MATHS

BOOKS - PSEB

CONTINUITY AND DIFFERENTIABILITY

Example

1. Check the continuity of the function f given by $f(x) = 2x + 3$ at $x = 1$

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2. Examine whether the function f given by $f(x) = x^2$,is continuous at $x = 0$

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3. Discuss the continuity of the function f given by $f(x) = |x|$ at $x = 0$

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4. Show that the function f given by: $f(x) = \{(x^3, +, 3, , \quad \text{if} \quad x \neq 0), (1, , , , \quad \text{if} \quad x = 0$ is not continuous at x=0

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5. Check the points where the constant function $f(x) = k$ is continuous.

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6. Prove that the identity function on real numbers given by $f(x) = x$ is continuous at every real number.

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7. Is the function defined by $f(x) = |x|$ a continuous function?

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8. Discuss the continuity of the function f given by

$f(x) = x^3 + x^2 - 1$

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9. Discuss the continuity of the function f defined by

$f(x) = \frac{1}{x}, x \neq 0$

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10. Discuss the continuity of the function f defined by:

$$f(x) = \begin{cases} x + 3 & \text{if } x \leq 0 \\ x - 2 & \text{if } x > 1 \end{cases}$$

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11. Find all the points of discontinuity of the function f defined by $f(x) = \begin{cases} x + 2 & \text{if } x < 1 \\ 0 & \text{if } x = 1 \\ x - 2 & \text{if } x > 1 \end{cases}$

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12. Discuss the continuity of the function defined by: $f(x) = \begin{cases} x + 2 & \text{if } x < 0 \\ -x + 2 & \text{if } x > 0 \end{cases}$

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13. Discuss the continuity of the function f given by: $f(x) = \begin{cases} x & \text{if } x \geq 0 \\ x^2 & \text{if } x < 0 \end{cases}$

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14. Show that every polynomial function is continuous.

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15. Find all the points of discontinuity of the greatest integer function defined by $f(x) = [x]$ where $[x]$ denotes the greatest integer less than or equal to x.

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16. Prove that every rational function is continuous.

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17. Discuss the continuity of sine function.

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18. Prove that the function defined by $f(x) = \tan x$ is a continuous function.

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19. Show that the function defined by $f(x) = \sin\left(x^2\right)$ is a continuous function.

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20. Show that the function f defined by $f(x) = |1 - x + |x\,|\,|$ where x is any real number, is a continuous function.

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21. Find the derivative of the function given by $f(x) = \sin(x^2)$

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22. Find the derivative of $\tan(2x + 3)$

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23. Differentiate $\sin\left(\cos\left(x^2\right)\right)$ with respect to x.

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24. Find $\frac{dy}{dx}$ if $x - y = \pi$

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25. Find $\frac{dy}{dx}$, if $y + \sin y = \cos x$

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26. Find the derivative of f given by $f(x) = \sin^{-1} x$ assuming it exists.

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27. Find the derivative of f given by $f(x) = \tan^{-1} x$ assuming it exists.

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28. Is it true that $x = e^{\log x}$ for all real x?

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29. Differentiate the following w.r.t. x: e^{-x}

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30. Differentiate the following w.r.t. x: $\sin(\log x), x > 0$

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31. Differentiate the following w.r.t. x: $\cos^{-1}(e^x)$

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32. Differentiate the following w.r.t. x: $e^{\cos x}$

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33. Differentiate : $\frac{\sqrt{(x-3)(x^2+4)}}{3x^2+4x+5}$ w.r.t. x.

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34. Differentiate a^x w.r.t. x, where a is a positive constant.

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35. Differentiate $x^{\sin x}$, $x > 0$ w.r.t. x.

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36. Find $\frac{dy}{dx}$, if $y^x + x^y + x^x = a^b$

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37. Find $\frac{dy}{dx}$ if x = acosθ,y=asinθ

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38. Find $\frac{dy}{dx}$ if $x = at^2, y = 2at$

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39. Find $\frac{dy}{dx}$ if $x = a(\theta + \sin\theta), y = a(1 - \cos\theta)$

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40. Find $\frac{dy}{dx}$ if $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$

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41. Find $d^2\frac{y}{dx^2}$ if $y = x^3 + \tan x$

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42. If $y = A\sin x + B\cos x$then prove that $d^2\frac{y}{dx^2} + y = 0$

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43. If $y = 3e^{2x} + 2e^{3x}$, prove that $d^2\frac{y}{dx^2} - 5\frac{dy}{dx} + 6y = 0.$

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44. If $y = \sin^{-1} x$, show that : $\left(1 - x^2\right)d^2\frac{y}{dx^2} - x\frac{dy}{dx} = 0$

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45. Verify Rolle's theorem for the function $y = x^2 + 2$, $a = -2$ and $b = 2$

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46. Verify Mean Value Theorem for the function $f(x) = x^2$ in the interval [2, 4].

