



## MATHS

### BOOKS - CENGAGE

# GRAPHS OF TRIGONOMETRIC FUNCTIONS

## Illustrations

1. Plot  $y = \sin x$  and  $y = \sin 2x$ .



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2. Plot  $y = \sin x$  and  $y = \frac{\sin x}{2}$



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3. Draw the graph of  $y = \tan(3x)$ .



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4. Draw the graph of  $y = \sec^2 x - \tan^2 x$ . Is  $f(x)$  periodic? If yes, what is its fundamental period?



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5. Draw the graph of  $y = \frac{\tan x}{\tan x}$ . Is  $f(x)$  periodic? If

yes, what is its fundamental period?



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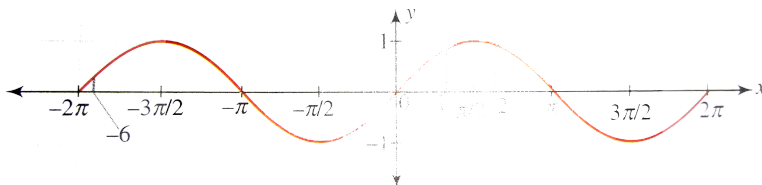
6. Which of the following is highest?

(a) cosec 1

(b) cosec 2

(c) cosec 4

(d) cosec (-6)



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7. Draw the graph of  $y = \cos \pi x$ .



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8. Find the number of solution to the equation  $x^2 \tan x = 1, x \in [0, 2\pi]$ .



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9. Solve  $\tan x > \cot x$ , where  $x \in [0, 2\pi]$ .



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**10.** Let  $f(x) = x \sin \pi x$ ,  $x > 0$ . Then for all natural numbers  $n$ ,  $f'(x)$  vanishes at a unique point in the interval  $\left(n, n + \frac{1}{2}\right)$  a unique point in the interval  $\left(n + \frac{1}{2}, n + 1\right)$  a unique point in the interval  $(n, n + 1)$  two points in the interval  $(n, n + 1)$



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**11.** If  $0 < \alpha < \frac{\pi}{3}$ , then prove that  $\alpha(\sec \alpha) < \frac{2\pi}{3}$ .



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12. Draw the graph and discuss the continuity of

$$f(x) = [\sin x + \cos x], x \in [0, 2\pi], \quad \text{where } [.]$$

represents the greatest integer function.



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13. Draw the graph of  $y = [\cos x], x \in [0, 2\pi]$ , where

$[\cdot]$  represents the greatest integer function.



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14. Draw the graph of  $f(x) = e^{\sin x}$ .



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15. Draw the graph of  $y = \sin 2^x$ .



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16. Draw the graph of  $y = (\sin 2x) \sqrt{1 + \tan^2 x}$ , find its domain and range.



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17. Draw the graph  $y = \sin^2 x$ .



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18. Draw the graph of  $y = \sin^3 x$ .



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19. Find the range of

$$f(x) = |\sin x| + |\cos x|, x \in \mathbb{R}.$$



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20. Draw the graph of  $f(x) = \sqrt{\sin x}$ .



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21. Draw the graph of  $y = \frac{\cos\left(|x| + \frac{\pi}{2}\right)}{\sin x}$ . Is the function periodic?



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22. Draw the graph of  $f(x) = \cos \pi[x]$ , where  $[\cdot]$  represents the greatest integer function. Find the period of the function.



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23. Draw the graph of

$$f(x) = \sec x + \operatorname{cosec} x, x \in (0, 2\pi) - \{\pi/2, \pi, 3\pi/2\}$$

Also find the values of 'a' for which the equation  $\sec x + \operatorname{cosec} x = a$  has two distinct root and four distinct roots.

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24. if:  $f(x) = \frac{\sin x}{\sqrt{1 + \tan^2 x}} - \frac{\cos x}{\sqrt{1 + \cot^2 x}}$ , then

find the range of  $f(x)$

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**25.** Find the area bounded by the following curve :

(i)  $f(x) = \sin x, g(x) = \sin^2 x, 0 \leq x \leq 2\pi$

(ii)  $f(x) = \sin x, g(x) = \sin^4 x, 0 \leq x \leq 2\pi$



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**26.** Write the equivalent (piecewise) definition of

$$f(x) = \operatorname{sgn}(\sin x).$$



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**27.** Find the range of  $f(x) = [\sin\{x\}]$ , where  $\{ \}$  represents the fractional part function and  $[ \ ]$

represents the greatest integer function.

A.  $-1$

B.  $0$

C.  $1$

D.  $0.5$



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**28.** Draw a graph of  $f(x) = \sin\{x\}$ , where  $\{x\}$  represents the greatest integer function.



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**29.** Draw the graph of

$f(x)$  maximum  $\{2 \sin x, 1 - \cos x\}, x \in (0, \pi)$ .

Also find the range of

$g(x)$  min  $\{2 \sin x, 1 - \cos x\}, x \in (0, \pi)$



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**30.** Draw the graph of  $y = \log_e(\sin x)$ .



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**31.** Draw the graph of  $[y] = \sin x, x \in [0, 2\pi]$  where

$[\cdot]$  denotes the greatest integer function



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32. Draw the graph of  $y = x \sin x$ .



