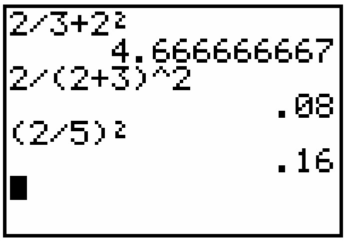
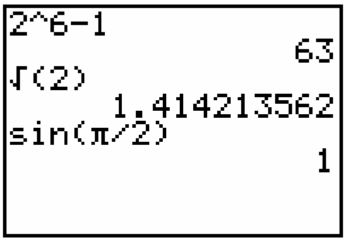
2 Elementary actions

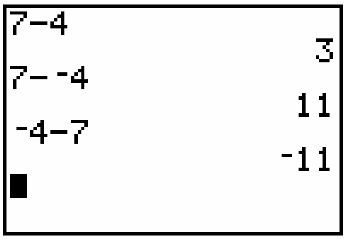
2.1 Calculation

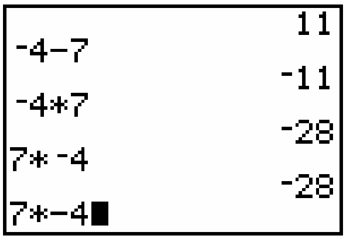
The way you calculate with the **TI-83/84 Plus** is the same as on a scientific calculator. To perform the calculations mentioned below you just press the keys in the same order you see the calculations on the home screen. You carry out your input (or a command) by pressing **ENTER**.



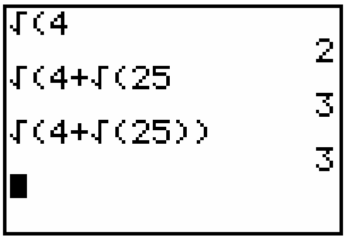


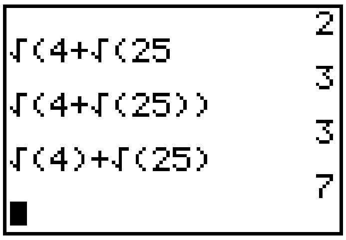
– = the difference
(-) = the opposite



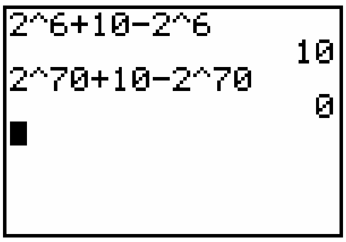


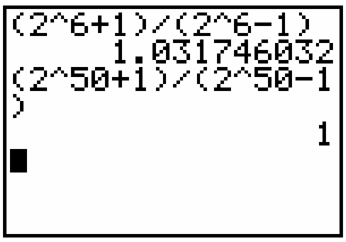
Notice that if you press √ or **SIN** automatically a first bracket appears. It's not necessary to place the second bracket but from a pedagogical point of view it's recommended.





The **TI-83/84 Plus** is a graphing calculator that does all its calculations numerically and in its standard mode it uses floating point numbers. Sometimes this gives strange results:





2nd[ENTRY] = recall previous performed calculations
CLEAR = clear the input line or the home screen

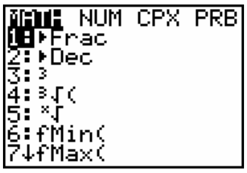
2.2 Menus

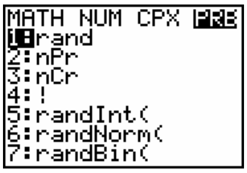
The advanced function keys contain menus. The use of menus we will explain by means of the **MATH** menu.

After pressing **MATH** the home screen will be replaced by the **MATH** menu.

