BYJU'S The Learning App

CBSE Board Class 10 Maths Chapter 9- Applications of Trigonometry Objective Questions

Applications of Trigonometry

1. A Technician has to repair a light on a pole of height 10 m. She needs to reach a point 1 m below the top of the pole to undertake the repair work. What should be the length of the ladder that she should use which, when inclined at an angle of 60° to the ground, would enable her to reach the required position? Also, how far from the foot of the pole should she place the foot of the ladder?

(A) $\frac{1}{6\sqrt{3}}$ m

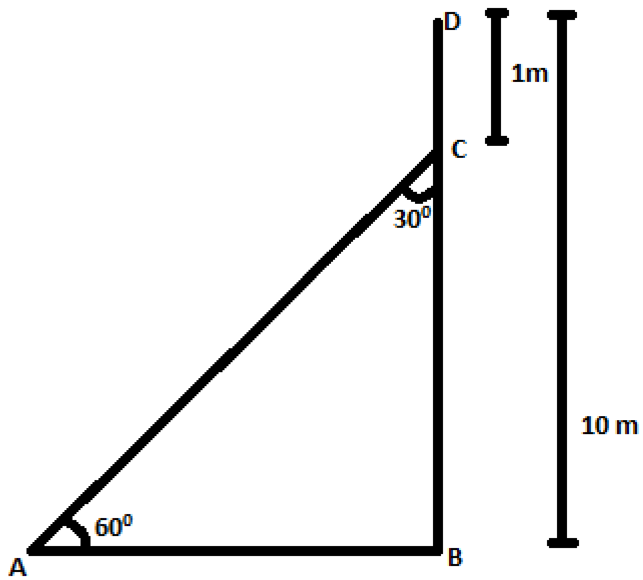
(B) $\frac{\sqrt{3}}{6}$ m

(C) $\frac{1}{\sqrt{3}}$ m

(D) $6\sqrt{3}$ m

Answer: (D) $6\sqrt{3}$ m

Solution: The given situation is represented by the figure below



DB - DC = CB

⇒BC=9msin60 °=BCAC⇒AC=BCsin60°= $9\sqrt{32} = 18\sqrt{3} = 6\sqrt{3}m$

∴height of ladder should be $6\sqrt{3}$

2. A statue, 2 m 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 the angle of elevation of the top of the pedestal is 45°. Find the height of the pedestal.

(A) $2(\sqrt{3}+1)$

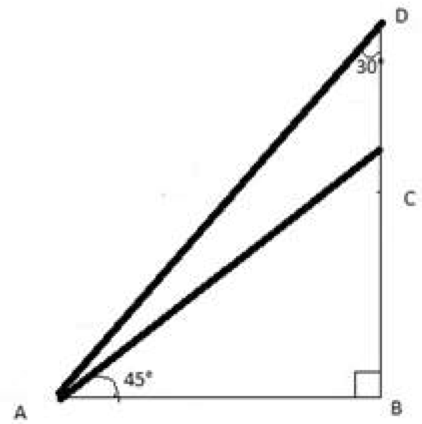
(B) $2(\sqrt{3}-1)$

(C) $\frac{1}{2(\sqrt{3})}$

(D) $\frac{\sqrt{3}+1}{2}$

Answer: (B) $2(\sqrt{3}-1)$

Solution:



CD = 2m

Let BC = x

AB = x (using tan 45∘)

In ΔABD

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

We know CD = BD - BC = 2m

⇒ $x(\sqrt{3}-1)$

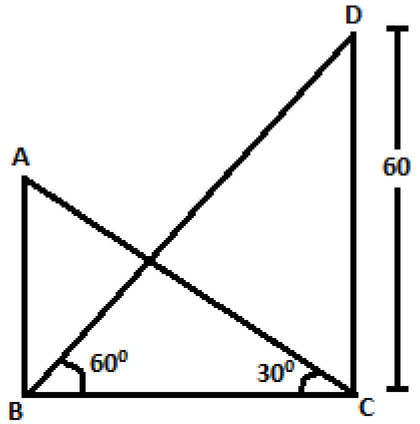
⇒ x = $2(\sqrt{3}-1)$, which is height.

