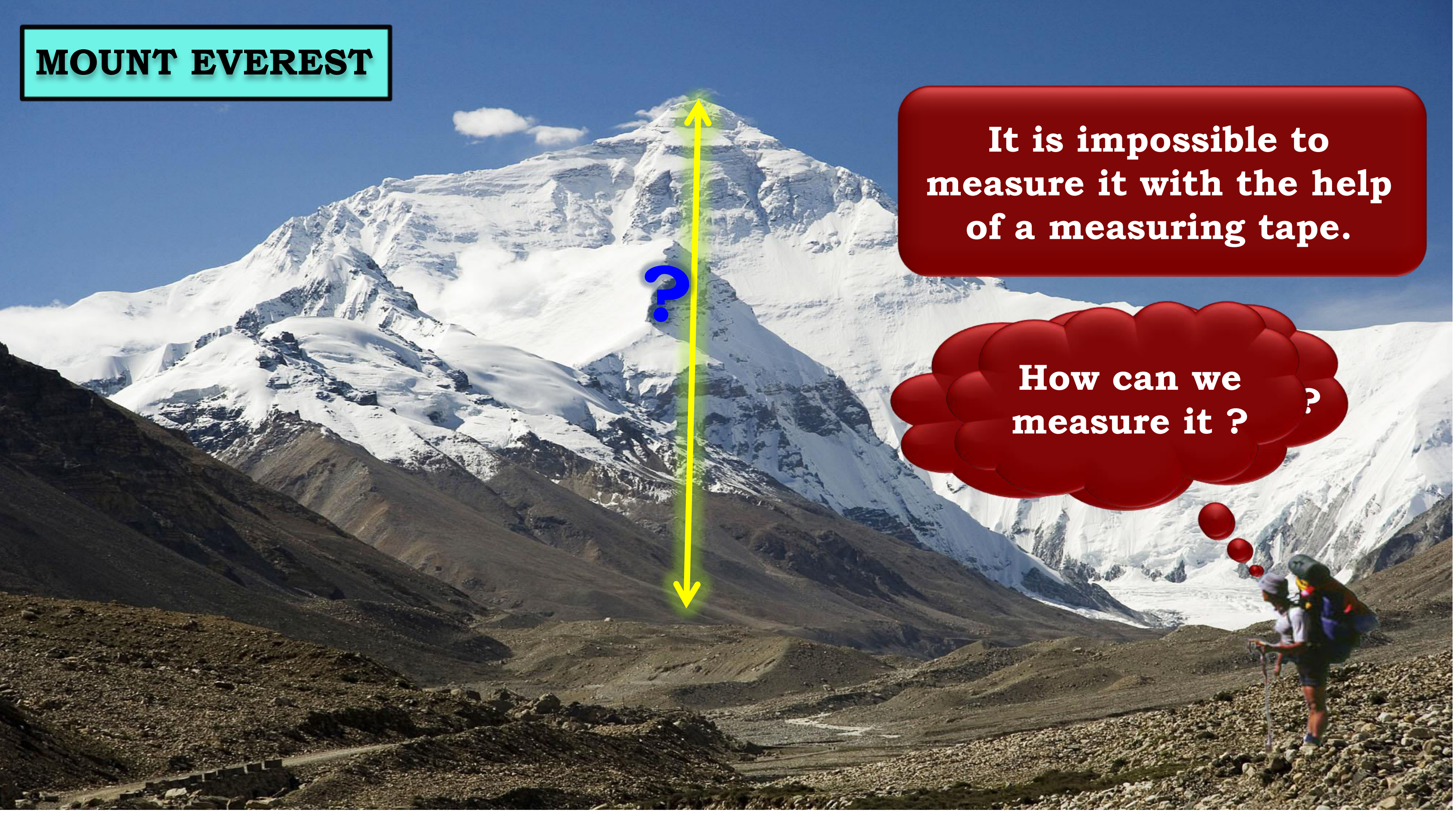
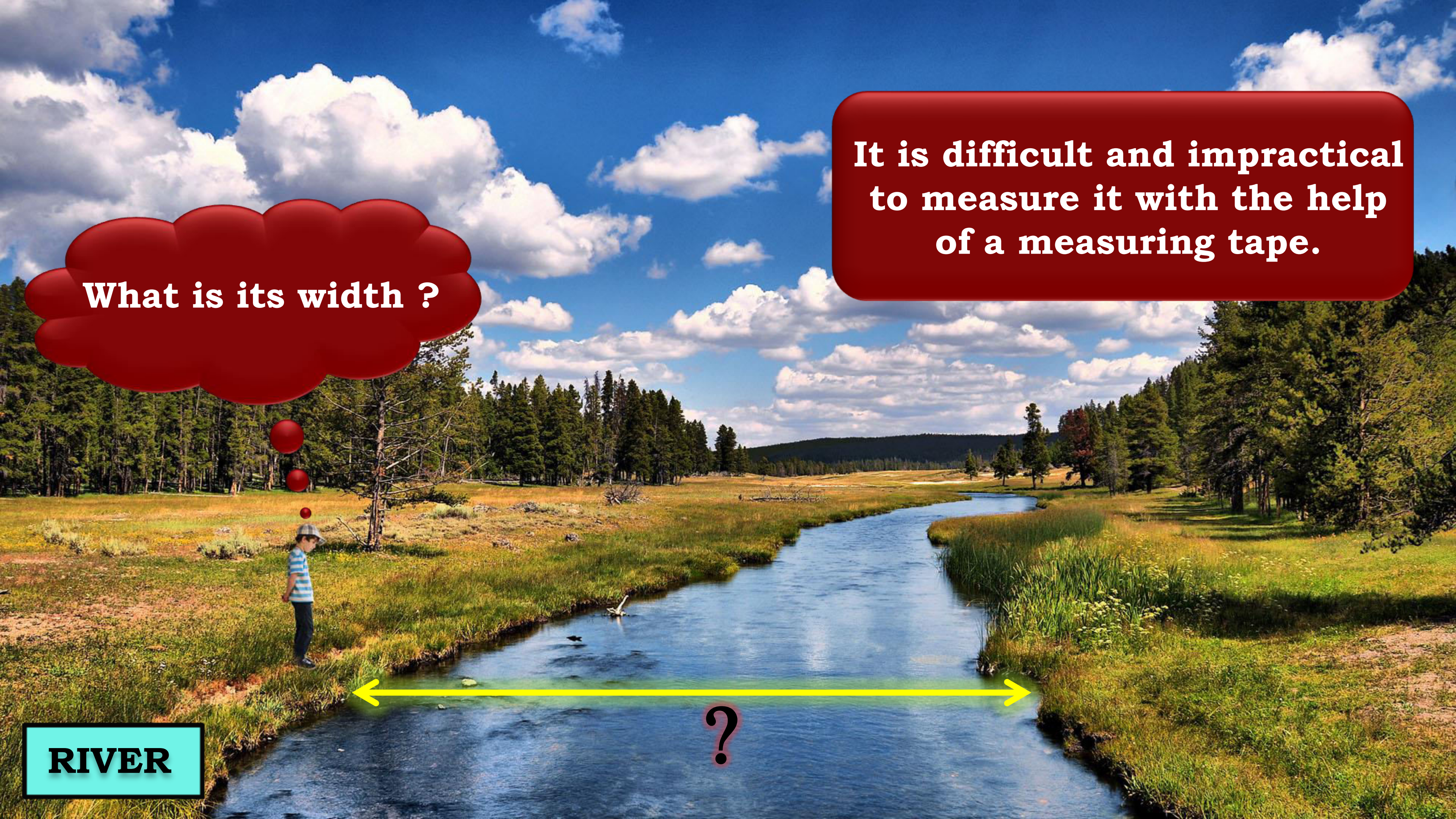
SOME APPLICATIONS OF TRIGONOMETRY

- Introduction

Module 1


MOUNT EVEREST
?
It is impossible to measure it with the help of a measuring tape.
How can we measure it ?


What is its width ?
It is difficult and impractical to measure it with the help of a measuring tape.
?
RIVER

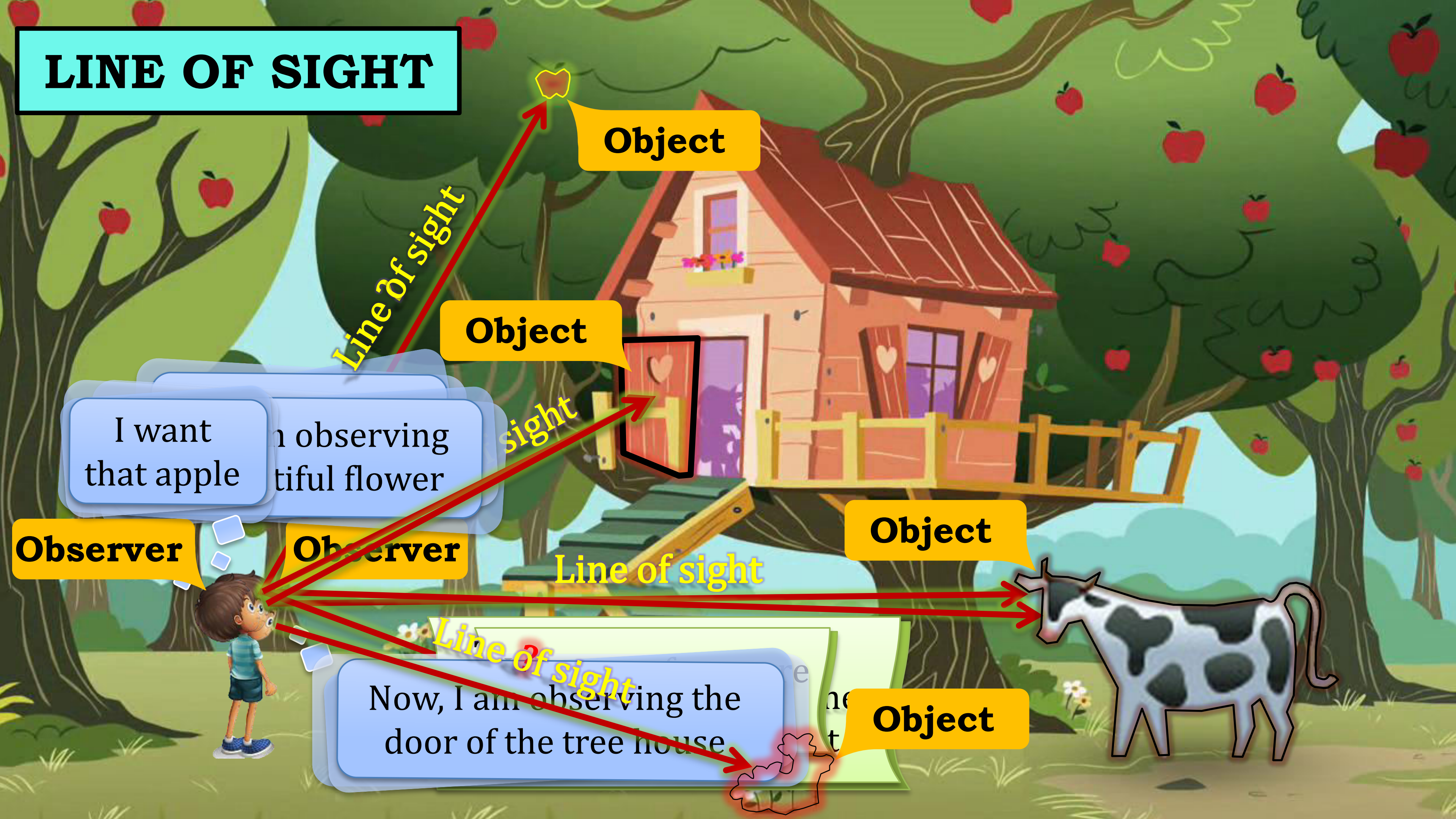

EIFFEL TOWER
It is impossible to measure it with the help of a measuring tape.
Hey...Its looking beautiful.
Yes
at is its height ?

Such Heights and Distances can be found by Applying TRIGONOMETRY.

We need to learn few important terms :

1. Line of sight
2. Horizontal line
3. Angle of Elevation
4. Angle of Depression

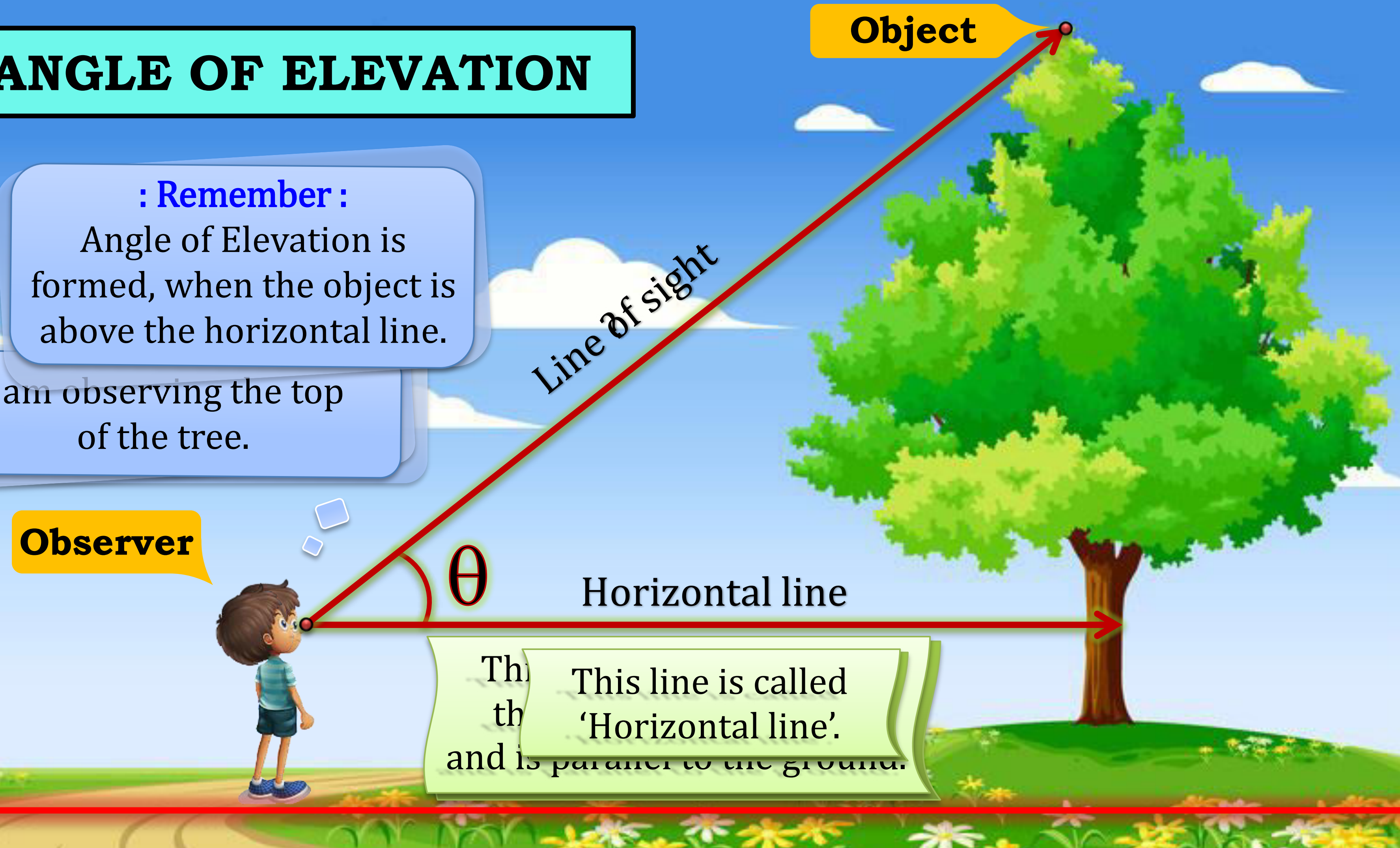
I am going to explain you all the important terms.


LINE OF SIGHT
Object
Line of sight
Object
I want that apple
observing
flower
sight
Observer
Observer
Object
Line of sight
Line of sight
Now, I am observing the door of the tree house
Object

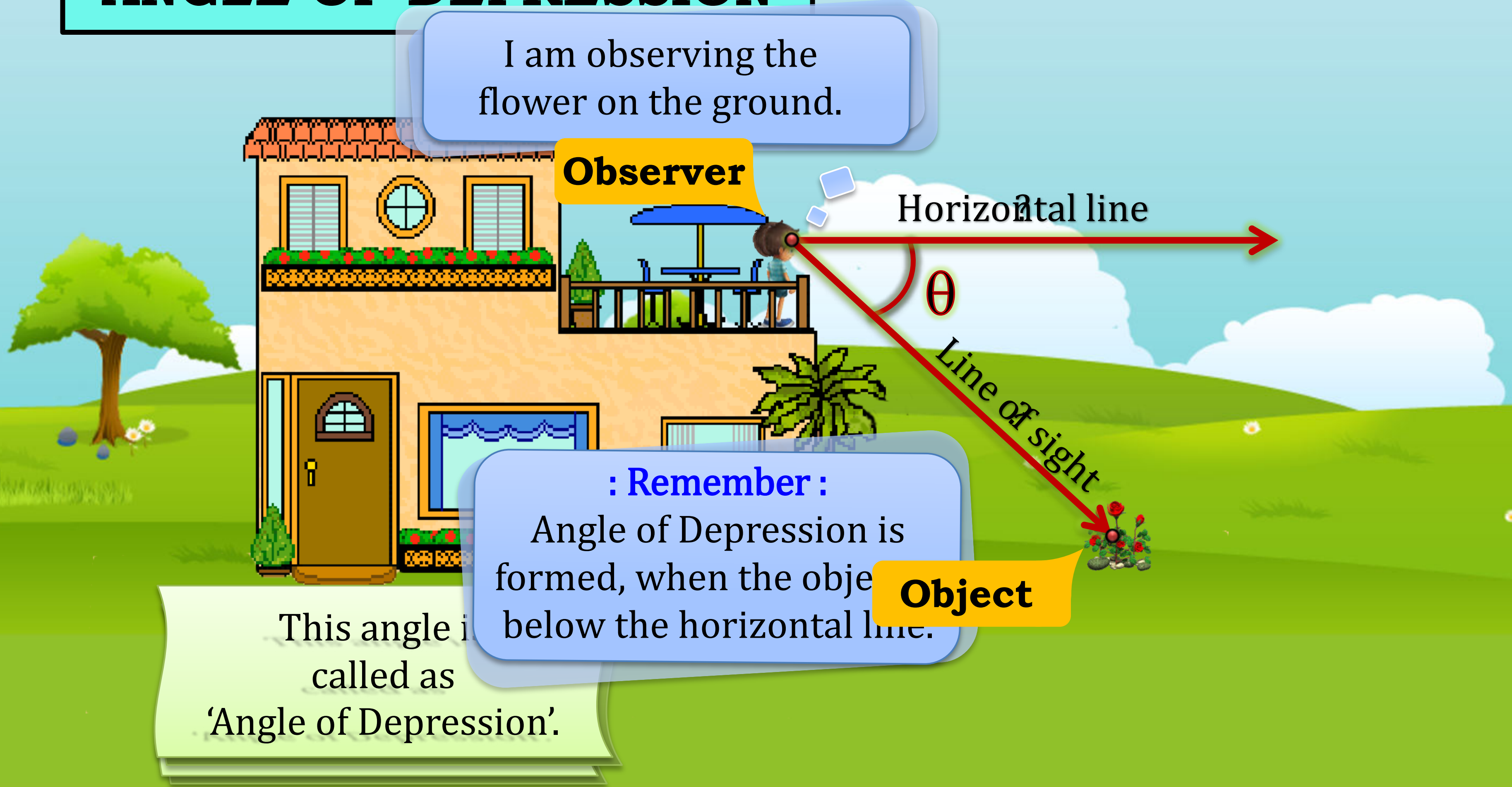
ANGLE OF ELEVATION

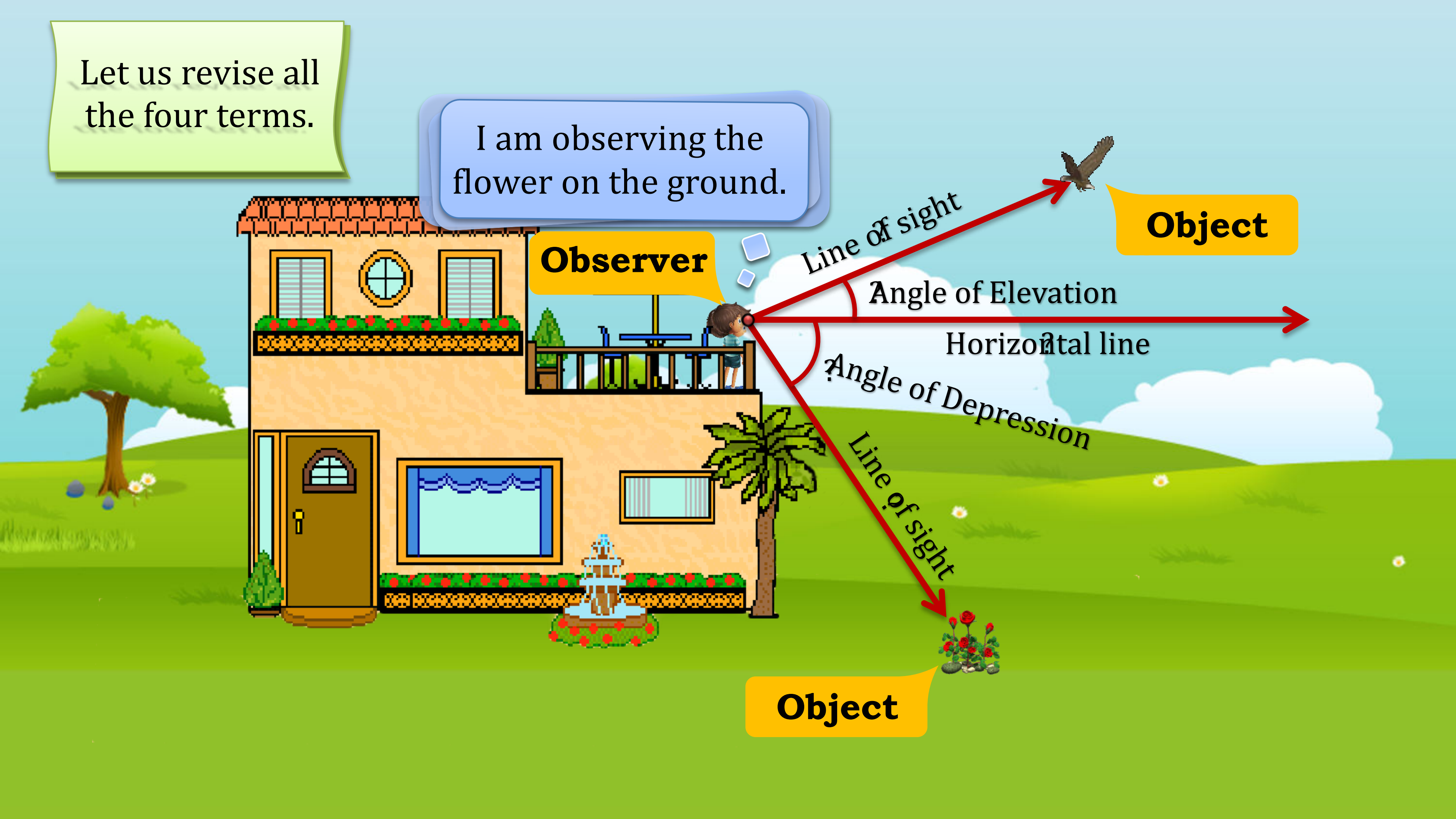
: Remember :
Angle of Elevation is formed, when the object is above the horizontal line.

