Exercise – 14.1

1.

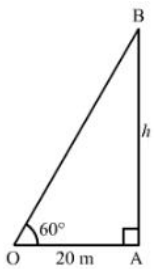
Sol:

Let AB be the tower standing vertically on the ground and O be the position of the obsrever we now have:

$OA = 20\,m, \angle OAB = 90^\circ \text{ and } \angle AOB = 60^\circ$

Let

$AB = h\,m$



Now, in the right ΔOAB, we have:

$\frac{AB}{OA} - \tan 60^\circ = \sqrt{3}$

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

$\Rightarrow h = 20\sqrt{3} = (20 \times 1.732) = 36.64$

Hence, the height of the pole is $34.64\ m.$

2.

Sol:

Let OX be the horizontal ground and A be the position of the kite.

Also, let O be the position of the observer and OA be the thread.

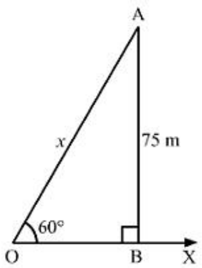
Now, draw $AB \perp OX$.

We have:

$\angle BOA = 60^\circ, OA = 75\,m \text{ and } \angle OBA = 90^\circ$

Height of the kite from the ground $= AB = 75\ m$

Length of the string $OA = x\,m$



In the right ΔOBA, we have:

$$\frac{AB}{OA} = \sin 60° = \frac{\sqrt{3}}{2}$$

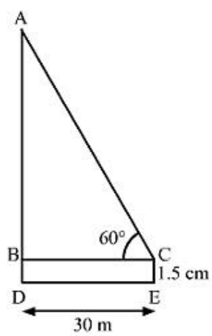
$$\Rightarrow \frac{75}{x} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow x = \frac{75 \times 2}{\sqrt{3}} = \frac{150}{1.732} = 86.6\,m$$

Hence, the length of the string is $86.6\,m$

3.

Sol:



Let CE and AD be the heights of the observer and the chimney, respectively.
We have,

$BD = CE = 1.5\ m,\ BC = DE = 30\ m$ and $\angle ACB = 60°$

In ΔABC

$$\tan 60° = \frac{AB}{BC}$$

$$\Rightarrow \sqrt{3} = \frac{AD - BD}{30}$$

$$\Rightarrow AD - 1.5 = 30\sqrt{3}$$

$$\Rightarrow AD = 30\sqrt{3} + 1.5$$

$$\Rightarrow AD = 30 \times 1.732 + 1.5$$

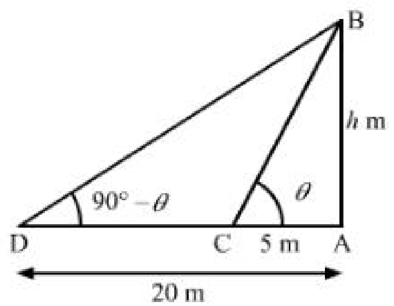
$$\Rightarrow AD = 51.96 + 1.5$$

$\Rightarrow AD = 53.46\ m$

So, the height of the chimney is 53.46 m (approx).

4.

Sol:



Let the height of the tower be AB.
We have.
$AC = 5m, AD = 20m$

Let the angle of elevation of the top of the tower $(i.e.\ \angle ACB)$ from point C be θ.

Then,
the angle of elevation of the top of the tower (i.e. Z ADB) from point D
$= (90° - \theta)$

Now, in ΔABC

$$\tan\theta = \frac{AB}{AC}$$

$$\Rightarrow \tan\theta = \frac{AB}{5} \qquad ....(i)$$

Also, in ΔABD,

$$\cot(90° - \theta) = \frac{AD}{AB}$$

$$\Rightarrow \tan\theta = \frac{20}{AB} \qquad ....(ii)$$

From (i) and (ii), we get

$$\frac{AB}{5} = \frac{20}{AB}$$

$\Rightarrow AB^2 = 100$

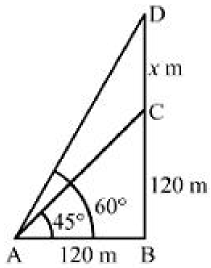
$\Rightarrow AB = \sqrt{100}$

$\therefore AB = 10m$

So, the height of the tower is 10 m.

5.

Sol:



Let BC and CD be the heights of the tower and the flagstaff, respectively.
We have,

$AB = 120\,m, \angle BAC = 45°, \angle BAD = 60°$

Let $CD = x$

In $\Delta ABC,$

$\tan 45° = \frac{BC}{AB}$

$\Rightarrow 1 = \frac{BC}{120}$

$\Rightarrow BC = 120\,m$

Now, in $\Delta ABD,$

$\tan 60° = \frac{BD}{AB}$

$\Rightarrow \sqrt{3} = \frac{BC + CD}{120}$

$\Rightarrow BC + CD = 120\sqrt{3}$

$\Rightarrow 120 + x = 120\sqrt{3}$

$\Rightarrow x = 120\sqrt{3} - 120$

$\Rightarrow x = 120\left(\sqrt{3} - 1\right)$

$\Rightarrow x = 120(1.732 - 1)$

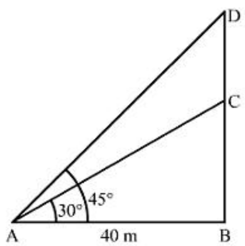
$\Rightarrow x = 120(0.732)$

$\Rightarrow x = 87.84 \approx 87.8\,m$

So, the height of the flagstaff is 87. 8 m.

6.

Sol:



Let BC be the tower and CD be the water tank.

We have,

$AB = 40\,m, \angle BAC = 30^\circ \text{ and } \angle BAD = 45^\circ$

In ΔABD,

$$\tan 45^\circ = \frac{BD}{AB}$$

$$\Rightarrow 1 = \frac{BD}{40}$$

$$\Rightarrow BD = 40\,m$$

Now, in ΔABC,

$$\tan 30^\circ = \frac{BC}{AB}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{BC}{40}$$

$$\Rightarrow BC = \frac{40}{\sqrt{3}}$$

$$\Rightarrow BC = \frac{40}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

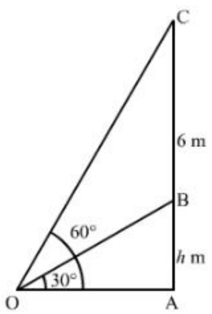
$$\Rightarrow BC = \frac{40\sqrt{3}}{3}\,m$$

(i) The height of the tower, $BC = \frac{40\sqrt{3}}{3} = \frac{40 \times 1.73}{3} = 23.067 \approx 23.1\,m$

(ii) The depth of the tank, $CD = (BD - BC) = (40 - 23.1) = 16.9\,m$

7.

Sol:



Let AB be the tower and BC be the flagstaff,
We have,
$BC = 6m, \angle AOB = 30° \; and \; \angle AOC - 60°$
Let $AB = h$
In $\Delta AOB,$

$\tan 30° = \frac{AB}{OA}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{OA}$

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

Now, in $\Delta AOC,$

$\tan 60° = \frac{AC}{OA}$

$\Rightarrow \sqrt{3} = \frac{AB + BC}{h\sqrt{3}}$ [Using (i)]

$\Rightarrow 3h = h + 6$

$\Rightarrow 3h - h = 6$

$\Rightarrow 2h = 6$

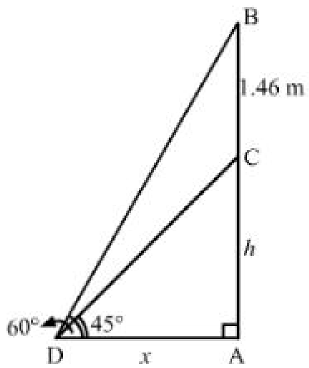
$\Rightarrow h = \frac{6}{2}$

$\Rightarrow h = 3 \; m$

So, the height of the tower is 3 m.

8.

Sol:
Let AC be the pedestal and BC be the statue such that $BC = 1.46m$.
We have:
$\angle ADC = 45°$ and $\angle ADB = 60°$
Let:
$AC = h m$ and $AD = x m$



In the right ΔADC, we have:

$$\frac{AC}{AD} = \tan 45° = 1$$

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

$$\Rightarrow h = x$$

Or,

$$x = h$$

Now, in the right ΔADB, we have:

$$\frac{AB}{AD} = \tan 60° = \sqrt{3}$$

$$\Rightarrow \frac{h + 1.46}{x} = \sqrt{3}$$

On putting $x = h$ in the above equation, we get

$$\frac{h + 1.46}{h} = \sqrt{3}$$

$$\Rightarrow h + 1.46 = \sqrt{3}h$$

$$\Rightarrow h\left(\sqrt{3} - 1\right) = 1.46$$

$$\Rightarrow h = \frac{1.46}{\left(\sqrt{3} - 1\right)} = \frac{1.46}{0.73} = 2\,m$$

Hence, the height of the pedestal is 2 m.