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

(A) 30m
(B) 40m
(C) 20m
(D) 10m

Answer: (C) 20m

Solution:



The given situation can be represented by figure above

∴tan60°=DC/BC⇒BC=DC/tan60°= 60/ $\sqrt{3}$ = 20 $\sqrt{3}$ m
tan30°=AB/BC

⇒AB=BC×tan30°=20 $\sqrt{3}$ $\times$ (1/ $\sqrt{3}$) = 20m

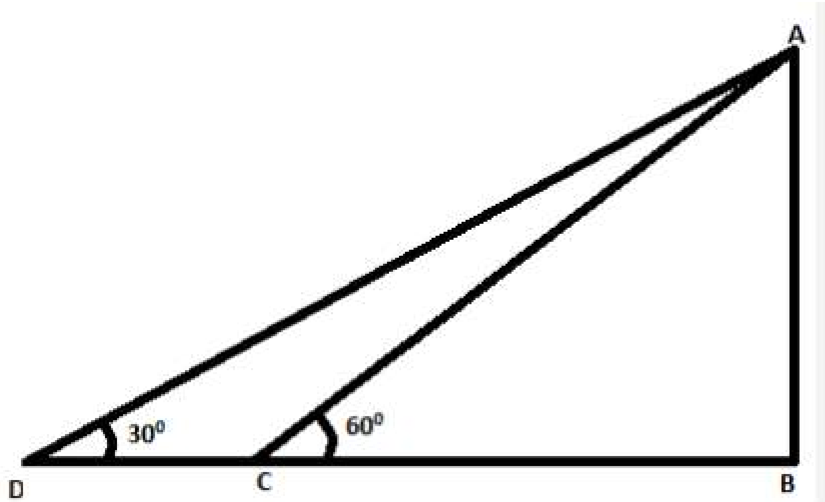
Thus, height of building is 20m

4. A TV tower stands vertically on a bank of a canal, with a height of $10\sqrt{3}$ m . 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 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 distance between the opposite bank of the canal and the point with 30° angle of elevation.

(A) 30m
(B) 20m
(C) 45m
(D) 35m

Answer: (B) 20m

Solution:



The above figure represents the situation given in the question

tan60°=AB/ BC

⇒AB=BCtan60°= $BC\sqrt{3}$ ……….(1)

⇒BC=AB/tan60°=AB/ tan60°
tan30°=AB/BD=AB/ (CD+BC)

⇒DC+BC=AB/tan30°=AB $\sqrt{3}$

⇒DC=AB $(\sqrt{3}+\frac{1}{\sqrt{3}})$
⇒DC=20m, which is the required distance.

5. As observed from the top of a 150 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.

(A) $150(\sqrt{3}+1)$

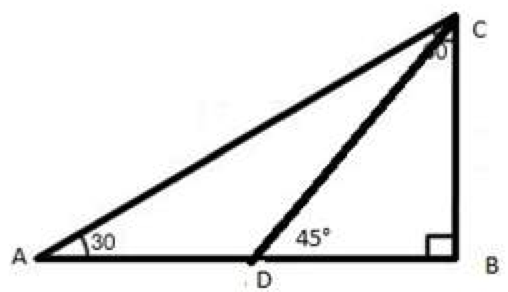
(B) $150(\sqrt{3}-1)$

(C) $\frac{150}{(\sqrt{3}-1)}$

(D) $\frac{150}{(\sqrt{3}+1)}$

Answer: (B) $150(\sqrt{3}-1)$

Solution:



Here Lighthouse BC = 150 m

In ΔBDC,

BD = BC = 150m (using tan 45°)

In ΔABC,

AB = BC $\sqrt{3}$ (using tan 30°)

AB= 150 $\sqrt{3}$

Hence distance AD = $150(\sqrt{3}-1)$

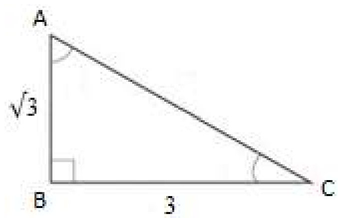
6. An observer $\sqrt{3}$ m tall is 3 m away from the pole $2\sqrt{3}$ high. What is the angle of elevation of the top?

