

Solving Differential Equations

by

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Textbook Correlation: Key Topic

- Differential Equations

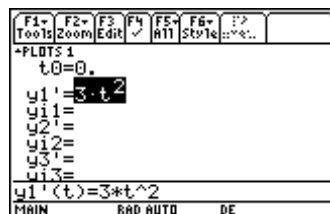
NCTM Principles and Standards:

- Process Standard
 - Representation
 - Connections

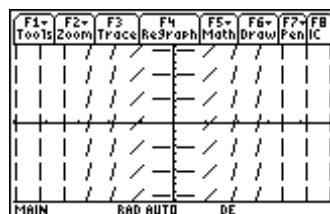
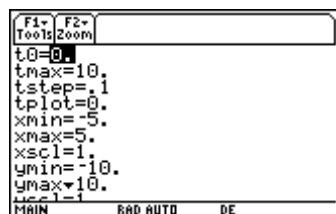
Exercises:

Exercise 1. Solve the differential equation $y' = 3t^2$ ($\frac{dy}{dt} = 3t^2$) graphically, numerically and analytically.

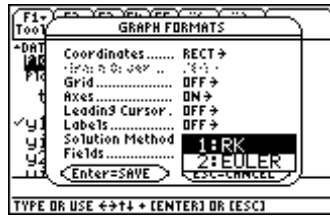
Method I: Graphically with Slope Fields



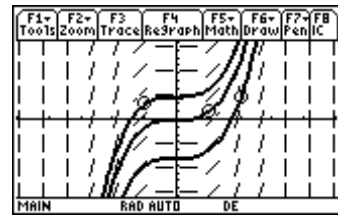
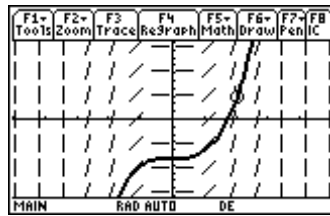
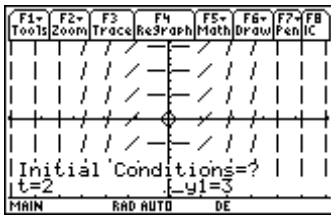
Press the **MODE** key and select **6: DIFF EQUATIONS**. Enter $3t^2$ for $y1'(t)$ in the Y= editor.



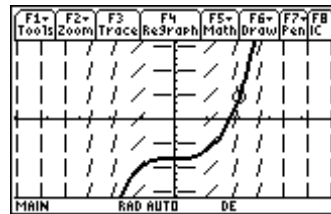
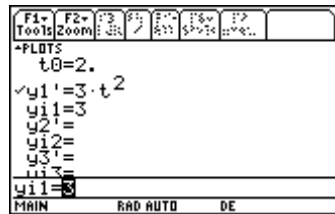
Enter the parameters in the **WINDOW** as illustrated above. Press Green Diamond F3 to **GRAPH**.



In the **Format** dialog box under the F1 pull down menu (**F1**, option **9**), select **1:RK** (Runge Kutta) for Solution Method and **1:SLPFLD** for Fields.

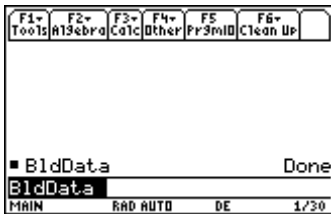


Option **F8** allows you to enter the initial conditions. Simply type the desired value for t , press **ENTER** and do likewise for y_1 . The approximate solution will be drawn on the screen. Many solutions can be drawn on the same screen by entering more initial conditions.



Another way to enter an initial condition is in the Y= editor. Enter the initial t value at the top and the corresponding y_1 value as shown in the left screen above.

Method II: Numerically with Tables

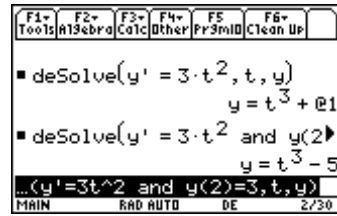
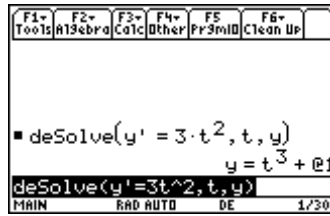


| DATA | t | y1 | c1 | c2 | c3 |
|------|-----|-------|----|----|----|
| 1 | 2. | 3. | | | |
| 2 | 2.1 | 4.261 | | | |
| 3 | 2.2 | 5.648 | | | |
| 4 | 2.3 | 7.167 | | | |

ric1=2.

