

MATLAB 5: Graph for Exercise 5.1#49

This fifth MATLAB exercise differs from the previous four in that the MATLAB commands that you will use are not given to you. Instead, you are given a model graph, and you have to figure out commands to type in order to produce a similar graph. All of the features on the model graph are ones for which you have learned MATLAB commands in the first four MATLAB exercises. In order to do the current exercise, you might need to review those four. Some of the graphical features that you need to produce are:

- Three functions graphed on the same set of axes
- Some graphs solid; some dashed
- Key points highlighted with appropriately-sized dots and coordinates
- Additional graphical labels added consisting of text and mathematical symbols

One new MATLAB skill that you will learn that was previously overlooked is:

- Producing graphical labels involving exponents that contain more than one character

In exercise 5.1#49 from Homework 5, you will apply the Mean Value Theorem to the function $s(t) = \frac{1}{100}t^3$,

where $0 \leq t \leq 5$. In part (a) of that problem, you are asked to compute the “average velocity between $t = 0$ and $t = 5$ ”. Denote this average velocity by the letter m . The result that you should get is

$$\text{The “average velocity between } t = 0 \text{ and } t = 5\text{” is } m = \frac{1}{4}.$$

In part (c), you are asked to find a value of time t in the open interval $0 < t < 5$ such that the “instantaneous velocity at time t ” is $s'(t) = m = \frac{1}{4}$. The result that you should get is

$$\text{The “instantaneous velocity at time } t = \frac{5}{3^{1/2}}\text{” is } s'\left(\frac{5}{3^{1/2}}\right) = m = \frac{1}{4}.$$

As the textbook discusses on page 171, and as we discussed in Group Work 3, the words “average velocity between $t = 0$ and $t = 5$ ” represent the slope of a secant line that can be drawn on the graph of $s(t)$. The words

“instantaneous velocity at time $t = \frac{5}{3^{1/2}}$ ” represent the slope of a tangent line that can be drawn on the graph of

$s(t)$. You are not asked to find the equations of these lines, but it is not hard to find them. They are:

- The equation for the secant line is $g(t) = \frac{t}{4}$. It intersects the graph of $s(t)$ at $(0,0)$ and $\left(5, \frac{5}{4}\right)$.
- The equation for the tangent line is $h(t) = \frac{t}{4} - \frac{5}{2 \cdot 3^{3/2}}$. The point of tangency is $\left(\frac{5}{3^{1/2}}, \frac{5}{4 \cdot 3^{3/2}}\right)$.

Using MATLAB, make a picture that shows the graphs of the functions $s(t)$, $g(t)$, and $h(t)$. Use as your model the picture that I produce in my Homework #4 solutions for exercise 4.1#32. Your picture should have important points highlighted with coordinates and appropriately-sized dots, as they are in the model picture. Make the secant line and tangent line dotted, as they are in the model picture. Label the secant line and tangent line as they are labeled in the model picture. Print your picture and turn it in along with your solution to homework exercise 5.1#49.

New MATLAB skill: producing exponents of more than one character in graphical labels

When labeling your graph, you will need to make text boxes containing exponents that contain symbols like

$3^{1/2}$. If you type the characters $3^{(1/2)}$ into the textbox, the resulting picture will show $3^{(1/2)}$, which is not

what you want. Instead, type the characters $3^{\{1/2\}}$ into the textbox. The resulting picture will show $3^{1/2}$.