(A) 60°
(B) 30°
(C) 45°
(D) 90°

Answer: (B) 30°

Solution:

Concept: 1 Mark
Application: 1 Mark



Height of the pole that is above man's height = $2\sqrt{3} - \sqrt{3} = \sqrt{3}m$

Hence, AB = $\sqrt{3}m$

BC = 3m

Hence, tan C = AB/BC = $\frac{\sqrt{3}}{3} = \frac{1}{\sqrt{3}}$

⟹ C, angle of elevation = 30°

Introduction

7. 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.

(A) $10 + \sqrt{3}$

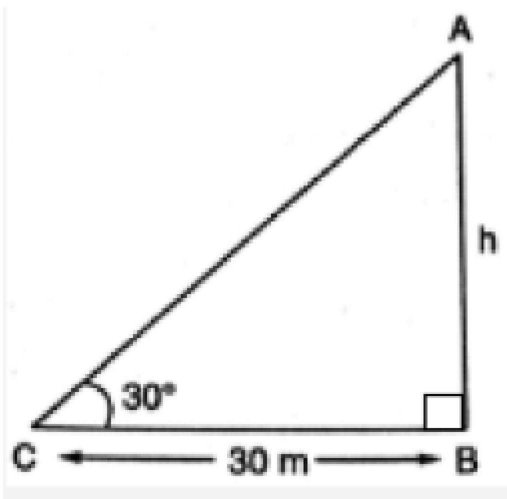
(B) $10 - \sqrt{3}$

(C) $10\sqrt{3}$

(D) $\frac{10}{\sqrt{3}}$

Answer: (C) $10\sqrt{3}$

Solution: In ΔABC, taking tangent of ∠C, we have,



tan C=AB/BC

⇒tan 30°=h/30

⇒ $\frac{1}{\sqrt{3}}$ = h/30

$$\Rightarrow h = \frac{30}{\sqrt{3}}\, metres = \frac{30^{10}\sqrt{3}}{3}$$

=10(1.732)

=17.32m= $10\sqrt{3}$ m

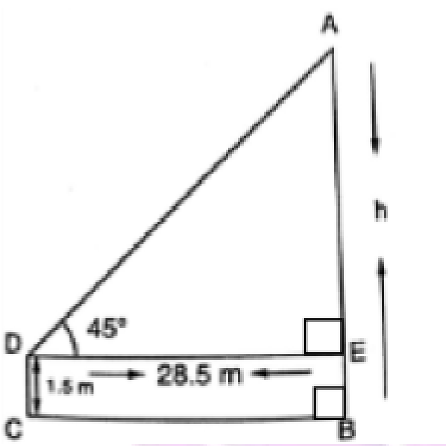
Hence, the height of the tower is $10\sqrt{3}$ metres

8. An observer 1.5 m tall is 28.5 m away from a tower. The angle of elevation of the top of the tower from her eyes is 45°. What is the height of the tower?

(A) 20m
(B) 10m
(C) 40m
(D) 30m

Answer: (D) 30m

Solution: Let AB be the tower of height h and CD be the observer of height 1.5 m at a distance of 28.5 m from the tower AB.



In ΔAED, we have

$\tan 45° = h/28.5$

$\Rightarrow 1 = h/28.5$

$\Rightarrow h = 28.5$ m

$\therefore h = AE + BE = AE + DC$

$= (28.5 + 1.5)$ m $= 30$ m

Height of tower = h + 1.5

= 28.5 + 1.5

= 30 m

Hence, the height of the tower is 30 m.

9. An electrician has to repair an electric fault on a pole of height 4 m. He needs to reach a point 1.3 m below the top of the pole to undertake the repair work. What should be the length of the ladder that he should use which when inclined at an angle of 60° to the horizontal would enable him to reach the required position?

(A) $\frac{9\sqrt{3}}{5}$

(B) $\frac{9\times 5}{\sqrt{3}}$

(C) $\frac{9}{\sqrt{3}}$

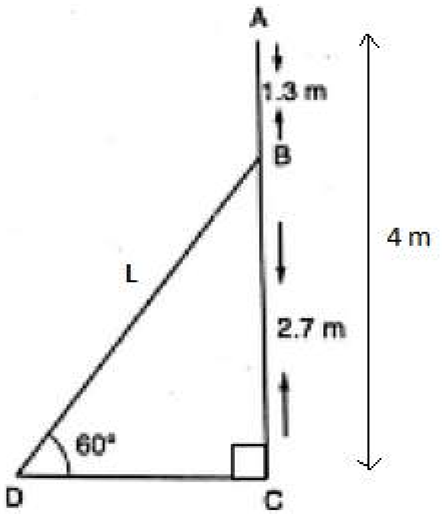
(D) $\frac{\sqrt{3}}{5}$

Answer: (A) $\frac{9\sqrt{3}}{5}$

Solution: Let AC be the electric pole of height 4 m. Let B be a point 1.3 m below the top A of the pole AC.

