

# Assignments in Mathematics Class X (Term II)

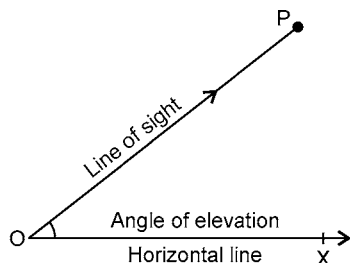
## 9. SOME APPLICATIONS OF TRIGONOMETRY

### IMPORTANT TERMS, DEFINITIONS AND RESULTS

- **Line of sight** : When an observer looks from a point O at an object P, then the line OP is called the *line of sight*.

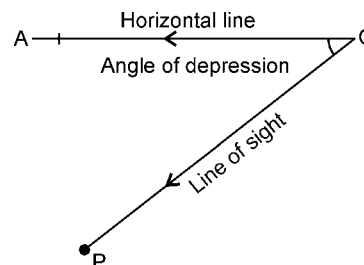
- **Angle of elevation** : The angle which the line of sight makes with the horizontal line through O is called the *angle of elevation* of P, as seen from O; i.e.,  $\angle XOP$ .

Or the angle of elevation of an object 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 the object.

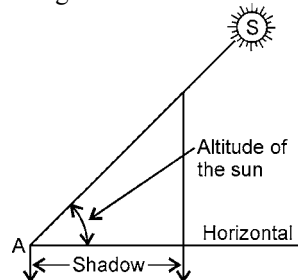


- **Angle of depression** : The angle which the line of sight makes with the horizontal line through O is called the *angle of depression* of P, as seen from O.

Or the angle of depression of an object 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 the object.



- **Altitude of the Sun** : The altitude of the sun is simply the angle of elevation of the sun.



### SUMMATIVE ASSESSMENT

#### MULTIPLE CHOICE QUESTIONS

[1 Mark]

#### A. Important Questions

1. The angles of elevation of the top of a tower from two points distant  $a$  and  $b$  from the base and in the same straight line with it, are complementary, then the height of the tower is :

- (a)  $ab$       (b)  $\sqrt{ab}$       (c)  $\frac{a}{b}$       (d)  $\sqrt{\frac{a}{b}}$

2. The ratio of the length of a rod and its shadow is  $1 : \sqrt{3}$ . The altitude of the sun is :

- (a)  $30^\circ$       (b)  $45^\circ$       (c)  $60^\circ$       (d)  $90^\circ$

3. The angle of elevation of a cloud from a point  $h$  metres above a lake is  $\theta$ . The angle of depression of its reflection in the lake is  $45^\circ$ . The height of the cloud is :

- (a)  $\frac{h(1 + \tan \theta)}{(1 - \tan \theta)}$       (b)  $\frac{h(1 - \tan \theta)}{(1 + \tan \theta)}$

- (c)  $\frac{h(1 + \tan \theta)}{\tan \theta}$       (d) none of these

4. The height of a tower is 50 m. When the sun's altitude changes from  $30^\circ$  to  $45^\circ$ , the shadow of the tower becomes  $x$  metres less. The value of  $x$  is :

- (a) 50 m      (b)  $50\sqrt{3}$  m

- (c)  $50(\sqrt{3} - 1)$  m      (d)  $\frac{50}{\sqrt{3}}$  m

5. If the angle of elevation of a building from a distance of 100 m from its foot is  $60^\circ$ , then the height of the building is :

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

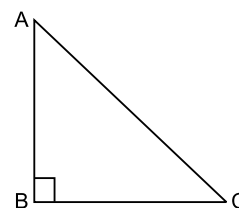
- (c)  $50\sqrt{3}$  m      (d)  $\frac{200}{\sqrt{3}}$  m

