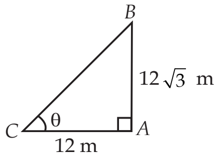
Some Applications of Trigonometry

CHAPTER 9

TRY YOURSELF

SOLUTIONS

1. Let AB be the building of height $12\sqrt{3}$ m and AC is the shadow of AB of length 12 m.



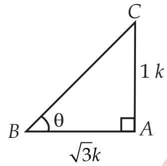
Let $\angle ACB = \theta$

Now, in right ΔABC,

$$\tan\theta = \frac{AB}{AC} = \frac{12\sqrt{3}}{12}$$

$\Rightarrow \quad \tan\theta = \sqrt{3} = \tan 60° \Rightarrow \theta = 60°$

2. Let AC be the height of the tower, AB be the length of its shadow and θ be the angle of elevation of the sun.

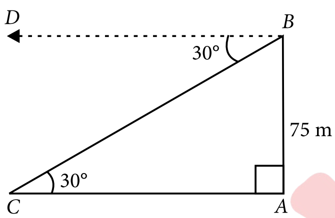


In right ΔABC, $\tan\theta = \dfrac{AC}{AB} = \dfrac{1k}{\sqrt{3}k} = \dfrac{1}{\sqrt{3}}$ [Given]

$\Rightarrow \quad \tan\theta = \tan 30° \Rightarrow \theta = 30°$

Hence, angle of elevation of the sun is 30°.

3.



Let AB be the tower of height 75 m and C is the position of car.

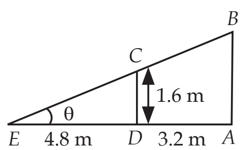
In right ΔABC, $\cot 30° = \dfrac{AC}{AB}$

$\Rightarrow \quad AC = AB\cot 30° = 75\times\sqrt{3} = 75\sqrt{3}$ m

Thus, the distance of the car from the base of the tower is $75\sqrt{3}$ m.

4. Let AB be the lamp-post and CD be the 1·6 m tall girl. Here, ED = 4·8 m is the shadow of CD.

Let $\angle AEB = \angle DEC = \theta$



In right ΔEDC,

$$\tan\theta = \frac{CD}{ED} = \frac{1.6}{4.8} = \frac{1}{3} \quad \text{....(i)}$$

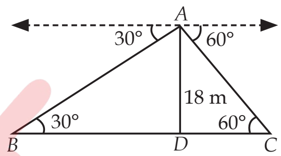
In right ΔABE,

$$\tan\theta = \frac{AB}{AE} = \frac{AB}{4.8+3.2} = \frac{AB}{8}. \quad \text{...(ii)}$$

From (i) and (ii), $\dfrac{AB}{8} = \dfrac{1}{3} \Rightarrow AB = \dfrac{8}{3}$ m

Hence, the height of lamp post is $\dfrac{8}{3}$ m.

5. Let AD be the tree of height 18 m. B and C are the foot of the poles on opposite side of the river BC.



In right ΔADB,

$$\tan 30° = \frac{AD}{BD}$$

$\Rightarrow \quad \dfrac{1}{\sqrt{3}} = \dfrac{18}{BD} \Rightarrow BD = 18\sqrt{3}$ m

In right ΔADC,

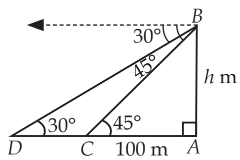
$$\tan 60° = \frac{AD}{DC}$$

$\Rightarrow \quad \sqrt{3} = \dfrac{18}{DC} \Rightarrow DC = \dfrac{18}{\sqrt{3}} = 6\sqrt{3}$ m

Now, width of the river, $BC = BD + DC$

$= 18\sqrt{3} + 6\sqrt{3} = 24\sqrt{3}$ m

6. Let AB be the lighthouse of height h m and C and D are the positions of ship.



In right ΔABC,

$$\tan 45° = \frac{AB}{AC} \Rightarrow 1 = \frac{AB}{100}$$

$\Rightarrow \quad AB = 100$

So, height of the lighthouse is 100 m.

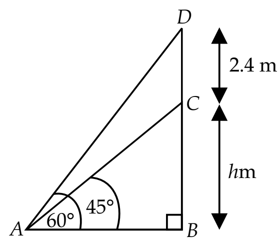
Now, in right ΔABD,

$$\tan 30° = \frac{AB}{AD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{100}{100+CD}$$

$\Rightarrow \quad 100 + CD = 100\sqrt{3}$

$\Rightarrow \quad CD = 100(\sqrt{3} - 1) = 73.2$ m

7. In the figure, DC represents the statue and BC represents the pedestal.



Now, in right ΔABC,

$$\frac{AB}{BC} = \cot 45° = 1$$

$\Rightarrow \quad \dfrac{AB}{h} = 1 \Rightarrow AB = h$ metres

Now in right ΔABD,

$$\frac{BD}{AB} = \tan 60° \Rightarrow \frac{h+2.4}{h} = \sqrt{3}$$

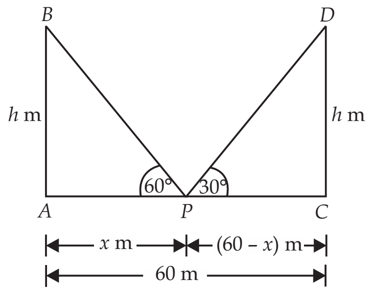
$\Rightarrow \quad h + 2.4 = \sqrt{3}h \Rightarrow h(\sqrt{3}-1) = 2.4$

