RELATIONSHIP OF ELEMENTS OF MATHEMATICAL ANALYSIS WITH CERTAIN PROBLEMS OF MATHEMATICS

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Abstract

This article contains important recommendations for the development of mathematics education and for effectively conveying the concepts of differential calculus to students and strengthening their mathematical skills. It is emphasized that teachers should teach students new, effective problem-solving methods in and out of class.

The article presents the main theorems of differential calculus and examples explaining how they are used in solving mathematical problems. This process develops students' independent thinking, the desire to find new ways to solve practical problems. In addition, effective methods of using the interval method in solving inequalities help to deepen students' mathematical understanding.

Also, in the article, issues related to the derivative and its practical application are shown through examples, and the importance of teaching students' practical skills for the correct application of formulas and successful completion of mathematical mental work. is emphasized.

Keywords: Mathematical education, differential calculus, function derivative, integration, mathematical analysis, trigonometric functions, algebraic inequalities, derivative application, maximum and minimum points, interval methods, surfaces and volumes, mathematical analysis, parametric problems, solving equations, trigonometry, function graphs, practical problems, mathematical formulas, proving inequalities, methodological approaches, checking variables.

MATEMATIK ANALIZ ELEMENTLARINI MATEMATIKANING AYRIM MASALALARI BILAN BOG‘LIQLIGI.

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Annotatsiya:

Mazkur maqola matematika ta’limini rivojlantirish va differensial hisob tushunchalarini o‘quvchilarga samarali tarzda yetkazish, ularning matematik ko‘nikmalarini mustahkamlash uchun muhim tavsiyalarni o‘z ichiga oladi. O‘qituvchilar darslarda va darsdan tashqarida o‘quvchilarga yangi, samarali masala yechish metodlarini o‘rgatishlari kerakligi ta’kidlanadi.

Maqolada differensial hisobning asosiy teoremalari va ularning matematik masalalarni yechishda qanday qo‘llanilishini tushuntiruvchi misollar keltirilgan. Bu jarayon o‘quvchilarning mustaqil fikrlashini, amaliy masalalarni yechishda yangi usullarni topish istagini rivojlantiradi.

Bundan tashqari, tengsizliklarni yechishda interval metodidan foydalanishning samarali usullari, o‘quvchilarning matematik tushunchalarini yanada chuqurlashtirishga yordam beradi.
Shuningdek, maqolada hosila va uning amaliy qo‘llanilishiga oid masalalar misollar orqali ko‘rsatilgan bo‘lib, o‘quvchilarga formulalarni to‘g‘ri qo‘llash va matematik aqliy ishlarni muvaffaqiyatli bajarish bo‘yicha amaliy ko‘nikmalarni o‘rgatishning muhimligi ta’kidlanadi.

Kalit so‘zlar: Matematik ta’lim, differensial hisob, funksiya hosilasi, integratsiya, matematik tahlil, trigonometrik funksiyalar, algebraik tengsizliklar, hosilani qo‘llash, maksimum va minimum nuqtalar, intervallar metodlari, yuzalar va hajmlar, matematik analiz, parametrik masalalar, tengliklar yechimi, trigonometriya, funksiya grafigi, amaliy masalalar, matematik formulalar, tengsizliklarni isbotlash, metodologik yondashuvlar, o‘zgaruvchilarni tekshirish.

АННОТАЦИЯ:
Данная статья содержит важные рекомендации для развития математического образования и эффективного донесения до учащихся понятий дифференциального исчисления и укрепления их математических навыков. Подчеркивается, что учителя должны обучать учащихся новым, эффективным методам решения проблем в классе и вне занятий.
В статье представлены основные теоремы дифференциального исчисления и примеры, поясняющие, как они используются при решении математических задач. Этот процесс развивает самостоятельное мышление учащихся, стремление находить новые пути решения практических задач. Кроме того, эффективные методы использования интервального метода при решении неравенств помогают углубить математические знания учащихся.
Также в статье на примерах показаны вопросы, связанные с производной и ее практическим применением, и подчеркнута важность обучения студентов практическим навыкам для правильного применения формул и успешного выполнения математической умственной работы.