9.

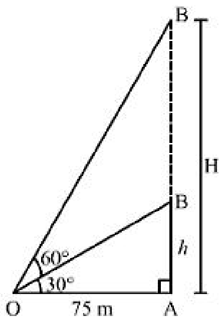
Sol:

Let AB be the unfinished tower, AC be the raised tower and O be the point of observation

We have:

$OA = 75m, \angle AOB = 30^\circ$ and $\angle AOC = 60^\circ$

Let $AC = H$ m such that $BC = (H - h)m$.



In ΔAOB, we have:

$$\frac{AB}{OA} = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h}{75} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow h = \frac{75}{\sqrt{3}} m = \frac{75 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = 25\sqrt{3}\, m$$

In ΔAOC, we have:

$$\frac{AC}{OA} = \tan 60^\circ = \sqrt{3}$$

$$\Rightarrow \frac{H}{75} = \sqrt{3}$$

$$\Rightarrow H = 75\sqrt{3}m$$

$\therefore$ Required height $= (H - h) = \left(75\sqrt{3} - 25\sqrt{3}\right) = 50\sqrt{3}m = 86.6\, m$

10.

Sol:

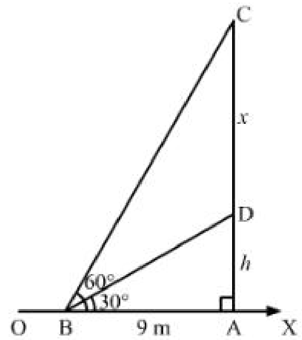
Let OX be the horizontal plane, AD be the tower and CD be the vertical flagpole

We have:

$AB = 9\,m, \angle DBA = 30°$ *and* $\angle CBA = 60°$

Let:

$AD = h\,m$ *and* $CD = x\,m$



In the right $\Delta ABD,$ we have:

$$\frac{AD}{AB} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h}{9} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow h = \frac{9}{\sqrt{3}} = 5.19\ m$$

Now, in the right $\Delta ABC,$ we have

$$\frac{AC}{BA} = \tan 60° = \sqrt{3}$$

$$\Rightarrow \frac{h+x}{9} = \sqrt{3}$$

$$\Rightarrow h + x = 9\sqrt{3}$$

By putting $h = \frac{9}{\sqrt{3}}$ in the above equation, we get:

$$\frac{9}{\sqrt{3}} + x = 9\sqrt{3}$$

$$\Rightarrow x = 9\sqrt{3} - \frac{9}{\sqrt{3}}$$

$$\Rightarrow x = \frac{27-9}{\sqrt{3}} = \frac{18}{\sqrt{3}} = \frac{18}{1.73} = 10.4$$

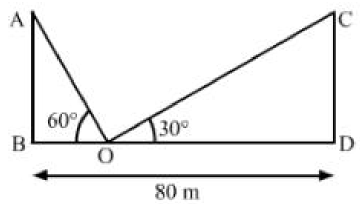
Thus, we have:

Height of the flagpole = 10. 4 m

Height of the tower = 5. 19 m

11. ° °

Sol:



Let AB and CD be the equal poles; and BD be the width of the road.

We have,

$\angle AOB = 60°$ *and* $\angle COD = 60°$

In $\Delta AOB,$

$$\tan 60° = \frac{AB}{BO}$$

$$\Rightarrow \sqrt{3} = \frac{AB}{BO}$$

$$\Rightarrow BO = \frac{AB}{\sqrt{3}}$$

Also, in $\Delta COD,$

$$\tan 30° = \frac{CD}{DO}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{CD}{DO}$$

$$\Rightarrow DO = \sqrt{3}CD$$

As, $BD = 80$

$$\Rightarrow BO + DO = 80$$

$$\Rightarrow \frac{AB}{\sqrt{3}} + \sqrt{3}CD = 80$$

$$\Rightarrow \frac{AB}{\sqrt{3}} + \sqrt{3}AB = 80$$ (Given: AB = CD)

$$\Rightarrow AB\left(\frac{1}{\sqrt{3}} + \sqrt{3}\right) = 80$$

$$\Rightarrow AB\left(\frac{1+3}{\sqrt{3}}\right) = 80$$

$$\Rightarrow AB\left(\frac{4}{\sqrt{3}}\right) = 80$$

$\Rightarrow AB = \frac{80+\sqrt{3}}{4}$

$\Rightarrow AB = 20\sqrt{3}m$

Also, $BO = \frac{AB}{\sqrt{3}} = \frac{20\sqrt{3}}{\sqrt{3}} = 20\,m$

So, $DO = 80 - 20 = 60\,m$

Hence, the height of each pole is $20\sqrt{3}\,m$ and point P is at a distance of 20 m from left pole ad 60 m from right pole.

12.

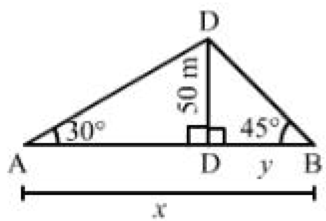
Sol:

Let CD be the tower and A and B be the positions of the two men standing on the opposite sides.

Thus, we have:

$\angle DAC = 30°, \angle DBC = 45°$ *and* $CD = 50\ m$

Let $AB = x\,m$ and $BC = y\,m$ such that $AC = (x-y)m.$



In the right $\Delta DBC,$ we have:

$\frac{CD}{BC} = \tan 45° = 1$

$\Rightarrow \frac{50}{y} = 1$

$\Rightarrow y = 50\,m$

In the right $\Delta ACD,$ we have:

$\frac{CD}{AC} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow \frac{50}{(x-y)} = \frac{1}{\sqrt{3}}$

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

On putting $y = 50$ in the above equation, we get:

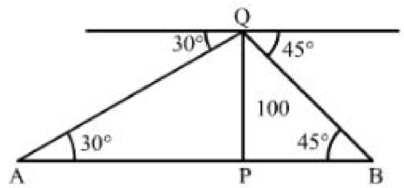
$x-50=50\sqrt{3}$

$\Rightarrow x=50+50\sqrt{3}=50\left(\sqrt{3}+1\right)=136.6\,m$

$\therefore$ Distance between the two men $=AB=x=136.6\,m$

13.

Sol:



Let PQ be the tower
We have,

$PQ=100m, \angle PQR=30°$ *and* $\angle PBQ=45°$

In $\Delta APQ,$

$\tan 30°=\frac{PQ}{AP}$

$\Rightarrow \frac{1}{\sqrt{3}}=\frac{100}{AP}$

$\Rightarrow AP=100\sqrt{3}\ m$

Also, in $\Delta BPQ,$

$\tan 45°=\frac{PQ}{BP}$

$\Rightarrow 1=\frac{100}{BP}$

$\Rightarrow BP=100\,m$

Now, $AB=AP+BP$

$=100\sqrt{3}+100$

$=100\left(\sqrt{3}+1\right)$

$=100\times(1.73+1)$

$=100\times 2.73$

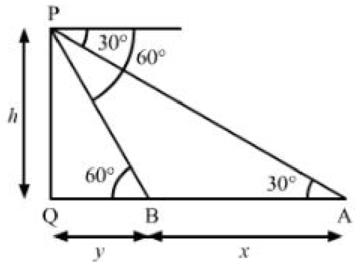
$=273\,m$

So, the distance between the cars is $273m.$

14.

Sol:

◦



Let PQ be the tower.

