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Some models of using ClassPad in teaching mathematics for secondary students

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1. *Properties of the Functions*

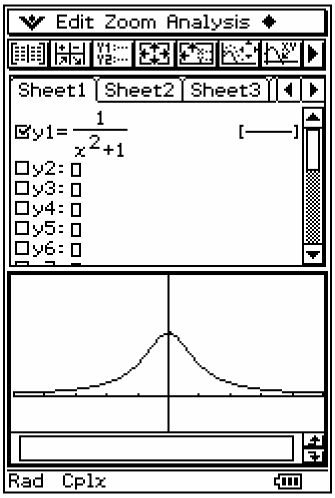
Mathematics is about ideas. One of the most important is the idea of function. It is functions which bring algebra to life, but it is hard to describe exactly what they are. However we can see functions at work when we make tables of values, draw graphs, solve equations, illustrate the rates of change, for example the decay rate of a radioactive substance, the rate of the population of a country, etc.

The largest and most difficult part of the syllabus for the secondary mathematics is formed by the functions. Teachers of mathematics, using classical methods, are limited significantly to present only several basic types of functions (linear, quadratic, polynomial, exponential, logarithmic functions, etc.). However, new teaching methods using graphic scientific calculators in the classroom, such as Cassio`s ClassPad, enable students to make limitless experiments with functions, to draw their graphs and achieve some knowledge of higher quality even from advanced, non-classical functions.

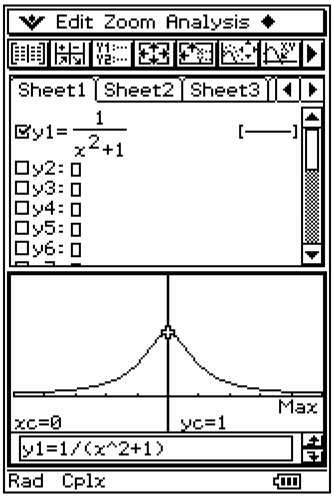
- **Exercises:**

Using ClassPad find the values of the domain and the range of the function $y = \frac{1}{(x^2+1)}$ and state whether it is symmetric or asymmetric.

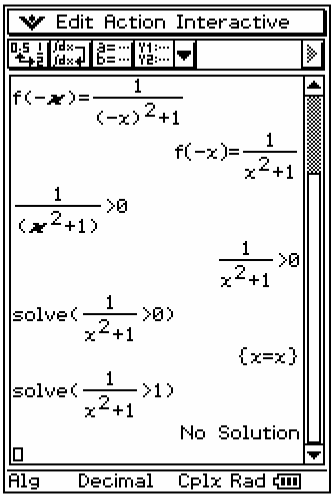
- **Answer:**



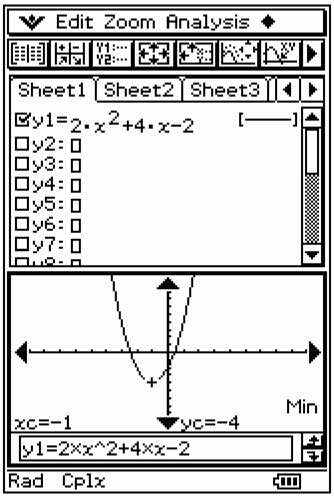
The graph of the function is seen to be symmetrical about the y - axis. D(f) - the values of the domain of the function is the set of rational numbers. R(f) - the values of the range of the function: all the y values are larger than 0 and smaller than y-max = 1. So R(f) = $(0,1\rangle$



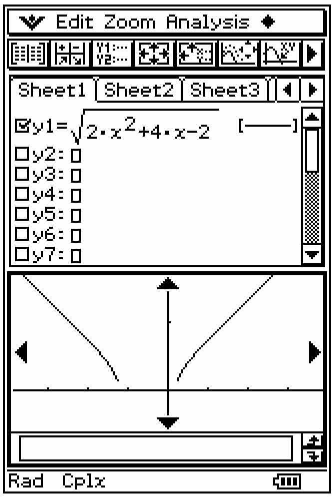
ClassPad enables students to visualize the functions, make hypothesis and hence check by calculations.



