MATHS

BOOKS - RD SHARMA MATHS (ENGLISH)

DIFFERENTIABILITY

Others

1. Find the values of a and b so that the function $f(x) = \begin{cases} x^2 + 3x + a & \text{if } x \leq 1 \\ bx + 2 & \text{if } x > 1 \end{cases}$ is differentiable at each $x \in R$

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2. Show that $f(x) = \{12x - 13, \quad \text{if } x \leq 3, 2x^2 + 5 \text{ if } x > 3$ is differentiable at $x = 3$. Also, find $f'(3)$.

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3. Show that $f(x) = (x)^{\frac{1}{3}}$ is not differentiable at $x = 0$.

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4. Show that $f(x) = |x - 3|$ is continuous but not differentiable at $x = 3$.

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5. Show that the function $f(x) = \left\{ x^m \sin\left(\frac{1}{x}\right), 0, x \neq 0, x = 0 \right.$ is differentiable at $x = 0$,if $m > 1$ and continuous but not differentiable at $x = 0$,if $0 < m < 1$.

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6. Discuss the continuity and differentiability of the function $f(x) = |x| + |x-1|$ in the interval $(-1, 2)$.

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7. Show that the function f defined as follows

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

is continuous at x=2 but not differentiable.

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8. Discuss the continuity and differentiability of

$$f(x) = \begin{cases} (x-c)\cos\left(\frac{1}{x-c}\right) & x \neq c \\ 0 & x = c \end{cases}$$

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9. Write an example of a function which is everywhere continuous but fails to be differentiable exactly at five points.

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10. Discuss the continuity and differentiability of f(x)=|log|x||

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11. If f is defined by $f(x) = x^2 - 4x + 7$, show that $f'(5) = 2f'\left(\frac{7}{2}\right)$

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12. If f is defined by $f(x) = x^2$, find $f'(2)$.

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13. Find the derivative of the function f defined by $f(x) = mx + c$ at $x = 0$.

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14. Discuss the continuity and differentiability of $f(x) = e^{|x|}$.

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15. If for the function $\varphi(x) = \lambda x^2 + 7x - 4$, $\varphi'(5) = 97$, find λ.

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16. Is $|\sin x|$ differentiable ?What about $\cos|x|$?

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17. The set of points where the function $f(x)$ given by $f(x) = |x-3|\cos x$ is differentiable, is (a) R (b) $R - \{3\}$ (c) $(0, \infty)$ (d) none of these

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18. If $f(x) = \begin{cases} \dfrac{1-\cos x}{x \sin x}, & x \neq 0 \text{ and } \dfrac{1}{2}, x = 0 \end{cases}$ then at $x = 0$, $f(x)$ is (a)continuous and differentiable (b)differentiable but not continuous (c)continuous but not differentiable (d)neither continuous nor differentiable

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19. If $f(x) = \begin{cases} \dfrac{1}{1+e^{\frac{1}{x}}}, & x \neq 00, x = 0, then f(x) \end{cases}$ is continuous as well as differentiable at $x = 0$ continuous but not differentiable at $x = 0$ differentiable but not continuous at $x = 0$ none of these

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20. If $f(x) = |3 - x| + (3 + x)$, where (x) denotes the least integer greater than or equal to x, then $f(x)$ is continuous and differentiable at $x = 3$ continuous but not differentiable at $x = 3$ differentiable but not continuous at $x = 3$ neither differentiable nor continuous at $x = 3$

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21. Let $f(x) = a + b|x| + c|x|^4$, where $a, bandc$ are real constants. Then, $f(x)$ is differentiable at $x = 0$, if $a = 0$ (b) $b = 0$ (c) $c = 0$ (d) none of these

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22. The function $f(x) = \frac{\sin(\pi[x - \pi])}{4 + [x]^2}$, where [] denotes the greatest integer function, (a) is continuous as well as differentiable for all

$x \in R$ (b) continuous for all x but not differentiable at some x (c) differentiable for all x but not continuous at some x .(d) none of these

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23. Let $f(x) = \{ax^2 + 1, x > 1; \quad x + \frac{1}{2}, x \leq 1. \, then, \, f(x)$ is derivable at $x = 1,$ if $a = 2$ (b) $a = 1$ (c) $a = 0$ (d) $a = \frac{1}{2}$

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

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25. It A is a symmetric matrix, write whether A^T is symmetric or skew - symmetric matrix.

