MATHS

BOOKS - V PUBLICATION

LIMITS AND DERIVATIVES

Question Bank

1. Find the limits : (i) $\lim_{x \to 1} \left[x^3 - x^2 + 1\right]$

(ii)

$\lim_{x \to 3} [x(x+1)] (iii) \lim_{x \to -1} \left[1 + x + x^2 + \ldots + x^{10}\right]$

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2. Evaluate $\lim_{x \to 2} \left[\frac{x^2 - 4}{x^3 - 4x^2 + 4x} \right]$

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3. $\lim_{x \to 0} \frac{\sqrt{1+x} - 1}{x}$

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4. Evaluate : i) $\lim_{x \to 0} \frac{\sin 4x}{\sin 2x}$ (ii) $\lim_{x \to 0} \frac{\tan x}{x}$

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5. Evaluate the following limits. $\lim_{x \to 3} (x + 3)$

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6. Evaluate $\lim_{x \to \pi} \left(x - \frac{22}{7} \right)$

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7. Evaluate $\lim_{r \to 1} \pi r^2$

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8. Evaluate $\lim_{x \to 4} \frac{4x + 3}{x - 2}$

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9. Choose the correct value $\underset{x \to -1}{L} t\left[\frac{x^{10}+x^5+1}{x-1}\right]$ from the bracket $\left(\frac{1}{2}, -\frac{1}{2}, \frac{1}{3}, 0\right)$

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10. Evalute

$$\lim_{x \to 0} \frac{(x+1)^5 - 1}{x}$$

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11. Evalute

$$\lim_{x \to 2} \frac{3x^2 - x - 10}{x^2 - 4}$$

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12. Evalute

$$\lim_{x \to 3} \frac{x^4 - 81}{2x^2 - 5x - 3}$$

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13. Evaluate $\lim_{x \to 0} \frac{ax + b}{cx + 1}$

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14. Evalute

$$\lim_{x \to 1} \frac{z^{\frac{1}{3}} - 1}{z^{\frac{1}{6}} - 1}$$

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15. Evaluate $\lim_{x \to 1} \frac{ax^2 + bx + c}{cx^2 + bx + a}$

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16. Evalute

$$\lim_{x \to 1} \frac{\frac{1}{x} + \frac{1}{2}}{x + 2}$$

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17. Evalute $\lim_{x \to 0} \frac{\sin ax}{bx}$

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18. Evaluate $\lim_{x \to 0} \frac{\sin ax}{\sin bx}, a, b \neq 0$

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19. Evalute

$$\lim_{x \to \pi} \frac{\sin(\pi - x)}{\pi(\pi - x)}$$

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20. Evaluate the following limits $\lim_{x \to 0} \frac{\cos x}{\pi - x}$

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21. Evaulate $\operatorname{Lim}_{x \to 0} \frac{\cos 2x - 1}{\cos x - 1}$.

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22. Evalute

$$\lim_{x \to 0} \frac{ax + x \cos x}{b \sin x}$$

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23. Evaluate $\lim_{x \to 0} x \sec x$

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24. Evaluate $\lim_{x \to 0} \frac{\sin ax + bx}{ax + \sin bx}, a, b, a + b \neq 0$

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25. Evaluate $\lim_{x \to 0} (\cos ecx - \cot x)$

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26. Evalute

$$\lim_{x \to \frac{\pi}{2}} \frac{\tan 2x}{x - \frac{\pi}{2}}$$

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27. Find $\lim_{x \to 0} f(x)$ and $\lim_{x \to 1} f(x)$ where $f(x) = \begin{cases} 2x + 3 & x \leq 0 \\ 3(x + 1) & x > 0 \end{cases}$

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28. Find $\lim_{x \to 1} f(x)$ where $f(x) = \begin{cases} x^2 - 1 & x \leq 1 \\ -x^2 - 1 & x > 1 \end{cases}$

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29. Evalute

$$\lim_{x \to 0} f(x) \text{ , where } f(x) = \begin{cases} \frac{|x|}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$$

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30. Evalute

$$\lim_{x \to 0} f(x) \text{ , where } f(x) = \begin{cases} \frac{|x|}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$$

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31. Find $\lim_{x \to 5} f(x)$, where $f(x) = |x| - 5$

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32. If $f(x) = \begin{cases} a + bx & x < 1 \\ 4 & x = 1 \\ b - ax & x > 1 \end{cases}$ and

$\lim_{x \to 1} f(x) = f(1)$, then find the value of a and b.