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47. Differentiate w.r.t. x, the following function: $\sqrt{3x+2} + \frac{1}{\sqrt{2x^2+4}}$

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48. Differentiate w.r.t. x, the following function: $e^{\sec^2 x} + 3\cos^{-1} x$

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49. Differentiate w.r.t. x, the following function: $\log_7(\log x)$

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50. Differentiate w.r.t. x, the following function: $\cos^{-1}(\sin x)$

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51. Differentiate the following w.r.t. x : $\tan^{-1}\left(\frac{\sin x}{1+\cos x}\right)$

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52. Differentiate the following w.r.t. x : $\sin^{-1}\left(\frac{2^{x+1}}{1+4^x}\right)$

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53. Find $f'(x)$ if $f(x) = (\sin x)^{\sin x}$ for all `0

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54. For a positive constant a find $\frac{dy}{dx}$,where $y = a^{t+\left(\frac{1}{t}\right)}$, and $x = \left(t + \frac{1}{t}\right)^a$

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55. Differentiate $\sin^2 x$ w.r.t. $e^{\cos x}$

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Exercise

1. Prove that the function $f(x) = 5x - 3, iscontNuousatx = 0, atx = -3$ and $atx = 5$

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2. Examine the continuity of the function $f(x) = 2x^2 - 1$ at $x = 3$

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3. Examine the following function for continuity:

$f(x) = x - 5$

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4. Examine the following function for continuity:

$f(x) = \frac{1}{x-5}, x \neq 5$

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5. Examine the following function for continuity:

$f(x) = \frac{x^2 - 25}{x+5}, x \neq -5$

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6. Examine the following function for continuity:

$f(x) = |x - 5|$

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7. Prove that the function $f(x) = x^n$, is continuous at $x = n$, where n is a positive integer.

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8. Is the function f defined by $f(x) = \begin{cases} x & \text{if } x \leq 1 \\ 5 & \text{if } x > 1 \end{cases}$

continuous at, x=0?At x=1? At x=2 ?

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9. Find the point (s) of discontinuity of f (x), if :

$$f(x) = \begin{cases} 2x + 3 & \text{if} \quad x \leq 2 \\ 2x - 3 & \text{if} \quad x > 2 \end{cases}$$

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10. Find all points of discontinuity of f, where f is defined by :

`f(x)={(|x|+3,,,,if x <= -3),(-2x,,,,if -3=3):}`

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11. Find all points of discontinuity of f, where f is defined by :

$$f(x) = \begin{cases} \frac{|x|}{x} & \text{if} \quad x \neq 0 \\ 0 & \text{if} \quad x = 0 \end{cases}$$

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12. Find all points of discontinuity of f, where f is defined by:

$$f(x) = \begin{cases} \frac{x}{|x|} & \text{if } x < 0 \\ -1 & \text{if } x \geq 0 \end{cases}$$

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13. Find all points of discontinuity of f, where f is defined by :

$$f(x) = \begin{cases} x + 1 & x \geq 1 \\ x^2 + 1 & x < 1 \end{cases}$$

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14. Find all points of discontinuity of f, where f is defined by :

$$f(x) = \begin{cases} x^3 - 3 & x \leq 2 \\ x^2 + 1 & x > 2 \end{cases}$$

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15. Find all points of discontinuity of f, where f is defined by :

$$f(x) = \begin{cases} x^{10} - 1 & x \leq 1 \\ x^2 & x > 1 \end{cases}$$

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16. Is the function defined by

$$f(x) = \begin{cases} x + 5 & \text{if } x \leq 1 \\ x - 5 & \text{if } x > 1 \end{cases}$$ a continuous function?

