



MATHS

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SOME AAPLICATIONS OF TRIGONOMETRY

Textual Examples

1. A tower stands vertically on the ground. From a point on the ground, which is 15m away from the foot of the tower, the angle of elevation of the top of the tower is found to be 60° . Find the height of the tower.



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2. An electrician has to repair an electric fault on a pole of height 5m. She needs to reach a point 1.3m below the top of the pole to undertake the repair work (see the given figure). What should be the length of the ladder that she should use which, when inclined at an angle of 60° to teh horizontal, would enable her to reach the required position? Also, how far from the foot of the pole shoudl she place the foot of the ladder?

(you may take $\sqrt{3}=1.73$)



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3. An observer 1.5m tall is 28.5m 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?



4. From a point P on the ground the angle of elevation of the top of a 10m tail 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 the distance of the building from

the point P. (You may take $\sqrt{3}=1.732$)





5. The shadow of a tower standing on a level ground is found to be 40m longer when the

sum's altitide is 30° than when it is $60^\circ.$ Find

the height of the tower.



6. The angles of depression of the top and the bottom of an 8m tall building from the top of a multi-storeyed building are 30° and 45° ,

respectively. Find the height of the multistoreyed building and the distance between the two buildings.



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7. From a point on a bridge across a river, the angles of depression of the banks on opposite sides of the river are 30° and 45° , respectively. If the bridge is at a height of 3m from the banks, find the width of the river.





Other Important Examples

1. A building stands on a horizontal plane and is surmounted by a vertical flag-stagg of height h. At a point on the plane, the angles of elevation of the bottom and the top of the flag-staff are α and β respectively. Prove that $h \tan \alpha$ the height of the building is aneta - an lphaFlag-staff B Building Watch Video Solution

2. If the angle of elevation of a cloud from a point h metres above the surface of a lake is α and the angle of depression of its reflexion in the lake is β , prove that the height of the cloud is $\frac{h(\tan\beta + \tan\alpha)}{\tan\beta - \tan\alpha}$ metres.

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3. A spherical balloon of radius r subtends an angle θ at the eye of an observer. If the angle of elevation of its centre is ϕ , find the height

of the centre of the balloon.





Exercise 91

1. 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° (see the given figure)





2. 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 8m.

Find the height of the tree.



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3. A constractor 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 1.5m, 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 ?





4. The angle of elevation of the top of a tower from a point on the ground, which is 30m away from the foot of the tower, is 30° . Find the height of the tower.



5. A kite is flying at a height of 60m 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.

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6. A 1.5m tall boy is standing at some distance

from a 30m tall building. The angle of

elevation from his eyes to the top of the building increase from 30° to 60° as he walks towards the building. Find the distance he walked towards the building.





7. 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 the tower.





8. 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 the angle of elevation of the top of the pedestal is 45° .

Find the height of the pedestal.



9. 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 50m high, find the height of the building.





10. Two poles of equal heights are standing opposite each other on either side of the road, which is 80m 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.





11. 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 20m 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° (see the given figure). Find the height of the tower and the width of the canal.



12. From the top of a 7m high building, the angle of elevation of the top of a cable tower is 60° and the angle of depression of its foot







13. As observed from the top of a 75m 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





14. A 1.2m 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 eyes of the girl at any instant is 60° . After some time, the angle of elevation reduces to 30° (see the given figure). Find the distance travelled by the balloon during the interval.



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



16. The angles of elevation of the top of a tower from two points at a distance of 4m and 9m from the base of the tower and in the same straight line with it are complementary.

Prove that the height of the tower is 6m.



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Test Your Skills

1. The angle of elevation of the top of a tower 30m high from the foot of another tower in the same plane is 60° and the angle of elevation of the top the second tower from the foot of the first tower is 30° . Find the distance between the two towers and also find the height of the other tower.

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2. A ladder rests against a wall at an inclination α to the horizontal. Its foot is pulled away from the wall through a distance p so that its upper end slides a distance q down the wall and then the ladder makes an angle β to the horizontal. Show that $rac{p}{q} = rac{\coseta - \coslpha}{\sinlpha - \sineta}$

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3. A window of a house is h metres above the ground. From the window, the angles of elevation and depression of the top and the bottom of another house situated on the opposite sides of the lane are found to be α and β respectively. Prove that the height of the other house is $h(1 + \tan \alpha \cot \beta)$ metres.

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



5. The angle of elevation of a jet plane from a point on the ground had measure 60° . After a flight of 30 seconds, the angle of elevation has measure 30° . If the jet plane is flying at a constant height of $4500\sqrt{3}m$, find the speed of the jet plane

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Practice Thoroughly

1. A jet plane is at a vertical height of h. The angles of depression of two tanks on the ground in the same line with the plane are α and $\beta(\alpha > \beta)$. Prove that the distance between the tanks is $\frac{h(\tan \alpha - \tan \beta)}{\tan \alpha \tan \beta}$

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2. A pole stands erect on the ground. If the angle of elevation of the top of the pole from

a point 90m away from the foot of the pole is

 $30^{\,\circ}$, find the height of the pole.



