



MATHS

NCERT - NCERT MATHEMATICS (GUJRATI)

LIMITS AND DERIVATIVES

Example

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

(ii) $\lim_{x \rightarrow 3} [x(x + 1)]$

(iii) $\lim_{x \rightarrow -1} [1 + x + x^2 + \dots + x^{10}]$



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2. Evaluate :

$$\lim_{x \rightarrow 1} \frac{x^{15} - 1}{x^{10} - 1}$$



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3. Evaluate :

$$\lim_{x \rightarrow 0} \frac{\sqrt{1+x} - 1}{x}$$



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4. Evaluate :

$$\lim_{x \rightarrow 0} \frac{\sin 4x}{\sin 2x}$$



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5. Evaluate :

$$\lim_{x \rightarrow 0} \frac{\tan x}{x}$$



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6. Find the derivative at $x = 2$ of the function

$$f(x) = 3x.$$



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7. Find the derivative of the function

$$f(x) = 2x^2 + 3x - 5 \text{ at } x = -1. \quad \text{Also}$$

prove that $f'(0) + 3f'(-1) = 0$.



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



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9. Find the derivative of

$$f(x) = 3atx = 0 \text{ and } atx = 3.$$



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



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11. Find the derivative of $f(x) = x^2$.



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12. Find the derivative of the constant function

$f(x) = a$ for a fixed real number a .



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



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14. Compute the derivative of

$$6x^{100} - x^{55} + x.$$



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15. Find the derivative of

$$f(x) = 1 + x + x^2 + x^3 + \dots + x^{50} \text{ at } x = 1$$

.



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



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



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18. Compute the derivative of $\tan x$.



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



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Miscellaneous Examples

1. Find the derivative of f from the first principle, where f is given by

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



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2. Compute derivative of

$$f(x) = \sin 2x$$



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3. Compute derivative of

$$g(x) = \cot x$$



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4. Find the derivative of

$$\frac{x^5 - \cos x}{\sin x}$$



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5. Find the derivative of

$$\frac{x + \cos x}{\tan x}$$



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1. Evaluate the following limits in

$$\lim_{x \rightarrow 3} x + 3$$



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2. Evaluate the following limits in

$$\lim_{x \rightarrow \pi} \left(x - \frac{22}{77} \right)$$



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3. Evaluate the following limits in

$$\lim_{r \rightarrow 1} \pi r^2$$



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4. Evaluate the following limits in

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



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5. Evaluate the following limits in

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



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6. Evaluate the following limits in

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



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7. Evaluate the following limits in

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



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8. Evaluate the following limits in

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



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9. Evaluate the following limits in

$$\lim_{x \rightarrow 0} \frac{ax + b}{cx + 1}$$



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10. Evaluate the following limits in

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



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11. Evaluate the following limits in

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



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12. Evaluate the following limits in

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



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13. Evaluate the following limits in

$$\lim_{x \rightarrow 0} \frac{\sin ax}{bx}$$



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14. Evaluate the following limits in

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



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15. Evaluate the following limits in

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



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16. Evaluate the following limits in

$$\lim_{x \rightarrow 0} \frac{\cos x}{\pi - x}$$



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17. Evaluate the following limits in

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



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18. Evaluate the following limits in

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



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19. Evaluate the following limits in

$$\lim_{x \rightarrow 0} x \sec x$$



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20. Evaluate the following limits in

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



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21. Evaluate the following limits in

$$\lim_{x \rightarrow 0} (\operatorname{cosec} x - \cot x)$$



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22. Evaluate the following limits in

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



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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

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



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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

$$f(x) = (x - a_1)(x - a_2)\dots(x - a_n).$$

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

$$\lim_{x \rightarrow 0} f(x) \text{ and } \lim_{x \rightarrow 1} f(x) \text{ exist?}$$



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Exercise 13 2

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



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



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3. Find the derivative of $99x$ at $x = 100$.



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4. Find the derivative of the following functions from first principle.

$$x^3 - 27$$



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5. Find the derivative of the following functions from first principle.

$$(x - 1)(x - 2)$$



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6. Find the derivative of the following functions from first principle.

$$\frac{1}{x^2}$$



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7. Find the derivative of the following functions from first principle.

$$\frac{x + 1}{x - 1}$$



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8. 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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9. 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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10. For some constants a and b , find the derivative of

$$(x - a)(x - b)$$



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11. For some constants a and b , find the derivative of

$$(ax^2 + b)^2$$



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12. For some constants a and b , find the derivative of

$$\frac{x - a}{x - b}$$



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



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14. Find the derivative of

$$2x - \frac{3}{4}$$



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15. Find the derivative of

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



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16. Find the derivative of

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



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17. Find the derivative of

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



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18. Find the derivate of

$$x^{-4}(3 - 4x^{-5})$$



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19. Find the derivate of

$$\frac{2}{x+1} - \frac{x^2}{3x-1}$$



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



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21. Find the derivative of the following functions:

$\sin x \cos x$



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22. Find the derivative of the following functions:

$$\sec x$$



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23. Find the derivative of the following functions:

$$5 \sec x + 4 \cos x$$



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24. Find the derivative of the following functions:

$$\operatorname{cosec} x$$



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25. Find the derivative of the following functions:

$$3 \cot x + 5 \operatorname{cosec} x$$



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26. Find the derivative of the following functions:

$$5 \sin x - 6 \cos x + 7$$



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27. Find the derivative of the following functions:

$$2 \tan x - 7 \sec x$$



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Miscellaneous Exercise On Chapter 13

1. Find the derivative of the following functions from first principle:

$$-x$$



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2. Find the derivative of the following functions from first principle:

$$(-x)^{-1}$$



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3. Find the derivative of the following functions from first principle:

$$\sin(x + 1)$$



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4. Find the derivative of the following functions from first principle:

$$\cos\left(x - \frac{\pi}{8}\right)$$



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5. Find the derivative of the following functions (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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6. Find the derivative of the following functions (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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7. Find the derivative of the following functions (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):

$$(ax + b)(vx + d)^2$$



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8. Find the derivative of the following functions (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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9. Find the derivative of the following functions (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):

$$\left(\frac{1 + \frac{1}{x}}{1 - \frac{1}{x}} \right)$$



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10. Find the derivative of the following functions (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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11. Find the derivative of the following functions (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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12. Find the derivative of the following functions (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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13. Find the derivative of the following functions (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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14. Find the derivative of the following functions (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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15. Find the derivative of the following functions (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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16. Find the derivative of the following functions (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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17. Find the derivative of the following functions (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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18. Find the derivative of the following functions (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):

$$\operatorname{cosec} x \cot x$$



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19. Find the derivative of the following functions (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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20. Find the derivative of the following functions (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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21. Find the derivative of the following functions (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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22. Find the derivative of the following functions (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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23. Find the derivative of the following functions (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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24. Find the derivative of the following functions (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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25. Find the derivative of the following functions (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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26. Find the derivative of the following functions (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):

$$(x^3 + 1) \cos x$$



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27. Find the derivative of the following functions (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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28. Find the derivative of the following functions (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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29. Find the derivative of the following functions (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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30. Find the derivative of the following functions (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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31. Find the derivative of the following functions (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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32. Find the derivative of the following functions (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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33. Find the derivative of the following functions (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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