MATHS

BOOKS - NAGEEN MATHS (HINGLISH)

Continuity and Differentiability

Solved Example

1. Show that the function $f(x) = x^2 + 3x + 5$,is continuos at x=1.

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2. If $f(x) = \begin{cases} x^2 & x \neq 0, \\ 4 & x = 0 \end{cases}$ then find whether f(x) is continuous at $x = 0$

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3. Show that $f(x) = |x|$ is continuous at x=0

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4. Discuss the continuity of $f(x) = |x| + |x - 1|$ at x=0 and x=1.

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5. Show that f(x)=cos x is continuous for all values of x.

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6. If $f(x) = \begin{cases} \dfrac{x^3 + x^2 - 16x + 20}{(x-2)^2}, & x \neq 0 \end{cases}$

k, x=0 is continuous for all real values of x, find the value of K.

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7. The function f(x) is defined as follows : $\therefore f(x) = \begin{cases} 4x + a, x < 1 \\ 6, \quad x = 1 \\ 3x - b, x > 1 \end{cases}$

If f(x) is continuous at x=1 , find the value of a and b.

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8. A function f(x) is defined as follows : `f(x)={(x sin ""1/x ", " x ne 0),(0 ", " x=0):}

Discuss its continuity at x=0

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9. Discuss of the continutiy of the fuction $f(x) = \begin{cases} \frac{\sin x}{2}, & x < 0 \\ x + 2, x \geq 0 \end{cases}$

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10. Prove that tangent function is continous in its domain.

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11. Discuss the continuity of the function $f(x) = \begin{cases} 2x - 1, x < 1 \\ 3x - 2, x \geq 1 \end{cases}$

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12. Discuss the differentiability of $f(x) = x^3$ at $x = 1$

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13. Show that the function $f(x) = \frac{x^3}{2}$ is not differentiable at x=0.

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14. Show that the function

$f(x) = \begin{cases} 1 + x, & x \leq 2, \\ 5 - x, & x > 2 \end{cases}$ is not differentiable at x=2

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15. Show that the function f(x)=|x-2| is continuous but not differentiable at x=2.

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16. Differentiate $(px+q)^3$ with respect to x

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17. Differentiate $\tan px$ with respect to x

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18. Differentiate log sin $\frac{x}{3}$ with respect to 'x'

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19. Find the derivative of $\sin^2 x$ with respect to x

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20. Differentiate log(sin x) with respect to x

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21. Find the derivative of tan x with respect to 'x'

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22. Differentiate $\log(\sec x + \tan x)$ with respect to x :

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23. Find the derivatiive of $\cos\left(\tan x^3\right)$

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24. Differenitane $\frac{1}{x\sqrt{1+x^2}}$ with respect to 'x'.

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25. If y= $y=\sqrt{\frac{1-\sin 2x}{1+\sin 2x}}$ prove that $\frac{dy}{dx}+\sec^2\left(\frac{\pi}{4}-x\right)=0.$

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26. Differentiate $\frac{e^{2x}+e^{-2x}}{e^{2x}-e^{-2x}}$

with respect to 'x'

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27. Find the derivative of $\cos^{-1}2x$ with respect to 'x'.

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28. Find the derivative to $\sec(\tan^{-1})$ x with respect to 'x'

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29. Find the derivative of $x \tan^{-1}$ x with respect to 'x'

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30. Find the derivative of $\cos^{-1}(\cot x)$ with respect to 'x'

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31. if $y = \dfrac{\sin^{-1} x}{\sqrt{1-x^2}}$ then prove that $(1-x)^2 . \dfrac{d}{dx} = xy + 1$

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32. Find the derivative of $\tan^{-1}\left(\frac{1-\cos x}{\sin x}\right)$ with respect to 'x'

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33. Find the derivative of $\tan^{-1}\left(\frac{\cos x-\sin x}{\cos x+\sin x}\right)$ with respect to 'x'

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34. Differentiate $\sin^{-1}\left(\frac{1}{\sqrt{1+x^2}}\right)$ with respect to 'x'

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35. If $y=\cot^{-1}\left(\frac{1+\sqrt{1+x^2}}{x}\right)$ then find $\frac{dy}{dx}$

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36. Differentiate $\sin(-1)\left[\frac{\sqrt{1+x}+\sqrt{1-x}}{2}\right]$ with respect to 'x'.

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37. If $y=\tan^{-1}\left[\frac{x}{1+\sqrt{1-x^2}}\right]$ then find $\frac{dy}{dx}$

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38. If y=$\tan^{-1}\left(\frac{ax-b}{bx+a}\right)$ then prove that $d\frac{u}{dx}=\frac{1}{1+x^2}$.

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39. If $x^2+y^2=25$ then find $\frac{dy}{dx}$.

A. $\frac{dy}{dx}=y$

B. $\frac{dy}{dx}=x$

C. $\frac{dy}{dx} = -\frac{y}{x}$

D. $\frac{dy}{dx} = -\frac{x}{y}$

Answer: D

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40. If $\sqrt{x} + \sqrt{y} = \sqrt{a}$ differentiate both sides with respect to x

A. $\frac{dy}{dx} = \frac{\sqrt{x}}{\sqrt{y}}$

B. $\frac{dy}{dx} = -\frac{\sqrt{x}}{\sqrt{y}}$

C. $\frac{dy}{dx} = -\frac{\sqrt{y}}{\sqrt{x}}$

D. $\frac{dy}{dx} = \frac{\sqrt{y}}{\sqrt{x}}$

Answer: C

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41. If $x^4 + y^4 - a^2xy = 0$ then find $\frac{dy}{dx}$

A. $\frac{dy}{dx} = \frac{a^2 - 4x^3}{4y^3 - a^2x}$

B. $\frac{dy}{dx} = \frac{a^2y - x^3}{4y^3 - a^2x}$

C. $\frac{dy}{dx} = \frac{a^2y - 4x^3}{y^3 - a^2x}$

D. $\frac{dy}{dx} = \frac{a^2y - 4x^3}{4y^3 - a^2x}$

Answer: D

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42. If cos (x+y)=y sin x then find $\frac{dx}{dy}$

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43. If y=x sin y then prove that $x\frac{dy}{dx} = \frac{y}{1 - x\cos y}$

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44. If $\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$, then prove that $\frac{dy}{dx}=\sqrt{\frac{1-y^2}{1-x^2}}$

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45. If $y=x^{\sin^{-1}x}$ then finde $\frac{dy}{dx}$.

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46. Differentiate $x^{\sin x}$ with respect to 'x'.

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47. Find the derivative of $(1+\cos x)^x$ with respect to x.

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48. Differentiate $x^x + (\sin x)^{\sin x}$ with respect to 'x'.

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49. Differentiate $\sqrt{\frac{1-x}{1+x}}$ with respect to x.

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50. Differentiate

$\sqrt{(x+1)(x+2)(x+3)}$ with respect to x.

A. $((x+1)(x+2)(x+3))$

$\left(\frac{1}{x+1}+\frac{1}{x+2}+\frac{1}{x+3}\right).$

B. $\frac{1}{4}\sqrt{(x+1)(x+2)(x+3)}$

$\left(\frac{1}{x+1}+\frac{1}{x+2}+\frac{1}{x+3}\right).$

C. $\frac{1}{\sqrt{(x+1)(x+2)(x+3)}}$

$\left(\frac{1}{x+1}+\frac{1}{x+2}+\frac{1}{x+3}\right).$

D. $\frac{1}{2}\sqrt{(x+1)(x+2)(x+3)}$

$\left(\frac{1}{x+1}+\frac{1}{x+2}+\frac{1}{x+3}\right)$.

Answer: D

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51. If $x^a \cdot y^b = (x+y)^{a+b}$ then prove that $\frac{dy}{dx} = \frac{y}{x}$

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52. If $x^y + y^x = a^b$ then find $\frac{dy}{dx}$.

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53. If $y = (\sin x)^{\sin x^{\sin x} \cdots \cdot \infty}$ then prove that $\frac{dy}{dx} = \frac{y^2 \cot x}{1 - y\log(\sin x)}$

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54. If $y=\sqrt{x+\sqrt{x+\sqrt{+\ldots..\infty}}}$ then prove that $(2y-1)\frac{dy}{dx}=1.$

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55. If $y=a^{x^{a^{x}\ldots\infty}}$ then prove that $\frac{dy}{dx}=\frac{y^2\log y}{x(1-y\log x\log y)}$

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56.

