MATHS

BOOKS - NEW JYOTHI MATHS (TAMIL ENGLISH)

LIMITS AND DERIVATIVES

Examples

1. Evaluate $\lim_{x \to -1} \frac{x^2 - 5x + 6}{x - 1}$

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2. Evaluate $\lim_{x \to a} \frac{\sqrt{x} + \sqrt{a}}{x + a}$

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3. solve the limit ; $\lim_{x \to -1} \frac{x^{10} + x^5 + 1}{x - 1}$

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4. Evaluate $\lim_{x \to 0} \frac{a + bx}{c + x}$

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5. Find $\lim_{x \to -2} \frac{x^2 + 5x + 6}{x^2 + 3x + 2}$

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6. For any positive integer n, $\lim_{x \to a} \frac{x^n - a^n}{x - a} = na^{n-1}$

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7. solve the limit ; $\lim_{x \to 1} \frac{x^{15} - 1}{x^{10} - 1}$

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

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9. Evaluate $\lim_{x \to 1} \dfrac{x^7 - 1}{x^4 - 1}$

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10. Find $\lim_{x \to -1} \dfrac{x^5 + 1}{x^3 + 1}$

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11. Evaluate $\lim_{x \to 0} \dfrac{\sqrt{1 + x} - 1}{x}$

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12. Evaluate

i. $\lim_{x \to 0} \frac{\tan x - \sin x}{\sin^3 x}$

ii. $\lim_{x \to 0} \frac{\cos 2x - 1}{\cos x - 1}$

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13. If x is measured in radian, then prove that

$$\lim_{x \to 0} \frac{1 - \cos x}{x} = 0$$

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14. If x is measured in radian

(i) $\lim_{x \to 0} \frac{x}{\sin x} = 1$

(ii) $\lim_{x \to 0} \frac{\tan x}{x} = 1$

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15. solve the limit ; $\lim_{x \to 0} \frac{\sin ax}{\sin bx}, a, b \neq 0.$

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

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17. Evaluate $\lim_{x \to 0} \frac{1 - \cos 4x}{x^2}$

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18. Evaluate (i) $\lim_{x \to 0} \frac{\sin 3x}{x}$

(ii) Find $\lim_{x \to 0} \frac{\sin 3x}{\sin 7x}$

(iii) Evaluate $\lim_{x \to 0} \left(\frac{\sin 3x + 7x}{3x + \sin 7x} \right)$

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19. Evaluate $\lim_{x \to \frac{\pi}{2}} \frac{\cot x}{\frac{\pi}{2} - x}$

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20. Evaluate $\lim_{x \to 0} (\operatorname{cosec} x - \cot x)$

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21. Let $f(x) = \begin{cases} a + bx, x < 1 \\ 4, x = 1 \\ b - ax, x > 1 \end{cases}$ and if $\lim_{x \to 1} f(x) = f(1)$ what are the possible values of a and b

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22. 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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23. Evaluate $\lim_{z \to 1} \frac{z^{\frac{1}{3}} - 1}{z^{\frac{1}{8}} - 1}$

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24. Evaluate $\lim_{x \to -2} \frac{\frac{1}{x} + \frac{1}{2}}{x + 2}$

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25. Evaluate $\lim_{x \to 0} \frac{\sin ax}{bx}$

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26. Evaluate $\lim_{x \to 0} \frac{\cos x}{\pi - x}$

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27. What is ; $\lim_{x \to 0} \frac{ax + x \cos x}{b \sin x}$.

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

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

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30. 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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31. Evaluate $\lim_{x \to 0} f(x)$, where $f(x) = \begin{cases} \frac{|x|}{x}, x \neq 0 \\ 0, x = 0 \end{cases}$

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

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

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

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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35. 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 $\lim_{x \to a} f(x)$ exist?

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36. If the function f(x) satisfies $\lim_{x \to 1} \frac{f(x) - 2}{x^2 - 1} = \pi$, then $\lim_{x \to 1} f(x)$ is equal to

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37. If $f(x) = \begin{cases} mx^2 + n, x < 0 \\ nx + m, 0 \leq x \leq 1 \\ nx^3 + m, x > 1 \end{cases}$

For what integers m and n does both $\lim_{x \to 0} f(x)$ and $\lim_{x \to 1} f(x)$ exist?

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

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39. Derivative of $f(x) = x^n$ is nx^{n-1} for any positive integer n.

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40. If $y = 5x^3 + 3x^2 + 7$, then find $\frac{dy}{dx}$.