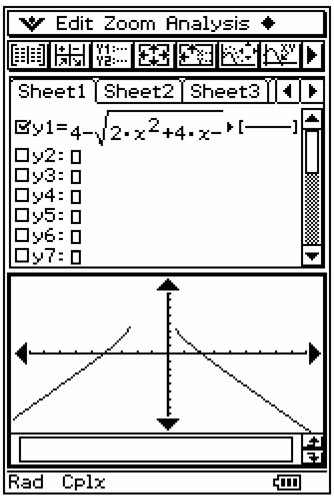
- **Exercises:**
  - $y = 2x^2 + 4x - 2$



- $y = \sqrt{2x^2 + 4x - 2}$



- $y = 4 - \sqrt{2x^2 + 4x - 2}$

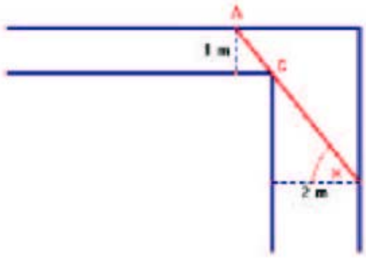


2. *Practical problems of optimization*

The theory of extrema applying practical problems of optimization is taught in Slovakia only in the last year of secondary education when students have already learnt finding the turning points (maxima, minima) of the functions by the differential calculations. Many fascinating exercises may be solved by this method which is much more useful because the tasks are solved by mathematical modeling rather than just by the mechanical differential calculations. Graphic scientific calculators draw the graphs quickly and find the maxima and the minima of the functions easily allowing students to solve interesting exercises which otherwise may not be solved at the secondary level.

Exercise 1:

Carrying a ladder of 4 metres and holding it in a horizontal position in a corridor shown in Figure 1 is it possible to turn round the corner? Is there enough room for the ladder?

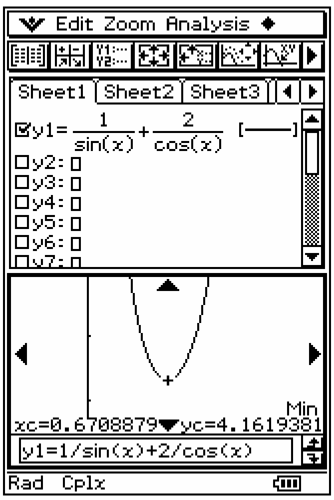


Answer:

A ladder of maximum length which "goes in" that corridor turn at that particular rotation (the angle of the rotation can be given by **x**) is:

l(x) $l(x)=\dfrac{1}{\sin(x)}+\dfrac{2}{\cos(x)}, x\in(0,\dfrac{\pi}{2})$

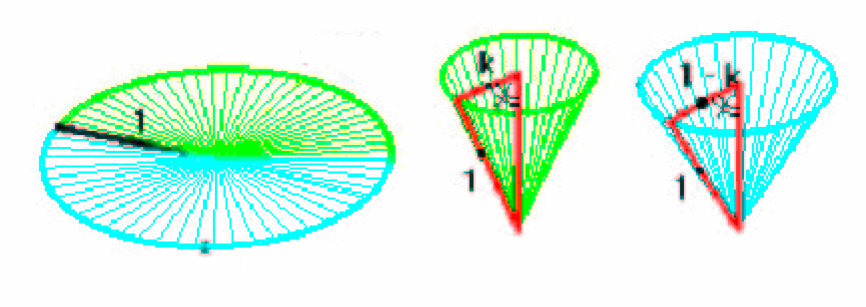
Using ClassPad plot the graph of the function and find the minimum



It is seen that the minimum of the function is 4.1619381 what means that the ladder of 4 meters can be turned round in the corridor turn.
The task can be solved geometrically, too.

Exercise 2:

Ann and John, as seen in Figure 3, want to make from paper 2 ice-cream cones with the largest possible volumes (considering regular cones - no topping). In other words: Cut up a circle of 1 dm in diameter made of paper into 2 cones with the largest sums of possible volumes.

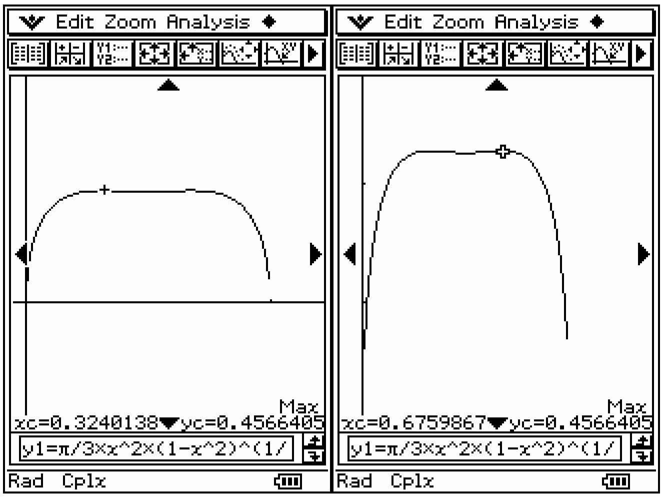


Answer:

$$V_1 = \frac{\pi}{3}k^2\sqrt{1-k^2}$$

$$V_2 = \frac{\pi}{3}(1-k)^2\sqrt{1-(1-k)^2}$$

$$V = V_1 + V_2 = \frac{\pi}{3}k^2\sqrt{1-k^2} + \frac{\pi}{3}(1-k)^2\sqrt{1-(1-k)^2}$$



We can draw the graph of the sum of the two cones as seen in the Figure 3.