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26. If $f(x) = \{x^2 + 3x + a, x \leq 1, bx + 2, f \text{ or } x > 1$ is everywhere differentiable, find the values of $aandb$.

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27. Let $f(x) = |x|$ and $g(x) = |x^3|$, then (a)$f(x)andg(x)$ both are continuous at $x = 0$ (b)$f(x)andg(x)$ both are differentiable at $x = 0$ (c)$f(x)$ is differentiable but $g(x)$ is not differentiable at $x = 0$ (d)$f(x)$ and $g(x)$ both are not differentiable at $x = 0$

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28. Is $|\sin x|$ differentiable? What about $\cos|x|$?

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29. Find the values of $aandb$ so that the function $f(x) = \{x^2 + 3x + a, \quad \text{if} \quad x \leq 1bx + 2, \quad \text{if} \quad x > 1$ is differentiable at each $x \in R$.

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30. The function $f(x) = e^{-|x|}$ is continuous everywhere but not differentiable at $x = 0$ continuous and differentiable everywhere not continuous at $x = 0$ none of these

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31. Discuss the continuity and differentiability of $f(x) = \{1 - x, x < 1(1 - x)(2 - x), 1 \leq x \leq 2(3 - x), x > 2$

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32. If $y = (x-1)\log(x-1) - (x+1)\log(x+1)$, prove that : $\frac{dy}{dx} = \log\left(\frac{x-1}{1+x}\right)$

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33. The set of points where the function $f(x) = x|x|$ is differentiable is

$(-\infty, \infty)$ (b) $(-\infty, 0) \cup (0, \infty)$ $(0, \infty)$ (d) $[0, \infty)$

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34. The function $f(x) = \sin^{-1}(\cos x)$ is (a) . discontinuous at $x = 0$ (b). continuous at $x = 0$ (c) . differentiable at $x = 0$ (d) . non of these

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35. Let $f(x) = \begin{cases} \frac{1}{|x|} f \text{ or } |x| \geq 1 ax^2 + bf \text{ or } |x| < 1 \Leftrightarrow (x) \end{cases}$ is continuous and differentiable at any point, then $a = \frac{1}{2}, b = -\frac{3}{2}$ (b)

$a = -\frac{1}{2}, b = \frac{3}{2}$ $a = 1, b = -1$ (d) none of these

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36. If $f(x) = \sqrt{1 - \left(\sqrt{1} - x^2\right)}$, then $f(x)$ is (a)continuous on [-1, 1] and differentiable on (-1, 1) (b) continuous on [-1,1] and differentiable on $(-1, 0) \cup (0, 1)$ (C) continuous and differentiable on [-1, 1](d) none of these

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37. If $f(x) = a|\sin x| + be^{|x|} + c|x|^3$ and if $f(x)$ is differentiable at $x = 0$ then

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38. Solve the following equation for x :

$$\cos\left(\tan^{-1} x\right) = \sin\left(\cot^{-1}\left(\frac{3}{4}\right)\right)$$

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39. Find the principal values the following :

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

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40. Solve the following equation for x :

$$\cos\left(\tan^{-1} x\right) = \sin\left(\cot^{-1}\left(\frac{3}{4}\right)\right)$$

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41. For the principal values, evaluate the following :

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

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42. If A is a square matrix such that $|A|=2$, write the value of $\left|\forall^{T}\right|$

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43. Find the domain of the function $f(x)=\sin^{-1}\sqrt{x-1}$

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44. If $\sin^{-1}x+\sin^{-1}y+\sin^{-1}z=\frac{3\pi}{2}$, then find the value of $x^2+y^2+z^2$

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45. If f(x) = $\left(\frac{x^l}{x^m}\right)^{l+m}\left(\frac{x^m}{x^n}\right)^{m+n}\left(\frac{x^n}{x^l}\right)^{n+l}$, then find f'(x).