I am observing the top of the tree.



ANGLE OF DEPRESSION

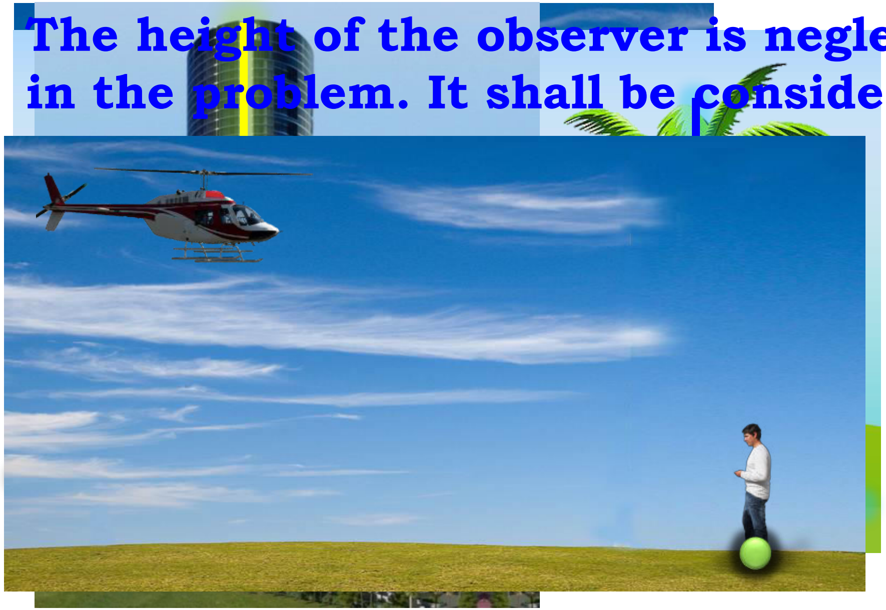




Let us revise all the four terms.
I am observing the flower on the ground.
Observer
Object
Line of sight
Angle of Elevation
Horizontal line
Angle of Depression
Line of sight
Object

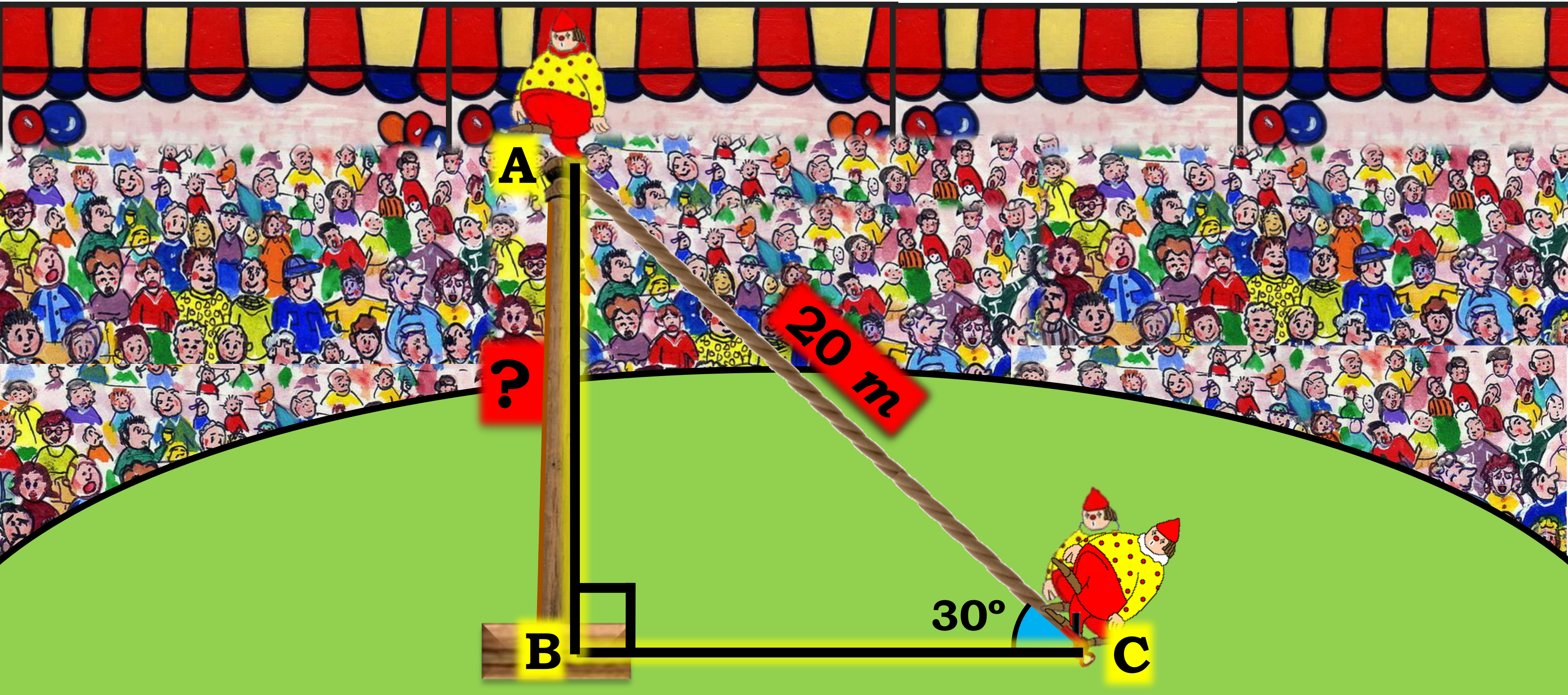
Points to be remembered while drawing the figures to solve the problems :

1. All the **heights of** objects such as **towers, trees, buildings,** etc. shall be considered as a **'line segment perpendicular to the ground'.**
2. The height of the observer is neglected, if it is **not given** in the problem. It shall be considered as a **'point'.**



Module 2

Q. A circus artist is climbing a 20m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the height of the pole, if the angle made by the rope with the ground level is 30°.



Q. A circu... ...ope,
which ... the
top of ...
Find t...
made ... is 30°.

Ratio ...
Hypo...

For '∠C'
Opposite side → AB
Hypotenuse → AC

Sol. L...) = 20 *m*

L... ole (AB) be '*h*' *m*

In ri... ΔABC,

$\sin 30^\circ = \frac{1}{2}$

$$\sin 30^\circ = \frac{AB}{AC}$$

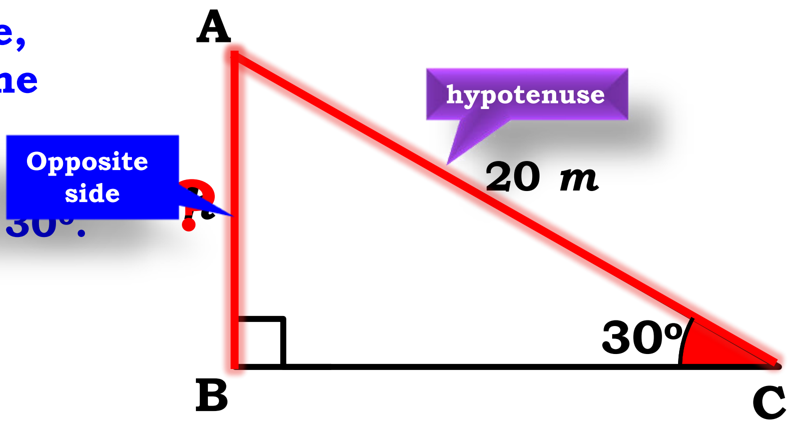
$$\therefore \quad \frac{1}{2} = \frac{h}{20}$$

$$\therefore \quad 2h = 20$$

$$\therefore \quad h = \frac{20}{2}$$

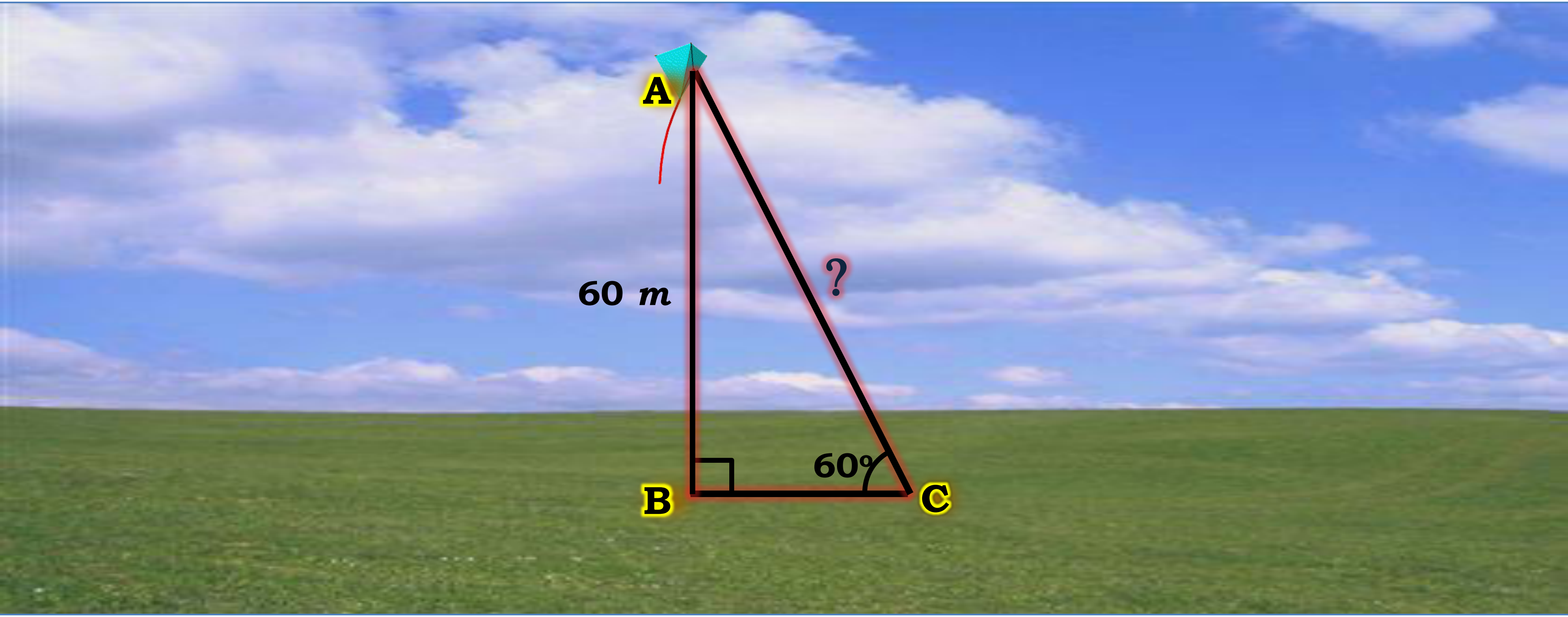
$$\therefore \quad h = 10$$

∴ **Height of the pole is 10 *m***



Module 3

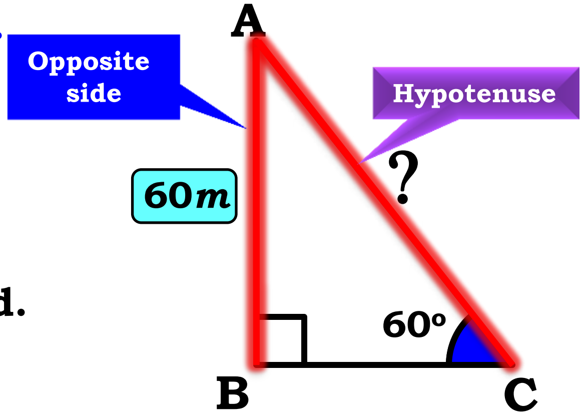
Q. **A kite is flying at a height of 60m above the ground. The string attached to the kite is temporarily tied to the ground. The inclination of the string with the ground is 60°. Find the length of the string, assuming that there is no slack in the string.**



Q. A kite is fl... the ground.
The string ... rily tied
to the gro... g with
the groun... tring,
assuming ... ng.

Ratio ... nd
Hypo ... of

Now, let us rationalise the denominator



Sol.

AB represents the distance of the kite from ground.

AB = 60 m.

AC re... th of the string.

∠ACB ...

In righ...

$\sin 60^\circ = \frac{\sqrt{3}}{2}$

$$\sin 60^\circ = \frac{AB}{AC}$$

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

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

$$\therefore \quad AC = \frac{120}{\sqrt{3}}$$

$$\therefore \quad AC = \frac{120}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\therefore \quad AC = \frac{\overset{40}{\cancel{120}}\sqrt{3}}{\cancel{3}}$$

$\sqrt{3} = 1.73$

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

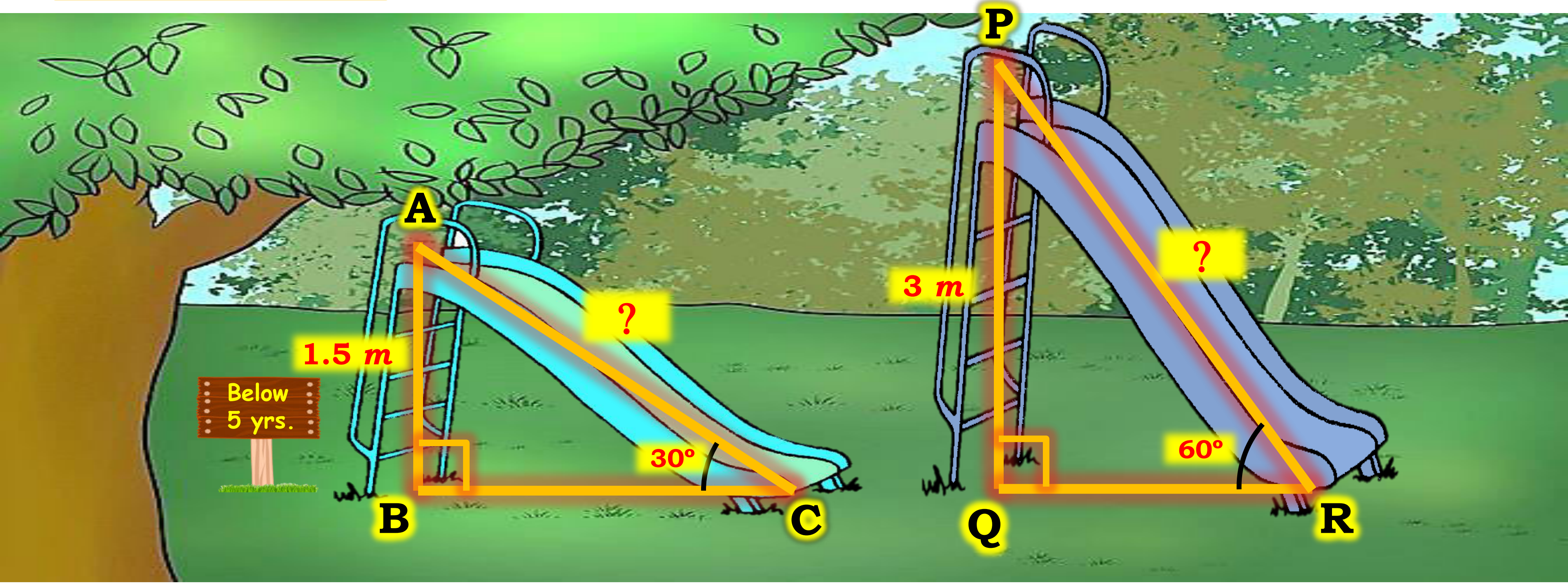
$$\therefore \quad AC = 40 \times 1.73$$

$$\therefore \quad AC = 69.2\ m$$

∴ The length of the string is 69.2 *m*

Module 4

Q. A contractor plans to install two slides for the children to play in a park. For the children below the age of 5 years, she prefers to have a slide whose top is at a height of 1.5 m, and is inclined at an angle of 30° to the ground, whereas for elder children, she wants to have a steep slide at a height of 3m, and inclined at an angle of 60° to the ground. What should be the length of the slide in each case?



Q. A contractor plans to install two slides for the children

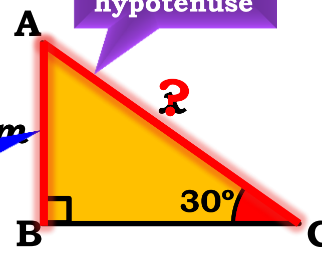
t... below the ... slide whose ... and ... clined at ... us of ... as f... ... stee... s... d at an angle of 60° to the ground.

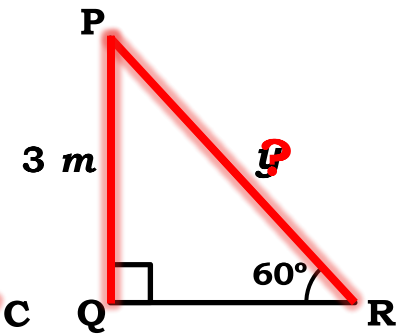
What should be the length of the slide in each

For '∠C'

Opposite side → AB

Hypotenuse → AC





Sol.

Let the length of slide for the children below 5 years (AC) be 'x' m

Length of slide for the elder children (PR) be 'y' m

Height of 1st slide (AB) = 1.5 m

Height of 2nd slide (PQ) = 3 m

$\sin 30° = \frac{1}{2}$

...dren :

In ri... ΔABC,

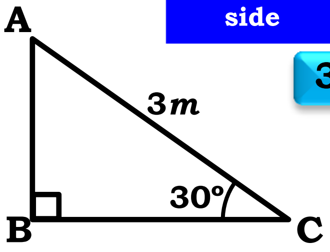
$\sin 30° = \frac{AB}{AC}$

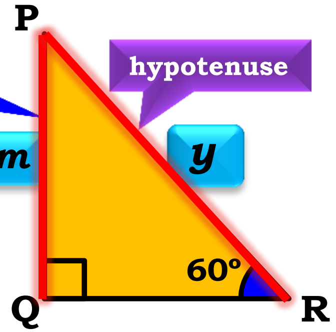
$\therefore \quad \frac{1}{2} = \frac{1.5}{x}$

$\therefore \quad x = 1.5 \times 2$

$\therefore \quad x = 3$

Q. A contractor plans to install two slides for the children
to play ... the
age of ... whose
top is a ... at
an ang...
elder ch...
slide at a height of 3m, and inclined at an
angle of 60° to the ground.
Wh... ength of the slide in each case?





Ratio of opposite side and Hypotenuse reminds us of **'sin'**

Sol. ... en :

$\sin 60° = \frac{\sqrt{3}}{2}$

In right ΔPQR,

$\sin 60° = \frac{PQ}{PR}$

$\therefore \quad \frac{\sqrt{3}}{2} = \frac{3}{y}$

$\therefore \quad \sqrt{3}y = 3 \times 2$

$\therefore \quad y = \frac{6}{\sqrt{3}}$

$\therefore \quad y = \frac{6}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$\therefore \quad y = \ldots$

$\sqrt{3} = 1.73$

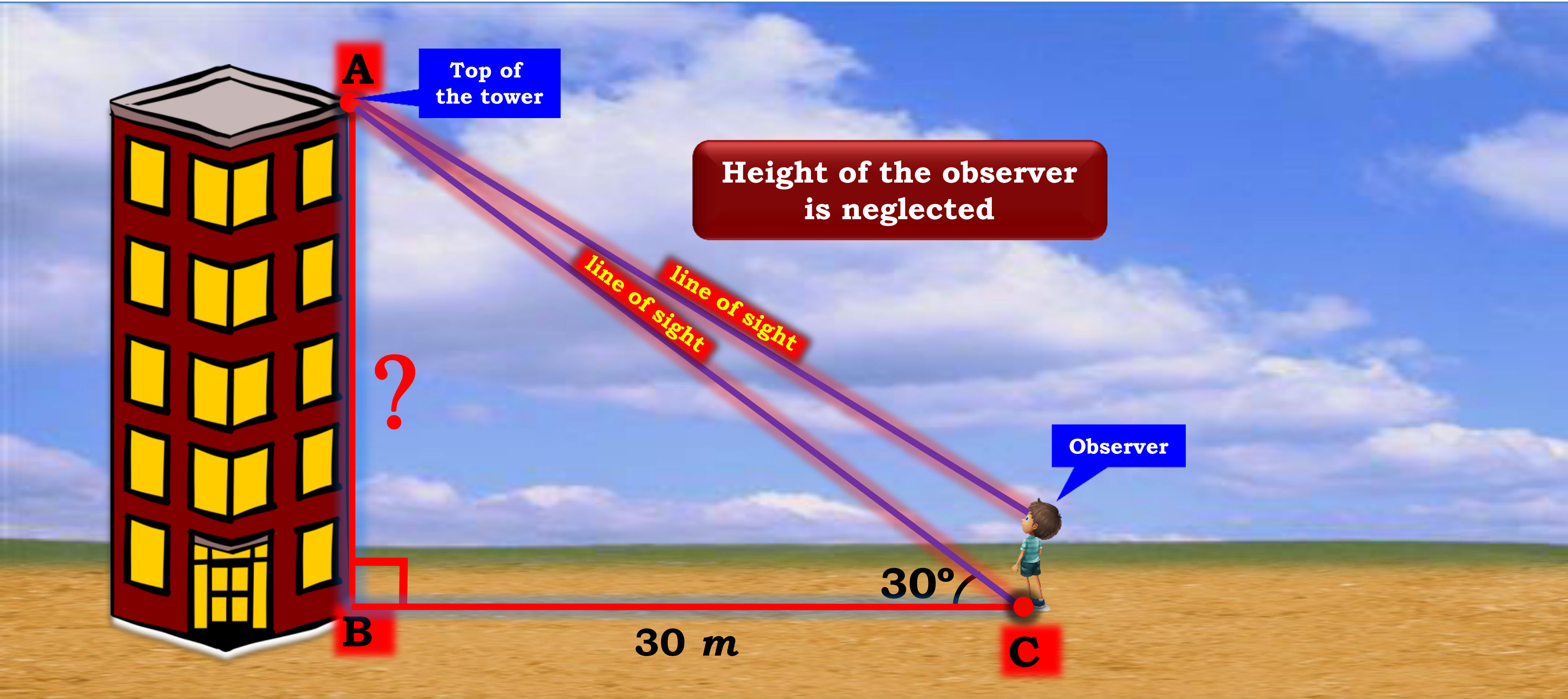
$\therefore \quad y = 2\sqrt{3}$

$\therefore \quad y = 2 \times 1.73 = 3.46$

$\therefore$ **Length of slide for children below 5 years is 3 m and length of slide for elder children is 3.46 m**

Module 5

Q. 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.



Q. The angle ... **wer from a point on** ... **y from the foot of t** ... **t of the tower**

Now, let us rationalise the denominator

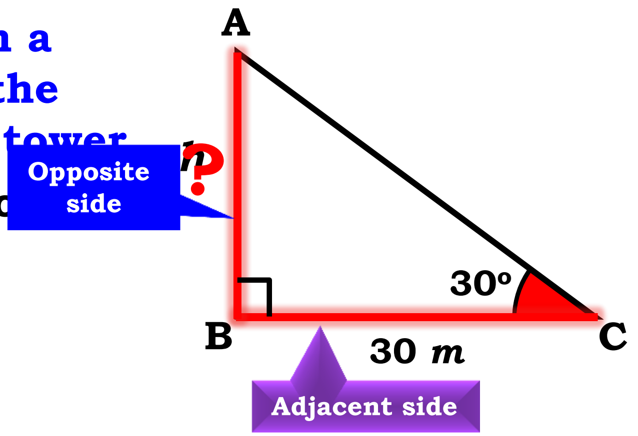
Sol. Distanc ... **a point o**

gr ...