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41. (i). If $y = x^3 - 1$, find $\frac{dy}{dx}$.

(ii). If $y = 2x^2 + 4$, find $\frac{dy}{dx}$

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42. Let $y = x^3 - 7x + 3 + 4a^{2a} + 5a^2$, where a is a constant. Find $\frac{dy}{dx}$

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43. Find the derivative of $x^2 + x + 1$ from first principles.

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44. Find the derivative of $\frac{2x + 3}{x - 2}$ from first principle.

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45. Find the derivative of x from the first principle, where f is given by $f(x) = x + \frac{1}{x}$

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46. Find the derivatives of i. sinx,

ii. $\cos x$,

iii. $\tan x$

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47. Find the derivative of

$\sin x + \cos x$

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48. Find the derivative of xsin x from first priciple.

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49. Find the derivative of $\sqrt{x}$

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50. Compute the derivative of $f(x) = \sin 2x$

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

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52. If $y = \left(x^2 + 1\right)\cos x,$ then find $\frac{dy}{dx}$ using product rule.

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53. If $y = \frac{x}{\sin x}$, then find $\frac{dy}{dx}$ using quotient rule.

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54. Find the derivative of $\frac{\sin x}{x}$

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55. Find $f'(x)$, given $f(x) = \dfrac{\cos x}{1 + \sin x}$

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56. Find the derivative of $\dfrac{x + \cos x}{\tan x}$

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57. If $y = \dfrac{\sin(x + a)}{\cos x}$, then prove that $\dfrac{dy}{dx} = \dfrac{\cos a}{\cos^2 x}$.

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58. Find $f'(x)$, given $f(x) = \dfrac{x^2 + 5x + 6}{x^2 + 3x + 2}$.

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59. Given $f(x) = \dfrac{x^3 - 1}{x + 2}$, find i. $f'(x)$ ii. $f'(x)$ at x=1

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60. If $xy = c^2$, then prove that $x^2 \dfrac{dy}{dx} + c^2 = 0$

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61. Differentiate $\dfrac{x^2 \tan x}{1 + x}$ w.r.t. x

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62. For the function

$f(x) = \frac{x^{100}}{100} + \frac{x^{99}}{99} + \ldots . \frac{x^2}{2} + x + 1$and

$f'(1) = 100f'(0)$?.

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63. Find the derivative of

$x^n + ax^{n-1} + a^2x^{n-1} + \ldots + a^{n-1}x + a^n$ for some

fixed real number a.

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64. For some constant a and b, find the derivative of

i. $(x-a)(x-b)$ ii. $\left(ax^2+b\right)^2$

iii. $\dfrac{x-a}{x-b}$

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

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66. Find the derivative of $(px+q)\left(\dfrac{r}{x}+s\right)$

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67. Find the derivative of $\dfrac{1+\frac{1}{x}}{1-\frac{1}{x}}$

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68. Find the derivative of $\dfrac{1}{ax^2+bx+c}$

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

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70. Find the derivative of $\frac{\sin x + \cos x}{\sin x - \cos x}$

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

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

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73. Find the derivative of $\frac{x}{1+\tan x}$

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74. Find the derivative of $(x+\sec x)(x-\tan x)$

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Exercise

1. $\lim_{x \to 1} \frac{x^{10}-1}{x-1}$ is

A. 10

B. 9

C. 11

D. 0

Answer: A

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2. $\lim_{x \to 1} \frac{\sqrt{x} - 1}{x - 1}$ is

A. $\sqrt{2}$

B. 1

C. $\frac{\sqrt{2}}{2}$

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

Answer: D

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3. $\lim_{x \to 0} \frac{\sqrt{x^2+1}-1}{\sqrt{x^2+9}-3}$ is

A. 3

B. 4

C. 1

D. 2

Answer: A

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4. $\lim_{x \to -1} \frac{x^9 + 1}{x + 1}$ is

A. 9

B. -9

C. 8

D. -8

Answer: A

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5. $\lim_{x \to 3} \frac{x^2 - x - 6}{x - 3}$ is

A. 4

B. 5

C. 3

D. -5

Answer: B

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6. $\lim_{x \to 2} \frac{x^5 - 32}{x^3 - 18}$ is

A. 20

B. $\frac{20}{3}$

C. $\frac{32}{3}$

D. 32

Answer: B

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7. $\lim_{\theta \to 0} \frac{\sin 7\theta}{\sin 3\theta}$ is