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17. Discuss the continuity of the function f, where f is defined by: $f(x) = \begin{cases} 2x & \text{if } x < 0 \\ 0 & \text{if } 0 \leq x \leq 1 \\ 4x & \text{if } x > 1 \end{cases}$

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18. Discuss the continuity of the function f, where f is defined by: $f(x) = \begin{cases} -2 & \text{if } x \leq -1 \\ 2x & \text{if } -1 \leq x \leq 1 \\ 2 & \text{if } x > 1 \end{cases}$

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19. Find the relationship between a and b so that the function f defined by: $f(x) = \begin{cases} ax + 1 & \text{if } x \leq 3 \\ bx + 3 & \text{if } x > 3 \end{cases}$ is continuous at $x = 3$

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20. For what value of λ is the function defined by $f(x) = \begin{cases} \lambda(x^2 - 2x) & \text{if } x \leq 0 \\ 4x + 1 & \text{if } x > 0 \end{cases}$ continuous at $x = 0$? What about continuity at $x = 1$?

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21. Show that the function defined by $g(x) = x - [x]$ is discontinuous at all integral points. Here $[x]$ denotes the greatest integer less than or equal to x.

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22. Is the function defined by $f(x) = x^2 - \sin x + 5$ continuous at $x = \pi$

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23. Discuss the continuity of the following function: $f(x) = \sin x + \cos x$

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24. Discuss the continuity of the following function: $f(x) = \sin x - \cos x$

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25. Discuss the continuity of the following function: $f(x) = \sin x \cdot \cos x$

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26. Discuss the continuity of the cosine, cosecant, secant and cotangent functions.

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27. Find all points of discontinuity of f, where:

$$f(x) = \begin{cases} \frac{\sin x}{x} & \text{if } x < 0 \\ x + 1 & \text{if } x \geq 0 \end{cases}$$

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28. Determine if f defined by : $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$ is a continuous function?

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29. Examine the continuity of f, where f is defined by :

$$f(x) = \begin{cases} \sin x - \cos x & \text{if } x \neq 0 \\ -1 & \text{if } x = 0 \end{cases}$$

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30. Find the values of k so that the function f is continuous at the indicated point : $f(x) = \begin{cases} k\frac{\cos x}{\pi - 2x} & \text{if } x \neq \frac{\pi}{2} \\ 3 & \text{if } x = \frac{\pi}{2} \end{cases}$ at $x = \frac{\pi}{2}$

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31. Find the values of k so that the function f is continuous at the indicated point : $f(x) = \begin{cases} kx^2 & \text{if } x \leq 2 \\ 3 & \text{if } x > 2 \end{cases}$ at $x = 2$

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32. Find the values of k so that the function f is continuous at the indicated point : $f(x) = \begin{cases} kx + 1 & \text{if } x \leq \pi \\ \cos x & \text{if } x > \pi \end{cases}$ at $x = \pi$

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33. Find the values of k so that the function f is continuous at the indicated point : $f(x) = \begin{cases} kx + 1 & \text{if } x \leq 5 \\ 3x - 5 & \text{if } x > 5 \end{cases}$ at $x = 5$

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34. Find the values of a and b such that the function defined by : `f(x)={(5,,,, if x le2),(ax+b,,,, if 2

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35. Show that the function defined by $f(x) = \cos\left(x^2\right)$ is a continuous function.

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36. Show that the function defined by $f(x) = |\cos x|$ is a continuous function.

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37. Examine the continuity of the function 'f' at x = 0, if `f(x) = {(x sin(1/x)),(0):}, ((x ne 0),(x = 0))

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38. Find all the points of discontinuity of f defined by $f(x) = |x| - |x + 1|$

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39. Differentiate the functions with respect to x: $\sin\left(x^2 + 5\right)$

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40. Differentiate the functions with respect to x: $\cos(\sin x)$

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41. Differentiate the functions with respect to x: $\sin(ax+b)$

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42. Differentiate the functions with respect to x: $\sec\left(\tan\left(\sqrt{x}\right)\right)$

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43. Differentiate the functions with respect to x: $\frac{\sin(ax+b)}{\cos(cx+d)}$

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44. Differentiate the functions with respect to x: $\cos x^3 \cdot \sin^2\left(x^5\right)$

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45. Differentiate the functions with respect to x: $2\sqrt{\cot\left(x^2\right)}$

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46. Differentiate the functions with respect to x: $\cos\left(\sqrt{x}\right)$

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47. Prove that the function f given by $f(x) = |x - 1|, x \in R, x = 1$ is not differentiable at x = 1.