$y=\sqrt{\sin+\cos x+\sqrt{\sin x+\cos x+\sqrt{\sin x+\cos x+....\infty}}}$ then find

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57. If $x=at^2$ and $y=2$ at then find $\frac{dy}{dx}$

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58. If $x = a(t + \sin t)$ and $y = a(1 - \cos t)$ then find $\frac{dy}{dx}$.

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59. If $x = a\cos^3 t$ and $y = a\sin^3 t$ then find $\frac{dy}{dx}$

A. $\cot t$

B. $-\tan t$

C. $\tan t$

D. $-\cot t$

Answer: B

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60. If $x = (a + b)\cos\theta - b\cos\left(\frac{a+b}{b}\right)\theta$ and y =(a+b) sin theta -b $\sin\left(\frac{a+b}{2b}\right)\theta$ then prove that

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61. If $x = \sin^{-1}\frac{2t}{1+t^2}$ and $y = \tan^{-1}\frac{2t}{1-t}$ the n find $\frac{dy}{dx}$.

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62. Find the derivative of x^7 with respect to x^2.

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63. $D \Leftrightarrow erential$e^(tanx)`with respect to sin x.

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64. Differentiate $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$ with respect to $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$

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65. Find the 2nd derivative of $x^6 . e^{6x}$ with respect to x.

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66. Find the 2nd dervtive of sin (cosx)with respect to x.

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67. If $y = \sec x + \tan x$ then prove that $\frac{d^2y}{dx^2} = \frac{\cos x}{(1 - \sin x)^2}$.

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68. If $y = e^{ax}$ sin be then prove that $\frac{d^2y}{dx^2} - 2a\frac{dy}{dx} + (a^2 + b^2)y = 0$.

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69. If $x = a\cos^3\theta, y = a\sin^3\theta$ then find $\frac{d^2y}{dx^2}$

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70. If $y = A\sin^2 x + B\cos^2 x$ then prove that $\sin 2x.\, y_2 - 2\cos 2x.\, y_1 = 0$

where $y = \frac{dy}{dx}, y_2 = \frac{d^2y}{dx^2}.$

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71. Verify Rolles theorem for function $f(x) = x^2 - 4x + 3$ on $[1,\ 3]$

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72. Verify Rolle's theorem for the function f(x) = x^2 in the interval $[-1, 1]$.

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73. Verify Rolle's theorem for the function f(x) = $x^3 + 3x^2 - 24x - 80$ in the interval $[-4, 5]$.

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74. Verify Rolle's theorem for $f(x) = \sqrt{1 - x^2}$ in the interval [-1,1].

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75. Verify Rolle's theorem for the function f(x) = cos2x in the interval $[0, \pi]$.

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76. Verify Rolle's theorem for the function f(x) = {log $\left(x^2 + 2\right) - \log 3$} in the interval $[-1, 1]$.

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77. Discuss the applicability the Rolle's theorem for the function f(x) = x^2 in the interval [2,3].

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78. Discuss the applicability of the Rolle's theorem for the function f(x) = |x| in the interval $[-1, 1]$

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79. Verify Lagrange's Mean value theorem for the function f(x) = $x^2 - 1$ in the interval [3,5].

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80. $f(x) = \frac{1}{4x - 1}$ in $[1, 4]$

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81. Using Lagrange's Mean Value theorem , find the co-ordinates of a point on the curve $y = x^2$ at which the tangent drawn is parallel to the line joining the points (1,1) and (3,9).

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Exercies 5 A

1. Prove that the function f(x) $= 2x^2 - 3x + 2$ is continuous at at x=1.

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2. The fuction f(x) is defined as follows:

$$f(x) = \begin{cases} 2x - 3 & x < 2 \\ x - 1 & x \geq 2 \end{cases}$$

Prove that f(x) is continuous x at =2.

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3. Discuss the continuity of the function f(x) $= \begin{cases} 1+x^2 & x \leq 1 \\ 1-x & x > 1 \end{cases}$ at x=1.

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4. If f(x) f(x) $= \begin{cases} \frac{x^2-9}{x-3}, & x \neq 3 \\ 6, & x = 3 \end{cases}$ then show that f(x) is continuous at x=3.

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5. Discuss the continuity of the function

f(x) $= \begin{cases} x, & x \geq 0 \\ 2, & x < 0 \end{cases}$ at x=0

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6. The fuction f(x) is defined in the interval [0,1] as follows:

$$f(x) = \begin{cases} 0, & x = 0 \\ \frac{1}{2} - x, & 0 < x < \frac{1}{2} \\ \frac{1}{2}, & x = \frac{1}{2} \\ \frac{2}{3} - x, & \frac{1}{2} < x < 1 \\ 1, & x = 1 \end{cases}$$

Discuss the continuity of the function at $x = \frac{1}{2}$

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7. Discuss the continuity of the function

$= f(x)$={(3-x", "x le 0),(x", "x gt 0):}` at x=0.

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8. Show that the function $f(x) = \begin{cases} x - 4, & x \leq 5 \\ 5x - 24, & x > 5 \end{cases}$ is cotinuous at x=5.

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9. Discuss the continutily of the following fuction at x=1 and 2

$$f(x) = \begin{cases} 5x - 4, & x \leq 1 \\ 4x^2 - 3x, & 1 < x < 2 \\ 3x + 4, & x \geq 2 \end{cases}$$

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10. If $f(x) = \begin{cases} x^2 + 1, & x \neq 1 \\ 3, & x = 1 \end{cases}$, then check whether the function f(x) is continuous or discontinuous at x=1

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11. Discuss the continuiy of the function

$$f(x) = \begin{cases} \frac{1}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$ at x=0.

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12. Discuss the continuity of the function

$$f(x) = \begin{cases} \frac{|x|}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$ at x=0

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13. (i) Dissusse the continuity of the function $f(x) = \begin{cases} |x-a|, & x \neq a \\ 0, & x = a \end{cases}$ at $x = a$ (ii) Discuss the continutiy of the function

$$f(x) = \begin{cases} \frac{|x-3|}{x-3}, & x \neq 3 \\ 0, & x = 3 \end{cases}$$ at $x = 3$

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14. Show that $f(x) = \sin x$ is continuous for all values of x.

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15. Prove that $f(x) = \begin{cases} \frac{\sin x}{x}; & x \neq 0 \text{ and } 1; \\ & x = 0. \end{cases}$ is continuous at $x = 0.$

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16. If $f(x) = \begin{cases} \frac{\sin 3x}{\sin 5x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$, then discuss its continuity at x= 0. .

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17. Show that the function $f(x) = \begin{cases} \frac{\sin 3x}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$, is discontinuous at x=0.

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18. Discuss the continuity of $f(x) = \begin{cases} \frac{\sin^2 2x}{x^2}, & x \neq 0 \\ 1, & x = 0 \end{cases}$, at x=0.

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19. Discuss the continuity of $f(x) = \begin{cases} \cos\frac{1}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$,

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20. Discuss the continuity of $f(x) = \begin{cases} \sin\frac{1}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$,

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21. Discuss the continutiy of $f(x) = \begin{cases} x\cos\frac{1}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$,

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22. Disuss the continutiy of $f(x) = \begin{cases} \frac{\sin^2 x}{x^2}, & x \neq 0 \\ 0, & x = 0 \end{cases}$,

at x=0

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23. If the function $f(x) = \begin{cases} \frac{3x^3 - 2x^2 - 1}{x - 1}, & x \neq 1 \\ K, & x = 1 \end{cases}$,

is continuous at x=1,find the value of k.

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24. For what value of k, the function

$f(x) = \begin{cases} Kx^2, & x \leq 2 \\ 5, & x > 2 \end{cases}$,

is continuous at x=2.

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25. For what value of k, the function

$f(x) = \begin{cases} \frac{x^2 - 4}{x - 2}, & x \neq 2 \\ k, & x = 2 \end{cases}$,

is continuous at x =2.

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26. For what value of k, the function

$$f(x) = \begin{cases} 2x+1, & x > 2 \\ k, & x = 2 \\ 3x-1, & x < 2 \end{cases},$$

is continuous at x=2.

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27. If the function $f(x)$ given by $f(x) = \begin{cases} 3ax+b & \text{if } x > 1 \\ 11 & \text{if } x = 1 \\ 5ax-2b & \text{if } x < 1 \end{cases}$ is continuous at $x = 1$ then find the values of a and b.

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28. Discuss the continuity of the function

$$f(x) = \begin{cases} \frac{1+\cos x}{\tan^2 x}, & x \neq \pi \\ \frac{1}{2}, & x = \pi \end{cases},$$

$at = \pi$.

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29. Discuss the continuity of the function

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

at =0.

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30. Prove that the function f(x) $= 2x - |x|$ is continuous at x=0.

