9. TRIGONOMETRY AND ITS APPLICATIONS

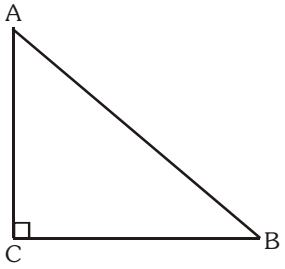
Some Important Formulae and Results of Trigonometry

■ Trigonometric Ratios

$\sin\theta = \frac{P}{H}$ $\quad$ $\text{cosec}\,\theta = \frac{H}{P}$

$\cos\theta = \frac{B}{H}$ $\quad$ $\sec\theta = \frac{H}{B}$

$\tan\theta = \frac{P}{B}$ $\quad$ $\cot\theta = \frac{B}{P}$



$\sin\theta$	$\cos\theta$	$\tan\theta$	
P	B	P	$\Rightarrow$ Pandit Badri Prasad
H	H	B	$\Rightarrow$ Har Har Bole
$\text{cosec}\,\theta$	$\sec\theta$	$\cot\theta$	

P $\rightarrow$ Perpendicular (AC)

B $\rightarrow$ Base (BC)

H $\rightarrow$ Hypotenuse (AB)

Thus, $\boxed{\begin{array}{l}\sin\theta\,\text{cosec}\,\theta = 1\\ \cos\theta\sec\theta = 1\\ \tan\theta\cot\theta = 1\end{array}}$ and $\boxed{\begin{array}{l}\tan\theta = \frac{\sin\theta}{\cos\theta}\\ \cos\theta = \frac{\cos\theta}{\sin\theta}\end{array}}$

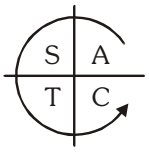
- $(\sin\theta)^{-1}$ is not written as $\sin^{-1}\theta$. Thus $\sin^{-1}\theta \neq (\sin\theta)^{-1}$, etc but $(\sin\theta)^2 = \sin^2\theta$ and $(\sin\theta)^3 = \sin^3\theta$

■ Trigonometric Identities

$\sin^2\theta + \cos^2\theta = 1$	$1 + \tan^2\theta = \sec^2\theta$	$1 + \cot^2\theta = \text{cosec}^2\theta$
$\sin^2\theta = 1 - \cos^2\theta$	$\sec^2\theta - \tan^2\theta = 1$	$\text{cosec}^2\theta - \cot^2\theta = 1$
$\cos^2\theta = 1 - \sin^2\theta$	$\tan^2\theta = \sec^2\theta - 1$	$\cot^2\theta = \text{cosec}^2\theta - 1$

■ Sign of Trigonometric Ratios

sin and cosec +ve	All +ve
tan and cot +ve	cos and sec +ve



A $\rightarrow$ All
S $\rightarrow$ sin/cosec
T $\rightarrow$ tan/cot
C $\rightarrow$ cos/sec

Remember: **A**dd **S**ugar **T**o **C**offee

■ Values of trigonometrical ratios for particular angles

Angle θ / Ratio	0°	30° =π/6	45° =π/4	60° =π/3	90° =π/2	120° =2π/3	135° =3π/4	150° =5π/6	180° =π	270° =3π/2	360° =2π
sin θ	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	–1	0
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{\sqrt{3}}{2}$	–1	0	1
tan θ	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	n.d	$-\sqrt{3}$	–1	$-\frac{1}{\sqrt{3}}$	0	n.d	0
cot θ	n.d	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	$-\frac{1}{\sqrt{3}}$	–1	$-\sqrt{3}$	n.d	0	n.d
sec θ	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	n.d	–2	$-\sqrt{2}$	$-\frac{2}{\sqrt{3}}$	–1	n.d	n.d
cosec θ	n.d	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	n.d	–1	n.d

■ Range of Trigonometric Ratios

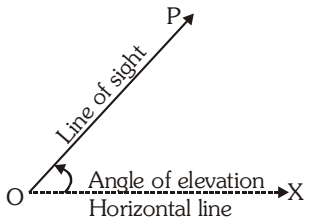
- $-1 \le \sin\theta \le 1 \Rightarrow |\sin\theta| \le 1$
- $-1 \le \cos\theta \le 1 \Rightarrow |\cos\theta| \le 1$
- $\text{cosec}\,\theta \le -1$ and $\text{cosec}\,\theta \ge 1 \Rightarrow |\text{cosec}\,\theta| \ge 1$
- $\sec\theta \le -1$ and $\sec\theta \ge 1 \Rightarrow |\sec\theta| \ge 1$
- $-\infty < \tan\theta < \infty$ i.e., $\tan\theta$ may asume any value