A. 4

B. 7

C. $\frac{7}{3}$

D. $\frac{3}{7}$

Answer: C

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8. $\lim_{x \to 1} \frac{x^3 + x^2 + x - 3}{x - 1}$ is

A. 3

B. 12

C. 4

D. 6

Answer: D

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9. $\lim_{x \to 1} \frac{x^3 + x^2 + x - 3}{x - 1}$ is

A. n+1

B. $n(n+1)$

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

D. $\frac{n(n+1)}{2}$

Answer: D

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10. $\lim_{x \to 0} \frac{1 - \cos 2x}{2x^2}$ is

A. 2

B. 0

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

D. 1

Answer: D

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11. $\lim_{x \to 0} x \sin\left(\frac{1}{x}\right)$ is

A. 0

B. 1

C. -1

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

Answer: A

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12. $\lim_{x \to 0} \sin\frac{1}{x}$ is

A. 0

B. 1

C. ∞

D. Doest not exist

Answer: D

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13. Let $3f(x) - 2f\left(\frac{1}{x}\right) = x$ the $f'(2)$ is equal to

A. $\frac{2}{7}$

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

C. 2

D. $\frac{7}{2}$

Answer: B

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14. $\lim_{x \to \infty} \frac{\sin x}{x}$ is

A. 1

B. 0

C. -1

D. none of these

Answer: B

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15. $\lim_{x \to 1} \frac{\sqrt{1 - \cos 2(x-1)}}{x-1}$ is

A. $\sqrt{2}$

B. $-\sqrt{2}$

C. does not exist

D. $\sqrt{1}$

Answer: C

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16. $\lim_{x \to 0} \frac{1 - \cos(1 - \cos x)}{x^4}$ is

A. $\frac{1}{8}$

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

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

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

Answer: A

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17. $\lim_{x \to 0} \frac{\sin 2x}{1 - \sqrt{1 - x}}$

A. 4

B. 8

C. 2

D. 1

Answer: A

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18. $\lim_{x \to 0} \frac{\sqrt{1+x^2}-1}{1-\cos x} =$

A. 1

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

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

D. ∞

Answer: A

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19. $\lim_{x \to 4} \frac{\sqrt{1+x} - \sqrt{9-x}}{x-4}$ is equal to

A. 0

B. ∞

C. $\frac{1}{5}$

D. $\frac{1}{\sqrt{5}}$

Answer: D

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20. $\lim_{x \to 0} \frac{3x + |x|}{7x - 5|x|}$

A. 2

B. $\frac{1}{6}$

C. 0

D. Doest not exist

Answer: D

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21. $\lim_{x \to 0} \frac{\tan 3x - \tan 2x - \tan x}{x} =$

A. 0

B. ∞

C. -6

D. -4

Answer: C

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22. $\lim_{x \to 0} \frac{\tan 3x - \tan 2x - \tan x}{x} =$

A. 0

B. ∞

C. 6

D. -6

Answer: A

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23. $\lim_{x \to \infty} \frac{x^3 + 3x^2 + 3x + 1}{2x^3 - 5x^2 + 7} =$

A. 0

B. 1

C. 2

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

Answer: D

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24. $\lim_{x \to \infty} \frac{\sqrt{x}}{\sqrt{x + \sqrt{x + \sqrt{x}}}}$

A. 1

B. 0

C. $\frac{1}{3}$

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

Answer: A

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25. $\lim_{x \to \infty} \left(\sqrt{4x^2 + 2x + 1} - \sqrt{4x^2 + 1} \right)$ is

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

B. 1

C. -1

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

Answer: A

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

A. 0

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

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

D. -2

Answer: B

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27. $\lim_{x \to \infty} \frac{1^2 + 2^2 + \ldots + n^2}{n^3}$

A. 1

B. 0

C. $\frac{1}{3}$

D. $\frac{1}{6}$

Answer: C

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28. If $\lim_{x \to 0} f(x) = l \in R$, then

A. $\lim_{x \to 0} f(x^2) = l^2$

B. $\lim_{x \to 0} f\left(\frac{x}{l}\right) = 1$

C. $\lim_{x \to 0} f(2x) = 2l$

D. $\lim_{x \to 0} f(-x) = l$

Answer: D

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29. $\lim_{x \to \infty} \sqrt{\frac{x - \sin x}{x + \cos^2 x}} =$

A. 0

B. 1

C. ∞

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

Answer: B

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30. $\lim_{x \to +\infty} \frac{\sqrt{2x^2+5}}{2x+3}$ is