КЛЮЧЕВЫЕ СЛОВА: Математическое образование, дифференциальное исчисление, производная функции, интегрирование, математический анализ, тригонометрические функции, алгебраические неравенства, применение производной, точки максимума и минимума, интервальные методы, поверхности и объемы, математический анализ, параметрические задачи, решение уравнений, тригонометрия, функция. графики, практические задачи, математические формулы, доказательство неравенств, методические подходы, проверка переменных.

Introduction
To develop mathematics education, the teacher must clearly define the work that needs to be done in the lesson and outside the lesson, the main goal and the ways to achieve it.
After each lesson, the student must be able to imagine what he has learned and what he needs to learn independently.
Students strive to independently find new and effective ways to solve practical problems.

The concept of the derivative of a function is an important concept in the course of mathematical analysis. The derivative is the basis of differential calculus and the basis of integral calculus.
The main section of the topic "Derivative and its applications" is the application of the derivative to verify the function, plot its graph, and find the maximum and minimum values. The materials of this topic are used in the study of classes of functions, for example, trigonometric, exponential, logarithmic, and other functions. This topic is also of great practical importance and plays a major role in establishing interdisciplinary connections.
Learning the concept of an elementary function is naturally connected with problems of differential calculus. Using an elementary function in calculating areas and volumes simplifies many problems. In the school mathematics course, algebraic inequalities are studied using the interval method in the 11th grade. Solving inequalities using the interval method creates many conveniences and also facilitates understanding by students. However, in order to further clarify this concept in the minds of students and develop their ideas about it, it is appropriate to apply the elements of mathematical analysis to solving inequalities in more depth.[1]
The scope of application of the derivative in solving elementary mathematical problems is very wide. This is, for example, the use of derivatives in converting algebraic expressions into real forms, factoring, proving theorems, calculating sums, solving equations, inequalities and systems, proving inequalities, solving parametric problems, checking functions, and others. These problems are based on a number of basic theorems, which are given below:

1. If functions $f(x)$ and $g(x)$ *are differentiable at* $(a;b)$ and $f(x)=g(x)$. If $x\hat{e}(a;b)$, then $f'(x)=g'(x)$, $x\hat{e}(a;b)$.
2. If functions $f(x)$ and $g(x)$ *are differentiable at* $(a;b)$ and
$f'(x)=g'(x)$, $x\hat{e}(a;b)$, then the functions $f(x)$ and $g(x)$ differ by a constant number S.
3. If functions $f(x)$ and $g(x)$ are differentiable at $(a;b)$ *and* $f'(x)=0$, $x\hat{e}(a;b)$, then $f(x)$ is a constant function on $x\hat{e}(a;b)$: $f(x)=S$.
4. If the function $f(x)$ *is differentiable* at the point x_0 $(x_0\hat{e}(a;b))$, then the function is continuous at the point $x=x_0$. (The reverse is false).
5. If the function $f(x)$ is differentiable at $(a;b)$ *and* $f'(x)>0$, $(f'(x)<0)$ $x\hat{e}(a;b)$, then the function $f(x)$ *is* $(a;b)$ grows in (decreases).
6. If $f(x)$ is a function $[a;b)$ ($[a;b]$, $(a;b]$) continuous in the interval and increasing (decreasing) in $(a;b)$, then $f(x)$ $[a;b)$ ($[a;b]$, $(a;b]$) function increases (decreases) in $(a;b)$.
7. If $f(x)$ and $g(x)$ are continuous in $[a;b]$ *and* differentiable in $(a;b)$, $f'(x)<g'(x)$, $x\hat{e}(a;b)$ and $f(x)\leq g(x)$, then $f(x)<g(x)$, $x\hat{e}(a;b)$ will be.
8. If the function $f(x)$ is continuous on the section $[a;b]$, differentiable at $(a;b)$ *and* $f(a)=f(b)$, then at least one point $s(a;b)$ is found and $f'(s)=0$ satisfies.
9. If the function $f(x)$ is continuous on the section $[a;b]$, differentiable at $(a;b)$ *and* $f(a)=f(b)$, then there is a point s *such* that ($s\hat{e}(a;b)$) , for which:
$f(a)-f(b)=f'(s)(b-a)$
10. A g a r $f(x)$ function a $(a;b)$ or a liqd a is continuous bo ‘ lib , this or a liqd a shund a y x_0 point a ($x_0\hat{e}(a;b)$) is found a ki , (a,x_0) interval a $f'(x)>0$ and (x_0,b) interval a $f'(x)<0$ is a , u hold a x_0 point a is a function of a max point a si be