We have,

$\angle PBQ = 60^\circ$ and $\angle PAQ = 30^\circ$

Let $PQ = h, AB = x$ and $BQ = y$

In ΔAPQ,

$$\tan 30^\circ = \frac{PQ}{AQ}$$

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

$$\Rightarrow x + y = h\sqrt{3} \qquad ....(i)$$

Also, in ΔBPQ,

$$\tan 60^\circ = \frac{PQ}{BQ}$$

$$\Rightarrow \sqrt{3} = \frac{h}{y}$$

$$\Rightarrow h = y\sqrt{3} \qquad ....(ii)$$

Substituting $h = y\sqrt{3}$ in (i), we get

$$x + y = \sqrt{3}\left(y\sqrt{3}\right)$$

$$\Rightarrow x + y = 3y$$

$$\Rightarrow 3y - y = x$$

$$\Rightarrow 2y = x$$

$$\Rightarrow y = \frac{x}{2}$$

As, speed of the car from A to B $= \frac{AB}{6} = \frac{x}{6}$ units / sec

So, the time taken to reach the foot of the tower i.e. Q from B $= \frac{BQ}{speed}$

$= \frac{y}{\left(\frac{x}{6}\right)}$

$= \frac{\left(\frac{x}{2}\right)}{\left(\frac{x}{6}\right)}$

$= \frac{6}{2}$

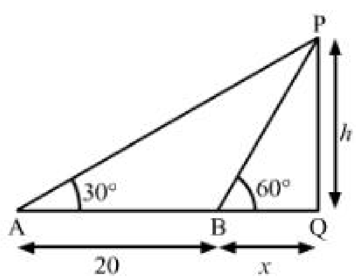
$= 3 \text{ sec}$

So, the time taken to reach the foot of the tower from the given point is 3 seconds.

15.

°

Sol:



Let PQ=h m be the height of the TV tower and BQ= x m be the width of the canal.
We have,

$AB = 20\ m, \angle PAQ = 30°, \angle BQ = x\ and\ PQ = h$

In $\Delta PBQ,$

$\tan 60° = \frac{PQ}{BQ}$

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

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

Again in $\Delta APQ,$

$\tan 30° = \frac{PQ}{AQ}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{AB+BQ}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{x\sqrt{3}}{20+3}$ [Using (i)]

$\Rightarrow 3x = 20 + x$

$\Rightarrow 3x - x = 20$

$\Rightarrow 2x = 20$

$\Rightarrow x = \frac{20}{2}$

$\Rightarrow x = 10\,m$

Substituting $x = 10$ in (i), we get

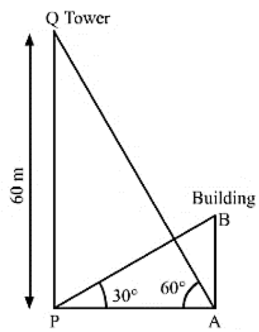
$h = 10\sqrt{3}m$

So, the height of the TV tower is $10\sqrt{3}\,m$ and the width of the canal is 10 m.

16.

°

Sol:



Let AB be thee building and PQ be the tower.
We have,

$PQ = 60\,m, \angle APB = 30°, \angle PAQ = 60°$

In ΔAPQ,

$\tan 60° = \frac{PQ}{AP}$

$\Rightarrow \sqrt{3} = \frac{60}{AP}$

$\Rightarrow AP = \frac{60}{\sqrt{3}}$

$\Rightarrow AP = \frac{60\sqrt{3}}{3}$

$\Rightarrow AP = 20\sqrt{3}\,m$

Now, in ΔABP,

$\tan 30° = \frac{AB}{AP}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{20\sqrt{3}}$

$\Rightarrow AB = \frac{20\sqrt{3}}{\sqrt{3}}$

$\therefore AB = 20\,m$

So, the height of the building is 20 m

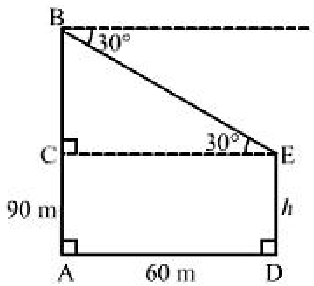
17.

Sol:

Let DE be the first tower and AB be the second tower.

Now, AB = 90 m and AD = 60 m such that CE = 60 m and $\angle BEC = 30°$.

Let DE = h m such that AC = h m and BC = $(90-h)m$.



In the right ΔBCE, we have:

$\frac{BC}{CE} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow \frac{(90-h)}{60} = \frac{1}{\sqrt{3}}$

$\Rightarrow (90-h)\sqrt{3} = 60$

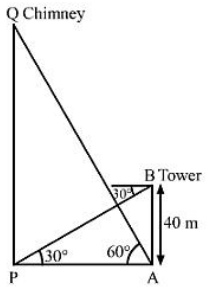
$\Rightarrow h\sqrt{3} = 90\sqrt{3} - 60$

$\Rightarrow h = 90 - \frac{60}{\sqrt{3}} = 90 - 34.64 = 55.36\ m$

$\therefore$ Height of the first tower $= DE = h = 55.36m$

18.

Sol:



Let PQ be the chimney and AB be the tower.
We have,

$AB = 40m, \angle APB = 30°$ *and* $\angle PAQ = 60°$

In $\Delta ABP,$

$\tan 30° = \frac{AB}{AP}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{40}{AP}$

$\Rightarrow AP = 40\sqrt{3}\,m$

Now, in $\Delta APQ,$

$\tan 60° = \frac{PQ}{AP}$

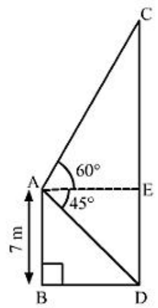
$\Rightarrow \sqrt{3} = \frac{PQ}{40\sqrt{3}}$

$\therefore PQ = 120\,m$

So, the height of the chimney is 120 m.
Hence, the height of the chimney meets the pollution norms.
In this question, management of air pollution has been shown

19.

Sol:



Let AB be the 7-m high building and CD be the cable tower,

We have,

$AB = 7\,m, \angle CAE = 60°, \angle DAE = \angle ADB = 45°$

Also, $DE = AB = 7\,m$

In $\Delta ABD,$

$\tan 45° = \frac{AB}{BD}$

$\Rightarrow 1 = \frac{7}{BD}$

$\Rightarrow BD = 7\,m$

So, $AE = BD = 7\,m$

Also, in $\Delta ACE,$

$\tan 60° = \frac{CE}{AE}$

$\Rightarrow \sqrt{3} = \frac{CE}{7}$

$\Rightarrow CE = 7\sqrt{3}m$

Now, $CD = CE + DE$

$= 7\sqrt{3} + 7$

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

$= 7\left(1.732 + 1\right)$

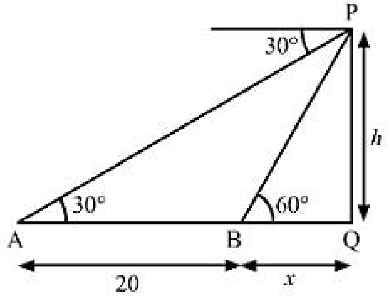
$= 7\left(2.732\right)$

$= 19.124$

$\approx 19.12\,m$

So, the height of the tower is $19.12\,m.$

20. **Sol:**



Let PQ be the tower.

We have,

$AB = 20m, \angle PAQ = 30°$ and $\angle PBQ = 60°$

Let $BQ = x$ and $PQ = h$

In ΔPBQ,

$$\tan 60° = \frac{PQ}{BQ}$$

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

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

Also, in ΔAPQ,

$$\tan 30° = \frac{PQ}{AQ}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{AB + BQ}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{x\sqrt{3}}{20 + x} \qquad \text{[Using (i)]}$$

$$\Rightarrow 20 + x = 3x$$

$$\Rightarrow 3x - x = 20$$

$$\Rightarrow 2x = 20$$

$$\Rightarrow x = \frac{20}{2}$$

$$\Rightarrow x = 10m$$

From (i),

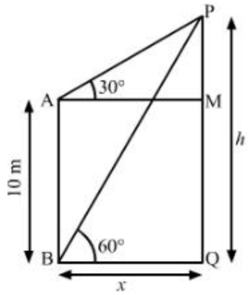
$h = 10\sqrt{3} = 10 \times 1.732 = 17.32m$

Also, $AQ = AB + BQ = 20 + 10 = 30m$

So, the height of the tower is 17. 32 m and its distance from the point A is 30 m.

21.

Sol:



Let PQ be the tower

We have,

$AB = 10\,m, \angle MAP = 30° \text{ and } \angle PBQ = 60°$

Also, $MQ = AB = 10\,m$

Let $BQ = x \text{ and } PQ = h$

So, $AM = BQ = x \text{ and } PM = PQ - MQ = h - 10$

In $\Delta BPQ,$

$$\tan 60° = \frac{PQ}{BQ}$$

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

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

Now, in $\Delta AMP,$

$$\tan 30° = \frac{PM}{AM}$$

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

$$\Rightarrow h\sqrt{3} - 10\sqrt{3} = x$$

$$\Rightarrow h\sqrt{3} - 10\sqrt{3} = \frac{h}{\sqrt{3}} \qquad \text{[Using (i)]}$$

$$\Rightarrow 3h - 30 = h$$

$$\Rightarrow 3h - h = 30$$

$$\Rightarrow 2h = 30$$

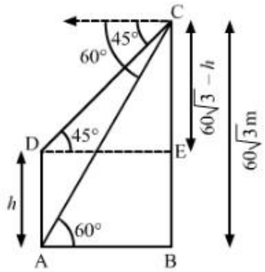
$$\Rightarrow h = \frac{30}{2}$$

$$\therefore h = 15\,m$$

So, the height of the tower is 15 m.

