CHAPTER

11 HEIGHTS AND DISTANCES

Syllabus

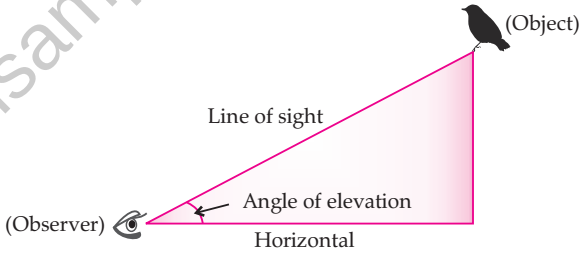
- *Simple problems on heights and distances. Problems should not involve more than two right triangles. Angles of elevation / depression 30°, 45°, 60° only.*

Chapter Analysis

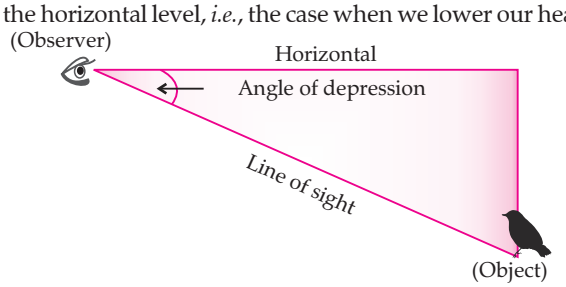
List of Topics	2016			2017			2018
	Delhi	Outside Delhi	Foreign	Delhi	Outside Delhi	Foreign	Delhi & Outside Delhi
Heights and distances	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (1 M) 1 Q (3 M) 1 Q (4 M)	1 Q (4 M)

Revision Notes

- The line of sight is the line drawn from the eye of an observer to the point in the object viewed by the observer.
- The angle of elevation of a point on the object being viewed is the angle formed by the line of sight with the horizontal when it is above the horizontal level, *i.e.*, the case when we raise our head to look at a point on the object.



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

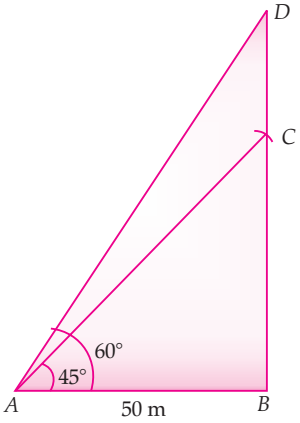


- The height of object above the water surface is equal to the depth of its image below the water surface.
- The values of the trigonometric ratios of an angle do not vary with the length of the sides of the triangle, if the angles remain the same.

How it is done on GREENBOARD ?

Q. The angle of elevation of the top of a tower from a point 50 m away from the base of the tower is 45°. The angle of elevation of the top of the flag mounted on the tower is 60°. Find the height of the flag. U

Sol. : Step I : Let BC be the tower, CD be the flag and A is the point of observation.



Step II : First we will calculate the height of tower BC using triangle ABC, ∠B = 90°

$$\tan 45^\circ = \frac{BC}{50}$$

$$\Rightarrow \quad 1 = \frac{BC}{50}$$

$$\Rightarrow \quad BC = 50 \text{ metre}$$

Step III : Calculation of height BD.

In ΔABD, ∠B = 90°

$$\tan 60^\circ = \frac{BD}{50}$$

$$\Rightarrow \quad \sqrt{3} = \frac{BD}{50}$$

$$\Rightarrow \quad BD = 50\sqrt{3} \text{ metre}$$

Step IV : Calculation for height of flag

Height of flag CD = BD – BC

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

$$\Rightarrow \quad CD = 50(\sqrt{3} - 1)$$

$$= 50\ (1.73 - 1)$$

$$= 50 \times 0.73$$

$$\Rightarrow \quad \text{Height of flag} = 36.5 \text{ metre}$$

Objective Type Questions (1 mark each)

[A] Multiple Choice Questions :

Q. 1. A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then the Sun's elevation is :

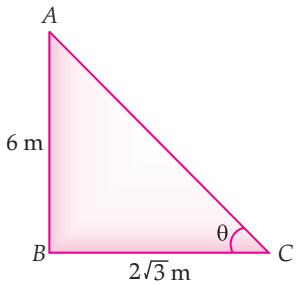
(a) 60° **(b) 45°**
(c) 30° **(d) 90°**

A **[NCERT Exemp.]**

Sol. Correct option : (a)

Explanation : In ΔABC, $\angle B = 90°$

$$\tan\theta = \frac{6}{2\sqrt{3}} = \sqrt{3} = \tan 60° \Rightarrow \theta = 60°$$



Q. 2. The angle of depression of a car parked on the road from the top of 150 m high tower is 30°. The distance of the car from the tower (in metres) is :

(a) $50\sqrt{3}$ **(b) $150\sqrt{3}$**
(c) $150\sqrt{2}$ **(d) 75**

A **[Board Term-2, Delhi Set, 1, 2, 3, 2014]**

Sol. Correct option : (b)

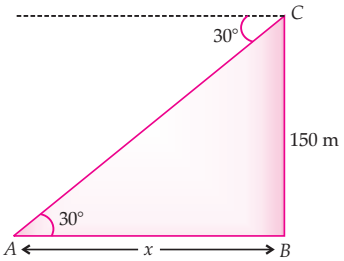
Explanaton : In ΔABC, $\angle B = 90°$

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

$$\tan 30° = \frac{150}{x}$$

$$\frac{1}{\sqrt{3}} = \frac{150}{x}$$

$$x = 150 \text{ m}$$



Q. 3. The length of a string between a kite and a point on the ground is 85 m. If the string makes an angle θ with the ground level such that $\tan\theta = \frac{15}{8}$, then the kite is at what height from the ground ?

(a) 75 m **(b) 79.41 m**

(c) 80 m **(d) 72.5 m**

A [Board Term-2, Outside Delhi Set, 1, 2, 3, 2014]

Sol. Correct option : (a)

Explanaton : $\tan\theta = \frac{15}{8}$

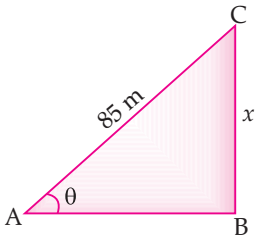
$\sin\theta = \frac{15}{17}$ ...(i)

Now, $\sin\theta = \frac{x}{85}$ ...(ii)

From, equation (i) and (ii),

$\frac{15}{17} = \frac{x}{85}$

$x = 75$ m.



Q. 4. If the height of a vertical pole is $\sqrt{3}$ times the length of its shadow on the ground, then the angle of elevation of the Sun at that time is :

(a) 30° **(b) 60°**

(c) 45° **(d) 75°**

C + A [Board Term-2, Foreign Set- I, II, III, 2014]

Sol. Correct option : (b)

Explanaton : Let the length of shadow is x,

Then height of pale $= \sqrt{3}\,x$

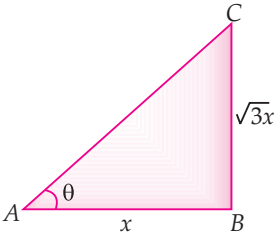
Now, $\tan\theta = \frac{CB}{AB}$

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

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

$\tan\theta = \tan 60°$

$\theta = 60$.



Q. 5. The angle of depression of a car, standing on the ground, from the top of a 75 m high tower, is 30°. The distance of the car from the base of the tower (in m.) is :

(a) $25\sqrt{3}$ **(b) $50\sqrt{3}$**

(c) $75\sqrt{3}$ **(d) 150**

C + A [Board Term- 2, 2013]

Sol. Correct option : (c)

Try yourself, similar to Q. No. 2 in MCQs.

Q. 6. From the top of a cliff 20 m high, the angle of elevation of the top of a tower is found to be equal to the angle of depression of the foot of the tower. The height of the tower is :

(a) 20 m **(b) 40 m**

(c) 60 m **(d) 80 m**

C + A [Board Comptt. Set-I, 2013]

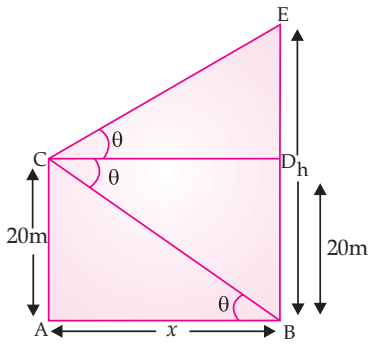
Sol. Correct option : (b)

Explanation : In ΔABC, $\angle A = 90°$

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

$\tan\theta = \frac{20}{x}$

$x = \frac{20}{\tan\theta}$ ...(i)



In ΔCDE, $\angle D = 90°$

Now, $\tan\theta = \frac{ED}{CD}$

$\tan\theta = \frac{h-20}{x}$

$x = \frac{h-20}{\tan\theta}$ ...(ii)

From equation (i) and (ii),

$\frac{h-20}{\tan\theta} = \frac{20}{\tan\theta}$

$h - 20 = 20$

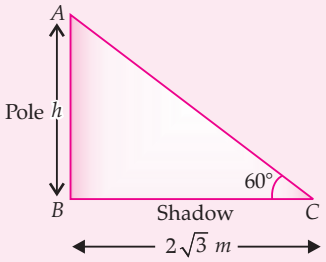
$h = 40$ m.

[B] Very Short Answer Type Questions :

Q. 1. A pole casts a shadow of length $2\sqrt{3}$ m on the ground, when the Sun's elevation is 60°. Find the height of the pole.

C + A [Foreign Set I, II, III, 2015]

Sol. Let the height of pole be h.



$$\frac{h}{2\sqrt{3}} = \tan 60°$$

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

$$\Rightarrow \quad h = 6 \text{ m.} \qquad \mathbf{1}$$

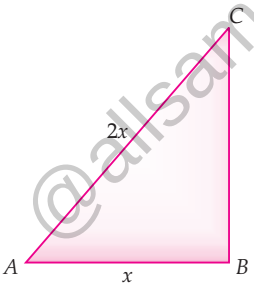
[CBSE Marking Scheme, 2015]

Q. 2. If the length of the ladder placed against a wall is twice the distance between the foot of the ladder and the wall. Find the angle made by the ladder with the horizontal.

C + A [CBSE S.A.-2 2015 Set-HODM4OL]

Sol. Let the distance between the foot of the ladder and the wall, AB be x.

then AC, the length of the ladder $= 2x$



In ΔABC, $\angle B = 90°$

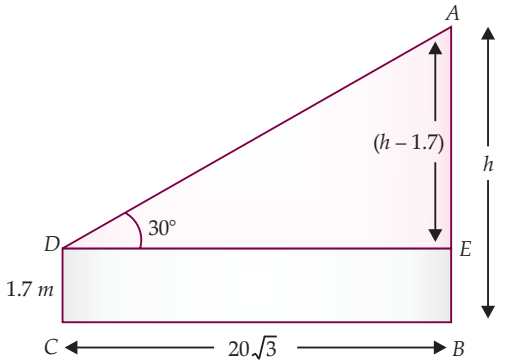
$$\cos A = \frac{x}{2x}$$

$$\Rightarrow \quad \cos A = \frac{1}{2} = \cos 60° \Rightarrow A = 60° \qquad \mathbf{1}$$

Q. 3. An observer, 1.7 m tall, is $20\sqrt{3}$ m away from a tower. The angle of elevation from the eye of observer to the top of tower is 30°. Find the height of the tower.

C + A [Foreign Set I, II, III, 2016]

Sol.



Let height of the tower AB be h metre

$$\Rightarrow \quad AE = h - 1.7$$

$$BC = DE = 20\sqrt{3} \text{ m. (given)}$$

In ΔADE, $\angle E = 90°$

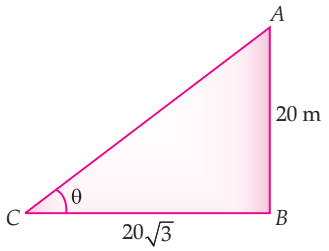
$$\tan 30° = \frac{h-1.7}{20\sqrt{3}}$$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{h-1.7}{20\sqrt{3}}$$

$$\Rightarrow \quad h - 1.7 = 20$$

$$\text{or} \quad h = 20 + 1.7 = 21.7 \text{ m} \qquad \mathbf{1}$$

Q. 4. In figure, a tower AB is 20 m high and BC, its shadow on the ground, is $20\sqrt{3}$ m long. Find the Sun's altitude.



C + A [Outside Delhi CBSE, 2015 Set I, II, III]

Sol. Let the $\angle ACB$ be θ, $\angle B = 90°$

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

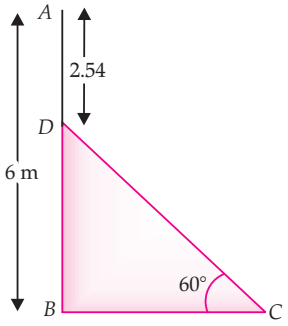
$$\tan \theta = \frac{20}{20\sqrt{3}} = \frac{1}{\sqrt{3}} = \tan 30° \qquad \mathbf{1}$$

$$\Rightarrow \quad \theta = 30°$$

Thus, the Sun's altitude is 30°.

