MATHS

BOOKS - MAXIMUM PUBLICATION

CONTINUITY & DIFFERENTIABILITY

Example

1. Consider the function $g(x) = \frac{|x-2|}{x-2}$

Find the domain and range of the function

$g(x)$.

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2. Consider the function $g(x) = \frac{|x-2|}{x-2}$

check whether the g(x) is continuous at $x = 2$.

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3. If $f(x) = x + |x| + 1$, then which of the follow represents $f(x)$

A. $f(x) = \begin{cases} 2x - 1 & x \geq 0 \\ 1 & x < 0 \end{cases}$

B. `f(x)={(2x+1, x ge0),(1,x lt0):}

C. `f(x)={(2x, xle0),(2,xgt0):}

D. `f(x)={(2x+1, xle0),(1,xgt0):}

Answer:

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4. If $f(x) = x + |x| + 1$

test whether f(x) is continous at $x = 0$ Explain.

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5. Consider the function

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

Find $\lim_{x \to 0} f(x)$

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6. Consider the function

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

Is $f(x)$ continuous at $x = 0$?

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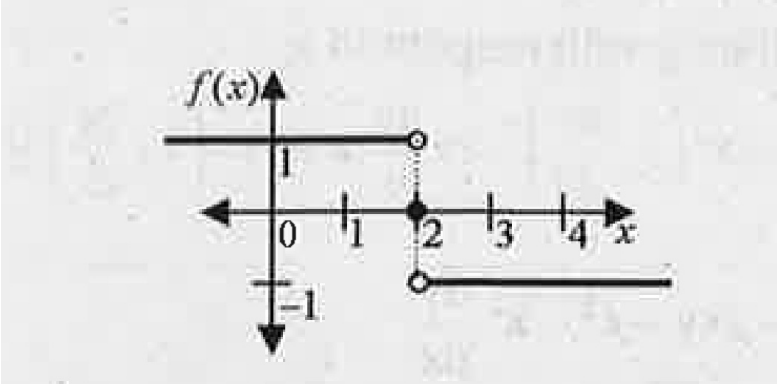
7. Consider the figure and answer the question.

Identify the graphed function.

$$f(x) = \frac{|x|}{x}$$



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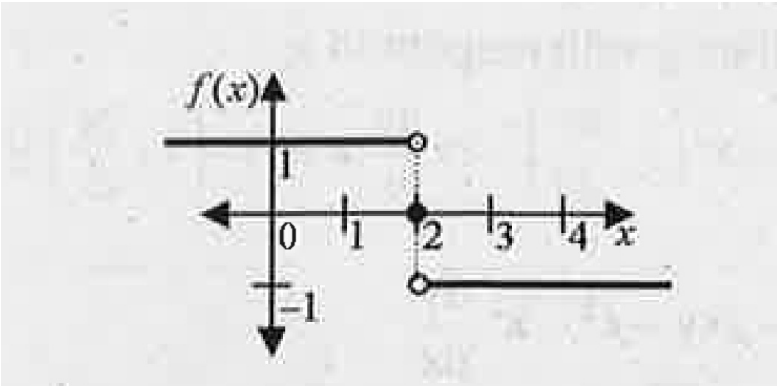
8. Consider the figure and answer the question.

Identify the graphed function.

$$f(x) = \begin{cases} \frac{|x-2|}{x-2} & x \neq 2 \\ 0 & x = 2 \end{cases}$$



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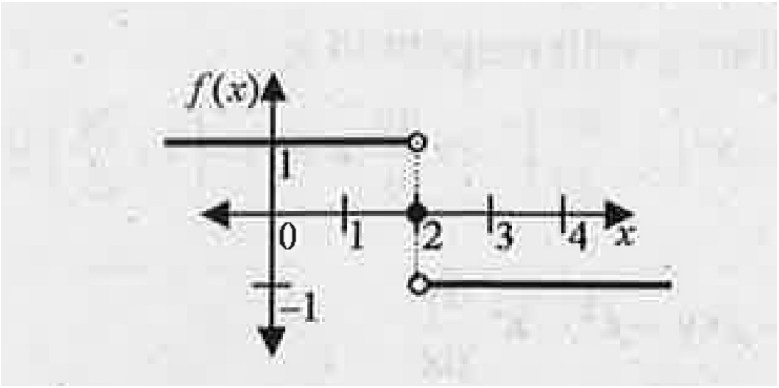
9. Consider the figure and answer the question.

