

This is the beginning of an exciting subtraction of derivatives. Relax
and enjoy!

By Tuzman Alexander

December 17, 2020



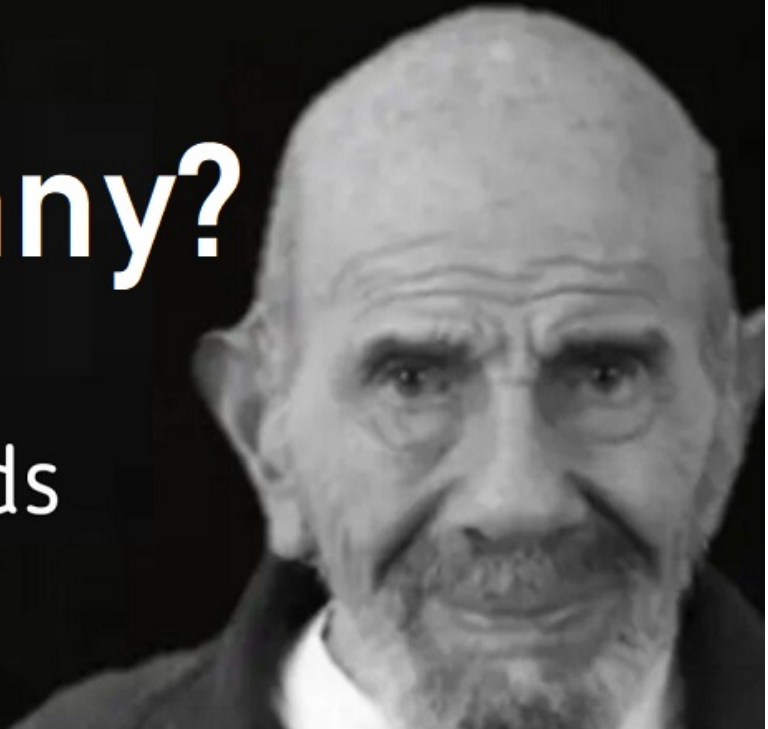
1 This is subtraction of 1'st derivative

Riddle from Jacques Fresco

$$\sin(x + 8) + (\cos(x^9 + 9))^2$$

How many?

Thirty seconds
are given for
reflection



Let's differentiate expressions and find their derivatives!



9



0

Let's differentiate expressions and find their derivatives!

Me: Can I have

x

Mom: "No, we have already
this function at home"

this function at home:

1

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$x^9$$

What I am studying in university:

$$x^{9-1} \cdot 9 \cdot 1$$

What I will need in life:

B3		:	X	✓	<i>f_x</i>	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

Me: Can I have

$$x^9 + 9$$

Mom: "No, we have already
this function at home"

this function at home:

$$x^{9-1} \cdot 9 \cdot 1 + 0$$

Let's differentiate expressions and find their derivatives!



$$\cos(x^9 + 9)$$

$$(0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0)$$

Let's differentiate expressions and find their derivatives!

BEFORE 

$$(\cos(x^9 + 9))^2$$

AFTER 

$$\begin{aligned} & (\cos(x^9 + 9))^{2-1} \cdot 2 \cdot (0 - \sin(x^9 + 9)) \cdot \\ & (x^{9-1} \cdot 9 \cdot 1 + 0) \end{aligned}$$

Let's differentiate expressions and find their derivatives!

What I have studied in school:

8

What I am studying in university:

0

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$x$$

What I am studying in university:

$$1$$

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$x + 8$$

Functions in 2020:

$$1 + 0$$



**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!



$$\sin(x + 8)$$



$$\cos(x + 8) \cdot (1 + 0)$$

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$\sin(x + 8) + (\cos(x^9 + 9))^2$$

What I am studying in university:

$$\begin{aligned} &\cos(x + 8) \cdot (1 + 0) + (\cos(x^9 + 9))^{2-1} \cdot 2 \cdot \\ &(0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \end{aligned}$$

What I will need in life:

B3					
1+2					
	A	B	C	D	E
1					
2					
3		1+2			
4					
5					

Let's make expressions simpler and easier!

I have a problem, doctor. Nobody understands me.

$$\cos(x + 8) \cdot (1 + 0) + (\cos(x^9 + 9))^{2-1} \cdot 2 \cdot (0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0)$$



Just try to be simpler.

Ok.

$$\cos(x + 8) + \cos(x^9 + 9) \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9$$

$$\cos(x + 8) + \cos(x^9 + 9) \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9$$



We have just calculated the derivative!