■ Geometrical ratios of negative and associated angles

Angle	$-\theta$	$(90-\theta)$	$(90+\theta)$	$(180-\theta)$	$(180+\theta)$	$(360-\theta)$	$(360+\theta)$
$\sin\theta$	$-\sin\theta$	$\cos\theta$	$\cos\theta$	$\sin\theta$	$-\sin\theta$	$-\sin\theta$	$\sin\theta$
$\cos\theta$	$\cos\theta$	$\sin\theta$	$-\sin\theta$	$-\cos\theta$	$-\cos\theta$	$\cos\theta$	$\cos\theta$
$\tan\theta$	$-\tan\theta$	$\cot\theta$	$-\cot\theta$	$-\tan\theta$	$\tan\theta$	$-\tan\theta$	$\tan\theta$

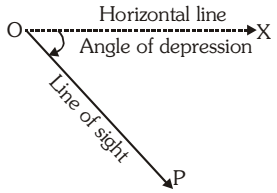
■ Angles of Elevation

The angle between the horizontal line drawn through the observer eye and line joining the eye to any object is called the angle of elevation of the object,



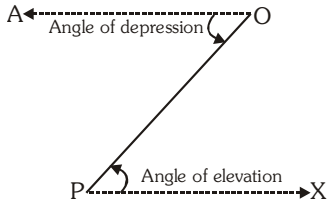
■ Angle of Depression

The angle between the horizontal line drawn through the observer eye and the line joining the eye to any object is called the angle of depression of the object



■ Points to remember

- The angle of elevation as well as angle of depression are measured with reference to horizontal line.
- All objects such as towers, trees, mountains etc. shall be considered as linear for mathematical convenience, throughout this section.
- The height of the observer, is neglected, if it is not given in the problem.
- Angle of depression of P as seen from O is equal to the angle of elevation of O, as seen from P. i.e., $\angle AOP = \angle OPX$.



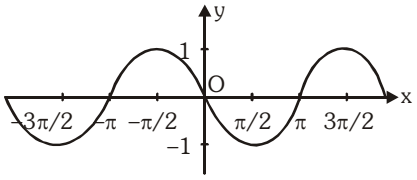
- To find one side of a right angled triangle when another side and an acute angle are given, the hypotenuse also being regarded as a side.

  $\frac{\text{Required side}}{\text{Given side}}$ = a certain T-ratio of the given angle.
- The angle of elevation increases as the object moves towards the right of the line of sight.
- The angle of depression increases as the object moves towards the left of the line of sight.

1. 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°. Find the time taken by the boat to reach the shore.

(1) 6 min. (2) 7 min. (3) 8 min. (4) 9 min.

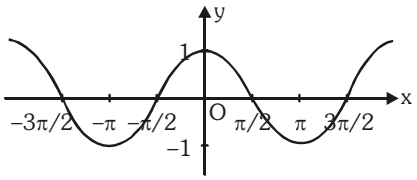
2. Select the equation represented by the graph below.



(1) y = cos x (2) y = sin x

(3) y = tan x (4) y = – sin x

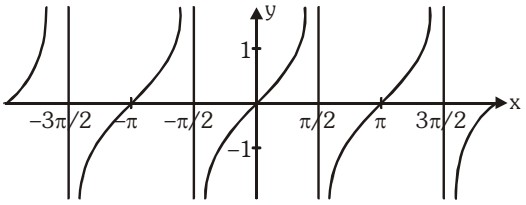
3. Select the equation represented by the graph below.



(1) y = cos x (2) y = sin x

(3) y = tan x (4) y = – sin x

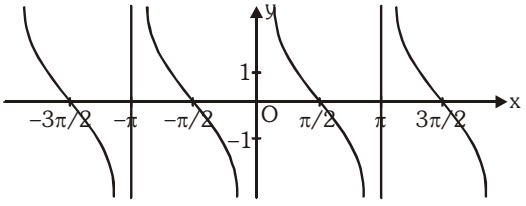
4. Select the equation represented by the graph below.