22.

Sol:



Let AD be the tower and BC be the cliff.

We have,

$BC = 60\sqrt{3}, \angle CDE = 45° \text{ and } \angle BAC = 60°$

Let $AD = h$

$\Rightarrow BE = AD = h$

$\Rightarrow CE = BC - BE = 60\sqrt{3} - h$

In ΔCDE,

$$\tan 45° = \frac{CE}{DE}$$

$$\Rightarrow 1 = \frac{60\sqrt{3} - h}{DE}$$

$\Rightarrow DE = 60\sqrt{3} - h$

$\Rightarrow AB = DE = 60\sqrt{3} - h$ ....(i)

Now, in ΔABC,

$$\tan 60° = \frac{BC}{AB}$$

$$\Rightarrow \sqrt{3} = \frac{60\sqrt{3}}{60\sqrt{3} - h}$$ [Using (i)]

$\Rightarrow 180 - h\sqrt{3} = 60\sqrt{3}$

$\Rightarrow h\sqrt{3} = 180 - 60\sqrt{3}$

$$\Rightarrow h = \frac{180 - 60\sqrt{3}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\Rightarrow h = \frac{180\sqrt{3} - 180}{3}$$

$$\Rightarrow h = \frac{180\left(\sqrt{3} - 1\right)}{3}$$

$\therefore h = 60(\sqrt{3} - 1)$

$= 60(1.732 - 1)$

$= 60(0.732)$

Also, $h = 43.92\,m$

So, the height of the tower is 43. 92 m.

23.

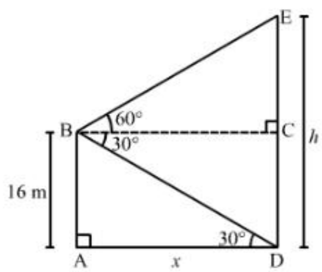
Sol:

Let AB be the deck of the ship above the water level and DE be the cliff.

Now,

$AB = 16m$ such that $CD = 16m$ and $\angle BDA = 30°$ and $\angle EBC = 60°$

If $AD = x\,m$ and $DE = h\,m$, then $CE = (h - 16)m$.



In the right ΔBAD, we have

$$\frac{AB}{AD} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{16}{x} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow x = 16\sqrt{3} = 27.68\,m$$

In the right ΔEBC, we have:

$$\frac{EC}{BC} = \tan 60° = \sqrt{3}$$

$$\Rightarrow \frac{(h - 16)}{x} = \sqrt{3}$$

$$\Rightarrow h - 16 = x\sqrt{3}$$

$$\Rightarrow h - 16 = 16\sqrt{3} \times \sqrt{3} = 48 \qquad \left[\because x = 16\sqrt{3}\right]$$

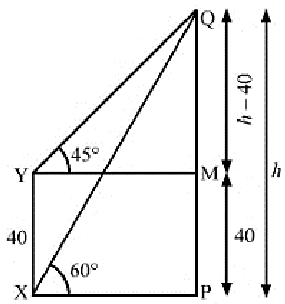
$$\Rightarrow h = 48 + 16 = 64\,m$$

$\therefore$ Distance of the cliff from the deck of the ship $= AD = x = 27.68\,m$

And,
Height of the cliff $= DE = h = 64\,m$

24.

Sol:



We have
$XY = 40\,m, \angle PXQ = 60^\circ$ *and* $\angle MYQ = 45^\circ$
Let $PQ = h$
Also, $MP = XY = 40\,m, MQ = PQ - MP = h - 40$
In $\Delta MYQ,$

$$\tan 45^\circ = \frac{MQ}{MY}$$

$$\Rightarrow 1 = \frac{h-40}{MY}$$

$$\Rightarrow MY = h - 40$$

$$\Rightarrow PX = MY = h - 40 \qquad ....(i)$$

Now, in $\Delta MXQ,$

$$\tan 60^\circ = \frac{PQ}{PX}$$

$$\Rightarrow \sqrt{3} = \frac{h}{h-40} \qquad \text{[From (i)]}$$

$$\Rightarrow h\sqrt{3} - 40\sqrt{3} = h$$

$$\Rightarrow h\sqrt{3} - h = 40\sqrt{3}$$

$$\Rightarrow h\left(\sqrt{3}-1\right) = 40\sqrt{3}$$

$$\Rightarrow h = \frac{40\sqrt{3}}{\left(\sqrt{3}-1\right)}$$

$$\Rightarrow h = \frac{40\sqrt{3}}{(\sqrt{3}-1)} \times \frac{(\sqrt{3}+1)}{(\sqrt{3}+1)}$$

$$\Rightarrow h = \frac{40\sqrt{3}(\sqrt{3}+1)}{(3-1)}$$

$$\Rightarrow h = \frac{40\sqrt{3}(\sqrt{3}+1)}{2}$$

$$\Rightarrow h = 20\sqrt{3}(\sqrt{3}+1)$$

$$\Rightarrow h = 60 + 20\sqrt{3}$$

$$\Rightarrow h = 60 + 20 \times 1.73$$

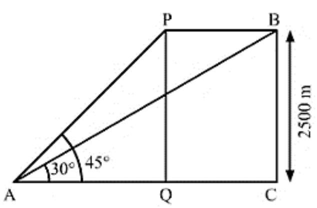
$$\Rightarrow h = 60 + 34.6$$

$$\therefore h = 94.6\, m$$

So, the height of the tower PQ is 94. 6 m.

25.

Sol:



Let the height of flying of the aero-plane be PQ = BC and point A be the point of observation.

We have,

$PQ = BC = 2500\, m, \angle PAQ = 45° \text{ and } \angle BAC = 30°$

In ΔPAQ,

$$\tan 45° = \frac{PQ}{AQ}$$

$$\Rightarrow 1 = \frac{2500}{AQ}$$

$$\Rightarrow AQ = 2500\ m$$

Also, in ΔABC,

$$\tan 30° = \frac{BC}{AC}$$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{2500}{AC}$

$\Rightarrow AC = 2500\sqrt{3}\,m$

Now, $QC = AC - AQ$

$= 2500\sqrt{3} - 2500$

$= 2500\left(\sqrt{3} - 1\right)m$

$= 2500\left(1.732 - 1\right)$

$= 2500\left(0.732\right)$

$= 1830\,m$

$\Rightarrow PB = QC = 1830\,m$

So, the speed of the aero-plane $= \frac{PB}{15}$

$= \frac{1830}{15}$

$= 122\,m/s$

$= 122 \times \frac{3600}{1000}\ km/h$

$= 439.2\ km/h$

So, the speed of the aero-plane is $122\,m/s$ or $439.2\ km/h$.

26.

Sol:

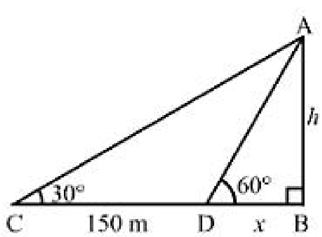
Let AB be the tower

We have:

$CD = 150\,m, \angle ACB = 30° \; and \; \angle ADB = 60°$

Let:

$AB = h\,m \; and \; BD = x\,m$



In the right ΔABD, we have:

$$\frac{AB}{AD} = \tan 60° = \sqrt{3}$$

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

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

Now, in the right $\Delta ACB,$ we have:

$$\frac{AB}{AC} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h}{x+150} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \sqrt{3}h = x+150$$

On putting $x = \frac{h}{\sqrt{3}}$ in the above equation, we get:

$$\sqrt{3}h = \frac{h}{\sqrt{3}} + 150$$

$$\Rightarrow 3h = h + 150\sqrt{3}$$

$$\Rightarrow 2h = 150\sqrt{3}$$

$$\Rightarrow h = \frac{150\sqrt{3}}{2} = 75\sqrt{3} = 75 \times 1.732 = 129.9\,m$$

Hence, the height of the tower is 129.9 m

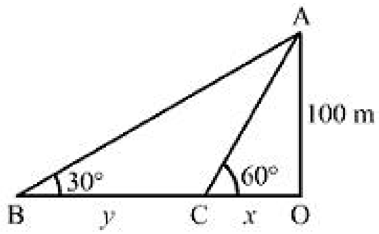
27.