Identify the graphed function.

$$f(x) = \begin{cases} \frac{|x+2|}{x+2} & x \neq 2 \\ 0 & x = 2 \end{cases}$$



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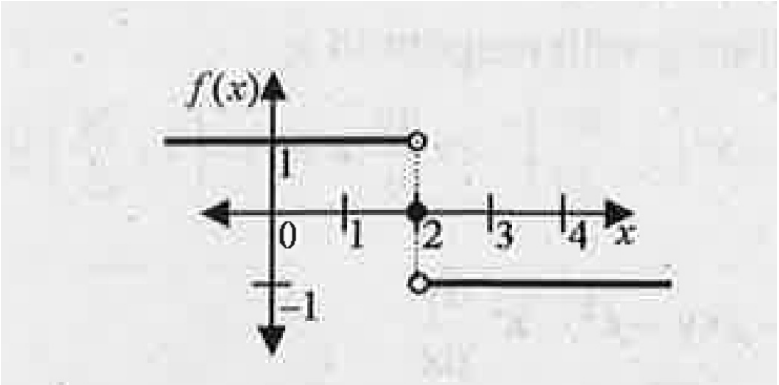
10. Consider the figure and answer the question.

Identify the graphed function.

$$f(x) = \frac{|x-1|}{x-1}$$



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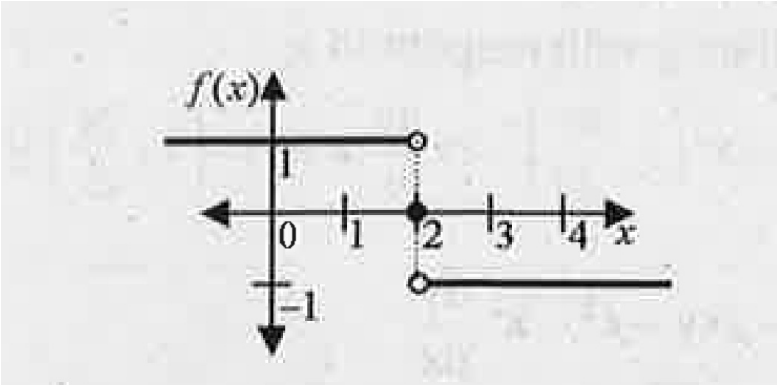
11. Consider the figure and answer the question.

Discuss the continuity of the above function at

$x = 2$.



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12. Consider $f(x) = \begin{cases} 2x & \text{if} \quad x < 2 \\ 2 & \text{if} \quad x = 2 \\ x^2 & \text{if} \quad x > 2 \end{cases}$

Find $\lim_{x \to 2^-} f(x)$ and $\lim_{x \to 2^+} f(x)$

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13. Consider $f(x) = \begin{cases} 2x & \text{if} \quad x < 2 \\ 2 & \text{if} \quad x = 2 \\ x^2 & \text{if} \quad x > 2 \end{cases}$

$f(x)$ is continuous . If not so, how can you make it continuous.

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14. If $y = \log_{10} x + \log_x 10 + \log_x x + \log_{10} 10$ then $\frac{dy}{dx}$ = ?

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15. Examine the continuity of the function

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

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16. Find $\frac{dy}{dx}$ of the following

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

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17. Find $\frac{dy}{dx}$ of the following

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

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18. Find $\frac{dy}{dx}$ of the following

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

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19. Find $\frac{dy}{dx}$ of the following

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

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20. Find $\frac{dy}{dx}$ of the following

$\sqrt{x} + \sqrt{y} = 1$

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21. Find $\frac{dy}{dx}$ of the following

$x^2 + xy + y = 100$

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22. Find $\frac{dy}{dx}$ of the following

$$x^2(x-y) = y^2(x+y)$$

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23. Find $\frac{dy}{dx}$ of the following

$$xy^2 + x^2y = 2$$

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24. Find $\frac{dy}{dx}$ of the following

$$\sin y = x\cos(a+y)$$

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25. Find $\frac{dy}{dx}$ of the following

