

# TI-89/TI-89 Platinum/Voyage 200 tutorial

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The TI-89 is a great calculator. By a great calculator I mean that it is one of the best calculators you can find at the moment. Another great calculator is the HP 49g+ which is the first calculator to include an SD expansion Card.

The TI-89 will be a calculator that will assist you for many years to come. This short tutorial will let you be familiarized with some of the features of the calculator. The calculator main reference remains the TI-89 guidebook.

P.S. : I will use the TI-89 for simplification but the other calculators like the TI-89 Platinum and Voyage 200 are also concerned by the tutorial.

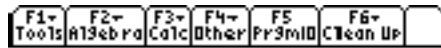
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# 1 Solving equations & system of linear equations

Suppose we want to solve the following equation:  $-3x^3 + 3x^2 - 2x + 5 = 0$   
The syntax is:

```
solve(-3x^3+3x^2-2x+5=0, x)
or
zeros(-3x^3+3x^2-2x+5, x)
```



```
■ solve(-3·x^3 + 3·x^2 - 2·x + 5 = 0, x)
x = 1.38632
```

---

MAIN      RAD AUTO      FUNC      1/30

I have written ",x" after the equation because the variable to solve for in this equation is  $x$   
Suppose we want to solve the following system of linear equations:

$$\begin{aligned} 2x - 3y + 5z &= -1 \\ -3x + 5y - 2z &= 3 \\ 5x - 7y + 8z &= -2 \end{aligned}$$

The syntax is :

```
solve(2x+3y+5z=-1 and -3x+5y-2z=3 and 5x-7y+8z=-2, x, y, z)
or
zeros(2x+3y+5z+1, -3x+5y-2z-3, 5x-7y+8z+2, x, y, z)
```



```
■ solve(2·x - 3·y + 5·z = -1 and -3·x + 5·y - 2·z = 3 and 5·x - 7·y + 8·z = -2, x, y, z)
x = 21/10 and y = 19/10 and z = -1/10
```

---

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## 2 Derivation & Integration

### 2.1 Derivation

Suppose we want to compute the derivative of :  $x^2 + 3x - 5$   
The syntax is:

```
d(function, variable, degree)
degree can be omitted, it's 1 by default
```

F1→ Tools	F2→ Algebra	F3→ Calc	F4→ Other	F5 Fr3mID	F6→ Clean Up	
--------------	----------------	-------------	--------------	--------------	-----------------	--

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


---


$$\frac{d(x^2+3*x-5, x)}$$

MAIN      RAD AUTO      FUNC      1/30

Compute the partial derivative  $f_x$  of  $f(x) = \sin xy + \cos^2(x + y)$

F1→ Tools	F2→ Algebra	F3→ Calc	F4→ Other	F5 Fr3mID	F6→ Clean Up	
--------------	----------------	-------------	--------------	--------------	-----------------	--

$$\frac{d}{dx}(\sin(x \cdot y) + (\cos(x + y))^2)$$

$$\cos(x \cdot y) \cdot y - 2 \cdot \sin(x + y) \cdot c$$

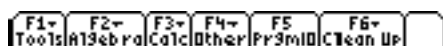

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$$\frac{d(\sin(x*y)+\cos(x+y)^2, x)}$$

MAIN      RAD AUTO      FUNC      1/30

## 2.2 Integration

Let's say we want to compute  $\int \sin x$ :

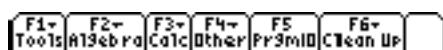


$$\int \sin(x) dx = -\cos(x)$$

Compute

$$\iint x^2y + y^2 + \sin y \, dx \, dy$$

To do that on paper we first integrate for  $x$  supposing  $y$  constant then we integrate for  $y$  supposing  $x$  constant



$$\iint (x^2 \cdot y + y^2 + \sin(y)) \, dx \, dy = -\cos(y) \cdot x + \frac{y^3 \cdot x}{3} + \frac{y^2 \cdot x^3}{6}$$

Let's say we want to compute the value of following integral  $\int_1^{10} x \cos x$ :



$$\int_1^{10} (x \cdot \cos(x)) \, dx = \cos(10) + 10 \cdot \sin(10) - \cos(1)$$

## 3 Limits, sums & Taylor series

### 3.1 Limits

Suppose we want to compute:

$$\lim_{x \rightarrow \infty} x^2$$

The syntax is:

lim(function, variable, point, direction)  
 direction is either 1 or -1 and can be omitted  
 1: limit from right  
 -1: limit from left

