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# Solution of the calculus in the computer by using MathCAD software

# حل التفاضل والتكامل في الكمبيوتر باستخدام برنامج الماثكاد

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**Abstract:**
In this research we give a brief explain the basic usage of MathCad software in calculus, and we will see in program mathcad can typing and evaluating mathematical expression, computing symbolically or numerically, where Mathcad scripting codes, also will explain set of notes which will describe how to use some of the features of MathCAD that perform calculus by using some of operators, also supported this solution by the some examples, and finally the mathcad software lets you use the language of mathematics which a consider new technique and fast in mathematical.

**الخلاصة**
في هذا البحث نعطي ملخص يوضح الاستعمال الاساسي لبرنامج الماثكاد في حساب التفاضل والتكامل ونحن سنرى في برنامج الماثكاد انه يمكن ان نطبع ونقيم او نحسب تعبيراً رياضيا , يحسب بشكل رمزي او بشكل عددي , حيث ان الماثكاد يكتب الرموز . وايضا سنوضح مجموعة من الملاحظات التي ستصف كيف نستعمل البعض من ميزات الماثكاد الذي يؤدي الى حساب التفاضل والتكامل والتي تعتبر طريقة جديدة وسريعة في الرياضيات.

## 1. Introduction

Mathcad software has a lot of history going back to 1988 with its first version that ran under MS-DOS. Today, Mathcad 12 runs under Microsoft Windows 2000 and Windows XP windows 7. To this day, it's still the easiest program for a user to type set mathematical problems with automatic computation for this problem.

Also it does not need any special programming skills to use the software. Where the symbols used look like math symbols (eg. matrices, integrals, dervative etc.). The users are used to using spreadsheets for complex mathematical calculations will be relieved to know that Mathcad uses a whiteboard like environment called a worksheet that works just like a word processor's blank document.

From Mathcad's worksheet, the user can easily put in a symbolic mathematical problem to be solved and can add text, graphics, and annotations to the worksheet. Mathcad is most commonly used to easily document mathematical and engineering calculations in an easy-to-read manner also being able to calculate automatically. In other words, Mathcad is a very powerful word processor for math that has good computation abilities.

Also MathCAD is a computer software program that allows you to enter and manipulate mathematical equations, perform calculations, analyze data, and plot data. This combination makes MathCAD an invaluable tool to physical chemists, engineer and who combine physical science with mathematics to describe chemical phenomena.

Also we explain and asserting It is designed to be is a unique, powerful way to work with equations, numbers, text, and graphs. Unlike any other mathematical software, Mathcad does math the same way you do, because it looks and works like a scratchpad and pencil.

## 2. Operators of MathCAD programming

We can use calculus operators to evaluate expressions numerically or analytically. Click on the $\int \frac{dy}{dx}$ . Button in the Math toolbar to bring up the Calculus toolbar, or choose Toolbars > Calculus from the View menu. Where the toolbar has 13 operators. Now, let's take a look of these operators:

1) Derivative : $\frac{d}{dx}$
2) Nth derivative : $\frac{d^n}{dx^n}$
3) Infinity : $\infty$
4) Definite integral : $\int_a^b$
5) Indefinite integral : $\int$
6) Summation : $\sum_{n=1}^{m}$
7) Summation with range variables : $\sum_n$
8) Iterated product : $\prod_{n=1}^{m}$
9) Iterated product with range variables : $\prod_n$
10) Two-sided limit : $\lim_{\to a}$
11) Right-hand limit : $\lim_{\to a^+}$
12) Left-hand limit : $\lim_{\to a^-}$
13) gradient : $\Delta_x f$

## 3. Solutions calculus functions both numerically and symbolically in MathCAD

We can use MathCAD programming for solution calculus function for finding derivatives and higher order derivatives, definite integrals and indefinite integrals, limits, sums and iterated product. We well explain each operator with examples.

### 3.1. Derivatives

To evaluate derivative in MathCAD by using the steps following:
- Open new window for the MathCAD programming.
- Define the variable value at which you want to derivative for numerical evaluation, but can doing without defined the variable for symbolic evaluation.
- Open toolbars menu from view then open calculus toolbar then click derivative operator.
- Fill in the two agents of derivative operator.
- For numeric evaluation, press = from the keyboard to get result.
- For symbolic evaluation, click the simplify from the symbolic toolbar to get result.

### 3.1.1.Illustrative Examples

Example (3.1.1.1):- To find the derivative by using MathCAD programming of the function xsin(x) when $x=\frac{\pi}{2}$

Solution:- by using steps above, we have:

$x:=\frac{\pi}{2}$

$\frac{d}{d\blacksquare}\blacksquare$ (Fill this two agent of derivative operator)

$\frac{d}{dx}x^{\sin(x)}$ (Press = from the keyboard to get the numerical result)

$\frac{d}{dx}x^{\sin(x)} = 1$

Example (3.1.1.2):- find the derivative by using MathCAD programming of the function in the above example without define variable (meaning symbolic evaluation).