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

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26. Find $\frac{dy}{dx}$ of the following

$$y = \tan^{-1}\left(\frac{3x - x^3}{1 - 3x^2}\right)$$

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27. Find $\frac{dy}{dx}$ of the following

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

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28. Find $\frac{dy}{dx}$ of the following

$$y = \sec^{-1}\left(\frac{1}{2x^2 - 1}\right)$$

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29. Find $\frac{dy}{dx}$ of the following

$$y = \tan^{-1}\sqrt{\frac{1 - \cos x}{1 + \cos x}}$$

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30. Find $\frac{dy}{dx}$ of the following

$$y = \cos^{-1} \frac{\left(x - x^{-1}\right)}{x + x^{-1}}$$

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31. Find $\frac{dy}{dx}$ of the following

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

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32. Find $\frac{dy}{dx}$ of the following

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

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33. Find $\frac{dy}{dx}$ of the following

$y = e^t \cos t\,, x = e^t \sin t$

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34. If $y = \log\left(\frac{1}{x}\right)$, show that $\frac{dy}{dx} + e^y = 0$

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35. If $e^y(x+1)=1$. Show that

$$\frac{dy}{dx} = -e^y$$

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36. If $e^y(x+1)=1$. Show that

$$\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$$

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37. Evalute $\lim_{x \to 0} \frac{k \cos x}{\pi - 2x}$

(Hint: Put π-2x=y , where k is a constant.)

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38. Find the value of k if $f(x)$ is a continious function give by

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

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39. If $f(x) = \begin{cases} x - |x| & x < 2 \\ 0 & x = 2 \\ 3x - 5 & x > 2 \end{cases}$

Find $\lim_{x \to 2} f(x)$

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40. Is $f(x) = x^2$ continuous at $x = 2$?

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41. If $x = 2\cos\theta, y = 3\sin\theta$

Find $\frac{dy}{dx}$.

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42. If $x = 2\cos\theta, y = 3\sin\theta$

Find $\frac{d^2y}{dx^2}$.

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

$\left(x^2+1\right)^2 y_2 + 2x\left(x^2+1\right) y_1 = 2\,.$

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44. Find $\frac{dy}{dx}$ If $y = \sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$,

$0 < x < 1$

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45. Let f(x)=`{(cosx,0lexlec),(sinx,c Find the value of c if f is continuous on $[0, \pi]$.

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46. Find $\frac{dy}{dx}$ if $x = 2\sin\theta, y = 3\cos\theta$

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47. Examine whether the function defined by

$$f(x) = \begin{cases} x + 5 & x \leq 1 \\ x - 5 & x > 1 \end{cases}$$ is continuous or not .

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48. If $x = a^{\sin^{-1}t}$, $y = a^{\cos^{-1}t}$, $a > 0$, show that

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

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49. If `f(x)={(1-x,0

A. f is continuous in $[0, 1]$

B. f is continuous in $[1, 2]$

C. f is continuous in $[0, 2]$

D. f is continuous in $[0, 1]$

Answer:

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50. If $(1, x \leq 3), (ax + b, `3$ find $f(3^+)$ and $f(3^-)$

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51. If $\{(1, x \leq 3)$, `(ax+b,3 hence find the value of 'a' and 'b' so that `f(x) is continuous.

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52. Consider $f(x) = \begin{cases} 2x+3 & x \leq 2 \\ x+2k & x > 2 \end{cases}$

Find $f(2)$

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53. Consider $f(x) = \begin{cases} 2x+3 & x \leq 2 \\ x+2k & x > 2 \end{cases}$

Evalute $\lim_{x \to 2^+} f(x)$

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54. Consider $f(x) = \begin{cases} 2x+3 & x \leq 2 \\ x+2k & x > 2 \end{cases}$

Find the value of k, if is continious at $x = 2$.

