Rightarrow \quad \sqrt{3} = \frac{1500\sqrt{3}}{x}$$

$$[\because \tan 60° = \sqrt{3}\,]$$

$$\Rightarrow \quad x = 1500 \text{ m} \qquad \ldots\text{(i)}$$

In $\Delta\, EAD$

$$\tan 30° = \frac{ED}{AD}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{1500\sqrt{3}}{x+y} \left[\because \tan 30° = \frac{1}{\sqrt{3}}\right]$$

$$\Rightarrow \quad x + y = 1500 \times 3$$

$$\Rightarrow \quad y = 4500 - 1500 = 3000 \text{ m}$$

[Using equation (i)]

$$\text{Speed of aeroplane} = \frac{\text{Distance}}{\text{time}} = \frac{3000}{15}$$

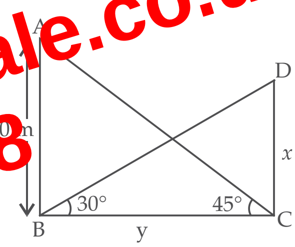
$$= 200 \text{ m/s or } 720 \text{ km/hr}$$

Q. 8. 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 45°. If the tower is 30 m high, find the height of the building.

[CBSE Delhi, Term 2, Set 1, 2015]

Ans. Let *AB* be the tower and *CD* be a building of height 30 m and *x* m respectively.

Let the distance between the two be *y* m.



Then, in ΔABC

$$\frac{30}{y} = \tan 45°$$

$$\frac{30}{y} = 1 \Rightarrow y = 30$$

And, in ΔBDC

$$\frac{x}{y} = \tan 30°$$

$$x = y \tan 30°$$

$$x = 30 \times \frac{1}{\sqrt{3}} = 10\sqrt{3}$$

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

Long Answer Type Questions (4 marks each)

Q. 1. From a point on the ground, the angles of elevation of the bottom and the top of a tower fixed at the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

[CBSE OD, Set 1, 2020]

$100 + d = 100\sqrt{3}$.

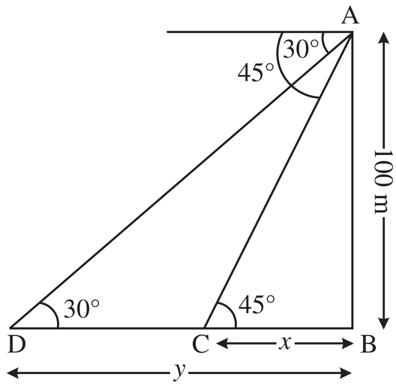
$\rightarrow d = 100\sqrt{3} - 100. = 100(\sqrt{3}-1)$

Given, $\sqrt{3} = 1.732$,

$\Rightarrow d = 100(1.732-1)$ $\rightarrow$ The distance between the boats is 73.2m.

$= 100 \times 0.732 = 73.2$m.

Let AB be the light house and two ships be at C and D.



In ΔABC,

$$\frac{BC}{AB} = \cot 45°$$

$$\Rightarrow \quad \frac{x}{100} = 1$$

$$\Rightarrow \quad x = 100 \quad ...(i)$$

Similarly, in ΔABD,

$$\frac{BD}{AB} = \cot 30°$$

$$\Rightarrow \quad \frac{y}{100} = \sqrt{3}$$

$$\Rightarrow \quad y = 100\sqrt{3} \quad ...(ii)$$

Distance between two ships $= y - x$

$= 100\sqrt{3} - 100$

[from equation (i) and (ii)]

$= 100(\sqrt{3} - 1)$

$= 100(1.732 - 1)$

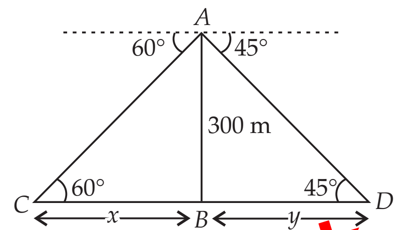
$= 100(0.732)$

$= 73.2$ m

Q. 11. An aeroplane is flying at a height of 300 m above the ground. Flying at this height, the angles of depression from the aeroplane of two points on both banks of a river in opposite directions are 45° and 60° respectively. Find the width of the river. [Use $\sqrt{3} = 1.732$]

[CBSE OD, Term 2, Set 1, 2017]

Ans. Let aeroplane is at A, 300 m high from a river, C and D are opposite banks of river.



In right ΔABC,

$$\frac{BC}{AB} = \cot 60°$$

$$\Rightarrow \frac{x}{300} = \frac{1}{\sqrt{3}} \Rightarrow x = \frac{300}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$= 100\sqrt{3}$ m

$= 100 \times 1.732 = 173.2$ m

In right ΔABD,

$$\frac{BD}{AB} = \cot 45°$$

$$\Rightarrow \quad \frac{y}{300} = 1 \Rightarrow y = 300 \text{ m}$$

Width of river $= x + y$

$= 173.2 + 300$

$= 473.2$ m

Q. 12. A man observes a car from the top of a tower, which is moving towards the tower with a uniform speed. If the angle of depression of the car changes from 30° to 45° in 12 minutes, find the time taken by the car now to reach the tower.

[CBSE OD, Term 2, Set 2, 2017]

Ans. Let AB is a tower, car is at point D at 30° and goes to C at 45° in 12 minutes.