Sol:

Let OA be the lighthouse and B and C be the positions of the ship.

Thus, we have:

$OA = 100\,m, \angle OBA = 30°$ *and* $\angle OCA = 60°$



Let

$OC = x\,m$ *and* $BC = y\,m$

In the right $\Delta OAC,$ we have

$\frac{OA}{OC} = \tan 60° = \sqrt{3}$

$\Rightarrow \frac{100}{x} = \sqrt{3}$

$\Rightarrow x = \frac{100}{\sqrt{3}} m$

Now, in the right ΔOBA, we have:

$\frac{OA}{OB} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow \frac{100}{x+y} = \frac{1}{\sqrt{3}}$

$\Rightarrow x + y = 100\sqrt{3}$

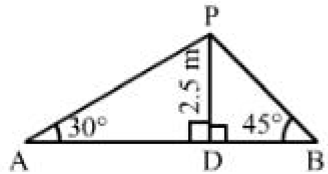
On putting $x = \frac{100}{\sqrt{3}}$ in the above equation, we get:

$y = 100\sqrt{3} - \frac{100}{\sqrt{3}} = \frac{300-100}{\sqrt{3}} = \frac{200}{\sqrt{3}} = 115.47 m$

$\therefore$ Distance travelled by the ship during the period of observation $= B = y = 115.47 m$

28.

Sol:



Let A and B be two points on the banks on the opposite side of the river and P be the point on the bridge at a height of 2.5 m.

Thus, we have:

$DP = 2.5, \angle PAD = 30° \; and \; \angle PBD = 45°$

In the right ΔAPD, we have:

$\frac{DP}{AD} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow \frac{2.5}{AD} = \frac{1}{\sqrt{3}}$

$\Rightarrow AD = 2.5\sqrt{3} m$

In the right ΔPDB, we have:

$\frac{DP}{BD} = \tan 45° = 1$

$\Rightarrow \frac{2.5}{BD} = 1$

$\Rightarrow BD = 2.5m$

$\therefore$ Width of the river $= AB = (AD + BD) = (2.5\sqrt{3} + 2.5) = 6.83m$

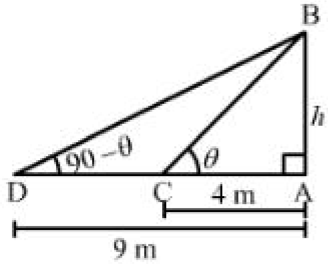
29.

Sol:

Let AB be the tower and C and D be two points such that $AC = 4m$ *and* $AD = 9m$.

Let:

$AB = h\,m, \angle BCA = \theta$ *and* $\angle BDA = 90° - \theta$



In the right ΔBCA, we have:

$\tan\theta = \frac{AB}{AC}$

$\Rightarrow \tan\theta = \frac{h}{4}$ ....(1)

In the right ΔBDA, we have:

$\tan(90° - \theta) = \frac{AB}{AD}$

$\Rightarrow \cot\theta = \frac{h}{9}$ $[\tan(90° - \theta) = \cot\theta]$

$\Rightarrow \frac{1}{\tan\theta} = \frac{h}{9}$ ....(2) $\left[\cot\theta = \frac{1}{\tan\theta}\right]$

Multiplying equations (1) and (2), we get

$\tan\theta \times \frac{1}{\tan\theta} = \frac{h}{4} \times \frac{h}{9}$

$\Rightarrow 1 = \frac{h^2}{36}$

$\Rightarrow 36 = h^2$

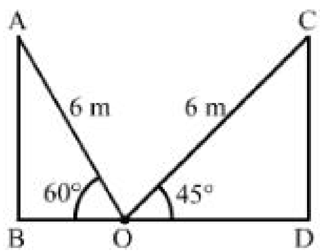
$\Rightarrow h = \pm 6$

Height of a tower cannot be negative

$\therefore$ Height of the tower = 6 m

30.

Sol:



Let AB and CD be the two opposite walls of the room and the foot of the ladder be fixed at the point O on the ground.

We have,

$AO = CO = 6m, \angle AOB = 60° \text{ and } \angle COD = 45°$

In ΔABO,

$$\cos 60° = \frac{BO}{AO}$$

$$\Rightarrow \frac{1}{2} = \frac{BO}{6}$$

$$\Rightarrow BO = \frac{6}{2}$$

$$\Rightarrow BO = 3m$$

Also, in ΔCDO,

$$\cos 45° = \frac{DO}{CO}$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{DO}{6}$$

$$\Rightarrow DO = \frac{6}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$$

$$\Rightarrow DO = \frac{6\sqrt{2}}{2}$$

$\Rightarrow DO = 3\sqrt{2}\, m$

Now, the distance between two walls of the room = BD

$= BO + DO$

$= 3 + 3\sqrt{2}$

$= 3\left(1+\sqrt{2}\right)$

$= 3(1+1.414)$

$= 3(2.414)$

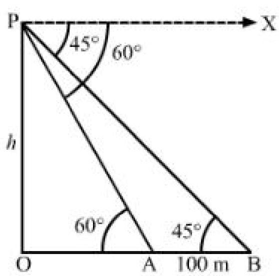
$= 7.242$

$\approx 7.24\, m$

So, the distant between two walls of the room is 7. 24 m.

31.

Sol:



Let OP be the tower and points A and B be the positions of the cars.

We have,

$AB = 100\, m, \angle OAP = 60^\circ \text{ and } \angle OBP = 45^\circ$

Let $OP = h$

In ΔAOP,

$\tan 60^\circ = \frac{OP}{OA}$

$\Rightarrow \sqrt{3} = \frac{h}{OA}$

$\Rightarrow OA = \frac{h}{\sqrt{3}}$

Also, in ΔBOP,

$\tan 45^\circ = \frac{OP}{OB}$

$\Rightarrow 1 = \frac{h}{OB}$

$\Rightarrow OB = h$

Now, $OB - OA = 100$

$\Rightarrow h - \frac{h}{\sqrt{3}} = 100$

$\Rightarrow \frac{h\sqrt{3} - h}{\sqrt{3}} = 100$

$\Rightarrow \frac{h\left(\sqrt{3} - 1\right)}{\sqrt{3}} = 100$

$\Rightarrow h = \frac{100\sqrt{3}}{\left(\sqrt{3} - 1\right)} \times \frac{\left(\sqrt{3} + 1\right)}{\left(\sqrt{3} + 1\right)}$

$\Rightarrow h = \frac{100\sqrt{3}\left(\sqrt{3} + 1\right)}{\left(3 - 1\right)}$

$\Rightarrow h = \frac{100\left(3 + \sqrt{3}\right)}{2}$

$\Rightarrow h = 50\left(3 + 1.732\right)$

$\Rightarrow h = 50\left(4.732\right)$

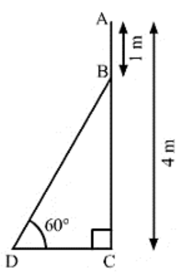
$\therefore h = 236.6\,m$

So, the height of the tower is 236.6 m.

Disclaimer. The answer given in the textbook is incorrect. The same has been rectified above.

32.

Sol:



Let AC be the pole and BD be the ladder

We have,

$AC = 4m, AB = 1m \text{ and } \angle BDC = 60°$

And, $BC = AC - AB = 4 - 1 = 3m$

In $\Delta BDC,$

$\sin 60° = \frac{BC}{BD}$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{3}{BD}$

$\Rightarrow BD = \frac{3 \times 2}{\sqrt{3}}$

$\Rightarrow BD = 2\sqrt{3}$

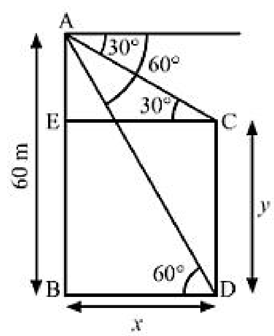
$\Rightarrow BD = 2 \times 1.73$

$\therefore BD = 3.46m$

So, he should use 3.46 m long ladder to reach the required position.

33.