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55. Find $\frac{dy}{dx}$ if

$y = (\log x)^{\cos x}$

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56. Find $\frac{dy}{dx}$ of

$x = 2at^2 , y = at^4$

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57. Find $\frac{dy}{dx}$ of

$x = a(\cos\theta + \theta\sin\theta)\,, y = a(\sin\theta - \theta\cos\theta)$

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58. Find $\frac{dy}{dx}$ of

$y = x^x$

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59. Find $\frac{dy}{dx}$ of

$$y = (x \log x)^{\log(\log x)}$$

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60. Find $\frac{dy}{dx}$ of

$$y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + \ldots .}}}$$

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61. Find $\frac{dy}{dx}$ of

$$y^x = x^{\sin y}$$

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62. Find $\frac{dy}{dx}$ of

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

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63. Find $\frac{dy}{dx}$ of

$$y = (\sin x)^x + \sin^{-1}\sqrt{x}$$

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64. Find $\frac{d^2y}{dx^2}$

$$y = x^2 + 3x + 2$$

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65. Find $\frac{d^2y}{dx^2}$

$y = \tan^{-1} x$

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66. Match the following.

A	B
$\frac{d}{dx}(e^x \sin x)$	$-\sin 2x$
$\frac{d}{dx}(\cos^2 x)$	$e^x \cos x$
$\frac{d}{dx}(\sin^{-1} e^x)$	$2 \cot 2x$
$\frac{d}{dx}(\log \sin 2x)$	$e^x(\sin x + \cos x)$
	$\frac{e^x}{\sqrt{1-e^{2x}}}$

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67. If $x = \sin t$ and $y = \sin mt$ show that

$y = \sin\left(m \sin^{-1} x\right)$

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68. If $x = \sin t$ and $y = \sin mt$ show that

$\frac{dy}{dx} =$

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69. If $x = \sin t$ and $y = \sin mt$ show that

$$(1 - x^2)y_2 - xy_1 + m^2 y = 0$$

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70. Consider the function

$$f(x) = x(x - 2), x \in [1, 3]$$

Verify mean value theorem for the function in

$[1, 3]$.

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71. Verify Lagranges' Mean value theorem for the function $f(x) = 2x^2 - 10x + 29$ in $[2, 9]$

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72. Let $f(x) = x(x-1)(x-2)$, $x \in [0, 2]$

Find $f(0)$ and $f(2)$

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73. Let $f(x) = x(x-1)(x-2)\,, x \in [0, 2]$

Find $f'(x)$

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74. Let $f(x) = x(x-1)(x-2)\,, x \in [0, 2]$

Find thevalues of x where $f'(x) = 0$ verify Rolle's theorem.

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75. Verify Rolle's Theorem for the function

$f(x) = x^2 + 2x - 8\,, x \in [-4, 2]$

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76. Examine that Rolle's Theorem is applicable to the function in the given intervals , justify your answer .

$f(x) = [x]\,, x \in [5, 9]$

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77. Examine that Rolle's Theorem is applicable to the function in the given intervals , justify your answer .

$f(x) = x^2 - 1 , x \in [1, 2]$

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78. Examine the continuity of the function

`f(x)={(absx+3„xle-3),(-2x„-3

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79. Test continuity for the folowing functions.

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

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80. Test continuity for the folowing functions.

$$f(x) = \begin{cases} 2^{\frac{1}{x}} & x \neq 0 \\ 3 & x = 0 \end{cases} at x=0`$$

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81. Test continuity for the folowing functions.

$$f(x) = \begin{cases} \frac{x^2-4x+3}{x^2-1} & x \neq 1 \\ 2 & x = 1 \end{cases} \text{ at } x = 1$$

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82. If $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$ prove that

$$(1-x^2)y^2 = \left(\sin^{-1} x\right)^2$$

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83. If $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$ prove that

$$(1-x^2)y_1 - xy = 1$$

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84. If $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$ prove that

$$(1-x^2)y_2 - 3xy_1 - y = 0$$

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85. At what point on the curve $y = x^2$, $x \in [-2, 2]$ at which the tangent is parallel to x-axis?

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86. If $f(x) = \dfrac{\sqrt{(1+px)} - \sqrt{(1-px)}}{x}$,

$-1 \leq x < 0$

$= \dfrac{2x+1}{x-2}, 0 \leq x \leq 1$

is continuous in the interval $[-1, 1]$.

Find $\lim_{x \to 0} f(x)$

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87. If $f(x) = \dfrac{\sqrt{(1+px)} - \sqrt{(1-px)}}{x}$,

$-1 \leq x < 0$

$= \dfrac{2x+1}{x-2}, 0 \leq x \leq 1$

is continuous in the interval $[-1, 1]$.