[CBSE Marking Scheme, 2015]

Q. 5. In the given figure, AB is a 6 m high pole and DC is a ladder inclined at an angle of 60° to the horizontal and reaches up to point D of pole. If AD = 2.54 m, find the length of the ladder. (use $\sqrt{3}$ = 1.73)



C + A **[Delhi Set I, II, III, 2016]**

Sol. Given, $AD = 2.54$ m (Given)

$\therefore$ $DB = 6 - 2.54 = 3.46$ m

In ΔBCD, $\angle B = 90°$

$$\sin 60° = \frac{BD}{DC}$$

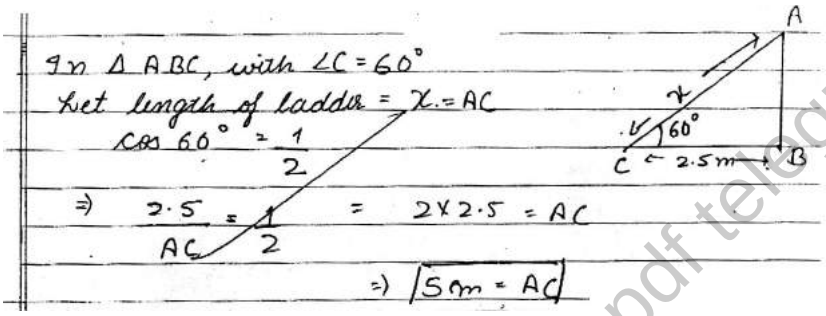
$$\frac{\sqrt{3}}{2} = \frac{3.46}{DC}$$

$$\therefore \quad DC = \frac{3.46 \times 2}{\sqrt{3}} = \frac{3.46 \times 2}{1.73} = 4\ m$$

$\therefore$ Length of ladder = 4 m. **1**

Q. 6. A ladder, leaning against a wall, makes an angle of 60° with the horizontal. If the foot of the ladder is 2.5 m away from the wall, find the length of the ladder. C + A **[Outside Delhi, Set II 2016]**

Sol.



[Topper Answer, 2016] **1**

Q. 7. An observer 1.5 m tall is 28.5 m away from a tower 30 m high. Find the angle of elevation of the top of the tower from his eye.

C + A **[Board Term-2, 2012 Set (50)]**

Sol. Let AE be observer = 1.5 m

BD is the tower = 30 m

$\angle BAC = \theta$, $BC = 30 - 1.5 = 28.5$ m

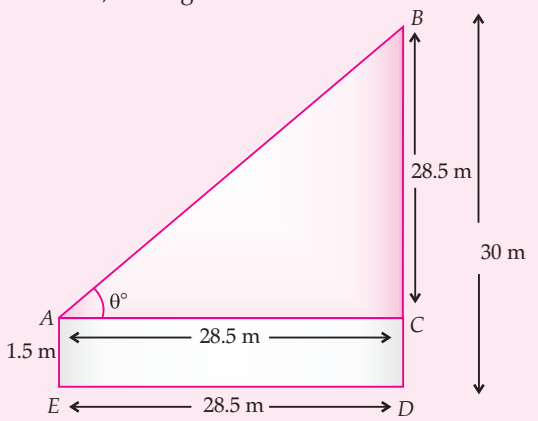
In ΔBAC, $\frac{BC}{AC} = \tan\theta$

$\Rightarrow$ $\frac{28.5}{28.5} = \tan\theta$

$\Rightarrow$ $\tan\theta = 1 = \tan 45°$

$\Rightarrow$ $\theta = 45°$ **1**

Hence, the angle of elevation is 45°.



[CBSE Marking Scheme, 2012]

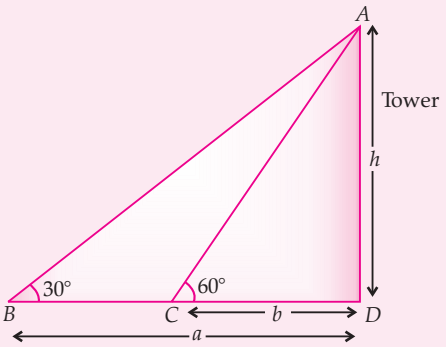
Q. 8. If the angles of elevation of the top of a tower from two points distant a and b ($a > b$) from its foot and in the same straight line from it are respectively 30° and 60°, then find the height of the tower.

C + A **[Board Term-2, 2014]**

Sol. Let the height of tower be h metre.

From ΔABD, $\frac{h}{a} = \tan 30°$

$\therefore$ $h = a \times \frac{1}{\sqrt{3}} = \frac{a}{\sqrt{3}}$ ...(i)



From ΔACD, $\frac{h}{b} = \tan 60°$

$\therefore$ $h = b \times \sqrt{3} = b\sqrt{3}$ ...(ii)

From (i), $a = \sqrt{3}\ h$

From (ii), $b = \frac{h}{\sqrt{3}}$

$\therefore$ $a \times b = \sqrt{3}\ h \times \frac{h}{\sqrt{3}}$

$\Rightarrow$ $h^2 = ab$

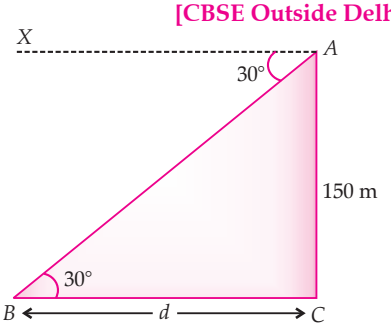
$\Rightarrow$ $h = \sqrt{ab}$ m **1**

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

[CBSE Marking Scheme, 2014]

Q. 9. The angle of depression of a car parked on the road from the top of a 150 m high tower is 30°. Find the distance of the car from the tower (in m). C + A **[Delhi CBSE Term-2, 2014]** **[CBSE Outside Delhi, 2014]**

Sol.



Let the distance of the car from the tower be d meter.

$\angle BAX = \angle ABC = 30°$ (alternate angles)

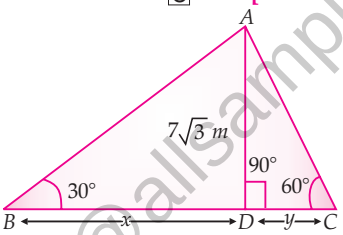
In ΔACB, $\angle C = 90°$

$$\tan 30° = \frac{150}{d}$$

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

$\therefore$ $d = 150\sqrt{3}$ m. **1**

Q. 10. In the given figure, if $AD = 7\sqrt{3}$ m, then find the value of BC. C + A **[Board Term-2, 2012]**



Sol. Let $BD = x$ m and $DC = y$ m.

From ΔABD, $\angle D = 90°$

$$\frac{7\sqrt{3}}{x} = \tan 30°$$

$\Rightarrow$ $\frac{7\sqrt{3}}{x} = \frac{1}{\sqrt{3}}$

$\Rightarrow$ $x = 7\sqrt{3} \times \sqrt{3}$

$= 21$ m ½

From ΔADC, $\angle D = 90°$

$$\frac{7\sqrt{3}}{y} = \tan 60°$$

$\Rightarrow$ $7\sqrt{3} = y\sqrt{3}$

$\Rightarrow$ $y = 7$ m,

$BC = BD + DC$

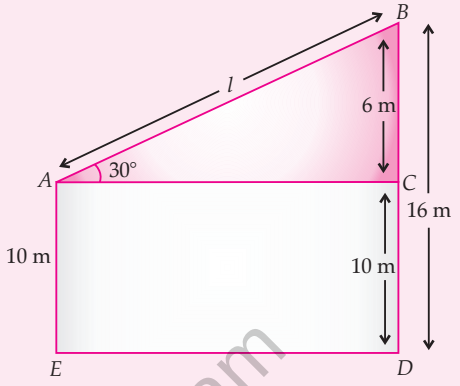
$= 21 + 7 = 28$ m. ½

Hence, the value of $BC = 28$ m.

[CBSE Marking Scheme, 2012]

Q. 11. The top of two poles of height 16 m and 10 m are connected by a wire of length l metre. If wire makes an angle of 30° with the horizontal, then find l. C + A **[Board Term-2, 2012]**

Sol.



Let BD and AE be two poles

Where $BD = 16$ m, $AE = 10$ m

$\therefore$ Length, $BC = BD - CD$

$= BD - AE$

$= 16 - 10 = 6$ m.

From ΔABC

$$\frac{BC}{l} = \sin 30°$$

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

$\Rightarrow$ $l = 6 \times 2 = 12$ m. **1**

Hence, the value of $l = 12$ m.

[CBSE Marking Scheme, 2012]

Q. 12. A pole 6 m high casts a shadow $2\sqrt{3}$ m long on the ground, then find the Sun's elevation.

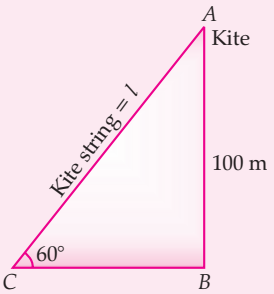
C + A **[Board Term-2, 2012 Set (17, 25, 32)]**

Sol. Try yourself, similar of Q. No. 4 in VSATQ.

Q. 13. Find the length of kite string flying at 100 m above the ground with the elevation of 60°.

C + A **[Board Term-2, 2012]**

Sol.



Let the length of kite string AC be l m.

$\angle ACB = 60°$, height of kite $AB = 100$ m.

From ΔABC, $\frac{AB}{BC} = \sin 60°$

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

$\Rightarrow$ $l = \frac{2 \times 100}{\sqrt{3}}$

$$= \frac{200}{\sqrt{3}}$$

$$= \frac{200}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{200\sqrt{3}}{3}$$ **1**

Hence, the length the kite string $= \frac{200\sqrt{3}}{3}$ m.

[CBSE Marking Scheme, 2012]

Q. 14. Find the angle of elevation of the top of the tower from the point on the ground which is 30 m away from the foot of the tower of height $10\sqrt{3}$ m. C + U **[Board Term-2, 2012]**

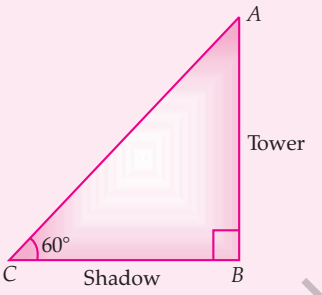
Sol. Try yourself, similar of Q. No. 4 in VSATQ.

Q. 15. If the altitude of the Sun is 60°, what is the height of a tower which casts a shadow of length 30 m ?

C + U **[Board Term-2, 2011 Set (B1)]**

Sol. Let AB be the tower whose height be h m.

BC = shadow = 30 m.



From ΔABC, $\frac{AB}{BC} = \tan 60°$

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

$h = 30\sqrt{3}$ m

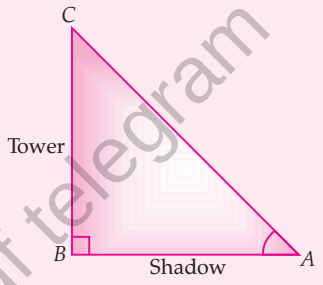
Hence, the height of tower $= 30\sqrt{3}$ m. **1**

[CBSE Marking Scheme, 2011]

Q. 16. The ratio of the height of a tower and the length of its shadow on the ground is $\sqrt{3}:1$. What is the angle of elevation of the Sun ?

C + U **[Board Term-2, 2016][Delhi Set-I, II 2017]**

Sol.



Let the height of tower be AB and its shadow be BC.

$\therefore$ $\frac{BC}{AB} = \tan\theta = \frac{\sqrt{3}}{1}$

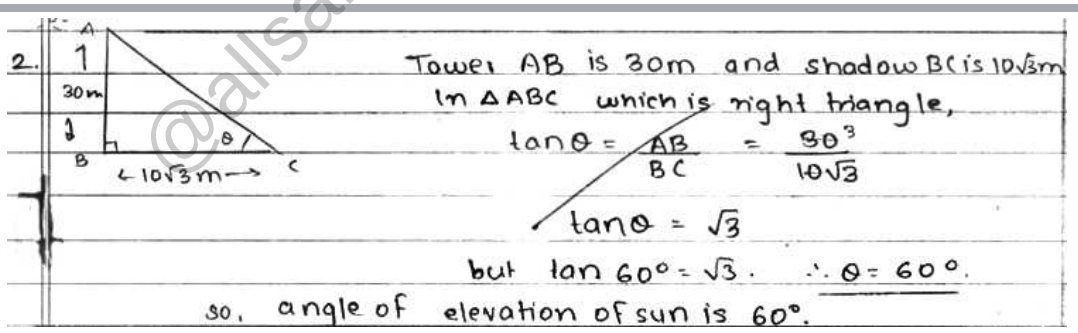
$= \tan 60°$

Hence, the angle of elevation of Sun = 60°. **1**

[CBSE Marking Scheme, 2017]

Q. 17. If a tower 30 m high, casts a shadow $10\sqrt{3}$ m long on the ground, then what is the angle of elevation of the sun ? C + U **[Outside Delhi Set-I, II, III 2017][Outside Delhi Compt. Set-I, II, III 2017]**

Sol.



[Topper Answer 2017] **1**

Short Answer Type Questions-I

(2 marks each)

Q. 1. From the top of light house, 40 m above the water, the angle of depression of a small boat is 60°. Find how far the boat is from the base of the light house. C + U **[Board Term-2, 2015]**

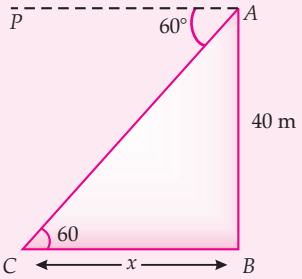
Sol. Let AB be the light house and C be the position of the boat.

Since, $\angle PAC = 60°$ $\therefore$ $\angle ACB = 60°$ **1**

Let BC be x m.