◀ or ▶ : navigation between the submenus
▼ or ▲ : navigation in a submenu

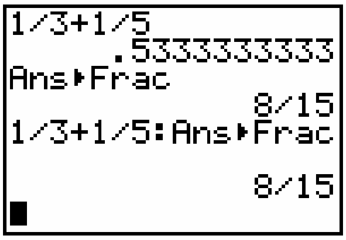
The **MATH** menu contains the following four submenus:

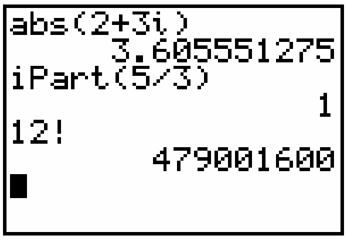


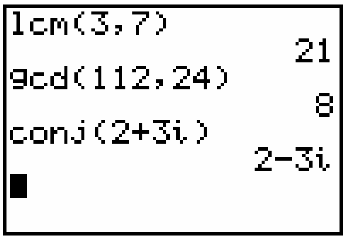


To select a command you can press the desired number (or letter) or you can mark the command and press **ENTER**.

Ans = the variable that contains the last result (**Last Answer - 2nd[ANS]**)







2nd[*i*] = the complex number *i*

You can always leave a menu without making a choice by pressing **CLEAR** or **2nd[QUIT]**.

2nd[QUIT] = return to home screen

Activity 1

Cross numbers

Fill in the following cross numbers. For each figure, decimal point and minus sign you need a separate box. Use an accuracy of two decimals (without rounding and as **MODE FLOAT**).

2nd[EE]6 = 10^6 or **2nd[10ˣ]** $\sqrt[3]{8} = 3\sqrt[x]{\ }\ 8$ – **MATH<MATH> 5:** $\sqrt[x]{\ }$ or **3:** $\sqrt[3]{\ }$(

Across

1. $\frac{463}{94}\cdot 47$

4. $4\left(\frac{458+\frac{1}{4}}{3}\right)$

8. $2^{10}-\sqrt{196}$

11. $10\left(\cos\left(\frac{\pi}{3}\right)+2^2\cdot 5\cdot\sin\left(\frac{\pi}{6}\right)\right)$

12. $2\left(307+\sqrt{96100}\right)10^3$

Down

2. $-(-81)^3$

4. $\frac{9710}{25\cdot 63}$

3. $\frac{(13.6\cdot 10^2)(2.8\cdot 10^{-4})}{24.3\cdot 10^{-4}}$

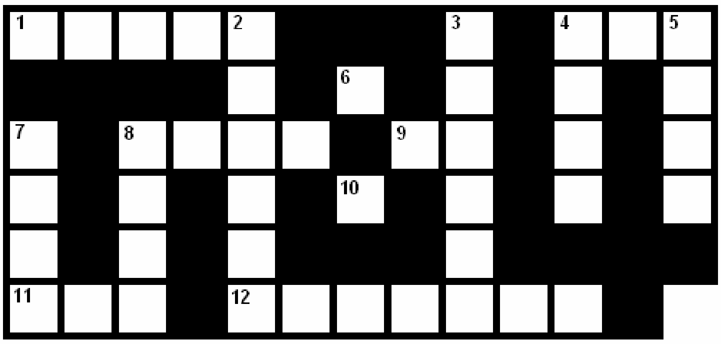
5. $\sqrt{765^2+1836^2}$

6. $\frac{2\cdot 10^{-2}}{63}\sqrt{500(17852+1993)}$

7. $6\sqrt{11}+\sqrt[3]{4.4}-1.83^5$

8. $\frac{12+3}{7+5}$

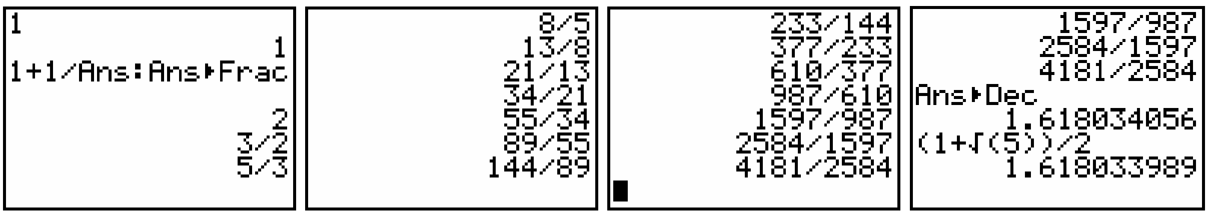
9. $2002-11^{-11}-2002$



Activity 2

The Golden Number φ

Investigate the behavior of the following sequence: $1,\ 1+1,\ 1+\frac{1}{1+1},\ 1+\frac{1}{1+\frac{1}{1+1}},\ 1+\frac{1}{1+\frac{1}{1+\frac{1}{1+1}}},\ \ldots\ldots$

