Topics in Calculus: Applications of Derivatives

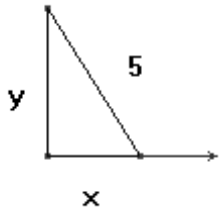
Visualizing Related Rate Problems

NCTM Principles and Standards

- **Content Standard:** Represent and analyze mathematical situations and structures using algebraic symbols
- **Process Standard**: Use representations to model and interpret physical, social, and mathematical phenomena

When the variables that model a problem can be written as functions of time (t) the relationships may be visualized by graphing using parametric mode on the TI-89. Let's look at the old stand-by sliding ladder problem from a new perspective!

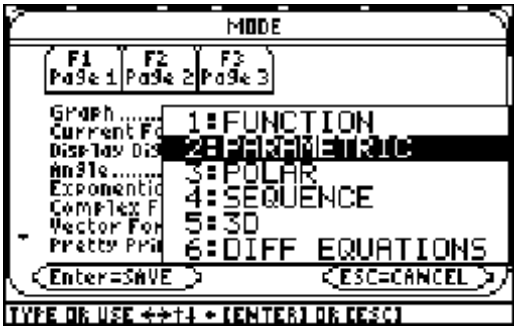
> A 5 m ladder is leaning against a wall. The base of the ladder is being pulled away at a rate of 2m/sec. How fast is the top of the ladder moving down the wall when the base of the ladder is 3m from the wall?



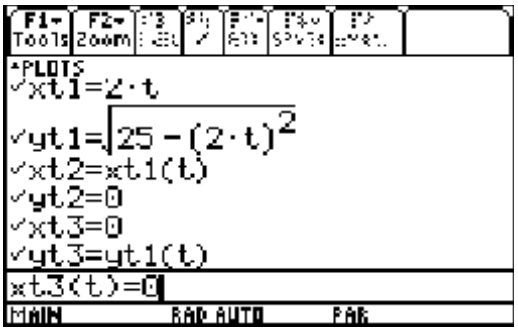
$x^2 + y^2 = 25 \rightarrow y = \sqrt{25 - x^2}$ $\qquad x = 2t$

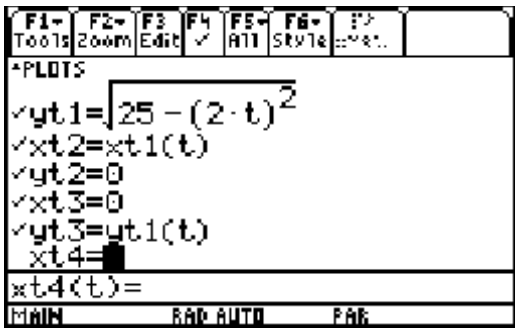
$\frac{dx}{dt} = 2\,m/\sec$ $\qquad y = \sqrt{25 - (2t)^2}$

- To graph the problem first change to parametic mode by pressing [MODE] ▶ [2] [ENTER].

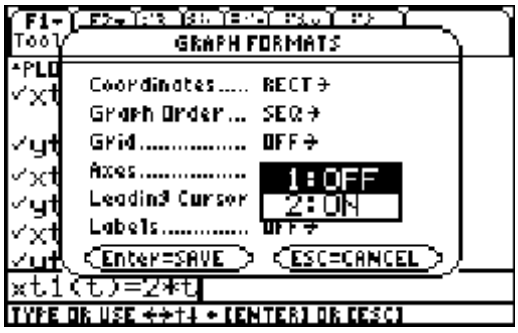


- Press [◆][F1] and enter the parametric equations for x and y. Enter xt2, yt2, xt3, and yt3 as shown below. Press [F6] ([2nd][F1]) [2] to select the dot style.

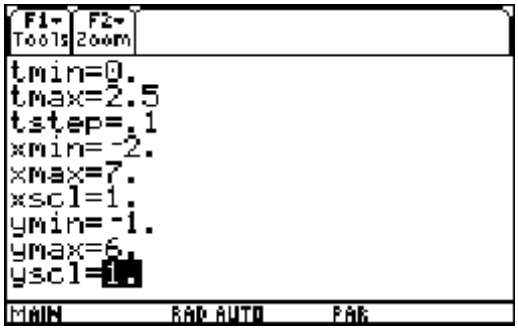




- Turn off the x and y axes. Make sure the TI-89 has the grapher open. Press [F1] and ⊙ to go down to choice 9 (Format) on the menu or press [9]. Once the format screen is open press ⊙ to move down to the 4th line and press [ENTER]. Select axes off and press [ENTER].



- Press ♦[F2] and set the window as shown.



- Put the TI-89 in simultaneous mode by pressing [F1] and ⊙ to go down to choice 9 (Format) on the menu or press [9] **or** simply use the shortcut keys ♦[I] to go directly to the format screen. Once the format screen is open press ⊙ to move down to the 2nd line and press [ENTER]. Select SIMUL and press [ENTER].

- Press ♦[F3] to graph the parametric equations. Press [ENTER] to pause the graph and press [ENTER] to resume graphing. Notice the spacing of the dots. The distance between them is the rate of change per unit of time! Press [F3]◐/◑ to trace the parametric equations. Press ◓/⊙ to switch among the equations.