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Exercies 5 B

1. Prove that the function $f(x) = \begin{cases} \frac{\sin 3x}{x}, & x < 0 \\ x + 3, & x \geq 0 \end{cases}$ is everywhere continous .

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2. Discuss the continutiy of the function

$$f(x) = \begin{cases} \frac{\sin x}{x}, & x < 0 \\ 2x + 3, & x \geq 0 \end{cases}$$

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3. Discuss the continuity of the function

$$f(x) = \begin{cases} \frac{|x|}{x} & , \quad \text{if} \quad x \neq 00 \\ & , \quad \text{if} \quad x = 0 . \end{cases}$$

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4. Discuss the continutiy of the function

$$f(x) = \begin{cases} 3x + 5, & x \geq 2 \\ 6x - 1, & x < 2 \end{cases}$$

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5. Prove that cot x is continuous in its domain

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6. Discuss the continutiy of the function $f(x) = \begin{cases} 4x - 2, & x \leq 2 \\ 3x, & x > 2 \end{cases}$

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7. If the function $f(x) = \begin{cases} 5, & x \leq 2 \\ ax + b, & 2 < x \leq 10 \\ 21, & x > 10 \end{cases}$

continuous ,find the values of a and b

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Exercies 5 C

1. Show that the function f(x) $= x^2$ is continuous and differentiable at x=2.

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2. Show that the function $f(x) = \begin{cases} 5-x, & x \geq 2 \\ x+1, & x < 1 \end{cases}$

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3. Show that the function $f(x) = \begin{cases} 1-x, & x < 1 \\ x^2-1, & x \geq 1 \end{cases}$ is continuous but not differentiable at x=1

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4. Show that the function $f(x) = \begin{cases} 3+x, & x \geq 0 \\ 3-x, & x < 0 \end{cases}$ is not differentiable at x=0

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5. show that the function is always differentiable .

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6. Show that the function $f(x) = \begin{cases} x^2 + 2, & x \geq 1 \\ 2x + 1, & x < 1 \end{cases}$ is always differentiable at x=1

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7. Show that the function $f(x) = |x - 3|,\ x \in \ | R,$ is continuous but not differentiable at $x = 3.$

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8. Show that the function $f(x) = \begin{cases} x\dfrac{\sin 1}{x} & , \quad when\ x \neq 00 \\ & when\ x = 0 \end{cases}$ is continuous but not differentiable at $x = 0$.

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9. If $f(x) = \begin{cases} 1+\sin x, & 0 \le x < \pi/2 \\ 1, & x < 0 \end{cases}$ then show that f(0) =|x| does not exist.

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10. If $f(x) = |x|$ then show that $f(3) = 1$

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11. If f(x) =If $f(x) = \begin{cases} x^2 + 3x + a, & x \le 1 \\ bx + 2, & x > 1 \end{cases}$ is differentiable for all values of x, than find the values of 'a' and 'b'.

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12. If $f(x) = \begin{cases} x^2, & x \le 1 \\ x^2 - x + 1, & x > 1 \end{cases}$ then show that f(x) is not differentiable at x=1 .

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13. Prove that the function If $f(x) = \begin{cases} \frac{x}{1+e^{1/x}}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ is not differentiable

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14. Prove that the function

If $f(x) = \begin{cases} 6x - 5, & x \leq 3 \\ 2x^2 - 6x + 13, & x > 3 \end{cases}$ is differentiable at x=3.

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Exercies 5 D

1. sin 5 x

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2. tan 3x

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3. $\cos\left(x^4\right)$

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4. $\tan\left(x^2\right)$

Watch Video Solution

5. $\sin^4 x$

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6. $\cot^2 x$

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7. e^{5x}

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8. $e^{\frac{x}{a}}$

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9. e^{x^2+1}

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10. $\log\left(x^2+3\right)$

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11. $\sin^{\circ}$

Watch Video Solution

12. $\cos x^{\circ}$

Watch Video Solution

13. log cos x

Watch Video Solution

14. log tan x

Watch Video Solution

15. $\sqrt{\sin x}$

Watch Video Solution

Watch Video Solution

16. $\sqrt{\sec x}$

Watch Video Solution

17. $\tan \sqrt{x}$

Watch Video Solution

18. $\text{cosec} \sqrt{x}$

Watch Video Solution

19. $e^{\sin x}$

Watch Video Solution

20. $e^{\tan x}$

Watch Video Solution

21. $\cos e^{x}$

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22. $\tan(e^{x}+5)$

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23. $\dfrac{1}{\sqrt{x+1}+\sqrt{x}}$

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24. $e^{mx}.\cos nx$

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25. $e^{-2x}\sin 4x$

Watch Video Solution

26. $\sqrt{ax^2+bx+c}$

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27. $\sqrt{\log x}$

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28. $\dfrac{e^x+e^{-x}}{e^x-e^{-x}}$

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29. $\log\left(x+\frac{1}{x}\right)$

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30. $\log s\left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)$

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31. $\sin^3(ax+b)$

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32. $\log\left(\sin x^2\right)$

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33. log (sec 2x +tan 2 x)

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34. log {log (cos x}

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35. Differentiate $\log \tan\left(\frac{\pi}{4}+\frac{x}{2}\right)$ with respect to x :

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36. Differentiate $\log \sqrt{\frac{1+\sin x}{1-\sin x}}$ with respect to x :

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37. $\frac{x}{\sqrt{1-x^2}}$

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38. $y = \frac{a^2 + x^2}{\sqrt{a^2 - x^2}}$ then dy/dx=

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39. $e^{(x^2)\,/\,(1+x^2)}$

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40. $\log\left(x + \sqrt{x^2 - 1}\right)$

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41. $\log \sqrt{\frac{1 + x^2}{1 - x^2}}$

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42. $\tan^2\left(\frac{\pi x^2}{2}\right)$

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43. $\sqrt{\frac{1-\tan x}{1+\tan x}}$

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44. $e^x.\log(\sin 2x)$

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45. If $y=\sqrt{\frac{1-x}{1+x}}$ then $\frac{dy}{dx}$ equals

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46. find the derivative of the function w.r.t $x\sqrt{\frac{a^2-x^2}{a^2+x^2}}$

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47. $\sin\left(\frac{1+x^2}{1-x^2}\right)$

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48. If $x \in (\pi, 2\pi)$, prove that $\frac{\left(\sqrt{1+\cos x}\right)+\left(\sqrt{1-\cos x}\right)}{\left(\sqrt{1+\cos x}\right)-\sqrt{1-\cos x}} = \cot\left(\frac{\pi}{4}+\frac{x}{2}\right)$

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49. If $y = \sin x.\cos(2x)$ then prove that $\frac{dy}{dx} = y[\cot x - 2\tan 2x]$

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50. If $y = \log\left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)$. Prove that $\frac{dy}{dx} = \frac{x-1}{2x(x+1)}$

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51. if $y = \sqrt{\frac{1-\cos x}{2}}$, the n prove that $\frac{dy}{dx} = \frac{1}{2}\cos\frac{x}{2}$.

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Exercies 5 E

1. $\sin^{-1} 3x$

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2. $\cot^{-1}\sqrt{x}$

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3. $\sin^{-1}(ax)$

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4. $\cos^{-1}\left(\frac{x}{a}\right)$

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5. (i) $\tan^{-1}\sqrt{x}$ (ii) $\tan^{-1}(2x+1)$

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6. $\log\left(\sin^{-1}x\right)$

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7. $\cos ec^{-1}3x$

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8. $\sec^{-1}\left(\frac{x}{a}\right)$

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9. $\cos^{-1}\left(\frac{1-x}{1+x}\right)$

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10. $\sin^{-1}\frac{x}{1+x}$

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11. $\sin\left(\tan^{-1}2x\right)$

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12. $\tan^{-1}(\cos\sqrt{x})$

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13. $2\tan^{-1}x - \log(1+x^2)$

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14. $\sqrt{\cot^{-1}\sqrt{x}}$

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15. $e^{ax}.\sin^{-1}bx$

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16. $e^{ax}.\sin^{-1}bx$

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17. (i)$b\tan^{-1}\left(\frac{x}{a}+\tan^{-1}\frac{x}{a}\right)$

(ii) $\left(\sin^{-1}x\right)^2-\left(\cos^{-1}x\right)^2$

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18. $\cos\left(a\sin^{-1}\frac{1}{x}\right)$

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19. If $y=x\sin^{-1}x+\sqrt{1-x^2}$ then prove that $\frac{dy}{dx}=\sin^{-1}x.$