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46. Show that $f(x) = |x|$ is not differentiable at $x = 0$.

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47. Evaluate : $\tan\left(\cos^{-1}\left(-\frac{7}{25}\right)\right)$

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48. For what choice of a and b is the function $f(x) = \{x^2, x \leq c \text{ and } ax + b, x > c$ is differentiable at $x = c$

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49. Discuss the differentiability of $f(x) = x|x|$ at $x = 0$

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50. Show that the function f(x)={ $x^2 \sin\left(\frac{1}{x}\right)$, when $x \neq 0$ and 0 when $x = 0$ } is differentiable at x=0.

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51. If $f(2) = 2 and f'(2) = 1$, then find $\left(\lim\right)_{x \to 2} \frac{xf(2) - 2f(x)}{x - 2}$

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52. If $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \frac{3\pi}{2}$, then find the value of $x^2 + y^2 + z^2$

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53. Show that $f(x) = |x|$ is not differentiable at $x = 0$.

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54. Show that the function $f(x) = \{x - 1 \quad , \quad \text{if} \quad x < 2$

$2x - 3 \quad , \quad \text{if} \quad x \geq 2$ is not differentiable at $x = 2$.

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55. Show that the function $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right) & \text{if} \quad x \neq 0 \\ 0 & \text{if} \quad x = 0 \end{cases}$ is differentiable at x=0 and $f'(0) = 0$

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56. Show that $f(x) = x^2$ is differentiable at $x = 1$ and find $f'(1)$.

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57. Show that the function $f(x) = |x - 1|$ for all $x \in R$, is not differentiable at $x = 1$.

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58. Discuss the differentiability of $f(x) = x|x|$ at $x = 0$.

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

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60. Discuss the differentiability of $f(x) = \left\{ xe - \left(\frac{1}{|x|} + \frac{1}{x} \right), x \neq 0x, x = 0atx = 0 \right.$

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61. If $f(x)$ is differentiable at $x = a$, find $\left(\lim \right)_{x \to a} \frac{x^2 f(a) - a^2 f(x)}{x - a}$

.

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62. For what choice of a and b is the function $f(x) = \{x^2 \quad , \quad x \leq c \quad ax + b \quad , \quad x > c$ is differentiable at $x = c$.

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63. If $f(2) = 4$ and $f'(2) = 1$, then find $\left(\lim \right)_{x \to 2} \frac{x\, f(2) - 2f\,(x)}{x - 2}$.

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64. A function $f: R \to R$ satisfies that equation $f(x+y) = f(x)f(y)$ for all $x, y \in R$, $f(x) \neq 0$. Suppose that the function $f(x)$ is differentiable at $x = 0$ and $f'(0) = 2$. Prove that $f'(x) = 2\, f(x)$.

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65. Show that $f(x) = |x - 3|$ is continuous but not differentiable at $x = 3$.

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66. Show that $f(x) = x^{1/3}$ is not differentiable at $x = 0$.

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67. Show that $f(x) = \begin{cases} 12x - 13, & \text{if } x \leq 3 \\ 2x^2 + 5, & \text{if } x > 3 \end{cases}$ is differentiable at $x = 3$. Also, find $f'(3)$.

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68. Show that the function f defined as follows `f(x)={3x-2, 0 < x <=1 , 2x^2 - x ,1< x <=2 , 5x-4, x > 2 is continuous at x=2 , but not differentiable thereat.

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69. Discuss the continuity and differentiability of the function $f(x) = |x| + |x - 1|$ in the interval (-1, 2).

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70. Find whether the following function is differentiable at x = 1 and x = 2 or not : $f(x) = \{x, x < 1 2 - x, 1 \leq x \leq 2 - 2 + 3x - x^2, x > 2$

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71. Show that the function $f(x) = \left\{x^m \sin\left(\frac{1}{x}\right), x = 0, 0, \quad x \neq 0, \quad x = 0\right.$ is differentiable at $x = 0$, if $m > 1$

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72. Show that the function $f(x) = \left\{x^m \sin\left(\frac{1}{x}\right), \quad x \neq 0, 0 \; x = 0\right.$ is differentiable at $x = 0$, if (m>1)

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73. Show that the function $f(x) = \left\{ x^m \sin\left(\frac{1}{x}\right), \quad x \neq 00, \qquad x = 0 \right.$ is neither continuous nor differentiable, if $m \leq 0$

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74. Find the values of a and b so that the function $f(x) = \{x^2 + 3x + a, \quad \text{if} \quad x \leq 1$

$bx + 2, \quad \text{if} \quad x > 1 \quad is$ differentiable at each x in R .

