



## MATHS

### BOOKS - CBSE COMPLEMENTARY MATERIAL MATHS (HINGLISH)

#### CONTINUITY AND DIFFERENTIABILITY

##### 1 Marks Questions

1. Let  $f(x) = \sin x \cos x$ . Write down the set of points of discontinuity of  $f(x)$ .



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2. Given  $f(x) = \frac{1}{x+2}$ , write down the set of points of discontinuity of  $f(x)$ .



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3. Write the set of points of continuity of  $f(x) = |x - 1| + |x + 1|$

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4. Write the number of points of discontinuity of  $f(x) = [x]$  in  $[3, 7]$ .

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5. If  $y = e^{\log(x^5)}$ , find  $\frac{dy}{dx}$ .

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6. If  $f(x) = x^2g(x)$  and  $g(1) = 6$ ,  $g'(1) = 3$ , find the value of  $f'(1)$ .

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7. If  $y = a \sin t$ ,  $x = a \cos t$  then find  $\frac{dy}{dx}$ .



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8. The value of  $f(0)$  so that  $f(x) = \frac{(-e^x + 2^x)}{x}$  may be continuous at  $x = 0$  is



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9. Find the values of  $x$  for which  $f(x) = \frac{x^2 + 7}{x^3 + 3x^2 - x - 3}$  is discontinuous.



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10. If  $y = \tan^{-1} x + \cot^{-1} x + \sec^{-1} x + \operatorname{cosec}^{-1} x$ . then  $\frac{dy}{dx}$  is equal to

A.  $\pi$

B. 0

C. 1

D.  $\frac{x^2 - 1}{x^2 + 1}$

**Answer: B**



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11. If  $y = \log_e e^{\sin x^2}$ , find  $\frac{dy}{dx}$



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12. If  $y = \log_a x + \log_x a + \log_x x + \log_a a$ , then  $\frac{dy}{dx}$  is equal to

A.  $\frac{1}{x} + x \log a$

B.  $\frac{1}{x \log a} + x \log a$

C.  $\frac{\log a}{x} + \frac{x}{\log a}$

D. None of these

Answer: D

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13. If  $y = 5^x x^5$ , then  $\frac{dy}{dx}$  is

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14. Find the differential coefficient of  $\sin^{-1}(2x\sqrt{1-x^2})$  w. r. t.  $\sin^{-1}(3x - 4x^3)$ .

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15. If  $y = \sqrt{\sin x + \sqrt{\sin x} \sqrt{\sin x + \dots \dots \dots \infty}}$ , then  $(2y - 1) \frac{dy}{dx}$  is equal to

A.  $\sin x$

B.  $-\sin x$

C.  $\cos x$

D.  $-\cos x$

**Answer: C**



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## 2 Marks Questions

1. Differentiate  $\sin(x^2)$  w. r. t.  $e^{\sin x}$



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2.  $y = x^y$  then find  $\frac{dy}{dx}$



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3. If  $y = x^x + x^3 + 3^x + 3^3$ , find  $\frac{dy}{dx}$



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4. If  $y = 2 \sin^{-1}(\cos x) + 5 \operatorname{cosec}^{-1}(\sec x)$ . Find  $\frac{dy}{dx}$ .



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5. If  $y = e^{[\log(x+1) - \log x]}$ . Find  $\frac{dy}{dx}$



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6. Differentiate  $\sin^{-1}[x\sqrt{x}]$  w.r.t.x.



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7. Find the derivative of  $|x^2 + 2|$  w.r.t.x.



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8. Find the domain of continuity of  $f(x) = \sin^{-1} x - [x]$ ,  $[\ ]$  represents greatest integer function .

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9. Find the derivative of  $\cos(\sin x^2)$  w.r.t.x. at  $x = \sqrt{\frac{\pi}{2}}$ .

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10. If  $y = e^{3 \log x + 2x}$ , Prove that  $\frac{dy}{dx} = x^2(2x + 3)e^{2x}$ .

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11. Differentiate  $\sin^2(\theta^2 + 1)$  w. r. t.  $\theta^2$ .

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12. Find  $\frac{dy}{dx}$  if  $y = \sin^{-1}\left(\frac{\sqrt{x}-1}{\sqrt{x}+1}\right) + \sec^{-1}\left(\frac{\sqrt{x}+1}{\sqrt{x}-1}\right)$

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13. If  $x^2 + y^2 = 1$  verify that  $\frac{dy}{dx} \cdot \frac{dx}{dy} = 1$

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14. Find  $\frac{dy}{dx}$  when  $y = 10^{x^{10^x}}$ .