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Exercies 5 F

1. Differentiate `tan^(-1){sqrt((1+cosx)/(1-cosx))},\ \ 0

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2. $\tan^{-1}\left(\frac{\cos x}{1+\sin x}\right)$

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3. $\cos^{-1}\left(\frac{\sqrt{1+\cos x}}{2}\right)$

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4. $\tan^{-1}\left(\frac{\sin x}{1+\cos x}\right)$

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5. $\tan^{-1}\left(\sqrt{\frac{1-\cos 3x}{1+\cos x}}\right)$

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6. $\sec^{-1}\left(\frac{1+\tan^2 x}{1-\tan^2 x}\right)$

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7. $\cos ec^{-1}\left(\frac{1+\tan^2 x}{2\tan x}\right)$

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8. $\sin^{-1}(\cos x)+\tan^{-1}(\cot x)$

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9. $\sin^{-1}(1-2x^2)$

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10. The derivative of $\cos^{-1}(2x^2 - 1)$ w.r.t. $\cos^{-1}$ is

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11. $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$

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12. Differentiate $\cos^{-1}(4x^3 - 3x)$ with respect to x , if $x \in \left(\frac{1}{2}, 1\right)$

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13. Differentiate $\sin^{-1}(3x - 4x^3)$ with respect to x , if `1/2

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14. $\tan^{-1}\left(\frac{1+x}{1-x}\right)$

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15. $\cos^{-1}\left(\frac{1-x^{2n}}{1+x^{2n}}\right)$

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16. $\cos^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right)$

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17. Differentiate $\tan^{-1}\left(\frac{a+x}{1-ax}\right)$ with respect to x

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18. $\cos^{-1}\left(\frac{x-x^1}{x+x^{-1}}\right)$

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19. $\cot^{-1}\left(\sqrt{1+x^2}-x\right)$

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20. Differentiate `tan^(-1)((3a^2x-x^3)/(a^3-3a x^2)),\ -1/(sqrt(3))

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21. $\tan^{-1}\left(\frac{3-5x}{1+15x}\right)$

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22. $\tan^{-1}\left(\frac{5x}{1-6x^2}\right)$

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23. $\tan^{-1}\left(\frac{2x}{1-15x^2}\right)$

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24. Differentiate $\tan^{-1}\left(\frac{4\sqrt{x}}{1-4x}\right)$

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25. $\sin^{-1}\left[x\sqrt{1-x}-\sqrt{x}\sqrt{1-x^2}\right]$

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26. $\sin^{-1}\left(\frac{x-1}{x+1}\right)+\sec^{-1}\left(\frac{x+1}{x-1}\right)$

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27. $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$

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28. If $y=\tan^{-1}\left\{\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right\}$, `-1

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29. Differentiate the following functions w.r.t.x

$\sin\left[2\tan^{-1}\sqrt{\frac{1-x}{1+x}}\right]$

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30. $\tan^{-1}\sqrt{\frac{1+\sin x}{1-\sin x}}$

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31. If $y = x\sqrt{a^2 - x^2} + a^2 \sin^{-1}\left(\frac{x}{a}\right)$ then prove that $\frac{dy}{dx} = 2\sqrt{a^2 - x^2}$

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Exercies 5 G

1. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

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

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3. $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$

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4. If $x^{2/3} + y^{2/3} = a^{2/3}$, find $\frac{dy}{dx}$

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5. $5x^2 + 5y^2 - 7y + 3x = 2 = 0$

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6. $\sin(xy) + \frac{x}{y} = x^2 - y$

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7. $x^2 + y^2 = \log(xy)$

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8. xsin 2y = y cos 2x

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9. $y \sec x - y^2 \cos x + 2x = 0$

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10. $e^x \log y = \sin^{-1} x + \sin^{-1} y$

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11. If $\sqrt{1-x^6} + \sqrt{1-x^6} = a\left(x^3 - y^3\right)$, then prove that $\frac{dy}{dx} = \frac{x^2}{y^2}\sqrt{\frac{1-y^6}{1-x^6}}$

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12. If $e^x + e^y = e^{x+y}$ then prove that $\frac{dy}{dx} = -e^{y-x}$

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Exercies 5 H

1. $y = x^{\sin 2x}$

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2. $y = (\log x)^x$

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3. $y = (\log_e x)^{\sin x}$

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4. $y = x^{\tan x}$

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5. $y = (\sin x)^{\log x}$

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6. $y = (1 + x)^{x}$

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7. Find $\frac{dy}{dx}$ when $(\tan x)^{y} = (\tan y)^{x}$

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8. $y = (\sin x)^{\tan x} + (\cos x)^{\sec x}$

Watch Video Solution

9. $y = (\sin x)^{\cos x} + (\cos x)^{\sin x}$

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10. $y = (\tan x)^{\cot x} + (\cot x)^{\tan x}$

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11. $y = x^{\log x} + (\log x)^{x}$

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12. $y = e^{\sin x} + (\tan x)^{x}$

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13. $(\cos x)^y = (\sin y)^x$

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14. $y = (\tan x)^{\log x} + (\cos x)^{\sin x}$

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15. $y = x^{\sin x} + a^{\sin x}$

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16. (i) $y = \dfrac{(x-a)(x-b)}{\sqrt{x-c}}$ (ii) $y = \sqrt{\dfrac{(x-a)(x-b)}{(x-c)(x-d)}}$

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17. $y = \sin x \cdots \in 2x \cdots \in 4x \cdots \in 8x$

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18. $y = \sqrt{\frac{x^2 + x + 1}{x^2 - x + 1}}$

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19. $y = \frac{(x+1)^2 \cdot \sqrt{x-1}}{(x+3)^3 e^x}$

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20. $y = (x+1)^2 (x+2)^3 (x+3)^4$

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21. $y = \tan x \tan 2x \tan 3x \tan 4x$

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22. (i) $x^y \cdot y^x = 1$ (ii) $y = e^{x^x}$

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23. (i) $y = e^x \sin^3 x \cos^4 x$ (ii) $y = x \cdot e^{x \sin x}$

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24. If y=$\sqrt{x+y}$ then prove that $\frac{dy}{dx} = \frac{1}{2y-1}$

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

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26. If $x(x) + y^y = 1$ then find $\frac{dy}{dx}$.

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Exercies 5 I

1.

$If y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + ... \infty}}}$ then prove that $\frac{dy}{dx} = \frac{\cos x}{2y -$

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2.

$If y = \sqrt{\cos x + \sqrt{\cos x + \sqrt{\cos x + ... \infty}}}$ then prove that $\frac{dy}{dx} = \frac{\sin x}{1 - 2}$

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3.

$If y = \sqrt{\tan x + \sqrt{\tan x + \sqrt{\tan x + ... \infty}}}$ then prove that $\frac{dy}{dx} = \frac{\sec^2}{2y -}$

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4.

$If y = \sqrt{\log x + \sqrt{\log x + \sqrt{\log x + ... \infty}}}$ then prove that $\frac{dy}{dx} = \frac{1}{x(2y}$

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5. If $y = x^{x^{x \ldots \infty}}$ then prove that $x\frac{dy}{dx} = \frac{y^2}{1 - y\log x}$

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6. If $y = (\cos x)^{(\cos x)^{(\cos x) \ldots \infty}}$ then prove that $\frac{dy}{dx} = \frac{y^2 \tan x}{y\log(\cos x) - 1}$.

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7. If $y = e^{x+e^{x+e^{x+\ldots\ldots\infty}}}$,prove that $\frac{dy}{dx} = \frac{y}{1-y}$

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8. If $y = x + \frac{1}{x + \frac{1}{x+\ldots\ldots\infty}}$ then prove that xdy/dx =y/(2y -x).`

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9. $y = x^2 + \frac{1}{x^2 + \frac{1}{x^2+\ldots\ldots\infty}}$ then prove that $x\frac{dy}{dx} = \frac{2xy^2}{1+y^2}$.

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10. If $y = \sqrt{x}^{\sqrt{x}^{\sqrt{x}\ldots\infty}}$ then prove that `dy/dx=(y^2)/(x(2-y log x)).