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33. Let $a_1, a_2, \ldots\ldots\ldots\ldots\ldots, a_n$ be fixed real numbers and define a function $f(x) = (x - a_1)(x - a_2)\ldots\ldots\ldots(x - a_n)$. What is

$\lim_{x \to a_1} f(x)$? For some $a \neq a_1, a_2, \ldots\ldots a_n$ compute

$\lim_{x \to a} f(x)$

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34. If f(x)=$\begin{cases} |x|+1 & x<0 \\ 0 & x=0 \\ |x|-1 & x>0 \end{cases}$, for what value(s) of a does $\lim_{x \to 0}$ f(x) exist ?

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35. If the function f(x) satisfies $\lim_{x \to 1} \frac{f(x)-2}{x^2-1} = \pi$, evaluate $\lim_{x \to 1} f(x)$

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36. Find the derivative at $x = 2$ of the function $f(x) = 3x$.

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37. Find the derivative of the function $f(x) = 2x^2 + 3x - 5$ at x=-1.Also prove that $f'(0) + 3f'(-1) = 0$.

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38. Find the derivative of $\sin x$ at $x = 0$.

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39. Find the derivative of $f(x) = 3$ at $x = 0$ and $x = 3$.

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40. Find the derivative of $f(x) = 10x$.

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41. Find the derivative of $y = x^2$ using the first principle.

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42. Find the derivative of the constant function $f(x) = a$ for a fixed real number a.

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43. Find the derivative of $\frac{1}{x}$ from first principle.

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44. Compute the derivative of $6x^{100} - x^{55} + x$.

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45. Derivative of $f(x) = 1 + x + x^2 + x^3 + \ldots + x^{50}$ at $x = 1$ is

a)50 b)1250 c)1275 d) $\frac{101}{2}$

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46. Find the derivative of $f(x) = \frac{x+1}{x}$.

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47. Compute the derivative of $\sin x$.

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48. Find the derivative of $\tan x$ using first principle.

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49. (b)Compute the derivative of $f(x) = \sin^2 x$

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50. Derivative of $x^2 - 2$ at $x = 10$ is .....a)10 b)20 c)-10 d)-20

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51. (a)Find the derivative of $99x at x = 100.$

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52. Find the derivative of x at $x = 1.$

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53. Find the derivative of $\frac{x+1}{x-1}$ from first principle.

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54. If $f(x) = \frac{x^{100}}{100} + \frac{x^{99}}{99} + \ldots\ldots + \frac{x^2}{2} + x + 1$ prove that $f'(1) = 100f'(0)$

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55. Find the derivative of $x^n + ax^{n-1} + a^2x^{n-2} + \ldots\ldots + a^{n-1}x + a^n$ for some fixed real number a.

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56. Find the derivative of

$$y = \left(ax^2 + b\right)^2$$

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57. Find the derivative of $\frac{x^n - a^n}{x - a}$ for some constant a.

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58. Find the derivative of

i) $2x - \frac{3}{4}$ ii) $\left(5x^3 + 3x - 1\right)(x - 1)$ iii)

$x^{-3}(5+3x)$

iv) $x^5(3-6x^{-9})$ v) $x^{-4}(3-4x^{-5})$

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59. Find the derivative of $\cos x$ from first principle.

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60. Find the derivative of the following functions 5 sin x - 6 cos x + 7

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61. Find the derivative of

$$f(x) = \frac{2x + 3}{x - 1}$$

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62. (a)Find the derivative of $\sin x + \cos x$ from first principle

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63. Compute derivative of (i) $f(x) = \sin 2x (ii) g(x) = \cot x.$

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64. Find the derivative of $\frac{x + \cos x}{\tan x}$

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65. (b)Find the derivative of `sin(x+1) from first principle.

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66. Find the derivative of $(ax + b)(cx + d)^2$

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67. Find the derivative of

$$y = \frac{ax + b}{cx + d}$$

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68. Find the derivative of the following $\frac{1 + \frac{1}{x}}{1 - \frac{1}{x}}$.