In ΔABC, $\frac{AB}{BC} = \tan 60°$

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



$$\Rightarrow \quad x = \frac{40}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{40\sqrt{3}}{3} \text{ m}$$

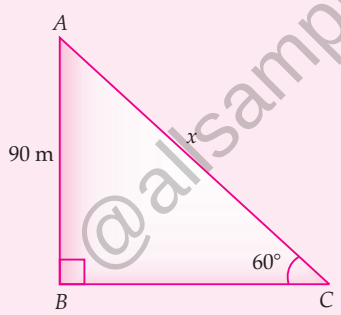
Hence, the boat is $\frac{40\sqrt{3}}{3}$ m away from the foot of the light house. **[CBSE Marking Scheme, 2015]** **1**

Q. 2. A kite is flying at a height of 90 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. [Take $\sqrt{3} = 1.732$]

C + U **[Delhi CBSE, Term-2, 2014]**
[Board Term-2, 2011, Set A1]

Sol. In right ΔABC, $\frac{AB}{AC} = \sin 60°$

$$\Rightarrow \quad \frac{90}{x} = \frac{\sqrt{3}}{2} \qquad \text{½}$$



$$\Rightarrow \quad x = \frac{90 \times 2}{\sqrt{3}} = \frac{180 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}}$$

$$\Rightarrow \quad x = \frac{180\sqrt{3}}{3}$$

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

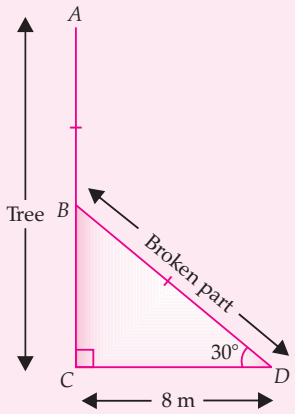
$$= 60 \times 1.732 \qquad \text{1½}$$

Hence length of string = 103.92 m.

[CBSE Marking Scheme, 2011]

Q. 3. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle of 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. C + A **[Board Term-2, 2011, Set A1]**

Sol.



½

Let the tree be AC and is broken at B. The broken part touches at the point D on the ground.

In right ΔBCD,

$$\cos 30° = \frac{CD}{BD}$$

$$\Rightarrow \quad \frac{\sqrt{3}}{2} = \frac{8}{BD}$$

$$\Rightarrow \quad BD = \frac{16}{\sqrt{3}} \qquad \text{½}$$

and $\tan 30° = \frac{BC}{CD}$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{BC}{8}$$

$$\Rightarrow \quad BC = \frac{8}{\sqrt{3}}$$

$$\therefore \quad \text{Height of tree} = BC + BD$$

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

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

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

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

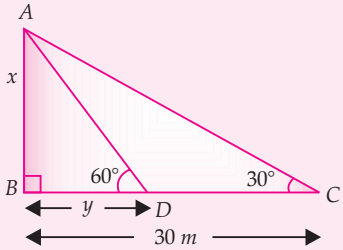
Hence, the height of the tree = $8\sqrt{3}$ m. **1**

[CBSE Marking Scheme, 2011]

Q. 4. If the shadow of a tower is 30 m long, when the Sun's elevation is 30°. What is the length of the shadow, when the Sun's elevation is 60° ?

C + A **[Board Term-2, 2011, Set C1]**

Sol.



1

Let the height of the tower be x m and shadow be y m.

In ΔABC, $\frac{AB}{BC} = \tan 30°$

$\Rightarrow \frac{x}{30} = \tan 30° = \frac{1}{\sqrt{3}}$

$\Rightarrow x = 10\sqrt{3}$ m

In ΔABD, $\frac{AB}{BD} = \tan 60°$

$\frac{10\sqrt{3}}{y} = \tan 60° = \sqrt{3}$ **1**

$\Rightarrow y = 10$ m

Hence, the length of shadow = 10 m.

[CBSE Marking Scheme, 2011]

Q. 5. From a point *P* on the ground the angle of elevation of the top of a 10 m tall building is 30°. *A* flag is hoisted at the top of the building and the angle of elevation of the top of the flagstaff from *P* is 45°. Find the length of the flagstaff and distance of building from point *P*. [Take $\sqrt{3} = 1.732$] C + A **[Board Term-2, 2012 (20), Delhi 2013] [Board Term-2, 2011, A1]**

Sol. Let the height of flagstaff be $BD = x$ m

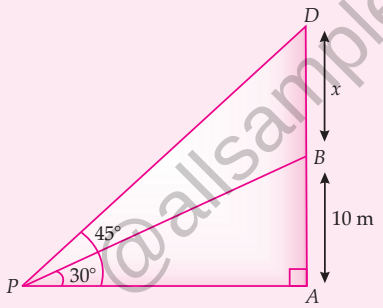
$\therefore \tan 30° = \frac{AB}{AP}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{10}{AP}$

$AP = 10\sqrt{3}$ m **1**

$\therefore$ Distance of the building from P

$= 10 \times 1.732 = 17.32$ m ½



$\tan 45° = \frac{AD}{AP}$ or $1 = \frac{10 + x}{17{\cdot}32}$

Hence,

length of the flagstaff

$x = 17{\cdot}32 - 10{\cdot}00 = 7.32$ m. ½

[CBSE Marking Scheme, 2011, 2012]

Q. 6. A player sitting on the top of a tower of height 20 m observes the angle of depression of a ball lying on the ground as 60°. Find the distance between the foot of the tower and the ball. Take $\sqrt{3} = 1{\cdot}732$

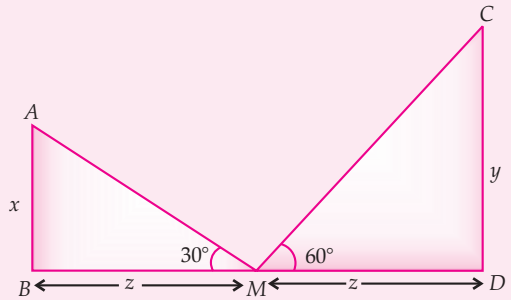
C + A **[Board Term-2, 2011, B1]**

Sol. Try yourself, similar to Q. No. 1 in SATQ-I.

Q. 7. The tops of two towers of height *x* and *y*, standing on the ground, subtend the angles of 30° and 60° respectively at the centre of the line joining their feet, then find *x* : *y*.

C + A **[Delhi CBSE Term-2, 2015 (Set I, II, III)]**

Sol.



Let M be the centre of the line joining their feet.

Let $BM = MD = z$

$\therefore \tan\theta = \frac{\text{perpendicular}}{\text{base}}$

In ΔABM,

$\therefore \frac{x}{z} = \tan 30°$

$\Rightarrow x = z \times \frac{1}{\sqrt{3}}$ ...(i) ½

In ΔCDM,

$\frac{y}{z} = \tan 60°$

$y = z \times \sqrt{3}$ ...(ii) ½

From (i) and (ii),

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

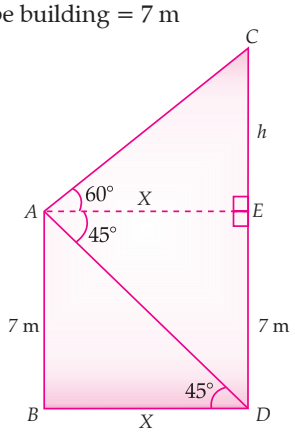
$\therefore \frac{x}{y} = \frac{1}{3}$

$x : y = 1 : 3$ **1**

[CBSE Marking Scheme, 2015]

Q. 8. From the top of a 7 m high building the angle of elevation of the top of a tower is 60° and the angle of depression of its foot is 45° Find the height of the tower. C + A **[Delhi Set-I, II, III, 2017]**

Sol. Let AB be building = 7 m



CD be the height of tower = $(7 + h)$ m ½

Let distance between two be x m.

$\therefore BD = AE = x$ m

Now in ΔABD $\frac{AB}{BD} = \tan 45°$ ½

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

$\Rightarrow$ $x = 7$ m ½

In ΔCEA $\frac{CE}{AE} = \tan 60°$

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

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

Substituting the value of x we get

$h = 7\sqrt{3}$

$CD = CE + ED$

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

Hence, the height of tower $= 7\left(1 + \sqrt{3}\right)$ m. ½

Q. 9. The shadow of a tower standing on the ground is found to be 40 m longer when the Sun's altitude is 30°, than when it is 60°. Find the height of the tower. C + A **[Board Term-2, 2011, B1]**

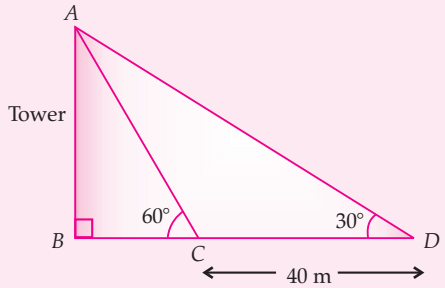
Sol. In ΔABC,

$\tan 60° = \frac{AB}{BC}$

$\Rightarrow$ $AB = \sqrt{3}BC$ ...(i) **1**

In ΔABD,

$\tan 30° = \frac{AB}{BC + CD}$



$\Rightarrow$ $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}BC}{BC + 40}$; [using (i)]

$BC + 40 = 3BC$

$40 = 2BC$

$\Rightarrow$ $BC = 20$ m

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

$\therefore$ Height of tower $= 20\sqrt{3}$ m. **1**

[CBSE Marking Scheme, 2011]

Short Answer Type Questions-II

(3 marks each)

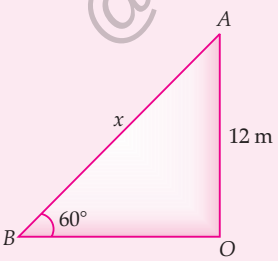
Q. 1. An electric pole is 12 m high. A steel wire tied to top of the pole is affixed at a point on the ground to keep the pole upright. If the wire makes an angle of 60° with the horizontal through the foot of the pole, find the length of the wire.

C + U **[CBSE SA.-2 2016 HODM4OL]**

Sol. Let OA be the electric pole and B be the point on the ground to fix the wire.

Let BA be x m.

In ΔABO, $\frac{AO}{AB} = \sin 60°$ **1**



1

$\Rightarrow$ $\frac{12}{x} = \frac{\sqrt{3}}{2}$

$\Rightarrow$ $x = \frac{12 \times 2}{\sqrt{3}}$

$= \frac{24}{\sqrt{3}} = 8\sqrt{3}$

$= 8 \times 1.73 = 13.84$ m **1**

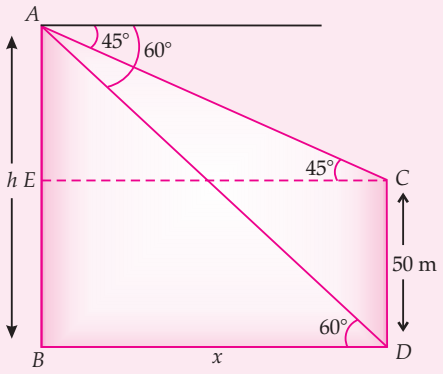
Hence, the length of wire = 13.84 m.

[CBSE Marking Scheme, 2016]

Q. 2. The angles of depression of the top and bottom of a 50 m high building from the top of a tower are 45° and 60° respectively. Find the height of the tower and the horizontal distance between the tower and the building. (Use $\sqrt{3} = 1.73$)

C + A **[Delhi Set I, II, III, 2016]**

Sol.



½

$\tan 45° = \frac{h - 50}{x}$

$\Rightarrow$ $x = h - 50$ ½

$\tan 60° = \frac{h}{x}$ ½

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

Hence $h - 50 = \frac{h}{\sqrt{3}}$ ½

$$\sqrt{3}h - 50\sqrt{3} = h$$
$$\sqrt{3}h - h = 50\sqrt{3}$$
$$h(\sqrt{3}-1) = 50\sqrt{3}$$
$$h = \frac{50\sqrt{3}}{\sqrt{3}-1}$$
$$h = \frac{50\sqrt{3}(\sqrt{3}+1)}{3-1}$$
$$h = \frac{50(3+\sqrt{3})}{2}$$
$$\Rightarrow \quad h = 75 + 25\sqrt{3}$$
$$= 118.25 \text{ m.} \qquad \textbf{1}$$

[CBSE Marking Scheme, 2016]

Q. 3. An aeroplane, when flying at a height of 4000 m from the ground passes vertically above another aeroplane at an instant when the angles of elevation of the two planes from the same point on the ground are 60° and 45° respectively. Find the vertical distance between the aeroplanes at that instant. (Take $\sqrt{3} = 1.73$)

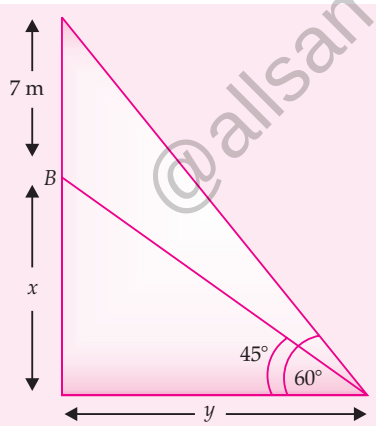
C + A **[Foreign Set III, 2016]**

Sol. Try yourself, similar to Q. No. 5 in SATQ-I.

Q. 4. A 7 m long flagstaff is fixed on the top of a tower standing on the horizontal plane. From point on the ground, the angles of elevation of the top and bottom of the flagstaff are 60° and 45° respectively. Find the height of the tower correct upto one place of decimal.

(Use $\sqrt{3} = 1.73$) C + A **[Foreign Set II, 2016]**

Sol.



½

(i) $\frac{x}{y} = \tan 45° = 1$

$\Rightarrow \quad x = y$ **1**

(ii) $\frac{x+7}{y} = \tan 60° = \sqrt{3}$

$\Rightarrow \quad 7 = (\sqrt{3}-1)x$ **1+½**

$$x = \frac{7(\sqrt{3}+1)}{2}$$
$$= \frac{7(2.73)}{2}$$
$$= 9.6 \text{ m} \quad \textbf{[CBSE Marking Scheme, 2016]}$$

Q. 5. Two men on either side of a 75 m high building and in line with base of building observe the angles of elevation of the top of the building as 30° and 60°. Find the distance between the two men. (Use $\sqrt{3} = 1.73$).