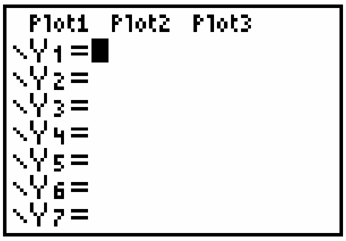


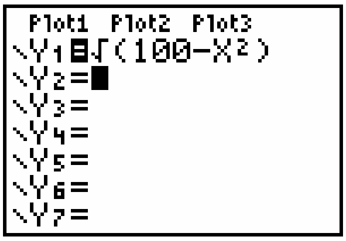
ENTER = Redo the last carried out command

2.3 Function Graphing

a. Definition of a function

Press **Y=** and define the variable **Y1** as mentioned below (Press **ENTER** after the input of the function).

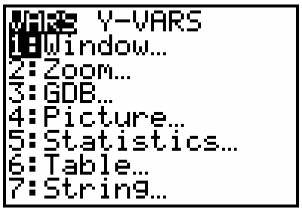


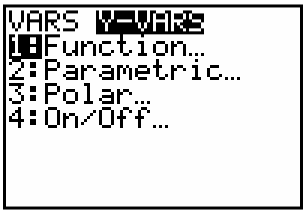


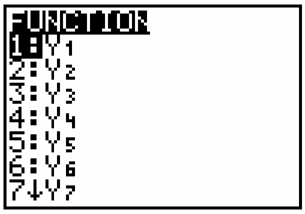
Notice that after the definition of the variable **Y1** the corresponding equal sign will be marked. This means that the function **Y1** is ready to be plotted. Then go on defining **Y2** as **-Y1**.

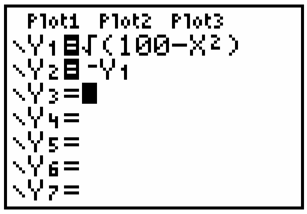
!! It is not possible to type in the variable **Y1** as **Y** followed by **1** !!

Select **Y1** out of the variable menu: **VARS<Y-vars> 1:Function…**





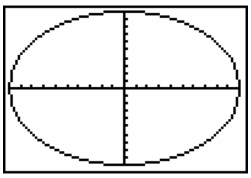




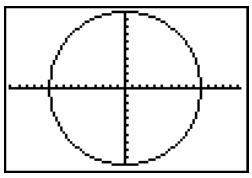
b. Graph of a function

After the definition of a function you can plot a function by selecting an appropriate window in the **ZOOM** menu.

Select first **6:Zstandard** and then **5:Zsquare**. Compare both results.



ZStandard



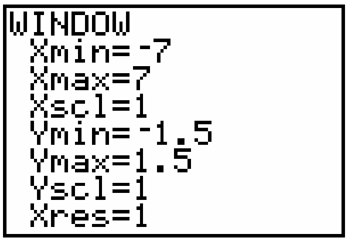
Zsquare

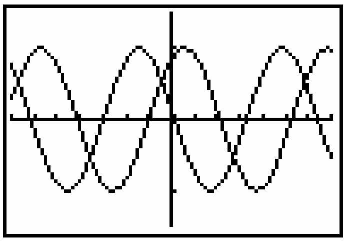
If you know the window settings you can plot the function immediately by pressing **GRAPH**.

You can turn off or deselect the functions **Y1** and **Y2** (not to be plotted) by placing the cursor on the equal signs and press **ENTER**.