6. From the top of a cliff 50 m high the angle of elevation 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) 50 m (b) 100 m (c) 125 m (d) 150 m
7. The altitude of the sun is  $60^\circ$ . The height of a tower which casts a shadow of length 30 m is :  
 (a)  $30\sqrt{3}$  m (b) 15 m  
 (c)  $\frac{30}{\sqrt{3}}$  m (d)  $15\sqrt{2}$  m
8. A pole subtends an angle of  $30^\circ$  at a point on the same level as its foot. At a second point  $h$  metres above the first, the depression of the foot of the pole is  $60^\circ$ . The height of the pole is :  
 (a)  $\frac{h}{2}$  m (b)  $\sqrt{3}$  m (c)  $\frac{h}{3}$  m (d)  $\frac{h}{\sqrt{3}}$  m
9. The angle of elevation of the top of a tower from a point P on the ground is  $\alpha$ . After walking a distance  $d$  towards the foot of the tower, angle of elevation is found to be  $\beta$ . The height of the tower is :  
 (a)  $\frac{d}{\cot \alpha + \cot \beta}$  (b)  $\frac{d}{\cot \alpha - \cot \beta}$   
 (c)  $\frac{d}{\tan \alpha + \tan \beta}$  (d)  $\frac{d}{\tan \beta - \tan \alpha}$
10. The length of the shadow of a tower standing on level plane is found to be  $2x$  metres longer when the sun's altitude is  $30^\circ$  than when it was  $45^\circ$ . The height of the tower is :  
 (a)  $x(\sqrt{3} - 1)$  m (b)  $x(\sqrt{3} + 1)$  m  
 (c)  $\frac{x}{\sqrt{3} - 1}$  m (d)  $\frac{\sqrt{3} - 1}{x}$  m
11. As observed from the top of a 75 m high light-house from the sea-level, the angles of depression of two ships are  $30^\circ$  and  $45^\circ$ . One ship is exactly behind the other on the same side of the light-house. The distance between the two ships is :  
 (a) 75 m (b)  $75(\sqrt{3} + 1)$  m  
 (c)  $75(\sqrt{3})$  m (d)  $75(\sqrt{3} - 1)$  m
12. Two persons are  $a$  metres apart and the height of one is double that of the other. If from the middle point of the line joining their feet, an observer finds the angular elevation of their tops to be complementary, then the height of the short person is :  
 (a)  $\frac{a}{4}$  (b)  $\frac{a}{\sqrt{2}}$  (c)  $a\sqrt{2}$  (d)  $\frac{a}{2\sqrt{2}}$

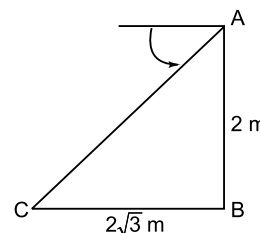
## B. Questions From CBSE Examination Papers

1. If the altitude of the sun is  $60^\circ$ , the height of the tower which casts a shadow of length 30 m is :  
**[2011 (T-II)]**  
 (a)  $30\sqrt{3}$  m (b)  $\frac{30}{3}\sqrt{3}$  m  
 (c)  $15\sqrt{3}$  m (d) 15 m
2. The tops of two poles of heights 20 m and 14 m are connected by a wire. If the wire makes an angle of  $30^\circ$  with the horizontal, then the length of the wire is :  
**[2011 (T-II)]**  
 (a) 34 m (b) 12 m (c) 6 m (d) 17 m
3. The length of the string of a kite flying at 100 m above the ground with the elevation of  $60^\circ$  is :  
**[2011 (T-II)]**  
 (a) 100 m (b)  $100\sqrt{2}$  m  
 (c)  $\frac{200}{\sqrt{3}}$  (d) 200 m
4. A ladder of 10 m length touches a wall at height of 5 m. The angle  $\theta$  made by it with the horizontal is :  
**[2011 (T-II)]**  
 (a)  $90^\circ$  (b)  $60^\circ$  (c)  $45^\circ$  (d)  $30^\circ$
5. The measure of angle of elevation of top of a tower  $75\sqrt{3}$  m high from a point at a distance of 75 m from foot of the tower in a horizontal plane is :  
**[2011 (T-II)]**  
 (a)  $30^\circ$  (b)  $60^\circ$  (c)  $90^\circ$  (d)  $45^\circ$
6. A pole 10 m high casts a shadow 10 m long on the ground, then the sun's elevation is :  
**[2011 (T-II)]**  
 (a)  $60^\circ$  (b)  $45^\circ$  (c)  $30^\circ$  (d)  $90^\circ$
7. The angle of depression from the top of a tower 12 m high, at a point on the ground is  $30^\circ$ . The distance of the point from the top of the tower is :  
**[2011 (T-II)]**  
 (a) 12 m (b) 6 m (c)  $12\sqrt{3}$  m (d) 24 m
8. A tree casts a shadow 4 m long on the ground, when the angle of elevation of the sun is  $45^\circ$ . The height of the tree (in metres) is : **[2011 (T-II)]**  
 (a) 3 (b) 4 (c) 4.5 (d) 5.2
9. If sun's elevation is  $60^\circ$ , then a pole of height 6 m will cast a shadow of length : **[2011 (T-II)]**  
 (a)  $6\sqrt{3}$  m (b)  $\sqrt{3}$  m  
 (c)  $2\sqrt{3}$  m (d)  $3\sqrt{2}$  m

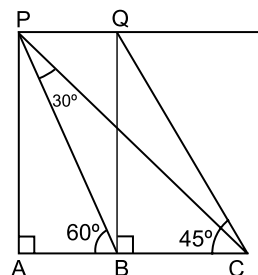
10. The angle of elevation of the top of a building 50 m high, from a point on the ground is  $45^\circ$ . The distance of the point from the foot of the building is : **[2011 (T-II)]**  
 (a) 100 m (b) 50 m (c) 45 m (d) 60 m
11. A tree 6 m tall casts a 4 m long shadow. At the same time a pole casts a shadow 10 m long. The height of the pole is : **[2011 (T-II)]**  
 (a) 40 m (b) 20 m (c) 15 m (d) 10 m
12. If the angle of elevation of top of a tower from a point at a distance of 100 m from its foot is  $60^\circ$ , then the height of the tower is : **[2011 (T-II)]**  
 (a)  $50\sqrt{3}$  m (b)  $\frac{200}{\sqrt{3}}$  m  
 (c)  $\frac{100}{\sqrt{3}}$  m (d)  $100\sqrt{3}$  m
13. The angle formed by the line of sight with the horizontal, when the point being viewed is above the horizontal level is called : **[2011 (T-II)]**  
 (a) vertical angle (b) angle of depression  
 (c) angle of elevation (d) obtuse angle
14. If the ratio of height of a tower and the length of its shadow on the ground is  $\sqrt{3} : 1$ , then the angle of elevation of the sun is : **[2011 (T-II)]**  
 (a)  $60^\circ$  (b)  $45^\circ$  (c)  $30^\circ$  (d)  $90^\circ$
15. If the height and length of the shadow of a man are the same, then the angle of elevation of the sun is : **[2011 (T-II)]**  
 (a)  $30^\circ$  (b)  $60^\circ$  (c)  $45^\circ$  (d)  $15^\circ$
16. If  $AB = 4$  m and  $AC = 8$  m, then angle of observation of A as observed from C is : **[2011 (T-II)]**  
 (a)  $60^\circ$  (b)  $30^\circ$   
 (c)  $45^\circ$  (d) cannot be determined



17. If the angle of depression of an object from a 75 m high tower is  $30^\circ$ , then the distance of the object from the base of tower is : **[2011 (T-II)]**  
 (a)  $25\sqrt{3}$  m (b)  $50\sqrt{3}$  m  
 (c)  $75\sqrt{3}$  m (d) 150 m
18. The figure, shows the observation of point C from point A. The angle of depression from A is : **[2011 (T-II)]**  
 (a)  $60^\circ$  (b)  $30^\circ$  (c)  $45^\circ$  (d)  $75^\circ$



19. From the figure, the angle of depression of point C from the point P is : **[2011 (T-II)]**  
 (a)  $90^\circ$  (b)  $60^\circ$  (c)  $30^\circ$  (d)  $45^\circ$



## SHORT ANSWER TYPE QUESTIONS

[2 Marks]

### B. Questions From CBSE Examination Papers

1. A tower stands vertically on the ground. From a point on the ground which is 60 m away from foot of the tower, the angle of elevation of the top of the tower is found to be  $60^\circ$ . Find the height of the tower. **[2011 (T-II)]**
2. A ladder 15 m long just reaches the top of a vertical

wall. If the ladder makes an angle of  $60^\circ$  with the wall, find the height of the wall. **[2011 (T-II)]**

3. A tower stands vertically on the ground. From a point on the ground which is 15 m away from the foot of the tower, the angle of elevation of the top of the tower is found to be  $60^\circ$ . Find the height of the tower. **[2011 (T-II)]**

