
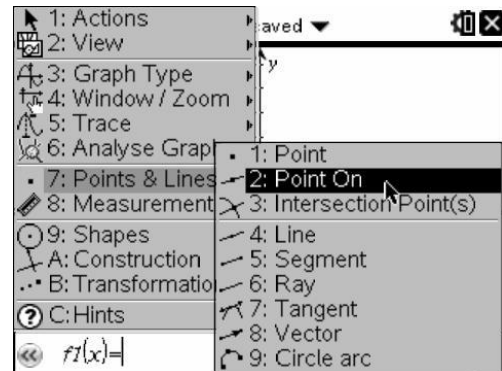
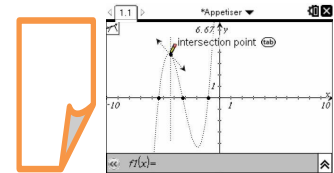


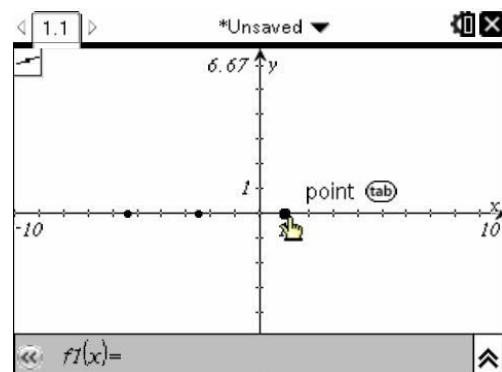
## Getting started


### Long - paper – version

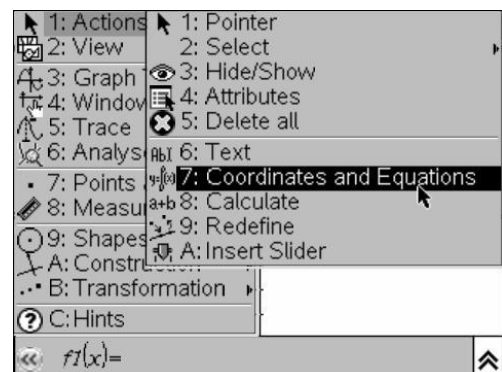
First, open “Graphs & Geometry”. Press  to get the shown screen.



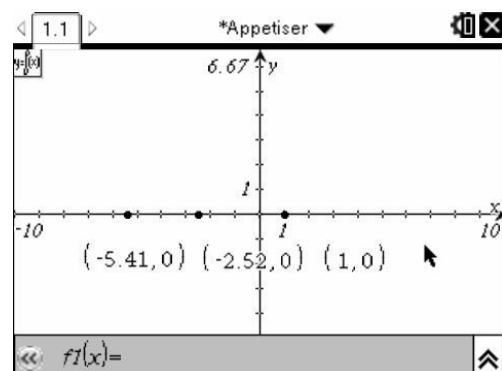
Choose three points on the x-axis.



The coordinates of these three points are visualized. Press  again.

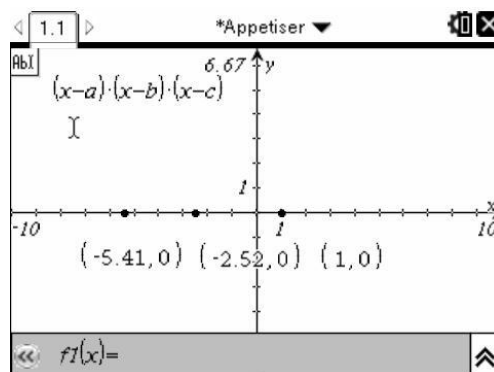


Clicking the points shows the coordinates.

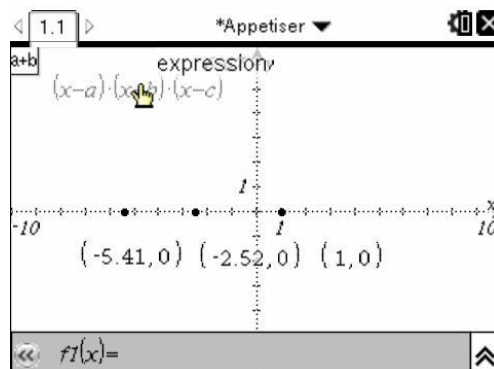


A polynomial function/rational function including these points is going to be constructed.

First, a textbox (☰ – Actions – Text) with a definition of the function with its factor components is created.

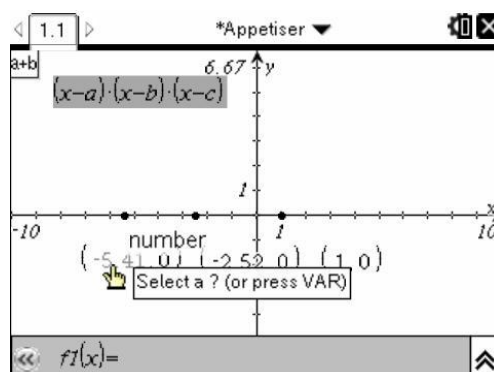


The letters a, b and c represent the given zeros of the function and are now assigned to the values. Choose (☰ – Actions – Calculate), and click on the textbox created above.