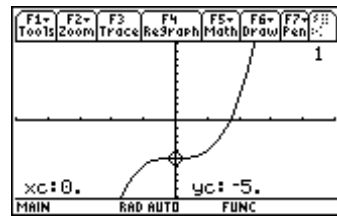
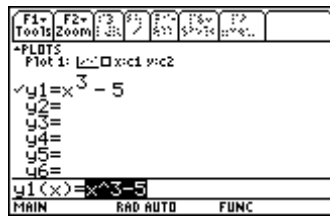
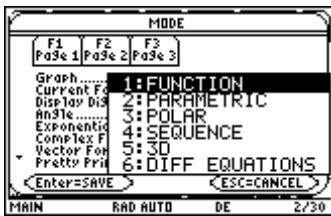
After graphing the approximate solution, enter the **BldData** command from **CATALOG**. Press **APPS** and select **6:Data Matrix Editor**, **1:Current**.

Method III: Analytically

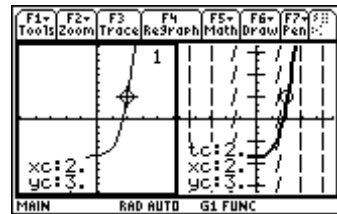
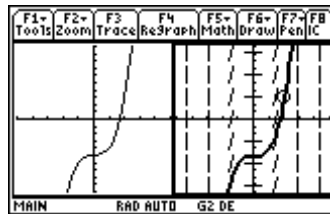


On the **HOME** screen select **F3(Calc)**, **C:deSolve**. The prime, ', is typed using the 2nd = in the sixth row, first column of the TI-89. Note that @1 represents an arbitrary constant in the solution. Constants in subsequent solutions will be denoted by @2, @3, etc.

The exact solution can be graphed in function mode and compared with the approximate solution as illustrated below.

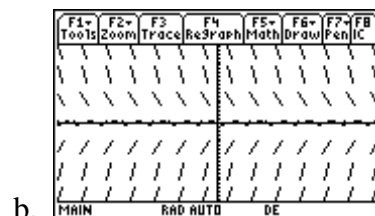
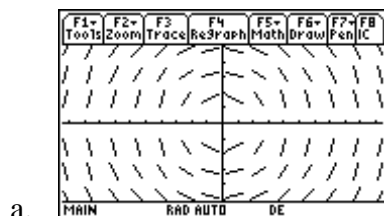


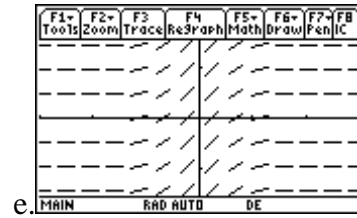
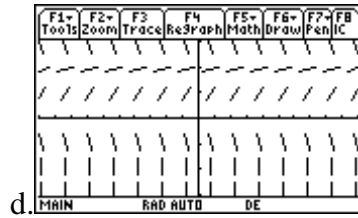
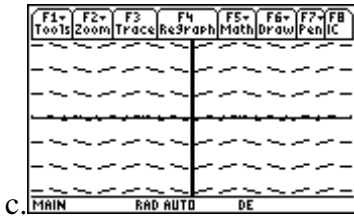
The TI-89 will display both graphs at the same time. Using the Trace feature on each graph as displayed below provides one way to compare the approximate solution with the exact solution.



Exercise 2: Match the following differential equations and slopefields:

- 1) $y' = \sin(t)$ 2) $y' = -t/y$ 3) $y' = y(2-y)$ 4) $y' = e^{-t}$ 5) $y' = 1-y$





Refer to pp.163-187 of the *TI-89 Guidebook* for more information about differential equation graphing and pg. 543 for details about the Runge Kutta method.