3. A bridge across a valley is h metres long. There is a temple in the valley directly below the bridge. The angles of depression of the top of the temple from the two ends of the bridge are α and β . Prove that the height of the bridge above the top of the temple is $h(\tan \alpha \tan \beta)$ metres. an lpha + an eta



4. At a point on level ground, the angle of elevation of the top of a tower is found to be such that its tangent is $\frac{5}{12}$. On walking 192 m towards the tower, the tangent of the angle of elevation is $\frac{3}{4}$. Find the height of the tower.

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5. As observed from the top of a light house 100m above sea level, the angle of depression

of a boat, sailing directly towards it, changes from 30° to 45° . Determine the distance travelled by the boat during the period of observation ($\sqrt{3}=1.732$)

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6. From the top of a building 60m 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.



7. At the foot of a mountain, the angle of its summit is 45° . After ascending 1000m towards the mountain up a slope of 30° inclination, the angle of elevation is found to be 60° . Find the height of the mountain $(\sqrt{3} = 1.732)$

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Objective Questions

1. A kite is flying at a height of 75m from the level ground, attached to a taut string inclined at 60° to the horizontal. Then, the length of the string ism

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2. A ladder makes an angle of 60° with the ground, when placed leaning on a wall. If the foot of the ladder is 8m away from the wall, then the length of the ladder ism



3. The angle of elevation of the top of a tower from a point on the ground 30m away from the foot of the tower is 30° . Then, the height of the tower ism

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4. If the height of a man and the length of his shadow are equal, then the Sun's elevation is.....at that time.



shadow is.....m



6. The angle of elevation of the top of a 15m high tower from a point 15m away from the base of the tower is......

A. 30°

B. 60°

C. 45°

D. $75^{\,\circ}$

Answer: D



7. The angle of depression of a boat from a 50m high bridge is 30° . Then, the horizontal distance of the boat from the bridge is.....m

A. $50\sqrt{3}$

B. 50

C. $25\sqrt{3}$

D. 25

Answer: C



8. The angle of elevation of a bird sitting on top of a tree as seen from the point at a

distance of 20m from the base of the tree is

 $60^{\,\circ}$. Then, the height of the tree ism

A. $20\sqrt{3}$

B. $10\sqrt{3}$

C. 20

D. 10

Answer: B::C



9. The length of the shadow of a 10m high tree ism when the angle of elevation of the Sun is 30° .

A. 10 B. $\frac{10}{\sqrt{3}}$ C. $10\sqrt{3}$

D. 20

Answer: A::C



10. The top of two poles of height 16m and 10m are connected by a wire. If the wire makes an angle of 30° with the horizontal, then its length is......m

A. 26

B. 16

C. 12

D. 10

Answer: A::B

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11. The angle of elevation of the top of a tower from a point P on the ground is α . After walking a distance of d m towards the foot of the tower, the angle of elevation of the top of the tower is found to be β . Then,holds good.

A.
$$lpha < eta$$

B. $\alpha > \beta$

$$\mathsf{C}.\, lpha=eta$$

D. none of these

Answer: A::B

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12. A 1.8m tall girl stands at a distance of 4.6m from a lamp post and casts a 5.4m long shadow on the ground. Then, the height of the lamp post is.....m

A. 1.53

 $\mathsf{B.}\,\frac{10}{3}$

C. 13.8

D. 0.8

Answer: A::C

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13. The angle of elevation of the top of a tower at a distance 500m from the foot is 30° . Then, the height of the tower ism.

A. $250\sqrt{3}$

B. $500\sqrt{3}$



D. 250

Answer: C



14. A tower stands on a horizontal plane. The shadow of the tower when the angle of the elevation of the Sun is 30° is 45m more than

when the angle of elevation of the Sun is $60^{\,\circ}$,

Then, the height of the tower is.....m

A.
$$\frac{45\sqrt{3}}{2}$$

B. $45\sqrt{3}$
C. $45\sqrt{2}$
D. $\frac{45}{\sqrt{3}}$

Answer: B::C::D



15. The angle of elevation of the top of a tower from a point 30m away from its foot is 30° . Then, the angle of elevation of the top of the same tower from a point 10m away from its foot is......

- A. $10^{\,\circ}$
- B. 45°
- C. 60°
- D. 15°

Answer:



length of its shadow when the Sun's altitiude is 45° ?



17. An observer, 1.5m tall, is 28.5m away from a30m high tower. Determine the angle of

elevation of the top of the tower from the

eyes of the observer.



18. An observer 1.7m tall, is $20\sqrt{3}m$ away from a tower. The angle of elevation of the top of

the tower from the eyes of the observer is 30°

. Find the height of the tower.

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19. The angle of elevation of the top of an adjustable pole from a point on the ground is 30° . What will be the angle of elevation of the top of the pole if its height is tripled?



20. The two towers of heights x and y, standing on level ground, subtend angles of 30° and 60° respectively at the centre of the line joining their feet. Then, find x: y



21. When the Sun's altitude is 45° , the height of a tower and the length of its shadow are equal.

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22. In a right triangle, if the measure of an acute angle is 30° , the side opposite to that angle is half the hypotenuse.

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23. A 10m long ladder leaning on a wall reaches the height of 5m on the wall. Then, the ladder makes a 30° angle with the wall.

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24. Walking 20m on a slope of inclination 30° with the level ground, one reaches 10m above

the ground level.

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