Find P.

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88. If $f(x) = \dfrac{\sqrt{(1+px)} - \sqrt{(1-px)}}{x}$,

$-1 \leq x < 0$

$= \frac{2x+1}{x-2}, 0 \leq x \leq 1$

is continuous in the interval $[-1, 1]$.

Find P.

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89. If $ax^2 + 2hxy + by^2 = 1$

Find $\frac{dy}{dx}$

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90. If $ax^2 + 2hxy + by^2 = 1$

Find $\frac{d^2y}{dx^2}$

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91. Consider the function $y = x^x\sqrt{x}$

Express the above function as

$\log y = \left(x + \frac{1}{2}\right)\log x$

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92. Consider the function $y = x^{x}\sqrt{x}$

Find $\frac{dy}{dx}$

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93. Verify mean value theorem for the function

$f(x) = (x-2)^{2}$ in $[1, 4]$.

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94. Find a point on the curve $y = (x-2)^2$ at which the tangent is parallel to the chord joining the points $(1, 1)$ and $(4, 4)$

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95. Find a point on the curve $y = (x-2)^2$ at which the tangent is parallel to the x-axis .

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96. Differentiate $x^{\sin x}$ w.r.t. x

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

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98. If $y = \sin^{-1}(\cos x) + \cos^{-1}(\sin x)$, then find $\frac{dy}{dx}$.

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99. Differentiate $\frac{x-1}{x-3}$ with respect to x .

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

with respect to x.

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101. Define $|x|$

A. $|x| = \sqrt{x^2}$

B. $|x| = x$

C. $|x| = -x$

D. $|x| = x^2$

Answer:

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102. At which point $\frac{d}{dx}|x|$ does not exist?

Find $\frac{d}{dx}|x|$.

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103. Find $\frac{d}{dx}\left|x^3 - 7x\right|$. Also , find the point at which the derivative does not exist.

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104. Match the following.

A	B
$\frac{d}{dx}(e^x \sin x)$	$-\sin 2x$
$\frac{d}{dx}(\cos^2 x)$	$e^x \cos x$
$\frac{d}{dx}(\sin^{-1} e^x)$	$2 \cot 2x$
$\frac{d}{dx}(\log \sin 2x)$	$e^x(\sin x + \cos x)$
	$\frac{e^x}{\sqrt{1-e^{2x}}}$

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

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106. If $x = a\sec^3\theta$ and $y = a\tan^3\theta$

$\frac{dx}{d\theta}, \frac{dy}{d\theta}$

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107. If $x = a\sec^3\theta$ and $y = a\tan^3\theta$

Find $\frac{dy}{dx}$

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108. If $x = a\sec^3\theta$ and $y = a\tan^3\theta$

$$\frac{d^2y}{dx^2}$$

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109. If $x = a\sec^3\theta$ and $y = a\tan^3\theta$

Show that $\left(\frac{d^2y}{dx^2}\right)_{\theta=\frac{\pi}{4}} = \frac{1}{12a}$

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110. Consider the function

$$f(x) = \begin{cases} 1 - x & x < 0 \\ 1 & x = 0 \\ 1 + x & x > 0 \end{cases}$$

Complete the following table

x	- 2	- 1	0	1	2
f (x)	———	———	1	———	———

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111. Consider the function

$$f(x) = \begin{cases} 1 - x & x < 0 \\ 1 & x = 0 \\ 1 + x & x > 0 \end{cases}$$

Draw a rough sketch of $f(x)$.

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112. Consider the function

$$f(x) = \begin{cases} 1 - x & x < 0 \\ 1 & x = 0 \\ 1 + x & x > 0 \end{cases}$$

Draw a rough sketch of $f(x)$. What is your inference from the graph about its continuity. Verify your answer using limits.

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113. Consider the equation

$$\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$$

Simplify the above equation to

$\sin^{-1}x-\sin^{-1}y=2\cot^{-1}a$ by giving suitable substitution.

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114. Consider the equation

$$\sqrt{1-x^2}+\sqrt{1-y^2}=a(x-y)$$

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

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115. Match the following.