(1) y = cot x (2) y = – cot x

(3) y = tan x (4) y = – tan x

5. Select the equation represented by the graph below



(1) y = – tan x (2) y = sec x

(3) y = 2 sin x (4) y = cot x

6. The value of $\frac{\tan^3\theta}{1+\tan^2\theta}+\frac{\cot^3\theta}{1+\cot^2\theta}=$

(1) $\frac{1-\sin^2\theta\cos^2\theta}{2\sin\theta\cos\theta}$ (2) $\frac{1+2\sin^2\theta\cos^2\theta}{\sin\theta\cos\theta}$

(3) $\frac{1-2\sin^2\theta\cos^2\theta}{\sin\theta\cos\theta}$ (4) $\frac{2\sin^2\theta\cos^2\theta}{1-\sin\theta\cos\theta}$

7. The value of tan 1° tan 2° tan 3° ... tan 89° is

(1) 0 (2) 1 (3) – 1 (4) 2

8. If x tan 45° sin 30° = cos 30° tan 30°, then x is equal to

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

(3) $\frac{1}{\sqrt{2}}$ (4) 1

9. If x and y are complementary angles, then

(1) sin x = sin y (2) tan x = tan y

(3) cos x = cos y (4) sec x = cosec y

10. If A, B and C are interior angles of a ΔABC, then $\cos\left(\frac{B+C}{2}\right)$ is equal to

(1) $\sin\frac{A}{2}$ (2) $-\sin\frac{A}{2}$

(3) $\cos\frac{A}{2}$ (4) $-\cos\frac{A}{2}$

11. If cot θ + cos θ = p and cot θ – cos θ = q, then the value of $p^2 - q^2$ is :

(1) $2\sqrt{pq}$ (2) $4\sqrt{pq}$ (3) 2pq (4) 4pq

12. If sec A + tan A = x, then sec A =

(1) $\frac{x^2-1}{x}$ (2) $\frac{x^2-1}{2x}$

(3) $\frac{x^2+1}{x}$ (4) $\frac{x^2+1}{2x}$

13. The value of $5\tan^2 A - 5\sec^2 A + 1$ is equal to

(1) 6 (2) –5

(3) 1 (4) – 4

14. If x = a cos θ and y = b sin θ, then $b^2x^2 + a^2y^2$ =

(1) ab (2) b^2+a^2

(3) a^2b^2 (4) a^4b^4

15. Given that $\sin A = \frac{\sqrt{3}}{2}$ and $\cos B = \frac{\sqrt{3}}{2}$, then $\tan (A + B) =$

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

(3) $\sqrt{3}$ (4) Not defined

16. If $\cos\theta - \sin\theta = \sqrt{2}\sin\theta$, then $\cos\theta + \sin\theta$

(1) $\sqrt{2}\sin\theta$ (2) $\sqrt{2}\cos\theta$

(3) $2\cos\theta$ (4) $2\sin\theta$

17. If $x\sin^3\theta + y\cos^3\theta = \sin\theta\cos\theta$ and $x\sin\theta - y\cos\theta = 0$. Then $x^2 + y^2 =$

(1) 0 (2) 1 (3) 2 (4) 3

18. If $\sin A - \cos A = 0$, then the value of $\sin^4 A + \cos^4 A$ is

(1) 2 (2) 1 (3) 3/4 (4) 1/2

19. The shadow of a flagstaff is three times as long as the shadow of the flagstaff when the sunrays meet the ground at an angle of 60°. find the angle between the sunrays and the ground at the time of long shadow.

(1) 60° (2) 90° (3) 45° (4) 30°

20. A boy standing on the ground and flying a kite with 75 m of string at an elevation of 45°. Another boy is standing on the roof of 25 m high building and is flying his kite at an elevation of 30°. Both the boys are on the opposite side of the two kites. Find the length of the string that the second boy must have, so that the kites meet.