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33. Draw the graph of  $y = e^x \sin 2\pi x$ .



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34. Let  $[x]$  denotes the greatest integer less than or equal to  $x$ . If  $f(x) = [x \sin \pi x]$ , then  $f(x)$  is



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35. Evaluate :  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$

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36. Discuss maxima/minima of

$$f(x) = \frac{x}{1 + x \tan x}, x \in \left(0, \frac{\pi}{2}\right)$$

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37. Find the values of  $a$  if equation

$$1 - \cos x = \frac{\sqrt{3}}{2} |x| x a, x \in (0, \pi), \text{ has exactly one}$$

solution.

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**38.** Find the number of solutions of the equation

$$\sin x = x^2 + x + 1.$$

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**39.** Prove that

$$\sin x + 2x \geq \frac{3x(x+1)}{\pi}, \quad \forall x \in \left[0, \frac{\pi}{2}\right] \text{ (Justify the$$

inequality, if any used).

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**40.** Find the ratio of the areas of two regions of the curve  $C_1 \equiv 4x^2 + \pi^2 y^2 = 4\pi^2$  divided by the curve  $C_2 \equiv y = -\left(\operatorname{sgn}\left(x - \frac{\pi}{2}\right)\right)\cos x$  (where  $\operatorname{sgn}(x) = \operatorname{signum}(x)$ ).



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**41.** Solve  $\tan x < 2$ .



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42. Solve  $\sin x > \frac{1}{2}$  or find the domain of

$$f(x) = \frac{1}{\sqrt{1 + 2 \sin x}}$$



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43. Solve :  $2 \cos^2 \theta + \sin \theta \leq 2$ , where

$$\pi/2 \leq \theta \leq 3\pi/2.$$



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44. Solve  $\sin \theta + \sqrt{3} \cos \theta \geq 1, \pi$



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45. Let  $f(x) = \begin{cases} x^2 + 3x, & -1 \leq x < 0 \\ -\sin x, & 0 \leq x < \pi/2 \\ -1 - \cos x, & \frac{\pi}{2} \leq x \leq \pi \end{cases}$ .

Draw the graph of the function and find the following

(a) Range of the function

(b) Point of inflection

(c) Point of local minima

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46. Evaluate  $\int_0^2 x(2-x)^3 dx$

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## Exercise

1. Draw the graph of  $y = \operatorname{cosec}^2 x - \cot^2 x$ . Is  $f(x)$  periodic? If yes, what is its fundamental period?



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2. Draw the graph of  $y = \cos \pi x$ .



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3. Draw the graph of  $y = \cos^2 x$ .



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4. Find the value of  $x$  for which

$f(x) = \sqrt{\sin x - \cos x}$  is defined,  $x \in [0, 2\pi)$ .

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5. Draw the graph of  $y = \tan^2 x$ .

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6. Draw the graph of  $y = \sin x + \cos x$ ,  $x \in [0, 2\pi]$ .

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7. Draw the graph of  $y = [\cos x]$ ,  $x \in [0, 2\pi]$ , where  $[\cdot]$  represents the greatest integer function.



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8. Draw the graph of  $y = \sin \pi \sqrt{x}$ .



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9. The number of roots of the equation  $x \sin x = 1$ ,  $x \in [-2\pi, 0) \cup (0, 2\pi)$  is 2 (b) 3 (c) 4 (d) 0



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10. Evaluate :  $\left[ \lim_{x \rightarrow 0} \frac{\tan x}{x} \right]$ , where  $[\cdot]$  represents the greatest integer function.



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11. For  $f(x) = \sin x - x^2 + 1$ , check whether the function is increasing, decreasing or has a point of extremum ?



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12. Draw the graph of the function  $f(x) = \max(\sin x, \cos 2x)$ ,  $x \in [0, 2\pi]$ . Write the equivalent definition of  $f(x)$  and find the range of the function.

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13. Draw the graph of  $y = \cos x$ ,  $x \in [0, 2\pi]$ , where  $[\cdot]$  denotes the greatest integer function.

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14. The total number of solution of  $\sin\{x\} = \cos\{x\}$  (where  $\{ \}$  denotes the fractional part) in  $[0, 2\pi]$  is equal to 5 (b) 6 (c) 8 (d) none of these



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15. Draw the graph of  $f(x) = |\tan x| + |\cot x|$ .



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16. Find the number of solutions to

$$\cos x = \frac{x}{10}, x > 0.$$



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17. The number of solutions of  $\tan x - mx = 0, m > 1$ , in  $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$  is 1 (b) 2 (c) 3 (d)  $m$

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18. Find the number of solutions to  $\log_e |\sin x| = -x^2 + 2x$  in  $\left[-\frac{\pi}{2}, \frac{3\pi}{2}\right]$ .

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19. Solve  $\cos x = \frac{1}{2}$ .

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20. Prove that the least positive value of  $x$ , satisfying  $\tan x = x + 1$ , lies in the interval  $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

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21. Draw the graph of  $y = \frac{x^2}{10} \sin x$ .

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22. Draw the graph of  $y = \frac{\sin x}{x}$ .



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