Sol:



We have,

$AB = 60m, \angle ACE = 30° \text{ and } \angle ADB = 60°$

Let $BD = CE = x \text{ and } CD = BE = y$

$\Rightarrow AE = AB - BE = 60 - y$

In $\Delta ACE,$

$\tan 30° = \frac{AE}{CE}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{60-y}{x}$

$\Rightarrow x = 60\sqrt{3} - y\sqrt{3}$ ....(i)

Also, in ΔABD,

$\tan 60° = \frac{AB}{BD}$

$\Rightarrow \sqrt{3} = \frac{60}{x}$

$\Rightarrow x = \frac{60}{\sqrt{3}}$

$\Rightarrow x = \frac{60}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$\Rightarrow x = \frac{60-\sqrt{3}}{3}$

$\Rightarrow x = 20\sqrt{3}$

Substituting $x = 20\sqrt{3}$ in (i), we get

$20\sqrt{3} = 60\sqrt{3} - y\sqrt{3}$

$\Rightarrow y\sqrt{3} = 60\sqrt{3} - 20\sqrt{3}$

$\Rightarrow y\sqrt{3} = 40\sqrt{3}$

$\Rightarrow y = \frac{40\sqrt{3}}{\sqrt{3}}$

$\Rightarrow y = 40\,m$

(i) The horizontal distance between AB and CD = BD = x

$= 20\sqrt{3}$

$= 20 \times 1.732$

$= 34.64\,m$

(ii) The height of the lamp post $= CD = y = 40\,m$

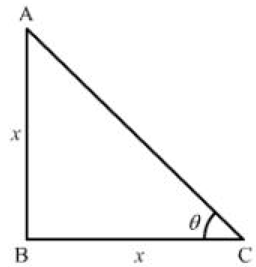
(iii) the difference between the heights of the building and the lamp post

$= AB - CD = 60 - 40 = 20\,m$

Exercise – Multiple Choice Question

1.

Sol:



Let AB represents the vertical pole and BC represents the shadow on the ground and θ represents angle of elevation the sun.

In ΔABC,

$\tan\theta = \frac{AB}{BC}$

$\Rightarrow \tan\theta = \frac{x}{x}$ (As, the height of the pole, $AB =$ the length of the shadow, $BC = x$)

$\Rightarrow \tan\theta = 1$

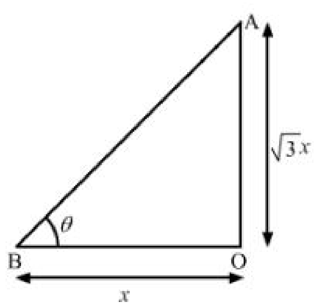
$\Rightarrow \tan\theta = \tan 45°$

$\therefore \theta = 45°$

Hence, the correct answer is option (c).

2.

Sol:



Here, AO be the pole; BO be its shadow and θ be the angle of elevation of the sun.

Let $BO = x$

Then, $AO = x\sqrt{3}$

In ΔAOB,

$$\tan\theta = \frac{AO}{BO}$$

$$\Rightarrow \tan\theta = \frac{x\sqrt{3}}{x}$$

$$\Rightarrow \tan\theta = \sqrt{3}$$

$$\Rightarrow \tan\theta = \tan 60°$$

$$\therefore \theta = 60°$$

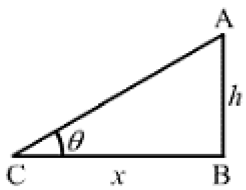
Hence, the correct answer is option (c).

3.

Ans: (b)

Sol:

Let AB be the pole and BC be its shadow.



Let $AB = h$ and $BC = x$ such that $x = \sqrt{3}h$ (given) and θ be the angle of elevation.

From ΔABC, we have

$$\frac{AB}{BC} = \tan\theta$$

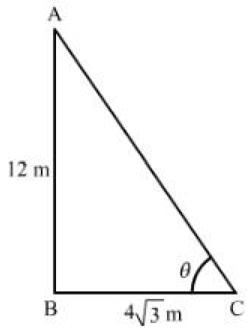
$$\Rightarrow \frac{h}{x} = \frac{h}{\sqrt{3}h} = \tan\theta$$

$$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \theta = 30°$$

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

4. Sol:



Let AB be the pole, BC be its shadow and θ be the sun's elevation.

We have,

$AB = 12\, m \text{ and } BC = 4\sqrt{3}\, m$

In ΔABC,

$$\tan\theta = \frac{AB}{BC}$$

$$\Rightarrow \tan\theta = \frac{12}{4\sqrt{3}}$$

$$\Rightarrow \tan\theta = \frac{3}{\sqrt{3}}$$

$$\Rightarrow \tan\theta = \frac{3}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\Rightarrow \tan\theta = \frac{3\sqrt{3}}{3}$$

$$\Rightarrow \tan\theta = \sqrt{3}$$

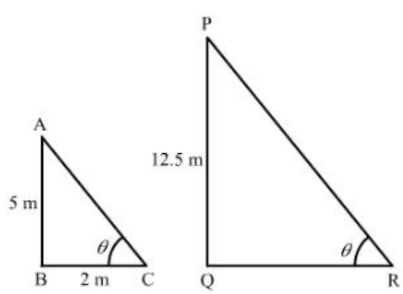
$$\Rightarrow \tan\theta = \tan 60°$$

$$\therefore \theta = 60°$$

Hence, the correct answer is option (a).

5.

Sol:



Let AB be a stick and BC be its shadow, and PQ be the tree and QR be its shadow.
We have,

$AB = 5m, BC = 2m, PQ = 12.5\ m$

In ΔABC,

$$\tan\theta = \frac{AB}{BC}$$

$$\Rightarrow \tan\theta = \frac{5}{2} \qquad ....(i)$$

Now, in ΔPQR,

$$\tan\theta = \frac{PQ}{QR}$$

$$\Rightarrow \frac{5}{2} = \frac{12.5}{QR} \qquad \text{[Using (i)]}$$

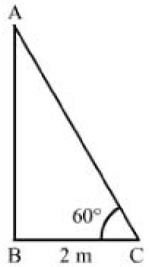
$$\Rightarrow QR = \frac{125 \times 2}{5} = \frac{25}{5}$$

$$\therefore QR = 5m$$

Hence, the correct answer is option (d).

6.

Sol:



Let AB be the wall and AC be the ladder.
We have,

$BC = 2m\ and\ \angle ACB = 60°$

In ΔABC,

$$\cos 60° = \frac{BC}{AC}$$

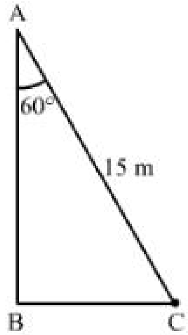
$$\Rightarrow \frac{1}{2} = \frac{2}{AC}$$

$\therefore AC = 4m$

Hence, the correct answer is option (d).

7.

Sol:



Let AB be the wall and AC be the ladder

We have,

$AC = 15m \text{ and } \angle BAC = 60°$

$\cos 60° = \frac{AB}{AC}$

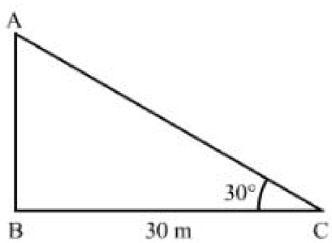
$\Rightarrow \frac{1}{2} = \frac{AB}{15}$

$\therefore AB = \frac{15}{2} \; m$

Hence, the correct answer is option (c).

8.

Sol:



Let AB be the tower and point C be the point of observation on the ground.

We have,

$BC = 30\,m \ and \ \angle ACB = 30°$

In ΔABC,

$$\tan 30° = \frac{AB}{BC}$$

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

$$\Rightarrow AB = \frac{30}{\sqrt{3}}$$

$$\Rightarrow AB = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

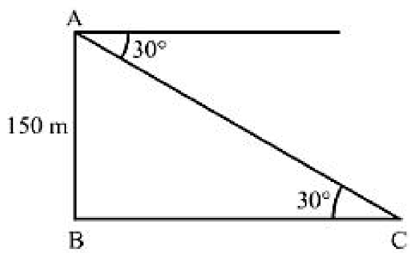
$$\Rightarrow AB = \frac{30\sqrt{3}}{3}$$

$\therefore AB = 10\sqrt{3}\ m$

Hence, the correct answer is option (b).

9.

Sol:



Let AB be the tower and point C be the position of the car.
We have,

$AB = 150\,m \ and \ \angle ACB = 30°$

In ΔABC,

$$\tan 30° = \frac{AB}{BC}$$

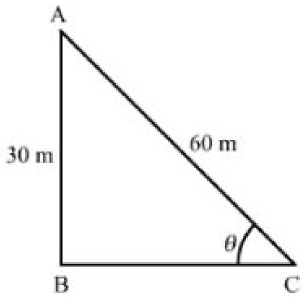
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{150}{BC}$$

$\therefore BC = 150\sqrt{3}\ m$

Hence, the correct answer is option (b).