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Exercies 5 J

1. x=a cos t, y=b sin t

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2. $x = a\left(\cos t + \log \tan\left(\frac{t}{2}\right)\right), y = a \sin t$ then find $\frac{dy}{dx}$

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3. $x = a \tan \theta, y = b \sec \theta$

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4. $x = 2\cos^2 t, y = 6\sin^2 t$

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5. $x = \sqrt{\sin 2t}, y = \sqrt{\cos 2t}$

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6. $x = a(t - \sin t), y = a(1 - \cos t)$

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7. If $x = \frac{3at}{1+t^3}, y = \frac{3at^2}{1+t^3}, then \frac{dy}{dx}$ is

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8. $x = 2\cos t - \cos 2t, y = 2\sin t - \sin 2t$ Find d y / d x

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9. $x = a\sin 2t(1 + \cos 2t), y = b\cos 2t(1 - \cos 2t)$ find $\frac{dy}{dx}$

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10. Find $\frac{dy}{dx}$, when $x = \frac{\cos^{-1} 1}{\sqrt{1+t^2}} \text{and} y = \frac{\sin^{-1} t}{\sqrt{1+t^2}}, tR$

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11. $x = 3\sin t - 2\sin^3 t, y = 3\cos t - 2\cos^3 t$then find $\frac{dy}{dx}$

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12. $x = e^t(\sin t + \cos t), y = e^t(\sin t - \cos t)$

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13. If $x = a(\cos t + t\sin t)$ and `y=a(sint-tcost),\ 0

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14. If $x = a(\cos t + t \sin t)$ and `y=a(sint-tcost),\ 0

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Exercies 5 K

1. Differentiate x^8 with respect to x^4

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2. Differentiate e^x with respect to $\sqrt{x}$)

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3. Differentiate $x \sin^{-1} x$ with respect to $\cos^{-1} x$.

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4. Differentiate (log x) with repect to tan x.

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5. Differentiate log x with respect to sin x

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6. Differentiate $\sin^{-1}\left(2x\sqrt{1-x^2}\right)$ with respect to $\sin^{-1}x$.

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7. Differentiate $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ with respect to $\tan^{-1}x, x \neq 0$.

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8. Differentiate $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$ with respect to $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$, if $x \in (-1, 1)$

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9. Differentiate $\sec^{-1}\frac{1}{2x^2-1}$ with respect to $\sqrt{1-x^2}$

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10. Differentiate $\tan^{-1}\left(\frac{x}{\sqrt{1-x^2}}\right)$ with respect to $\cos^{-1}(2x^2-1)$.

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11. Differentiate $\tan^{-1}\sqrt{\frac{1-x^2}{1+x^2}}$ with respect to $\cos^{-1}x^2$

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12. Differentiate $\tan^{-1}\left\{\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}\right\}$ with respect to $\cos^{-1}x^2$

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Exercies 5 L

1. Find the 2nd derivative if x^3 log x with respect to x.

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2. If $y=\tan^{-1}x^3$ then find $\frac{d^2y}{dx^2}$.

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3. Find the 2nd dervative of e^{ax+b} with respect to x.

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4. If $y = x + \cot x$ then prove that $\sin^2 x \frac{d^2y}{dx^2} - 2y2x = 0.$

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5. If $y = \log(\sin x)$, prove that $\frac{d^3y}{dx^3} = 2\cos x \cos ec^3 x$.

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6. If $y = A\cos nx + B\sin nx$, $showthat$ $\frac{d^2y}{dx^2} + n^2y = 0$

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7. (i) If $y = a\sin(\log x)$ then prove that $x^2 \cdot \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$. (ii) If $y = a\cos(\log_e x) + b\sin(\log_e x)$, then prove that $x^2 \cdot y_2^2 + x \cdot y_1 + y = 0.$

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8. If $y = \left(\sin^{-1} x\right)^2$ then prove that $\left(1 - x^2\right)\frac{d^2y}{dx^2} - x\frac{dy}{dx} - 2 = 0.$

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9. If $y = \sin(\sin x)$ then prove that

$$\frac{d^2y}{dx^2} + \tan x.\ \frac{dy}{dx} + y\cos^2 x = 0$$

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10. IF $y = e^{\tan^{-1} x}$ then prove that :

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

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11. If $y^3 - 3ax^2 + x^3 = 0,$ then prove that $\frac{d^2y}{dx^2} + \frac{2a^2x^2}{y^5} = 0$

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

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13. If $y = e^{\tan x}$ then prove that:

$\cos^2 x \frac{d^2y}{dx^2} - (1+\sin 2x)\frac{dy}{dx} = 0$

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14. If $y = Ae^{-kt}\cos(pt+c)$, then prove that $\frac{d^2y}{dt^2} + 2k\frac{dy}{dx} + n^2y = 0$, where $n^2 = p^2 + k^2$

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

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16. If $x = a(t - \sin t), y = a(1 - \cos t)$ then find $\frac{d^2y}{dx^2}$.

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17. If $x = \sin t$ and $y = \sin mt$ then prove that $\sqrt{1 - x^2}\frac{d^2y}{dx^2} - x\frac{dy}{dx} + m^2y$.

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18. If $y = \left(\sin^{-1} x\right)^2 + \left(\cos^{-1} x\right)^2$, then prove that $\left(1 - x^2\right)y_2 - xy_1 - 4 = 0.$

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Exercies 5 M

1. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = x^2 in the interval $[-2, 2]$.

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2. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $x^2 - 5x - 6$ in the interval $[-1, 6]$.

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3. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $x^2 - 6x + 8$ in the interval [2,4].

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4. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $x(x-4)^2$ in the interval [0,4].

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5. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $x^3 - 7x^2 + 16x - 12$ in the interval [2,3].

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6. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $(x-2)(x-4)(x-6)$, in the interval [2,6].

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7. Verify Rolle's theorem for the following functions in the given intervals.

(i) f(x) = $(x-2)(x-3)^2$ in the interval [2,3] .

(ii) f(x) = $x^3(x-1)^2$ in the interval [0,1].

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8. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = $(x-2)^4(x-3)^3$ in the interval [2,3].

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9. Verify Rolle's theorem for the following functions in the given intervals.

f(x) sin x in the interval $[0, \pi]$.

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10. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = sin 3x in the interval $[0, \pi]$.

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11. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = sinx + cos x in the interval $[0, \pi/2]$.

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12. Verify Rolle's theorem for the following functions in the given intervals.

$f(x) = \sin^2 x$ in the interval $[0, \pi]$.

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13. Verify Rolle's theorem for the following functions in the given intervals.

f(x) = e^x cos x in the interval $[-\pi/2, \pi/2]$.

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14. Discuss the applicability of the Rolle's theorem for the following functions in the given intervals.

(i) f(x) = $(x-2)(2x-1)$ in the interval [1,2].

(ii) f(x) = tan x in the interval $[0, \pi]$.

(iii) f(x) = sin $\frac{1}{x}$ in the interval [-2,2] .

(iv) f(x) = |x| in the interval [-2,2] .

(v) f(x) = $x^{1/3}$ in the interval [-2,2].

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15. Verify Rolles theorem for the function $f(x) = \log\left\{\frac{x^2 + ab}{x(a+b)}\right\}$ on $[a,\ b]$, where `0

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16. Using Rolle's theorem , find a point on the curve $y = x^2, x \in [-1, 1]$ at which the tangent is parallel to X-axis.

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17. Using Rolle's theroem, find the point on the curve $y = x(x-4), x \in [0, 4]$, where the tangent is parallel to X-axis.

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18. Verify Rolle's theorem for the function

$f(x) = 2x^3 + x^2 - 4x - 2$ in the interval $\left[-\frac{1}{2}, \sqrt{2}\right]$.

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19. It is given that for the function f given by $f(x) = x^3 + bx^2 + ax$, $x \in [1, 3]$. Rolles theorem holds with $c = 2 + \frac{1}{\sqrt{3}}$. Find the values of a and b.

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Exercies 5 N

1. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $x^2 + x - 2$ in the interval [0,4] .

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2. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $1 + 2x - x^2$ in the interval [0,1] .

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3. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $x(x + 2)^2$ in the interval [0,2]

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4. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $(x-2)(x-3)(x-4)$, in the interval [2,5]/

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5. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = e^x in the interval [0,1].

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6. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

(i) f(x) = sin x in the interval $[\pi/2, 5\pi/2]$.

(ii) f(x) = $\log_e x$ in the interval [1,e].

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7. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $\sqrt{x^2 - 4}$ in the interval [2,4]

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8. Verify Lagrange's Mean Value theorem for the following functions in the given intervals

f(x) = $\tan^{-1} x$ in the interval [0,1]

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9. Using Lagrange's theorem , find the value of c for the following functions :

(i) $x^3 - 3x^2 + 2x$ in the interval [0,1/2].

(ii) f(x) = $2x^2 - 10x + 1$ in the interval [2,7].

(iii) f(x) = (x-4) (x-6) in the interval [4,10].

(iv) f(x) = $\sqrt{x-1}$ in the interval [1,3].

(v) f(x) = $2x^2 + 3x + 4$ in the interval [1,2].

