

МАТН 122

FARMAN

3.1: DERIVATIVE OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Матн 122

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Calculus for Business Administration and Social Sciences



OUTLINE

MATH 122

FARMAN

3.1: DERIVATIVE: OF POLYNO-MIALS CONSTANTS LINEARITY

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

1 3.1: DERIVATIVES OF POLYNOMIALS

- Constants
- Linearity
- Power Rule



OUTLINE

MATH 122

1 3.1: DERIVATIVES OF POLYNOMIALS

- Constants
- Linearity
- Power Rule



2 3.2: EXPONENTIAL AND LOGARITHMIC FUNCTIONS



MATH 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS

CONSTANTS

LINEARITY

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • Let f(x) = a for $a \in \mathbb{R}$ (this means "a is an element of \mathbb{R} ", the set of real numbers).



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS

LINEARITY

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • Let f(x) = a for $a \in \mathbb{R}$ (this means "a is an element of \mathbb{R} ", the set of real numbers).

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• The difference quotient for any *x*₀, *x*₁ is

$$\frac{f(x_0) - f(x_1)}{x_0 - x_1}$$



Матн 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS

LINEARITY BOWER BULL

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • Let f(x) = a for $a \in \mathbb{R}$ (this means "a is an element of \mathbb{R} ", the set of real numbers).

• The difference quotient for any *x*₀, *x*₁ is

$$\frac{f(x_0) - f(x_1)}{x_0 - x_1} = \frac{a - a}{x_0 - x_1}$$



Матн 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS

LINEARITY BOWER BULL

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • Let f(x) = a for $a \in \mathbb{R}$ (this means "a is an element of \mathbb{R} ", the set of real numbers).

• The difference quotient for any x_0, x_1 is

$$\frac{f(x_0)-f(x_1)}{x_0-x_1}=\frac{a-a}{x_0-x_1}=0.$$



Матн 122

FARMAN

3.1: Derivatives of Polynomials constants

LINEARITY

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • Let f(x) = a for $a \in \mathbb{R}$ (this means "a is an element of \mathbb{R} ", the set of real numbers).

• The difference quotient for any x_0, x_1 is

$$\frac{f(x_0)-f(x_1)}{x_0-x_1}=\frac{a-a}{x_0-x_1}=0.$$

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• Therefore f'(x) = 0.



Матн 122

FARMAN

3.1: DERIVATIVE OF POLYNO-MIALS CONSTANTS LINEARITY

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS Let *f* and *g* be differentiable functions, and let $a \in \mathbb{R}$.



Матн 122

FARMAN

3.1: DERIVATIVE: OF POLYNO-MIALS CONSTANTS

LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS Let *f* and *g* be differentiable functions, and let $a \in \mathbb{R}$.

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 $\frac{\mathsf{d}}{\mathsf{d}x}\left(f(x)\pm g(x)\right)$



Матн 122

FARMAN

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LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS Let *f* and *g* be differentiable functions, and let $a \in \mathbb{R}$.

$$\frac{\mathrm{d}}{\mathrm{d}x}(f(x)\pm g(x))=\frac{\mathrm{d}}{\mathrm{d}x}f(x)\pm \frac{\mathrm{d}}{\mathrm{d}x}g(x)$$



Матн 122

FARMAN

3.1: DERIVATIVE: OF POLYNO-MIALS CONSTANTS

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS Let *f* and *g* be differentiable functions, and let $a \in \mathbb{R}$. • $\frac{d}{dx}(f(x) \pm g(x)) = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$ • $\frac{d}{dx}(af(x))$

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Матн 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS Let *f* and *g* be differentiable functions, and let $a \in \mathbb{R}$. • $\frac{d}{dx}(f(x) \pm g(x)) = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$ • $\frac{d}{dx}(af(x)) = a\frac{d}{dx}f(x).$

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DERIVATIVE OF A POWER FUNCTIONS

MATH 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS The derivative of x^n for $n \in \mathbb{R}$ is

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(x^{n}\right)=nx^{n-1}.$$

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DERIVATIVE OF A POWER FUNCTIONS

Матн 122

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$$\frac{\mathrm{d}}{\mathrm{d}x}\left(x^{n}\right)=nx^{n-1}.$$

