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Calculator Lesson 12

Slope Fields

Given a differential equation

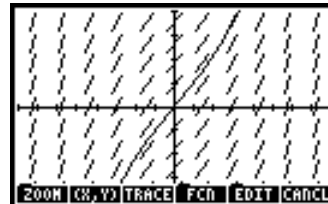
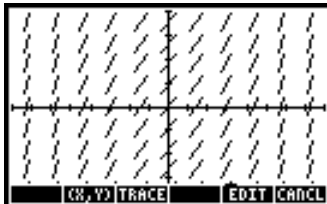
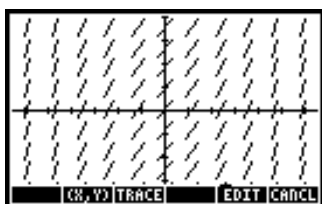
$$\frac{dy}{dx} = f(x, y),$$

the slope field is a graph that shows the approximate shape of the general solution. At each point (x, y) there is a short line segment drawn with its slope equal to $f(x, y)$.

We will demonstrate by creating a slope field for the differential equation

$\frac{dy}{dx} = x^2 + 1$. Press **LS(hold) 2D/3D** to get into the PLOT SETUP dialog box, choose

Slopefield for **Type:** and in **Eq:** enter $x^2 + 1$. Now press **NXT F6-OK LS(hold) WIN** to get into PLOT WINDOW dialog box. The window will be set from -1 to 1 both horizontally and vertically. Reset **X-Left** to -2 and **X-Right** to 2, change **Step Indep:** to 11 and **Depnd:** to 9, then **F5-ERASE F6-DRAW**. You should see the slope field shown in the figure on the left below.



The tick marks on this graph are set to 10 pixels. Suppose we want them to .25 units. It is a bit tricky to convince the calculator that we really want the tick marks at .25 units, but the following sequence will get the job done. Go back to PLOT SETUP and choose **Function** for **Type:** and change the ticks to .25 units. Now press **NXT F6-OK**, then get right back into PLOT SETUP, change **Type:** back to **Slopefield** then erase and draw. You should now have tick marks .25 units apart as in the figure in the center above.

We can look at the slope field and imagine what the graph of the solution to the differential equation will look like, but to graph it we must have the solution. In this case

that is not difficult to find. The antiderivative of $x^2 + 1$ is $\frac{1}{3}x^3 + x + C$. Go back to

PLOT SETUP, choose **Function** for **Type:** and enter $\frac{1}{3}x^3 + x$ into **Eq.:** Now draw

without erasing and you will get the graph shown on the right above. In this case we have chosen $C = 0$. Try different values for C , 0.5, 1, -0.5, etc. to see what happens.

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