



# MATHS

## BOOKS - PSEB

### LIMITS AND DERIVATIVES

#### Exercise

1. Evaluate the following limits:-  $\lim_{x \rightarrow 3} x + 3$



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2. Evaluate the following limits:-

$$\lim_{x \rightarrow \pi} \left( x - \frac{22}{7} \right)$$



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3. Evaluate the following limits:-  $\lim_{r \rightarrow 1} \pi r^2$



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4. Evaluate the following limits:-  $\lim_{x \rightarrow 4} \frac{4x + 3}{x - 2}$



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5. Evaluate the following limits:-

$$\lim_{x \rightarrow -1} \frac{x^{10} + x^5 + 1}{x - 1}$$



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6. Evaluate the following limits:-

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



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7. Evaluate the following limits:-

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



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8. Evaluate the following limits:-

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



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9. Evaluate the following limits:-  $\lim_{x \rightarrow 0} \frac{ax + b}{cx + 1}$



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10. Evaluate the following limits:-

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



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11. Evaluate the following limits:-

$$\lim_{x \rightarrow 1} \frac{ax^2 + bx + c}{cx^2 + bx + a}, a + b + c \neq 0$$



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12. Evaluate the following limits:-

$$\lim_{x \rightarrow -2} \frac{\frac{1}{x} + \frac{1}{2}}{x + 2}$$



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13. Evaluate the following limits:-  $\lim_{x \rightarrow 0} \frac{\sin ax}{bx}$



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14. Evaluate the following limits:-

$$\lim_{x \rightarrow 0} \frac{\sin ax}{\sin bx}, a, b \neq 0$$



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15. Evaluate the following limits:-

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



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16. Evaluate the following limits:-  $\lim_{x \rightarrow 0} \frac{\cos x}{\pi - x}$



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17. Evaluate the following limits:-

$$\lim_{x \rightarrow 0} \frac{\cos 2x - 1}{\cos x - 1}$$



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18. Evaluate the following limits:-

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



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19. Evaluate the following limits:-  $\lim_{x \rightarrow 0} x \sec x$





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20. Evaluate the following limits:-

$$\lim_{x \rightarrow 0} \frac{\sin ax + bx}{ax + \sin bx} \quad a, b, a + b \neq 0$$



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21. Evaluate the following limits:-

$$\lim_{x \rightarrow 0} (\cos ecx - \cot x)$$



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22. Evaluate the following limits:-

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



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23. Find  $\lim_{x \rightarrow 0} f(x)$  and  $\lim_{x \rightarrow 1} f(x)$ , where

$$f(x) = \begin{cases} 2x + 3 & x \leq 0 \\ 3(x + 1) & x > 0 \end{cases}$$



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24. Find  $\lim_{x \rightarrow 1} f(x)$  where

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



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25. Evaluate  $\lim_{x \rightarrow 0} f(x)$ , where

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



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26. Find  $\lim_{x \rightarrow 0} f(x)$ , where

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



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



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

$\lim_{x \rightarrow 1} f(x) = f(1)$  what are possible values of

a and b ?



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29. Let  $a_1, a_2, \dots, a_n$  be fixed real numbers and

define a function

$$f(x) = (x - a_1)(x - a_2)\dots(x - a_n). \quad \text{What}$$

is  $\lim_{x \rightarrow a_1} f(x)$ ? For some  $a \neq a_1, a_2, \dots, a_n$ ,

compute  $\lim_{x \rightarrow a} f(x)$ .



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30. 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  $\lim_{x \rightarrow a} f(x)$  exists?



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31. If the function  $f(x)$  satisfies

$$\lim_{x \rightarrow 1} \frac{f(x) - 2}{x^2 - 1} = \pi, \text{ evaluate } \lim_{x \rightarrow 1} f(x).$$



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32. 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  $\lim_{x \rightarrow 0} f(x)$

and  $\lim_{x \rightarrow 1} f(x)$  exist?



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33. Find the derivative of  $x^2 - 2$  at  $x = 10$ .



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**34.** Find the derivative of  $99x$  at  $x = 100$ .



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**35.** Find the derivative of  $x$  at  $x = 1$ .