REMARK 1

The derivative of a linear function is

$$\frac{\mathrm{d}}{\mathrm{d}x}(mx+b)=m\frac{\mathrm{d}}{\mathrm{d}x}x+\frac{\mathrm{d}}{\mathrm{d}x}(b)=m$$



DERIVATIVE OF POLYNOMIALS

MATH 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS Consider a degree *n* polynomial,

$$p(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_2 x^2 + a_1 x + a_0.$$



DERIVATIVE OF POLYNOMIALS

МАТН 122

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3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS Consider a degree *n* polynomial,

$$p(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0.$$

The derivative is

$$p'(x) = \frac{d}{dx}(a_nx^n + a_{n-1}x^{n-1} + \dots + a_2x^2 + a_1x + a_0)$$

= $a_n\frac{d}{dx}(x^n) + a_{n-1}\frac{d}{dx}(x^{n-1}) + \dots$
+ $a_2\frac{d}{dx}(x^2) + a_1\frac{d}{dx}(x)$



DERIVATIVE OF POLYNOMIALS

МАТН 122

FARMAN

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The derivative is

$$p'(x) = \frac{d}{dx}(a_nx^n + a_{n-1}x^{n-1} + \dots + a_2x^2 + a_1x + a_0)$$

= $a_n\frac{d}{dx}(x^n) + a_{n-1}\frac{d}{dx}(x^{n-1}) + \dots$
+ $a_2\frac{d}{dx}(x^2) + a_1\frac{d}{dx}(x)$
= $na_nx^{n-1} + (n-1)a_{n-1}x^{n-2} + \dots + 2a_2x + a_1.$

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МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

1
$$A(t) = 3t^5$$

2
$$r(p) = p^5 + p^3$$

• $f(x) = 5x^2 - 7x^3$ • $g(t) = \frac{t^2}{4} + 3$

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МАТН 122

FARMAN

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A'(t) =



МАТН 122

FARMAN

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2
$$r(p) = p^5 + p^3$$

3
$$f(x) = 5x^2 - 7x^3$$

3 $g(t) = \frac{t^2}{4} + 3$

$$A'(t) = \frac{\mathsf{d}}{\mathsf{d}t} \left(3t^5 \right)$$



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МАТН 122

FARMAN

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3
$$f(x) = 5x^2 - 7x^3$$

3 $g(t) = \frac{t^2}{4} + 3$

$$\begin{aligned} \mathbf{A}'(t) &= \frac{d}{dt} \left(3t^5 \right) \\ &= 3 \left(\frac{d}{dt} \left(t^5 \right) \right) \end{aligned}$$

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МАТН 122

POWER RULE

LOGARITH-

Differentiate the following

1 $A(t) = 3t^5$ (

2)
$$r(p) = p^5 + p^3$$

3
$$f(x) = 5x^2 - 7x^3$$

3 $g(t) = \frac{t^2}{4} + 3$

$$A'(t) = \frac{d}{dt} (3t^5)$$
$$= 3 \left(\frac{d}{dt} (t^5) \right)$$
$$= 3 \left(5t^4 \right)$$



МАТН 122

POWER RULE

LOGARITH-

Differentiate the following

•
$$A(t) = 3t^5$$

• $r(p) = p^5 + p$

2)
$$r(p) = p^5 + p^3$$

So
$$f(x) = 5x^2 - 7x^3$$
So $g(t) = \frac{t^2}{4} + 3$

$$A'(t) = \frac{d}{dt} (3t^5)$$
$$= 3 \left(\frac{d}{dt} (t^5) \right)$$
$$= 3 \left(5t^4 \right)$$
$$= 15t^4.$$



MATH 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

1
$$A(t) = 3t^5$$

2 $r(p) = p^5 + p^3$

Solution
$$f(x) = 5x^2 - 7x^3$$
Solution $g(t) = \frac{t^2}{4} + 3$

r'(p) =



MATH 122

FARMAN

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1
$$A(t) = 3t^5$$

2 $r(p) = p^5 + p^3$

$$r'(p) = rac{\mathrm{d}}{\mathrm{d}p}\left(p^5+p^3
ight)$$

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МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

$$\begin{array}{ll} r'(\rho) & = & \displaystyle \frac{\mathrm{d}}{\mathrm{d}\rho} \left(\rho^5 + \rho^3\right) \\ & = & \displaystyle \frac{\mathrm{d}}{\mathrm{d}\rho} \left(\rho^5\right) + \displaystyle \frac{\mathrm{d}}{\mathrm{d}\rho} \left(\rho^3\right) \end{array}$$