Le ... **ole (AB) be 'h' m**

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

In ri ... **ΔABC,**



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

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{h}{30}$$

$$\therefore \quad \sqrt{3} \times h = 30$$

$$\therefore \quad h = \frac{30}{\sqrt{3}}$$

$$\therefore \quad h = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\therefore \quad h = \frac{\overset{10}{\cancel{30}}\sqrt{3}}{\cancel{3}}$$

$\sqrt{3} = 1.73$

$$\therefore \quad h = 10\sqrt{3}$$

$$\therefore \quad h = 10 \times 1.73$$

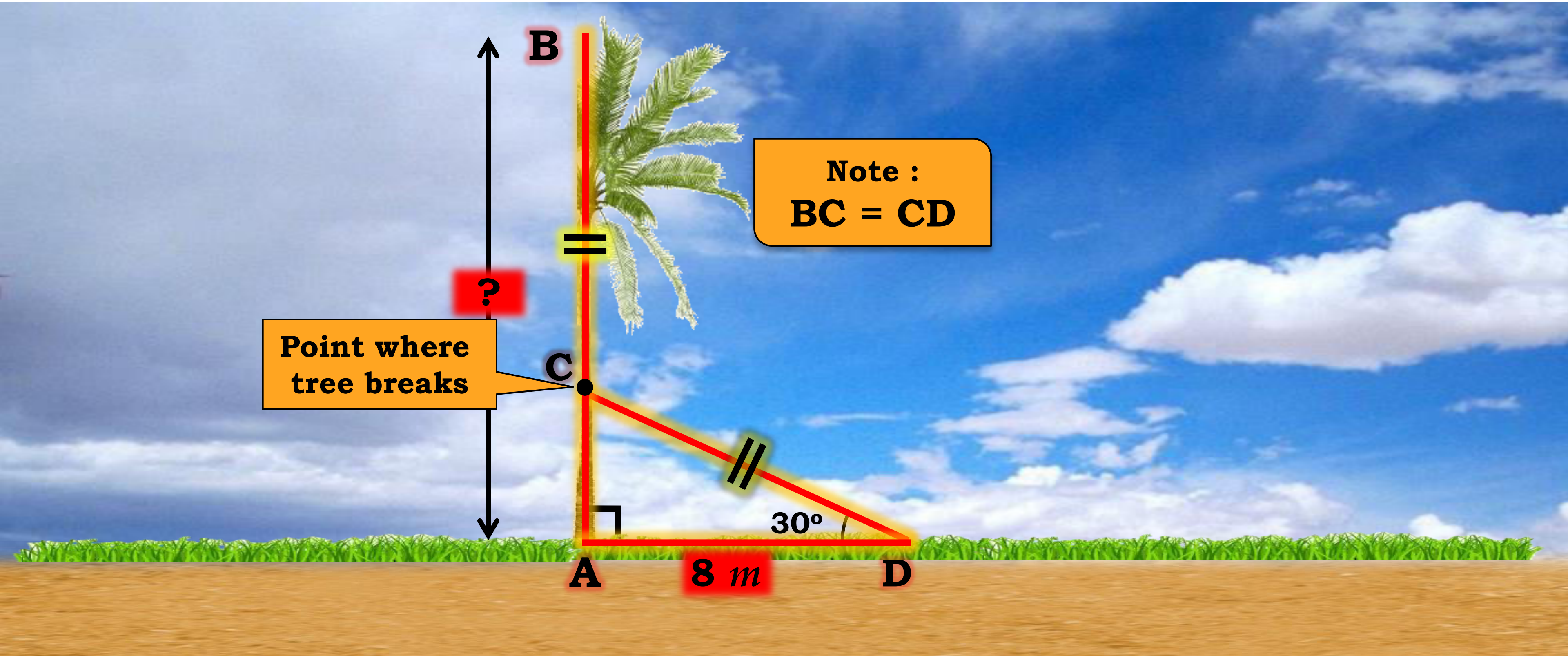
$$\therefore \quad h = 17.3$$

$\therefore$ **Height of the tower is 17.3 m**

Thank You

Module 6

Q. 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.



Q. A tree brea… ken part b… ends so th… the ground making an… e between the foot o… he top touches the ground is 8 m. Find the height of the tree.

Observe AB

CD

Sol. AB represents the height of the tree which breaks at point C.

BC … length o…

AC … length o…

tan 30° $= \frac{1}{\sqrt{3}}$

cos 30° $= \frac{\sqrt{3}}{2}$

In right ΔCAD,

$$\boxed{\tan 30^\circ} = \frac{AC}{AD}$$

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{AC}{8}$$

$$\therefore \quad AC = \frac{8}{\sqrt{3}}$$

In right ΔCAD,

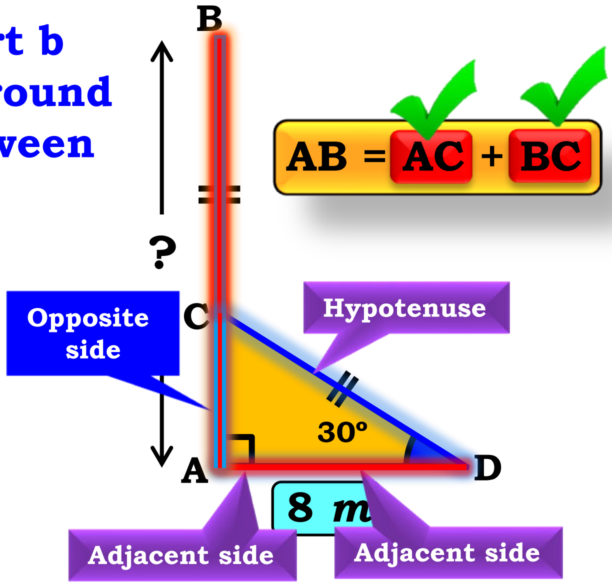
$$\boxed{\cos 30^\circ} = \frac{AD}{CD}$$

CD = BC

$$\therefore \quad \frac{\sqrt{3}}{2} = \frac{8}{BC}$$

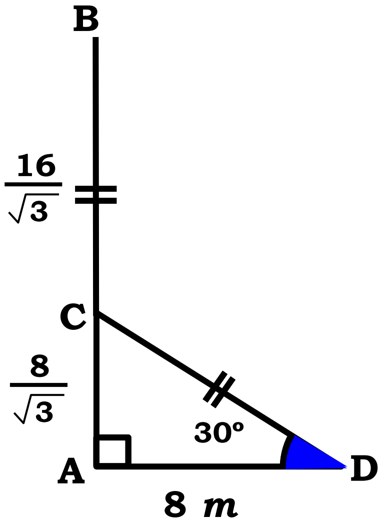
$$\therefore \quad \sqrt{3}\,BC = 16$$

$$\therefore \quad BC = \frac{16}{\sqrt{3}}$$



Q. A tree breaks due to storm and the broken part b ends so that the t... touches the ground making an angle 3... stance between the foot of the tre... ere the top touches the ground is 8 m. Find the height of the tree.

Now, let us rationalise the denominator



Sol.

$$\text{Height of tree} = \boxed{AC} + \boxed{BC}$$

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

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

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

$$\therefore \quad \text{Height of tree} = \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

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

$$BC = \frac{16}{\sqrt{3}}$$

$\sqrt{3} = 1.73$

$$= 8\sqrt{3}$$

$$= 8\,(1.73)$$

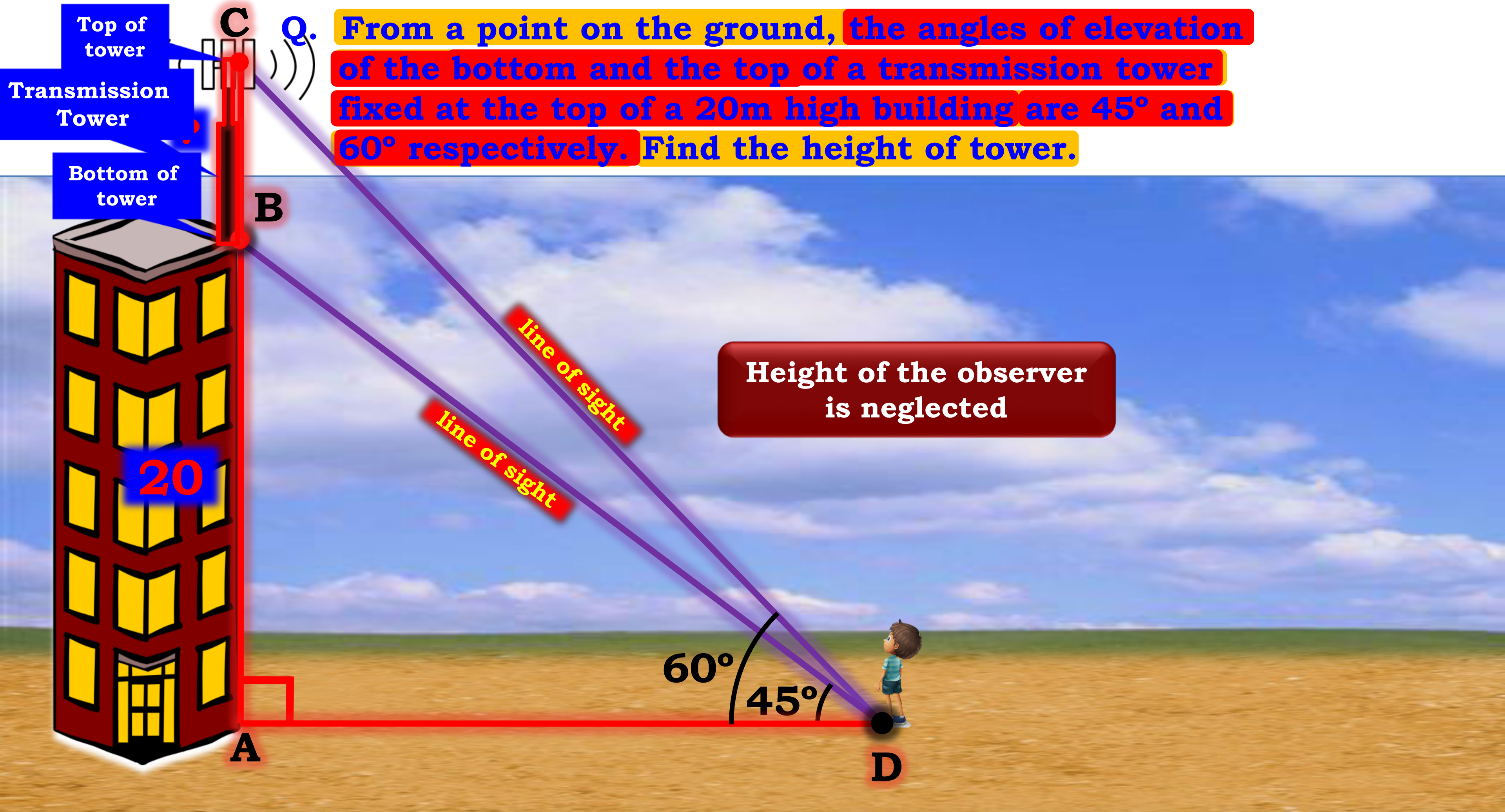
$$= 13.84\ m$$

Height of the tree is 13.84 *m*

Module 7
New sum to be added.
Question is in R+ book

Module 8

Q. 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 20m high building are 45° and 60° respectively. Find the height of tower.



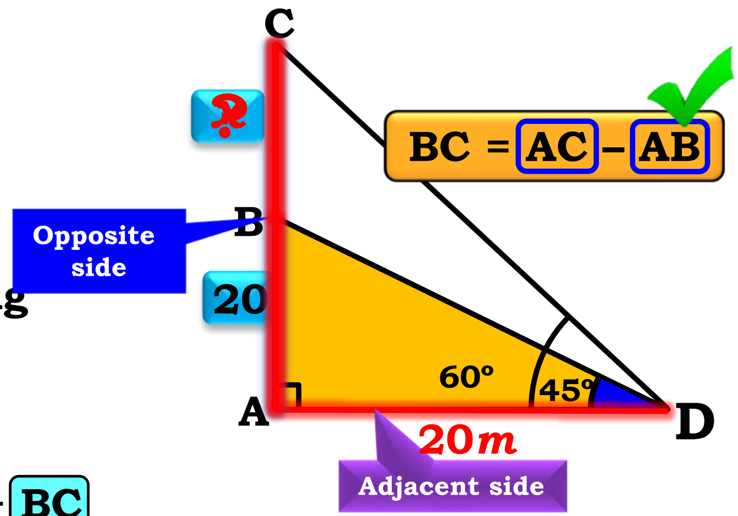
Q. From a poin... ...ngles of eleva... ...e and ...p of a tra... ...s of ...op of a 20... ...° respectively. Find the height of tower.

Rat...

Adja...

Now, Consider

Let us find AC



Sol. AB represents the height of the building

AB = 20m

BC represents the height of the transmission tower.

Le...

In ...D,

tan 45° = ?

$\tan 45° = \dfrac{AB}{AD}$

$\therefore \quad 1 = \dfrac{20}{AD}$

$\therefore \quad AD = 20\ m$

$AC = AB + BC$

$\therefore \quad AC = 20 + x$

$\therefore \quad AC = (20 + x)\ m$

Q. From a p… es
of eleva… o
of a tran… op
of a … °
resp… height of tower.

Ratio of opposite side and Adjacent side reminds us of …tan'

$\tan 60^\circ = \sqrt{3}$

Sol. In right angled ΔCAD,

$$\tan 60^\circ = \frac{AC}{AD}$$

$$AC = (20 + x)\ m$$

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

$$\therefore \quad 20\sqrt{3} = \ldots$$

$\sqrt{3} = 1.73$

$$\therefore \quad x = \ldots 0$$

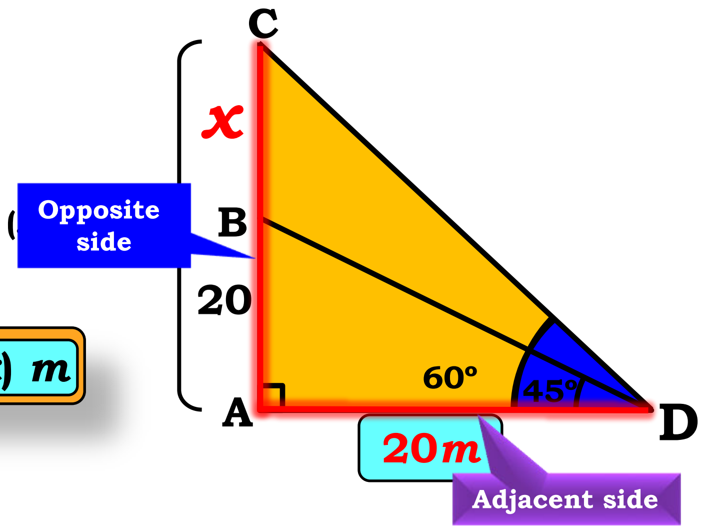
$$\therefore \quad x = 20(\sqrt{3} - 1)$$

$$\therefore \quad x = 20(1.73 - 1)$$

$$\therefore \quad x = 20 \times 0.73$$

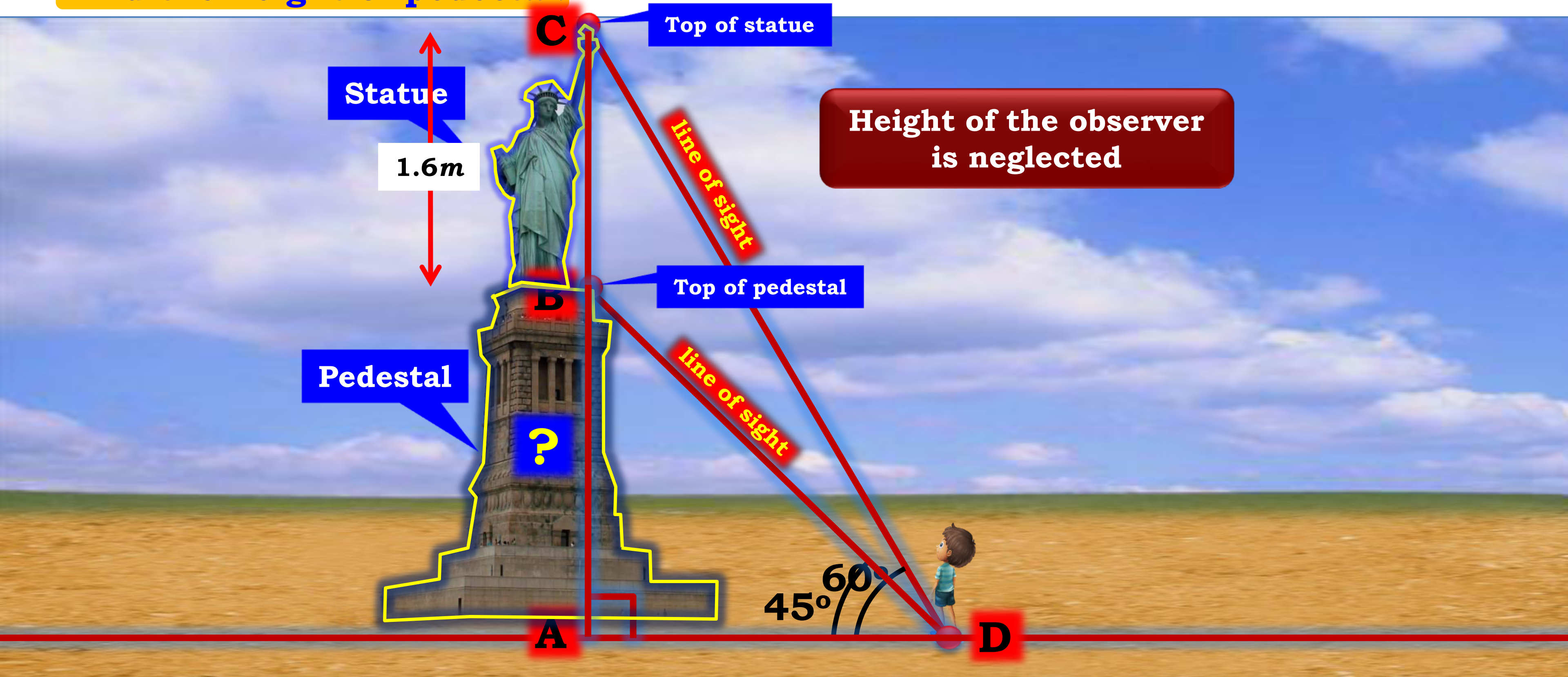
$$\therefore \quad x = 14.6$$

$\therefore$ **Height of the transmission tower is 14.6 m**



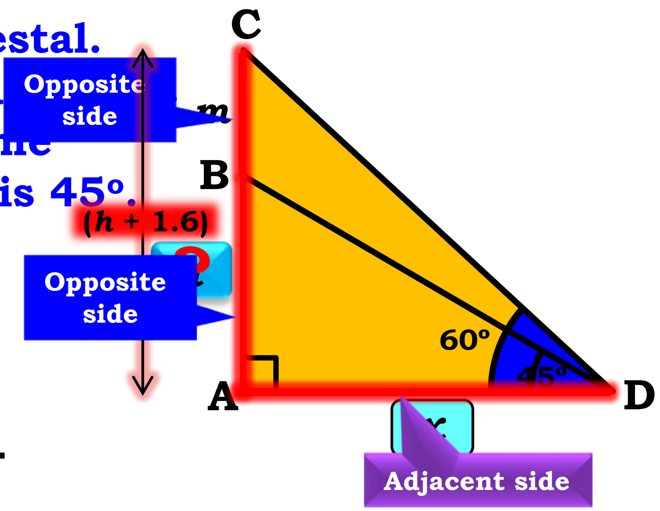
Module 9

Q. A statue 1.6m tall, stands on the top of a pedestal. From a point on the ground, the angle of elevation of the top of the statue is 60° and from the same point angle of elevation of the top of pedestal is 45°. Find the height of pedestal.



Q. A statue 1.6m t... of a pedestal.
From a poin... R... nd ... eleva...
of the top of... Ac... s of ... e same
point angle ... A... stal is 45°.
Find the heig...

Fo... C... Observe $\angle$D



Sol. Let the height of pedestal (AB) be 'h' m

Hei...) = 1.6 m

Let ...

In rig... BAD,

tan 45° = P

$\tan 45° = \dfrac{AB}{AD}$

$\therefore \quad 1 = \dfrac{h}{x}$

$\therefore$

tan 60° = $\sqrt{3}$

In ri...

