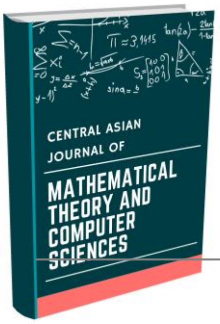

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PROBLEMS OF FORMING STUDENTS' UNDERSTANDING OF FUNCTION DIFFERENTIATION

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Abstract

This article deals with the differential (derivative) of a function, which is considered one of the important topics in mathematics. Examples of calculating the differential of a function using specific examples are also given. The examples are presented in a clear format that is easy for students to understand.

A R T I C L E I N F O

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Introduction. Everyone in the fields mathematician to the laws based on modern of computers success with app to be done and his day by day developed going, age of experts belongs to areas, issues mathematician models make up to know and in it count technique current reach duties is putting These issues modeling mathematician deeds and methods using done is increased. As you know, in mathematics existing, natural numbers, arithmetic from actions since, present modern, linear algebra and analytical geometry, differential and integral calculus and differential to Eqs concepts of the real world are models. of these concepts all humanity from needs to be things counting, economy account such as livelihood for necessary from issues come came out and developed is going That's it because of today's our research mathematics important of subjects one has been function differential in particular take to go decision we did.

Analysis and results . $y = f(x)$ the function (a, b) is defined in the interval, and the limit of the ratio of the x_0 product of Δx the function at a point Δy to the product of the argument, when the product of the argument tends to zero, $y = f(x)$ is called the derivative of the function x_0 at the point. This is the limit

$$y', f'(x_0), \quad \frac{dy}{dx}, \quad \frac{df}{dx}$$

from symbols one with is determined .

So to the definition basically

$$f'(x_0)=\lim_{\Delta x\to 0}\frac{\Delta y}{\Delta x}=\lim_{\Delta x\to 0}\frac{f(x_0+\Delta x)-f(x_0)}{\Delta x}$$

will be , this limit exists if , the derivative x_0 at the point there is is called

Derivative to find process ***differentiation*** **that** is called

Function derivative derivative to the definition basically to find one how many examples let's see :

Example 1. $y=x^3$ of the function derivative derivative to the definition basically find.

Solving . $\lim\limits_{\Delta x\to 0}\frac{\Delta y}{\Delta x}$ the limit we count .

$$\Delta y=(x+\Delta x)^3-x^3=x^3+3x^2\Delta x+3x\Delta x^2+\Delta x^3-x^3=3x^2\Delta x+3x\Delta x^2+\Delta x^3$$

being _

$$\lim_{\Delta x\to 0}\frac{\Delta y}{\Delta x}=\lim_{\Delta x\to 0}\frac{3x^2\Delta x+3x\Delta x^2+\Delta x^3}{\Delta x}=\lim_{\Delta x\to 0}\frac{\Delta x(3x^2+3x\Delta x+\Delta x^2)}{\Delta x}=$$
$$=\lim_{\Delta x\to 0}(3x^2+3x\Delta x+\Delta x^2)=3x^2$$

will be

So by $y'=3x^2$ doing _

Example 2. $y=\sin x$ function derivative derivative to the definition basically , find .

Solving . argument $x, \Delta x$ do not increase while , is a function Δy do not increase takes _

$$\Delta y=\sin(x+\Delta x)-\sin x=2\cos(x+\Delta x/2)\sin\Delta x/2;$$

$$\frac{\Delta y}{\Delta x}=2\cos\left(x+\frac{\Delta x}{2}\right)\frac{\sin(\Delta x/2)}{\Delta x}=\cos\left(x+\frac{\Delta x}{2}\right)\frac{\sin(\Delta x/2)}{(\Delta x/2)};$$

$$\Delta x\to 0 \quad d\grave{a} \quad \cos\left(x+\frac{\Delta x}{2}\right)\to\cos x. \quad \lim_{\Delta x\to 0}\frac{\sin(\Delta x/2)}{(\Delta x/2)}=1.$$

So by $\lim\limits_{\Delta x\to 0}\frac{\Delta y}{\Delta x}=\cos x, \qquad y'=(\sin x)'=\cos x$ doing

will be

In general , x and y of variables physical , economic , chemical from the meanings give up if y we are late from x according to received derivative , y of x to depends being of change speed represents _

of the function differential - $y=f(x)$ function x_0 at the point differentiable , i.e to the derivative have if, that is

$$\ell im_{\Delta x\to 0}\frac{\Delta y}{\Delta x}=y', \quad \frac{\Delta y}{\Delta x}=y'+\alpha, \quad \Delta x\to 0 \quad d\grave{a} \quad \alpha\to 0$$

being, in this α infinite small function will be So,

$$\Delta y = y'\Delta x + \alpha\,\Delta x \qquad (1)$$

will be (1) to formula **function gain formula for** is called

Function of the increase $y'\Delta x$ to the head ***function differential*** is called and dy with is determined.