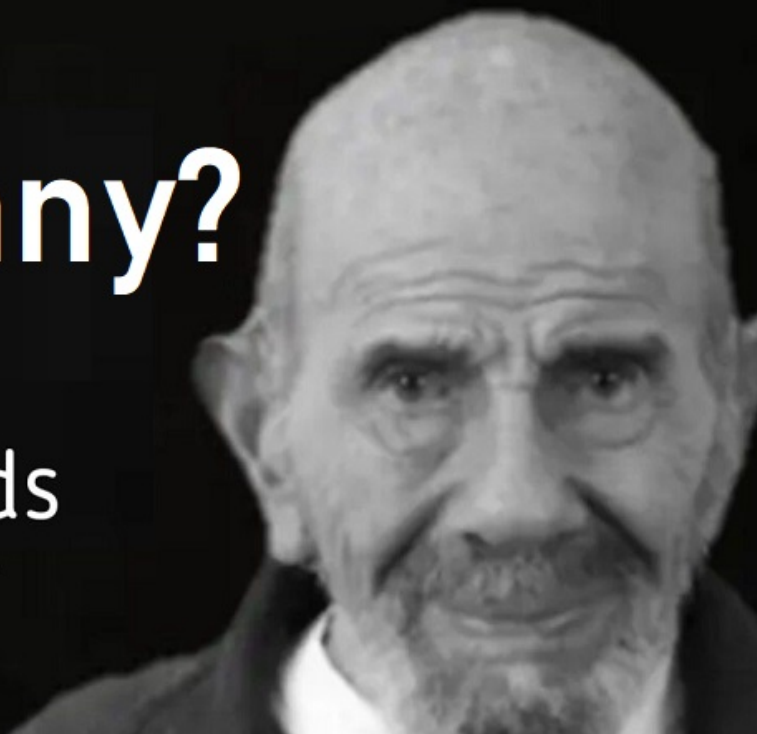
2 This is subtraction of 2'st derivative

Riddle from Jacques Fresco

$$\cos(x + 8) + \cos(x^9 + 9) \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9$$

How many?

Thirty seconds
are given for
reflection



Let's differentiate expressions and find their derivatives!

Me: Can I have

9

Mom: "No, we have already
this function at home"

this function at home:

0

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$x$$

What I am studying in university:

$$1$$

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

Me: Can I have

$$x^8$$

Mom: "No, we have already
this function at home"

this function at home:

$$x^{8-1} \cdot 8 \cdot 1$$

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$x^8 \cdot 9$$

What I am studying in university:

$$x^{8-1} \cdot 8 \cdot 1 \cdot 9 + x^8 \cdot 0$$

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!



9



0

Let's differentiate expressions and find their derivatives!

BEFORE 

x

AFTER 

1

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$x^9$$

Functions in 2020:

$$x^{9-1} \cdot 9 \cdot 1$$



**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$x^9 + 9$$

Functions in 2020:

$$x^{9-1} \cdot 9 \cdot 1 + 0$$



**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!



$$\sin(x^9 + 9)$$



$$\cos(x^9 + 9) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0)$$

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$\sin(x^9 + 9) \cdot x^8 \cdot 9$$

Functions in 2020:

$$\begin{aligned} &\cos(x^9 + 9) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot x^8 \cdot 9 + \\ &\sin(x^9 + 9) \cdot (x^{8-1} \cdot 8 \cdot 1 \cdot 9 + x^8 \cdot 0) \end{aligned}$$



**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!

What I have studied in school:

2

What I am studying in university:

0

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

What I have studied in school:

9

What I am studying in university:

0

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

BEFORE 

x

AFTER 

1

Let's differentiate expressions and find their derivatives!



$$x^9$$



$$x^{9-1} \cdot 9 \cdot 1$$

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$x^9 + 9$$

Functions in 2020:

$$x^{9-1} \cdot 9 \cdot 1 + 0$$



**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!

Me: Can I have

$$\cos(x^9 + 9)$$

Mom: "No, we have already
this function at home"

this function at home:

$$(0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0)$$

Let's differentiate expressions and find their derivatives!