(1) 43.05 m (2) 34.05 m

(3) 45.05 m (4) 56.05 m

21. If $\frac{\sin A}{\sin B} = p$ and $\frac{\cos A}{\cos B} = q$, then $\tan B$ is equal to

(1) $\pm\frac{p}{q}\sqrt{\frac{q^2-1}{1-p^2}}$ (2) $\pm\sqrt{\frac{q^2-1}{1-p^2}}$

(3) $\pm\frac{p}{q}\sqrt{\frac{p^2-1}{1-q^2}}$ (4) None of these

22. If $T_n = \sin^n\theta + \cos^n\theta$, then $2T_6 - 3T_4 + 1$ is equal to

(1) 0 (2) $\sin\theta$

(3) $\cos\theta$ (4) $2\sin\theta\cos\theta$

23. If $T_n = \sin^n\theta + \cos^n\theta$, then $6T_{10} - 15T_8 + 10T_6 - 1$ is equal to

(1) 0 (2) 1 (3) $\sin^2\theta$ (4) $\sin^3\theta$

24. If $\sin\theta$ and $\cos\theta$ are the roots of $ax^2 + bx + c = 0$ $(ac \neq 0)$, then

(1) $a^2 + b^2 - 2ac = 0$ (2) $a^2 - b^2 + 2ac = 0$

(3) $(a + c)^2 = b^2 + c^2$ (4) None of these

25. A flagstaff 5 m high stands on a building 25 m high. At an observer at a height of 30 m, the flagstaff and the building subted equal angles. The distance of the observe from the top of the flagstaff is :-

(1) $\frac{5\sqrt{3}}{2}$ (2) $5\sqrt{\frac{3}{2}}$

(3) $5\sqrt{\frac{2}{3}}$ (4) None

26. In an equilateral triangle the inradius r and circumradius R are connected by

(1) $r = \frac{R}{3}$ (2) $r = \frac{R}{2}$

(3) $r = 4R$ (4) None

27. The perimeter of a triangle ABC is 6 times the A.M. of the sines of its angles. If a = 1, the angle A (acute) is

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{6}$

28. The angle of elevation of the top of two vertical towers as seen from the middle point of the line joining the feet of the towers are 60° and 30° respectively. The ratio of heights of the towers is :-

(1) 2 : 1 (2) $\sqrt{3}$: 1

(3) 3 : 2 (4) 3 : 1

29. A tower of height h standing at the centre of a square with sides of length a makes the same angle α at each of the four corners. Then $\frac{a^2}{h^2\cot^2\alpha}$ is :-

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

(3) 2 (4) 4

30. A river flows due North, and a tower stands on its left bank. From a point A upstream and on the same bank as the tower, the elevation of the tower is 60° and from a point B just opposite A on the other bank the elevation is 45°. If the tower is 360 m high, the breadth of the river is :-

(1) $120\sqrt{6}$ m (2) $\frac{240}{\sqrt{3}}$ m

(3) $240\sqrt{3}$ m (4) $240\sqrt{6}$ m

31. A tower subtends an angle of 30° at a point on the same level as the foot of tower. At a second point h m high above the first, the depression of the foot of tower is 60°. The horizontal distance of the tower from the point is:-

(1) $\frac{h}{\sqrt{3}}$ (2) $\frac{h\cot 60°}{\sqrt{3}}$

(3) $\frac{h\cot 60°}{3}$ (4) h cot 30°

32. The angle of elevation of a cloud at a height h above the level of water in a lake is α and the angle of depression of its image in the lake is β. The height of the cloud above the surface of the lake is equal to

(1) $\frac{h(\tan\beta + \tan\alpha)}{(\tan\beta - \tan\alpha)}$ (2) $\frac{h\cos(\alpha + \beta)}{\sin(\beta - \alpha)}$

(3) $\frac{h(\cot\alpha + \cot\beta)}{\cos\alpha - \cos\beta}$ (4) h

33. A balloon of radius r subtends an angle α at the eye of an observer and the elevation of the centre of the balloon from the eye is β, the height h of the centre of the balloon is given by :-

(1) $\frac{r\sin\beta}{\sin\alpha}$ (2) r sin β sin α

(3) $\frac{r\sin\beta}{\sin(\alpha/2)}$ (4) $\frac{r\sin\alpha}{\sin(\beta/2)}$

34. A man observes that when he moves up a distance c metres on a slope, the angle of depression of a point on the horizontal plane from the base of the slope is 30°, and when he moves up further a distance c metres, the angle of depression of that point is 45°. The angle of inclination of the slope with the horizontal is :-

(1) 60° (2) 45° (3) 75° (4) 30°

35. The angle of elevation of the top of a tower from a point A due south of the tower is α and from a point B due east of the tower is β. If AB = d, then the height of the tower is :-

(1) $\frac{d}{\sqrt{\tan^2\alpha - \tan^2\beta}}$ (2) $\frac{d}{\sqrt{\tan^2\alpha + \tan^2\beta}}$

(3) $\frac{d}{\sqrt{\cot^2\alpha + \cot^2\beta}}$ (4) $\frac{d}{\sqrt{\cot^2\alpha - \cot^2\beta}}$

36. AB is vertical tower. The point A is on the ground and C is the middle point of AB. The part CB subtend an angle α at a point P on the ground. If AP = nAB, then tan α =

(1) $n(n^2 + 1)$ (2) $\frac{n}{2n^2 - 1}$

(3) $\frac{n^2}{2n^2 + 1}$ (4) $\frac{n}{2n^2 + 1}$

37. The top of a hill observed from the top and bottom of a building of height h is at angles of elevation p and q respectively. The height of hill is :-

(1) $\frac{h\cot p}{\cot q - \cot p}$ (2) $\frac{h\cot p}{\cot p - \cot q}$

(3) $\frac{h\tan p}{\tan p - \tan q}$ (4) $\frac{h\tan p}{\tan q - \tan p}$

38. A man standing on a level plane observes the elevation of the top of a pole to be α. He then walks a distance equal to double the height of the pole and finds that the elevation is now 2α. Then α =

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{4}$

(3) $\frac{\pi}{12}$ (4) $\frac{\pi}{8}$

39. The angle of elevation of a cloud from a point x m above a take is θ and the angle of depression of its reflection in the take is 45°. The height of the cloud is

(1) x tan (45° – θ) (2) x tan (45° + θ)

(3) $\frac{1}{x}$ cot (45° – θ) (4) $\frac{1}{x}$ cot (45° + θ)

40. Two poles of height a and b stand at the centres of two circular plots which touch each other externally at a point and the two poles subtend angles of 30° and 60° respectively at this point, then distance between the centres of these plots is :-

(1) a + b (2) $\frac{(3a + b)}{\sqrt{3}}$ (3) $\frac{a + 3b}{\sqrt{3}}$ (4) $a\sqrt{3} + b$

41. From a point on the horizontal plane, the elevation of the top of a hill is 45°. After walking 500 m towards its summit up a slope inclined at an angle of 15° to the horizon the elevation is 75°, the height of the hill is :-

(1) $500\sqrt{6}$ m (2) $500\sqrt{3}$ m

(3) $250\sqrt{6}$ m (4) $250\sqrt{3}$ m

42. If $x = a\,\text{cosec}^n\theta$ and $y = b\cot^n\theta$, then by eliminating θ

(1) $(x/a)^{2/n} + (y/b)^{2/n} = 1$

(2) $(x/a)^{2/n} - (y/b)^{2/n} = 1$

(3) $(x/a)^2 - (y/b)^2 = 1$

(4) $(x/a)^{1/n} - (y/b)^{1/n} = 1$

43. Find the value of $\dfrac{1}{(1+\tan^2\theta)} + \dfrac{1}{(1+\cot^2\theta)}$

(1) 1/2 (2) 2

(3) 1 (4) 1/4

44. If $\tan\theta = p/q$, then $\dfrac{p\sin\theta - q\cos\theta}{p\sin\theta + q\cos\theta} =$

(1) $(p^2 + q^2)/(p^2 - q^2)$ (2) $(p^2 - q^2)/(p^2 + q^2)$

(3) $(p^2 + q^2)/(p^2 - q^2)$ (4) None of these

45. If $\tan A + \sin A = m$ and $\tan A - \sin A = n$, then

$\dfrac{(m^2 - n^2)^2}{mn} =$

(1) 4 (2) 3

(3) 16 (4) 9

46. If $\text{cosec}\,\theta - \sin\theta = m$ and $\sec\theta - \cos\theta = n$ then $(m^2n)^{2/3} + (mn^2)^{2/3} =$

(1) –1 (2) 1

(3) 0 (4) None of these

47. If $7\sin^2\theta + 3\cos^2\theta = 4$, then $\tan\theta =$

(1) $\pm\dfrac{1}{3}$ (2) $\pm\dfrac{1}{2}$

(3) $\pm\dfrac{1}{\sqrt{3}}$ (4) $\pm\dfrac{1}{\sqrt{2}}$

48. The value of $\dfrac{\sin^3 A + \cos^3 A}{\sin A + \cos A} + \dfrac{\cos^3 A - \sin^3 A}{\cos A - \sin A}$ is

(1) 0 (2) 1

(3) 2 (4) None of these

49. $\dfrac{\cot\theta - \text{cosec}\,\theta + 1}{\cot\theta + \text{cosec}\,\theta - 1}$ is equal to