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МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

$$\begin{aligned} r'(p) &= \frac{d}{dp} \left(p^5 + p^3 \right) \\ &= \frac{d}{dp} \left(p^5 \right) + \frac{d}{dp} \left(p^3 \right) \\ &= 5p^4 + 3p^2. \end{aligned}$$

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Матн 122

FARMAN

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Differentiate the following

1
$$A(t) = 3t^5$$

2 $r(p) = p^5 + p^3$

a
$$f(x) = 5x^2 - 7x^3$$
a $g(t) = \frac{t^2}{4} + 3$

f'(x) =



Матн 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

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$$A(t) = 3t^5$$

2 $r(p) = p^5 + p^3$

S
$$f(x) = 5x^2 - 7x^3$$
S $g(t) = \frac{t^2}{4} + 3$

$$f'(x) = \frac{\mathsf{d}}{\mathsf{d}x} \left(5x^2 - 7x^3 \right)$$



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

Differentiate the following

• $A(t) = 3t^5$ • $r(p) = p^5 + p^3$

$$f'(x) = \frac{\mathrm{d}}{\mathrm{d}x} \left(5x^2 - 7x^3 \right) = \frac{\mathrm{d}}{\mathrm{d}x} \left(5x^2 \right) - \frac{\mathrm{d}}{\mathrm{d}x} \left(7x^3 \right)$$



Матн 122

FARMAN

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Differentiate the following

1 $A(t) = 3t^5$ 2 $r(p) = p^5 + p^3$

$$f'(x) = \frac{d}{dx} \left(5x^2 - 7x^3 \right) = \frac{d}{dx} \left(5x^2 \right) - \frac{d}{dx} \left(7x^3 \right)$$
$$= 5\frac{d}{dx} \left(x^2 \right) - 7\frac{d}{dx} \left(x^3 \right)$$

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МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

Differentiate the following

1 $A(t) = 3t^5$ **3** $f(t) = r(p) = p^5 + p^3$ **4** $g(t) = r(p) = p^5 + p^3$

$$f'(x) = \frac{d}{dx} \left(5x^2 - 7x^3 \right) = \frac{d}{dx} \left(5x^2 \right) - \frac{d}{dx} \left(7x^3 \right) \\ = 5\frac{d}{dx} \left(x^2 \right) - 7\frac{d}{dx} \left(x^3 \right) = 5(2x) - 7(3x^2)$$



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

1 $A(t) = 3t^5$ 2 $r(p) = p^5 + p^3$ 3 g(t)

$$f(x) = 5x^2 - 7x^3$$
 $g(t) = \frac{t^2}{4} + 3$

$$f'(x) = \frac{d}{dx} \left(5x^2 - 7x^3 \right) = \frac{d}{dx} \left(5x^2 \right) - \frac{d}{dx} \left(7x^3 \right)$$

= $5\frac{d}{dx} \left(x^2 \right) - 7\frac{d}{dx} \left(x^3 \right) = 5(2x) - 7(3x^2)$
= $10x - 21x^2$.

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MATH 122

FARMAN

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3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Differentiate the following

- **1** $A(t) = 3t^5$
- **2** $r(p) = p^5 + p^3$

3
$$f(x) = 5x^2 - 7x^3$$

3 $g(t) = \frac{t^2}{4} + 3$

g'(t) =



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

Differentiate the following

A(t) = 3t⁵
 r(p) = p⁵ + p³

f(x) =
$$5x^2 - 7x^3$$
 g(t) = $\frac{t^2}{4} + 3$

$$g'(t) = \frac{d}{dt}\left(\frac{t^2}{4}+3\right)$$



МАТН 122

FARMAN

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POWER RULE

3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

Differentiate the following

• $A(t) = 3t^5$ • $r(p) = p^5 + p^3$

f(x) =
$$5x^2 - 7x^3$$
 g(t) = $\frac{t^2}{4} + 3$

$$g'(t) = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{t^2}{4}+3\right) = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{t^2}{4}\right) + \frac{\mathrm{d}}{\mathrm{d}t}(3)$$