$\tan 60° = \dfrac{AC}{AD}$

$\therefore \quad \sqrt{3} = \dfrac{h + 1.6}{x}$

$\therefore \quad \sqrt{3}x = h + 1.6$

$\therefore \quad \sqrt{3}h = h + 1.6$ [From (i)]

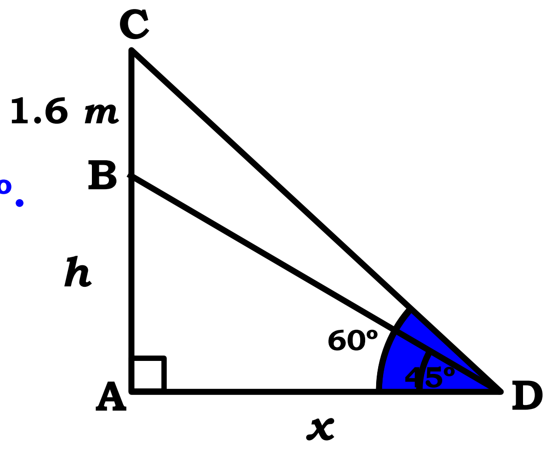
$\therefore \quad \sqrt{3}h - h = 1.6$

$\therefore \quad h(\sqrt{3} - 1) = 1.6$

$\therefore \quad h = \dfrac{1.6}{\sqrt{3} - 1}$

Q. A statue 1.6m tall stands on the top of a pedestal.
From a point or … of elevation
of the top of th… the same
point angle of e… edestal is 45°.
Find the height of pedestal.

Now, let us rationalise the denominator by taking its conjugate



Sol.

$$h = \frac{1.6}{\sqrt{3} - 1}$$

$$\therefore \quad h = \frac{1.6}{\sqrt{3} - 1} \times \frac{\sqrt{3} + 1}{\sqrt{3} + 1}$$

$$\therefore \quad h = \frac{1.6 \times (\sqrt{3} + 1)}{(\sqrt{3})^2 - (1)^2}$$

$$\therefore \quad h = \frac{1.6 \times (\sqrt{3} + 1)}{3 - 1}$$

$$\therefore \quad h = \frac{\overset{0.8}{\cancel{1.6}}}{\cancel{2}} \times (\sqrt{3} + 1)$$

$\sqrt{3} = 1.73$

$$\therefore \quad h = 0.8\,(\boxed{\sqrt{3}} + 1)$$

$$\therefore \quad h = 0.8\,(1.73 + 1)$$

$$\therefore \quad h = 0.8\,(2.73)$$

$$\therefore \quad h = 2.184$$

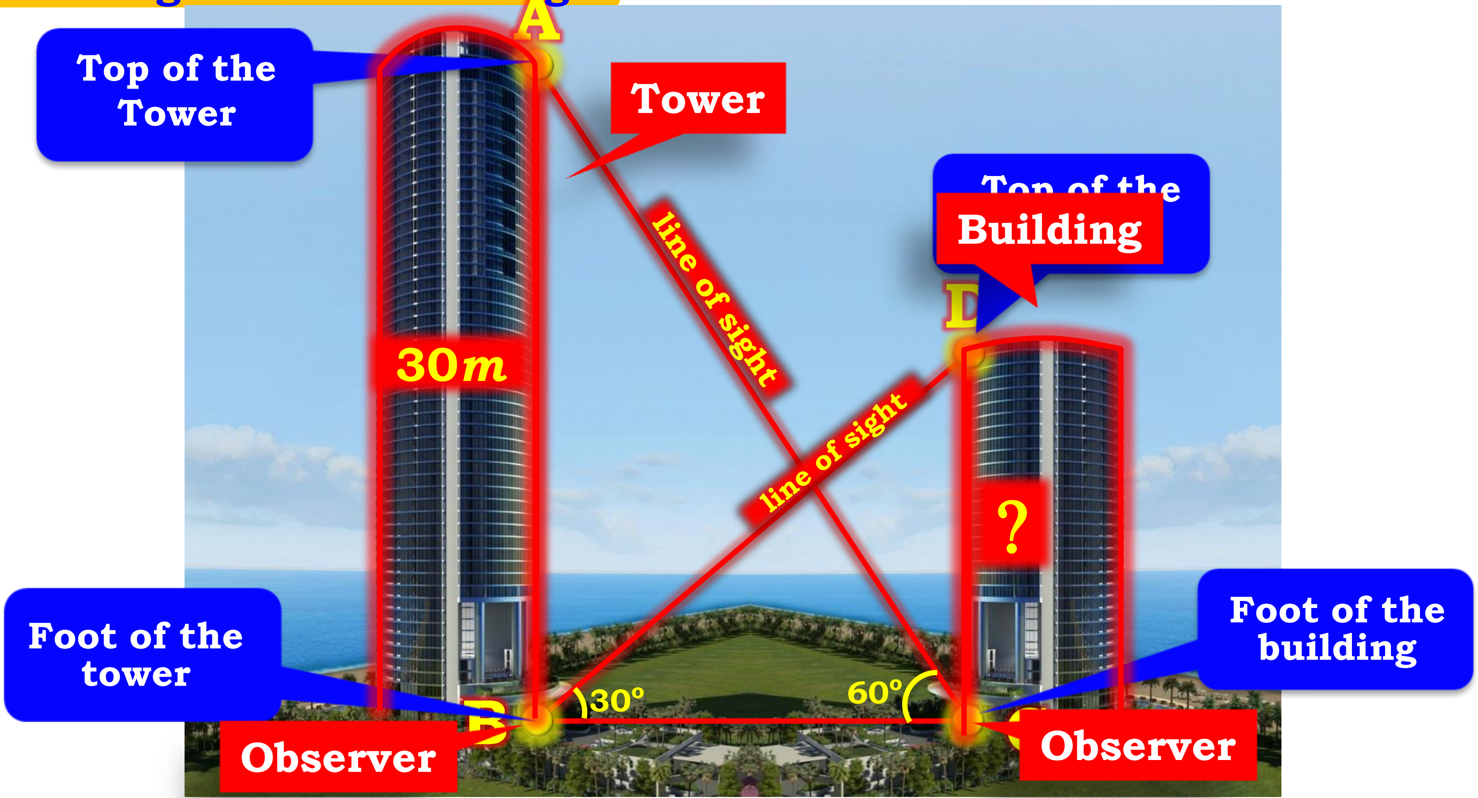
$\therefore$ **Height of the pedestal is 2.184 *m***

Module 10
Solved Example 4

Thank You

Module 11

Q. 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 tower from the foot of the building is 60°. If the tower is 30m high, find the height of the building ?



Q. The angle of elevation of the top of a building from the fo... and ... angle of elevation o... ...ıs of ...t of the building is ... find ... height of th...

Now, let us rationalise the denominator

Sol. AB represents the height of the tower.

AB = 30m

CD represents the height of the building.

$\angle DBC = 30^\circ$

$\angle$ ...

tan 60° = √3

In ... ∆ABC,

$\boxed{\tan 60^\circ} = \frac{\boxed{AB}}{BC}$

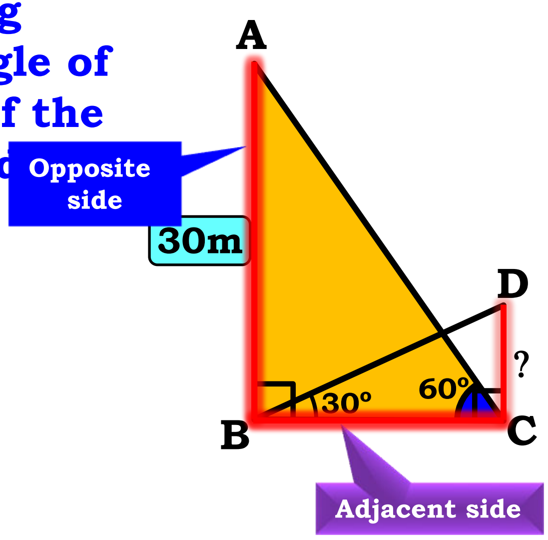
$\therefore \quad \sqrt{3} = \frac{30}{BC}$

$\therefore \quad BC = \frac{30}{\sqrt{3}}$

$\therefore \quad BC = \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$\therefore \quad BC = \frac{\overset{10}{\cancel{30}}\sqrt{3}}{\cancel{3}}$

$\therefore \quad BC = 10\sqrt{3}\ m$



Q. The angle of elevation of the top of a building from the foot of th... ...ngle of elevation of th... ...e bui... ...e hei...

Ratio of opposite side and Adjacent side reminds us of **'tan'**

$\tan 30^\circ =$

Sol. B...

In ri... angled ΔDBC,

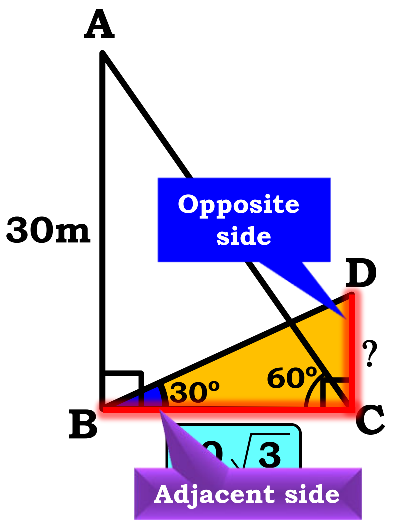
$$\boxed{\tan 30^\circ} = \frac{DC}{\boxed{BC}}$$

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{DC}{10\sqrt{3}}$$

$$\therefore \quad DC = \frac{10\cancel{\sqrt{3}}}{\cancel{\sqrt{3}}}$$

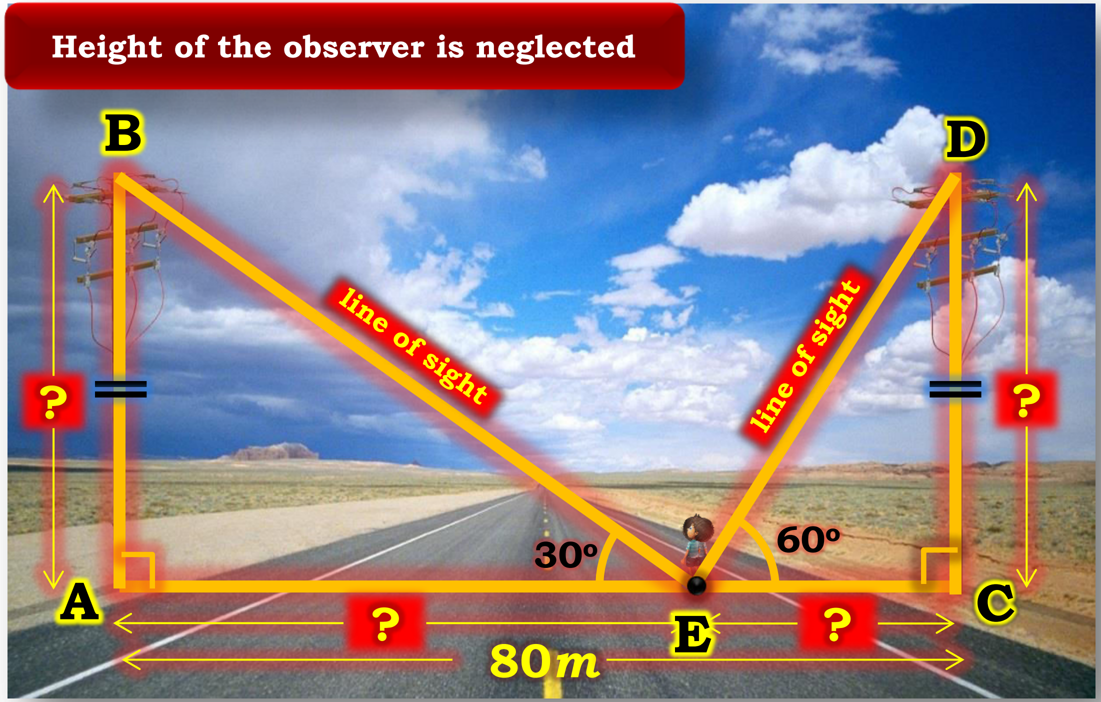
$$\therefore \quad DC = 10\ m$$

Height of the building is 10*m*



Module 12

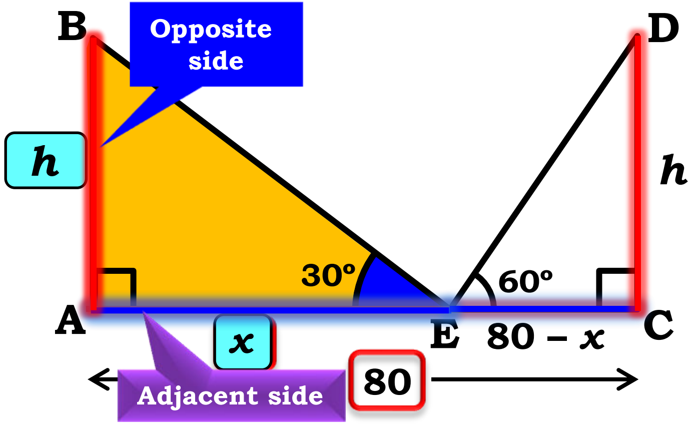
Q. Two poles of equal heights are standing opposite each other on either side of the road, which is 80 m wide. From a point between them on the road, the angles of elevation of the top of the poles are 60° and 30° respectively. Find the height of the poles and the distances of the point from the poles.



Q. Two poles of equal heights are standing opposite each other on either side of the ro... point be... es of el... of 60° ar... t of th... point from the poles.

Rat...
Adja...

For ∠AEB
Opposite side → AB
Adjacent side → AE



Sol. Let the height of poles be 'h' m

Width of the road (AC) = 80 m

Let the distance of the point E from pole AB i.e AE be 'x' m

∴ The di... t from the po... – x) m

In ri...

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

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

AE + EC = AC

∴ x + EC = 80

∴ EC = (80 – x) m

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{h}{x}$$

$$\therefore \quad x = \sqrt{3}\,h \quad \text{...(i)}$$

Q. Two poles of equal heights are standing
opp... e
roa...
bet...
ele...
and...
the p... ces of the point
from...

Ratio of opposite side and Adjacent side reminds us of **'tan'**

tan 60° = $\sqrt{3}$

Sol. In right ΔDCE,

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

$$\tan 60^\circ = \frac{CD}{EC}$$

$$\therefore \quad \sqrt{3} = \frac{h}{80 - x}$$

$$\therefore \quad \sqrt{3}\,(80 - x) = h$$

$$\therefore \quad h = \sqrt{3}\,(80 - \sqrt{3}\,h) \quad \text{[From (i)]}$$

$$\therefore \quad h = 80\sqrt{3} - 3h$$

$$\therefore \quad h + 3h = 80\sqrt{3}$$

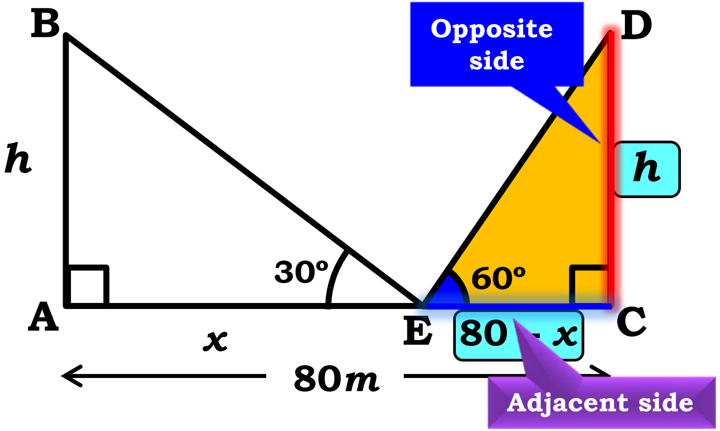
$$\therefore \quad 4h = 80\sqrt{3}$$

$$\therefore \quad \sqrt{3} = 1.73$$

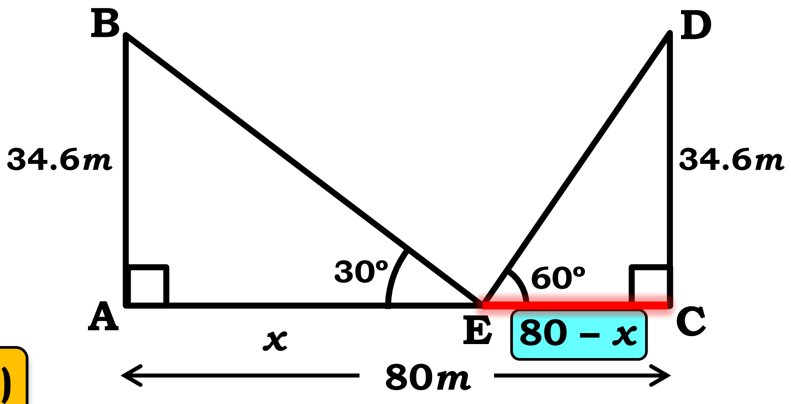
$$\therefore \quad h = 20\sqrt{3}$$

$$= 20 \times 1.73$$

$$= 34.6m$$



Q. 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.



Sol.

$$AE = x = \sqrt{3}\,\boxed{h}$$

$$\boxed{x = \sqrt{3}\,h \quad \ldots(i)}$$

$$= \sqrt{3} \times 20\sqrt{3}$$

$$\boxed{h = 20\sqrt{3}}$$

$$= 20 \times 3$$

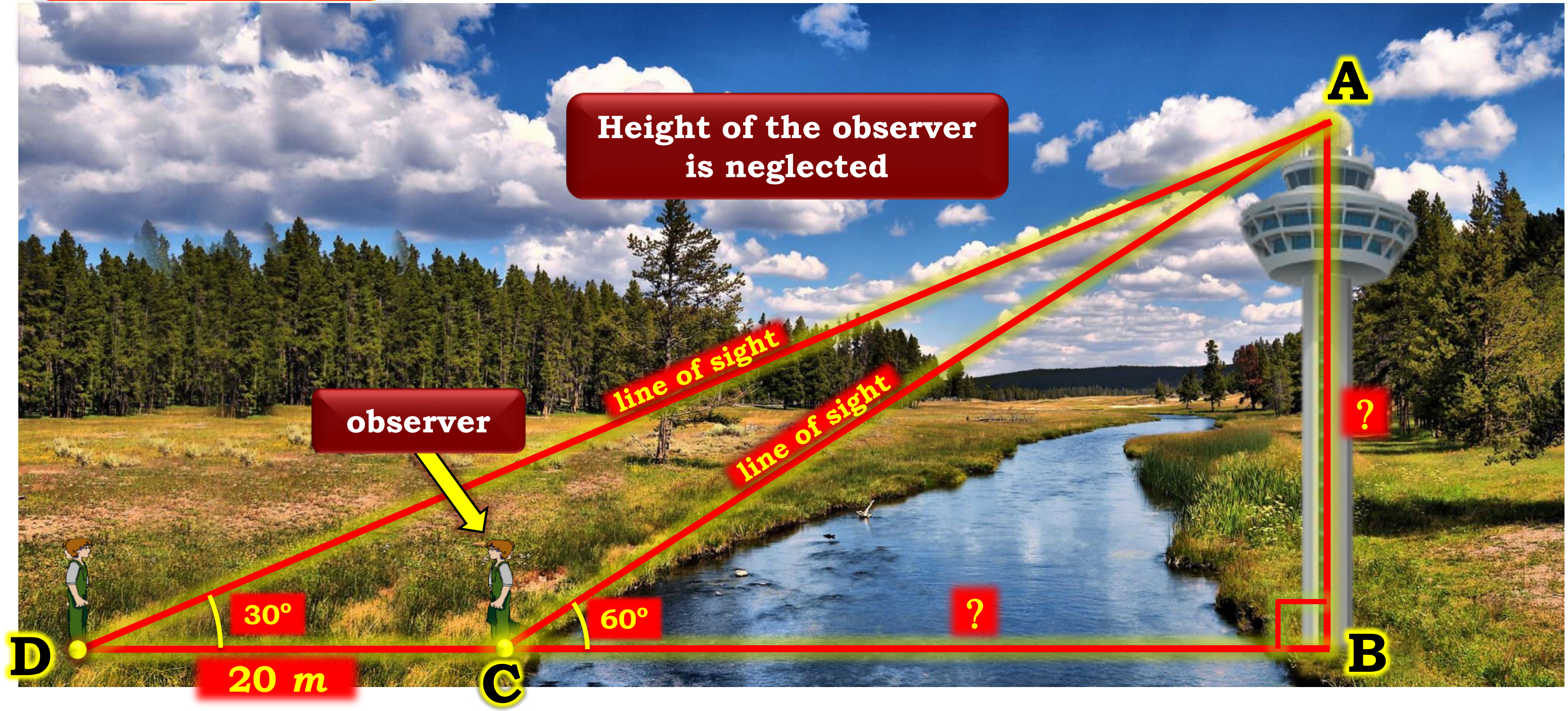
$$\boxed{x = 60}$$

$$EC = 80 - \boxed{x} = 80 - 60 = 20m$$

$\therefore$ Height of the poles are 34.6 m each
Distance of the point from pole AB is 60 m and
Distance of the point from pole CD is 20 m

Module 13

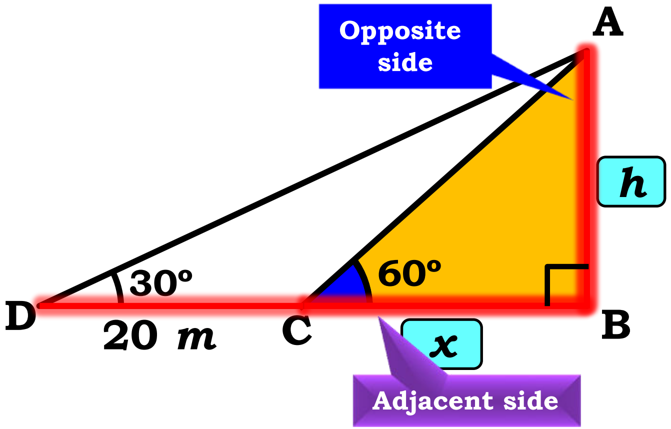
Q. A TV tower stands vertically on a bank of a canal. From a point on the other bank directly opposite the tower, the angle of elevation of the top of the tower is 60°. From another point 20 m away from this point on the line joining this point to the foot of the tower, the angle of elevation of the top of the tower is 30°. Find the height of the tower and the width of the canal.



Q. A TV tower stands vertically on a bank of a canal. From a point ... opposite the tower, ... f the tower is 60 ... from this point ... e foot of the towe ... of the tower is 30°. Find the height of the tower and the width of the canal.