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75. Show that the function $f(x) = \{|2x - 3|\,[x], \quad x \geq 1;$

$\sin\left(\frac{\pi x}{2}\right), \quad x < 1$ is continuous at $x = 1$.

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76. If $f(x) = \begin{cases} ax^2 - b, & \text{if } |x| < 1 \\ \frac{1}{|x|}, & \text{if } |x| \geq 1 \end{cases}$ is differentiable at $x = 1$, find $a,\ b$.

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77. Find the values of a and b, if the function $f(x)$ defined by $f(x) = \begin{cases} x^2 + 3x + a, & x \leq 1 \\ bx + 2, & x > 1 \end{cases}$ is differentiable at $x = 1$.

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78. If $f(x) = x^2 + 2x + 7$, find $f'(3)$.

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79. Find $f'(2)$ and $f'(5)$ when $f(x) = x^2 + 7x + 4$.

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80. For the function f given by $f(x) = x^2 - 6x + 8$, prove that $f'(5) = 4$.

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81. Discuss the continuity and differentiability of $f(x) = \{1 - x, \quad x < 1 \quad (1 - x)(2 - x), \quad 1 \leq x \leq 2 \quad 3 - x, \quad x > 2$

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82. Discuss the differentiability of $f(x) = |x - 1| + |x - 2|$

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83. If $f(x) = \{x^2 + 3x + a, \quad f \text{ or } \quad x \leq 1bx + 2, \qquad f \text{ or } \quad x > 1$

is everywhere differentiable, find the values of a and b.

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84. Discuss the differentiability of $f(x) = |(\log)_e x|, x > 0$

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85. If f is defined by $f(x) = x^2$, find $f'(2)$.

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86. If f is defined by $f(x) = x^2 - 4x + 7$, find $f'(x)$

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87. find the derivative of the function f given by $f(x) = 2x^3 - 9x^2 + 12x + 9$

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88. If for the function $\text{Phi}(x) = \lambda x^2 + 7x - 4$, $\text{Phiprime}\hat{}(5) = 97$, find λ.

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89. If $f(x) = x^3 + 7x^2 + 8x - 9$, find $f'(4)$.

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90. Find the derivative of the function f defined by $f(x) = mx + c$ at $x = 0$.

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91. Examine the differentiability of the function f defined by `f(x)={2x+3, if -3 <= x< -2, x+1, if -2<=x<0, x+2, if 0<=x<=1

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92. Write an example of a function which is everywhere continuous but fails to be differentiable exactly at five points.

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93. Discuss the continuity and differentiability of $f(x) = |\log|x||$.

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94. Discuss the continuity and differentiability of $f(x) = e^{|x|}$.

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95. Discuss the continuity and differentiability of

$$f(x) = \begin{cases} (x-c)\cos\left(\frac{1}{x-c}\right), & x \neq c0, \\ & x = c \end{cases}$$

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96. Is $|\sin x|$ differentiable? What about $\cos|x|$?

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97. Define differentiability of a function at a point.

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98. Is every differentiable function continuous?

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99. Is every continuous function differentiable?

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100. Give an example of a function which is continuous but not differentiable at a point.

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101. If $f(x)$ is differentiable at $x = c$, then write the value of $(\lim)_{x \to c} f(x)$.

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102. If $f(x) = |x - 2|$ write whether $f'(2)$ exists or not.

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103. Write the points where $f(x) = |(\log)_e x|$ is not differentiable.

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104. Write the points of non-differentiability of $f(x) = |\log|x||$.

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105. Write the derivative of $f(x) = |x|^3$ at $x = 0$.

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106. Write the number of points where $f(x) = |x| + |x - 1|$ is continuous but not differentiable.