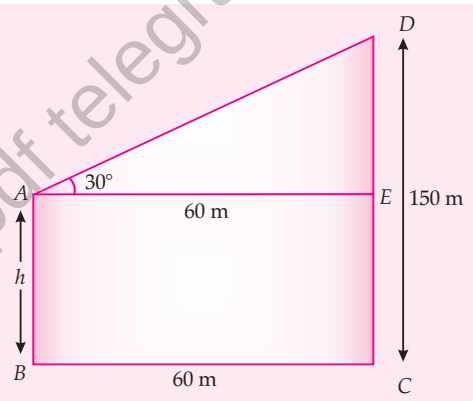
C + A **[Foreign Set I, 2016] [Board Term-2013]**

Sol. Try yourself, similar to Q. No. 10 in VSATQ.

Q. 6. The horizontal distance between two towers is 60 m. The angle of elevation of the top of the taller tower as seen from the top of the shorter one is 30°. If the height of the taller tower is 150 m, them find the height of the shorter tower.

C + A **[Board Term-2, 2015]**

Sol.



½

Let AB and CD be two towers.

Let the height of the shorter tower AB be h m.

$BC = AE = 60$ m, $DE = DC - EC = (150 - h)$

In ΔAED, $\frac{DE}{AE} = \tan 30°$

$$\Rightarrow \quad \frac{150-h}{60} = \tan 30° = \frac{1}{\sqrt{3}} \qquad \textbf{1}$$
$$\Rightarrow \quad 150\sqrt{3} - h\sqrt{3} = 60$$
$$\Rightarrow \quad \sqrt{3}h = 150\sqrt{3} - 60$$
$$\Rightarrow \quad h = \frac{150\sqrt{3}}{\sqrt{3}} - \frac{60}{\sqrt{3}}$$
$$\Rightarrow \quad h = 150 - \frac{60}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$
$$\Rightarrow \quad h = (150 - 20\sqrt{3}) \text{ m.} \qquad \textbf{1½}$$

[CBSE Marking Scheme, 2015]

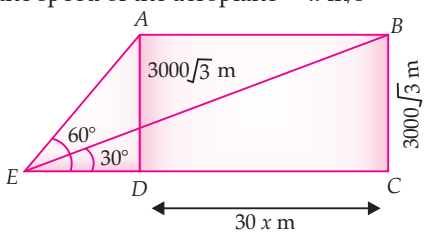
Q. 7. The angle of elevation of an aeroplane from a point on the ground is 60°. After a flight of 30 seconds the angle of elevation becomes 30°. If the aeroplane is flying at a constant height of $3000\sqrt{3}$ m, find the speed of the aeroplane.

C + A **[CBSE O.D. 2014]**

Sol. $\angle AED = 60°$ and $\angle BEC = 30°$

$AD = BC = 3000\sqrt{3}$ m

Let the speed of the aeroplane = x m/s



½

Then, $AB = DC = 30 \times x$

$= 30x$ m ...(i) ½

In ΔAED, $\angle D = 90°$

$$\tan 60° = \frac{AD}{DE}$$

$$\sqrt{3} = \frac{3000\sqrt{3}}{DE}$$

$DE = 3000$ m ...(ii) ½

In ΔBEC, $\angle C = 90°$

$$\tan 30° = \frac{BC}{EC}$$

$$\frac{1}{\sqrt{3}} = \frac{3000\sqrt{3}}{DE + CD}$$

$DE + CD = 3000 \times 3$

$3000 + 30x = 9000$ (from (i) and (ii))

$30x = 6000$

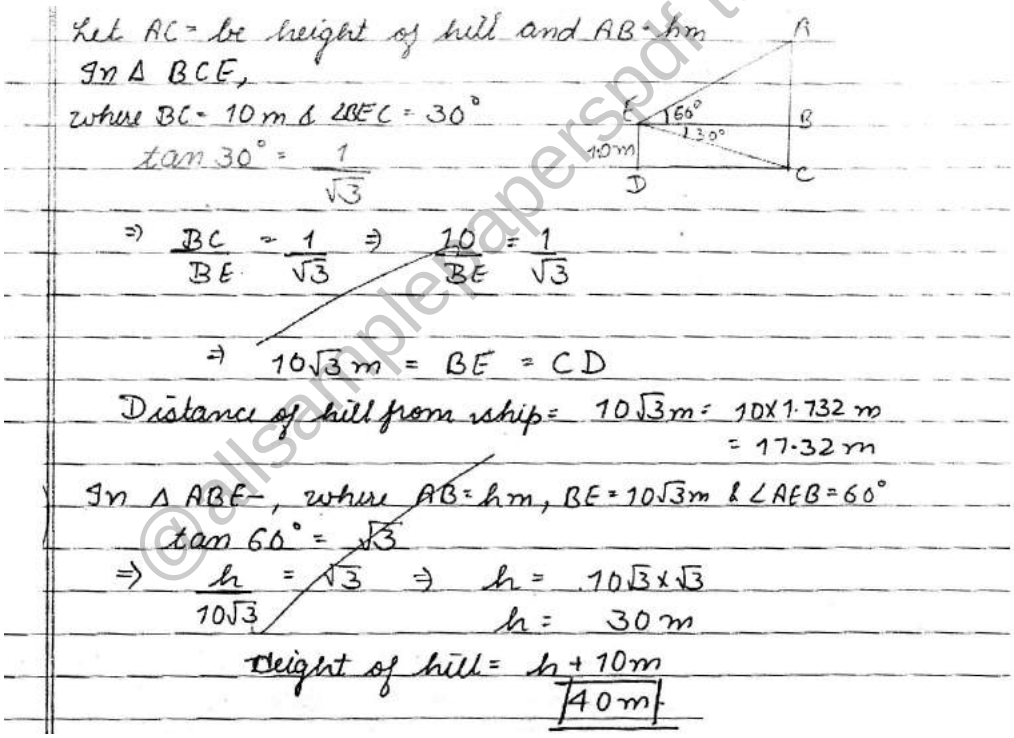
$x = 200$ m/s

Hence, the speed of plane = 200 m/s. **1**

$= 200 \times \frac{18}{5} = 720$ km/hr. ½

Q. 8. A man standing on the deck of a ship, which is 10 m above water level, observes the angle of elevation of the top of a hill as 60° and the angle of depression of the base of hill as 30°. Find the distance of the hill from the ship and the height of the hill. C + A **[Outside Delhi, Set-II 2016]**

Sol.

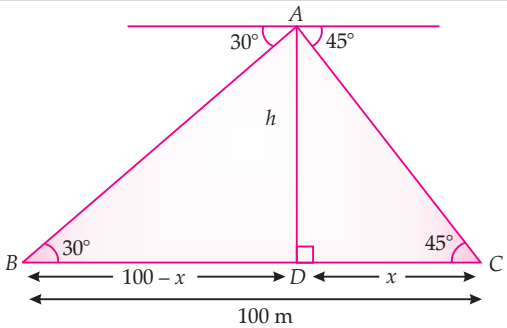


[Topper Answer, 2016] 3

Q. 9. Two ships are approaching a light house from opposite directions. The angle of depression of two ships from top of the light house are 30° and 45°. If the distance between two ships is 100 m., find the height of light-house.

C + A **[Foreign set I, II, III, 2014]**

Sol. Let AD be the height (h) m of the light house and BC is the distance between two ships



Given, $BC = 100$ m

In ΔADC $\tan 45° = \frac{h}{DC}$

$\Rightarrow$ $x = h$ ...(i) **1**

In ΔABD, $\tan 30° = \frac{h}{100 - DC}$

$\Rightarrow$ $\frac{1}{\sqrt{3}} = \frac{h}{100 - x}$

$\therefore$ $100 - x = h\sqrt{3}$ **1**

$100 - h = h\sqrt{3}$ [By (i)]

$\Rightarrow$ $100 = h + h\sqrt{3}$

$\Rightarrow$ $100 = h(1 + \sqrt{3})$

$h = \frac{100}{1 + \sqrt{3}}$

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

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

$= 50(\sqrt{3}-1)$ **1**

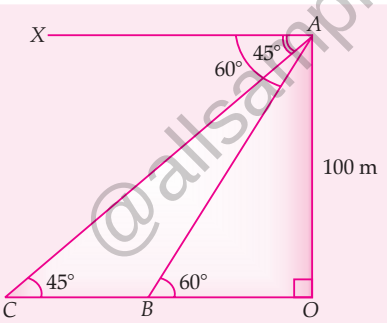
$= 50(1.732 - 1)$

$= 50 \times 0.732$

$\therefore$ Height of light house $= 36.60$ m.

Q. 10. From a top of a building 100 m high the angles of depression of two objects, on the same side, are observed to be 45° and 60°. Find the distance between the objects. C + A **[Board Term-2, 2014]**

Sol.



1

$\angle ACO = \angle CAX = 45°$

and $\angle ABO = \angle XAB = 60°$

Let A be a point and B, C be two objects.

In ΔACO, $\frac{AO}{CO} = \tan 45°$

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

$\Rightarrow$ $CO = 100$ m

Also in ΔABO, $\frac{AO}{OB} = \tan 60°$

$\Rightarrow$ $\frac{100}{OB} = \sqrt{3}$ **1**

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

$\therefore$ $BC = CO - OB = 100 - \frac{100}{\sqrt{3}}$

$= 100\left(1 - \frac{1}{\sqrt{3}}\right)$ m. **1**

$= 100\frac{(\sqrt{3}-1)}{\sqrt{3}}$

$= 100\frac{(\sqrt{3}-1)}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

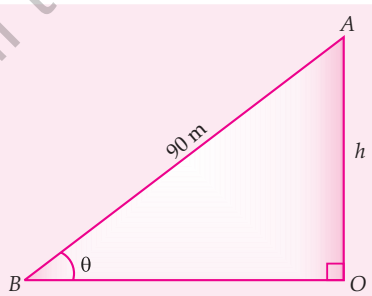
$= \frac{100(3-\sqrt{3})}{3}$ m

[CBSE Marking Scheme, 2014]

Q. 11. A boy, flying a kite with a string of 90 m long, which is making an angle θ with the ground. Find the height of the kite. (Given $\tan\theta = \frac{15}{8}$)

C + U **[Board Term-2, 2014]**

Sol.



1

Let A be the position of kite and AB be the string.

Since, it is given that

$\tan\theta = \frac{15}{8}$

$\therefore$ $AO = 15k$ m

$BO = 8k$ m

$AB = \sqrt{(15k)^2 + (8k)^2}$

$AB = 17k$

[Using Pythagoras Theorem.] **1**

$\therefore$ $\sin\theta = \frac{15}{17}$

In ΔABO, $\frac{AO}{AB} = \sin\theta = \frac{h}{90}$

$\Rightarrow$ $\frac{h}{90} = \frac{15}{17}$

$\Rightarrow$ $h = \frac{15 \times 90}{17}$

$= 79.41$ m **1**

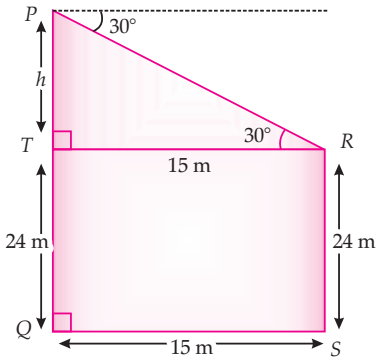
Hence, the height of kite is 79.41 m.

[CBSE Marking Scheme, 2014]

Q. 12 The horizontal distance between two poles is 15 m. The angle of depression of the top of first pole as seen from the top of second pole is 30°. If the height of the first pole is 24 m, find the height of the second pole. [Use $\sqrt{3} = 1.732$]

C + A **[Board Term-2, 2013]**

Sol.



1

In ΔPTR,

$$\tan 30° = \frac{PT}{TR}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{15}$$

$$h = \frac{15}{\sqrt{3}}$$

$$= 5\sqrt{3} \text{ m}$$

$$= 5 \times 1.732 = 8.66 \text{ m} \quad \mathbf{1}$$

$$PQ = PT + TQ \text{ m}$$

$$= (8.66 + 24) \text{ m}$$

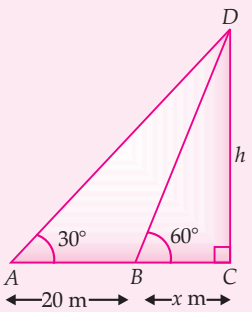
$$= 32.66 \text{ m}$$

$\therefore$ Height of the second pole is 32·66 m. **1**

Q. 13. The angle of elevation of the top of a tower from a point A on the ground is 30°. On moving a distance of 20 metre towards the foot of the tower to a point B the angle of elevation increases to 60°. Find the height of the tower and the distance of the tower from the point A.

C + A **[Board Term-2, 2012 Set (44)]**

Sol.



Let height of tower be h m

and distance BC be x m **1**

In ΔDBC, $\frac{h}{x} = \tan 60°$

$\Rightarrow$ $h = \sqrt{3}x$ ...(i) **1**

In ΔADC,

$$\frac{h}{x+20} = \tan 30° = \frac{1}{\sqrt{3}}$$

$\Rightarrow$ $\sqrt{3}h = x + 20$ ...(ii)

Substituting the value of h from eq. (i) in eq. (ii), we get

$3x = x + 20$

$\Rightarrow$ $x = 10$ m ...(iii)

$\therefore$ $AC = 30$ m. **1**

and $h = \sqrt{3} \times 10 = 10\sqrt{3}$

$= 10 \times 1{\cdot}732$

$= 17{\cdot}32$ m

[from (i) and (iii)]

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

[CBSE Marking Scheme, 2012]

Q. 14. A person observed the angle of elevation of the top of a tower as 30°. He walked 50 m towards the foot of the tower along level ground and found the angle of elevation of the top of the tower as 60°. Find the height of the tower.