Consider ΔABC

Adjacent side $\rightarrow$ BC



Sol. Let the height of tower be 'h' m

Let the width of the canal be 'x' m

D ... m

In ... ΔABC,

$\tan 60^\circ = \sqrt{3}$

$$\boxed{\tan 60^\circ} = \frac{\boxed{AB}}{\boxed{BC}}$$

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

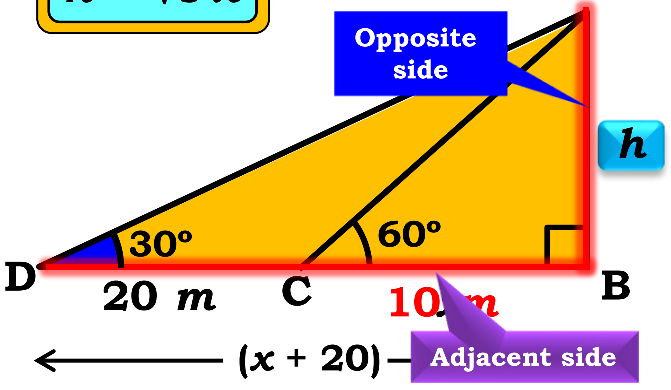
$$\therefore \quad h = \sqrt{3}\,x$$

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

Q. A TV tower stands vertically on a bank of a canal. From a ... opposite the to... op of the tower i... way from this po... o the foot of the t... e top of the tower i... ht of the tower and the width ...

Ratio of opposite side and Adjacent side reminds us of **'tan'**

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



Sol. In rig...

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

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

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

$\therefore \quad x + 20 = \sqrt{3}x \times \sqrt{3}$

$\therefore \quad x + 20 = 3x$

$\therefore \quad 20 = 2x$

$\therefore \quad x = 10$

$h = \sqrt{3}x$

$\sqrt{3} = 1.73$

$h = 10\sqrt{3}$

$h = 10 \times 1.73 = 17.3$

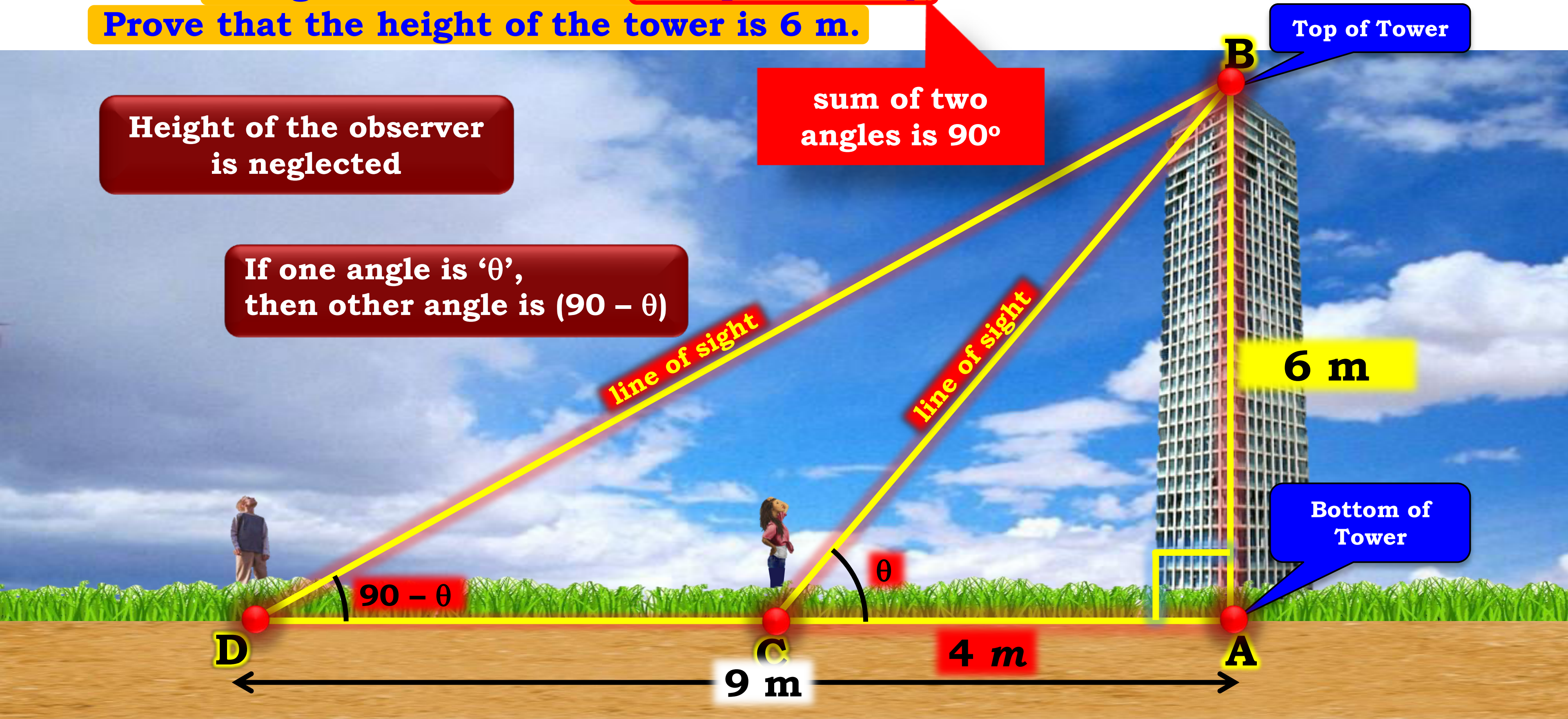
Width of the canal is 10 m and Height of the tower is 17.3 m

Module 14
Solved Example 5

Thank You

Module 15

Q. 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.

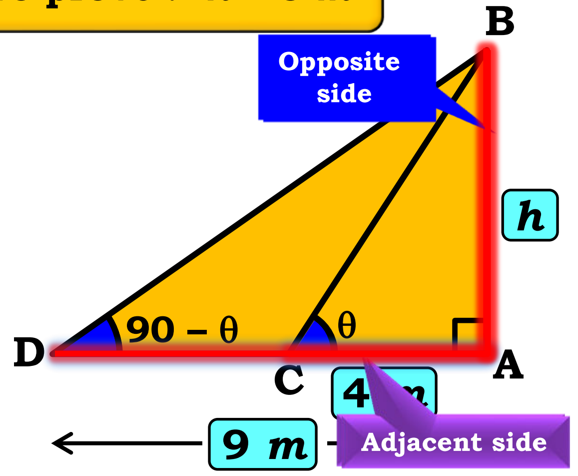


Q. The an... tower
from t... nd 9 m
from t... same
straigh... y.
Prove t... m.

R...
Ac...
'tan'

Now, consider ΔBAD

To prove : $h = 6\ m$



Sol. Let the height of tower (AB) be 'h' m

Distance of point C from the base of tower = $4\ m$

Distance of point D from the base of tower = $9\ m$

Let $\angle ACB = \theta$

So, $\angle ADB = (90 - \theta)$

In right ΔBAC,

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

$$\therefore \quad \tan\theta = \frac{h}{4} \quad \ldots(i)$$

In right ΔBAD

$$\frac{AB}{AD}$$

We know that,
tan (90-θ) = cot θ

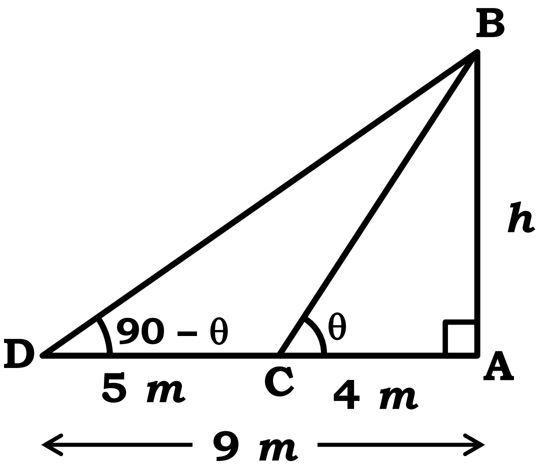
$\therefore$ tan ...

$$\cot\theta = \frac{1}{\tan\theta}$$

$$\therefore \quad \cot\theta = \frac{h}{9}$$

$$\therefore \quad \frac{1}{\tan\theta} = \frac{h}{9}$$

Q. **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.**



Sol.

$$\tan\theta = \frac{h}{4} \quad \ldots(i)$$

$$\therefore \quad \frac{1}{\tan\theta} = \frac{h}{9}$$

$$\therefore \quad \frac{9}{h} = \boxed{\tan\theta}$$

$$\therefore \quad \frac{9}{h} = \frac{h}{4}$$

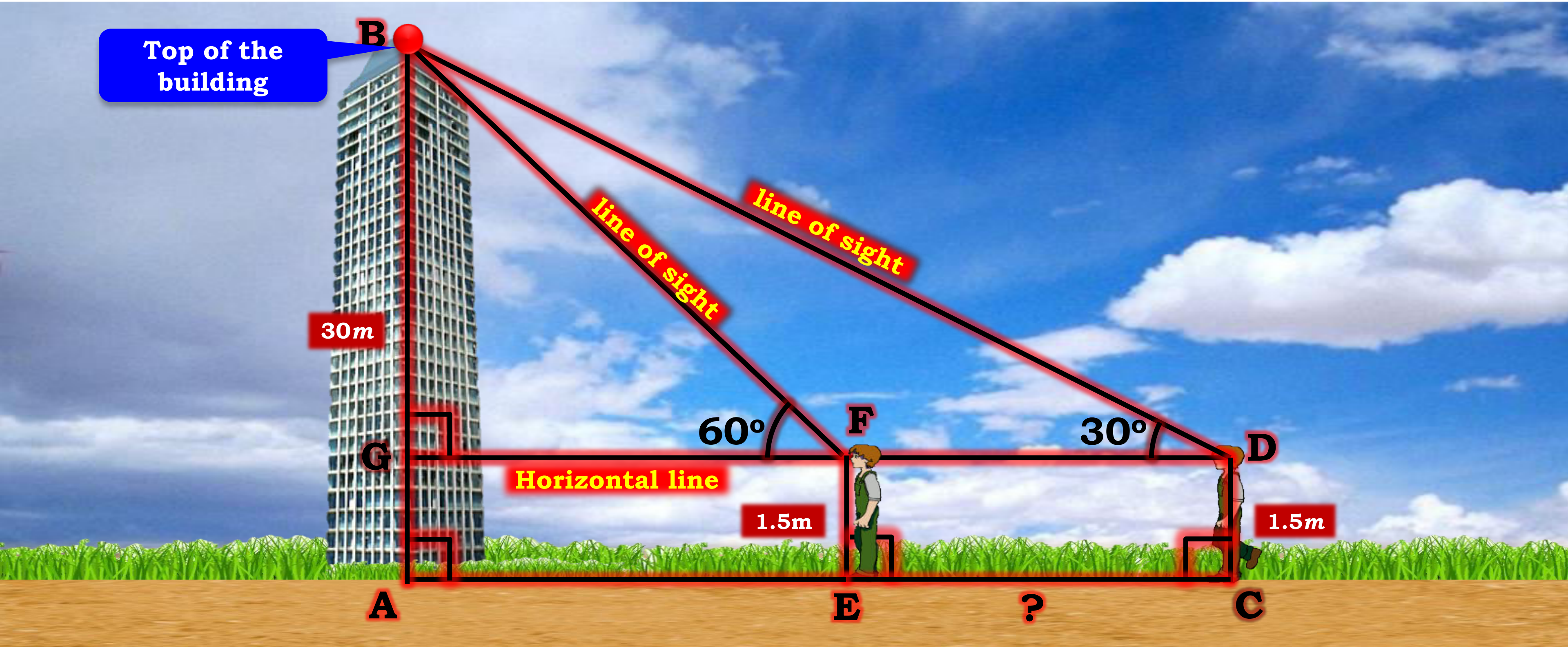
$$\therefore \quad 36 = h^2$$

$$\therefore \quad h = 6$$

$\therefore$ $\boxed{\text{Height of the tower is 6 } m}$

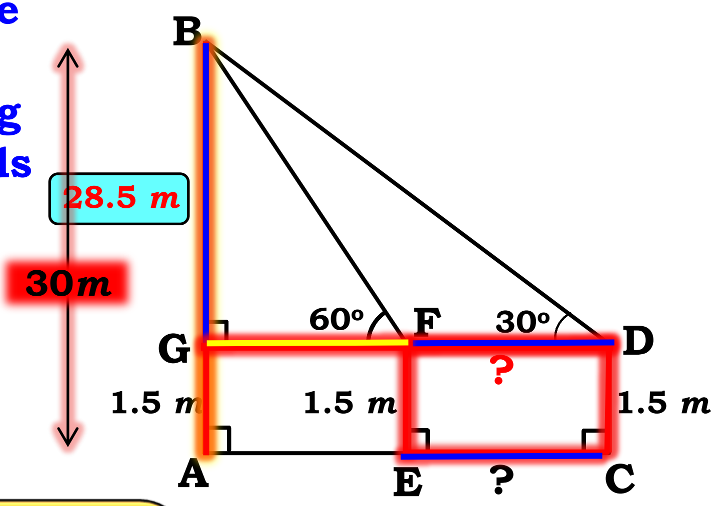
Module 16

Q. A 1.5 m tall boy is standing at some distance from a 30 m tall building. The angle of elevation from his eyes to the top of building increases from 30º to 60º as he walks towards the building. Find the distance he walked towards the building.



Q. A 1.5 m tall boy is standing at some distance
from a 30 m tall building. The angle of
elevation … of building
increases … ks towards
the build… walked
towards the building.

BG is a part of BA



Sol. Height of tower $\boxed{(AB) = 30\ m}$

Height of boy (CD) = $1.5\ m$

But, CD = EF = $\boxed{AG = 1.5\ m}$

$BG = \boxed{AB} - \boxed{AG}$

$\therefore\ BG = 30 - 1.5$

$\therefore\ BG = 28.5\ m$

□FECD is a rectangle

EC = FD

GD = GF + FD

$FD = \boxed{GD} - \boxed{GF}$

? ?

Q. A 1.5 m tall boy is standing at some distance
from a 3 ...
elevatio... ...din
increase ... ...ards
the building. Find the distance he walked
towards the building.

Ratio of opposite side and Adjacent side reminds us of **'tan'**

$FD = GD - \boxed{GF}$

Sol.

In right

$\tan 60^\circ = \sqrt{3}$

$$\tan 60^\circ = \frac{BG}{GF}$$

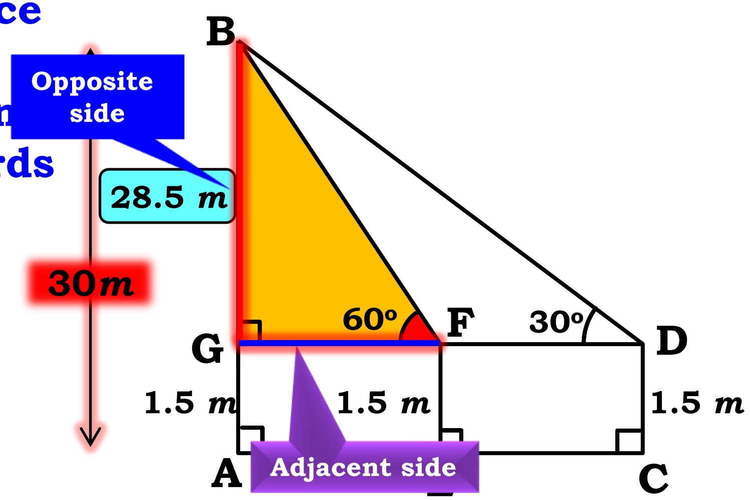
$$\therefore \quad \sqrt{3} = \frac{28.5}{GF}$$

$$\therefore \quad GF = \frac{28.5}{\sqrt{3}}$$

$$\therefore \quad GF = \frac{28.5 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}}$$

$$\therefore \quad GF = \frac{\overset{9.5}{\cancel{28.5}} \times \sqrt{3}}{\cancel{3}}$$

$$\therefore \quad GF = 9.5\sqrt{3}\ m$$



Q. A 1.5 ... distance
from ... f
eleva ... uilding
incre ... towards
the bu ... distance he walked
towar

Ratio of opposite side and Adjacent side reminds us of **'tan'**

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

Sol. In ri ... D,

$FD = GD - GF$

$GF = 9.5\sqrt{3}\ m$

$\tan 30^\circ = \frac{BG}{GD}$

$\therefore \quad \frac{1}{\sqrt{3}} = \frac{28.5}{GD}$

$\therefore \quad GD = 28.5\sqrt{3}\ m$

$FD = ($

$\sqrt{3} = 1.73$

$\therefore \quad FD = 28.\ \sqrt{3} - 9.5\sqrt{3}$

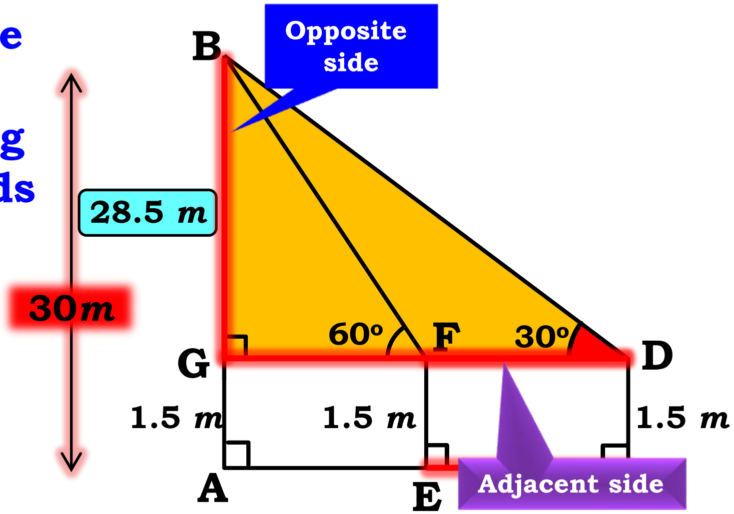
$= 19\sqrt{3}\ m$

$= 19 \times 1.73$

$\therefore \quad FD = 32.87\ m$

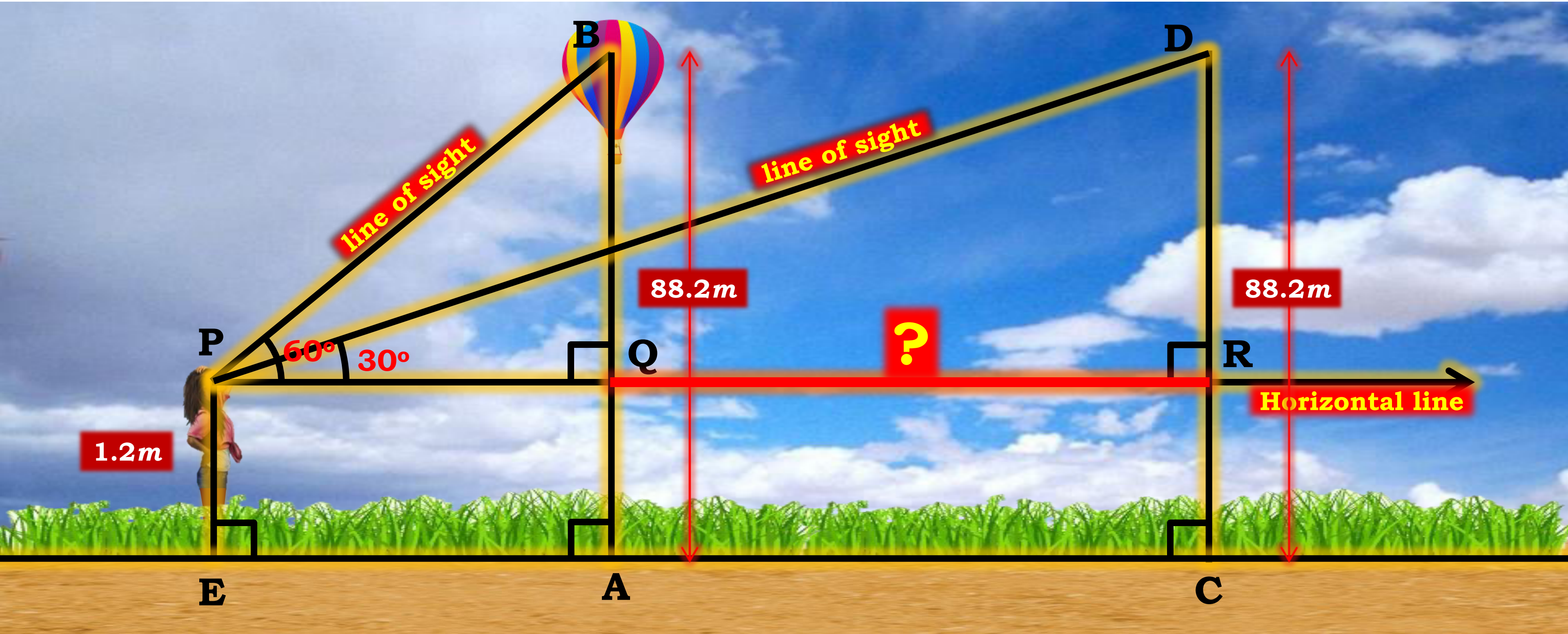
$\therefore \quad FD = EC = 32.87\ m$

$\therefore$ **Distance walked towards the building is 32.87*m***



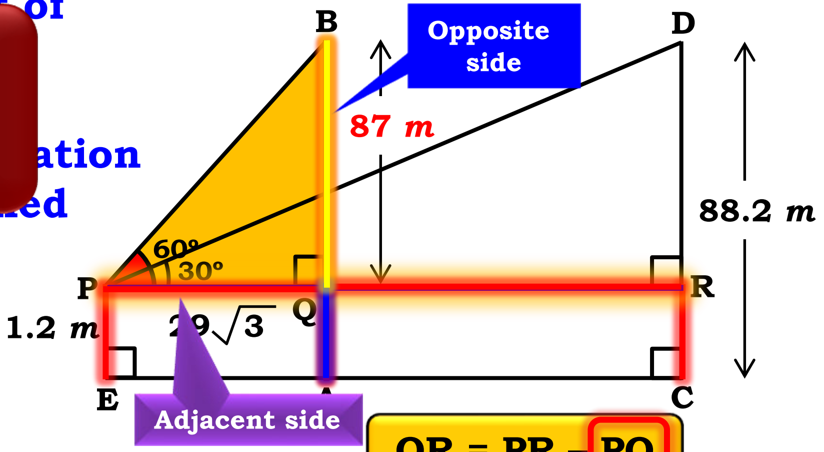
Module 17

Q. A 1.2 m tall girl spots a balloon moving with the wind in a horizontal line at a height of 88.2 m from the ground. The angle of elevation of the balloon from the eye of girl is 60°. After some time, angle of elevation reduces to 30°. Find the distance travelled by the balloon during the interval.