(1) 1 (2) $\cot\theta + \text{cosec}\,\theta$

(3) $\text{cosec}\,\theta - \cot\theta$ (4) None of these

50. One side of a parallelogram is 12 cm and its area is 60 cm^2. If the angle between the adjacent sides is 30°, then its other side is

(1) 10 cm (2) 8 cm

(3) 6 cm (4) 4 cm

51. A flagstaff stands vertically on a pillar, the height of the flagstaff being double the height of the pillar. A man on the ground at a distance finds that both the pillar and the flagstaff subtend equal angles at his eyes. The ratio of the height of the pillar and the distance of the man from the pillar is

(1) 1 : 3 (2) $3 : \sqrt{1}$

(3) $1 : \sqrt{3}$ (4) $\sqrt{3} : 2$

52. The distance between two multistoried buildings is 60 m. The angle of depression of the top of the first building as seen from the top of the second building which is 150 m high is 30°. The heigth of the first building is

(1) $(150 + 20\sqrt{3})$ m (2) $(150 - 20\sqrt{3})$ m

(3) $(150 + 10\sqrt{3})$ m (4) $(15 - 10\sqrt{3})$ m

53. An aeroplane flying horizontally 1 km above the ground is observed at an elevation of 60°. If after 10 s the elevation be 30°, the uniform speed of the aeroplane is

(1) $240\sqrt{3}$ km/hrs (2) $240/\sqrt{3}$ km/hrs

(3) $120/\sqrt{3}$ km/hrs (4) $120/\sqrt{3}$ km/hrs

54. A balloon leaves the earth at point A and rises at a uniform velocity. At the end of $1\dfrac{1}{2}$ min, an observer situated at a distance of 200 m from A finds the angular elevation of the balloon to be 60°. The speed of the balloon is

(1) 5.87 m/s (2) 4.87 m/s

(3) 3.87 m/s (4) 6.87 m/s

55. At the foot of a mountain, the elevation of its summit is 45°. After ascending one kilometer the mountain upon and incline of 30°, the elevation changes to 60°. The height of the mountain is

(1) 1.366 km (2) 1.266 km

(3) 1.166 km (4) 1.466 km

56. If $x = r\cos\alpha, \cos\beta$, $y = r\cos\alpha\sin\beta$ and $z = r\sin\alpha$ then $x^2 + y^2 + z^2$ is equal to

(1) r^2 (2) r^4

(3) 1 (4) None of these

57. From the top of a light house, the angles of depression of two stations on opposite sides of it at distance 'a' apart are α and β. The height of the light house is

(1) $\frac{a}{\cot\alpha\cot\beta}$ (2) $\frac{a}{\cot\alpha+\cot\beta}$

(3) $\frac{a\cot\alpha\cot\beta}{\cot\alpha+\cot\beta}$ (4) $\frac{a\tan\alpha\cot\beta}{\cot\alpha+\cot\beta}$

58. If the angle of elevation of an object from a point 100 m above a lake is found to be 30° and the angle of depression of its image in lake is 45°, then the height of the object above the lake is

(1) $100(2-\sqrt{3})$m (2) $100(2+\sqrt{3})$m

(3) $100(\sqrt{3}-1)$m (4) $1000(\sqrt{3}+1)$m

59. A person standing on the bank of a river observes that the angles subtended by a tree on the opposite bank is 60°. When he retires 40 m from the bank, he finds the angle to be 30°. The breadth of the river is

(1) 40 m (2) 60 m

(3) 20 m (4) 30 m

60. 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 of the river is 60° and when he retires 40 m away from the tree, the angle of elevation becomes 30°. The breadth of the river is

(1) 40 m (2) 20 m

(3) 30 (4) 60 m

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Ans.	4	4	1	3	4	3	2	4	4	1	2	4	4	3	4	2	2	4	4	
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	2	1	1	2,3	2	2	4	4	3	1	1	1	3	3	3	4	4	3	2	
Que.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	3	2	3	2	3	2	3	3	3	1	3	2	1	3	1	1	2	2	3	