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48. Prove that the greatest integer function defined by `f(x) = [x], 0

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49. Find $\frac{dy}{dx}$ in the following: $2x + 3y = \sin x$

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50. Find $\frac{dy}{dx}$ in the following: $2x + 3y = \sin y$

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51. Find $\frac{dy}{dx}$ in the following: $xy + y^2 = \tan x + y$

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52. Find $\frac{dy}{dx}$ in the following: $x^2 + xy + y^2 = 100$

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53. Find $\frac{dy}{dx}$ in the following: $x^3 + x^2y + xy^2 + y^3 = 81$

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54. Find $\frac{dy}{dx}$ in the following: $\sin^2 y + \cos xy = k$

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55. Find $\frac{dy}{dx}$ in the following: $\sin^2 x + \cos^2 y = 1$

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56. Find $\frac{dy}{dx}$ in the following: $y = \sin^{-1}\left(2\frac{x}{1+x^2}\right.$

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57. `y=tan^(-1)((3x - x^3)/(1-3x^2), -1/sqrt3

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58. `y=cos^(-1)((1 - x^2)/(1+x^2), 0

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59. Find $\frac{dy}{dx}$ in the following: `y=sin^-1((1 - x^2)/(1+x^2), 0

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60. Find $\frac{dy}{dx}$ in the following: `y=cos^-1((2x)/(1+x^2), -1

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61. Find $\frac{dy}{dx}$ in the following: $y = \sin^{-1}\left(2x\sqrt{1-x^2}\right)$, $-\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$

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62. Find $\frac{dy}{dx}$ in the following:$y = \sec^{-1}\left(\frac{1}{2x^2 - 1}\right)$, $0 < x < \frac{1}{\sqrt{2}}$

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63. Differentiate the following w.r.t. x: $\frac{e^x}{\sin x}$

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64. Differentiate the following w.r.t. x:$e^{\sin^{-1} x}$

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65. Differentiate the following w.r.t. x: $e^x \hat{} 3$

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66. Differentiate the following w.r.t. x: $\sin\left(\tan^{-1} e^{-x}\right)$

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67. Differentiate the following w.r.t. x: $\log(\cos e^{x})$

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68. Differentiate the following w.r.t. x: $e^{x} + e^{x^2} + \ldots + e^{x^5}$

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69. Differentiate the following w.r.t. x: $\sqrt{e^{\sqrt{x}}}, x > 0$

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70. Differentiate the following w.r.t. x: $\log(\log x), x > 1$

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71. Differentiate the following w.r.t. x: $\frac{\cos x}{\log x}, x > 0$

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72. Differentiate the following w.r.t. x: $\cos(\log x + e^x)$

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73. Differentiate the function w.r.t. x : $\cos x \cdot \cos 2x \cdot \cos 3x$

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74. Differentiate the function w.r.t. x : $\frac{\sqrt{(x-1)(x-2)}}{(x-3)(x-4)(x-5)}$

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75. Differentiate the function w.r.t. x : $(\log x)^{\cos x}$

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76. Differentiate the function w.r.t. x : $x^x - 2^{\sin x}$

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77. Differentiate the function w.r.t. x :

$(x+3)^2 \cdot (x+4)^3 \cdot (x+5)^4$

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78. Differentiate the function w.r.t. x : $\left(x+\frac{1}{x}\right)^x + x^{\left(1+\frac{1}{x}\right)}$

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79. Differentiate the function w.r.t. x : $(\log x)^x + x^{\log x}$

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80. Differentiate the function w.r.t. x : $(\sin x)^x + \sin^{-1}\sqrt{x}$

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81. Differentiate the function w.r.t. x : $x^{\sin x} + (\sin x)^{\cos x}$

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82. Differentiate the function w.r.t. x : $x^{x\cos x} + \frac{x^2+1}{x^2-1}$

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83. Differentiate the function w.r.t. x : $(x\cos x)^x + (x\sin x)^{\frac{1}{x}}$

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84. Find $\frac{dy}{dx}$ of the function : $x^y + y^x = 1$

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85. Find $\frac{dy}{dx}$ of the function : $y^x = x^y$

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86. Find $\frac{dy}{dx}$ of the function : $(\cos x)^y = (\cos y)^x$

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87. Find $\frac{dy}{dx}$ of the function : $xy = e^{x-y}$

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88. Find the derivative of the function given by $f(x) = (1+x)(1+x^2)(1+x^4)(1+x^8)$ and hence find $f'(1)$

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89. Differentiate $(x^2 - 5x + 8)(x^3 + 7x + 9)$ by using product rule.