C + A **[Board Term-2, 2012 Set (31)]**

Sol. Try yourself, similar to Q. No. 13 in SATQ-II.

Q. 15. A statue 1·6 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.

C + A **[Board Term-2 2012 (50)]**

Sol. Try yourself, similar to Q. No. 4 in SATQ-II.

Q. 16. From a point on a ground, the angle of elevation of bottom and top of a transmission tower fixed on the top of a 20 m high building are 45° and 60° respectively. Find the height of the tower.

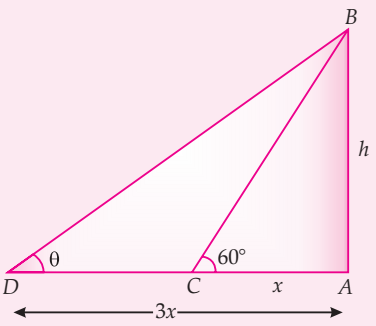
C + A **[Outside Delhi Compt. Set-I, II, III 2017]**

Sol. Try yourself, similar to Q. No. 5 in SATQ-I.

Q. 17. The shadow of a tower at a time is three times as long as its shadow when the angle of elevation of the sun is 60°. Find the angle of elevation of the sun at the time of the longer shadow.

C + A **[Foreign Scheme Set-I, II, III 2017]**

Sol.



½

In ΔABC, $\frac{AB}{AC} = \tan 60°$

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

$\Rightarrow$ $h = x\sqrt{3}$ **1**

In ΔABD, $\frac{AB}{AD} = \tan\theta$

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

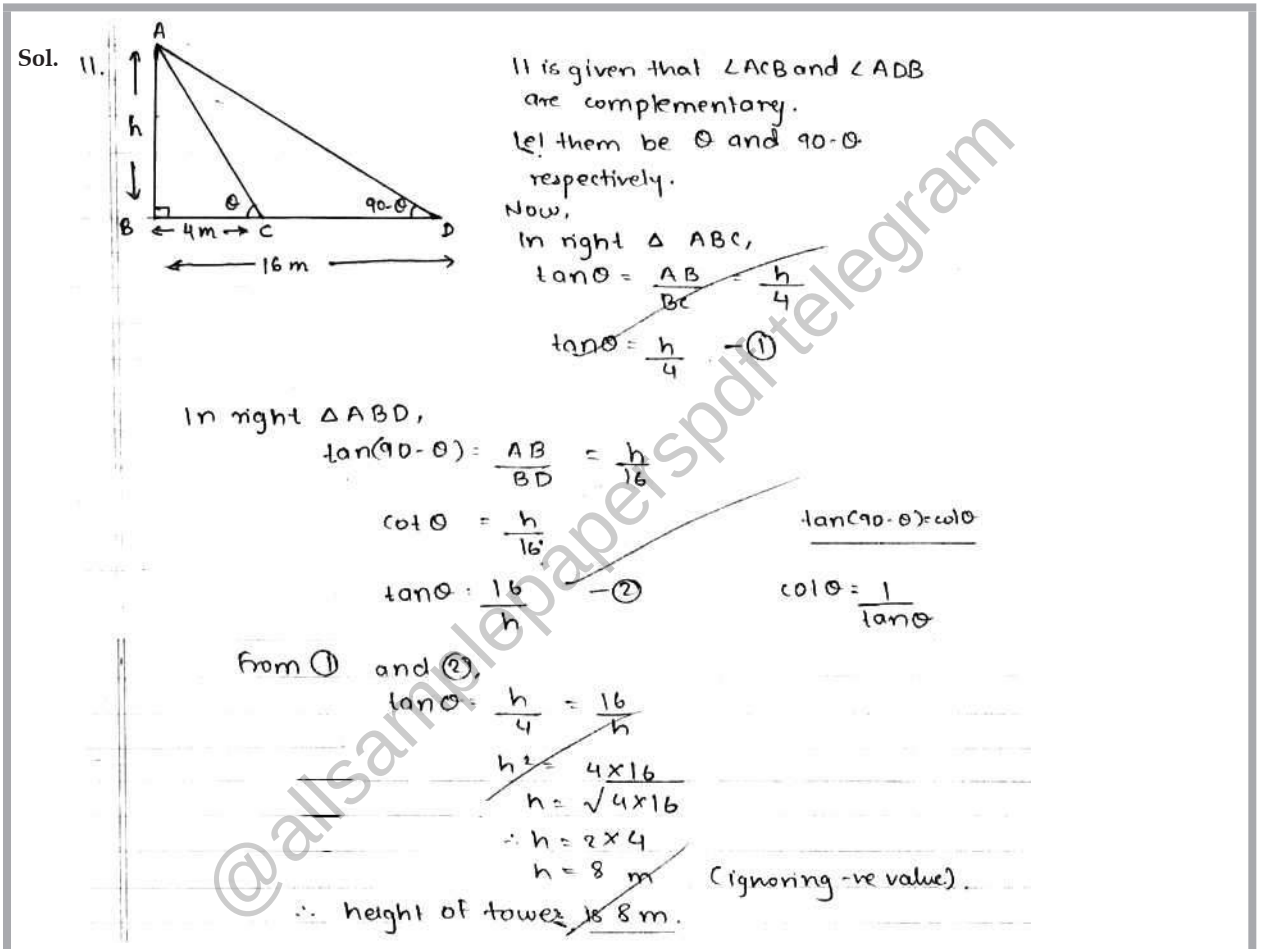
$\Rightarrow$ $\frac{x\sqrt{3}}{3x} = \frac{1}{\sqrt{3}} = \tan 30°$ **1**

$\therefore$ $\theta = 30°$ ½

[CBSE Marking Scheme, 2017]

Q. 18. On a straight line passing through the foot of a tower, two points *C* and *D* are at distances of 4 m and 16 m from the foot respectively. If the angles of elevation from *C* and *D* of the top of the tower are complementary, then find the height of the tower. C + A **[Outside Delhi, Set-I, II, III 2017]**

Sol.



[Topper Answer 2016] 3

Q. 19. From the top of a tower of height 50 m, the angles of depression of the top and bottom of a pole are 30° and 45° respectively. Find :

(i) How far the pole is from the bottom of the tower,

(ii) the height of the pole. (Use $\sqrt{3} = 1.732$)

C + A **[Foreign Set I, II, III, 2015]**

Sol. Try yourself, similar to Q. No. 2 in SATQ-II.

Q. 20. The angle of elevation of an aeroplane from a point A on the ground is 60°. After a flight of 15 seconds, the angle of elevation changed to 30°. If the aeroplane is flying at a constant height of 1500 $\sqrt{3}$ m, find the speed of the plane in km/hr.

C + A **[Outside Delhi CBSE, 2015 Set I, II, III]**

Sol. Try yourself, similar to Q. No. 7 in SATQ-II.

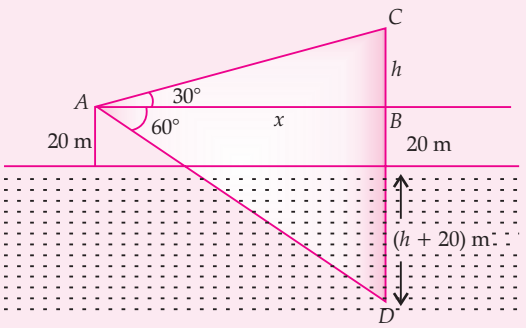
Q. 21. A bird sitting on the top of a 80 m high tree. From a point on the ground, the angle of elevation of the bird is 45°. The bird flies away horizontally in such a way that it remained at a constant height from the ground. After 2 seconds, the angle of elevation of the bird from the same point is 30°. Find the speed of flying of the bird. (Take $\sqrt{3} = 1.732$)

C + A **[Delhi Set I, III, 2016]**

Sol. Try yourself, similar to Q. No. 7 in SATQ-II.

Q. 22. At a point A, 20 metre above the level of water in a lake, the angle of elevation of a cloud is 30°. The angle of depression of the reflection of the cloud in the lake, at A is 60°. Find the distance of the cloud from A ? C + A **[Outside Delhi CBSE Board, 2015, Set I, II, III]**

Sol.



From, ΔABC,

$$\frac{h}{x} = \tan 30° = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \quad x = \sqrt{3}h. \qquad \text{...(i) } ½$$

From ΔABD,

$$\frac{40+h}{x} = \tan 60° = \sqrt{3}$$

$$\Rightarrow \quad x = \frac{40+h}{\sqrt{3}} \qquad \text{...(ii) } ½$$

From (i) and (ii),

$$\therefore \quad \sqrt{3}\ h = \frac{40+h}{\sqrt{3}}$$

$$\Rightarrow \quad 3h = 40 + h \text{ m.}$$

$$\Rightarrow \quad h = 20 \text{ m.} \qquad 1$$

$$\therefore \quad x = 20\ \sqrt{3}\ \text{m}$$

$$\therefore \quad AC = \sqrt{(BC)^2 + (AB)^2}$$

$$= \sqrt{(20)^2 + (20\sqrt{3})^2}$$

$$= \sqrt{400 + 1200}$$

$$= 40 \text{ m.} \qquad 1$$

Hence, the distance of the cloud = 40 m.

[CBSE Marking Scheme, 2015]

Q. 23. A person standing on the bank of a river, observes that the angle of elevation of the top of the tree standing on the opposite bank is 60°. When he retreats 20 m from the bank, he finds the angle of elevation to be 30°. Find the height of the tree and the breadth of the river.

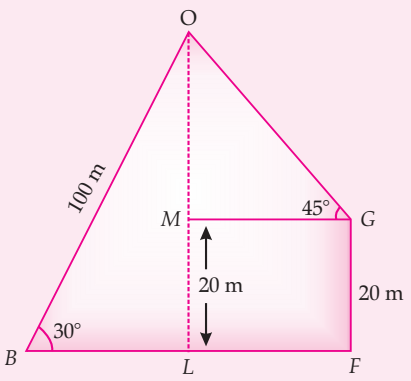
C + A **[Board Term-2, 2012 Set (59)]**

Sol. Try yourself, similar to Q. No. 13 in SATQ-II.

Q. 24. A boy observes that the angle of elevation of a bird flying at a distance of 100 m is 30°. At the same time, a girl finds the angle of elevation of the same bird from a building 20 m high is 45°. Find the distance of the bird from the girl.

C + A **[Board Term-2, 2014]**

Sol. Let O be the position of the bird and B be the position of the boy. Let FG be the building and G be the position of the girl.



1

In ΔOLB, $\quad \frac{OL}{BO} = \sin 30°$

$$\Rightarrow \quad \frac{OL}{100} = \frac{1}{2}$$

$$\Rightarrow \quad OL = 50 \text{ m}$$

$$OM = OL - ML$$

$$= OL - FG$$

$$= 50 - 20 = 30 \text{ m} \qquad 1$$

In ΔOMG, $\quad \frac{OM}{OG} = \sin 45°$

$$\Rightarrow \quad \frac{OM}{OG} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad \frac{30}{OG} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad OG = 30\sqrt{2} \text{ m.} \qquad 1$$

Hence, the distance of the bird from the girl is $30\sqrt{2}$ m.

[CBSE Marking Scheme, 2014]

Q. 25. The angle of elevation of a cloud from a point 200 m above the lake is 30° and the angle of depression of its reflection in the lake is 60°, find the height of the cloud above the lake.

C + A **[Board Term-2 2012 Set (59), 2011, Set B1]**

Sol. In ΔADC, $\quad \tan 30° = \frac{H - 200}{x}$

$$\Rightarrow \quad \frac{1}{\sqrt{3}} = \frac{H - 200}{x}$$

$$\Rightarrow \quad x = \sqrt{3}(H - 200) \text{ m} \qquad 1$$

In ΔADF, $\quad \tan 60° = \frac{H + 200}{x}$

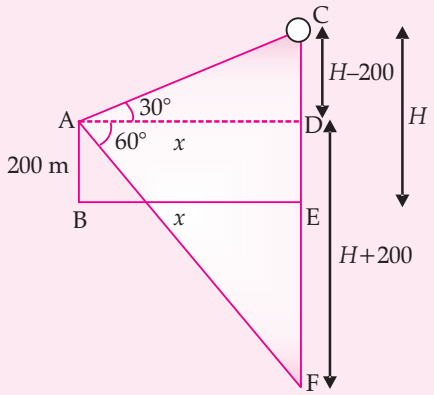
$$\sqrt{3} = \frac{H + 200}{x}$$

$$\Rightarrow \quad \sqrt{3} = \frac{H + 200}{\sqrt{3}(H - 200)}$$

$$\Rightarrow \quad 3(H - 200) = H + 200$$

$$\Rightarrow \quad 3H - H = 200 + 600$$

$$\Rightarrow \quad 2H = 800$$



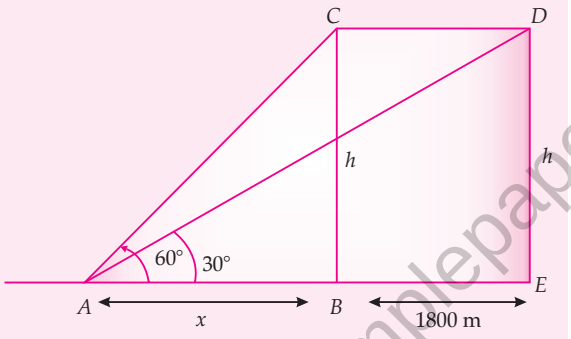
1

So, height of cloud $H = 400$ m. **1**

[CBSE Marking Scheme, 2011, 2012]

Q. 26. The angle of elevation of a jet fighter from point A on ground is 60°. After flying 10 seconds, the angle changes to 30°. If the jet is flying at a speed of 648 km/hour, find the constant height at which the jet is flying. C + A **[Board Term-2, 2012 Set (40)]**

Sol.