Then, BC = AC - AB = (4 - 1.3) m = 2.7 m

Let BD be the ladder inclined at an angle of 60° to the horizontal.



In ΔBCD, we have

sin60°=2.7/L

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{2.7}{L} \quad [\because BC = 2.7\ m]$

$\frac{\sqrt{3}}{2} = \frac{2.7}{L}$

$L = \frac{2}{\sqrt{3}} \frac{(27)}{10}$

$= \frac{2^1(27^9)}{3(10)}\sqrt{3}$

$= 1.8\sqrt{3}\ m$

or $\frac{9}{5}\sqrt{3}\ m$

$\Rightarrow BD = \frac{2\times 2.7}{\sqrt{3}} m = \frac{5.4}{\sqrt{3}} m = \frac{5.4\times\sqrt{3}}{3} m$

$\Rightarrow BD = (1.8)\sqrt{3}m = \frac{9}{5}\sqrt{3}m$

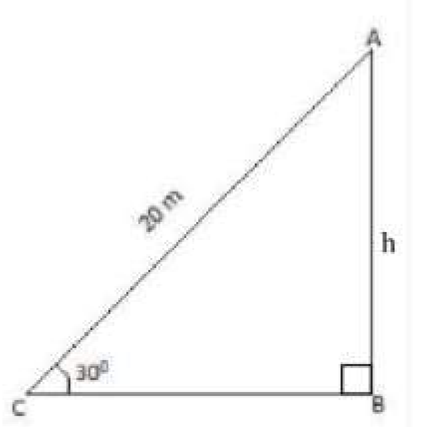
Hence, the length of the ladder should be $\frac{9\sqrt{3}}{5}$ m.

10. A circus artist is climbing a 20 m 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°.

(A) 10m
(B) 15m
(C) 20m
(D) 35m

Answer: (A) 10m

Solution: Let AB be the vertical pole and CA be the 20 m long rope such that its one end is tied from the top of the vertical pole AB and the other end C is tied to a point C on the ground.



In ΔABC, we have

sin 30°=h/20

⇒1/2=h/20

⇒h=10 m

Hence, the height of the pole is 10 m.

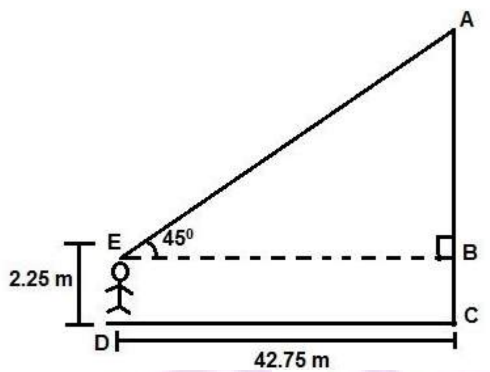
Heights and Distances

11. An observer 2.25 m tall is 42.75 m away from a chimney. The angle of elevation of the top of the chimney from her eyes is 45°. What is the height of the chimney?

(A) 40m
(B) 50m
(C) 45m
(D) 35m

Answer: (C) 45m

Solution:



The given situation is represented by the figure above:

In triangle ABE,
$\tan 45^\circ = AB/EB$

Also, EB=DC

$\therefore \tan 45^\circ = AB/DC$

$\Rightarrow AB = DC \times \tan 45^\circ$

$\Rightarrow AB = 1 \times 42.75$

Hence, the height of the chimney = AC = AB + BC
We can observe that BC = ED.
Thus, AC = AB + ED
= 42.75 + 2.25
= 45 m.

12. A tower stands vertically on the ground. From a point on the ground, which is 30 m away from the foot of the tower, the angle of elevation of the top of the tower is found to be 30°. Find the height of the tower.