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**36.** Find the derivative of the following function from first principle:-  $x^3 - 27$



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**37.** Find the derivative of the following function from first principle:-  $(x - 1)(x - 2)$



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**38.** Find the derivative of the following function from first principle:-  $\frac{1}{x^2}$



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39. Find the derivative of the following function from first principle:-  $\frac{x + 1}{x - 1}$



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40. For the function

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

Prove that  $f'(1) = 100f'(0)$ .



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**41.** Find the derivative of

$$x^n + ax^{n-1} + a^2x^{n-2} + \dots + a^{n-1}x + a^n$$

for some fixed real number  $a$ .



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**42.** For some constants  $a$  and  $b$ , find the derivative of  $(x - a)(x - b)$



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**43.** For some constants  $a$  and  $b$ , find the derivative of  $(ax^2 + b)^2$



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**44.** For some constants  $a$  and  $b$ , find the derivative of  $\frac{x - a}{x - b}$



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



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46. Find the derivative of:-  $2x - \frac{3}{4}$



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47. Find the derivative of:-

$$(5x^3 + 3x - 1)(x - 1)$$



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48. Find the derivative of:-  $x^{-3}(5 + 3x)$



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49. Find the derivative of:-  $x^5(3 - 6x^{-9})$



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50. Find the derivative of:-  $x^{-4}(3 - 4x^{-5})$



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51. Find the derivative of:-  $\frac{2}{x+1} - \frac{x^2}{3x-1}$



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



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**53.** Find the derivative of the following function:  $\sin x \cos x$



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**54.** Find the derivative of the following function:  $5 \sec x + 4 \cos x$



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**55.** Find the derivative of the following function:  $\cos ecx$



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**56.** Find the derivative of the following function:  $3 \cot x + 5 \cos ecx$



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**57.** Find the derivative of the following function:  $5 \sin x - 6 \cos x + 7$



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**58.** Find the derivative of the following function:  $2 \tan x - 7 \sec x$



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**59.** Find the derivative of the following function from first principle:  $-x$



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**60.** Find the derivative of the following function from first principle:  $(-x)^{-1}$



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**61.** Find the derivative of the following function from first principle:  $\sin(x + 1)$



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**62.** Find the derivative of the following function from first principle:  $\cos\left(x - \frac{\pi}{8}\right)$



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**63.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(x + a)$



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**64.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(px + q) \left( \frac{r}{x} + s \right)$





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**65.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(ax + b)(cx + d)^2$



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**66.** Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{ax + b}{cx + d}$



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**67.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{1 + \frac{1}{x}}{1 - \frac{1}{x}}$



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**68.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\frac{1}{ax^2 + bx + c}$



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**69.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\frac{ax + b}{px^2 + qx + r}$







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70. Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\frac{px^2 + qx + r}{ax + b}$



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71. Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{a}{x^4} - \frac{b}{x^2} + \cos x$



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**72.** Find the derivative of the following

function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $4\sqrt{x} - 2$



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**73.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(ax + b)^n$



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**74.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(ax + b)^n(cx + d)^m$





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**75.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\sin(x + a)$



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**76.** Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\cos e c x \cot x$



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77. Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{\cos x}{1 + \sin x}$



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**78.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\frac{\sin x + \cos x}{\sin x - \cos x}$



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**79.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\frac{\sec x - 1}{\sec x + 1}$





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**80.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $\sin^n x$



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**81.** Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{a + b \sin x}{c + d \cos x}$



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**82.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{\sin(x + a)}{\cos x}$



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**83.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $x^4(5 \sin x - 3 \cos x)$



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**84.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(x^2 + 1) \cos x$





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**85.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):

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



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**86.** Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(x + \cos x)(x - \tan x)$



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**87.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{4x + 5 \sin x}{3x + 7 \cos x}$



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**88.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers): 
$$\frac{x^2 \cos\left(\frac{\pi}{4}\right)}{\sin x}$$



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**89.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers): 
$$\frac{x}{1 + \tan x}$$



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**90.** Find the derivative of the following function (it is to be understood that  $a, b, c, d, p, q, r$  and  $s$  are fixed non-zero constants and  $m$  and  $n$  are integers):  $(x + \sec x)(x - \tan x)$



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**91.** Find the derivative of the following function (it is to be understood that  $a, b, c,$

$d, p, q, r$  and  $s$  are fixed non-zero constants and

$m$  and  $n$  are integers):  $\frac{x}{\sin^n x}$



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