½

In 3600 sec distance travelled by plane = 648000 m

In 10 sec distance travelled by plane $= \frac{648000}{3600} \times 10$

$= 1800$ m ½

In ΔABC,	In ΔAED,
$\frac{h}{x} = \tan 60°$,	$\frac{h}{x+1800} = \tan 30°$
$\frac{h}{x} = \sqrt{3}$,	$\frac{h}{x+1800} = \frac{1}{\sqrt{3}}$ **1**
$\Rightarrow h = x\sqrt{3}$ ..(i)	$\Rightarrow h = \frac{x+1800}{\sqrt{3}}$ ...(ii)

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

$$x\sqrt{3} = \frac{x+1800}{\sqrt{3}}$$ ½

$\Rightarrow 3x = x + 1800$

$\Rightarrow 2x = 1800$

$\Rightarrow x = 900$ m

$h = x\sqrt{3}$

$= 900 \times 1{\cdot}732$

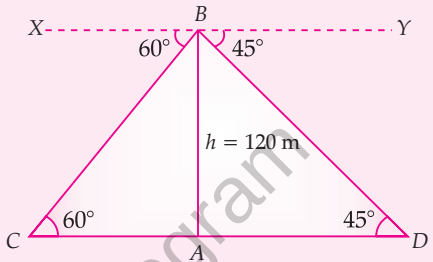
$= 1558{\cdot}8$ m

$\therefore$ Hence, the height of jet $= 1558{\cdot}8$ m. ½

[CBSE Marking Scheme, 2012]

Q. 27. From the top of a 120 m high tower, a man observes two cars on the opposite sides of the tower and in straight line with the base of tower with angles of depression as 60° and 45°. Find the distance between two cars. C + A **[Delhi Compt. Set-III, II, I 2017]**

Sol.



½

In ΔABD, $\angle ADB = \angle DBY = 45°$

(alternate angle)

and in ΔABC, $\angle BCA = \angle XBC = 60°$

$$\frac{AB}{AD} = \tan 45°$$

$$\frac{120}{AD} = 1$$

$\Rightarrow AD = 120$ m ...(i) **1**

Now, $\frac{AB}{CA} = \tan 60°$

$$\frac{120}{CA} = \sqrt{3}$$

$\Rightarrow CA = \frac{120}{\sqrt{3}} = 40\sqrt{3}$ m ½

$CD = AD + CA$

$= 120 + 40\sqrt{3}$

$= 120 + 40 \times 1{\cdot}732$

$= 120 + 69{\cdot}28$

$= 189{\cdot}28$ m

Hence the distance between two cars = 189·28 m. **1**

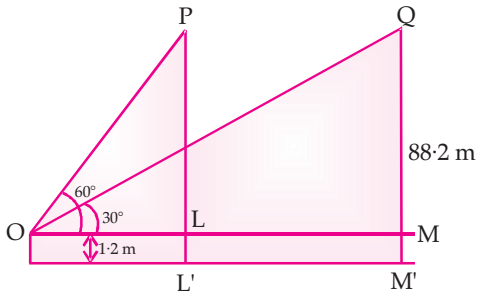
[CBSE Marking Scheme, 2017]

Q. 28. 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 form the edges of the girl at any instant of 60°. After sometime, the angle of elevation reduces to 30°.

(i) Find the distance travelled by the balloon during the interval.

(ii) Which mathematical concept is used in the above problem ? AE

Sol. (i) Let P be the position of the balloon when its angle of elevation from the eyes of the girl is 60° and Q be the position when angle of elevation is 30°.



1

In ΔOLP, $\tan 60° = \frac{PL}{OL}$

$\Rightarrow \sqrt{3} = \frac{PL' - LL'}{OL}$

$= \frac{88.2 - 1.2}{OL}$

$\Rightarrow \sqrt{3} = \frac{87}{OL}$

$\Rightarrow OL = \frac{87}{\sqrt{3}}$

In ΔOMQ, $\tan 30° = \frac{QM}{OM}$

$= \frac{QM' - MM'}{OM}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{88.2 - 1.2}{OM}$

$\Rightarrow OM = 87\sqrt{3}$

$\therefore$ Distance travelled by the balloon,

$PQ = LM = OM - OL$

$= \left(87\sqrt{3} - \frac{87}{\sqrt{3}}\right)$ m

$= 87\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right)$ m

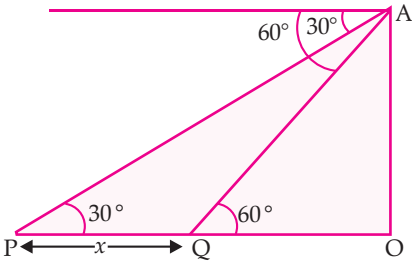
$= \frac{87 \times 2}{\sqrt{3}} = \frac{174}{\sqrt{3}}$ m

$= \frac{174\sqrt{3}}{3} = 58\sqrt{3}$ m 1

(ii) Height and distance. **1**

Q. 29. A man on a cliff observes a boat at an angle of depression of 30° which is approaching the shore to the point immediately beneath the observer with a uniform speed. Six minutes later, the angle of depression of the boat is found to be 60°.
(i) Find the time taken by the boat to reach the shore.
(ii) Which mathematical concept is used in the above problem ? AE

Sol.



(i) Let OA be the cliff and P be the initial position of the boat when the angle of depression is 30°. After 6 minutes the boat reaches to Q such that the angle of depression at Q is 60°.

Let $PQ = x$ m.

In $\angle POA$ and $\angle QOA$, we have

$\tan 30° = \frac{OA}{OP}$ and $\tan 60° = \frac{OA}{OQ}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{OA}{OP}$ and $\sqrt{3} = \frac{OA}{OQ}$ ½

$\Rightarrow OA = \frac{OP}{\sqrt{3}}$ and $OA = \sqrt{3}OQ$

$\Rightarrow \frac{OP}{\sqrt{3}} = \sqrt{3}OQ$

$\Rightarrow OP = 3OQ$

$\Rightarrow PQ = OP - OQ$

$= OP - \frac{OP}{3}$

$= \frac{2}{3} OP$ [$\because OQ = \frac{1}{3}$ OP] ½

Let the speed of the boat be v m/minute, then

PQ= Distance travelled by the boat in 6 minutes

$\Rightarrow PQ = 6v$ ½

$\Rightarrow \frac{2}{3}(OP) = 6v$ [$\because PQ = \frac{2}{3} OP$]

$\Rightarrow OP = 9v$

$\therefore$ Time taken by the boat to reach at the shore is given by,

$T = \frac{OP}{v}$

$\Rightarrow T = \frac{9v}{v}$ minutes

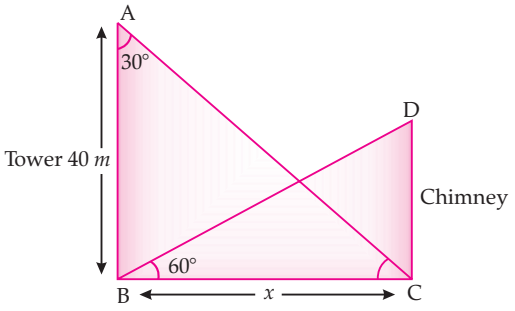
$= 9$ minutes ½

(ii) Height and distance. **1**

Q. 30. The angle of elevation of the top of a chimney from the foot of a tower is 60° and the angle of depression of the foot of the chimney from the top of the tower is 30°. If the height of tower is 40 m, find the height of smoke emitting chimney. According to pollution control norms, the minimum height of a smoke emitting chimney should be 100 m.

AE **[Foreign Set I, II, III, Term-2, 2014]**

Sol.



Let $AB = 40$ m be the height of the tower and CD be the height of smoking chimney.

Considering right angled ΔABC, we have

$$\tan 30° = \frac{BC}{AB}$$

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

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

Again, considering right triangle DBC, we have

$$\tan 60° = \frac{DC}{BC}$$

$$\Rightarrow \quad \sqrt{3} = \frac{DC}{BC} \qquad \textbf{1}$$

$$DC = \sqrt{3} \times \frac{40}{\sqrt{3}}$$

$$\Rightarrow \quad DC = 40 \text{ m}$$

$\therefore$ The height of chimney is 40 m. **1**

Long Answer Type Questions (4 marks each)

Q. 1. From the top of tower, 100 m high, a man observes two cars on the opposite sides of the tower with the angles of depression 30° & 45° respectively. Find the distance between the cars. (Use $\sqrt{3} = 1.73$)

C + A **[Board Sample Paper, 2016]**

Sol. Try yourself, similar to Q. No. 27 in SATQ-II.

Q. 2. The angle of elevation of the top B of a tower AB from a point X on the ground is 60°. At a point Y, 40 m vertically above X, the angle of elevation of the top is 45°. Find the height of the tower AB and the distance XB. C + A **[CBSE SA-2 2016 HODM 40L]**

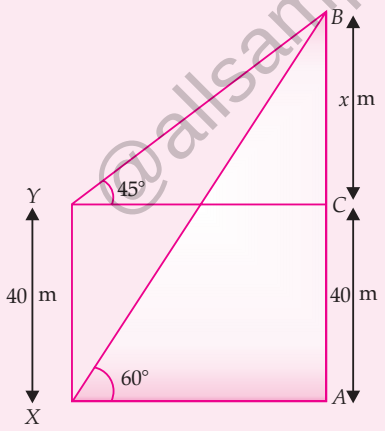
Sol. In ΔYCB, we have

$$\tan 45° = \frac{BC}{YC}$$

$$1 = \frac{x}{YC}$$

$$YC = x \text{ m}$$

$$\Rightarrow \quad XA = x \text{ m}$$



In ΔXAB,

$$\tan 60° = \frac{AB}{XA} \qquad ½$$

$$\sqrt{3} = \frac{x+40}{x} \qquad ½$$

$$\sqrt{3}x = x + 40$$

$$x\sqrt{3} - x = 40$$

$$x = \frac{40}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1} \qquad ½$$

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

$$= \left(20\sqrt{3}+20\right) \text{ m}$$

$\therefore$ Height of the tower $AB = x + 40$

$$= 20\sqrt{3} + 20 + 40 \qquad ½$$

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

$$= 20(\sqrt{3} + 3) \text{ m} \qquad ½$$

In ΔXAB,

$$\sin 60° = \frac{AB}{BX} \qquad ½$$

$$\frac{\sqrt{3}}{2} = \frac{AB}{BX} \qquad ½$$

$$BX = \frac{20(\sqrt{3}+3)2}{\sqrt{3}}$$

$$= 40\left(\sqrt{3}+1\right) \text{ m}$$

$$= 40 \times 2{\cdot}73 \text{ m}$$

$$= 109{\cdot}20 \text{ m} \qquad ½$$

[CBSE Marking Scheme, 2016]

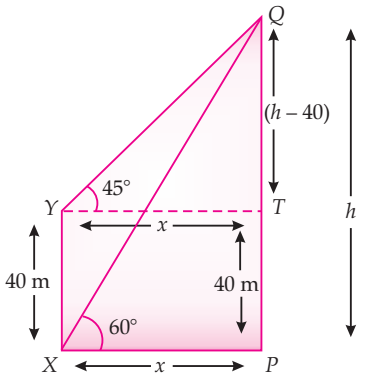
Q. 3. A vertical tower stands on a horizontal plane and is surmounted by a flagstaff of height 5 m. From a point on the ground the angles of elevation of the top and bottom of the flagstaff are 60° and 30° respectively. Find the height of the tower and the distance of the point from the tower. (take $\sqrt{3} = 1.732$)

C + U **[Foreign Set I, 2016]**

Sol. Try yourself, similar to Q. No. 4 in SATQ-II.

Q. 4. The angle of elevation of the top Q of a vertical tower PQ from a point X on the ground is 60°. From a point y 40 m vertically above X, the angle of elevation of the top Q of tower is 45°. Find the height of the tower PQ and the distance PX. (Use $\sqrt{3} = 1.73$) C + U **[O.D. Set I, III, 2016]**

Sol.



1

Let $PX = x$ m and $PQ = h$ m

$\therefore$ $QT = (h - 40)$ m

In ΔPQX,

$$\tan 60° = \frac{h}{x}$$

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

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

In ΔQTY, $\tan 45° = \frac{h-40}{x}$

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

$$\Rightarrow x = h - 40 \quad \text{... (ii) } \mathbf{1}$$

Solving (i) and (ii),

$$x = \sqrt{3}x - 40$$

$$\left(\sqrt{3}x - x\right) = 40$$

or $$\left(\sqrt{3} - 1\right)x = 40$$

or $$x = \frac{40}{\sqrt{3}-1} = 20\left(\sqrt{3}+1\right) \text{ m}$$

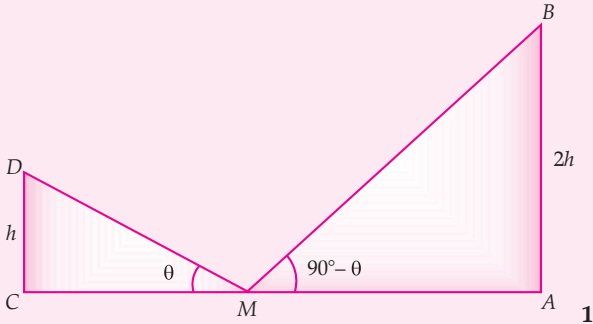
$$\therefore h = \sqrt{3} \times 20\left(\sqrt{3}+1\right) = 20\left(3+\sqrt{3}\right) \text{ m} \quad \mathbf{1}$$

$$20(3 + 1{\cdot}73) = 20 \times 4{\cdot}73$$

Hence, the height of tower is 94·6 m.