BEFORE 

$$\cos(x^9 + 9) \cdot 2$$

AFTER 

$$(0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot 2 + \cos(x^9 + 9) \cdot 0$$

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$\cos(x^9 + 9) \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9$$

What I am studying in university:

$$\begin{aligned} & ((0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot 2 + \\ & \cos(x^9 + 9) \cdot 0) \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9 + \cos(x^9 + \\ & 9) \cdot 2 \cdot (\cos(x^9 + 9) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot x^8 \cdot 9 + \\ & \sin(x^9 + 9) \cdot (x^{8-1} \cdot 8 \cdot 1 \cdot 9 + x^8 \cdot 0)) \end{aligned}$$

What I will need in life:

B3		:	X	✓	<i>f_x</i>	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

Functions in 1970:

8

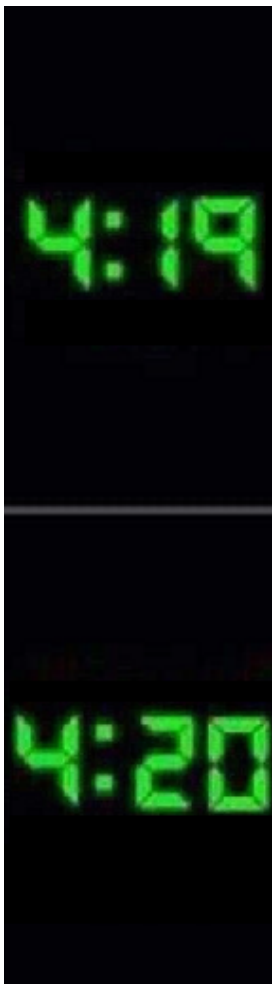
Functions in 2020:

0

~~$\frac{dx}{dy}$~~

**Stop differentiating
functions!**

Let's differentiate expressions and find their derivatives!



x

1

Let's differentiate expressions and find their derivatives!

BEFORE 

$$x + 8$$

AFTER 

$$1 + 0$$

Let's differentiate expressions and find their derivatives!

What I have studied in school:

$$\cos(x + 8)$$

What I am studying in university:

$$(0 - \sin(x + 8)) \cdot (1 + 0)$$

What I will need in life:

B3		:	X	✓	f_x	1+2
	A	B	C	D	E	
1						
2						
3		1+2				
4						
5						

Let's differentiate expressions and find their derivatives!

Functions in 1970:

$$\cos(x + 8) + \cos(x^9 + 9) \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9$$

Functions in 2020:

$$(0 - \sin(x + 8)) \cdot (1 + 0) + ((0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot 2 + \cos(x^9 + 9) \cdot 0) \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9 + \cos(x^9 + 9) \cdot 2 \cdot (\cos(x^9 + 9) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot x^8 \cdot 9 + \sin(x^9 + 9) \cdot (x^{8-1} \cdot 8 \cdot 1 \cdot 9 + x^8 \cdot 0))$$



**Stop differentiating
functions!**

Let's make expressions simpler and easier!

Teacher: don't worry, tasks on exam will be like this:

$$\begin{aligned} & \sin(x + 8) + \sin(x^9 + 9) \cdot x^8 \cdot 9 \cdot 2 \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9 + \cos(x^9 + 9) \cdot 2 \cdot (\cos(x^9 + 9) \cdot x^8 \cdot 9 \cdot x^8 \cdot 9 + \sin(x^9 + 9) \cdot x^7 \cdot 8 \cdot 9) \end{aligned}$$

Tasks on exam:

$$\begin{aligned} & (0 - \sin(x + 8)) \cdot (1 + 0) + ((0 - \sin(x^9 + 9)) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot 2 + \cos(x^9 + 9) \cdot 0) \cdot \sin(x^9 + 9) \cdot x^8 \cdot 9 + \cos(x^9 + 9) \cdot 2 \cdot (\cos(x^9 + 9) \cdot (x^{9-1} \cdot 9 \cdot 1 + 0) \cdot x^8 \cdot 9 + \sin(x^9 + 9) \cdot (x^{8-1} \cdot 8 \cdot 1 \cdot 9 + x^8 \cdot 0)) \end{aligned}$$

$$\begin{aligned} &\sin(x + 8) + \sin(x^9 + 9) \cdot x^8 \cdot 9 \cdot 2 \cdot \sin(x^9 + \\ &9) \cdot x^8 \cdot 9 + \cos(x^9 + 9) \cdot 2 \cdot (\cos(x^9 + 9) \cdot x^8 \cdot \\ &9 \cdot x^8 \cdot 9 + \sin(x^9 + 9) \cdot x^7 \cdot 8 \cdot 9) \end{aligned}$$



We have just calculated the derivative!

That is all!

Source code is available on my GitHub:

