SOME APPLICATIONS OF TRIGONOMETRY
PPT-3

SUBJECT : MATHEMATICS
CHAPTER NUMBER: 09
CHAPTER NAME : SOME APPLICATIONS OF TRIGONOMETRY

Website: www.odmegroup.org
Email: info@odmps.org
Toll Free: **1800 120 2316**
Sishu Vihar, Infocity Road, Patia, Bhubaneswar- 751024

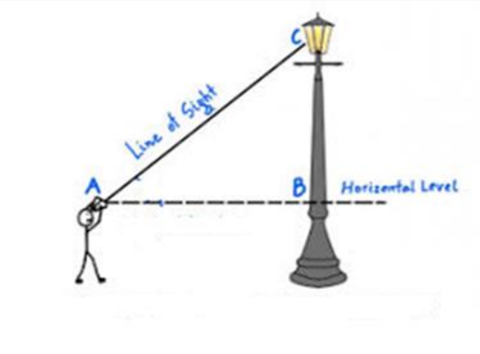
PREVIOUS KNOWLEDGE TEST

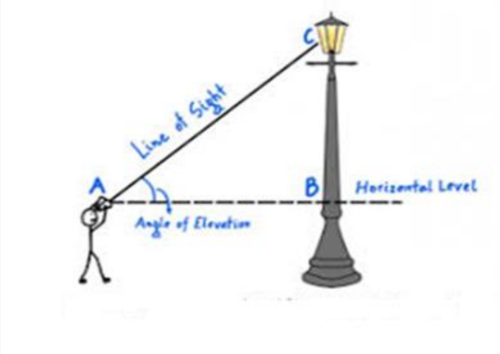
Line of sight: line of sight is the line drawn from the eye of an observer to the point in the object viewed by the observer

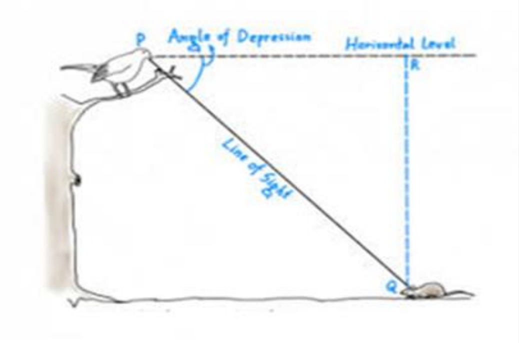
Horizontal level: It is the horizontal line through the eye of the observer

Angle of elevation: The angle of elevation of the point viewed is the angle formed by the line of sight with the horizontal when the point being viewed is above the horizontal level, i.e., the case when we raise our head to look at the object.

Angle of depression: The angle of depression of a point on the object being viewed is the angle formed by the line of sight with the horizontal when the point is below the horizontal level, i.e., the case when we lower our head to look at the point being viewed







LEARNING OUTCOME

1.Students will be able to analyze word problem and to draw the corresponding figure.

2.Students will be able to apply the knowledge of trigonometry in solving real life problems. .

Problem solving on heights and distances:
https://youtu.be/GyGKE8JFqrk(12.13)

1. 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.

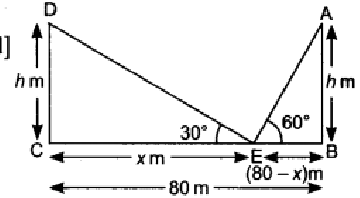
1. Two poles of equal heights are standing opposite each other on either side of the road, which is 80 m wide. From a point between them on the road, the angles of elevation of the top of the poles are 60° and 30°, respectively. Find the height of the poles and the distances of the point from the poles.

Let AB = CD = h m [Height of the poles]

Given: BC = 80 m [Width of the road]

Let CE = x m

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



In ΔCDE, $\dfrac{CD}{CE} = \dfrac{h}{x} = \tan 30°$

$$\frac{h}{x} = \frac{1}{\sqrt{3}} \Rightarrow x = \sqrt{3}h \quad \text{... }(i)$$

In ΔABE, $\dfrac{AB}{BE} = \tan 60° \Rightarrow \dfrac{h}{80 - x} = \sqrt{3}$

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

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

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

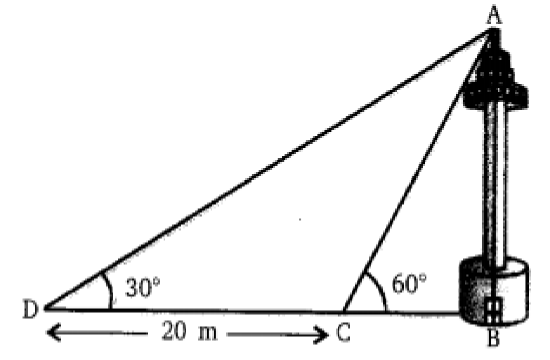
$$\sqrt{3}h = \frac{80\sqrt{3} - h}{\sqrt{3}} \Rightarrow 3h = 80\sqrt{3} - h \Rightarrow 4h = 80\sqrt{3} \Rightarrow h = 20\sqrt{3}$$

Substituting h in equation (i),

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

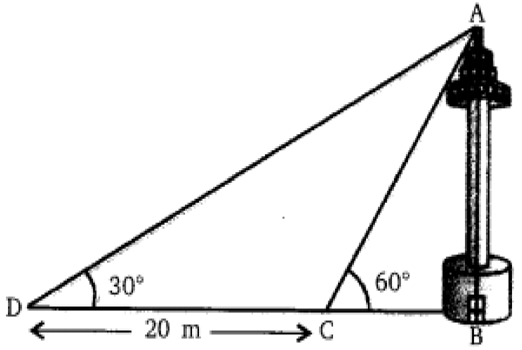
Hence, position of the point is at a distance of 60 m from pole CD and 20 m from pole AB.