Q. A 1.2 m tall girl spots a balloon moving with the wind in ... ight of 88.2 ... elev... girl ... ation redu... ed by the balloon during the interval.

Find : QR



QR = PR – PQ

Ra... Adj...

Fo... Op... Ad...

Now, let us rationalise the denominator

Sol. Height of balloon from the ground

(AB) = 88.2 *m*

Height of the girl (PE) = 1.2 *m*

PE = QA = RC = 1.2*m*

BQ = BA – QA

∴ BQ ...

tan 60° = $\sqrt{3}$

In rt. ΔBQP,

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

$$\therefore \sqrt{3} = \frac{87}{PQ}$$

$$\therefore PQ = \frac{87}{\sqrt{3}}$$

$$\therefore PQ = \frac{87}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\therefore PQ = \frac{87\sqrt{3}}{3}$$

$$\therefore PQ = 29\sqrt{3}$$

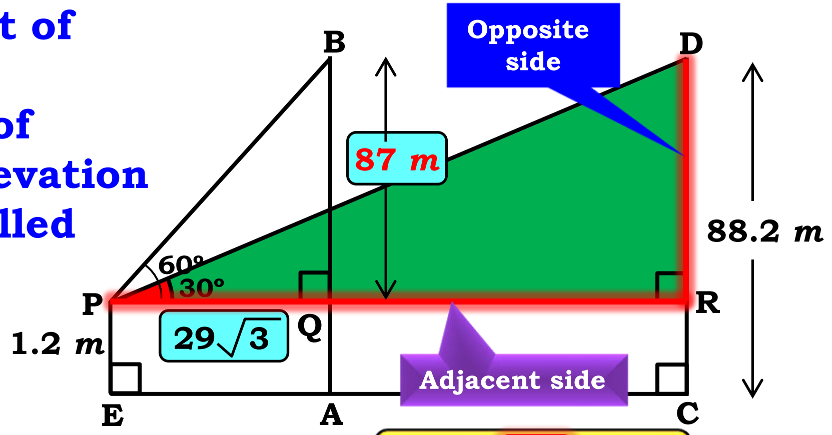
Q. A 1.2 m tall girl spots a balloon moving with the w... eight of 88.... elev... s of gi...) elevation re... velled by ... g the interval.

For $\angle P$

Opposite side $\rightarrow$ DR

Adjacent side $\rightarrow$ PR

$\tan 30 = \frac{}{\sqrt{3}}$



$QR = PR - PQ$

Sol. In ... ght ΔPRD,

$$\tan 30^\circ = \frac{DR}{PR}$$

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{87}{PR}$$

$$\therefore \quad PR = 87\sqrt{3}$$

$$QR = PR - PQ$$

$\sqrt{3} = 1.73$

$$\therefore \quad QR = 8\ldots \sqrt{3}$$

$$\therefore \quad QR = 58\sqrt{3}$$

$$\therefore \quad QR = 58 \times 1.73$$

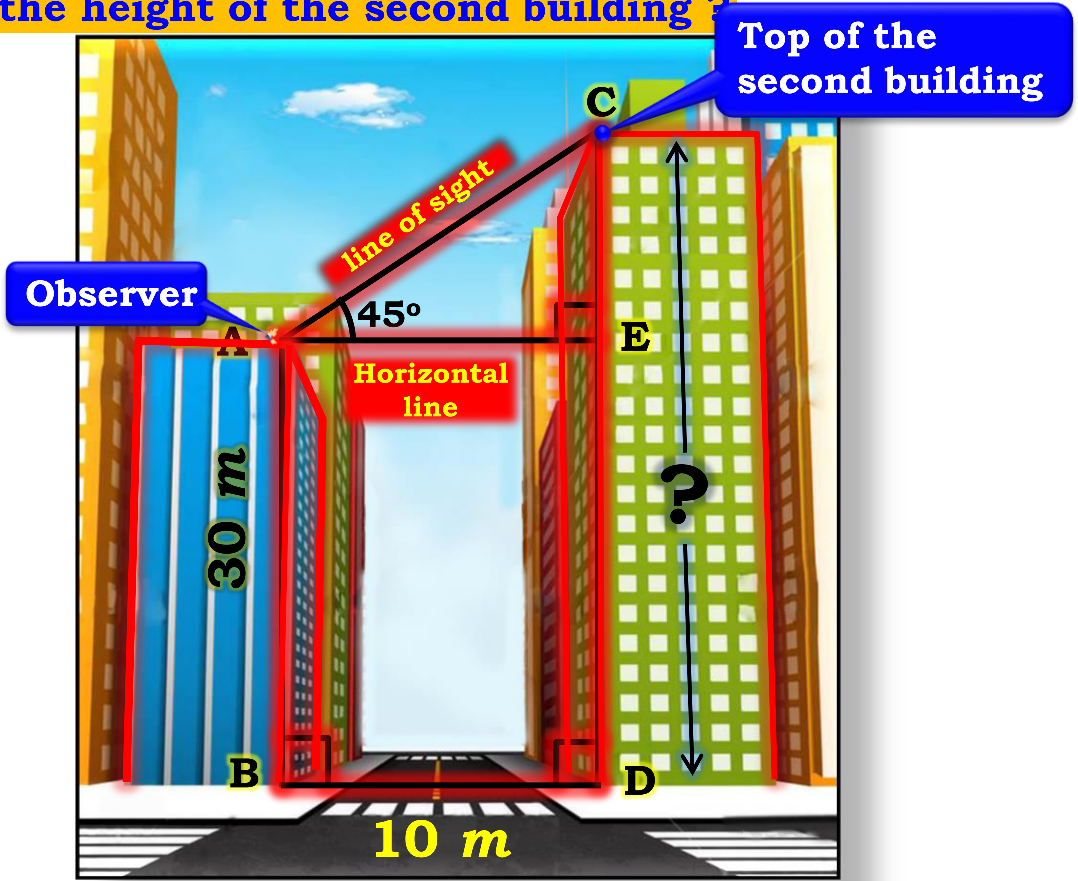
$$\therefore \quad QR = 100.34\ m$$

Distance travelled by the balloon is 100.34 m

Module 18
Solved Example 3

Module 19

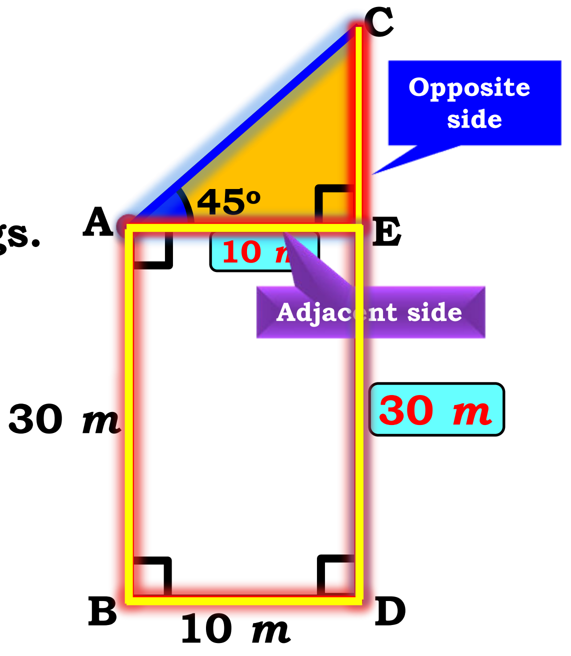
Q. Two buildings are in front of each other on either side of a road of width 10 metres. From the top of the first building, which is 30 metres high, the angle of elevation of top of the second is 45°. What is the height of the second building ?



Q. Two buildings are in front of each other
on e… …metres.
Fron… …hich is
30 m… …on of
top … …
What is the height of the second building ?

Rat…
Adja… …f
…E

CD is made up of CE and ED



Sol. AB and CD represents the heights of two buildings.

AB = 30 m

BD represents the width of the road.

BD = 10 m

A represents the position of the observer.

∠CAE is the angle of elevation.

∠CAE = 45°

□ABDE is a rectangle.

A…

B…

tan 45° = P

In ri… angled ΔCEA,

$$\tan 45^\circ = \frac{CE}{AE}$$

$$\therefore \quad 1 = \frac{CE}{10}$$

$$\therefore \quad CE = 10\ m$$

$$CD = CE + ED$$

$$\therefore \quad CD = 10 + 30$$

$$\therefore \quad CD = 40\ m$$

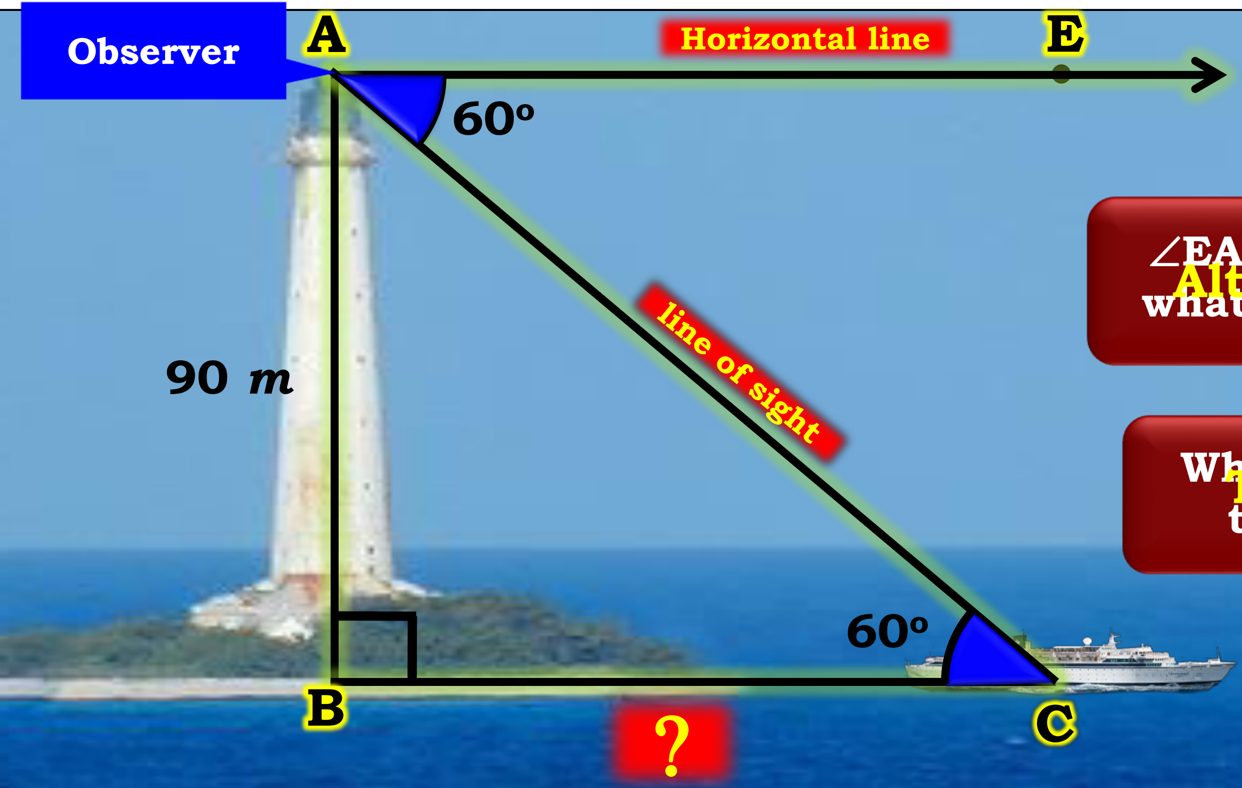
∴ The height of the second building is 40 m

Thank You

Module 20

Q. From the top of a light house, an observer looks at a ship and finds the angle of depression to be 60°. If the height of the light house is 90 m then find how far is that ship from the light house.

$(\sqrt{3} = 1.73)$



∠EAC and ∠ACB are what type of angles?

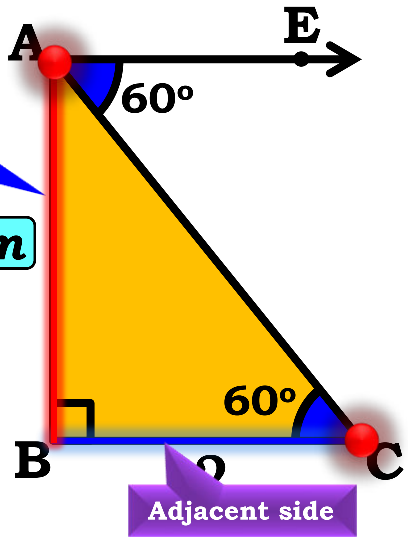
Alternate angles

What can we say about these two angles ?

They are equal

Q. From the [...] observer looki[...] e of dep[...] t of th[...] ligh[...] far is that ship from the light house.

Ratio of opposite side and Adjacent side reminds us of
'tan'



Sol. AB represents the height of the lighthouse.

C represents the position of ship.

A represents the position of observer.

$\angle EAC = 60^\circ$

$\angle EAC = \angle ACB$ [Alternate angles]

$\therefore \angle A$[...]

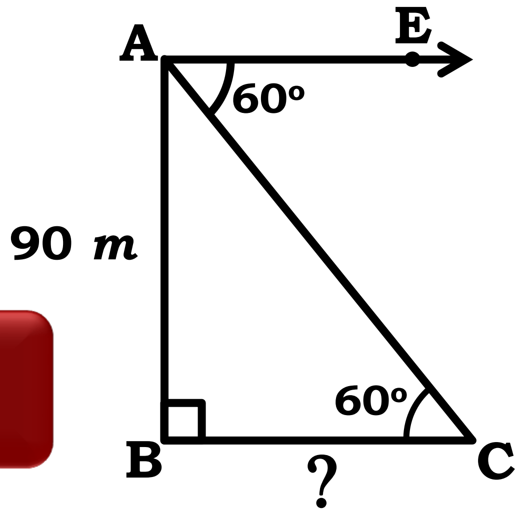
$\tan 60^\circ = \sqrt{3}$

In rig[...]angled ΔABC,

$\boxed{\tan 60^\circ} = \dfrac{\boxed{AB}}{BC}$

$\therefore \sqrt{3} = \dfrac{90}{BC}$

Q. From the top of a light house, an observer looks at a ship and finds the angle of depression to be 60°. If the height of the light house is 90 m then find how far is that ship from the light house.



Sol.

$$\sqrt{3} = \frac{90}{BC}$$

$$\therefore \quad BC = \frac{90}{\sqrt{3}}$$

Now, let us rationalise the denominator

$$\therefore \quad BC = \frac{90}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$\therefore \quad BC$$

$\sqrt{3} = 1.73$

$$\therefore \quad BC = 30\boxed{\sqrt{3}}$$

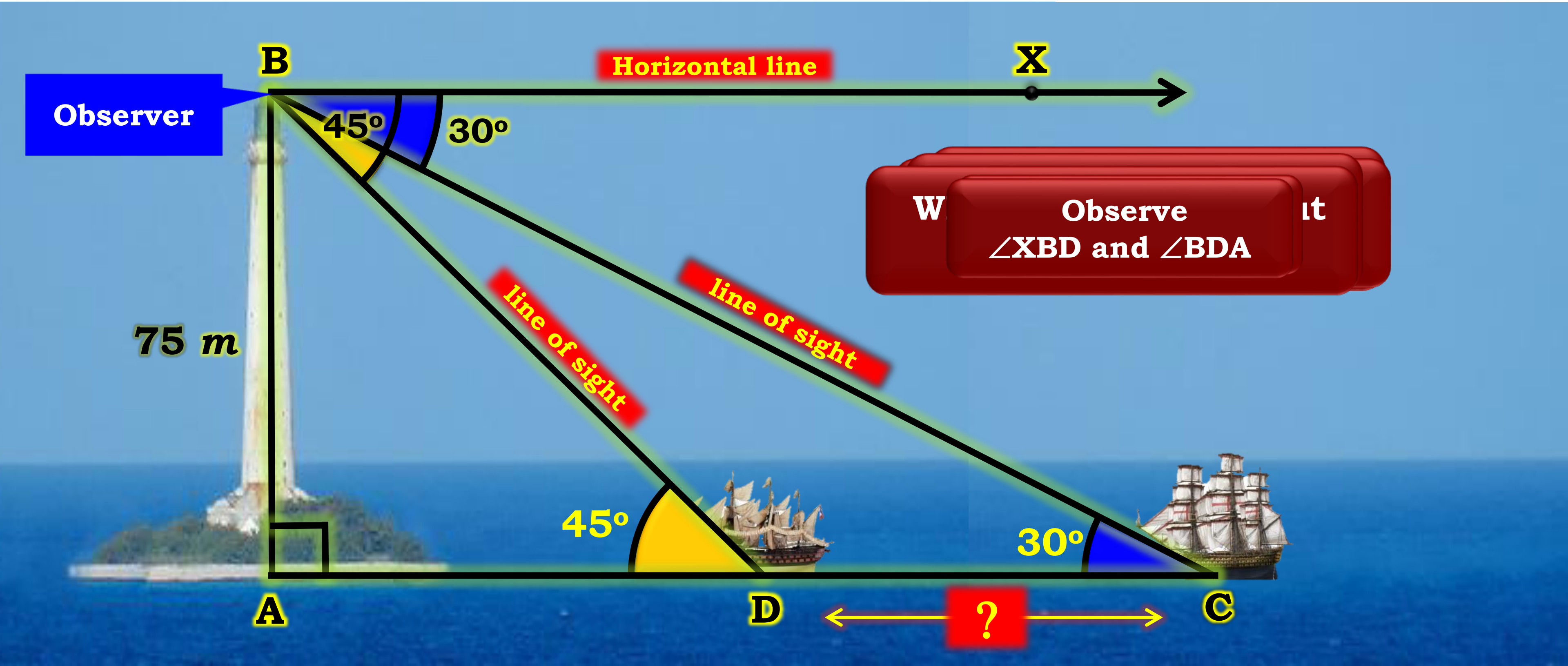
$$\therefore \quad BC = 30 \times 1.73$$

$$\therefore \quad BC = 51.9\ m$$

The ship is 51.9 *m* far from the lighthouse.

Module 21

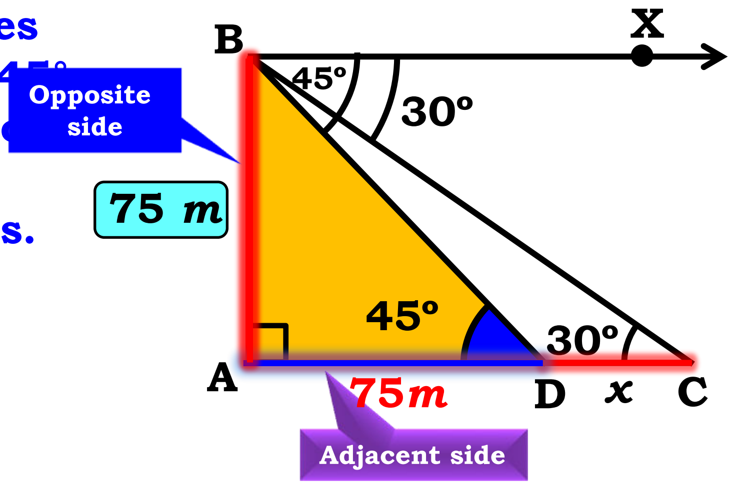
Q. As observed from the top of a 75 m high lighthouse from the sea-level, the angles of depression of two ships are 30° and 45°. If one ship is exactly behind the other on the same side of the lighthouse, find the distance between the two ships.



Q. As observed from the top of a 75 m high lighth... angles of dep... and 45°. If one ... her ... the sa... find the distance between the two ships.

I... de and A... ds us of ... tan

Consider ΔBAD



Sol. Height of light house (AB) = 75 m

AD is the distance of one ship from the foot of light house (AB)

Let the distance between two ... m

In r...

tan 45° = P

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

$$\therefore \quad 1 = \frac{75}{AD}$$

$$\therefore \quad AD = 75m \quad ...(i)$$

Q. As observed from the top of a 75 m high lig... angles of ... and 45°. If ... other ... th... fi... the two ships.

Ratio ... Adjace... nd ... s of

Observe ∠C

tan

$\sqrt{3}$

Sol. In ri...