## B. Questions From CBSE Examination Papers

1. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground making an angle  $30^\circ$  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. [2011 (T-II)]
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  $60^\circ$ . Find the length of the string assuming that there is no slack in the string. [Take  $\sqrt{3} = 1.732$ ] [2011 (T-II)]
3. 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  $60^\circ$ . Find the distance between the foot of the tower and the ball. [2011 (T-II)]
4. The shadow of a tower is 30 m long, when the sun's elevation is  $30^\circ$ . What is the length of the shadow, when sun's elevation is  $60^\circ$ ? [2011 (T-II)]
5. From a point P on the ground, the angle of elevation of the top of a 10 m tall building is  $30^\circ$ . A flag is hosted at the top of the building and the angle of elevation of the top of the flagstaff from P is  $45^\circ$ . Find the length of the flagstaff. (Take  $\sqrt{3} = 1.732$ ) [2011 (T-II)]
6. A person standing on the bank of the river observes that the angle subtended by a tree on the opposite bank is  $60^\circ$ , when he retreats 20 m from the bank, he finds the angle to be  $30^\circ$ , find the height of the tree. [2011 (T-II)]
7. The angle of elevation of the top of a tower from two points distant  $a$  and  $b$  from the base and in the same straight line with it are complementary. Prove that the height of tower is  $\sqrt{ab}$ . [2011 (T-II)]
8. A tower is 60 m high. From the top of it the angles of depression of the top and the bottom of a tree are found to be  $30^\circ$  and  $60^\circ$  respectively. Find the height of the tree and its distance from the tower. [2011 (T-II)]
9. A man standing on the top of a multi-storey building, which is 30 m high, observes the angle of elevation of the top of a tower as  $60^\circ$  and the angle of depression of the base of the tower as  $30^\circ$ . Find the horizontal distance between the building and the tower. Also, find the height of the tower. [2011 (T-II)]
10. An aeroplane, when 3000 m high, passes vertically above another plane at an instant when the angles of elevation of the two aeroplanes from the same point on the ground are  $60^\circ$  and  $45^\circ$  respectively. Find the vertical distance between the two aeroplanes. [2011 (T-II)]
11. A circus artist is climbing a rope 12 m long 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 is  $30^\circ$ . [2011 (T-II)]
12. The length of the shadow of a tower standing on level ground is found to be  $2x$  metres longer when the sun's altitude is  $30^\circ$  than when it was  $45^\circ$ . Prove that the height of tower is  $(\sqrt{3} + 1)x$  metres. [2011 (T-II)]
13. From the top of a 10 m tall tower the angle of depression of a point on a ground was found to be  $60^\circ$ . How far is the point from the base of the tower? [2011 (T-II)]
14. 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 his eyes is  $45^\circ$ . What is the height of the tower? [2011 (T-II)]

## LONG ANSWER TYPE QUESTIONS

## [4 Marks]

## A. Important Questions

1. Two poles of equal heights are standing opposite to each other on either side of a road, which is 100 metres wide. From a point between them on the road, the angles of elevation of their tops are  $30^\circ$  and  $60^\circ$ . Find the position of the point and also, the heights of the poles.
2. A tree breaks due to the storm and the broken part bends so that the top of the tree touches the ground making an angle of  $30^\circ$  with the ground. The distance from the foot of the tree to the point where the top touches the ground, is 10 metres. Find the height of the tree.
3. A boy is standing on the ground and flying a kite with 100 m of string at an elevation of  $30^\circ$ . Another boy is standing on the roof of a 20 m

high building and is flying his kite at an elevation of  $45^\circ$ . Both the boys are on the opposite sides of both the kites. Find the length of the string that the second boy must have so that the two kites meet.

