OPEN STUDENT FOUNDATION
STD 10 : MATHS
IMPORTANT QUESTION DAY 7

Section A

- **Write the answer of the following questions.** [Each carries 4 Marks] **[32]**

1. 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.

2. 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.

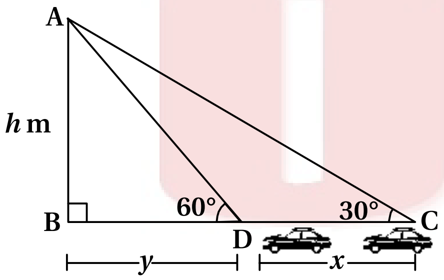
3. A kite is flying at a height of 60 m above the ground. The string attached to the kite is temporarily tied to a point on the ground. The inclination of the string with the ground is 60°. Find the length of the string, assuming that there is no slack in the string.

4. 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.

5. 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.

6. 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.

7. 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.



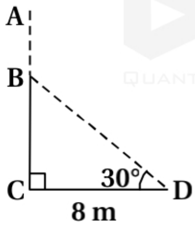
8. From the top of a 7 m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot is 45°. Determine the height of the tower.

Section A

- **Write the answer of the following questions.** [Each carries 4 Marks] **[32]**

1. 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.

➤ Let us suppose that AC denotes a tree which breaks at B due to storm. Its top A touches the ground at D.



$\therefore$ AB = BD and CD = 8m

BD makes an angle 30° with the ground.

$\therefore \angle BDC = 30°$

In Δ BCD, $\tan 30° = \frac{BC}{CD}$

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

$\therefore BC = \frac{8}{\sqrt{3}}$ m

➤ In Δ BCD $\cos 30° = \frac{CD}{BD}$

$\therefore \frac{\sqrt{3}}{2} = \frac{8}{BD}$

$\therefore BD = \frac{16}{\sqrt{3}}$

➤ $BD = AB = \frac{16}{\sqrt{3}}$

➤ The height of the tree,

AC = AB + BC

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

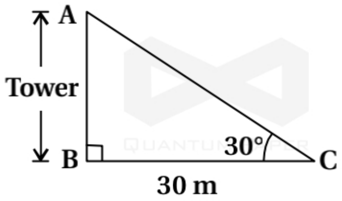
$= \frac{24}{\sqrt{3}}$

$= \frac{3 \times 8}{\sqrt{3}}$

$= 8\sqrt{3}$ m

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

2. 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.

➤ 

Let AB be a tower and C is a point on the ground which is 30 m away from the foot of the tower.

$\therefore$ BC = 30 m

In right angle Δ ABC, $\angle$ACB = 30°

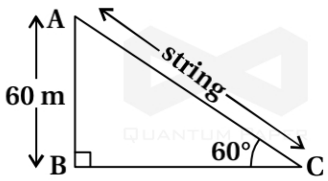
$\therefore \tan 30° = \frac{AB}{BC}$

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

$\therefore AB = \frac{30}{\sqrt{3}} = \frac{3 \times 10}{\sqrt{3}} = 10\sqrt{3}$

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

3. 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.

➤ 

➤ Let A is the position of the kite AC is string

The kite is flying at a height above the ground.

AB = 60 m

➤ In right angle Δ ABC, $\angle$ACB

$\therefore \sin 60° = \frac{AB}{AC}$

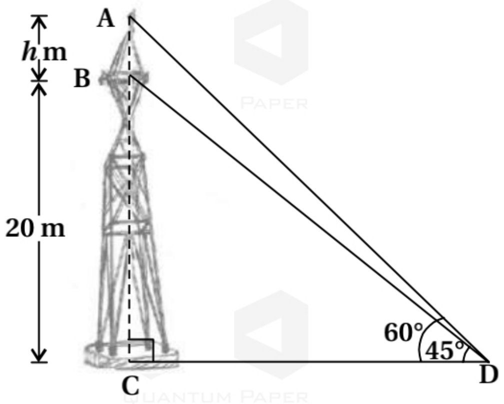
$\therefore \frac{\sqrt{3}}{2} = \frac{60}{AC}$

$\therefore AC = \frac{2 \times 60}{\sqrt{3}} = \frac{2 \times 3 \times 20}{\sqrt{3}}$

$\therefore \quad = 40\sqrt{3}$

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

4. 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.