To the definition mainly _

$$dy = y'\Delta x \qquad (2)$$

(2) in formula $y = x$ if _$dx = x'\Delta x$ or $dx = \Delta x$ is a function differential

$$dy = y'dx$$

in appearance will be

(1) from the formula $\Delta y \approx dy$ **approx equality come comes out** , that is Δx enough small when , is a function gain his to the differential approx equal to to say can _ In this $\Delta y \approx dy$ is , that is

$$f(x_0 + \Delta x) - f(x_0) \approx f'(x_0)\Delta x$$

or $f(x_0 + \Delta x) \approx f(x_0) + f'(x_0)\Delta x$ (3)

will be (3) from formula ***function value approx in calculations*** is used .

$y = f(x)$ of the function ***second in order differential*** that function from the differential received to the differential it is said and

$$d^2y = d(dy) = d(y'dx) = y''dx^2$$

with is determined .

Same so _$d^3y = y'''dx^3$, ... , $d^ny = y^{(n)}dx^n$ differentials are also determined.

Now while this examples seeing we leave: Example 3. $y = \sqrt{1+x^2}$ of the function the first and second in order find the differentials .

Solving. Before the first and second in order derivatives we find:

$$y' = (\sqrt{1+x^2})' = \frac{(1+x^2)'}{2\sqrt{1+x^2}} = \frac{2x}{2\sqrt{1+x^2}} = \frac{x}{\sqrt{1+x^2}};$$

$$y'' = \left(\frac{x}{\sqrt{1+x^2}}\right)' = \frac{x'\sqrt{1+x^2} - x(\sqrt{1+x^2})'}{(\sqrt{1+x^2})^2} =$$

$$= \frac{\sqrt{1+x^2} - x\cdot x/\sqrt{1+x^2}}{1+x^2} = \frac{1+x^2 - x^2}{(1+x^2)\sqrt{1+x^2}} = \frac{1}{\sqrt{(1+x^2)^3}}.$$

So by doing

$dy = \frac{x}{\sqrt{1+x^2}}dx$ and $d^2y = \frac{1}{\sqrt{(1+x^2)^3}}dx^2$

will be

Example 4. $f(x) = 3x^2 - 7$ of the function , the argument is from 2 to 2,001 when it changes increase find approx .

Solving. (3) from formula we use $x_0 = 2$, $\Delta x = 0.001.$
$f'(x) = 6x,\quad f'(x_0) = 6\cdot 2 = 12$, $\Delta f(x_0) \approx df(x_0) = f'(x_0)\ \ \Delta x = 12\cdot 0.001 =$
$= 0.012.$

Function gain instead of his differential take how much to the error road that it was placed we evaluate : of this for real gain we find

$$\Delta f(x_0) = f(x_0 + \Delta x) - f(x_0) = 3(x_0 + \Delta x)^2 - 7 - (3x_0^2 - 7) =$$
$$= 3x_0^2 + 6x_0\Delta x + 3(\Delta x)^2 - 7 - 3x_0^2 + 7 =$$
$$= 6x_0\Delta x + 3(\Delta x)^2 = 6\cdot 2\cdot 0.001 + 3\cdot 0.000001 = 0.012003.$$

So, absolutely error

$$|\ \Delta y - dy| = |0.012003 - 0.012| = 0.000003.$$

Relative error

$$\frac{|\Delta y - dy|}{dy} = \frac{0.000003}{0.012} = 0.00025 \text{ or } 0{,}025\%.$$

The approximate calculation error is quite small, which shows that the above approximate equality can be used in approximate calculations.

Second in order derivative to find examples seeing analysis by doing we go out $y = (2x^2 - 7)^3$ of the function second in order find the derivative.

Solving.

$$y' = \left[(2x^2 - 7)^3\right]' = 3(2x^2 - 7)^2(2x^2 - 7)' = 3(2x^2 - 7)^2\cdot 4x = 12x(2x^2 - 7)^2;$$
$$y'' = (y')' = \left[12x(2x^2 - 7)^2\right]' = 12\{x'(2x^2 - 7)^2 + x\left[(2x^2 - 7)^2\right]' =$$
$$= 12\left[(2x^2 - 7)^2 + 2x(2x^2 - 7)\cdot 4x\right] = 12(2x^2 - 7)(2x^2 - 7 + 8x^2) =$$
$$= 12(2x^2 - 7)(10x^2 - 7).$$

Conclusion. Summary as that's it we say maybe to the students mathematics from science functions derivatives topic in teaching different different pedagogical of technologies, modern study from materials use to the goal is appropriate. In students functions to derivatives circle formulas in mind stay them skills formation for different different competitions transfer and them encouraging to go it is necessary Function to the derivative circle scientific books, recommendation and study manuals to create more improvement it is necessary.

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