A	B
$\frac{d}{dx}(x)$	0
$\frac{d}{dx}8$	$\frac{1}{2\sqrt{x}}$
$\frac{d}{dx}\cos^{-1}x$	1
$\frac{d}{dx}\sqrt{x}$	$\frac{-1}{\sqrt{1-x^2}}$
	$2\sqrt{x}$

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

$$(1-x^2)y_2 - xy_1 - a^2y = 0$$

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117. Match the following.

A - y =	B- $\frac{dy}{dx}$
$\frac{1}{f(x)}$	$f'(x).e^{f(x)}$
$[f(x)]^n$	$f'(g(x)).g'(x)$
$e^{f(x)}$.	$-\frac{f'(x)}{[f(x)]^2}$
$f(g(x))$	$n(f(x))^{n+1}f(x)$
	$n(f(x))^{n-1}f'(x)$

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118. Differentiate the following

$$y = \frac{1}{5x^2 + 3x + 7}$$

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119. Differentiate the following

$$y = 3\,\mathrm{cosec}^4(7x)$$

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120. Differentiate the following

$$y = e^{2 \log \tan 5x}$$

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121. Consider $f(x) = \begin{cases} \frac{x^2 - x - 6}{x + 2} & x \neq -2 \\ -5 & x = -2 \end{cases}$

Find $f(-2)$

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122. Consider $f(x) = \begin{cases} \frac{x^2 - x - 6}{x+2} & x \neq -2 \\ -5 & x = -2 \end{cases}$

Check whether the function $f(x)$ is continuous at $x = -2$.

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123. If $f(x) = \sin(\log x)$,

prove that $x^2 y_2 + x y_1 + y = 0$

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124. Establish that $g(x) = 1 - x + |x|$ is continious at origin.

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125. Check whether $h(x) = |1 - x + |x||$ is continious at origin.

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126. Find $\frac{dy}{dx}$ of

$x = \sqrt{a^{\sin^{-1} t}}\, y = \sqrt{a^{\cos^{-1} t}}$

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127. Find $\frac{dy}{dx}$ of

$y = \cos^{-1} \frac{1 - x^2}{(1 + x^2)}$, 0<x<1

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128. Find $\frac{dy}{dx}$ of

$$y = \sin^{-1} 2x\sqrt{1-x^2} \quad \frac{-1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}},$$

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129. Find $\frac{dy}{dx}$ if $x^3 + 2x^2y + 3xy^2 + 4y^3 = 5$

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130. Find all points of discontinuity of f where

f is defined by $f(x) = \begin{cases} 2x+3 & x \leq 2 \\ 2x-3 & x > 2 \end{cases}$

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131. If $e^{x-y} = x^y$ then prove that $\frac{dy}{dx} = \frac{\log x}{[\log ex]^2}$

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132. Find $\frac{dy}{dx}$ of

$y = \sin^{-1}(3x - 4x^3) + \cos^{-1}(4x^3 - 3x)$

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133. Find $\frac{dy}{dx}$ of

$$y = \tan^{-1}\left(\sqrt{\frac{1-\cos x}{1+\cos x}}\right)$$

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134. Consider the function $f(x) = |x|, x \in R$

Draw the graph of $f(x) = |x|$

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135. Consider the function $f(x) = |x|, x \in R$

Show that the function is continious at x=0.

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136. Find the derivative of $y = x^a + a^x$ with respect to x.

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

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138. Check the continuity of the function given by $f(x)=\begin{cases} x\sin\frac{1}{x} & x\neq 0 \\ 1 & x=0 \end{cases}$

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139. Verify mean value theorem for the function $f(x) = x + \frac{1}{x}$ in the interval $[1, 3]$.

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140. Determine the value of k so that the function

$$f(x) = \begin{cases} k(x^2 + x + 1) & x < 0 \\ \cos x & x \geq 0 \end{cases}$$ is

continuous.

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141. If $y = \left[x + \sqrt{x^2 + 9}\right]^n$, show that

$$\frac{dy}{dx} = \frac{ny}{\sqrt{x^2 + 9}}$$

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142. Consider a function $f: R \to R$ defined by

$$f(x) = \begin{cases} a + x & x \leq 2 \\ b - x & x > 2 \end{cases}$$

Find a relation between a and b if f is continious at $x = 2$.