4. At the foot of a mountain the elevation of its summit is  $45^\circ$ . After ascending 1000 m towards the mountain up a slope of  $30^\circ$  inclination, the elevation is found to be  $60^\circ$ . Find the height of the mountain.
5. The angle of elevation of the top Q of a vertical tower PQ from a point X on the ground is  $60^\circ$ . At a point Y, 40 m vertically above X, the angle of elevation is  $45^\circ$ . Find the height of the tower PQ and the distance XQ.
6. A round balloon of radius  $r$  subtends an angle  $\alpha$  at the eye of the observer while the angle of elevation of its centre is  $\beta$ . Prove that the height of the centre of the balloon is  $r \sin \beta \operatorname{cosec} \frac{\alpha}{2}$ .
7. The angle of elevation of a cliff from a fixed point is  $\theta$ . After going up a distance of  $k$  metres towards the top of the cliff at an angle of  $\phi$ , it is found that the angle of elevation is  $\alpha$ . Show that the height of the cliff is

$$\frac{k(\cos \phi - \sin \phi \cot \alpha)}{\cot \theta - \cot \alpha} \text{ metres.}$$

8. If the angle of elevation of a cloud from a point  $h$  metres above a lake is  $\alpha$  and the angle of depression of its reflection in the lake from the same point is  $\beta$ , prove that the height of the cloud is  $\frac{h(\tan \beta + \tan \alpha)}{(\tan \beta - \tan \alpha)}$ .
9. A man on a cliff observes a boat at an angle of depression of  $30^\circ$  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  $60^\circ$ . Find the time taken by the boat to reach the shore.
10. A ladder rests against a wall at an angle  $\alpha$  to the horizontal. Its foot is pulled away from the wall through a distance  $a$ , so that it slides a distance  $b$  down the wall making an angle  $\beta$  with the horizontal. Show that  $\frac{a}{b} = \frac{\cos \alpha - \cos \beta}{\sin \beta - \sin \alpha}$ .
11. The angles of elevation of the top of a hill at the city centres of two towns on either side of the hill are observed to be  $30^\circ$  and  $60^\circ$ . If the distance up-hill from the first city centre is 9 km, find in

kilometres the distance up-hill from the other city centre.

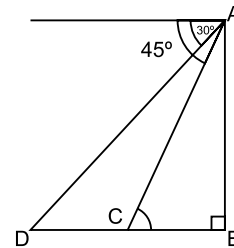
12. An aeroplane when 3000 m high passes vertically above another aeroplane at an instance when their angles of elevation at the same observation point are  $60^\circ$  and  $45^\circ$  respectively. How many metres higher is the one than the other ?
13. The distance between two vertical poles is 60 m. The height of one of the poles is double the height of the other. The angles of elevation of the tops of the poles from the middle point of the line segment joining their feet are complementary to each other. Find the heights of the poles.
14. The angles of elevation of a cloud from a point  $h$  metres above a lake is  $30^\circ$  and the angle of depression of its reflection in the lake is  $45^\circ$ . If the height of the cloud be 200 m, find  $h$ .
15. A bird is perched on the top of a tree 20 m high and its angle of elevation from a point on the ground is  $45^\circ$ . The bird flies off horizontally straight away from the observer and in one second the angle of elevation of the bird reduces to  $30^\circ$ . Find the speed of the bird.
16. From the top of a tower, the angles of depression of two objects on the same side of the tower are found to be  $\alpha$  and  $\beta$  ( $\alpha > \beta$ ). If the distance between the objects is  $a$  metres, show that the height of the tower is  $\frac{a \tan \alpha \tan \beta}{\tan \alpha - \tan \beta}$ .
17. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height  $h$ . At a point on the plane, the angles of elevation of the bottom and the top of the flagstaff are  $\alpha$  and  $\beta$  respectively. Prove that the height of the tower is  $\frac{h \tan \alpha}{\tan \beta - \tan \alpha}$ .
18. A tree standing on a horizontal plane is leaning towards east. At two points situated at distance  $a$  and  $b$  exactly due west of it, the angles of elevation of the top are  $\alpha$  and  $\beta$  respectively. Prove that the height of the top of the tree from the ground is  $\frac{(b-a) \tan \alpha \tan \beta}{\tan \alpha - \tan \beta}$ .
19. At a point on a level plane, a tower subtends an angle  $\alpha$  and a man  $a$  metres tall standing on its top subtends an angle  $\beta$ . Prove that the height of the tower is  $\frac{a \sin \alpha \cos(\alpha + \beta)}{\sin \beta}$ .