11. A g a r *f (x)* function a (*a; b*) or a liqd a is continuous bo ' lib , this or a liqd a shund a y x_0 point *a* (x_0 *ê(a;* b)) is found a ki , (*a,x 0* $^{)}$ *interval* a f ' (*x*) < *0* and a (x_0 , ^{b}) interval a f ' (*x*) > 0 is a , u hold a x_0 point a *f (x)* of the function a minimum point a si [2-3]

Example do a year :

I. Expression a Try it simply :

$$(x+y+z)^3-(x+y-z)^3-(y+z-x)^3-(z+x-y)^3$$

Solving .

"A *"* *x* the changer amount that count a b *f(x)* function a let 's see :

$$f(x)=(x+y+z)^3-(x+y-z)^3-(y+z-x)^3-(z+x-y)^3$$

f (x) function a d a n we get :

$$f'(x)=3(x+y+z)^3-3(x+y-z)^3-3(y+z-x)^3-3(z+x-y)^3=$$

$$=3\left((x+y)^2+2z(x+y)+z^2-(x+y)^2+2z(x+y)-z^2+(y+z)^2-2x(y+z)+x^2-(z-y)^2-2(z-y)x-x^2\right)=$$

$$=3\left(4z(x+y)+y^2+2yz+z^2-2xy-2xz-z^2+2zy-y^2-2zx+2yx\right)=3\cdot 8zy=24zy;$$

$$f'(x)=24zy\Rightarrow f(x)=24xyz+C,$$

here *S* γ may depend on x = 0

$$C=f(0)=(y+z)^3-(y-z)^3-(y+z)^3-(z-y)^3=0$$

$$C=0\Rightarrow \qquad f(x)=24xyz;$$

So , $(x+y+z)^3-(x+y-z)^3-(y+z-x)^3-(z+x-y)^3=24xyz:$

"B"

$$(x+y+z)^3-(x+y-z)^3-(y+z-x)^3-(z+x-y)^3=$$

$$=(x+y+z-x-y+z)\left((x+y+z)^2+(x+y+z)(x+y-z)+(x+y-z)^2\right)-$$

$$-(y+z-x+z+x-y)\left((y+z-x)^2-(y+z-x)(z+x-y)+(z+x-y)^2\right)=$$

$$=2z\left((x+y)^2+2z(x+y)+z^2+(x+y)^2-z^2+(x+y)^2-2z(x+y)+z^2\right)-$$

$$-2z\left(y^2+2zy+z^2-2xy-2zy+x^2-yz-yx+y^2-z^2-zx+zy+xz+x^2-xy+z^2-2zy+y^2+2xz-2xy+x^2\right)=$$

$$=2z\left(3(x+y)^2+z^2-3y^2-z^2+8xy-3x^2\right)=2z\left(3x^2+6xy+3y^2+8xy-3y^2-3x^2\right)=24xyz;$$

II. Factor the expression:

$$xy(x-y)+yz(y-z)+xz(z-x)$$

Solving .

