

During this year's TIME conference we used some of the new maturity exam questions provided by BIFIE to demonstrate different functionalities of the ClassPad II. BIFIE is the Austrian Center for Education, Research and Innovation. From the example below you can see a) how easy it is to be successful in Austrian exams just by using a CAS calculator and b) how easy it is to operate the ClassPad II.

Sports Car

A sports car accelerates from 0 meters per second to 28 meters per second (~ 100 km/h) in 4 seconds. $\mathbf{v(t)}$ describes the car's speed in meters per second during the period of acceleration subject to time (t) measured in seconds. The function of the car's speed can be expressed by the following equation: $\mathbf{v(t) = 0.5t^3 + 3.75t^2}$

Define $a(t) = \frac{d}{dt}(v(t))$	done
$v(4)$	28
$3.6 \times v(4)$	100.8

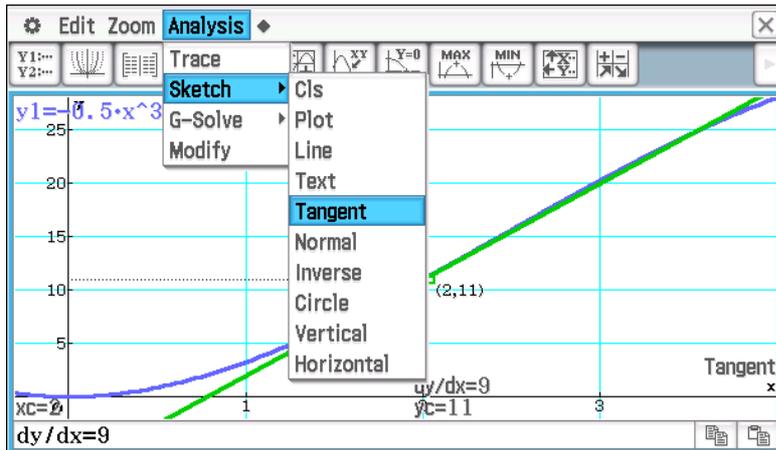
When analyzing kinematics the usual suspects to deal with are distance, acceleration, and speed. In the given function \mathbf{v} the integral of \mathbf{v} in the interval $[0;t]$ defines the amount of the distance starting at $t=0$. The corresponding function \mathbf{a} defining the car's acceleration can be calculated as a derivative of \mathbf{v} at the point \mathbf{t} . On ClassPad II the two necessary templates for the

integral  and the derivative  can be found by pressing the **Keyboard** button and selecting **Math2**. Alternatively, in the **Interactive** menu **f** and **diff** can be used comfortably.

The speed of 28m/s is reached after four seconds, which corresponds to 100.8km/h.

a) Enter the equation to calculate the acceleration $\mathbf{a(t)}$ at the moment of \mathbf{t} !
 Compute the momentary acceleration at $t = 2$.

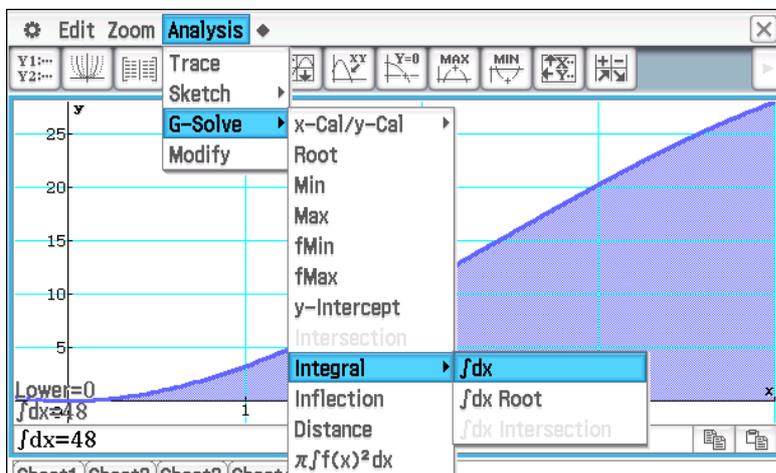
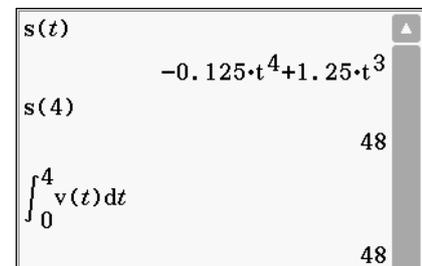
Due to the functions and computations already entered the first assignment of \mathbf{a} can be completed quite easily. The momentary acceleration can also be computed via the h-method. The template necessary for this computational method **lim** can be found by pressing **Keyboard** and **Math2**. Also, the result can be represented and verified graphically. In order to do this, press  to open the graphing window and pull $\mathbf{v(x)}$ into it. Use the **Analysis** menu to get to the pull down menu **Sketch** where a tangent can be drawn. By entering the value  the cursor jumps immediately to the correct position. In order to see the slope at that point, go to the settings menu  and activate **Derivative/Slope** in the Graph format settings.



b) Find a mathematical expression to compute the distance in meters. Find the numeric value in meters of the distance the car covered within the first 4 seconds.

The distance travelled can be computed by using the integral which we already used when defining the equation $s(t)$ at the beginning of this exercise. This function - or alternatively - a defined integral supply the desired result.

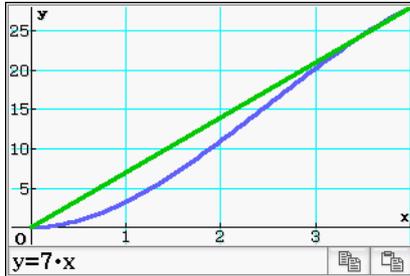
Once again, the result can be verified by using the $v(x)$ -diagram. Use the Analysis menu, drop to **G-Solve** and Integral. Using $\int dx$ and entering the requested limits provides the desired result.



c) Suppose this sports car accelerated in a steady manner - contrary to the previous statement - from 0 to 28 m/s in 4 seconds. The new expression for the car's speed is now $v_1(t)$ defining the car's speed in relation to t (time measured in seconds).

Find a new mathematical expression for the functional relation between v_1 and t . Compute the equation for v_1 .

The line connecting the values of speed at $t = 0\text{s}$ and $t = 4\text{s}$ is drawn. Using the two points the new function can be computed graphically. Analogous to exercise 3a) the two points $(0/0)$ and $(4/28)$ are connected using the Analysis menu **Sketch** by a straight line. The corresponding



equation is automatically shown in the line below the graph.

```
Define v1(t) =  $\frac{v(4)-v(0)}{4-0} (t-0) + v(0)$ 
v1(t) done
7*t
```

With kind permission of BIFIE, the Austrian Center of Educational Research, Innovation and Development. Thank you.