$\tan 30° = \dfrac{AB}{AC}$

$\therefore \quad \dfrac{1}{\sqrt{3}} = \dfrac{75}{x + 75}$

$\therefore \quad x + 75 = 75\sqrt{3}$

$\sqrt{3} = 1.73$

$\therefore \quad x = 75\sqrt{3} - 75$

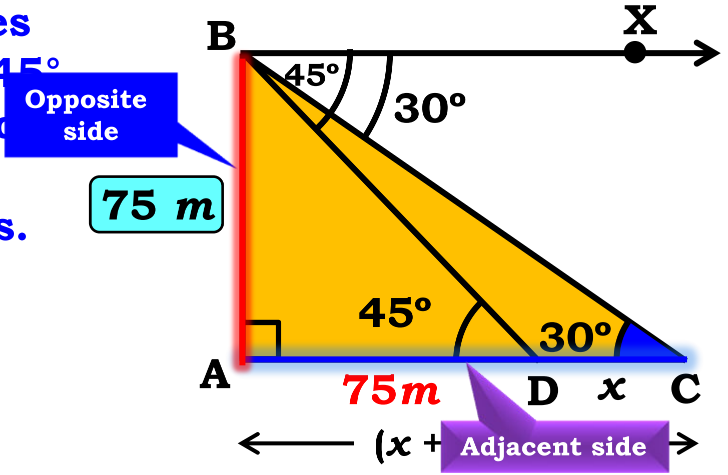
$\therefore \quad x = 75(\sqrt{3} - 1)$

$\therefore \quad x = 75(1.73 - 1)$

$\therefore \quad x = 75 \times 0.73$

$\therefore \quad x = 54.75$

$\therefore$ **Distance between the two ships is 54.75 m**

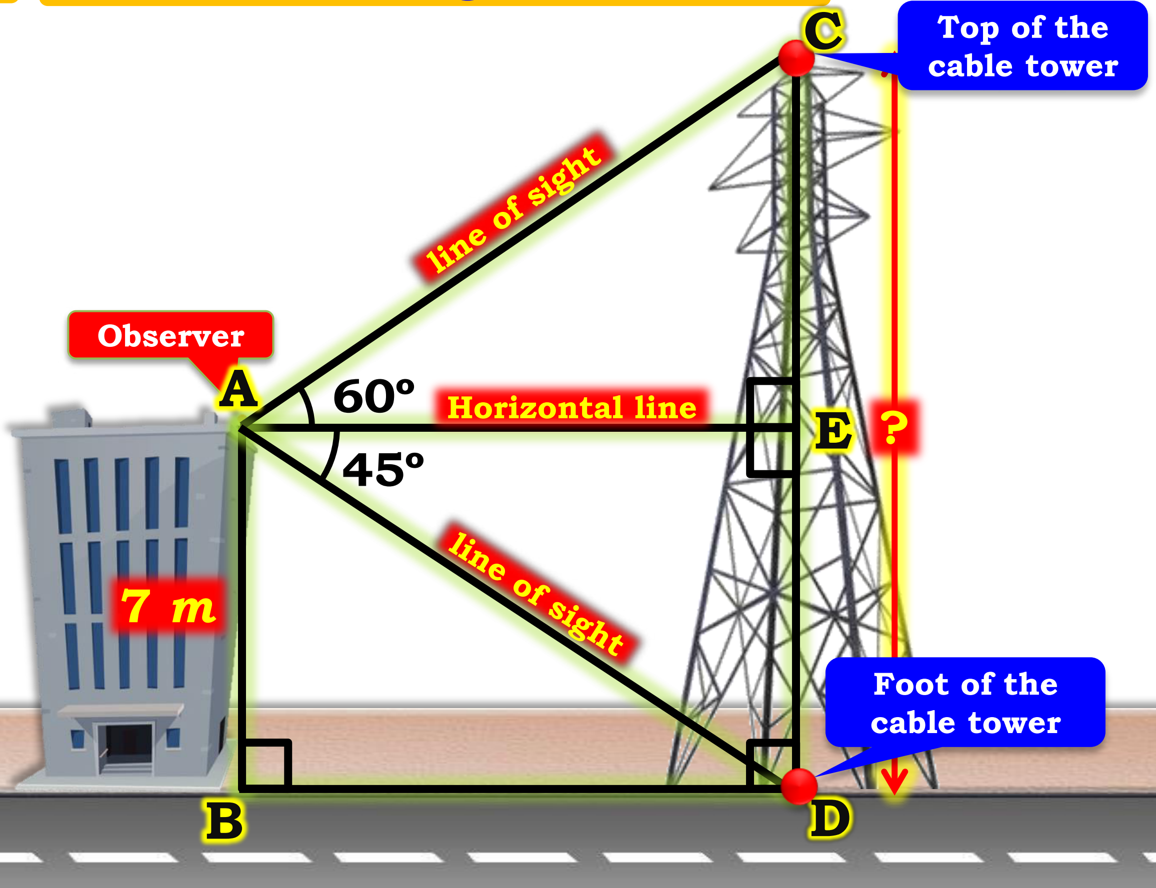


Module 22
Solved Example 7

Module 23
Solved Example 6

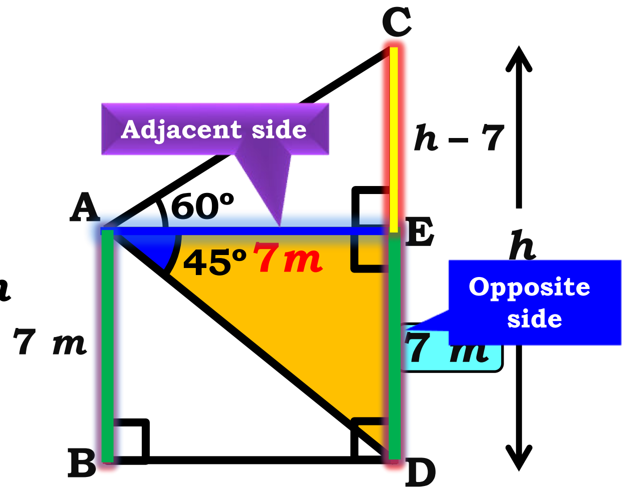
Module 24

Q. 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.



Q. From the top of a 7 m high building, the angle of elevation of the top of a cable to ... ession of it... D... .

Ratio of opposite side and Adjacent side reminds us of **'tan'**



Sol. Let the ... (CD) be 'h' m

Height of the building (AB) = $7\ m$

□ABDE is rectangle [By definition]

$\therefore$ AB = ED = $7\ m$

CE + ED = CD

$\therefore$ CE ...

$\therefore$ CE ...

tan 45° = ?

In right ΔAED,

$$\tan 45^\circ = \frac{ED}{AE}$$

$$\therefore \quad 1 = \frac{7}{AE}$$

$$\therefore \quad AE = 7m$$

Q. From the top of a 7 m high building, the an... ...f a cable tower ... ...ssion of its f... Det...

Ratio ... ...d
Adjacen... ... of

Observe ∠A

tan

Sol. In r... ΔAEC,

$$\tan 60^\circ = \frac{CE}{AE}$$

$$\therefore \quad \sqrt{3} = \frac{h-7}{7}$$

$$\therefore \quad 7\sqrt{3} \ldots$$

$$\sqrt{3} = 1.73$$

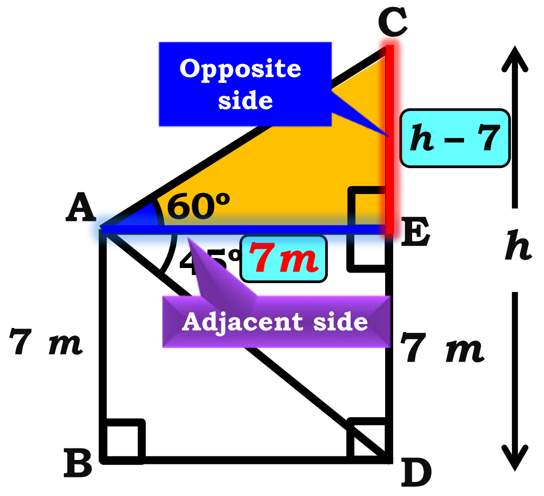
$$\therefore \quad 7\sqrt{3} + 7 \ldots$$

$$\therefore \quad h = 7(\sqrt{3} + 1)$$

$$\therefore \quad h = 7(1.73 + 1)$$

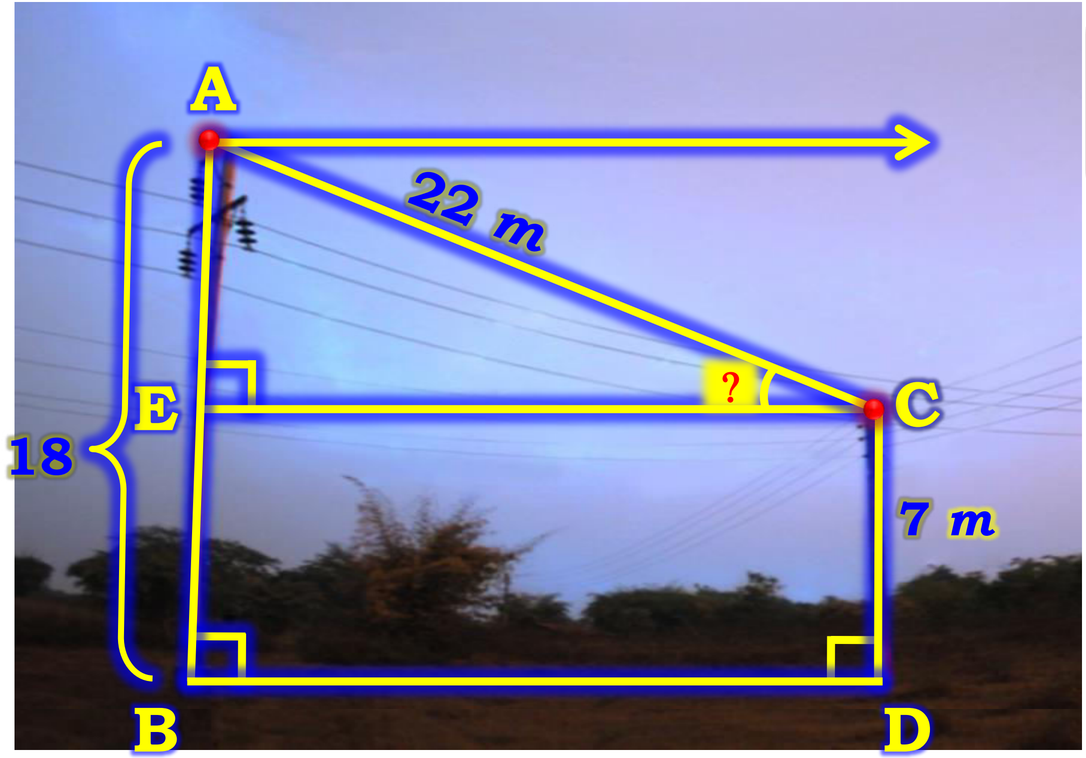
$$\therefore \quad h = 7 \times 2.73 = 19.11$$

$\therefore$ **Height of the cable tower is 19.11 m**



Module 25

Q. Two poles of height 18 metres and 7 metres are erected on the ground. A wire of length 22 metres is tied to the top of the poles. Find angle made by wire with the horizontal.



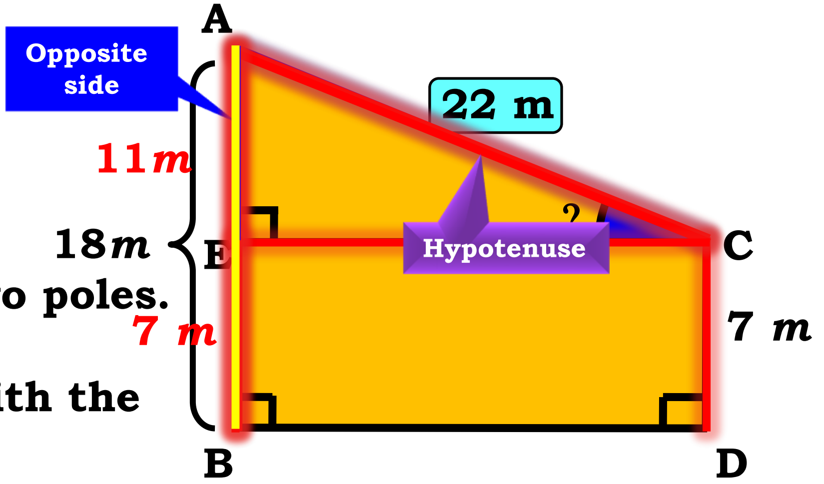
Consider CE ⊥ AB

Q. Two pole ... d
7 m ... d.
A wi ... to
the ... de
by w ...

Ratio
H

But we know that,

Observe AB



Sol. AB and CD represent the heights of two poles.
AC represents the length of wire.
∠ACE is the angle made by the wire with the horizontal.

□EBDC is a rectangle

CD = $\boxed{EB = 7m}$

AE + $\boxed{EB}$ = AB

∴ AE + 7 = 18

∴ $\boxed{AE = 11\ m}$

In right angled Δ AEC,

$$\sin C = \frac{AE}{AC}$$

$$\therefore \sin C = \frac{11}{22}$$

$$\therefore \boxed{\sin C = \frac{1}{2}}$$

But, $\boxed{\sin 30^\circ = \frac{1}{2}}$

$$\sin C = \sin 30^\circ$$

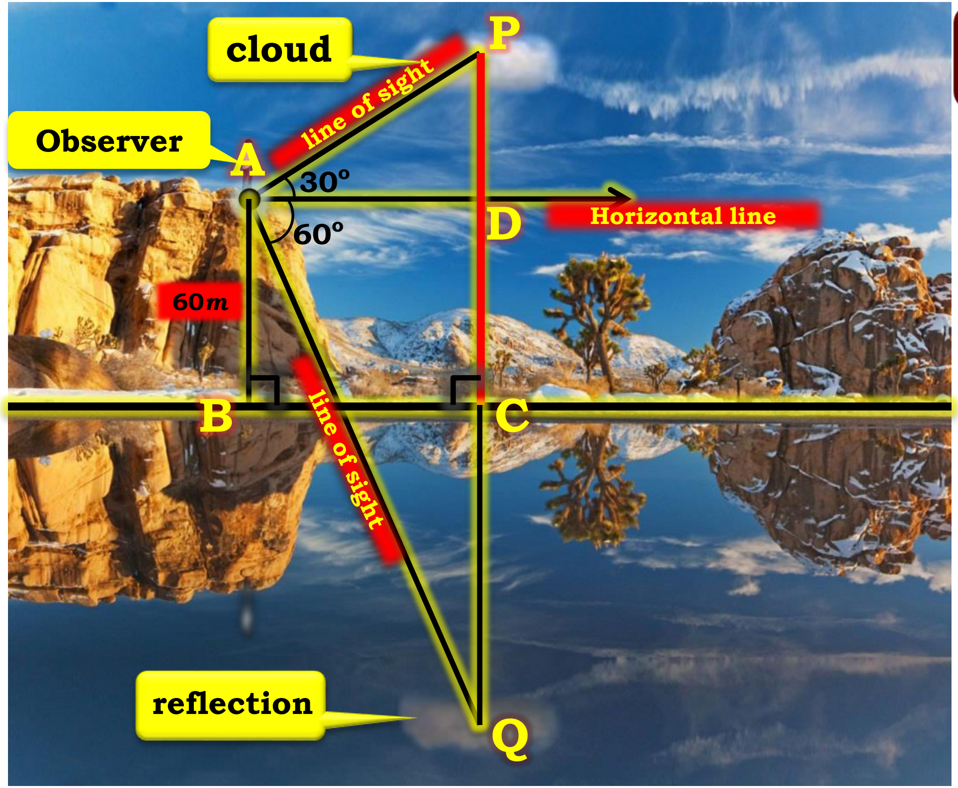
$$\therefore \angle C = 30^\circ$$

The angle made by wire with the horizontal is 30°

Thank You

Module 26

Q. The angle of elevation of a cloud from a point 60m above a lake is 30° and the angle of depression of the reflection of cloud in the lake is 60°. Find the height of the cloud from lake surface.



Height of the person is neglected

Distance of cloud from lake surface = Distance of its reflection from lake surface

Q. The angle of elevation of a cloud from a point ... the ang... on of cloud ... eight of the c...

Consider ΔADP

Sol. : A represents observer above the lake.

AB = 60 m

P represents the cloud.

$\angle$PAD is the angle of elevation.

$\angle$PAD = 30°

Q re... lection of cloud.

$\angle$DA... f depression.

$\angle$DAQ ...

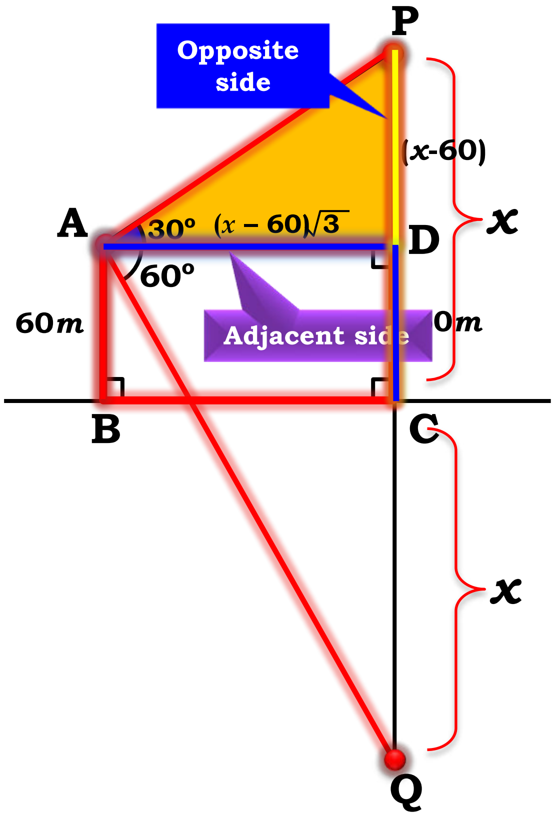
In right angled ΔADP,

$\tan 30° = \frac{1}{\sqrt{3}}$

$\boxed{\tan 30°} = \frac{\boxed{PD}}{AD}$

$\therefore \quad \frac{1}{\sqrt{3}} = \frac{x - 60}{AD}$

$\therefore \quad AD = (x - 60)\sqrt{3}\ m$



Q. The angle of elevation of a cloud from
a poi ... d
the a ... ection
of cl ... e height
of th ...

Ra
Adj

F
O
Adjacent side → AD

Consider ΔAQD

Sol. : In right angled ΔAQD,

$$\boxed{\tan 60^\circ} = \frac{DQ}{AD}$$

tan 60° = $\sqrt{3}$

$$\therefore \quad \sqrt{3} = \frac{x + 60}{\sqrt{3}(x - 60)}$$

$$\therefore \quad 3(x - 60) = x + 60$$

$$\therefore \quad 3x - 180 = x + 60$$

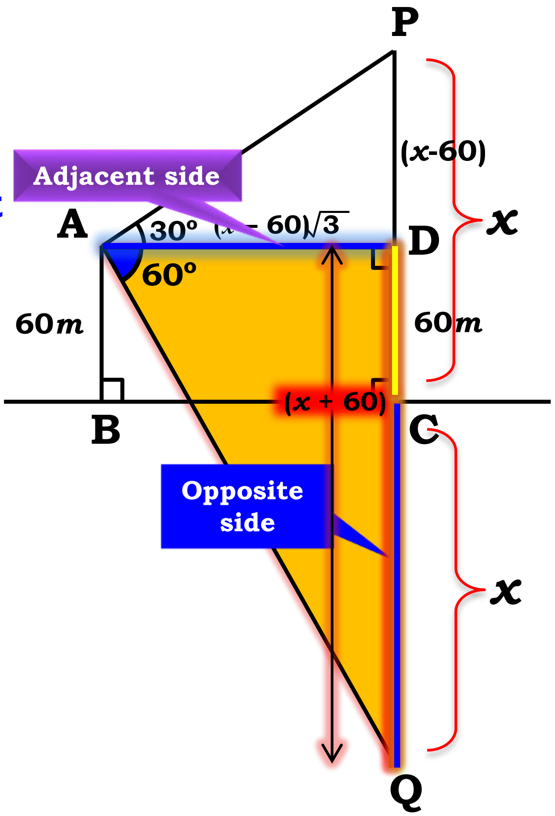
$$\therefore \quad 3x - x = 60 + 180$$

$$\therefore \quad 2x = 240$$

$$\therefore \quad x = 120$$

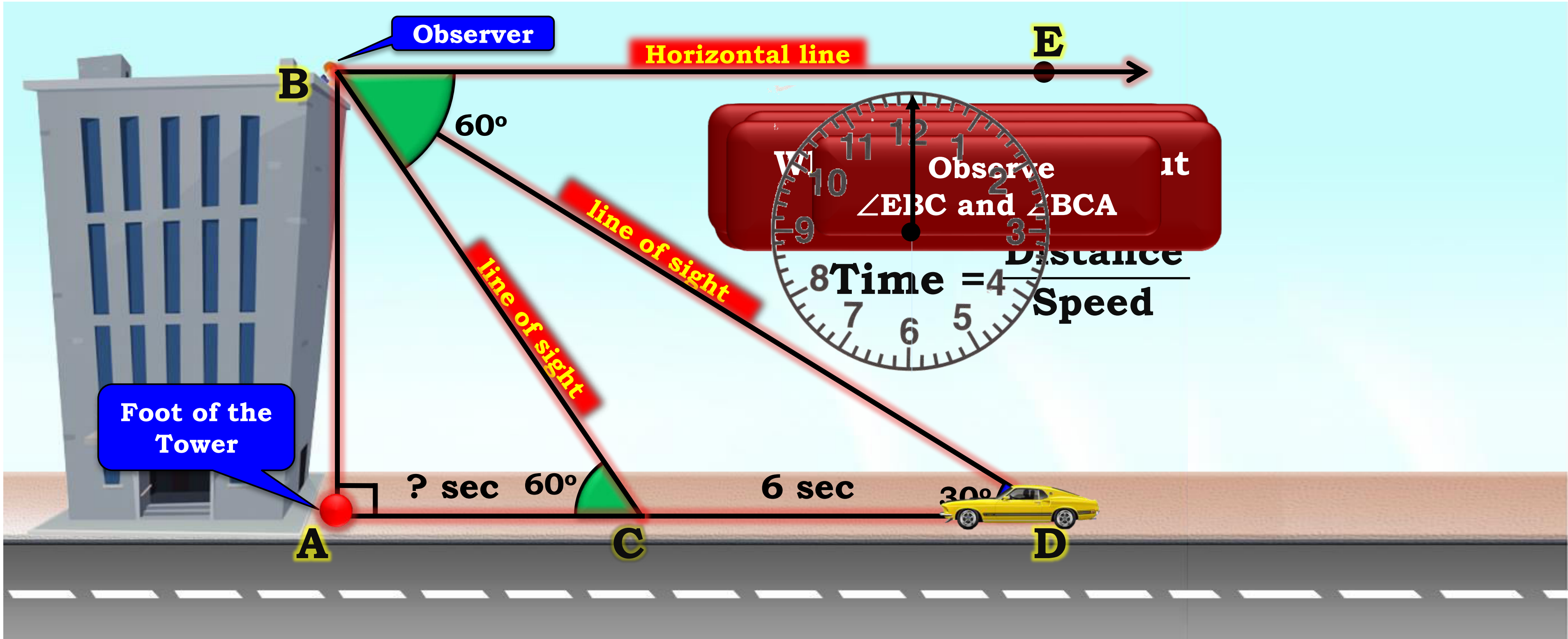
$$\therefore \quad PC = 120\ m$$

∴ **The height of cloud above the lake is 120 *m***

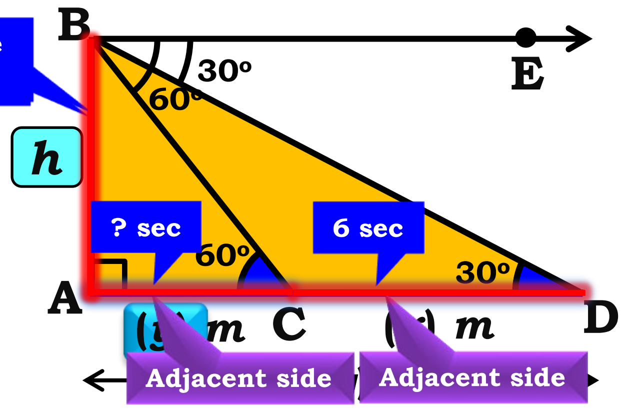


Module 27

Q. A straight highway leads to the foot of tower. A man standing at the top of tower observes a car at an angle of depression of 30°, which is approaching the foot of the tower with 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.



Q. A straight highway leads to the foot of tower. A man standing at the top of tower observes a ... , w ... tower w ... er, th ... found to be 60°. ... the car to reach the foot of the tower from this point.



Consider ΔBAC

Adjacent side → AD

Sol. Let the height of tower (AB) be 'h' m

Let the distance of the foot of tower to the car at C(...

L ... car in 6 ...

$\tan 60^\circ = \sqrt{3}$

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

In right ΔBAC,

$$\tan 60^\circ = \frac{AB}{AC}$$

$$\therefore \quad \sqrt{3} = \frac{h}{y}$$

$$\therefore \quad h = \sqrt{3}y \quad \text{...(i)}$$

In right ΔBAD,

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

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

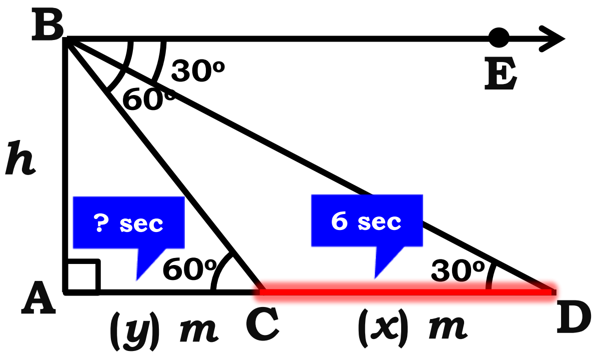
$$\therefore \quad x + y = h\sqrt{3}$$

$$\therefore \quad x + y = \sqrt{3}y \times \sqrt{3} \quad \text{[From (i)]}$$

$$\therefore \quad x + y = 3y$$

$$\therefore \quad x = 2y \quad \text{...(ii)}$$

Q. A straight highway leads to the foot of tower. A man standing at the top of tower observes a car at an angle of depression of 30°, which is approaching the foot of the tower with 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.



Sol. Distance covered by car in 6 seconds = x m

$\boxed{x = 2y}$ ...(ii)

$\therefore$ Speed of the car $= \dfrac{\text{Distance}}{\text{Time}}$

$= \dfrac{x}{6}$

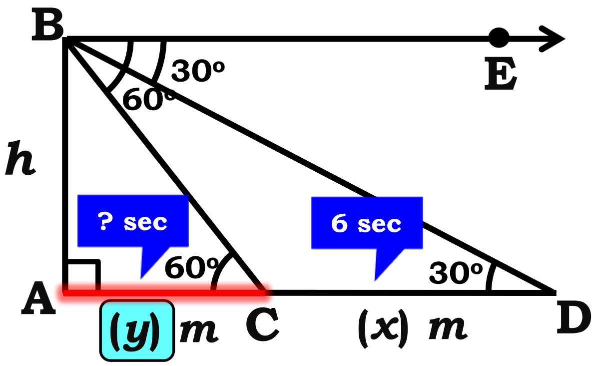
$= \dfrac{\cancel{2}y}{\cancel{6}_3}$ [From (ii)]

$\therefore$ Speed of the car $= \dfrac{y}{3}$ m/sec

$\therefore$ Time taken by car to reach the foot of tower from point C,

$\text{Time} = \dfrac{\text{Distance}}{\text{Speed}}$

Q. A straight highway leads to the foot of tower. A man standing at the top of tower observes a car at an angle of depression of 30°, which is approaching the foot of the tower with 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.



Sol. Time taken by car to reach the foot of tower from point C,

Speed of the car $= \dfrac{y}{3}$ m/sec

$$\text{Time} = \frac{\boxed{\text{Distance}}}{\boxed{\text{Speed}}}$$

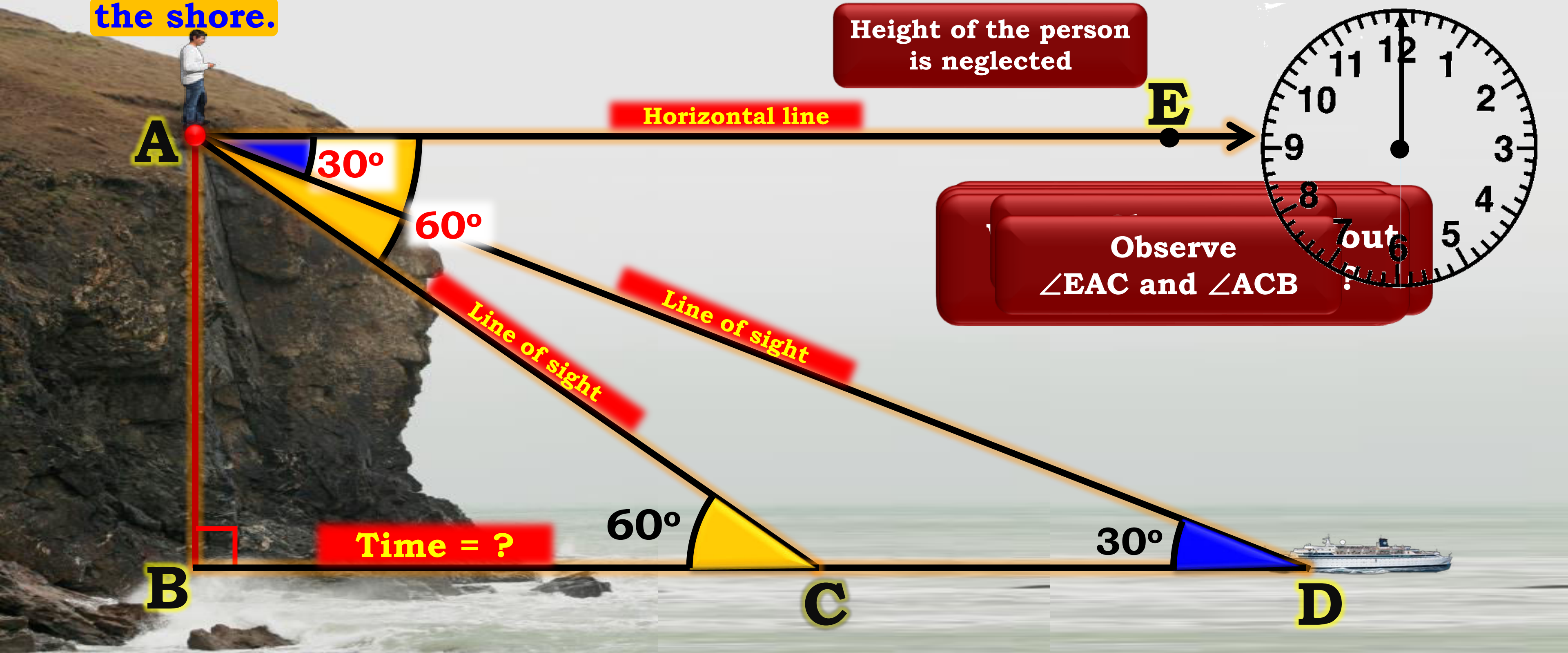
$$= \frac{y}{\frac{y}{3}}$$

$$= \cancel{y} \times \frac{3}{\cancel{y}} = 3 \text{ sec.}$$

Time taken by the car to reach the foot of tower from this point is 3 sec.

Module 28

Q. A man on cliff observes a boat at an angle of depression 30°, which is sailing towards the point of the shore immediately beneath him. Three minutes later the angle of depression of boat is found to be 60°. Assuming that the boat sails at uniform speed, determine how much more time it will take to reach the shore.



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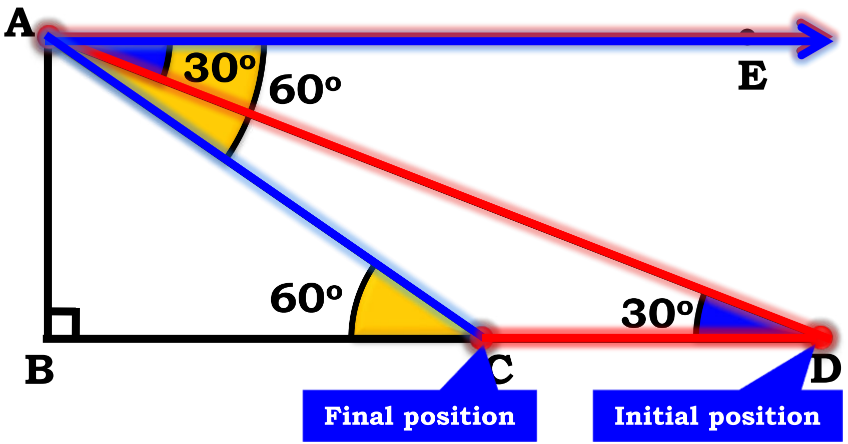


Sol. D and C are the initial and final positions of the ship.

A represents the position of observer.

$\angle EAD$ and $\angle EAC$ are the angles of depression.

$\angle EAD = 30°$, $\angle EAC = 60°$,

$\left.\begin{array}{l}\angle EAD = \angle ADB = 30° \\ \angle EAC = \angle ACB = 60°\end{array}\right\}$ [Alternate angles]

The ship took 3 mins to travel from D to C

Q. A man on cliff observes a boat at an angle of depression 30°, which is sailing towar... ...ediately beneath him. Three minutes later the an... ...und to be 60°. Assuming that the boat sails a... ...ow much more time it will take to reach the sh...

Ra... d
Adj... of

BC belongs to ΔABC

Sol.

Let the uniform speed be x

Time taken from C to D = 3 minutes

∴ Distance from C to D = Speed x Time

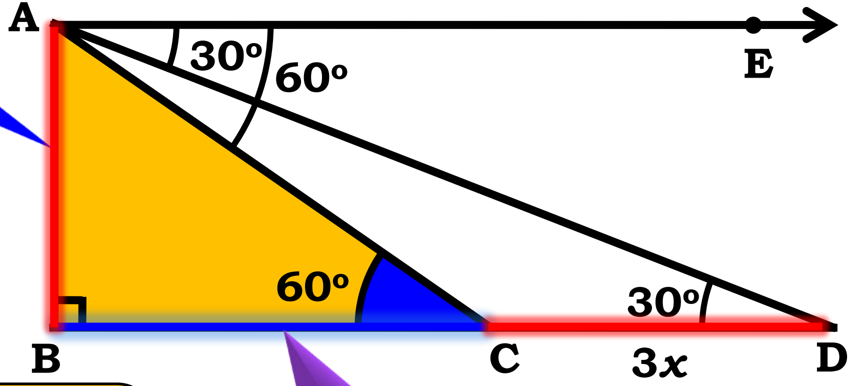
∴ CD = $x \times 3$

∴ CD

$\tan 60^\circ = \sqrt{3}$

In right angled ΔABC,

Opposite side



Adjacent side

$$\boxed{\tan 60^\circ} = \frac{AB}{BC}$$

$$\text{Time} = \frac{\text{Distance}}{\text{speed}}$$

$$= \frac{\boxed{BC}\,?}{x}$$

$$\therefore \quad \sqrt{3} = \frac{AB}{BC}$$

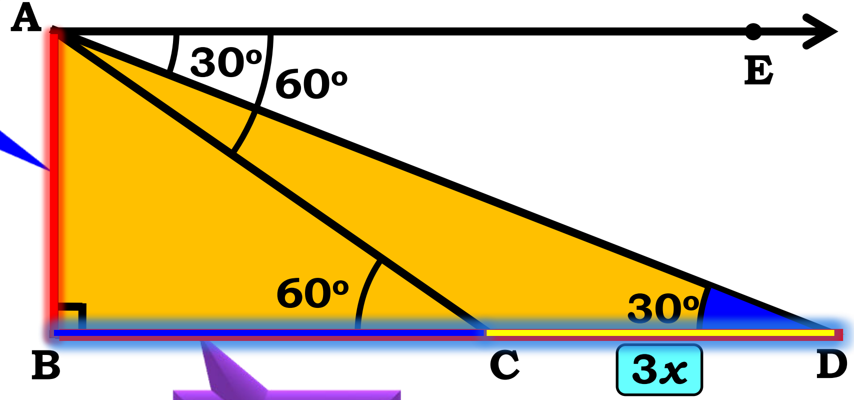
$$\therefore \quad AB = \sqrt{3}\ BC$$

Q. A man … gle of depression 30°, which is sailing towards … ely beneath him. Three minutes later the … to be 60°. Assuming that the boat sails … much more time it will take to reach the s…

Ratio of …

BD is made up of BC and CD

$\tan 30° = \frac{1}{\sqrt{3}}$



Opposite side

Adjacent side

Sol. In right angled ΔABD,

$$\boxed{\tan 30°} = \frac{AB}{BD}$$

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{AB}{BD}$$

$$\therefore \quad \boxed{AB} = \frac{BD}{\sqrt{3}}$$

$$\therefore \quad \sqrt{3}\ BC = \frac{BD}{\sqrt{3}}$$

$$\therefore \quad 3BC = \boxed{BD}$$

$$\therefore \quad 3BC = BC + CD$$

$$\therefore \quad 2BC = CD$$

$$\boxed{AB = \sqrt{3}\ BC}$$

$$\text{Time} = \frac{\boxed{BC}}{x}$$

$$\therefore \quad BC = \frac{\boxed{CD}}{2}$$

$$\therefore \quad BC = \frac{3x}{2}$$

$$\therefore \quad \boxed{BC = 1.5x \text{ units}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{speed}} = \frac{\boxed{BC}}{x}$$

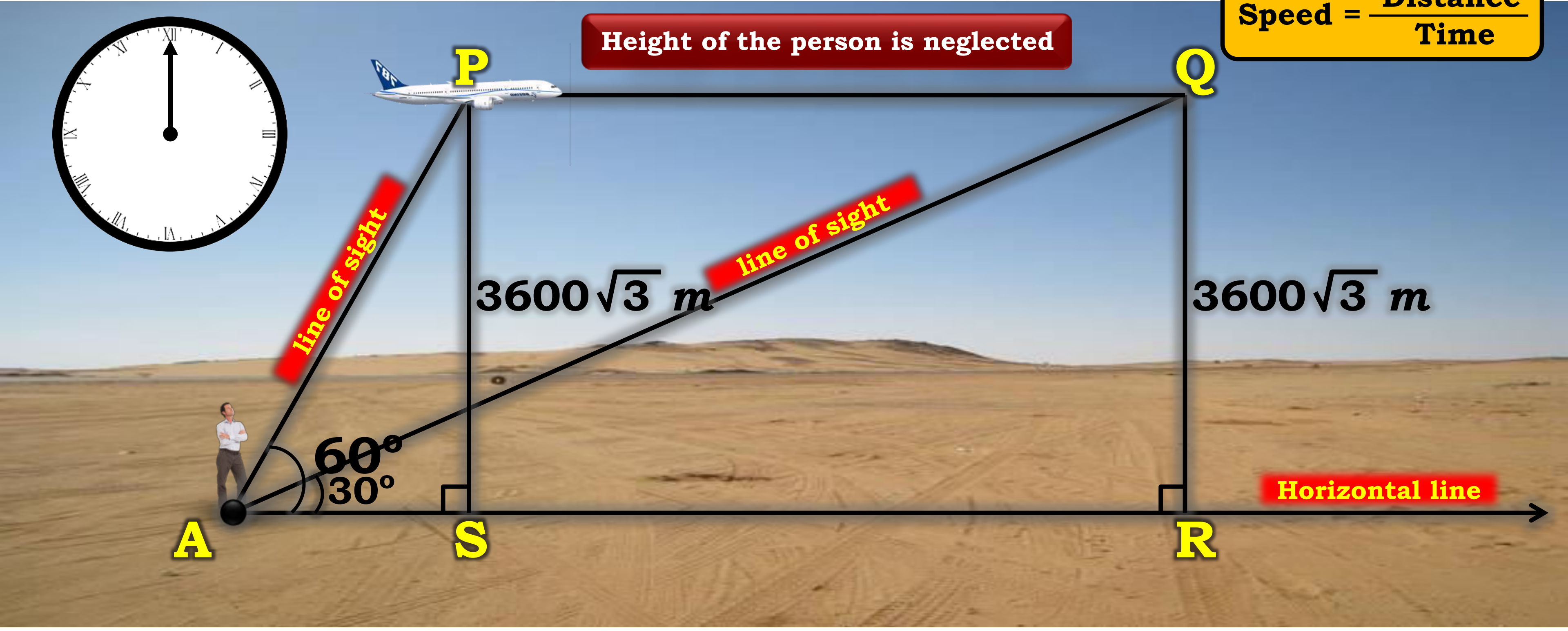
$$= \frac{1.5\cancel{x}}{\cancel{x}} = 1.5\ min$$

The time taken to reach the shore is 1.5 *min*

Module 29

Q. The angle of elevation of a jet plane from a point A on the ground is 60°. After a flight of 30 seconds, the angle of elevation changes to 30°. If the jet plane is flying at a constant height of $3600\sqrt{3}$ meter, Find the speed of the jet plane ($\sqrt{3} = 1.732$)

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$



Q. The angle of elevatio A on the ground is 60°.
After a flight of 30 s changes to 30°.
If the jet plane is fly 00$\sqrt{3}$ meter,
Find the speed of t

Ra nd
Adj s of

AS belongs to
ΔPSA

Sol. Let P and Q be the first and second position of a jet plane.

A represents the point on the ground.

∠PAS and ∠QAR are the angles of elevation.

∠PAS = 60°, ∠QAR = 30°

PS and QR represents constant height at whi is flying.

PS n

tan 60° = $\sqrt{3}$

In rig angled ΔPSA,

$$\tan 60^\circ = \frac{PS}{AS}$$

$$\therefore \quad \sqrt{3} = \frac{3600\sqrt{3}}{AS}$$

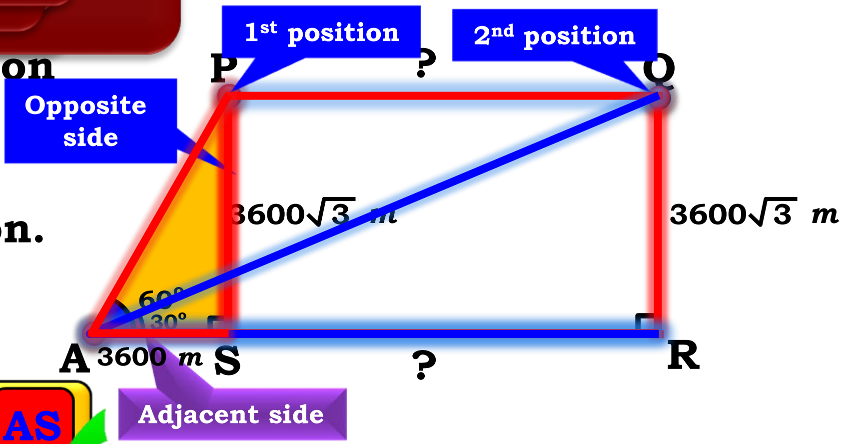
SR = AR – AS

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

∴

$\cancel{\sqrt{3}}$

∴ AS = 3600 m



Q. The angle of elevation of a jet plane from a point A on the ground is 60°.
After a flight of 3 ... and ... n changes to 30°.
If the je ... us of ... 600$\sqrt{3}$ meter,
Find th

tan 30

AR belongs ΔQRA

Sol. In right ... ΔQRA,

$$\tan 30^\circ = \frac{QR}{AR}$$

$$\therefore \quad \frac{1}{\sqrt{3}} = \frac{3600\sqrt{3}}{AR}$$

$$\therefore \quad AR = 3600\sqrt{3} \times \sqrt{3}$$

$$\therefore \quad AR = 3600 \times 3$$

$$\therefore \quad \boxed{AR = 10800\ m}$$

$$AS + SR = AR$$

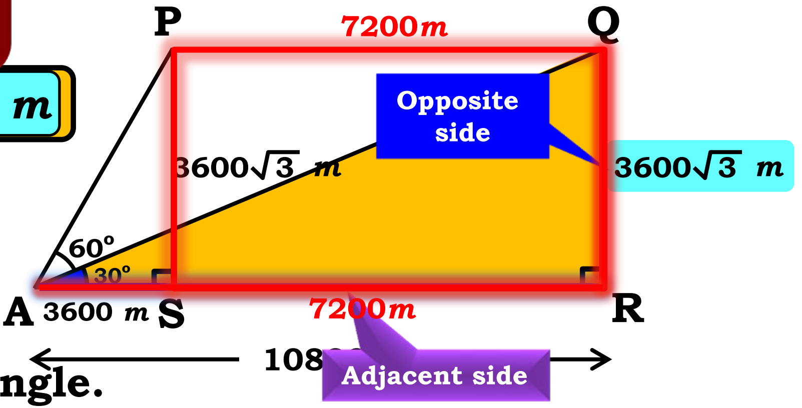
$$\therefore \quad 3600 + SR = 10800$$

$$\therefore \quad SR = 10800 - 3600$$

$$\therefore \quad SR = 7200\ m$$

$$\boxed{AS = 3600\ m}$$

$$SR = AR - AS$$



□PQRS is a rectangle.

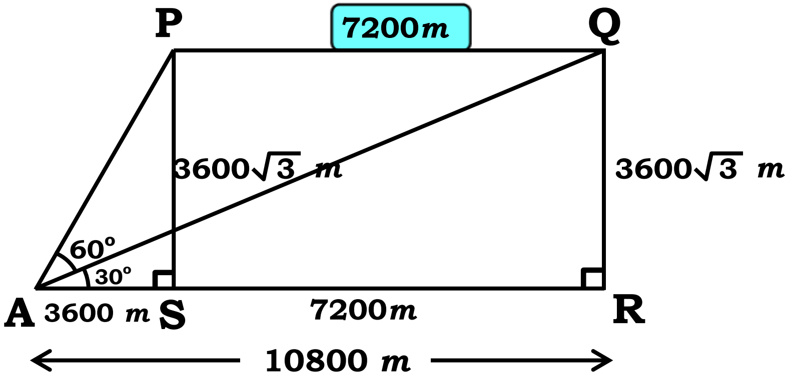
$$PQ = SR = 7200m$$

Distance covered in 30 sec. = 7200m

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{PQ}{30 \text{ sec.}}$$

Q. The angle of elevation of a jet plane from a point A on the ground is 60°. After a flight of 30 seconds, the angle of elevation changes to 30°. If the jet plane is flying at a constant height of $3600\sqrt{3}$ meter, Find the speed of the jet plane. ($\sqrt{3} = 1.732$)



Sol.

$$\text{Speed} = \frac{\boxed{PQ}}{30 \text{ sec.}}$$

1 hr. = 3600 sec.

$$= \frac{\boxed{7200\ m}}{\boxed{30 \text{ sec.}}}$$

$$= \frac{7200}{1000} \div \frac{30}{3600}\ km/hr.$$

$$= \frac{72\cancel{00}}{1\cancel{000}} \times \frac{\overset{12\cancel{0}}{\cancel{3600}}}{\cancel{30}} = 72 \times 12$$

$$= 864\ km/hr.$$

The speed of the jet plane is 864 km/hr.

Thank You