A. $\frac{1}{\sqrt{2}}$

B. ∞

C. 1

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

Answer: A

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31. A function $f: R \to R$ is such that $f(x+y) = f(x).f(y)$ for all x.y $\in R$ and $f(x) \neq 0$

for all $x \in R$. If $f'(0) = 2$ then $f'(x)$ is equal to

A. $f(x)$

B. $-f(x)$

C. $2f(x)$

D. $4f(x)$

Answer: C

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32. $f(x+y) = f(x).f(y)$ for all $x, y \in R$ and $f(5) = 2, f'(0) = 3$ then $f'(5)$ is equal to

A. 6

B. 3

C. 5

D. 0

Answer: A

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33. $f(x+y) = f(x).f(y)$ for all $x, y \in R$ and $f(5) = 2, f'(0) = 3$ then $f'(5)$ is equal to

A. $g'(x)$

B. $g(x)$

C. $f(x)$

D. $f'(x)$

Answer: C

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34. $f(x) = \frac{x}{1+|x|}$ then f is differentiable at

A. every where

B. except at x=± 1

C. except at x=0

D. except at x=0, or ± 1

Answer: A

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35. If $f'(a) = 2$ and $f(a) = 4$ then $\lim_{x \to a} \frac{xf(a) - af(x)}{x - a}$ equals to

A. $2a - 4$

B. $4 - 2a$

C. $2a + 4$

D. $4 + 2a$

Answer: B

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36. If f(x) be an even function. Then $f'(x)$

A. is an even function

B. is an odd function

C. may be even or odd

D. none of these

Answer: B

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37. let $f(x) = \frac{\sin 4\pi[x]}{1+[x]^2}$, where px] is the greatest integer less than or equal to x then

A. f(x) is not differentiable at some points

B. f'(x) exits but is different from zero

C. f'(x) for all x

D. f'(x)=0 but f is not a constant

Answer: C

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38. If $\lim_{x \to} \frac{f(x)}{x^2} = k$ then $\lim_{x \to 1} f(x) =$

A. 0

B. 1

C. k

D. not defined

Answer: C

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39. $f(x) = |x-1| + |x-3|$ then $f'(2)$ is

A. -2

B. 0

C. 2

D. Doest not exist

Answer: B

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40. $f(x) = \sqrt{x^2 + 1}$

then $\lim_{x \to 3} \frac{f(x) - \sqrt{10}}{x - 3}$ is

A. $\sqrt{10}$

B. $3\sqrt{10}$

C. $\frac{3\sqrt{10}}{10}$

D. $\frac{\sqrt{10}}{3}$

Answer: C

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41. If $\lim_{x \to a} \left\{ \frac{f(x)}{g(x)} \right\}$ exists, then

A. $\lim_{x \to a} f(x) = l$

B. $\lim_{x \to a} f(x) = 1$

C. $\lim_{x \to a} f(x) = 0$

D. $\lim_{x \to a} f(x) = \infty$

Answer: C

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42. If $f(1) = 1$ and $f'(1) = 2$ then $\lim_{x \to 1} \frac{(f(x))^2 - 1}{x^2 - 1}$ is

A. 2

B. 1

C. $\sqrt{2}$

D. 0

Answer: A

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43. $\lim_{x \to a} \frac{x^2 \sin x - a^2 \sin a}{x - a}$

A. $a^2 \cos a$

B. $a^2 \sin a$

C. $a^2 \cos a + 2a \sin a$

D. $a^2 \sin a + 2a \cos a$

Answer: C

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44. If $\lim_{x \to 2} \frac{x^p - 2^p}{x - 2} = 192$, then p

A. 2

B. 4

C. 6

D. 10

Answer: C

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45. if $\lim_{x \to 0} \frac{\sin ax}{x \cos bx} =$

A. 0

B. a

C. b

D. not defined

Answer: B

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46. if $\lim_{z \to -1} \frac{\sqrt{z} - 1}{1 - z} =$

A. 0

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

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

D. 1

Answer: B

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47. if $\lim_{x \to \frac{\pi}{4}} \left(\frac{\tan\left(\frac{\pi}{4} - x\right)}{\frac{\pi}{4} - x} \right) =$

A. 0

B. 1

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

D. not defined

Answer: B

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Questions From Competitive Exams

1. $\lim_{x \to 1} \frac{x^2 - 2x + 1}{|x^2 - 1|} =$

A. 0

B. 1

C. -1

D. 2

Answer: A

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2. Solve the limit ; $\lim_{x \to 0} \frac{(a^x - b^x)}{x} =$