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15. If  $y = x^x$ , find  $\frac{d^2y}{dx^2}$ .

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16. Find  $\frac{dy}{dx}$  if  $y = \cos^{-1}(\sin x)$

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17. If  
 $f(x) = x + 7$ , and  $g(x) = x - 7$ ,  $x \in R$  then find  $\frac{d}{dx}(f \circ g)(x)$ .

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18. Differentiate  $\log(7 \log x)$  w.r.t.  $x$

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19. If  $y = f(x^2)$  and  $f'(x) = \sin x^2$ . Find  $\frac{dy}{dx}$

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20. Find  $\frac{dy}{dx}$  if  $y = \sqrt{\sin^{-1} \sqrt{x}}$ .



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## 4 Marks Questions

1. Examine the continuity of the following function at the indicated points.

$$f(x) = \begin{cases} x^2 \cos\left(\frac{1}{x}\right) & x \neq 0 \\ 0 & x = 0 \end{cases} \quad \text{at } x=0$$



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2. Examine the continuity of the following function at the indicated points.

$$f(x) = \begin{cases} x - [x] & x \neq 1 \\ 0 & x = 1 \end{cases} \quad \text{at } x=1$$



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3. Examine the continuity of the following function at the indicated points.

$$f(x) = \begin{cases} \frac{e^{\frac{1}{x}} - 1}{e^{\frac{1}{x}} + 1} & x \neq 0 \\ 0 & x = 0 \end{cases} \quad \text{at } x=0$$

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4. Examine the continuity of the following function at the indicated points.

$$f(x) = \begin{cases} \frac{x - \cos(\sin^{-1} x)}{1 - \tan(\sin^{-1} x)} & x \neq \frac{1}{2} \\ \frac{-1}{\sqrt{2}} & x = \frac{1}{\sqrt{2}} \end{cases}$$

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5. Given that  $f(x) = \begin{cases} \frac{\sqrt{1+kx} - \sqrt{1-kx}}{x} & \text{if } -1 \leq x < 0 \\ \frac{2x+1}{x-1} & \text{if } 0 \leq x \leq 1 \end{cases}$  is continuous at  $x = 0$ . Find  $k$

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6. For what values of constant K, the following functions are continuous the indicated points.

$$f(x) = \begin{cases} (e^x - 1) & x \neq 0 \\ K & x = 0 \end{cases} \quad \text{at } x=0$$

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7. For what values of constant K, the following functions are continuous the indicated points.

$$f(x) = \begin{cases} \frac{1 - \cos 4x}{x^2} & x < 0 \\ K & x = 0 \\ \sqrt{x} + 8 & x > 0 \end{cases} \quad \text{at } x=0$$

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8. For what values a and b  $f(x) = \begin{cases} \frac{x+2}{|x+2|} + a & \text{if } x < -2 \\ a + b & \text{if } x = -2 \\ \frac{x+2}{|x+2|} + 2b & \text{if } x > -2 \end{cases}$  is

continuous at  $x=-2$

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9. Determine the values of  $a, b, c$  for which the function

$$f(x) = \begin{cases} \frac{\sin(a+1)x + \sin x}{x}, & f \text{ or } x < 0 \\ c, & f \text{ or } x = 0 \\ \frac{\sqrt{x+bx^2}}{bx^{3/2}}, & f \text{ or } x > 0 \end{cases}$$

is continuous at  $x = 0$

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$$10. f(x) = \begin{cases} [x] + [-x] & x \neq 0 \\ \lambda & x = 0 \end{cases}$$

Find the value of  $\lambda$ ,  $f$  is continuous at  $x=0$ ?

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$$11. \text{ Let } f(x) = \begin{cases} \frac{1 - \sin^3 x}{3 \cos^2 x} & \text{if } x < \frac{\pi}{2} \\ a & \text{if } x = \frac{\pi}{2} \\ \frac{b(1 - \sin x)}{(\pi - 2x)^2} & \text{if } x > \frac{\pi}{2} \end{cases},$$

if  $f(x)$  is continuous at  $x = \frac{\pi}{2}$ , find  $a$  and  $b$ .

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12. If  $f(x) = \begin{cases} x^2 + 3x + a, & x \leq 1 \\ bx + 2, & x > 1 \end{cases}$  is everywhere differentiable, find the values of  $a$  and  $b$ .