➤ 

➤ Let us suppose that BC be a high building and AB is a transmission tower fixed on it BC = 20 m

➤ D is a point on the ground. Given that $\angle ADC = 60°$ and $\angle BDC = 45°$.

➤ Let the height of the tower be AB = h m

➤ In right angle Δ BCD,

$$\tan 45° = \frac{BC}{CD}$$

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

$$\therefore\ CD = 20 \text{ m} \qquad \text{....(i)}$$

➤ In right angle Δ ACD,

$$\tan 60° = \frac{AC}{CD}$$

$$\therefore\ \sqrt{3} = \frac{20 + h}{20}$$

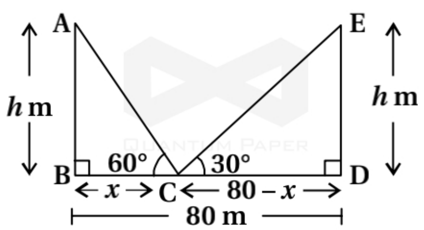
$$\therefore\ h = 20\sqrt{3} = 20 + h$$

$$\therefore\ h = 20\sqrt{3} - 20$$

$$= 20\left(\sqrt{3} - 1\right) \text{ m}$$

Therefore, the height of the transmission tower is $20\left(\sqrt{3} - 1\right)$ m.

5. 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.

➤ 

AB and DE are two poles of equal heights.

AB = DE = say h m.

There is a point C on the line segment BD joining their foot B and D.

BD = 80 m.

➤ From the point C, the angles of elevation of the top of two poles are 60° and 30° respectively.

$\therefore \angle ACB = 60°$ and $\angle ECD = 30°$

➤ Let suppose that BC = x m

$BC + CD = BD$ $(\because B - C - D)$

$\therefore x + CD = 80$

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

➤ In right angle Δ ABC, In right angle Δ EDC,

In right angle Δ ABC	In right angle Δ EDC
$\tan 60° = \frac{AB}{BC}$	$\tan 30° = \frac{ED}{CD}$
$\therefore \sqrt{3} = \frac{h}{x}$	$\therefore \frac{1}{\sqrt{3}} = \frac{h}{80 - x}$
$\therefore h = \sqrt{3}x$ ....(i)	$\therefore h = \frac{80 - x}{\sqrt{3}}$ ....(ii)

➤ From results (i) and (ii) we have,

$\sqrt{3}x = \frac{80 - x}{\sqrt{3}}$

$\therefore 3x = 80 - x$

$\therefore 4x = 80$

$\therefore x = 20$ m

$\therefore$ Therefore, the distance of the point C from the pole AB is 20 m.

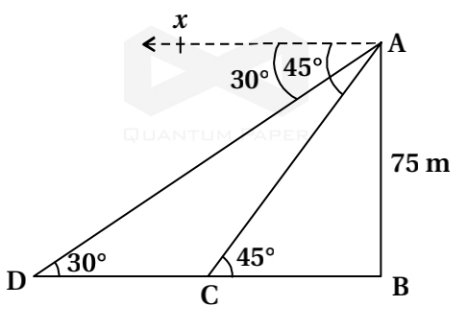
➤ $h = \sqrt{3}\,x = 20\sqrt{3}$ $(\because x = 20)$

$\therefore h = 20 \times 1.732 = 34.64$ m

Therefore, the height of the pole is 34.64 m

Therefore, the distance of the point C from the pole ED is $CD = 80 - x = 80 - 20 = 60$ m.

6. 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.

➤ 

➤ AB is a light house. A is its top. AB = 75 m.

➤ There are two ships C and D. D is exactly behind of the ship C. As observed from a point A, the angles of depression of ships C and D are respectively 45° and 30°.

So, $\angle ACB = \angle XAC = 45°$.

and $\angle ADB = \angle XAD = 30°$.

➤ The distance between two ships is CD.