Q. 5. Two posts are k metre apart and the height of one is double that of the other. If from the mid-point of the line segment joining their feet, an observer finds the angles of elevation of their tops to be complementary, then find the height of the shorter post. C + A **[Board Term-2, 2015]**

Sol.



1

Let AB and CD be the two posts such that $AB = 2CD$. Let M be the mid-point of CA. Let $\angle CMD = \theta$ and $\angle AMB = 90° - \theta$

Clearly, $$CM = MA = \frac{1}{2}k$$

Let $CD = h$ m, then AB = $2h$ m

Now, $$\frac{AB}{AM} = \tan(90° - \theta) = \cot\theta$$

$$\Rightarrow \frac{2h}{\left(\frac{k}{2}\right)} = \cot\theta$$

$$\Rightarrow \cot\theta = \frac{4h}{k} \quad \text{...(i) } \mathbf{1}$$

Also in ΔCMD, $\frac{CD}{CM} = \tan\theta$

$$\Rightarrow \frac{h}{\frac{k}{2}} = \tan\theta$$

$$\Rightarrow \tan\theta = \frac{2h}{k} \quad \text{...(ii) } \mathbf{1}$$

Multiplying (i) and (ii), $\frac{4h}{k} \times \frac{2h}{k} = 1$

$$\therefore h^2 = \frac{k^2}{8}$$

$$\Rightarrow h = \frac{k}{2\sqrt{2}} = \frac{k\sqrt{2}}{4} \text{ m} \quad \mathbf{1}$$

[CBSE Marking Scheme, 2015]

Q. 6. The angle of elevation of the top of a tower at a distance of 120 m from a point A on the ground is 45°. If the angle of elevation of the top of a flagstaff fixed at the top of the tower, at A is 60°, then find the height of the flagstaff.

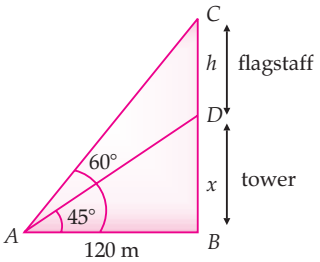
[Use $\sqrt{3} = 1.73$] C + A **[CBSE O.D. 2014]**

Sol. Height of flagstaff = $CD = h$ m

Height of tower = $BD = x$ m

$\angle DAB = 45°$, $\angle CAB = 60°$

$AB = 120$ m



1

ΔABD is right angled

$$\tan 45° = 1$$

$$\frac{x}{AB} = 1$$

$$x = AB = 120 \text{ m} \quad \mathbf{1}$$

ΔACB is right angled

$$\frac{h+x}{120} = \tan 60° = \sqrt{3}$$

$$h + 120 = 120\sqrt{3} \quad \textbf{1}$$

$$h = 120\sqrt{3} - 120$$

$$h = 120(\sqrt{3} - 1)$$

$$h = 120(1.73 - 1)$$

$$h = 120 \times 0.73$$

$$h = 87.6 \text{ m} \quad \textbf{1}$$

Hence, the height of the flagstaff = 87·6 m.

Q. 7. From the top of a building 60 m high the angles of depression of the top and the bottom of a tower are observed to be 30° and 60°. Find the height of the tower. C + A **[Delhi, CBSE Term-2 2014]**
[Board Term-2 2012 Set (31); 2011 Set (B1)]

Sol. Let AB is a building 60 m high and x is a tower h m high. Angle of depressions of top and bottom are given 30° and 60° respectively.

$DC = EB = h$ m and let $BC = x$ m.

$\Rightarrow$ $AE = (60 - h)$ m **1**

In ΔAED,

$$\frac{60-h}{ED} = \tan 30°$$

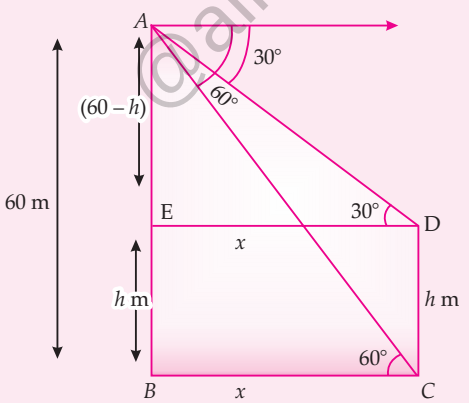
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{60-h}{BC}$$

$$\Rightarrow \sqrt{3}(60-h) = x \quad \text{...(i)} \ \textbf{1}$$

In ΔABC, $\frac{60}{x} = \tan 60°$

$$\Rightarrow 60 = \sqrt{3}x \quad \text{...(ii)}$$

Putting the value of x from equation (i) in equation (ii), we get



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

$\Rightarrow$ $60 = 3 \times (60-h)$ **1**

$\Rightarrow$ $20 = 60 - h$

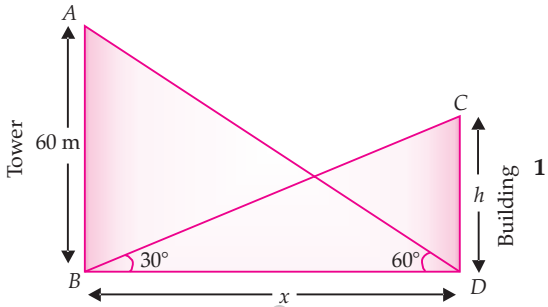
$\Rightarrow$ $h = 40$ m

Hence, the height of tower = 40 m. **1**

[CBSE Marking Scheme, 2011, 2012]

Q. 8. 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. C + U **[Delhi 2013]**

Sol.



1

In ΔABD, $\tan 60° = \frac{AB}{BD}$

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

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

$$= 20\sqrt{3} \text{ m} \quad \textbf{1}$$

Now, in ΔBCD, $\angle D = 90°$

$$\tan 30° = \frac{CD}{BD}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{20\sqrt{3}} \quad \textbf{1}$$

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

$\Rightarrow$ $h = 20$ m

Hence, the height of the building = 20 m. **1**

Q. 9. As observed from the top of a 100 m high light house 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 light house, find the distance between the two ships. [Use $\sqrt{3} = 1{\cdot}732$]

C + A **[CBSE Delhi/OD Set-2018]**

Sol. Try yourself, similar to Q. No. 10 in SATQ-II.

Commonly Made Error

- Most candidates are unable to draw the diagram as per the given data and lose their marks. Some candidates do calculation errors while solving the sum. Some take $\sqrt{3} = 1.73$ instead of 1.732 and hence write inaccurate answer.

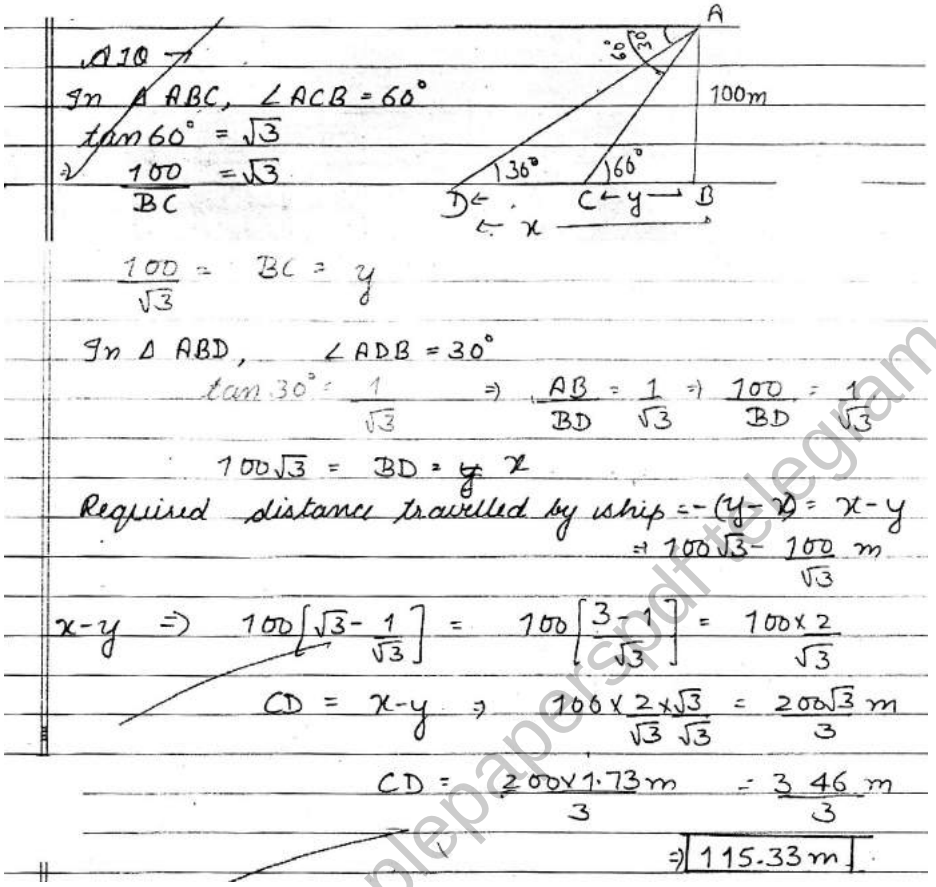
Answering Tip

- Students should do rounding off at the end while calculating the final answer.

Q. 10. As observed from the top of a light house, 100 m high above sea level, the angles of depression of a ship, sailing directly towards it, changes from 30° to 60°. Find the distance travelled by the ship during the period of observation. (Use $\sqrt{3} = 1.73$)

C [Outside Delhi, Set-II 2016]

Sol.



In Δ ABC, ∠ACB = 60°

$\tan 60° = \sqrt{3}$

$\frac{100}{BC} = \sqrt{3}$

$\frac{100}{\sqrt{3}} = BC = y$

In Δ ABD, ∠ADB = 30°

$\tan 30° = \frac{1}{\sqrt{3}} \Rightarrow \frac{AB}{BD} = \frac{1}{\sqrt{3}} \Rightarrow \frac{100}{BD} = \frac{1}{\sqrt{3}}$

$100\sqrt{3} = BD = x$

Required distance travelled by ship = $(y - x) = x - y$

$= 100\sqrt{3} - \frac{100}{\sqrt{3}}$ m

$x - y \Rightarrow 100\left[\sqrt{3} - \frac{1}{\sqrt{3}}\right] = 100\left[\frac{3-1}{\sqrt{3}}\right] = \frac{100 \times 2}{\sqrt{3}}$

$CD = x - y \Rightarrow \frac{100 \times 2 \times \sqrt{3}}{\sqrt{3}\sqrt{3}} = \frac{200\sqrt{3}}{3}$ m

$CD = \frac{200 \times 1.73}{3}$ m $= \frac{346}{3}$ m

$\Rightarrow$ 115.33 m

[Topper Answer 2016] **4**

Q. 11. The angle of elevation of a cloud from a point 60 m above the surface of the water of a lake is 30° and the angle of depression of its shadow from the same point in water of lake is 60°. Find the height of the cloud form the surface of water.

C + A [CBSE SQP-2018-19] [Delhi Set-2017]

[Board Term-2 Set (S), Set 59, 2015 Set B,]

Sol. Try yourself, similar to Q. No. 25 in SATQ-II.

Q. 12. A man on the top of a vertical observation tower observes a car moving at uniform speed coming directly towards it. If it takes 12 minutes for the angle of depression to change from 30° to 45°, how long will the car take to reach the observation tower from this point ?

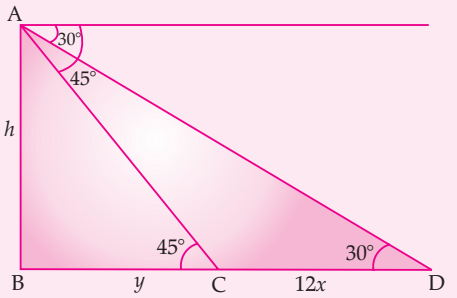
C + A [CBSE SQP-2018-19] [KVS, 2014]

Sol. Let the speed of car by x m/minutes

In ΔABC,

$$\frac{h}{y} = \tan 45°$$

$$\Rightarrow \quad h = y$$



1

In ΔABD,

$$\frac{h}{y + 12x} = \tan 30°$$

$$\Rightarrow \quad h\sqrt{3} = y + 12x$$

$$y\sqrt{3} - y = 12x$$

$$y = \frac{12x}{\sqrt{3} - 1} = \frac{12x(\sqrt{3}+1)}{2}$$

$$\Rightarrow \quad y = 6x\,(\sqrt{3}+1)$$

Hence, time taken from C to B = 6 $(\sqrt{3}+1)$ minutes [CBSE Marking Scheme, 2018-19] **1**

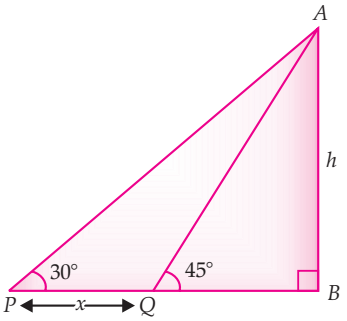
Detailed Answer :

Let AB be the tower of height h and x be the distance between two cars

$$\angle AQB = 45°$$

Now, in ΔABQ,

$$\tan 45° = \frac{AB}{BQ} \quad \mathbf{1}$$



$$\Rightarrow \quad 1 = \frac{h}{BQ}$$

$$\Rightarrow \quad BQ = h$$

In ΔAPB,

$$\tan 30° = \frac{AB}{PB}$$

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

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

$$i.e., \quad x = h\left(\sqrt{3}-1\right)$$

Thus, Speed $= \dfrac{h\left(\sqrt{3}-1\right)}{12}$ m/min **1**

Time for remaining distance, **1**

$$= \frac{h}{\frac{h\left(\sqrt{3}-1\right)}{12}} = \frac{12\left(\sqrt{3}+1\right)}{3-1}$$

$$= \frac{12}{2}\left(\sqrt{3}+1\right)$$

$$= 6\left(\sqrt{3}+1\right) \text{ min} \quad \mathbf{1}$$

Q. 13. The angle of depression of the top and bottom of a building 50 metres high as observed from the top of a tower are 30° and 45° respectively. Find the height of the tower and also the horizontal distance between the building and the tower.