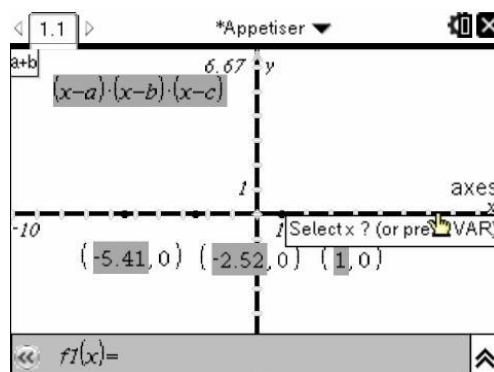


When asked for the letter a, just click on the coordinate of the first point.

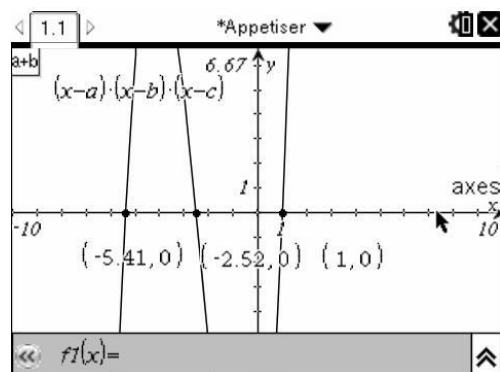
Repeat this for the letters b and c.




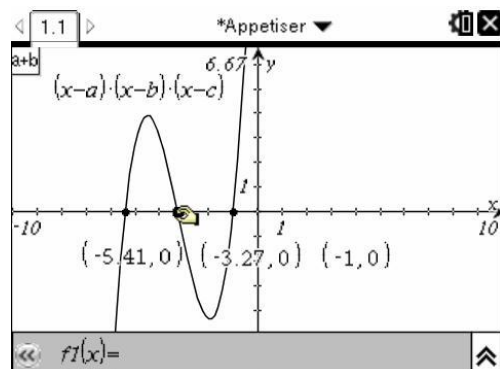
When asked for x, just click on the x-Axis.





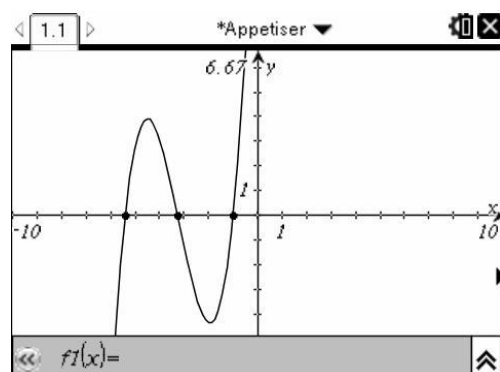
As a result, you will see the function including these points.





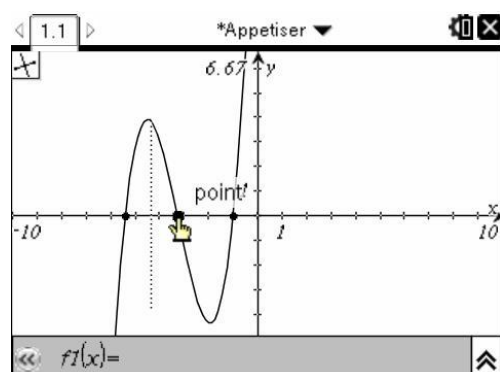
Grab  the points and move them around. You will see the function is re-calculated immediately.



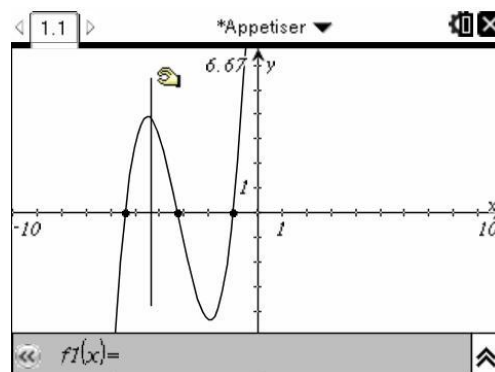
For a better view we now hide the coordinates and the textbox ( – Actions – Hide/Show, press  to exit this mode).



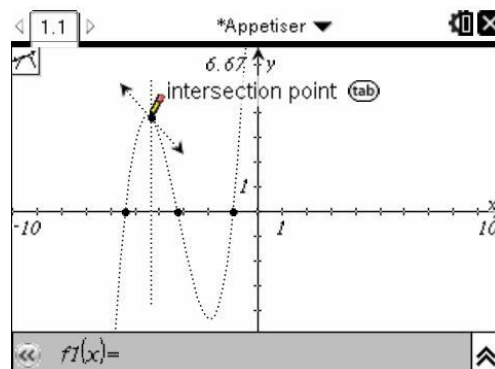
Construct the perpendicular bisector of two points of intersection of graph and x-axis, using  – Construction – Perpendicular bisector. Don't forget to exit this mode with .