10.

Sol:



Let point A be the position of the kite and AC be its string

We have,

$AB = 30m \text{ and } AC = 60m$

Let $\angle ACB = \theta$

In ΔABC,

$$\sin\theta = \frac{AB}{AC}$$

$$\Rightarrow \sin\theta = \frac{30}{60}$$

$$\Rightarrow \sin\theta = \frac{1}{2}$$

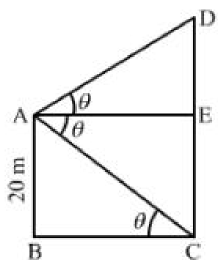
$$\Rightarrow \sin\theta = \sin 30°$$

$$\therefore \theta = 30°$$

Hence, the correct answer is option (b).

11.

Sol:



Let AB be the cliff and CD be the tower.

We have,

$AB = 20\,m$

Also, $CE = AB = 20\,m$

Let $\angle ACB = \angle CAE = \angle DAE = \theta$

In ΔABC,

$$\tan\theta = \frac{AB}{BC}$$

$$\Rightarrow \tan\theta = \frac{20}{BC}$$

$$\Rightarrow \tan\theta = \frac{20}{AE} \qquad (As,\ BC = AE)$$

$$\Rightarrow AE = \frac{20}{\tan\theta} \qquad ....(i)$$

Also, in ΔADE,

$$\tan\theta = \frac{DE}{AE}$$

$$\Rightarrow \tan\theta = \frac{DE}{\left(\frac{20}{\tan\theta}\right)} \qquad \text{[Using (i)]}$$

$$\Rightarrow \tan\theta = \frac{DE\times\tan\theta}{20}$$

$$\Rightarrow DE = \frac{20\times\tan\theta}{\tan\theta}$$

$$\Rightarrow DE = 20\,m$$

Now, $CD = DE + CE$

$= 20 + 20$

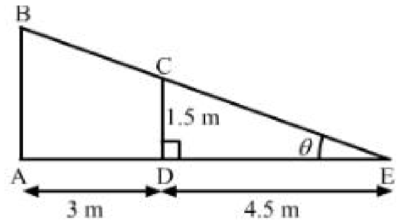
$\therefore CD = 40\,m$

Hence, the correct answer is option (b).

Disclaimer. The answer given in the textbook is incorrect. The same has been rectified above.

12.

Sol:



Let AB be the lamp post; CD be the girl and DE be her shadow.

We have,

$CD = 1.5m, AD = 3m, DE = 4.5m$

Let $\angle E = \theta$

In $\Delta CDE,$

$\tan\theta = \frac{CD}{DE}$

$\Rightarrow \tan\theta = \frac{1.5}{4.5}$

$\Rightarrow \tan\theta = \frac{1}{3}$ ....(i)

Now, in $\Delta ABE,$

$\tan\theta = \frac{AB}{AE}$

$\Rightarrow \frac{1}{3} = \frac{AB}{AD + DE}$ [Using (i)]

$\Rightarrow \frac{1}{3} = \frac{AB}{3 + 4.5}$

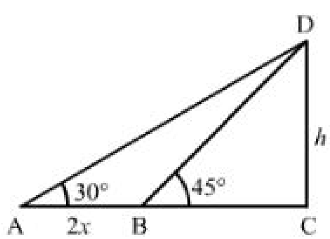
$\Rightarrow AB = \frac{7.5}{3}$

$\Rightarrow \therefore AB = 2.5m$

Hence, the correct answer is option (c).

13.

Sol:



Let CD = h be the height of the tower.
We have,
$AB = 2x, \angle DAC = 30° \text{ and } \angle DBC = 45°$
In $\Delta BCD,$

$\tan 45° = \frac{CD}{BC}$

$\Rightarrow 1 = \frac{h}{BC}$

$\Rightarrow BC = h$

Now, in $\Delta ACD,$

$\tan 30° = \frac{CD}{AC}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{AB + BC}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{2x + h}$

$\Rightarrow 2x + h = h\sqrt{3}$

$\Rightarrow h\sqrt{3} - h = 2x$

$\Rightarrow h\left(\sqrt{3} - 1\right) = 2x$

$\Rightarrow h = \frac{2x}{\left(\sqrt{3} - 1\right)} \times \frac{\left(\sqrt{3} + 1\right)}{\left(\sqrt{3} + 1\right)}$

$\Rightarrow h = \frac{2x\left(\sqrt{3} + 1\right)}{\left(\sqrt{3} - 1\right)}$

$\Rightarrow h = \frac{2x\left(\sqrt{3} + 1\right)}{2}$

$\therefore h = x\left(\sqrt{3} + 1\right) m$

Hence, the correct answer is option (d).

14.

Sol:

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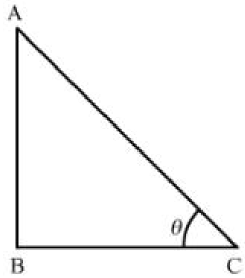
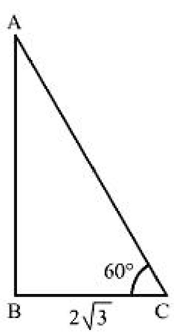


Let AB be the rod and BC be its shadow; and θ be the angle of elevation of the sun.
We have,
$AB : BC = 1 : \sqrt{3}$
Let $AB = x$
Then, $BC = x\sqrt{3}$
In ΔABC,
$$\tan\theta = \frac{AB}{BC}$$
$$\Rightarrow \tan\theta = \frac{x}{x\sqrt{3}}$$
$$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$$
$$\Rightarrow \tan\theta = \tan 30°$$
$$\therefore \theta = 30°$$
Hence, the correct answer is option (a).

15.

Sol:



Let AB be the pole and BC be its shadow.
We have,
$BC = 2\sqrt{3}m \ and \ \angle ACB = 60°$

In ΔABC,

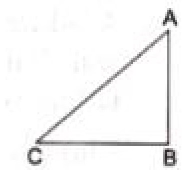
$$\tan 60° = \frac{AB}{BC}$$

$$\Rightarrow \sqrt{3} = \frac{AB}{2\sqrt{3}}$$

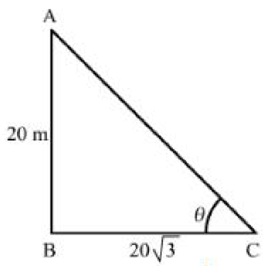
$$\therefore AB = 6m$$

Hence, the correct answer is option (b).

16.



Sol:



Let the sun's altitude be θ.

We have,

$AB = 20m$ *and* $BC = 20\sqrt{3}\ m$

In ΔABC,

$$\tan\theta = \frac{AB}{BC}$$

$$\Rightarrow \tan\theta = \frac{20}{20\sqrt{3}}$$

$$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}}$$

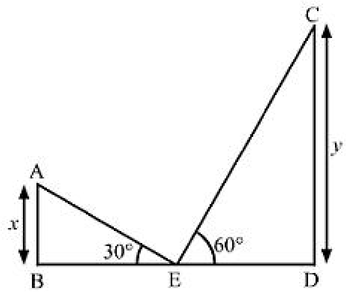
$$\Rightarrow \tan\theta = \tan 30°$$

$$\therefore \theta = 30°$$

Hence, the correct answer is option (a).

17.

Sol:



Let AB and CD be the two towers such that $AB = x$ and $CD = y$.

We have,

$\angle AEB = 30°, \angle CED = 60°$ and $BE = DE$

In ΔABE,

$$\tan 30° = \frac{AB}{BE}$$

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

$$\Rightarrow BE = x\sqrt{3}$$

Also, in ΔCDE,

$$\tan 60° = \frac{CD}{DE}$$

$$\Rightarrow \sqrt{3} = \frac{y}{DE}$$

$$\Rightarrow DE = \frac{y}{\sqrt{3}}$$

As, $BE = DE$

$$\Rightarrow x\sqrt{3} = \frac{y}{\sqrt{3}}$$

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

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

$\therefore x : y = 1 : 3$

Hence, the correct answer is option (c).

18. **Ans:** (b)

Sol:

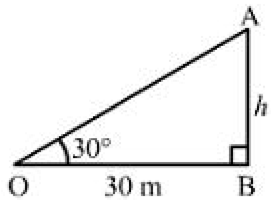
Let AB be the tower and O be the point of observation.