МАТН 122

FARMAN

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3.2: EXPO-NENTIAL ANI LOGARITH-MIC FUNCTIONS

Differentiate the following

A(t) = 3t⁵
 r(p) = p⁵ + p³

a
$$f(x) = 5x^2 - 7x^3$$
a $g(t) = \frac{t^2}{4} + 3$

$$g'(t) = \frac{d}{dt} \left(\frac{t^2}{4} + 3\right) = \frac{d}{dt} \left(\frac{t^2}{4}\right) + \frac{d}{dt} (3)$$
$$= \frac{1}{4} \frac{d}{dt} \left(t^2\right) + 0$$



МАТН 122

FARMAN

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A(t) = 3t⁵
 r(p) = p⁵ + p³

f(x) =
$$5x^2 - 7x^3$$
 g(t) = $\frac{t^2}{4} + 3$

$$g'(t) = \frac{d}{dt} \left(\frac{t^2}{4} + 3\right) = \frac{d}{dt} \left(\frac{t^2}{4}\right) + \frac{d}{dt} (3)$$
$$= \frac{1}{4} \frac{d}{dt} \left(t^2\right) + 0$$
$$= \frac{1}{4} (2t)$$



МАТН 122

FARMAN

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A(t) = 3t⁵
 r(p) = p⁵ + p³

f(x) =
$$5x^2 - 7x^3$$
 g(t) = $\frac{t^2}{4} + 3$

$$g'(t) = \frac{d}{dt} \left(\frac{t^2}{4} + 3\right) = \frac{d}{dt} \left(\frac{t^2}{4}\right) + \frac{d}{dt} (3)$$
$$= \frac{1}{4} \frac{d}{dt} \left(t^2\right) + 0$$
$$= \frac{1}{4} (2t)$$
$$= \frac{t}{2}.$$



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Find the derivative of

$$f(x) = x^3 - 2x^2 - 5x + 7.$$



МАТН 122

FARMAN

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3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

Find the derivative of

$$f(x) = x^3 - 2x^2 - 5x + 7.$$

$$f'(x) = \frac{d}{dx}(x^3 - 2x^2 - 5x + 7)$$



МАТН 122

FARMAN

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Find the derivative of

$$f(x) = x^3 - 2x^2 - 5x + 7.$$

$$f'(x) = \frac{d}{dx}(x^3 - 2x^2 - 5x + 7)$$

= $\frac{d}{dx}(x^3) - \frac{d}{dx}(2x^2) - \frac{d}{dx}(5x) + \frac{d}{dx}(7)$



МАТН 122

FARMAN

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Find the derivative of

f'

$$f(x) = x^3 - 2x^2 - 5x + 7.$$

$$(x) = \frac{d}{dx}(x^3 - 2x^2 - 5x + 7)$$

= $\frac{d}{dx}(x^3) - \frac{d}{dx}(2x^2) - \frac{d}{dx}(5x) + \frac{d}{dx}(7)$
= $\frac{d}{dx}(x^3) - 2\frac{d}{dx}(x^2) - 5\frac{d}{dx}(x) + 0$

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МАТН 122

FARMAN

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Find the derivative of

f'

$$f(x) = x^3 - 2x^2 - 5x + 7.$$

$$(x) = \frac{d}{dx}(x^3 - 2x^2 - 5x + 7)$$

= $\frac{d}{dx}(x^3) - \frac{d}{dx}(2x^2) - \frac{d}{dx}(5x) + \frac{d}{dx}(7)$
= $\frac{d}{dx}(x^3) - 2\frac{d}{dx}(x^2) - 5\frac{d}{dx}(x) + 0$
= $3x^2 - 4x - 5.$



EXPONENTIALS

MATH 122

FARMAN

3.1: DERIVATIVE: OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

The derivative of e^x is

$$\frac{\mathsf{d}}{\mathsf{d}x}(e^x)=e^x.$$

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МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS

• The derivative of the natural logarithm is

$$\frac{\mathrm{d}}{\mathrm{d}x}(\ln(x)) = \frac{1}{x}.$$



МАТН 122

FARMAN

3.1: DERIVATIVES OF POLYNO-MIALS CONSTANTS LINEARITY POWER RULE

3.2: EXPO-NENTIAL AND LOGARITH-MIC FUNCTIONS • The derivative of the natural logarithm is

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• The derivative of log_a(x) is



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