C + A **[Sample Question Paper 2017-18]**

Sol. Try yourself, similar to Q. No. 4 in LATQ.

Q. 14. A straight highway leads to the foot of a tower. A man standing on its top observes a car at an angle of depression of 30°, which is approaching the foot of the tower with a uniform speed. 6 seconds later, the angle of depression of the car becomes 60°. Find the time taken by the car to reach the foot of tower from this point.

C + A **[Delhi Compt Set-I, III, 2017]**

Sol. Try yourself, similar to Q. No. 12 in LATQ.

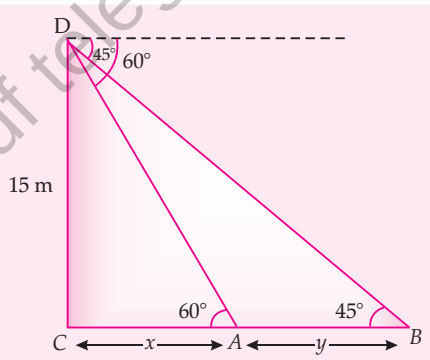
Q. 15. From a point P on the ground, the angles of elevation of the top of a 10 m tall building and a helicopter, hovering at some height vertically over the top of the building are 30° and 60° respectively. Find the height of the helicopter above the ground.

C + A **[Outside Delhi Compt. Set-I, II, III 2017]**

Sol. Try yourself, similar to Q. No. 3 in LATQ.

Q. 16. Two points A and B are on the same side of a tower and in the same straight line with its base. The angle of depression of these points from the top of the tower are 60° and 45° respectively. If the height of the tower is 15 m, then find the distance between these points. C + A **[Delhi Set-I 2017]**

Sol.



1

In ΔDCA, $\dfrac{DC}{CA} = \tan 60°$

$$\Rightarrow \quad \frac{15}{x} = \sqrt{3}$$

$$\Rightarrow \quad x = \frac{15}{\sqrt{3}}$$

$$\Rightarrow \quad x = 5\sqrt{3} \quad \mathbf{1}$$

In ΔDCB, $\dfrac{DC}{CB} = \tan 45° = \dfrac{15}{x+y} = 1$

$$\Rightarrow \quad x + y = 15 \quad \mathbf{1}$$

$$\Rightarrow \quad 5\sqrt{3} + y = 15$$

$$\Rightarrow \quad y = 15 - 5\sqrt{3}$$

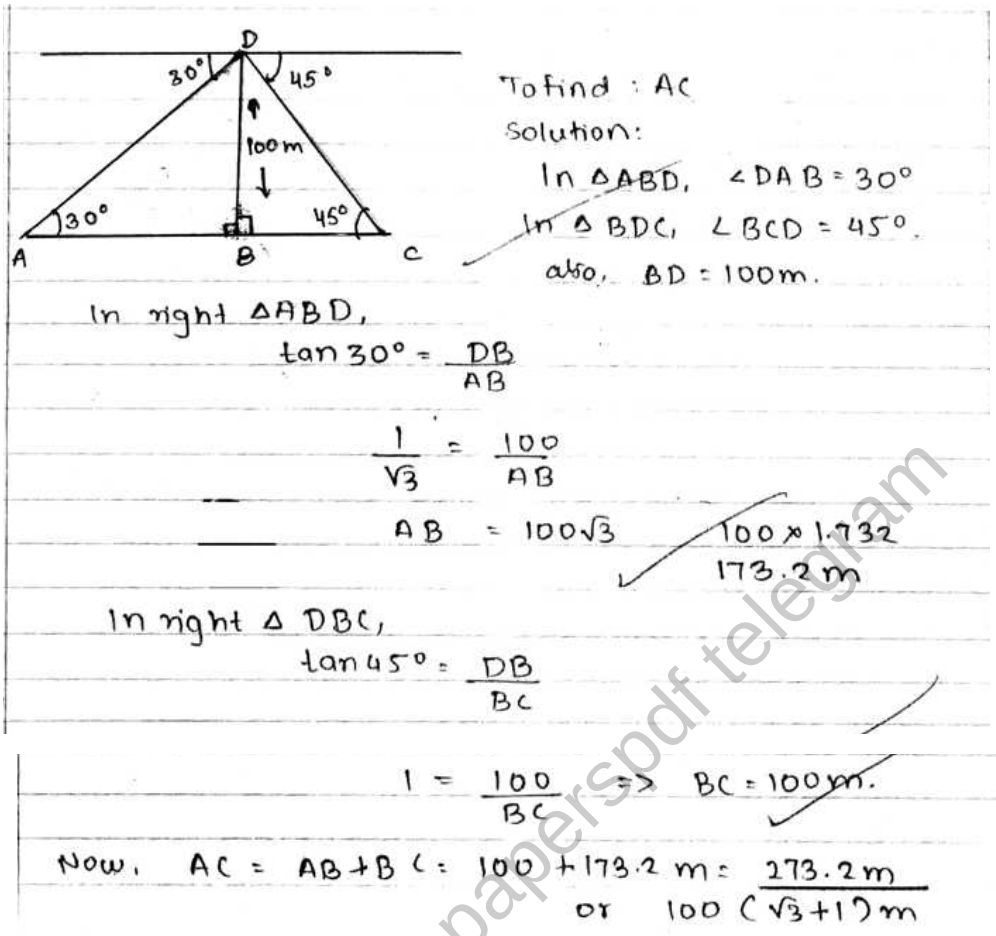
$$= 5\left(3-\sqrt{3}\right) \text{ m}$$

Hence, the distance between the points $= 5\left(3-\sqrt{3}\right)$ m.

[CBSE Marking Scheme, 2017] 1

Q. 17. From the top of a tower, 100 m high, a man observes two cars on the opposite sides of the tower and in same straight line with its base, with angles of depression 30° and 45°. Find the distance between the cars. [Take $\sqrt{3} = 1.732$] C + A **[Outside Delhi Compt. Set-III 2017]**

Sol.



[Topper Answer 2017] 4

Q. 18. An observer finds the angle of elevation of the top of the tower from a certain point on the ground as 30°. If the observer moves 20 m. towards the base of the tower, the angle of elevation of the top increases by 15°, find the height of the tower.

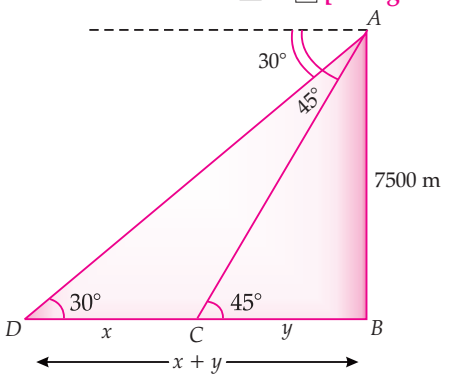
C + A **[Delhi Set-III 2017]**

Sol. Try yourself, similar to Q. No. 13 in SATQ-II.

Q. 19. The angle of depression of two ships from an aeroplane flying at the height of 7500 m are 30° and 45°. If both the ships are in the same line that one ship is exactly behind the other, find the side such distance between the ships.

C + A **[Foreign Set-II 2017]**

Sol.



½

In ΔABC, $\frac{AB}{BC} = \tan 45°$

$\Rightarrow \frac{7500}{y} = 1$

$\Rightarrow y = 7500$ **1**

In ΔABD, $\frac{AB}{BD} = \tan 30°$

$\frac{7500}{x+y} = \frac{1}{\sqrt{3}}$

$\Rightarrow x + y = 7500\sqrt{3}$

$x + 7500 = 7500\sqrt{3}$

$x = 7500\sqrt{3} - 7500$

$= 7500(\sqrt{3} - 1)$

$= 7500(1{\cdot}73 - 1)$

$= 7500 \times 0{\cdot}73$

$= 5475$ m

Hence, the distance between two ships

$= 5475$ m **1½**

Q. 20. An aeroplane is flying at a height of 300 m above the ground. Flying at this height, the angle of

depression from the aeroplane of two points on both banks of a river in opposite directions are 45° and 60°. Find the width of the river.

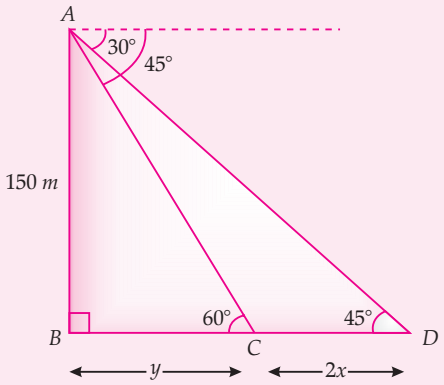
C + A **[Outside Delhi Set-I 2017]**

Sol. Try yourself, similar to Q. No. 17 in LATQ.

Q. 21. A moving boat observed from the top of a 150 m high cliff, moving away from the cliff. The angle of depression of the boat changes from 60° to 45° in 2 minutes. Find the speed of the boat.

C + A **[Delhi Set-I 2017]**

Sol.



1

Let the speed of the boat be x m/min.

$\therefore$ Distance covered in 2 minutes $= 2x$

$\therefore$ $CD = 2x$

Let BC be y m.

In ΔABC, $\frac{AB}{BC} = \tan 60°$

$\Rightarrow$ $\frac{150}{y} = \sqrt{3}$

$\Rightarrow$ $y = \frac{150}{\sqrt{3}}$

$\Rightarrow$ $y = 50\sqrt{3}$ m. ...(i)

In ΔABD, $\frac{AB}{BD} = \tan 45°$

$\Rightarrow$ $\frac{150}{y+2x} = 1$

$\Rightarrow$ $y + 2x = 150$ ...(ii) **1**

Substituting the value of y from (i) in (ii),

$50\sqrt{3} + 2x = 150$

$2x = 150 - 50\sqrt{3}$

$2x = 50(3 - \sqrt{3})$

$x = 25(3 - \sqrt{3})$ m. **1**

Speed of the boat $= 25(3 - \sqrt{3})$ m/min.

$= \frac{25(3-\sqrt{3}) \times 60}{1000}$

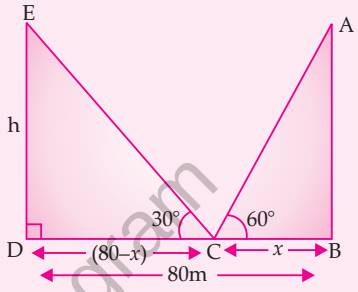
$= \frac{3}{2}(3 - \sqrt{3})$ km/hr. **1**

[CBSE Marking Scheme, 2017]

Q. 22. Two poles of equal heights are standing opposite to each other on either side of the road which is 80 m wide. From a point in between them on the road, the angles of elevation of the top of poles are 60° and 30° respectively. Find the height of the poles and the distances of the point from the poles.

C + A **[CBSE Comptt. Set-I, II, III-2018]**
[Board Term-2, 2012 Set (S, 28); 2011 Set (B), Delhi-2013]

Sol.



In ΔABC, $\frac{h}{x} = \tan 60°$

$\Rightarrow$ $h = x\sqrt{3}$ ...(1) **1**

In ΔEDC, $\frac{h}{80-x} = \tan 30°$

$\Rightarrow$ $h\sqrt{3} = 80 - x$ **1**

From (1), $x\sqrt{3} \times \sqrt{3} = 80 - x$

$\Rightarrow$ $x = 20$ m

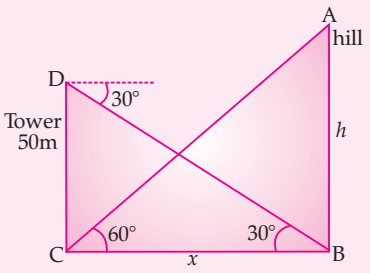
$\therefore$ $h = 20\sqrt{3}$ m

$\therefore$ The height of poles $= 20\sqrt{3}$ m

Hence, the distance of poles from the point are 20 m and 60m. **[CBSE Marking Scheme, 2018]** **1**

Q. 23. The angle of elevation of the top of a hill from the foot of a tower is 60° and the angle of depression from the top of the tower of the foot of the hill is 30°. If tower is 50 meter high, find the height of the hill. C + A **[CBCE Comptt. Set-I, II, III-2018]**
[Delhi CBSE 2015 Set, I, II, III]
[Board Term-2; 2012 Set- 34, 59]

Sol.



1

In ΔABC, $\frac{h}{x} = \tan 60°$

$\Rightarrow$ $h = x\sqrt{3}$ **1**

In ΔBCD, $\frac{50}{x} = \tan 30°$

$\Rightarrow$ $x = 50\sqrt{3}$ **1**

$\Rightarrow$ $h = 150$ m

$\Rightarrow$ Height of hill $= 150$ m **1**

[CBSE Marking Scheme, 2018]

Commonly Made Error

- The concept of angle of depression is not clear to many students. That's why they are not able to draw the diagram correctly.

Answering Tip

- The concept of angle of depression and angle of elevation must be clear to the students.

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