Also,

$\angle AOB = 30° \text{ and } OB = 30m$

Let:

$AB = hm$



In ΔAOB, we have:

$$\frac{AB}{OB} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h}{30} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow h = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{30\sqrt{3}}{3} = 10\sqrt{3}m.$$

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

19.

Ans: (a)

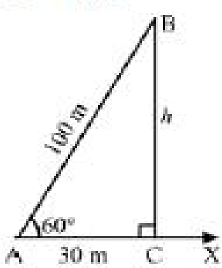
Sol:

Let AB be the string of the kite and AX be the horizontal line.

If $BC \perp AX$, then $AB = 100m \text{ and } \angle BAC = 60°$

Let:

$BC = hm$



In the right ΔACB, we have:

$$\frac{BC}{AB} = \sin 60° = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \frac{h}{100} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow h = \frac{100\sqrt{3}}{2} = 50\sqrt{3}\,m$$

Hence, the height of the kite is $50\sqrt{3}\,m$.

20.

Ans: (b)

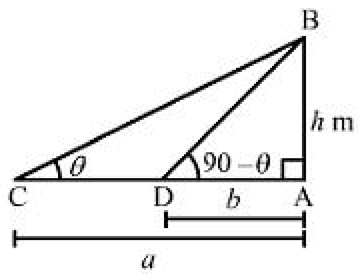
Sol:

Let:AB be the tower and C and D bee the points of observation on AC.

$\angle ACB = \theta, \angle ADB = 90 - \theta$ *and* $AB = h\,m$

Thus, we have:

$AC = a,\ AD = b$ *and* $CD = a - b$



Now, in the right $\Delta ABC,$ we have:

$$\tan\theta = \frac{AB}{AC} \Rightarrow \frac{h}{a} = \tan\theta \qquad ....(i)$$

In the right $\Delta ABD,$ we have:

$$\tan(90 - \theta) = \frac{AB}{AD} \Rightarrow \cot\theta = \frac{h}{b} \qquad ....(ii)$$

On multiplying (i) and (ii), we have:

$$\tan\theta \times \cot\theta = \frac{h}{a} \times \frac{h}{b}$$

$$\Rightarrow \frac{h}{a} \times \frac{h}{b} = 1 \qquad \left[\because \tan\theta = \frac{1}{\cot\theta}\right]$$

$\Rightarrow h^2 = ab$

$\Rightarrow h = \sqrt{ab}\ m$

Hence, the height of the tower is $\sqrt{ab}\ m$.

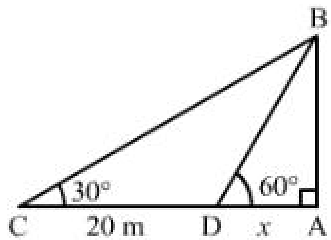
21.

Ans: (b)

Sol:

Let AB be the tower and C and D be the points of observation such that

$\angle BCD = 30°, \angle BDA = 60°, CD = 20\,m \text{ and } AD = x\,m.$



Now, in $\Delta ADB,$ we have:

$\frac{AB}{AD} = \tan 60° = \sqrt{3}$

$\Rightarrow \frac{AB}{x} = \sqrt{3}$

$\Rightarrow AB = \sqrt{3}x$

In $\Delta ACB,$ we have:

$\frac{AB}{AC} = \tan 30° = \frac{1}{\sqrt{3}}$

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

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

$\Rightarrow 3x = 20 + x$

$\Rightarrow 2x = 20 \Rightarrow x = 10$

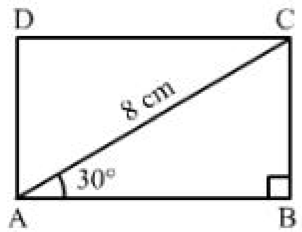
$\therefore$ Height of the tower $AB = \sqrt{3}x = 10\sqrt{3}\,m$

22.

Ans: (c)

Sol:

Let $ABCD$ be the rectangle in which $\angle BAC = 30° \text{ and } AC = 8 \text{ cm}$.



In ΔBAC, we have:

$$\frac{AB}{AC} = \cos 30° = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \frac{AB}{8} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow AB = 8\frac{\sqrt{3}}{2} = 4\sqrt{3}m$$

Again,

$$\frac{BC}{AC} = \sin 30° = \frac{1}{2}$$

$$\Rightarrow \frac{BC}{8} = \frac{1}{2}$$

$$\Rightarrow BC = \frac{8}{2} = 4 \ m$$

$\therefore$ Area of the rectangle $= (AB \times BC) = \left(4\sqrt{3} \times 4\right) = 16\sqrt{3} \ cm^2$

23.

Ans: (b) $\frac{1}{2}\left(\sqrt{3}+1\right)km$

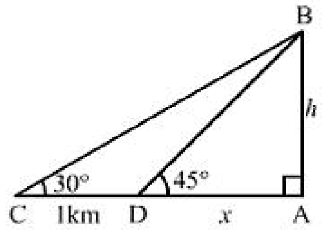
Sol:

Let AB be the hill making angles of depression at points C and D such that

$\angle ADB = 45°, \angle ACB = 30° \text{ and } CD = 1 \ km.$

Let:

$AB = h \ km \text{ and } AD = x \ km$



In ΔADB, we have:

$$\frac{AB}{AD} = \tan 45^\circ = 1$$

$$\Rightarrow \frac{h}{x} = 1 \Rightarrow h = x \qquad ....(i)$$

In ΔACB, we have:

$$\frac{AB}{AC} = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{h}{x+1} = \frac{1}{\sqrt{3}} \qquad ....(ii)$$

On putting the value of h taken from (i) in (ii), we get:

$$\frac{h}{h+1} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \sqrt{3}h = h+1$$

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

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

On multiplying the numerator and denominator of the above equation by $\left(\sqrt{3}+1\right)$, we get:

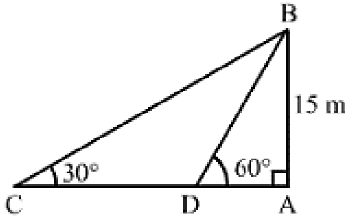
$$h = \frac{1}{\left(\sqrt{3}-1\right)} \times \frac{\left(\sqrt{3}+1\right)}{\left(\sqrt{3}+1\right)} = \frac{\left(\sqrt{3}+1\right)}{3-1} = \frac{\left(\sqrt{3}+1\right)}{2} = \frac{1}{2}\left(\sqrt{3}+1\right)km$$

Hence, the height of the hill is $\frac{1}{2}\left(\sqrt{3}+1\right)km.$

24.

Ans: (c)
Sol:
Let AB be the pole and AC and AD be its shadows.
We have:

$\angle ACB = 30°, \angle ADB = 60°$ *and* $AB = 15m$



In $\Delta ACB,$ we have

$$\frac{AC}{AB} = \cot 30° = \sqrt{3}$$

$$\Rightarrow \frac{AC}{15} = \sqrt{3} \Rightarrow AC = 15\sqrt{3}m$$

Now, in $\Delta ADB,$ we have:

$$\frac{AD}{AB} = \cot 60° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \frac{AD}{15} = \frac{1}{\sqrt{3}} \Rightarrow AD = \frac{15}{\sqrt{3}} = \frac{15\times\sqrt{3}}{\sqrt{3}\times\sqrt{3}} = \frac{15\sqrt{3}}{3} = 5\sqrt{3}\ m.$$

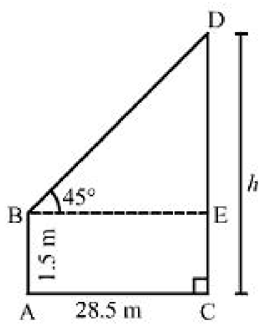
$\therefore$ Difference between the lengths of the shadows $= AC - AD = 15\sqrt{3} - 5\sqrt{3} = 10\sqrt{3}\ m$

25.

Ans: (b)

Sol:

Let AB be the observer and CD be the tower.



Draw $BE \perp CD,$ let $CD = h$ meters. Then,

$AB = 1.5m, BE = AC = 28.5m$ *and* $\angle EBD = 45°$

$DE = (CD - EC) = (CD - AB) = (h - 1.5)m.$

In right $\Delta BED,$ we have:

$$\frac{DE}{BE} = \tan 45° = 1$$

$$\Rightarrow \frac{(h-1.5)}{28.5} = 1$$

$$\Rightarrow h = 1.5 = 28.5$$

$$\Rightarrow h = 28.5 + 1.5 = 30\,m$$

Hence, the height of the tower is 30 m.

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