"A *"* *x* the changer amount that count a b $f(x)=xy(x-y)+yz(y-z)+xz(z-x)$ function a let 's meet .

$$f'(x)=2xy-y^2+z^2-2xz=2x(y-z)-(y-z)(y+z)=(y-z)(2x-y-z)$$

$$\left(x^2-(y+z)x\right)'=2x-y-z$$

$$(y-z)\left(x^2-(y+z)x\right)'=(y-z)(2x-y-z)=f'(x)$$

$$f(x)=(y-z)\left(x^2-(y+z)x\right)+C$$

S x depends on em a s , but *he* and a *z* depends on

x =0 d a *C* = *f* (0)= *yz (y – z)*

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$f(x)=(y-z)(x^2-(y+z)x)+yz(y-z)=(y-z)(x(x-y)-z(x-y))=(y-z)(x-z)(x-y)$ Let 's $xy(x-y)+yz(y-z)+xz(z-x)=(x-y)\cdot(x-z)\cdot(y-z)$. say

"B"

$$xy(x-y)+yz(y-z)+xz(z-x)=x^2y-xy^2+y^2z-yz^2+xz^2-x^2z=x^2(y-z)+yz(y-z)-$$
$$-x(y^2-z^2)=x^2(y-z)+yz(y-z)(y+z)=(y-z)(x^2+yz-xy-xz)=(y-z)(x(x-z)-y(x-z))=$$
$$=(y-z)(x-z)(x-y);$$

Let's take a look at the steps of using the derivation in proofs :

1. We assume that *f(x)=g(x)* .
2. *f(x)* is found.
3. *g(x)* is found.
4. Derivatives are considered equal.
5. If the derivatives are equal, *f(x)= g(x)= S* at a selected point $x=x_0$.
6. If A g a r *S* =0, the statement is true, if *C* ≠is 0, the statement is false.

Let's apply these considered steps to concrete situations. This method is especially useful for proving trigonometric expressions, because often students struggle to find the formulas needed to prove trigonometric expressions and prove the expression using long, circuitous paths.

Issues.

I. " A "

$$3(\sin^4 x+\cos^4 x)-2(\sin^6 x+\cos^6 x)=1.$$

Solution :

1. $3(\sin^4 x+\cos^4 x)-2(\sin^6 x+\cos^6 x)=1.$

2.

$$f'(x)=12\sin^3 x\cos x-12\cos^3 x\sin x-12\sin^5 x\cos x+12\cos^5 x\sin x=$$
$$=12\sin x\cos x(\sin^2 x-\cos^2 x-\sin^4 x+\cos^4 x)=$$
$$=12\sin x\cos x[\sin^2 x(1-\sin^2 x)-\cos^5 x(1-\cos^2 x)]=$$
$$=12\sin x\cos x(\sin^2 x\cos^2 x-\cos^2 x\sin^2 x)=0$$

3. *g '(x)* = 0
4. *f '(x)=g'(x)* 0=0
5. $x_0=\frac{\pi}{2}$ let it be

$f(\frac{\pi}{2})$= 3(1+0)-2(1+0)=1; $g(\frac{\pi}{2})$= 1

6. $S=f(x_0)-g(x_0)$= 1-1=0; *C* = 0

That 's right .

"B" .

$$3(\sin^4 x+\cos^4 x)-2(\sin^6 x+\cos^6 x)=1.$$

This is the same proof for , $\sin^6 x+\cos^6 x$ g a a^3+b^3 formula a d a n useful z a pride he is a student one q a r a shd a a ngl a b not enough

$$3\left(\sin^4 x+\cos^4 x\right)-2\left(\left(\sin^2 x\right)^3+\left(\cos^2 x\right)^3\right)=3\sin^4 x+3\cos^4 x-$$
$$-2\left(\sin^2 x+\cos^2 x\right)\left(\sin^4 x-\sin^2 x\cdot\cos^2 x+\cos^4 x\right)=\sin^4 x+2\sin^2 x\cdot\cos^2 x+\cos^4 x=$$
$$=\left(\sin^2 x+\cos^2 x\right)^2=1^2=1$$

II . $8\cos^4 x-\cos 4x=16\cos^2 x-4\cos 2x-5$

Solving. " A "