(A) 10m

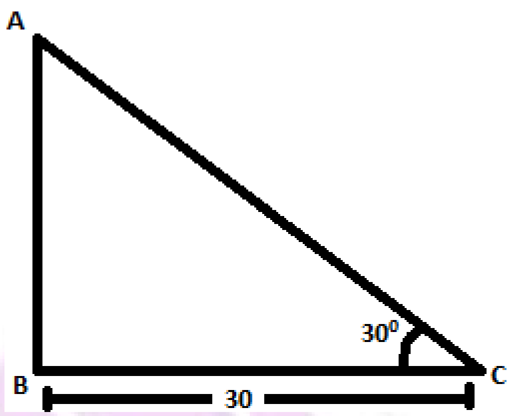
(B) $10\sqrt{3}$ m

(C) 30 $\sqrt{3}$ m

(D) 30m

Answer: (B) $10\sqrt{3}$ m

Solution: The given situation can be represented by the Δ below



Now, tan30°=AB/ BC

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

$$\Rightarrow 10\sqrt{3} = AB$$

∴Height of tower is $10\sqrt{3}$ m.

13. The angles of depression of the top and the bottom of a 10 m tall building from the top of a multi-storeyed building are 30° and 45°, respectively. Find the height of the multi-storeyed building.

(A) 5m

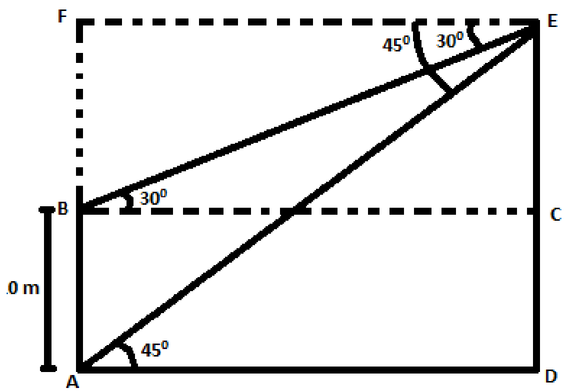
(B) $5(\sqrt{3}+3)m$

(C) 15m

(D) 10m

Answer: (B) $5(\sqrt{3}+3)m$

Solution:



The above figure represents the situation aptly

$$\angle CBE = \angle BEF \; and \; \angle DAE = \angle AEF \quad \text{(alternate angles)}$$

$$tan(\angle EAD) = tan45^\circ = \frac{ED}{AD} = \frac{EC+CD}{AD}$$

$$\Rightarrow AD \times tan45^\circ = EC + CD \ldots\ldots (1)$$

$$and \; tan(\angle EBC) = tan30^\circ = \frac{EC}{CB}$$

$$\Rightarrow CB \times tan30^\circ = EC \ldots\ldots (2)$$

Subtracting eq(2) from (1)

$$\Rightarrow AD \times tan45^\circ - CB \times tan30^\circ = CD$$

$$\Rightarrow AD(tan45^\circ - tan30^\circ) = CD \quad (\because AD = CB)$$

$$\Rightarrow AD\left(1 - \frac{1}{\sqrt{3}}\right) = 10$$

$$\Rightarrow AD = 5(3+\sqrt{3})m$$

$$\Rightarrow ED = AD(tan45^\circ = 1)$$

ED is the height of the building.

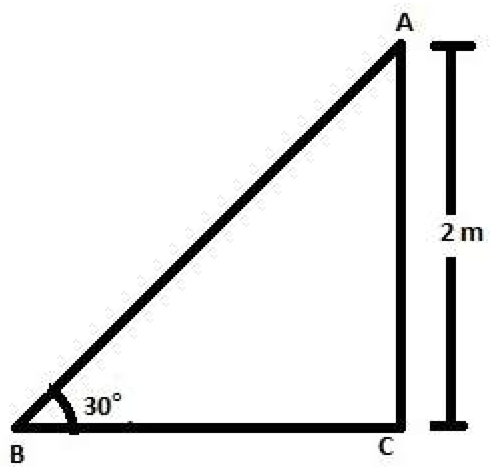
BYJU'S The Learning App

14. 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 2m and is inclined at an angle of 30° to the ground. What should be the length of the slide?

(A) 4
(B) 2
(C) 1.5
(D) 3

Answer: (A) 4

Solution: The given situation can be represented by the figure below



In right-angled triangle ABC,
sin∠ABC=AC/AB=1/2

⇒sin30°=2/AB⇒AB= 2/ (1/2)

⇒AB=4m

∴Length of the slide is 4m.

15. A kite is flying at a height of 30 m above the ground. The string attached to the kite is temporarily tied to a point on the ground. The inclination of the string with the ground is 60°. Find the length of the string, assuming that there is no slack in the string.

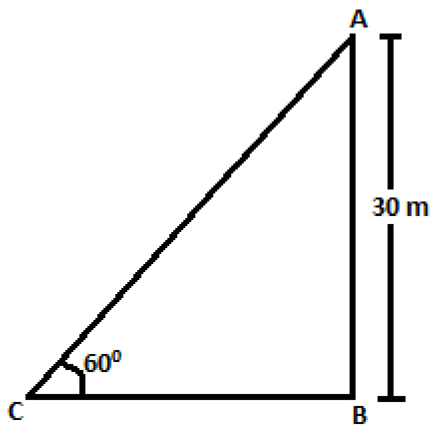
(A) $20\sqrt{3}$ m
(B) 30m

(C) $30\sqrt{3}$ m

(D) 60m

Answer: (A) $20\sqrt{3}$

Solution: The situation can be represented by the figure below:



In the given right-angled triangle:

sin (∠ACB) =AB/AC

⇒sin60°=AB/AC

⇒AC=AB/sin60°= $\frac{30}{\frac{\sqrt{3}}{2}} = \frac{60}{\sqrt{3}} = 20\sqrt{3}$

∴ Length of the string is $20\sqrt{3}$ m

16. A vertical pole of 30 m is fixed on a tower. From a point on the level ground, the angles of elevation of the top and bottom of the pole is 60° and 45°. Find the height of the tower.

(A) 20

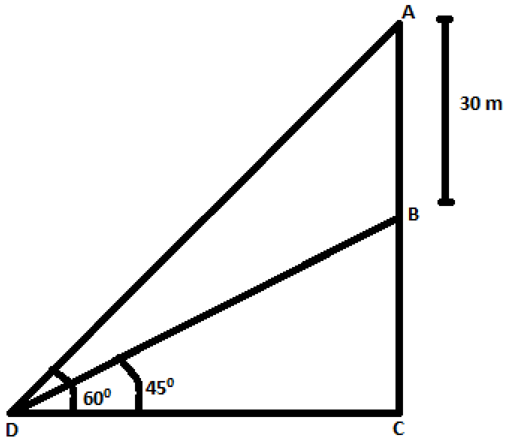
(B) $15(\sqrt{3}+1)$

(C) $15(\sqrt{3}-1)$

(D) 15

Answer: (B) $15(\sqrt{3}+1)$

Solution:



The situation can be represented by the figure above

$$tan60^\circ = \frac{AC}{CD} = \frac{AB+BC}{CD}$$
$$\Rightarrow (CD)tan60^\circ = AB + BC \ldots\ldots(1)$$
$$tan45^\circ = \frac{BC}{CD}$$
$$\Rightarrow (CD)tan45^\circ = BC \ldots\ldots(2)$$
$$Dividing\ eq(1)\ by\ (2)$$
$$\frac{tan60^\circ}{tan45^\circ} = \frac{AB+BC}{BC} \Rightarrow BC = \frac{AB}{(\sqrt{3}-1)} = 15(\sqrt{3}+1)m$$

17. The value of tan A +sin A=M and tan A – sin A=N.

The value of $(M^2 - N^2) / (MN)^{0.5}$

(A) 4
(B) 3
(C) 2
(D) 1

Answer: (A) 4

Solution: $M^2 - N^2$ = (Tan A+ Sin A + Tan A –Sin A) (Tan A +Sin A – Tan A+ Sin A)

$M^2 - N^2$ =4 tan A sin A

and $(MN)^{0.5} = (\tan^2 A - \sin^2 A)^{0.5}$

$(MN)^{0.5} = sinA[(\frac{1}{cos^2A}) - 1]^{0.5}$

$(MN)^{0.5}$ = tan A sin A

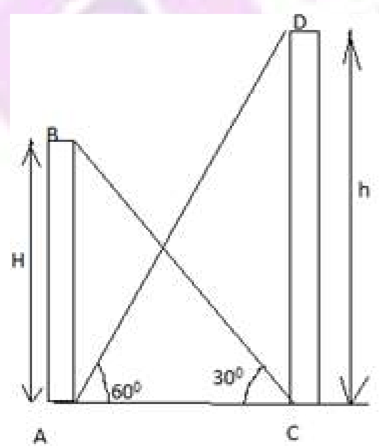
Therefore, $\frac{(m^2-n^2)}{(mn)^{0.5}} = 4$