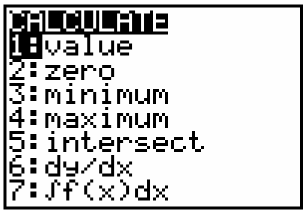
And to delete the function description place the cursor on the function description and press **CLEAR**.

You can also define the window settings manually by pressing the **WINDOW** key. Fill in the following setting and plot the function **sin(x+{1,3})** with these settings.





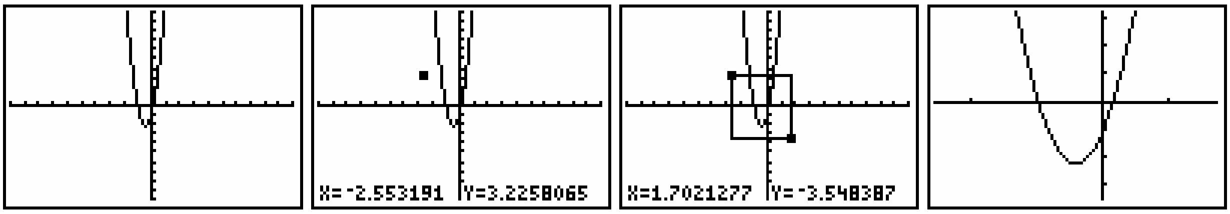
c. Numerical calculations



On the graph of a function several calculations can be done using the **CALC**-menu (**2nd[CALC]**). We will illustrate this by giving two examples:

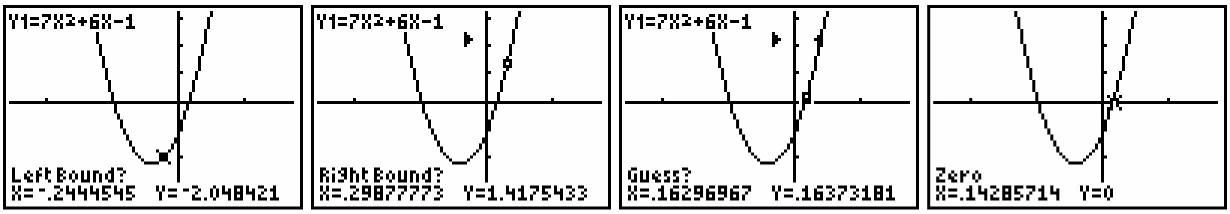
→ Determine the zeros of the function $f(x) = 7x^2 + 6x - 1$ ←

Below on the left you see the graph of the function f in a standard window. Use the **ZOOM** command **1:Zbox** to blow up the rectangle below. Put the cursor on the screen where you want to put the first vertex and press **ENTER**. Do the same for the opposite vertex. The enlargement will be shown automatically.

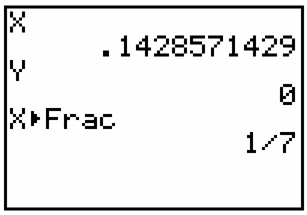


A continuous function with positive and negative values on a segment has a zero in that segment. We will calculate (approximately, numerically) a zero of f in such a segment with the **2nd[CALC] 2:zero**.

First enter the left and the right bound of the segment by moving the cursor to the desired value or by entering a numerical value and then pressing **ENTER**. Afterwards you need to enter a guess, the seed that will start the numerical process.



But a simple algebraic calculation gives us the zero $x = \frac{1}{7}$.

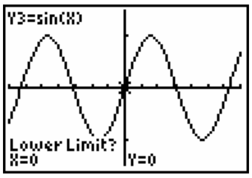


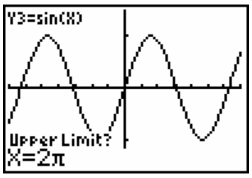
The calculator stores the coordinates of the zero in the variables **X** en **Y**. On the home screen you can try to transform the **X** coordinate into a rational number.