1. $8\cos^4 x-\cos 4x=16\cos^2 x-4\cos 2x-5$
2. $f\ '(x)=-32\cos^3 x\sin x+4\sin 4x=-32\cos^3 x\sin x+8\sin 2x\cos 2x=-8\sin 2x(2\cos^2 x-\cos 2x)= =-8\sin 2x(2\cos^2 x-\cos^2 x+\sin^2 x)=-8\sin 2x;$
3. $g\ '(x)=-32\sin x\cos x+8\sin 2x=-16\sin 2x+8\sin 2x=-8\sin 2x$;
4. $-8\sin 2x=-8\sin 2x;$
5. Let $x_0=\dfrac{\pi}{2}$

$$f\left(\pi/2\right)=8\cos^4\frac{\pi}{2}-\cos 4\frac{\pi}{2}=0-1=-1.$$

$$g\left(\pi/2\right)=16\cos^2\frac{\pi}{2}-4\cos 2\frac{\pi}{2}-5=4-5=-1$$

6. $f\left(\pi/2\right)=g\left(\pi/2\right)=0, \qquad C=0$

Dem a k , a yniy a t to ‘ g ' ri .

" B "

$$8\cos^4 x-\cos 4x=8\cos^4 x-\left(\cos^2 2x-\sin^2 2x\right)=$$
$$=8\cos^4 x-\left[\left(\cos^2 x-\sin^2 x\right)^2-4\sin^2 x\cos^2 x\right]=$$
$$=8\cos^4 x-\left[\cos^4 x-2\sin^2 x\cos^2 x+\sin^4 x-4\sin^2 x\cos^2 x\right]=$$
$$=8\cos^4 x-\left(\cos^4 x-6\cos^2 x\left(1-\cos^2 x\right)+\left(1-\cos^2 x\right)^2\right)=$$
$$=8\cos^4 x-\left(\cos^4 x-6\cos^2 x+6\cos^4 x+1-2\cos^2 x+\cos^4 x\right)=$$
$$=8\cos^4 x-\left(8\cos^4 x-8\cos^2 x+1\right)=8\cos^2 x-1$$
$$8\cos^4 x-\cos 4x=8\cos^2 x-1 \qquad (*)$$
$$16\cos^2 x-4\cos 2x-5=16\cos^2 x-4\left(2\cos^2 x-1\right)-5=$$
$$=16\cos^2 x-8\cos^2 x+4-5=8\cos^2 x-1$$
$$16\cos^2 x-4\cos 2x-5=8\cos^2 x-1 \qquad (**)$$

Comparing the equations (*) and (**).

$8\cos^4 x-\cos 4x=16\cos^2 x-4\cos 2x-5$ We'll make sure it's appropriate .

III.$2\cos^4 x-\frac{3}{4}=\cos 2x+\frac{1}{4}\cos 4x$ prove the point .

Solving. "A".

1.$2\cos^4 x-\frac{3}{4}=\cos 2x+\frac{1}{4}\cos 4x$

2. $f'(x)=-2\cdot 4\cos^3 x\sin x-0=-4\cos^2 x\sin 2x$

3. $g'(x) = -2\sin 2x - \sin 4x = -2\sin 2x - 2\sin 2x \cdot \cos 2x =$
$= -2\sin 2x(1+\cos 2x) = -4\cos^2 x \sin 2x$

4. $-4\sin 2x\cos^2 x = -4\sin 2x\cos^2 x$

5. $x_0 = \frac{\pi}{2}$ let it be

$$f\left(\tfrac{\pi}{2}\right) = 2\cdot\cos^4\frac{\pi}{2} - \frac{3}{4} = -\frac{3}{4}$$

$$g\left(\tfrac{\pi}{2}\right) = \cos\pi + \frac{1}{4}\cos 2\pi = -1 + \frac{1}{4} = -\frac{3}{4}$$

6. $f(x_0) - g(x_0) = 0 \qquad C = 0$

then , " B ".