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107. If $(\lim)_{x \to c} \dfrac{f(x) - f(c)}{x - c}$ exists finitely, write the value of $(\lim)_{x \to c} f(x)$.

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108. Write the value of the derivative of $f(x) = |x - 1| + |x - 3|$ at $x = 2$.

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109. If $f(x) = \sqrt{x^2 + 9}$, write the value of $(\lim)_{x \to 4} \dfrac{f(x) - f(4)}{x - 4}$.

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110. Let $f(x) = |x|$ and $g(x) = \left|x^3\right|$, then (a).$f(x)$ and $g(x)$ both are continuous at $x = 0$ (b) $f(x)$ and $g(x)$ both are differentiable at $x = 0$

(c) $f(x)$ is differentiable but $g(x)$ is not differentiable at $x = 0$ (d) $f(x)$ and $g(x)$ both are not differentiable at $x = 0$

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111. The function $f(x) = \sin^{-1}(\cos x)$ is discontinuous at $x = 0$ (b) continuous at $x = 0$ (c) differentiable at $x = 0$ (d) none of these

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112. The set of points where the function $f(x) = x|x|$ is differentiable is (a) $(-\infty, \infty)$ (b) $(-\infty, 0) \cup (0, \infty)$ (c) $(0, \infty)$ (d) $[0, \infty]$

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113. If $f(x) = \begin{cases} \dfrac{|x+2|}{\tan^{-1}(x+2)}, & x \neq -2, \\ & x = -2 \end{cases}$,

then (a).$f(x)$ is continuous at $x = -2$ (b) not continuous at $x = -2$

(c) differentiable at $x = -2$ (d) continuous but not derivative at $x = -2$

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114. Let $f(x) = (x + |x|)|x|$. Then, for all x f is continuous

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115. The function $f(x) = e^{|x|}$ is (a) Continuous everywhere but not differentiable at $x = 0$ (b) Continuous and differentiable everywhere (c) Not continuous at $x = 0$ (d) None of the above

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116. The function $f(x) = |\cos x|$ is (a) everywhere continuous and differentiable (b) everywhere continuous but not differentiable at

$(2n+1)\pi/2$, $n \in Z$ (c) neither continuous nor differentiable at $(2n+1)\pi/2, n \in Z$ (d) none of these

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117. If $f(x) = \sqrt{1-\sqrt{1-x^2}}$, then $f(x)$ is (a) continuous on [-1, 1] and differentiable on (-1, 1) (b) continuous on [-1, 1] and differentiable on (− 1 , 0) ∪ (0 , 1)` (c) continuous and differentiable on [-1, 1] (d) none of these

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118. If $f(x) = a|\sin x| + b\, e^{|x|} + c\,|x|^3$ and if $f(x)$ is differentiable at $x = 0$, then $a = b = c = 0$ (b) $a = 0,\ b = 0;\ c \in R$ (c) $b = c = 0,\ a \in R$ (d) $c = 0,\ a = 0,\ b \in R$

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119. If $f(x)=x^2+\frac{x^2}{1+x^2}+\frac{x^2}{(1+x^2)^2}+\ldots.+\frac{x^2}{(1+x^2)^n}+,$ then at $x=0, f(x)$ (a)has no limit (b) is discontinuous (c)is continuous but not differentiable (d) is differentiable

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120. If $f(x)=\left|(\log)_e x\right|$, then (a) $f'\left(1^+\right)=1$ (b) $f'\left(1^-\right)=-1$ (c) $f'(1)=1$ (d) $f'(1)=-1$

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121. If $f(x)=\left|(\log)_e|x||\right|$, then (a)$f(x)$ is continuous and differentiable for all x in its domain] (b) $f(x)$ is continuous for all x in its domain but not differentiable at $x=\pm 1$ (c) $f(x)$ is neither continuous nor differentiable at $x=\pm 1$ (d) none of these

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122. Let $f(x) = \begin{cases} \frac{1}{|x|} & f \text{ or } |x| \geq 1 \\ ax^2 + b & f \text{ or } |x| < 1 \end{cases}$. If $f(x)$ is continuous and differentiable at any point, then