A. 0

B. 1

C. $\log a - \log b$

D. $\frac{\log a}{\log b}$

Answer: C

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3. Solve the limit ; $\lim_{x \to \pi/2} \frac{a^{\cot x} - a^{\cos x}}{\cot x - \cos x}$ is equal to

A. log a

B. log 2

C. log x

D. none of these

Answer: A

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4. Solve the limit ; $\lim_{x \to 0} \frac{1 - \cos mx}{1 - \cos nx}$

A. m / n

B. m^2 / n^2

C. 1

D. 0

Answer: B

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5. ' lim_ (x to 0) (a^(x)-b^(x))/(e^(x)-1)` is equal to

A. $\log\frac{a}{b}$

B. $\log\frac{b}{a}$

C. log ab

D. loga+b

Answer: A

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6. $\lim_{x \to \frac{\pi}{6}} \frac{2\sin^2 x + \sin x - 1}{2\sin^2 x - 3\sin x + 1} =$

A. 3

B. -3

C. 6

D. 0

Answer: B

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7. $\lim_{x \to 0} \frac{\tan x - \sin x}{x^3}$

A. 0

B. 1

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

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

Answer: C

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8. $\lim_{n \to \infty} \left(\frac{1^2}{1-n^3} + \frac{2^2}{1-n^3} + \ldots + \frac{n^2}{1-n^3} \right) =$

A. $\frac{1}{3}$

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

C. $\frac{1}{6}$

D. $-\frac{1}{6}$

Answer: B

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9. Solve the limit ; $\lim_{x \to 0} \left(\frac{x}{\sqrt{1+x} - \sqrt{1-x}} \right)$

A. 0

B. 1

C. 2

D. -1

Answer: B

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10. $\lim_{x \to \infty} \left(\frac{x^3}{3x^2 - 4} - \frac{x^2}{3x + 2} \right)$ is equal to

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

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

C. $\frac{2}{9}$

D. $\frac{-6}{5}$

Answer: D

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11. $\lim_{x \to 0} \frac{(1+2x)^{10} - 1}{x}$ is equal to

A. 5

B. 10

C. 15

D. 20

Answer: D

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12. $\lim_{x \to 2} \frac{x^{100} - 2^{100}}{x^{77} - 2^{77}}$ is equal to

A. $\frac{100}{77}$

B. $\frac{100}{77}\left(2^{22}\right)$

C. $\frac{100}{77}\left(2^{21}\right)$

D. $\frac{100}{77}\left(2^{23}\right)$

Answer: D

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13. $\lim_{k \to \infty}\left(\frac{1^3+2^3+3^3+\ldots+k^3}{k^4}\right)$ is equal to

A. 0

B. 2

C. $\frac{1}{3}$

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

Answer: D

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14. The value of $\lim_{x \to 0} \frac{\log(1+2x)}{x}$ is equal to

A. 1

B. 2

C. 3

D. $\frac{3}{2}$

Answer: B

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15. $\lim_{x \to 0^-} \frac{1}{3 - 2^{\frac{1}{x}}}$ is equal to

A. 0

B. 1

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

D. $\frac{1}{3}$

Answer: D

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16. $\lim_{x \to 3} \frac{\sqrt{x} - \sqrt{3}}{\sqrt{x^2 - 9}}$ is equal to

A. 1

B. 2

C. $\sqrt{3}$

D. 0

Answer: D

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17. $\lim_{x \to 0} \frac{e^{x^2} - \cos x}{x^2} =$

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

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

C. 1

D. $-\frac{3}{2}$

Answer: A

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18. The value of $\lim_{x \to 3} \frac{x^5 - 3^5}{x^8 - 3^8}$ is equal to

A. $\frac{5}{8}$

B. $\frac{5}{64}$

C. $\frac{5}{216}$

D. $\frac{1}{27}$

Answer: C

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19. Let $f(x) = (x^5 - 1)(x^3 + 1), g(x) = (x^2 - 1)(x^2 - x + 1)$ and let $h(x)$ be such that $f(x) = g(x)h(x)$. Then $\lim_{x \to 1} h(x)$ is

A. 0

B. 1

C. 3

D. 5

Answer: D

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20. $\lim_{x \to 0} \frac{\log(1+3x^2)}{x(e^{5x}-1)} =$

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

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

C. $\frac{-3}{5}$

D. $\frac{-5}{3}$

Answer: A

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