➤ In right angle Δ ABC, In right angle Δ ABD,

$\tan 45° = \frac{AB}{BC}$ $\tan 30° = \frac{AB}{BD}$

$\therefore 1 = \frac{75}{BC}$ $\therefore \frac{1}{\sqrt{3}} = \frac{75}{BD}$

$\therefore BC = 75$ m $\therefore BD = \sqrt{3} \times 75 = 75\sqrt{3}$

➤ $D - C - B \Rightarrow CD + BC = DB$

$\therefore CD = DB - BC$

$= 75\sqrt{3} - 75$

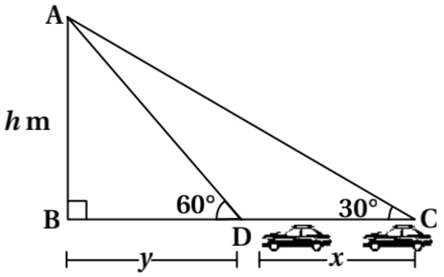
$= 75\left(\sqrt{3} - 1\right)$

$= 75\ (1.732 - 1)$

$= 75 \times 0.732 = 54.9$ m

Therefore, the distance between the two ships is $75\left(\sqrt{3} - 1\right)$ m or 54.9 m.

7. 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.



➤ Let AB is a tower, A is its top. A car is at a point C. A man standing at the top of the tower observesa car at C at an angle of depression of 30°.

$\therefore \angle ACB = 30°$

➤ After 6 seconds, a car reaches at a point D. The angle of depression of the car is to be 60°

$\therefore \angle ADB = 60°$

Suppose that CD = x and BD = y. AB = h m

➤ $B - D - C \Rightarrow CB = BD + DC = x + y$

In Δ ACB,	In Δ ABD,
$\tan 30° = \frac{AB}{CB}$	$\tan 60° = \frac{AB}{BD}$
$\therefore \frac{1}{\sqrt{3}} = \frac{h}{x + y}$	$\therefore \sqrt{3} = \frac{h}{y}$
$\therefore x + y = \sqrt{3}h$ ....(i)	$\therefore h = \sqrt{3}y$ ....(ii)

➤ From results (i) and (ii)

$\sqrt{3}h = x + y$

$\therefore\ \sqrt{3} \times \sqrt{3}y = x + y$

$\therefore\ 3y - y = x$

$\therefore\ 2y = x$ ....(iii)

➤ The distance travelled by a car in 6 seconds is CD = x.

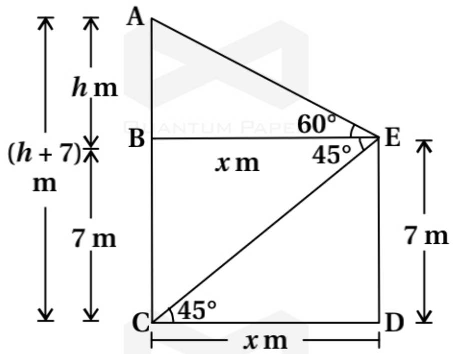
$\therefore$ The time to cover distance $x = 2y$ is 6 seconds.

$\therefore$ The time to cover distance y is 3 seconds.

➤ y = DB

Therefore, the time taken by the car to reach the foot of the tower is 3 seconds.

8. 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.

➤ 

➤ AC is a cable tower. A is its ED is a building ED = 7.

➤ BE = CD = x say

➤ In Δ ABC,

$\tan 60° = \frac{AB}{BE}$

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

$\therefore\ h = \sqrt{3}\,x$

$\therefore\ h = \sqrt{3} \times 7$

$= 7\sqrt{3}$ m

In Δ CDE,

$\tan 45° = \frac{ED}{CD}$

$\therefore\ 1 = \frac{7}{x}$

$\therefore\ x = 7$ m

➤ A – B – C so, AB + BC = AC

$h + 7 = AC$

$\therefore\ 7\sqrt{3} + 7 = AC$

$\therefore\ AC = 7\left(\sqrt{3} + 1\right)$

Therefore, the height of the cable tower is $7\left(\sqrt{3} + 1\right)$ m.