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90. Differentiate $(x^2 - 5x + 8)(x^3 + 7x + 9)$ by expanding the product to obtain a single polynomial.

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91. Differentiate $\left(x^2-5x+8\right)\left(x^3+7x+9\right)$ by logarithmic differentiation.

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92. If u, v and w are functions of x, then show that `d/dx(u cdot v cdot w) = du/dx (v cdotw + u cdot dv/dx cdot w +u cdot v dw/dx) in two ways - first by repeated application of product rule, second by logarithmic differentiation.

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93. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter, Find $\frac{dy}{dx}: x = 2at^2, y = at^4$

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94. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter, Find $\frac{dy}{dx}: : x = a\cos\theta, y = b\cos\theta$

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95. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter, Find $\frac{dy}{dx}: x = \sin t, y = \cos 2t$

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96. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter, Find $\frac{dy}{dx} : x = 4t, y = \frac{4}{t}$

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97. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter, Find $\frac{dy}{dx} : x = \cos\theta - \cos 2\theta, y = \sin\theta - \sin 2\theta$

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98. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter,

Find $\frac{dy}{dx}: x = \frac{\sin^3 t}{\sqrt{\cos 2}} t, y = \frac{\cos^3 t}{\sqrt{\cos 2}} t$

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99. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter,

Find $\frac{dy}{dx}: x = a\left(\cos t + \frac{\log \tan t}{2}\right) y = a \sin t$

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100. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter,

Find $\frac{dy}{dx}: x = a(\theta - \sin\theta), y = a(1 + \cos\theta)$

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101. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter,

Find $\frac{dy}{dx}: x = a\sec\theta, y = b\tan\theta$

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102. If x and y are connected parametrically by the equations given in Exercises 1 to 10, without eliminating the parameter,

Find $\frac{dy}{dx}: x = a(\cos\theta + \theta\sin\theta), y = a(\sin\theta - \theta\cos\theta)$

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103. Find $\frac{dy}{dx} = -\frac{y}{x}$ if $x = \sqrt{a^{\sin^{-1}t}}, y = \sqrt{a^{\cos^{-1}t}}$

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104. Find the second order derivatives of the function : $x^2 + 3x + 2$

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105. Find the second order derivatives of the function: x^{20}

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106. Find the second order derivatives of the function : $x \cdot \cos x$

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107. Find the second order derivatives of the function : $\log x$

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108. Find the second order derivatives of the function : $x^3 \log x$

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109. Find the second order derivatives of the function : $e^x \sin 5x$

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110. Find the second order derivatives of the function : $e^{6x} \cos 3x$

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111. Find the second order derivatives of the function : $\tan^{-1} x$

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112. Find the second order derivatives of the function : $\log(\log x)$

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113. Find the second order derivatives of the function : $\sin(\log x)$

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114. If $y = 5\cos x - 3\sin x$ prove that $\left(d^2\frac{y}{dx^2}\right) + y = 0$

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115. If $y = \cos^{-1} x$ Find $\left(d^2\frac{y}{dx^2}\right)$ in terms of y alone.

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116. If $y = 3\cos(\log x) + 4\sin(\log x)$ show that $x^2 y_2 + x y_1 + y = 0$

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117. If $y = Ae^{mx} + Be^{nx}$, Show that $\left(\frac{d^2}{dx^2}y\right) - (m+n)\frac{dy}{dx} + mny = 0$

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118. If $y = 500e^7x + 600e^{-7}x$ show that $\left(d^2\frac{y}{dx^2}\right) = 49y$

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119. If $e^y(x+1) = 1$ show that $\left(d^2\frac{y}{dx^2}\right) = \left(\frac{dy}{dx}\right)^2$ है।

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120. If $y = \left[\tan^{-1} x\right]^2$, then prove that : $\left(x^2+1\right)^2 y_2 + 2x\left(x^2+1\right) y_1 = 2.$

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121. Verify Rolle's theorem for the function $f(x) = x^2 + 2x - 8, x \in [-4, 2]$

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122. Examine if Rolle's theorem is applicable to any of the following functions. Can you say some thing about the converse of Rolle's theorem from these example? $f(x) = [x]$ for $x \in [5, 9]$

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123. Examine if Rolle's theorem is applicable to any of the following functions. Can you say some thing about the converse of Rolle's theorem from these example? $f(x) = [x]$ for $x \in [-2, 2]$

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124. Examine if Rolle's theorem is applicable to any of the following functions. Can you say some thing about the converse of Rolle's theorem from these example? $f(x) = x^2 - 1$ for $x \in [1, 2]$

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125. If $f:[-5,5] \to R$ is a differentiable function and if $f'(x)$ does not vanish anywhere, then prove that $f(-5) \neq f(5)$

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126. Verify Mean Value Theorem, if $f(x) = x^2 - 4x - 3$, in the interval [a, b], where a = 1 and b = 4.