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143. Consider a function $f: R \to R$ defined by $f(x) = \begin{cases} a + x & x \leq 2 \\ b - x & x > 2 \end{cases}$ Find a and b if f is continuous at $x = 2$ and $a + b = 2$.

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144. Find $\frac{dy}{dx}$, If $x = a(t - \sin t)$, $y = a(1 + \cos t)$

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145. Verify Rolle's theorem for the function

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

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146. Find the relationship between a and b so that the function f defined by

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

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147. Verify mean value theorem for the function

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

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148. Find 'a' and 'b' if the function

`f(x)={(sinx/x,-2lexle0),(axx2^x,0lexle1),(b+x,1

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149. Find the relation between 'a' and 'b' if the function f defined by

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

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

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151. Find the value of a and b such that the function $f(x) = \{(5a, x \leq 0)$,(asinx+cosx,0

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152. Find dy/dx , if $x = a\cos^2\theta$, $y = b\sin^2\theta$

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153. Find the second derivative of the function $y = e^x \sin x$

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154. Find $\frac{dy}{dx}$ of

$y^x = x^y$

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155. Find $\frac{dy}{dx}$ of

$(\cos x)^y = (\cos y)^x$

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156. Find $\frac{dy}{dx}$ if

$\sin x + \cos y = xy$

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157. Find $\frac{dy}{dx}$ if

$x = a\cos^3 t\,, y = a\sin^3 t$

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158. Find $\frac{dy}{dx}$ if

$y = x^x + (\log x)^x$

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159. Let $y = 3\cos(\log x) + 4\sin(\log x)$

find $\frac{dy}{dx}$

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160. Let $y = 3\cos(\log x) + 4\sin(\log x)$

Prove that $x^2 y_2 + x y_1 + y = 0$

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161. Find the derivative of $y = e^{2x + \log x}$

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162. Find $\frac{dy}{dx}$

if $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$

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163. Show that the function $f(x)$ defined by

$f(x) = \sin(\cos x)$ is a continuous function .

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164. If $\frac{dy}{dx} = \frac{1}{\frac{dx}{dy}}$, Show that $\frac{d^2y}{dx^2} = \frac{-\frac{d^2x}{dy^2}}{\left(\frac{dx}{dy}\right)^3}$

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165. Let $y = x^{\sin x} + (\sin x)^x$. Find $\frac{dy}{dx}$

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166. Given, $y = \sqrt{\tan^{-1} x}$ show

$2(1+x^2)y\frac{dy}{dx} = 1$

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167. Given, $y = \sqrt{\tan^{-1} x}$ show

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

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168. The function $f(x)$=`{(5,xle2),(ax+b,2

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169. Find $\frac{dy}{dx}$ if $y = \sin\left(x^{\sin x}\right)$

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170. If $y = ae^{mx} + be^{nx}$, show that

$$\frac{d^2y}{dx^2} - (m+n)\frac{dy}{dx} + mny = 0$$

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171. Match the following.

A	B
$\frac{d}{dx}(e^x \sin x)$	$-\sin 2x$
$\frac{d}{dx}(\cos^2 x)$	$e^x \cos x$
$\frac{d}{dx}(\sin^{-1} e^x)$	$2 \cot 2x$
$\frac{d}{dx}(\log \sin 2x)$	$e^x(\sin x + \cos x)$
	$\frac{e^x}{\sqrt{1-e^{2x}}}$

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172. If $y = \sin^{-1} x$, prove that $(1 - x^2)y_2 - xy_1 = 0$

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173. Consider $f(x) = \begin{cases} 3x - 8 & x \leq 5 \\ 2k & x > 5 \end{cases}$. Find the value of k if f(x) is continuous at x=5` .

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174. Find $\frac{dy}{dx}$, if $y = (\sin x)^{\log x}$, $\sin x > 0$

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175. If $y = \left(\sin^{-1} x\right)^2$, then show that

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

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176. Find dy/dx, if y=logx, x>0`

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177. Is $f(x) = |x|$ differentiable at $x = 0$?

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178. Find $\frac{dy}{dx}$, if $x = \sin\theta - \cos\theta$ and $y = \sin\theta + \cos\theta$