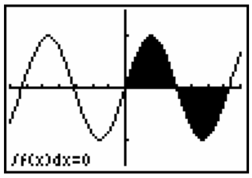
→ Definite integral ←

The command **2nd[CALC] 7:∫f(x)dx** calculates a numerical approximation of the definite integral.

$$\int_0^{2\pi} \sin(x)\,dx$$







Also here you can enter the lower and upper limit automatically or by selecting points on the graph.

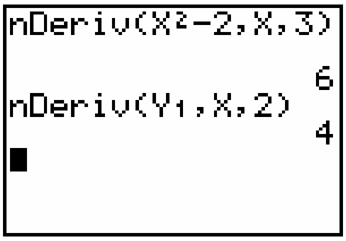
d. The derivative function

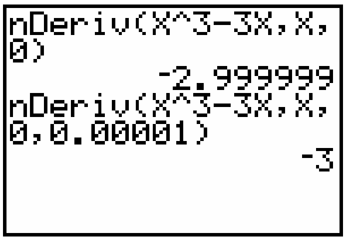
→ The numerical derivative ←

The command **MATH<MATH> 8:nDerive** calculates the numerical derivative of a function in a point: **nDerive**(expression.variable,value[,ε]). This command applies the following formula with the standard value $\varepsilon = 0.001$:

$$f\,'(x) = \frac{d\,f(x)}{dx} \approx \frac{f(x+\varepsilon) - f(x-\varepsilon)}{2\varepsilon}\left(= \frac{\Delta y}{\Delta x}\right).$$

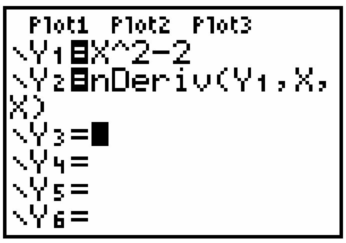
For **Y1=X^2-2** this command gives the following results. Study the right screen!

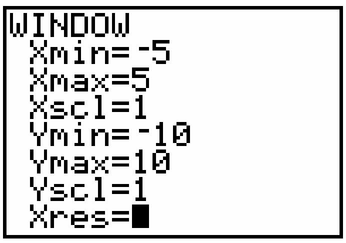


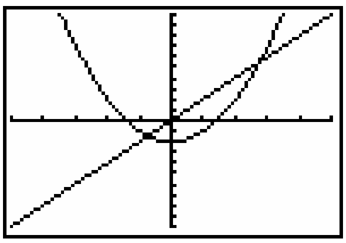


→ The derivative function ←

When you use the **nDerive** command in the **Y=** function definition window you can create a graphical representation of the derivatives of a lot of not too complicated, well-behaving functions. Define the functions **Y1** and **Y2** as mentioned below and plot both functions with the following window settings.







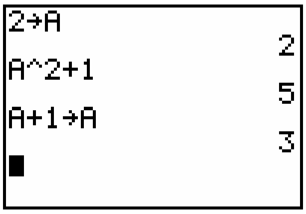
The plot above shows the relation of the decrease and increase of the function in terms of the sign of the derivative function.

Activity 3

An algebraic oddity

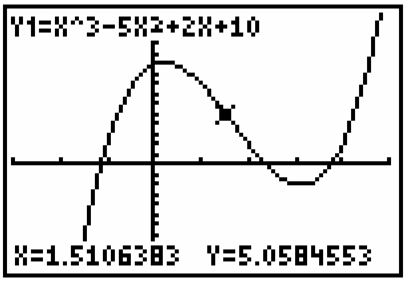
1. Define the function **Y1=X^3-5x^2+2x+10**.
2. Plot this function with the window settings **4:Zdecimal**.
3. Determine a linear function **Y2** so that the graphs of **Y1** and **Y2** have three intersection points.
4. Put the *x* coordinate of the intersection points into the variable **A**, **B** en **C**.

STO ▸ = store a value in a variable



5. Compute the sum **A+B+C**.
6. Compare the results of all the students. Conclusion?
7. Explain algebraically!

With the **TRACE** function you can move around on the graph.



To turn off the **TRACE** function you can press **GRAPH** or **CLEAR**.