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10. Using Lagranges mean value theorem, find a point on the curve $y = \sqrt{x-2}$ defined on the interval [2,3], where the tangent is parallel to the chord joining the end points of the curve.

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11. Using Lagrange's Mean Value theorem , find the co-ordinates of a point on the curve $y = x^3$ at which the tangent drawn is parallel to the chord joining the points (1,1) and (3,27).

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Exercies 5 O

1. Discuss the continuity of the function

$$f(x) = \begin{cases} \frac{|x|}{x}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$ at x=0

A. $x > 0$

B. $x < 0$

C. 0

D. None of these

Answer: C

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

A. R

B. $R - \{n\pi, n \in Z\}$

C. $R - \left\{\frac{n\pi}{2}, n \in Z\right\}$

D. None of these

Answer: D

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3. The function $f(x) = \begin{cases} 2ax, & x \geq 3 \\ 3x + 1, & x > 3 \end{cases}$ continuous at x= 3, then a =?

A. $\frac{5}{3}$

B. $\frac{5}{2}$

C. 5

D. None of these

Answer: A

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4. the function $f(x) = \begin{cases} \frac{\sin x}{x} + \cos x, & x \neq 0 \\ k, & x = 0 \end{cases}$ is continuous at $x = 0$ then find the value of k

A. 1

B. 2

C. 3

D. None of these

Answer: B

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5. The function $f(x) = \begin{cases} 5x - 4, & 0 < x \leq 1 \\ 4x^3 - 3x, & 1 < x < 2 \end{cases}$

A. continuous at x=1

B. discontinuous at x= 1

C. continuous at x= 2

D. None of these

Answer: A

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6. The function $f(x) = 2x - |x|$

A. discontinuous at x=0

B. continuous at =x 0

C. discontinuous at x= 1

D. None of these

Answer: B

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7. The value of 'k' for which $f(x) = \begin{cases} kx^2, & x \geq 2 \\ 12, & x < 2 \end{cases}$

continuous at x=2 is :

A. 1

B. 2

C. 3

D. 4

Answer: C

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8. The value of k for which $f(x) = \begin{cases} \frac{1-\cos 2x}{x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$

continuous at x=0, is :

A. 1

B. 2

C. 3

D. 4

Answer: B

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9. If the function $f(x) = \begin{cases} 3ax + b, & x > 1 \\ 11, & x = 1 \\ 5ax - 2b, & x < 1 \end{cases}$

continuous at x= 1 then (a, b) =?

A. (3,2)

B. (2,3)

C. (1,4)

D. (4,1)

Answer: A

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10. The value of 'a' for which $f(x) = \begin{cases} \frac{\sin^2 ax}{x^2}, & x \neq 0 \\ 1, & x = 1 \end{cases}$

is continuous at x=0 , is

A. ± 1

B. ± 2

C. 0

D. ± 3

Answer: A

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11. If $y = \sin^{-1} \frac{1}{\sqrt{1+x^2}}$ then $\frac{dy}{dx}$ at $x = 0$ is :

A. 1

B. 3

C. -1

D. None of these

Answer: C

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12. If $y = \frac{x}{x+5}$ then $x\frac{dy}{dx} = ?$

A. y(1-y)

B. y(1-y)

C. (1-y)

D. (1+y)

Answer: A

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13. If $x^y = e^{x-y}$ then $\frac{dy}{dx}?$

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

B. $\frac{1}{(\log ex)^2}$

C. $\frac{\log x}{(\log ex)^2}$

D. $\frac{1}{(\log ex)^2}$

Answer: C

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14. If $y = \tan^{-1}\left(\frac{x}{\sqrt{a^2 - x^2}}\right)$ then $\frac{dy}{dx} = ?$

A. $\frac{1}{\sqrt{a^2 - x^2}}$

B. $\frac{1}{\sqrt{x^2 - a^2}}$

C. $\frac{1}{\sqrt{a^2 + x^2}}$

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

Answer: A

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15. If $y = \tan^{-1}\left(\frac{1-x}{1+x}\right) + \cot^{-1}\left(\frac{1-x}{1+x}\right)$ then $\frac{dy}{dx}$?

A. -1

B. 1

C. 0

D. None of these

Answer: C

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16. If $y = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, then $\frac{dy}{dx} = -\frac{2}{1+x^2}$ (b) $\frac{2}{1+x^2}$ (c) $\frac{1}{2-x^2}$ (d) $\frac{2}{2-x^2}$

A. $\frac{2}{1+x^2}$

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

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

D. None of these

Answer: B

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17. If $y=\sqrt{\log x+\sqrt{\log x+\sqrt{\log x+\infty}}}, then \frac{dy}{dx} is$ $\frac{x}{2y-1}$ (b) $\frac{x}{2y+1}$ $\frac{1}{x(2y-1)}$ (d) $\frac{1}{x(1-2y)}$

A. $\frac{x}{2x-1}$

B. $\frac{y}{2x-1}$

C. $\frac{1}{x}(2y-1)$

D. $\frac{1}{y(2x-1)}$

Answer: C

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18. Differentiate $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ with respect to $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$, if `-1

A. 1

B. 2

C. -1

D. 2

Answer: A

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19. If $f(x) = x^2 + 7x + 10$ then $f'(2) = ?$

A. -4

B. $-\frac{5}{2}$

C. -11

D. 11

Answer: D

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20. At which point the slope to tangent is zero for the curvey $y = x^2 - 6x + 8$?

A. (3,1)

B. (3,-1)

C. (-3 ,1)

D. (-3 ,-1)

Answer: B

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Exercies 5 P

1. $f(x) = \begin{cases} \frac{|x^2 - x|}{x^2 - x} & x \neq 0,1 \\ 1, & x = 0 \\ -1, & x = 0 \end{cases}$ is continuose for all :

A. x

B. x except at x = 0

C. x except at x = 1

D. x except at = and x = 1

Answer: D

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2. Let $f(x) = \left\{ \frac{x-4}{|x-4|} + a, x < 4a + b, \frac{x-4}{|x-4|} + b, x > 4 \right.$ Then $f(x)$ is continous at $x = 4$ when $a = 0, b = 0$ b. $a = 1, b = 1$ c. $a = -1, b = 1$ d. $a = -1, b = -1$

A. (0, 0)

B. (1, 1)

C. (-1, 1)

D. (1, -1)

Answer: D

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3. The points of discontinuity of the function

$$f(x) = \begin{cases} 3x + 1, & 0 \leq x < 2 \\ 4x - 1, & 2 < x \leq 6 \\ 5x + 2, & 6 < x \leq 10 \end{cases}$$ are:

A. 6

B. 2

C. 6, 2

D. 6, 2, 0

Answer: A

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4. If $f(x) = x\frac{\sin(1)}{2}, x \neq 0$ then the value of the ltbRgt function at x = 0 so that the function is continuous at x= -0 , is :

A. 1

B. 0

C. -1

D. None of these

Answer: B

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5. The value of $f(0)$, so that the function $f(x) = \frac{(27-2x)^2 - 3}{9 - 3(243+5x)^{1/5} - 2}(x \neq 0)$ is continuous, is given $\frac{2}{3}$ (b) 6 (c) 2 (d) 4

A. 2

B. 4

C. 6

D. None of these

Answer: A

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6. If $(x) = |x| + |x - 1|,$ than :

A. f(x) is continous at x = 0 and at x = 1

B. f(x) is continous at x = -0 and discontinuous at a x = 1

C. f (x) is discontinous at x = 0 and continuous at x = 1

D. None of these

Answer: A

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7. $If f(x) = \begin{cases} \frac{\sqrt{1+\lambda x}-\sqrt{1-\lambda x}}{x}, & -1 \leq x < 0 \\ \frac{2x+1}{x-2}, & -0 \leq x < 1 \end{cases}$ is

continuous at x = 0 then $\lambda = ?$

A. -1

B. 1

C. $-\frac{1}{2}$

D. $\frac{1}{2}$

Answer: C

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8. If $f(x)\begin{cases} \frac{1-\cos 8x}{x^2}, & x \geq 0 \\ \lambda, & x < 0 \end{cases}$ is continous at

x = 0 than λ = ?

A. 32

B. 16

C. 64

D. 8

Answer: A

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9. f(x) = [x] (greatest integer function) is continuous at x = 0 then f(0) = ?

A. 0

B. -1

C. 1

D. $1/2$

Answer: D

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10. If $f(x) = \frac{2x + 3\sin x}{3x + 2\sin x}$, x ne 0 is continous at x = 0 then f (0) = ?