### 3.2 Sum

Compute

$$\sum_{i=1}^n k^2$$



$\sum_{k=1}^n (k^2)$   

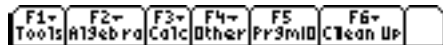
$$\frac{n \cdot (n+1) \cdot (2 \cdot n + 1)}{6}$$
  
 $\Sigma(k^2, k, 1, n)$   
 MAIN      RAD AUTO      FUNC

### 3.3 Taylor series

The syntax for computing Taylor series is:

taylor(function, variable, degree, point)  
 point can be omitted, it is 0 by default

Suppose we want to know the 6<sup>th</sup> degree Taylor expansion of  $\sin x$  around 0:



$\text{taylor}(\sin(x), x, 6, 0)$   

$$\frac{x^5}{120} - \frac{x^3}{6} + x$$
  
 $\text{taylor}(\sin(x), x, 6, 0)$   
 MAIN      RAD AUTO      FUNC      1/30

## 4 Polynomials

### 4.1 Expanding polynomials

The syntax is

expand(polynomial, variable)

Let's say we want to expand  $(x + y)^4$



```

■ expand((x + y)^4, x)
x^4 + 4 · x^3 · y + 6 · x^2 · y^2 + 4 · y^3
-----
expand((x+y)^4, x)
MAIN          RAD AUTO  FUNC          1/30

```

## 4.2 Factoring polynomials

The syntax is:

```
factor(function, variable)
```

Let's factor the function  $x^2 - 9$



```

■ factor(x^2 - 9, x)
(x - 3) · (x + 3)
-----
factor(x^2-9, x)
MAIN          RAD AUTO  FUNC          1/30

```

## 4.3 Common denominator

Let's put on the same denominator the function:

$$f(x, y) = \frac{1}{x^2} + \frac{1}{y^2 + 1}$$

```

x^2 · y^2 + x^2
■ comDenom(1/x^2 + 1/(y^2+1), x)
x^2 + y^2 + 1
-----
x^2 · y^2 + x^2
comdenom(1/x^2+1/(y^2+1), x)
MAIN          RAD AUTO  FUNC          2/30

```

## 5 Number operations

### 5.1 Factoring a number

The syntax is:

```
factor(number)
```

Let's factor the number 1050 for example:



```
■ factor(1050)      2·3·52·7
factor(1050)
MAIN          RAD AUTO  FUNC  1/30
```

## 5.2 Finding the GCD & LCM

The syntax is:

```
gcd(number1, number2) lcm(number1, number2)
```

To find the GCD & LCM of 3 numbers the syntax is:

```
gcd(gcd(number1, number2), number3)
lcm(lcm(number1, number2), number3)
```

## 5.3 Testing if a number is prime or not

```
isPrime(number)
```

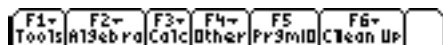
Let's see if 997 is prime or not



```
■ isPrime(997)      true
isPrime(997)
MAIN          RAD AUTO  FUNC  1/30
```

## 5.4 Finding the factorial of a number

Let's find : 64!



```
■ 64!
126886932185884164103433▶
64!
MAIN          RAD AUTO  FUNC  1/30
```



## 6 Differential Equations

Let's solve the following differential equation:

$$x'' + \omega^2 x = 0$$

The syntax is:

```
deSolve(function, x, y)
```

We must rename  $x$  to  $y$



```

■ deSolve(y'' + w^2 · y = 0, x, ▶
  y = @3 · cos(w · x) + @4 · sin(w ·
MAIN          RAD AUTO    FUNC

```

Note that the result is:  $@3\cos(w.x) + @4\sin(w.x)$  and  $@3$  and  $@4$  are constants like the constants  $c_1, c_2, \dots$  etc used in Mathematics courses.

## 7 Sequence

Suppose we want to find the terms of the following sequence:

$$U_{n+1} = 2U_n + 2, \quad U_0 = 2$$

We can use 2 methods: the *when* function or by using the *Sequence mode* of the calculator.