A. $a = \frac{1}{2}, b = -\frac{3}{2}$

B. $a = -\frac{1}{2}, b = \frac{3}{2}$

C. $a = 1, b = -1$

D. none of these

Answer: B

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123. The function $f(x) = x - [x]$, where [·] denotes the greatest integer function is (a) continuous everywhere (b) continuous at integer points only (c) continuous at non-integer points only (d) differentiable everywhere

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124. Let $f(x) = \{ax^2 + 1, \quad x > 1, \quad x + 1/2, \quad x \leq 1$ Then, $f(x)$ is derivable at $x = 1$, if $a = 2$ (b) $b = 1$ (c) $a = 0$ (d) $a = 1/2$

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125. Let $f(x) = |\sin x|$. Then, (a) $f(x)$ is everywhere differentiable. (b) $f(x)$ is everywhere continuous but not differentiable at $x = n\pi, \ n \in Z$ (c) $f(x)$ is everywhere continuous but not differentiable at $x = (2n + 1)\frac{\pi}{2}$, $n \in Z$. (d) none of these

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126. Let $f(x) = |\cos x|$ (a) Then, $f(x)$ is everywhere differentiable (b) $f(x)$ is everywhere continuous but not differentiable at $x = n\pi, \ n \in Z$ (c) $f(x)$ is everywhere continuous but not differentiable at $x = (2n + 1)\frac{\pi}{2}, \ n \in Z$ (d) none of these

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127. The function $f(x) = 1 + |\cos x|$ is (a) continuous no where (b) continuous everywhere (c) not differentiable at $x = 0$ (d) not differentiable at $x = n\pi, \quad n \in Z$

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128. The $f(x) = |\cos x|$ (a)Then, f (x) is everywhere differentiable at $x = (2n + 1)\,\pi/2, \quad n \in Z$ (b) continuous but not differentiable at $x = (2n + 1)\,\pi/2, \; n \in Z$ (c) neither differentiable nor continuous at $x = n\pi, \quad n \in Z$ (d) none of these

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129. The function $f(x) = \dfrac{\sin(\pi[x - \pi])}{4 + [x]^2}$, where [] denotes the greatest integer function,(a) is continuous as well as differentiable for

all $x \in R$ (b) continuous for all x but not differentiable at some x (c) differentiable for all x but not continuous at some x .(d) none of these

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130. Let $f(x) = a + b|x| + c|x|^4$, where $a,\ b,$ and c are real constants. Then, $f(x)$ is differentiable at $x = 0$, if

A. $a = 0$

B. $b = 0$

C. $c = 0$

D. none of these

Answer: B

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131. If $f(x) = |3 - x| + [3 + x]$, where $[x]$ denotes the least integer greater than or equal to x , then $f(x)$ is

A. (a) continuous and differentiable at $x = 3$

B. (b) continuous but not differentiable at $x = 3$

C. (c) differentiable but not continuous at $x = 3$

D. (d) neither differentiable nor continuous at $x = 3$

Answer: null

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132. If $f(x) = \begin{cases} \dfrac{1}{1 + e^{1/x}}, & x \neq 00, \\ & x = 0 \end{cases}$, then $f(x)$ is continuous as well as differentiable at $x = 0$ (b) continuous but not differentiable at $x = 0$ (c) differentiable but not continuous at $x = 0$ (d) none of these

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133. If $f(x)=\begin{cases}\dfrac{1-\cos x}{x\sin x}, & x\neq 0 \text{ and } \dfrac{1}{2}, x=0\end{cases}$ then at $x=0$, $f(x)$ is (a)continuous and differentiable (b)differentiable but not continuous (c)continuous but not differentiable (d)neither continuous nor differentiable

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134. The set of points where the function $f(x)$ given by $f(x)=|x-3|\cos x$ is differentiable, is R (b) $R-\{3\}$ (c) $(0,\ \infty)$ (d) none of these

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135. Let f(x)={1, x <= -1, |x|, -1 < x < 1, 0, x >=1 . Then, f is (a) continuous at x=-1 (b) differentiable at x=-1 (c) everywhere continuous (d) everywhere differentiable

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