$$2\cos^4 x - \frac{3}{4} = \cos 2x + \frac{1}{4}\cos 4x$$

$$\cos 2x + \frac{1}{4}\cos 4x = \cos 2x + \frac{1}{4}\cos^2 2x - \frac{1}{4}\sin^2 2x =$$

$$= 2\cos^2 x - 1 + \frac{1}{4}\left(2\cos^2 2x - 1\right) = 2\cos^2 x - 1 - \frac{1}{4} + \frac{1}{2}\left(2\cos^2 x - 1\right)^2 =$$

$$= 2\cos^2 x - \frac{5}{4} + \frac{1}{2}\left(4\cos^4 x - 4\cos^2 x + 1\right) =$$

$$= 2\cos^2 x - \frac{5}{4} + \frac{1}{2} + 2\cos^4 x - 2\cos^2 x =$$

$$= 2\cos^4 x - \frac{3}{4};$$

This:

$$\frac{\sin\alpha + \sin 3\alpha}{\cos\alpha + \cos 3\alpha} = tg 2\alpha$$

Solve the inequality.

$6x^2 + x - 2 < 0$.

Solving. Let's look at the function $f(x) = 6x^2 + x - 2$.

a) $D(f) = R$ because f is polynomial.

b) We find the points of intersection of the graph of the function f with the ordinate and abscissa axes.

$f(0) = -2$ *intersects* the ordinate axis at the point ($0;f(0)$) , i.e. at (0;-2).

$6x^2 + x - 2 = 0$, we will find the points of its intersection with the abscissa axis. The solutions of this equation $x = -\frac{2}{3}$ are v a $x = \frac{1}{2}$

So, the points (-3/2 ;0) and (1/2;0) are points of intersection with the abscissa axis.

c) $f'(x) = 12x + 1$

g) Set the derivative to 0 and find the critical points:

$12x + 1 = 0$, $x = -\frac{1}{12}$

d) We make this table.

x	**(- ∞;-1/12)**	**-1/12**	**(-1/12;+ ∞)**
f'(x)	—	0	+
f(x)	↘	*min*	↗

Apparently so that 6 $x^2 + x$ -2<0 sh a rt $x \in \left(\frac{-2}{3};\frac{1}{2}\right)$ or a liqd a b a j a ril a di .

Answer: $x \in \left(\frac{-2}{3};\frac{1}{2}\right)$

I. Inequalities system take off

$$\begin{cases} x^2 + x - 6 < 0 \\ x^2 - 2x - 3 \geq 0 \end{cases}$$

Solving. So , the condition $x^2 + x$ -6<0 $x \in (-3;2)$is fulfilled in the interval.

Let's look at the function x^2 -2 x -3= $f(x)$. The graph consists of a parabola (branches pointing upwards a >0) and intersects the abscissa axis at the points (-1;0) and a (3;0).

from the graph that the condition x^2 -2 x -3 ≥0 $x \in (-\infty; -1] \cup [3; +\infty)$is fulfilled in the interval.

In order to find the general solution of the inequalities $x^2 + x$ -6<0, x^2 -2 x -3 ≥0, we describe the solutions found above on the number line.

This is a general answer or system solution $x \in (-3;-1)$

Answer: $x \in (-3;-1)$

also possible to show inequalities such as $x^2 < 0$, $1/x > 0$.

II. Prove the inequality.

$x^2 - x^3 > \frac{1}{6}$, this on the ground $x \geq 0$.

Solving . $f(x)= x^2 - x^3$ function a let 's meet and that 's it of the function a o ‘ sish , k a m a yish or a liql a rini top a miz .

$f(x)=x^2-x^3=x^2(1-x), x \geq 0.$

$f'(x)=2x-3x^2=x(2-3x)$

$f'(x)>0$ in $0<x<2/3$

at $f'(x)=0$

$f'(x)<0$ at $x>2/3$

f(x) is continuous in [0;+ ∞] , so it increases in the interval [0;2/3] and ∞decreases in the interval [2/3;+].

x =2/3 is *the max* point of the function *f(x).*

$f(2/3)=(2/3)^2-(2/3)^3=4/27$ v a 4/27<1/6

Then $x \geq 0$ d a It follows that the inequality $x^2 - x^3 < 1/6$ *is reasonable.[4]*

When the above methods of solving problems are shown in mathematics circles, the first method is recognized as effective and original. However, this should not lead to the conclusion that the second method should be abandoned. Demonstrating different ways of solving problems will undoubtedly increase students' interest in science.

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