## B. Questions From CBSE Examination Papers

1. An aeroplane flying horizontally 1 km above the ground is observed at an elevation of  $60^\circ$ . After a flight of 10 seconds, its angle of elevation is observed to be  $30^\circ$  from the same point on the ground. Find the speed of the aeroplane in km/hour. **[2011 (T-II)]**
2. The angle of elevation of the top of a tower from two points P and Q at distance of 4 m and 9 m respectively from the base of the tower and in the same straight line with it are  $60^\circ$  and  $30^\circ$ . Prove that the height of the tower is 6 m. **[2011 (T-II)]**
3. 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  $60^\circ$ . When he moves 30 m away from the bank, he finds the angle of elevation to be  $30^\circ$ . Find the height of the tree and the width of the river. **[2011 (T-II)]**
4. The angle of elevation of a cloud from a point 60 m above the lake is  $30^\circ$  and the angle of depression of its reflection in the lake is  $60^\circ$ . Find the height of the cloud above the lake. **[2011 (T-II)]**
5. A straight highway leads to the foot of tower. A man standing at the top of tower observes a car at an angle of depression  $30^\circ$  which is approaching the foot of the tower with a uniform speed. Six second later, the angle of depression of the car is found to be  $60^\circ$ . Find the time taken by the car to reach the foot of the tower from this point. **[2011 (T-II)]**
6. As observed from the top of a light house, 100 m high above sea-level, the angle of depression of a ship sailing directly towards it, changes from  $30^\circ$  to  $60^\circ$ . Determine the distance travelled by the ship during the period of observation ( $\sqrt{3} = 1.732$ ) **[2011 (T-II)]**
7. A man standing on the deck of the ship which is 10 m above the sea level, observes the angle of elevation of the top of the cloud as  $30^\circ$  and angle of depression of its reflection in the sea was found to be  $60^\circ$ . Find the height of the cloud and also the distance of the cloud from the ship. **[2011 (T-II)]**
8. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height 'h'. At a point on the plane, the angles of elevation of the bottom and the top of the flagstaff are  $45^\circ$  and  $60^\circ$  respectively. Find the height of the tower. **[2011 (T-II)]**
9. From the top of a light house the angle of depression of a ship sailing towards it was found to be  $30^\circ$ . After 10 seconds the angle of depression changes

to  $60^\circ$ . Assuming that the ship is sailing at uniform speed, find how much time it will take to reach the light house. **[2011 (T-II)]**

10. From a point on the ground the angle of elevation of the bottom and the top of a flagstaff situated on the top of a 120 m tall house, was found to be  $30^\circ$  and  $45^\circ$  respectively. Find the height of the flagstaff. **[2011 (T-II)]**
11. A vertical tower is surmounted by a flag staff of height 5 metres. At a point on the ground, the angles of elevation of bottom and top of flag staff are  $45^\circ$  and  $60^\circ$  respectively. Find the height of the tower. **[2011 (T-II)]**
12. A man on the top of a vertical tower observes a car moving towards the tower. If it takes 12 minutes for the angle of depression to change from  $30^\circ$  to  $45^\circ$ , how soon after this the car will reach the tower ? **[2011 (T-II)]**



13. An aeroplane at an altitude of 200 m observes the angles of depression of two opposite points on two banks of the river to be  $45^\circ$  and  $60^\circ$ . Find, in metres, the width of the river. (Use  $\sqrt{3} = 1.732$ ) **[2011 (T-II)]**
14. From a window, 60 m high above the ground, of a house in a street, the angles of elevation and depression of the top and foot of another house on the opposite side of the street are  $60^\circ$  and  $45^\circ$  respectively. Show that the height of the opposite house is  $60(1 + \sqrt{3})$  metres. **[2011 (T-II)]**
15. Two pillars of equal heights are on either side of a road, which is 100 m wide. The angles of elevation of the top of the pillars are  $60^\circ$  and  $30^\circ$  at a point on the road between the pillars. Find the position of the point between the pillars on the road and the height of the pillars. **[2011 (T-II)]**
16. 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  $30^\circ$  and  $60^\circ$  respectively. Find the height of the tower. **[2011 (T-II)]**
17. Find the height of a mountain if the elevation of its top at an unknown distance from the base is  $60^\circ$  and at a distance 10 km further off from the mountain, along the same line, the angle of elevation is  $30^\circ$ . **[2011 (T-II)]**



















