### 7.1 The when() function

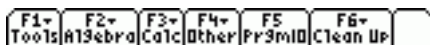
The syntax of this function is:

```
when(condition, true value, false value, unknown value)
false value & unknown value can be omitted.
```

when( $n=0, 2, 2u(n-1)+2$ )  $\rightarrow u(n)$

The sign  $\rightarrow$  is to store the function in  $u(n)$

To compute  $u_1$ , we write :  $u(1)$



```

■ { 2, n = 0
  2 · u(n - 1), else → u(n)
Done
■ u(1) 4
u(1)
MAIN          RAD AUTO    SEQ

```

Suppose we want to find the 5 first terms of the sequence, we should write:

$$u(1), u(2), u(3), u(4), u(5)$$

F1 Tools	F2 A13ebra	F3 Calc	F4 Other	F5 Pr3miD	F6 Clean Up	
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■  $\begin{cases} 2, n=0 \\ 2 \cdot u(n-1), \text{else} \rightarrow u(n) \end{cases}$   
 Done

u(1)	u(2)	u(3)	u(4)		
	4	8	16	32	64

{u(1),u(2),u(3),u(4),u(5)}  
 MAIN      RAD AUTO      SEQ      2/30

## 7.2 Using the Sequence mode

Let's take the previous example:  
The syntax is:

$$U_1 = 2U_{n-1} + 2, \quad U_{i1} = 2$$

$U_{i1}$  is the initial term

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">F1 Tools</td> <td style="width: 16.6%;">F2 Zoom</td> <td style="width: 16.6%;">F3 Edit</td> <td style="width: 16.6%;">F4 ✓</td> <td style="width: 16.6%;">F5 A11</td> <td style="width: 16.6%;">F6 Style</td> <td style="width: 16.6%;">F7 Axes...</td> </tr> </table> <p>       *PLOTS        ✓ u1=2·u1(n-1)+2        ui1=2        u2=■        ui2=        u3=        ui3=        u4=        u4=     </p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">u2(n)=</td> <td style="width: 16.6%;"></td> <td style="width: 16.6%;"></td> <td style="width: 16.6%;"></td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">MAIN</td> <td style="width: 16.6%;">RAD AUTO</td> <td style="width: 16.6%;">SEQ</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">F1 Tools</td> <td style="width: 16.6%;">F2 Setup</td> <td style="width: 16.6%;">F3 D</td> <td style="width: 16.6%;">F4 B</td> <td style="width: 16.6%;">F5 C</td> <td style="width: 16.6%;">F6 D</td> <td style="width: 16.6%;">F7 E</td> </tr> <tr> <td>n</td> <td>u1</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1.</td> <td>2.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2.</td> <td>6.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3.</td> <td>14.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4.</td> <td>30.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5.</td> <td>62.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p>n=1.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">MAIN</td> <td style="width: 16.6%;">RAD AUTO</td> <td style="width: 16.6%;">SEQ</td> </tr> </table>	F1 Tools	F2 Zoom	F3 Edit	F4 ✓	F5 A11	F6 Style	F7 Axes...	u2(n)=				MAIN	RAD AUTO	SEQ	F1 Tools	F2 Setup	F3 D	F4 B	F5 C	F6 D	F7 E	n	u1						1.	2.						2.	6.						3.	14.						4.	30.						5.	62.						MAIN	RAD AUTO	SEQ	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">F1</td> <td style="width: 16.6%;">F2</td> <td style="width: 16.6%;">F3</td> <td style="width: 16.6%;">F4</td> <td style="width: 16.6%;">F5</td> <td style="width: 16.6%;">F6</td> <td style="width: 16.6%;">F7</td> </tr> </table> <p style="text-align: center;">TABLE SETUP</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">tblStart.....</td> <td style="width: 20%;">1.</td> </tr> <tr> <td>Δtbl.....</td> <td>1.</td> </tr> </table> <p>       Graph &lt;-&gt; Table OFF →        Independent..... AUTO →        Enter=SAVE      ESC=CANCEL     </p> <p>u2(n)=</p> <p>TYPE + [ENTER]=OK AND [ESC]=CANCEL</p>	F1	F2	F3	F4	F5	F6	F7	tblStart.....	1.	Δtbl.....	1.
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Note that the table starts at 1 so  $U_0$  is equal to  $n = 1$  on the calculator, there is a shift of 1 between the calculator and the real world.