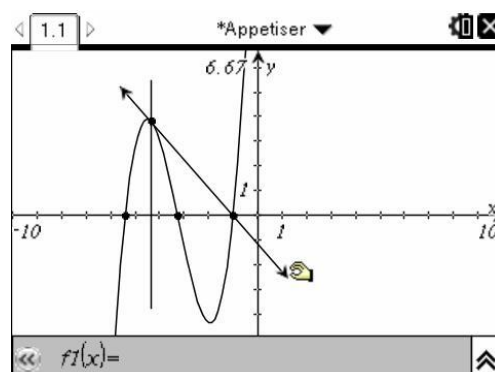
Grab the end of the perpendicular bisector and move it as long as the intersection point of graph and perpendicular bisector is visible.



Construct the tangent line in the intersection point of graph and perpendicular bisector. Use (menu) – Points & Lines – Tangent.



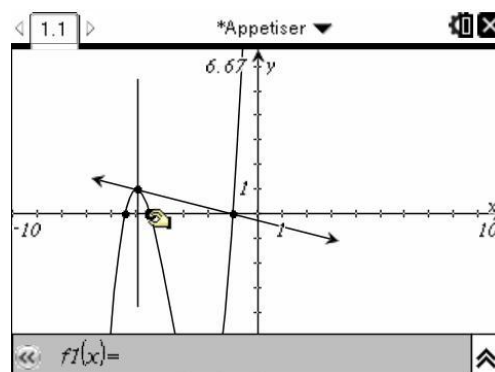
Grab the end of the tangent line and extend it. Be sure to exit the tangent mode by pressing (esc) before.



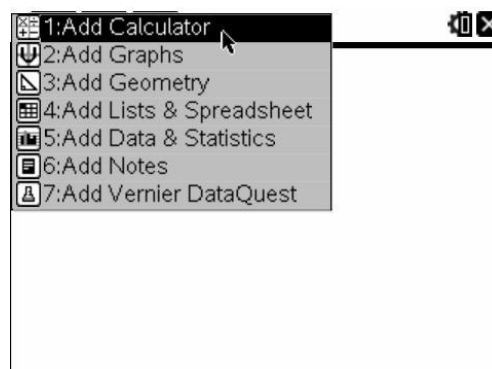
Now vary the points of intersection of the x-axis.

The tangent line always seems to include the third point!

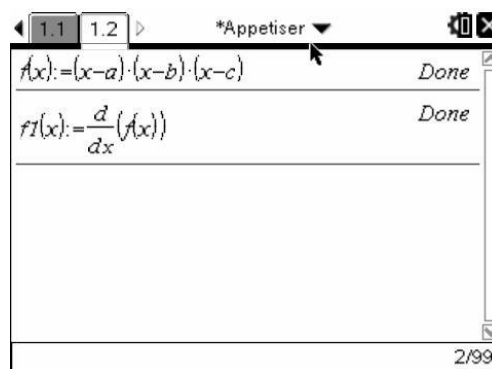
We will check this conjecture with the help of our CAS.



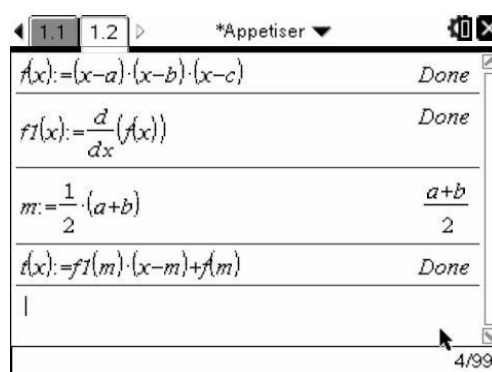
Add a Calculator-Application [+page]



The given function  $f$  and its derivative  $f'$  (written as  $f1$  – use  $\text{menu}$  – Calculus – Derivative) are defined.

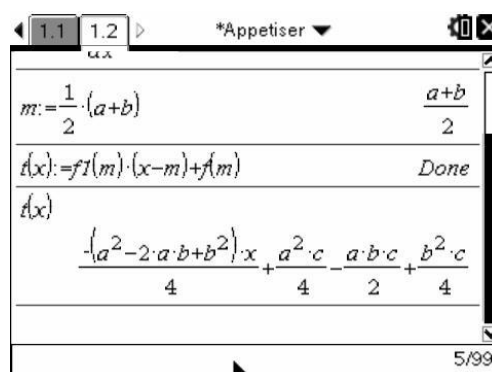


Now we need the mean value of  $a$  and  $b$ . We call it  $m$ . Next the function of the tangent line  $t(x)$  is calculated.



Let's have a look at the equation of the tangent line.

Does the third intersection point fulfil the equation?



Indeed it does!

1.1 1.2 \*Appetiser

$$m := \frac{1}{2} \cdot (a+b)$$

$$t(x) := f(t(m) \cdot (x-m) + f(m))$$

Done

$$t(x)$$

$$\frac{-(a^2 - 2 \cdot a \cdot b + b^2) \cdot x}{4} + \frac{a^2 \cdot c}{4} - \frac{a \cdot b \cdot c}{2} + \frac{b^2 \cdot c}{4}$$

$$t(c)$$

0

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