A. -1

B. 0

C. 1

D. None of these

Answer: C

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11. If $f(x) = \sin^{-1}\left(\frac{2x}{1 + x^2}\right)$ then $f(x)$ is differentiable on

A. $[-1, 11]$

B. $R - \{-1, 1\}$

C. $R - (-1, 1)$

D. None of these

Answer: B

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12. If $\tan^{-1}\left\{\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}\right\}=\alpha,$ then prove that $x^2=\sin 2\alpha$

A. $\frac{-x}{\sqrt{1-x^4}}$

B. $\frac{x}{\sqrt{1-x^4}}$

C. $\frac{-x}{\sqrt{1-x^2}}$

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

Answer: A

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13. $\frac{d}{dx}\left[\log\left\{e^x\left(\frac{x-2}{x+2}\right)^{\frac{3}{4}}\right\}\right]=$

A. $\left((x^2-1)\right.$

B. 1

C. $\frac{x^2+1}{x^2-4}$

D. $e^x . \frac{x^2-1}{x^2-4}$

Answer: A

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14. If x = $a\cos^3\theta, y = a\sin^3\theta$ then $\sqrt{1+\left(\frac{dy}{dx}\right)^2}$ =?

A. $\tan^2\theta$

B. $\sec^2\theta$

C. $\sec\theta$

D. $|\sec\theta|$

Answer: D

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15. If $f(x) = \tan^{-1}\sqrt{\frac{1+\sin x}{1-\sin x}}, 0 \le x \le \frac{\pi}{2}$ then $f'\left(\frac{\pi}{6}\right)$ =?

A. $-\frac{1}{4}$

B. $-\frac{1}{2}$

C. $\frac{1}{4}$

D. $\frac{1}{2}$

Answer: D

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16. The differential coeffcient of

$\cot^{-1}\left(\sqrt{\cos 2x}\right) atx = \frac{\pi}{6}$ is

A. $\sqrt{\frac{2}{3}}$

B. $\sqrt{\frac{1}{3}}$

C. $\sqrt{3}$

D. $\sqrt{6}$

Answer: A

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17. If $y^2 = ax^2 + bx + c$ where a, b c are contants then $y^3 \frac{d^2y}{dx^2} = ?$

A. A constant

B. A function of x

C. A function of y

D. None of these

Answer: A

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18. if $x^2 + y^2 = t - \frac{1}{t}$ and $x^4 + y^4 = t^2 + \frac{1}{t^2}$ then prove that $\frac{dy}{dx} = \frac{1}{x^3 y}$

A. 0

B. 1

C. -1

D. None of these

Answer: B

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19. If $y^{\frac{1}{m}} = x + \sqrt{1 + x^2}$ then $\left(1 + x^2\right) y_2 + x y_1 = ?$

A. my

B. $m^2 y$

C. $m^2 y^2$

D. None of these

Answer: B

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20. If $y = \sin^2\alpha + \cos^2(\alpha+\beta) + 2\sin\alpha\sin\beta\cos(\alpha+\beta)$ then $\frac{d^3y}{da^3} = ?$

A. $\frac{\sin^3(\alpha+\beta)}{\cos\alpha}$

B. $\sin(\alpha+\beta)$

C. 0

D. 1

Answer: C

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Exercies 5 1

1. Prove that the function $f(x) = 5x - 3$is continuous at $x = 0$, at $x = -3$and at $x = 5$.

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

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3. Examine the following functions for continuity.(a) $f(x) = x - 5$ (b) $f(x) = \frac{1}{x-5}$ (c) $f(x) = \frac{x^2 - 25}{x + 5}$(d) $f(x) = |x - 5|$

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

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5. 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 = 2 ?

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6. $f(x) = 2x + 3$ if $x \leq 2$ and $f(x) = 2x - 3$ if $x > 2$

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7. $f(x) = \begin{cases} |x| + 3 & \text{if } x \leq -3 \\ -2x & \text{if } -3 < x < 3 \\ 6x + 2 & \text{if } x \geq 3 \end{cases}$

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8. $\begin{cases} \frac{|x|}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$

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9. $\begin{cases} \frac{x}{|x|}, & \text{if } x < 0 \\ -1, & \text{if } x \geq 0 \end{cases}$

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10. $f(x)\begin{cases} x+1, & \text{if } x \geq 1 \\ x^2+1, & \text{if } x < 1 \end{cases}$

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11. $f(x)\begin{cases} x^3-3, & \text{if } x \leq 2 \\ x^2+1, & \text{if } x > 2 \end{cases}$

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12. $f(x)\begin{cases} 10^3-1, & \text{if } x \leq 1 \\ x^2, & \text{if } x > 1 \end{cases}$

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13. Is the function defined by $f(x) = \{x + 5, \quad \text{if} \quad x \leq 1x - 5, \quad \text{if} \quad x > 1$ a continuous function?

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14. Discuss the continuity of the function f, where f is defined by

$$f(x)\begin{cases} 3, & \text{if} \quad 0 \leq x \leq 1 \\ 4, & \text{if} \quad 1 < x < 3 \\ 5, & \text{if} \quad 3 \leq x \leq 10 \end{cases}$$

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15. $f(x)\begin{cases} 2x, & \text{if} \quad x < 0 \\ 0, & \text{if} \quad 0 \leq x \leq 1 \\ 4x, & \text{if} \quad x > 1 \end{cases}$

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16. $f(x)\begin{cases} -2, & \text{if } x \leq -1 \\ 2x, & \text{if } -1 < x \leq 1 \\ 2, & \text{if } x > 1 \end{cases}$

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17. Find the relationship between a and b so that the function f defined by $f(x) = \{ax + 1, \quad \text{if} \quad x \leq 3bx + 3 \quad \text{if} \quad x > 3$is continuous at $x = 3$.

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18. For what value of $\lambda$is the function defined by $f(x) = \{\lambda(x^2 - 2x), \quad \text{if} \quad x \leq 04x + 1, \quad \text{if} \quad x > 0$continuous at $x = 0$? What about continuity at $x = 1$?

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19. Show that the function defined by $g(x) = x - [x]$ is discontinuous at all integral points which [x] denotes the greatest integer function.

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

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21. Discuss the continuity of the following functions:(a) $f(x) = s \in x + \cos x$ (b) $f(x) = s \in x \cos x$ (c) $f(x) = s \in x\dot{\cos} x$

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

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23. 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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24. Determine if f defined by $f(x) = \begin{cases} x^2 \frac{\sin 1}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$

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25. 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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26. $f(x) = \begin{cases} \frac{k \cos x}{(\pi - 2x)}, & \text{if } x \neq \frac{\pi}{2} \\ 3, & \text{if } x = \frac{\pi}{2} \end{cases}$ $at x = \frac{\pi}{2}$.

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27. $f(x) = \begin{cases} kx^2, & \text{if } x \leq 2 \\ 3, & \text{if } x > 2 \end{cases}$ at x = 2

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28. Find the value of k for which $f(x) = \{kx + 1$ when $x \leq \pi \cos x$ when $x > \pi$

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29. Find the values of k so that the function f is continuous at the indicated point in $f(x) = \{kx + 1, \text{ if } x \leq 53x - 5, \text{ if } x > 5$ at $x = 5$

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30. Find the values of a and b such that the function defined by `f(x)={5, ifxlt=2a x+b , if2

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

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

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33. Examine that sin $|x|$ is a continuous function.

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

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Exercies 5 2

1. $\sin\left(x^2+5\right)$

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2. $\cos(\sin x)$

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3. $\sin(ax+b)$

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4. differentiate $\sec\left(\tan\left(\sqrt{x}\right)\right)$

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5. Differentiate : $\frac{\sin(ax+b)}{\cos(cx+d)}$

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6. Differentiate $\cos x^3 \cdot \sin^2\left(x^5\right)$

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7. Find $\frac{dy}{dx}$ for y=$2\sqrt{\cot\left(x^2\right)}$

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8. If $y = f(a)$ is a differentiable function of a and $a = g(x)$ is a differentiable function of x then $y = f(g(x))$ is a differentiable function of x and $\frac{dy}{dx} = \frac{dy}{da} \text{x} \frac{da}{dx}$.This rule is also known as CHAIN RULE. Based on the above information find the derivative of functions with respect to x in the following questions.

$\cos\left(\sqrt{x}\right)$

A. $\frac{\cos\left(\sqrt{x}\right)}{2\sqrt{x}}$

B. $-\frac{\cos\left(\sqrt{x}\right)}{2\sqrt{x}}$

C. $\frac{\sin\left(\sqrt{x}\right)}{2\sqrt{x}}$

D. $-\frac{\sin\left(\sqrt{x}\right)}{2\sqrt{x}}$

Answer: D

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

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10. Prove that the greatest integer function defined by $f(x) = [x], 0 < x < 3$is not differentiable at $x = 1 and x = 2.$

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Exercies 5 3

1. Find $\frac{dy}{dx}$ in the following

$2x + 3y = \sin x$

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2. $2x + 3y = \sin y$

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3. $ax + by^2 = \cos y$

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4. $xy + y^2 = \tan x + y$

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5. $x^2 + xy + y^2 = 100$

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6. $x^3 + x^2y + xy^2 + y^3 = 81$

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7. $\sin^2 y + \cos xy = k$

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8. $\sin^2 x + \cos^2 y = 1$

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9. Graph of $y = \sin^{-1}\left(\frac{2x}{1+x^2}\right)$

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10. $y = \tan^{-1}\left[\frac{3x - x^3}{1 - 3x^2}\right], -\frac{1}{\sqrt{3}} < x < \frac{1}{\sqrt{3}}$

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11. $y = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right) 0 < x < 1$

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12. $y = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right) 0 < x < 1$

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13. $y = \cos^{-1}\left(\frac{2x}{1+x^2}\right), \ -1 < x < 1$

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14. $y = \sin^{-1}\left(2x\sqrt{1-x^2}\right), \ -\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$

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15. $y = \sec^{-1}\left(\frac{1}{2x^2-1}\right), 0 < x < \frac{1}{\sqrt{2}}$

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Exercies 5 4

1. $\frac{e^x}{\sin x}$

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2. Evaluate: $\int e^{\sin \hat{} ((-1)x)} dx$.

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3. $= e^{x^3}$

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4. Find derivative of $\sin\left(\tan^{-1} e^{-x}\right)$ w.r.t. to x

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

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

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

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8. $\log(\log x), x > 1$

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

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10. Find derivative of $\cos(\log x + e^x)$, $x > 0$ w.r.t. to x

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Exercies 5 5

1. $\cos x \cdot \cos 2x \cdot \cos 3x$, find d y/ d x

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2. Differentiate $\sqrt{\frac{(x-1)(x-2)}{(x-3)(x-4)(x-5)}}$ with respect to x

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3. Differentiate $(\log x)^{\cos x}$ with respect to x.

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4. Find the derivative of $x^x - 2^{\sin x}$ w.r.t. x

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5. Find the derivative of $(x+3)^2(x+4)^3(x+5)^4$ w.r.t. x

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

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

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8. Differentiate the function $(\sin x)^x + \sin^1 x$ with respect to x.

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9. $x^{\sin x} + (\sin x)^{\cos x}$

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10. Differentiate $x^{x \cos x} + \frac{x^2 + 1}{x^2 - 1}$ with respect to x :

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

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12. $x^y + y^x = 1$

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13. $y^x = x^y$ then find dy/dx

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14. If $(\cos x)^y = (\cos y)^x$ find $\frac{dy}{dx}$.

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15. If $xy = e^{(x-y)}$, then find $\frac{dy}{dx}$.

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16. 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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17. Differentiate $\left(x^2-5x+8\right)\left(x^3+7x+9\right)$ in three ways mentioned below:(i) by using product rule(ii) by expanding the product to obtain a single polynomial.(iii) by logarithmic differentiation.Do they all give the same answer?

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18. If u, v and w are functions of x, then show that $\frac{d}{dx}(u\dot{v}\dot{w})=\frac{du}{dx}v\dot{w}+u\frac{\dot{dv}}{dx}\dot{w}+u\dot{v}\frac{dw}{dx}$ in two ways - first by repeated application of product rule, second by logarithmic differentiation.

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Exercies 5 6

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

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2. If x and y are connected parametrically by the equations given, without eliminating the parameter, Find $\frac{dy}{dx}.x = a\cos\theta, y = b\cos\theta$

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3. $x = \sin t, y = \cos 2t$

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4. $x = 4t, y = \frac{4}{t}$

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5. $x = \cos\theta - \cos 2\theta, y = \sin\theta - \sin 2\theta$

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6. If $x = a(\theta - \sin\theta)$, $y = a(1 + \cos\theta)$ find $\frac{d^2y}{dx^2}$

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7. If $x = \frac{\sin^3 t}{\sqrt{\cos 2t}}, y = \frac{\cos^3 t}{\sqrt{\cos 2t}}$ show that $\frac{dy}{dx} = 0att = \frac{\pi}{6}$

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8. In the curve $x = a\left(\cos t + \log\tan\left(\frac{t}{2}\right)\right), y = a\sin t$. Show that the portion of the tangent between the point of contact and the x-axis is of constant length.

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9. If $x = a\sec\theta, y = b\tan\theta$ then $\frac{dy}{dx} = ?$

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10. if $x = a(\cos\theta + \theta\sin\theta), y = a(\sin\theta - \theta\cos\theta)$ then $\frac{d^2y}{dx^2}$

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11. If $x = \sqrt{a^{\sin^{-1}t}}, y = \sqrt{a^{\cos^{-1}t}}$ then show that, $\frac{dy}{dx} = -\frac{y}{x}$.

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Exercies 5 7

1. $x^2 + 3x + 2$

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2. x^{20}

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3. $x \cdot \cos x$

Watch Video Solution

4. $\log x$

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5. Find derivative of $x^3 \log x$ w.r.t. to x

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6. $e^x \sin 5x$

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7. $e^{6x}\cos 3x$

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8. $\tan^{-1}x$

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9. differentiate: log(logx)

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10. the derivative of $\sin(\log x)$ is

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11. If $y = 5\ \cos x - 3\ \sin x$, prove that $\frac{d^2y}{dx^2} + y = 0.$

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12. If $y = \cos^{-1} x$, find $\frac{d^2y}{dx^2}$ in terms of y alone.

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

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15. If $y = 500\, e^{7x} + 600\, e^{-7x}$, show that $\frac{d^2y}{dx^2} = 49\, y$.

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16. If $e^y(x+1)=1$, $showthat\frac{d^2y}{dx^2}=\left(\frac{dy}{dx}\right)^2$.

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17. If $y=\left(\tan^{-1}x\right)^2$, show that $\left(x^2+1\right)^2y_2+2x\left(x^2+1\right)y_1=2$

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Exercies 5 8

1. Verify Rolles theorem for the function $f(x)=x^2+2x-8$, $x\in[-4,2]$.

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2. Examine if Rolles theorem is applicable to any of the following functions. Can you say something about the converse of Rolles theorem

from these example?(i) $f(x) = [x]$for $x \in [5, 9]$(ii) $f(x) = [x]$for $x \in [-2, 2]$(iii) `f(x)=x^

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

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4. 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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5. 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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6. Examine the applicability of Mean Value Theorem for all three functions given in the above exercise 2.

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Miscellaneous Exercise

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

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2. Differentiate w.r.t. x the functions$\sin^3 x + \cos^6 x$

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3. Find $\frac{dy}{dx}$ if y= $(5x)^{3\cos 2x}$

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4. $\sin^{-1}\left(x\sqrt{x}\right), 0 \leq x \leq 1$

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5. Differentiate w.r.t. x the function `(cos^(-1)x/2)/(sqrt(2x+7)),-2

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6. $\cot^{-1}\left(\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right) = \frac{x}{2}, x \in \left(0, \frac{\pi}{4}\right)$

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7. $(\log x)^{\log x}, x > 1$

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

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9. $(\sin x - \cos x)^{(\sin x - \cos x)}, \frac{\pi}{4} < x < \frac{3\pi}{4}$

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10. 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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11. Differentiate $x^x \hat{} (2-3) + (x-3)^x \hat{} 2$ with respect to x :

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12. Find $\frac{dy}{dx}$, if `y=12(1-cost), x=10(t-sint),-pi/2

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13. If $y = \sin^{-1} x + \sin^{-1} \sqrt{1 - x^2}$ then find $\frac{dy}{dx}$

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14. If $x\sqrt{1+y} + y\sqrt{1+x} = 0$, prove that $\frac{dy}{dx} = -\frac{1}{(x+1)^2}$.

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

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

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

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19. Using mathematical induction prove that $\dfrac{d}{dx}(x^n) = nx^{n-1}$ for all positive integers n.

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

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

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22. If $y = |f(x)g(x)h(x)lmnabc|$, prove that $\frac{dy}{dx} = |f'(x)g'(x)h'(x)lmnabc|$

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23. If $y = e^a \cos^{(-1)x}, -1 \leq x < 1, showthat$ $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} - a^2y = 0$

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