$\Rightarrow \quad h = \dfrac{2.4}{\sqrt{3}-1} = \dfrac{2.4}{\sqrt{3}-1}\times\dfrac{\sqrt{3}+1}{\sqrt{3}+1}$

$\Rightarrow \quad h = \dfrac{2.4(\sqrt{3}+1)}{2} = 1.2\,(\sqrt{3}+1)$

Thus, the height of the pedestal is $1.2\,(\sqrt{3}+1)$ m.

8. Let AB and CD be two poles of equal height, h m.



Then $AB = CD = h$ m

Let $AP = x$ m

$\therefore \quad CP = (60 - x)$ m

Now, in right ΔAPB,

$\dfrac{AB}{AP} = \tan 60^\circ$

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

Again, in right ΔCPD,

$\dfrac{CD}{CP} = \tan 30^\circ$

$\Rightarrow \quad \dfrac{h}{(60-x)} = \dfrac{1}{\sqrt{3}} \Rightarrow h = \dfrac{60-x}{\sqrt{3}}$ ...(ii)

From (i) and (ii), we get

$\sqrt{3}\,x = \dfrac{60-x}{\sqrt{3}}$

$\Rightarrow \quad 3x = 60 - x \Rightarrow 4x = 60 \Rightarrow x = 15$

$\therefore \quad CP = 60 - x = 60 - 15 = 45$ m

Now, from (i), we have

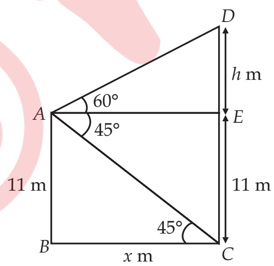
$h = 15 \times \sqrt{3} = 15 \times 1.732 = 25.98$

Thus, the required point is 15 m away from the first pole and 45 m away from the second pole and height of each pole is 25.98 m.

9. In the figure, let AB be the building.

$\therefore \quad AB = 11$ m

Let CD be the cable tower.



$\therefore \quad$ In right ΔDAE,

$\dfrac{DE}{EA} = \tan 60^\circ \Rightarrow \dfrac{h}{x} = \sqrt{3}$

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

Again, in right ΔABC,

$\dfrac{AB}{BC} = \tan 45^\circ$

$\Rightarrow \quad \dfrac{11}{x} = 1 \Rightarrow x = 11$ ... (ii)

From (i) and (ii), we get $h = 11\sqrt{3} = DE$

$\therefore \quad CD = CE + ED = 11 + 11\sqrt{3} = 11(1+\sqrt{3})$ m

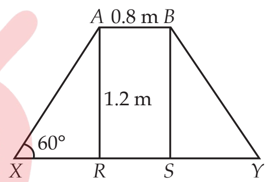
$= 11(1 + 1.732)\text{m} = 11(2.732)\text{m} = 30.052$ m

Hence, height of cable tower is 30.052 m.

10. Let AX and BY are the two legs at an angle of 60° to the ground.

AR and BS are two perpendiculars on base XY.

Now, in right ΔAXR,



$\sin 60^\circ = \dfrac{AR}{AX}$

$\Rightarrow \quad \dfrac{\sqrt{3}}{2} = \dfrac{1.2}{AX}$

$\Rightarrow \quad AX = \dfrac{2 \times 1.2}{\sqrt{3}} = \dfrac{2.4}{\sqrt{3}} = \dfrac{2.4}{1.732} = 1.4$ m (approx.)

Similarly, $BY = 1.4$ m

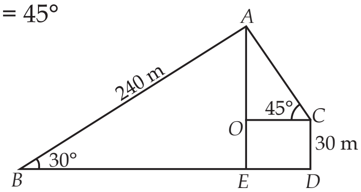
Hence, length of each leg is 1.4 m.

11. Let C and B be the positions of Mukesh (on the roof) and Ramesh respectively. Both the kites meet at point A.

Here, $AB = 240$ m, $CD = 30$ m,

$\angle ABD = 30°$ and $\angle ACO = 45°$

In ΔAEB,



$\sin 30^\circ = \dfrac{AE}{AB}$

$\Rightarrow \quad \dfrac{1}{2} = \dfrac{AE}{240}$

$\Rightarrow \quad AE = \dfrac{240}{2} = 120$ m

Now, $AO = AE - OE = AE - CD = (120 - 30)$ m $= 90$ m

In ΔAOC,

$\sin 45^\circ = \dfrac{AO}{AC} \Rightarrow \dfrac{1}{\sqrt{2}} = \dfrac{90}{AC} \Rightarrow AC = 90\sqrt{2}$

$= 90 \times 1.414 = 127.26$ m

Hence, Mukesh must have length of string as 127.26 m.