18. Two towers A and B are standing at some distance apart. From the top of tower A, the angle of depression of the foot of tower B is found to be 30°. From the top of tower B, the angle of depression of the foot of tower A is found to be 60°. If the height of tower B is 'h' m then the height of tower A in terms of 'h' is _____ m

(A) h/2 m
(B) h/3m
(C) $\sqrt{3}h$ m
(D) $\frac{h}{\sqrt{3}}m$

Answer: (B) h/3 m

Solution:



Let the height of tower A be = AB = H.

And the height of tower B = CD = h

In triangle ABC

tan30° = AB/AC = H/AC 1

In triangle ADC

tan60° = CD/AC = h/AC......................................2

Divide 1 by 2

We get tan30°/tan60° = H/h

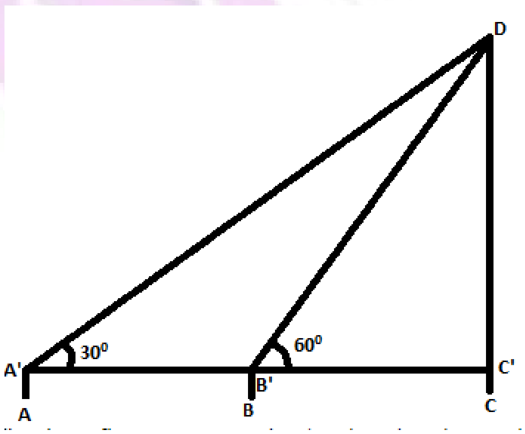
H= h/3

19. A 1.5 m tall boy is standing at some distance from a 31.5 m tall building. If he walks 'd' m towards the building the angle of elevation of the top of the building changes from 30° to 60°**.** Find the length d. (Take $\sqrt{3} = 1.73$)

(A) 30.15 m
(B) 38.33m
(C) 22.91m
(D) 34.55m

Answer: (D) 34.55m

Solution:



The above figure represents the situation given in question

$$AA' = BB' = CC' = 1.5$$

$$tan(\angle DB'C') = \frac{DC'}{B'C'}$$

$$and\ DC' = DC - CC' = 31.5 - 1.5 = 30m$$

$$\therefore tan60^\circ = \frac{30}{B'C'}$$

$$\Rightarrow B'C' = \frac{30}{tan60^\circ} = \frac{30}{\sqrt{3}} \ldots\ldots (1)$$

Similarly,

$$tan30^\circ = \frac{DC'}{A'C'} = \frac{DC'}{A'B' + B'C'}$$

$$\Rightarrow A'B' + B'C' = \frac{DC'}{tan30^\circ} = 30\sqrt{3} \ldots\ldots (2)$$

Subtracting eq (1) from (2)

$$A'B' = 30\sqrt{3} - \frac{30}{\sqrt{3}} = 30\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right) = 34.55\ m$$

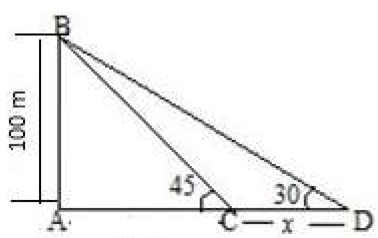
∴distance moved by boy is 34.55 m

20. The angles of depression of two objects from the top of a 100 m hill lying to its east are found to be 45° and 30°. Find the distance between the two objects. **(**Take, $\sqrt{3} = 1.732$ **)**

(A) 200m
(B) 150m
(C) 107.5m
(D) 73.2m

Answer: (D) 73.2 m

Solution: Let C and D be the objects and CD be the distance between the objects.



In ΔABC, tan 45° = AB/AC

AB=AC=100 m

In ΔABD, tan 30° = AB/AD

$$AD \times \frac{1}{\sqrt{3}} = 100$$
$$AD = 100 \times \sqrt{3} = 173.2m$$

CD=AD−AC=173.2−100=73.2 metres