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127. Verify Mean Value Theorem, if $f(x) = x^3 - 5x^2 - 3x$, in the interval [a, b], where a = 1 and b = 3. Find all $c \in (1,3)$ for which $f'(c) = 0$.

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128. Verify Mean Value Theorem, if $f(x) = x^3 - 5x^2 - 3x$, in the interval [a, b], where a = 1 and b = 3. Find all $c \in (1, 3)$ for which $f'(c) = 0$.

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129. Differentiate w.r.t. x the function : $\left(3x^2 - 9x + 5\right)^9$

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130. Differentiate w.r.t. x the function : $\sin^3 x + \cos^6 x$

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131. Differentiate w.r.t. x the function : $(5x)^{3\cos 2x}$

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132. Differentiate w.r.t. x the function : $\sin^{-1}\left(x\sqrt{x}\right), 0 \leq x \leq 1$

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133. Differentiate w.r.t. x the function : $\frac{\cos^{-1}\left(\frac{x}{2}\right)}{\sqrt{2x+7}}$, x lies between -2 and 2

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134. Differentiate w.r.t. x the function : `cot^-1[(sqrt(1+sinx) + sqrt(1-sinx))/(sqrt(1+sinx) - sqrt(1-sinx))], 0

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135. Differentiate w.r.t. x the function : $(\log x)^{\log x}$, $x > 1$

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136. Differentiate w.r.t. x the function : $\cos(a\cos x + b\sin x)$, for some constant a and b.

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137. Differentiate w.r.t. x the function : $(\sin x - \cos x)^{\sin x - \cos x}$, $x lies between \frac{\pi}{4}$ and $3\frac{\pi}{4}$

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138. Differentiate w.r.t. x the function : $x^x + x^a + a^x + a^a$, for some fixed $a > 0$ and $x > 0$

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139. Differentiate w.r.t. x the function : $x^{x^2-3} + (x-3)^{x^2}$, f or $x > 3$

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140. Find dy/dx if y =12(1-cost), x =10(t-sint)

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141. Find $\frac{dy}{dx}$ if $y = \sin^{-1} x + \sin^{-1} \sqrt{1 - x^2}, 0 < x < 1$

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142. If $x\sqrt{1+y} + y\sqrt{1+x} = 0$ for x lies between -1 and 1` prove that dy/dx =-1/(1+x)^2

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143. If $(x-a)^2+(y-b)^2=c^2$, for some $c>0$, prove that $\frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$ is a constant independent of a and b.

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144. If $\cos y = x\cos(a+y)$, with $\cos a \neq \pm 1$, prove that $\frac{dy}{dx}=\frac{\cos^2(a+y)}{\sin a}$

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145. If $x=a(\cos t + t\sin t)$ and $y=a(\sin t - t\cos t)$, find $\frac{d^2y}{dx^2}$

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146. If $f(x) = |x|^3$ show that $f''(x)$ exists for all real x and find it.

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147. Using mathematical induction prove that $d\frac{x^n}{dx} = nx^{n-1}$ for all positive integers n.

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148. Using the fact that $\sin(A+B) = \sin A \cos B + \cos A \sin B$ and the differentiation, obtain the sum formula for cosines.

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149. Does there exist a function which is continuous everywhere but not differentiable at exactly two points? Justify your answer.

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150. If $y = \begin{vmatrix} f(x) & g(x) & h(x) \\ 1 & m & n \\ a & b & c \end{vmatrix}$, prove that $\frac{dy}{dx} = \begin{vmatrix} f'(x) & g'(x) & h'(x) \\ l & m & n \\ a & b & c \end{vmatrix}$

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151. If $y = e^{a\cos^{-1}x}, -1 \leq x \leq 1,$ show that

$$(1-x^2)\frac{d^2y}{dx^2} - x\left(\frac{dy}{dx}\right) - a^2y = 0$$

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