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13. Find the relationship between  $a$  and  $b$  so that the function defined by

$$f(x) = \begin{cases} ax + 1 & x \leq 3 \\ bx + 3 & x > 3 \end{cases} \text{ is continuous at } x=3$$

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14. Differentiate  $\tan^{-1}\left(\frac{\sqrt{1-x^2}}{x}\right)$  w.r.t.  $\cos^{-1}(2x\sqrt{1-x^2})$ , when  $x \neq 0$ .

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15. If  $y = x^{x^x}$ , then find  $\frac{dy}{dx}$ .

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16. Differentiate  $(x \cos x)^x + (x \sin x)^{\frac{1}{x}}$  w.r.t.x.



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17. If  $x^m y^n = (x + y)^{m+n}$ , prove that  $\frac{dy}{dx} = \frac{y}{x}$ .



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18. If  $(x - y) \frac{x - y}{x} = a$ , Prove that  $y \frac{dy}{dx} + x = 2y$ .



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19. If  $x = \tan\left(\frac{1}{a} \log y\right)$ , show that  $(1 + x^2) \frac{d^2 y}{dx^2} + (2x - a) \frac{dy}{dx} = 0$ .



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20. If  $y = x \log \left\{ \frac{x}{(a + bx)} \right\}$ , then show that  $x^3 \frac{d^2y}{dx^2} = \left( x \frac{dy}{dx} - y \right)^2$ .

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21. Differentiate  $\sin^{-1} \left\{ \frac{2^{x+1} \cdot 3^x}{1 + (36)^x} \right\}$  with respect to  $x$ .

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22. If  $\sqrt{1 - x^6} + \sqrt{1 - y^6} = a(x^3 - y^3)$ , then prove that

$$\frac{dy}{dx} = \frac{x^2}{y^2} \sqrt{\frac{1 - y^6}{1 - x^6}}$$

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23. If  $f(x) = \sqrt{x^2 + 1}$ ,  $g(x) = \frac{x + 1}{x^2 + 1}$  and  $h(x) = 2x - 3$ , then find  $f'(h'(g'(x)))$ .

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24. If  $x = \sec\theta - \cos\theta$  and  $y = \sec^n\theta - \cos^n\theta$ , prove that

$$(x^2 + 4) \left( \frac{dy}{dx} \right)^2 = n^2 (y^2 + 4)$$



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25. If  $x^y + y^x + x^x = m^n$ . then find the value of  $\frac{dy}{dx}$ .



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26. If  $x = a \cos^3\theta$  and  $y = a \sin^3\theta$ , then find the value of  $\frac{d^2y}{dx^2}$  at  $\theta = \frac{\pi}{6}$ .



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27. If  $y = \tan^{-1} \left[ \frac{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}} \right]$  where  $0 < x < \frac{\pi}{2}$  find

$$\frac{dy}{dx}$$



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28. If  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  then show that  $\frac{d^2y}{dx^2} = -\frac{b^4}{a^2y^3}$ .



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29. Verify Rolle's theorem for the function  $f(x) = e^x \sin 2x$   $\left[0, \frac{\pi}{2}\right]$



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30. Verify Lagrange's mean value theorem for function  $f(x) = \sqrt{x^2 - 4}$  on  $[2, 4]$  and find a point ' $c$ ' in the indicated interval:



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31. If Rolle's theorem holds for the function  $f(x) = x^3 + bx^2 + ax + 5$  on  $[1, 3]$  with  $c = \left(2 + \frac{1}{\sqrt{3}}\right)$ , find the value of  $a$  and  $b$

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32. If  $y = \left\{ x + \sqrt{x^2 + 1} \right\}^m$ , show that  $(x^2 + 1)y_2 + xy_1 - m^2 y = 0$

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33. Differentiate  $\sin^{-1} \left[ \frac{3x + (4\sqrt{1-x^2})}{5} \right]$  w. r. t.  $x$ .

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34. If  $x^y = e^{x-y}$ , prove that  $\frac{dy}{dx} = \frac{\log x}{(1 + \log x)^2}$

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35. If  $f: [-5, 5] \rightarrow \mathbb{R}$  is differentiable function and if  $f'(x)$  does not vanish anywhere, then prove that  $f(-5) \neq f(5)$ .

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36. If  $y^{\frac{1}{n}} + y^{-\frac{1}{n}} = 2x$  then  $(x^2 - 1)y_2 + xy_1$  is equal to



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