2. 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°. From another point 20 m away from this point on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the canal.



2. 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°. From another point 20 m away from this point on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the canal.

Let the height of the tower AB be h m and x m be the width of the canal BC.



Then in right ΔABD,

$$\tan 30° = \frac{AB}{BD} = \frac{AB}{DC+CB}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{h}{20+x}$$

$$\Rightarrow \quad 20 + x = h\sqrt{3}$$

$$\Rightarrow \quad x = h\sqrt{3} - 20 \qquad \text{... (i)}$$

In right ΔABC, $\tan 60° = \frac{AB}{BC}$

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

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

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

$$\Rightarrow \quad h\sqrt{3} - \frac{h}{\sqrt{3}} = 20 \quad \Rightarrow \quad h\left(\frac{3-1}{\sqrt{3}}\right) = 20$$

$$\Rightarrow \quad h = \frac{20\sqrt{3}}{2} = 10\sqrt{3}$$

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**.

3. 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.

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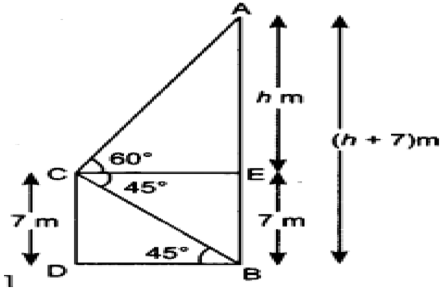
Let height of the tower AB = (h + 7) m

Given: CD = 7 m (height of the building).



$\angle ACE = 60°$, and $\angle ECB = 45°$

$\Rightarrow \quad \angle CBD = 45°$

In ΔCDB, $\quad \dfrac{CD}{DB} = \tan 45° \quad \Rightarrow \quad \dfrac{7}{DB} = 1$

$\Rightarrow \quad DB = 7$ m

In ΔAEC, $\quad \dfrac{AE}{CE} = \tan 60°$

$\Rightarrow \quad \dfrac{h}{7} = \sqrt{3} \qquad [\because DB = CE = 7m]$

$\Rightarrow \quad h = 7\sqrt{3}$ m

Now, $AB = h + 7 = 7\sqrt{3} + 7 = 7(\sqrt{3} + 1)$m

Hence, height of the tower $= 7(\sqrt{3} + 1)$m

4. 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.

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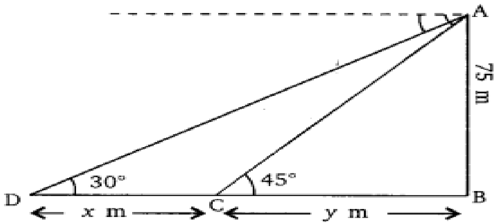
Given: $\angle ADB = 30°$, $\angle ACB = 45°$ and AB = 75 m

Let the distance between the ships be x m.



Then in right ΔABC, $\tan 45° = \frac{AB}{BC}$

$$\Rightarrow \quad 1 = \frac{75}{y} \quad \Rightarrow \quad y = 75 \text{ m} \quad \text{... (i)}$$

In right ΔADB, $\tan 30° = \frac{AB}{BD}$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{75}{x+y}$$

$$\Rightarrow x + 75 = 75\sqrt{3} \quad \text{[From equation (i)]}$$

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

Hence, the distance between the two ships is $\mathbf{75\left(\sqrt{3} - 1\right)}$ **m**.

5. The angles of elevation of the top of a tower from two points at a distance of 4 m and 9 m from the base of the tower and in the same straight line with it are complementary. Prove that the height of the tower is 6 m.

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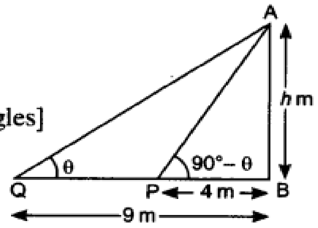

Let the height of the tower AB = h m

We have PB = 4 m, QB = 9 m

Let $\angle AQB = \theta$

Then, $\angle APB = 90° - \theta$ [Both are complementary angles]

In ΔABP, $\frac{AB}{PB} = \tan(90° - \theta)$

$\Rightarrow \frac{h}{4} = \cot\theta$

$\Rightarrow h = 4\cot\theta$ ... (*i*)

In ΔABQ, $\frac{AB}{QB} = \tan\theta$

$\frac{h}{9} = \tan\theta$

$h = 9\tan\theta$ ... (*ii*)

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

$h \times h = 4\cot\theta \times 9\tan\theta$

$\Rightarrow h^2 = 36\cot\theta \times \tan\theta = 36\frac{1}{\tan\theta} \times \tan\theta$

$\Rightarrow h^2 = 36 \Rightarrow h = 6$ m

Hence, the height of the tower is 6 m.

HOME ASSIGNMENT Ex. 9.1 Q. No 10 to Q16.

AHA

1. 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.

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