Solution: - by using steps of the derivatives, we have:

$\frac{d}{d\blacksquare}\blacksquare$ (Fill this two agent of derivative operator)

$\frac{d}{dx}x^{\sin(x)}$ (Click the simplify from the symbolic toolbar to get result)

$x^{\sin(x)-1}(\sin(x)+x\cos(x)\,\mathrm{lin}(x))$

## 3.2. Higher order derivatives

To evaluate higher order derivative, we use the same steps in evaluate the first derivative but in the third step choose operator Nth derivative.

## 3.2.1.Illustrative Example

Example (3.2.1.1):- To find the third derivative by using MathCAD programming of the function $y = x^4 + 3x^3 - 3x^2 + 4x - 8$ at x=1

Solution :- (numerically)

x:=1

$\frac{d^{\blacksquare}}{d\blacksquare^{\blacksquare}}\blacksquare$ (Fill this four agent of operator nth derivative)

$\frac{d^3}{dx^3}(x^4 + 3x^3 - 3x^2 + 4x - 8)$ (Press = from the keyboard to get the numerical result)

$\frac{d^3}{dx^3}(x^4 + 3x^3 - 3x^2 + 4x - 8) = 42$

Solution :- (symbolically)

$\frac{d^3}{dx^3}(x^4 + 3x^3 - 3x^2 + 4x - 8)$

$24x + 18$

## 3.3. Integrals

To evaluate the indefinite integral in MathCAD programming, we use the same steps in evaluate the derivatives but in step three we click the operator indefinite integral on calculus toolbar.

Also to evaluate the definite integral in MathCAD programming, we use the same this steps but in step three we click on the operator definite integral on calculus toolbar.

## 3.2.1. Illustrative Examples

Example (3.2.1.1):- Evaluate the indefinite integral $I(x)=\int \ln(x)\,dx$ , at x=1

Solution :- (symbolically)

$I(x):=\int \blacksquare\, d\blacksquare$ (Fill this two agent of indefinite integral operator)

$I(x):=\int \ln(x)\,dx$

$I(x):=x(\ln(x)-x)$

Solution:- (numerically)

After evaluate this integral a symbolically we substitute the value of x we get:

I(1) = -1

Example (3.2.1.2):- Evaluate the definite integral $\int_{-3}^{2}(6 - x - x^2)dx$

Solution:- (symbolically)

$\int_{\blacksquare}^{\blacksquare} \blacksquare d\blacksquare$ (Fill this four agent of definite integral operator)

$\int_{-3}^{2}(6 - x - x^2)dx$

$\frac{125}{6}$

Solution:- (numerically)

$\int_{-3}^{2}(6 - x - x^2)dx = 20.833$ (we know the numeric is press = from keyboard)

### 3.4. Limits

In calculus to find the limit for any function there is three forms.

The first form if the values of a function f(x) approach the value L as x approaches x0 , then f(x) has a limit L as x approaches x0 and denoted by:

$\lim_{x\to x_0} f(x) = L$ (Two-sided limit)

The second form is right hand limit which denoted by:

$\lim_{x\to a^+} f(x) = L1$

The third form is left hand limit which denoted by:

$\lim_{x\to a^-} f(x) = L2$

Now to evaluate this limit in MathCAD programming where is only symbolically, and by the same steps above choose Two-sided limit or right hand limit or left hand limit from calculus toolbar then after fill three placeholders of the limit operator click the simplify from the symbolic toolbar to get result.

#### 3.4.1. Illustrative Examples

Example (3.4.1.1):- Evaluate the following limits

(1) $\lim_{x\to 2}\frac{x^2-4}{x-2}$

4 (this result)

(2) $\lim_{x\to 0^+}\frac{1-\cos(x)}{x}$

0 (this result)

(3) $\lim_{x\to 0^-}\frac{x-\sin(x)}{x^3}$

$\frac{1}{6}$ (This result)

### 3.5. Sums and iterated product

We can evaluate summation and iterated product numerically and symbolically by the same steps in the derivative operator.

#### 3.5.1. Illustrative Examples

Example (3.5.1.1) :- Evaluate each of the following

(1) $\sum_{n=1}^{20}(\frac{1}{2})^{n-1} = 2$ (result numerically)

$\sum_{n=1}^{m}(\frac{1}{2})^{n-1} \to 2 - \frac{2}{2^m}$ (Result symbolically)

(2) $\prod_{n=1}^{4}\frac{n^2+2n}{n+1} = 72$ (result numerically or symbolically)

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