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69. Find the derivative of the following functions

$$\frac{1}{ax^2 + bx + c}$$

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70. Find the derivative of $\frac{ax+b}{px^2+qx+r}$

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71. Find the derivative of $\frac{px^2+qx+r}{ax+b}$

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72. Find the derivative of the following functions

$$\frac{a}{x^4} - \frac{b}{x^2} + \cos x$$

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73. Find the derivative of $4\sqrt{x} - 2$

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74. Find the derivative of $(ax + b)^n$

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75. Find the derivative of

$(ax + b)^n (ax + c)^m$

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76. Find the derivative of $\sin(x+a)$,where a is a constant.

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77. Find the derivative of $\cos ecx \cot x$

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78. Find the derivative of $\frac{\cos x}{1+\sin x}$

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79. Differentiate the following with respect to x.(i)

$$\frac{\sin x + \cos x}{\sin x - \cos x}$$

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80. Find the derivative of $\frac{\sec x - 1}{\sec x + 1}$

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81. Find the derivative of $\sin^n x$

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82. Find the derivative of $\frac{a + b \sin x}{c + d \cos x}$

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83. Find the derivative of $\frac{x + a}{\cos x}$.

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84. Find the derivative of $x^4(5 \sin x - 3 \cos x)$

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85. Find the derivative of $f(x) = \left(x^2 + 1\right)\cos x$

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86. Differentiate the following with respect to x.

$\left(ax^2 + \sin x\right)(p + q\cos x)$

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87. Find the derivative of $(x + \cos x)(x - \tan x)$

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88. Differentiate $\frac{4x + 5\sin x}{3x + 7\cos x}$

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89. Find the derivative of $f(x) = \frac{x^2 \cos\left(\frac{\pi}{4}\right)}{\sin x}$

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90. Find the derivative of $\left[\frac{x}{1 + \tan x}\right]$

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91. Differentiate $(x + \sec x)(x - \tan x)$

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92. Evaluate $\lim_{x \to 1} \left(\frac{2}{1 - x^2} + \frac{1}{x - 1} \right)$

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93. Evaluate: $\lim_{x \to 0} \frac{x}{\sqrt{a + x} - \sqrt{a - x}}$

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94. Find the value of k, if $\lim_{x \to 1} \frac{x^4 - 1}{x - 1} = \lim_{x \to k} \frac{x^3 - k^3}{x^2 - k^2}$

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95. Evaluate $\lim_{x \to 1} \frac{\left(x + x^2 + \ldots\ldots\ldots + x^n\right) - n}{x - 1}$

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96. Evaluate the following limits $\lim_{x \to 0} \frac{\tan x - \sin x}{x^3}$

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97. Evaluate: $\lim_{x \to 0} \frac{\sin 2x + \sin 6x}{\sin 5x - \sin 3x}$

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98. Evaluate: (i) $\lim_{x \to 1} \left(x^2 + 6x + 4\right)$ (ii) $\lim_{x \to 4} \frac{x^3 + 4}{1 - x}$ (iii) $\lim_{x \to 2} \sqrt{36 - x^2}$

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99. Evaluate $\lim_{x \to 1} \frac{\sqrt{x^2 - 1} + \sqrt{x - 1}}{\sqrt{x^2 - 1}}$

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100. Find k so that $\lim_{x \to 2} f(x)$ exists, where

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

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101. If for the function h, given by $h(x) = kx^2 + 7x - 4, h'(5) = 97$, find k

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102. If u, v, w are three differentiable functions of x, prove that

$$\frac{d}{dx}(uvw) = \left(\frac{du}{dx}\right)vw + u\left(\frac{dv}{dx}\right)w + uv\left(\frac{dw}{dx}\right).$$

Use this result to differentiate $x^3(x^2+1)(x^4+1)$ w.r.t. x.

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103. If $y = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots.$, show that $\frac{dy}{dx} = y$.

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104. It is known that for $x \neq 1$, we have $1 + x + x^2 + \ldots. + x^{n-1} = \frac{1-x^n}{1-x}$, using this

result, find the sum of the series $1 + 2x + 3x^2 + \ldots + (n-1)x^{n-2}$.

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105. Evalute

$$\lim_{x \to 1} \frac{x^7 - 1}{x^4 - 1}$$

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106. If $xy = c^2$, prove that $x^2 \frac{dy}{dx} + c^2 = 0$

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