MATH 1351 TI-85 EXERCISE VII
Derivatives as the limit of the difference quotient

In Section 1 of Chapter 3 we learned that the derivative of a function **f** at the input value **x** is the limiting value of the slopes of the chords drawn from (**x** , **f(x)**) to nearby points on the graph. This slope from (**x** , **f(x)**) to the nearby point (**x + h , f(x + h)**) is the *difference quotient*

DQ: **(f(x + h) - f(x)) / h**

for small positive and negative values of **h**. And its' limiting value we defined to be the slope of the *tangent line* to the graph at (**x , f(x)**).

Also in Section 1, we saw how to find a formula for this derivative in terms of the value **x** for some very simple functions. Here we will try to conjecture what such a derivative formula might be for a much more sophisticated function; namely, we'll consider the function **f(x) = ln (x).** We'll investigate the limit of the difference quotient at the three values **x** = 1, 2, & 3.

1. Compute each of the difference quotients for **f(x) = ln (x)** directly:

   for **x** = 1 & **h =** 10^-10 DQ = ______________________
   for **x** = 1 & **h = -**10^-10 DQ = ______________________
   for **x** = 2 & **h =** 10^-10 DQ = ______________________
   for **x** = 2 & **h =** -10^-10 DQ = ______________________
   for **x** = 3 & **h =** 10^-10 DQ = ______________________
   for **x** = 3 & **h =** -10^-10 DQ = ______________________

2. Sketch the graph of each DQ for each value of **x** = 1, 2, & 3 and use **ZOOM** and **TRACE** to estimate the value near 0. (The variable in each DQ is **h,** but the TI-85 recognizes only **x** as an independent variable. So we have to replace **h** in the above DQ with **x.** This shouldn't be too confusing since the **x** in the above DQ is to be replaced with the numbers 1, 2, & 3 anyway.)

So the graph of DQ corresponding to the point (1 , ln(1)) is the graph of
y = (ln (1 + x) - ln (1)) / x and limit as x -> 0 ≃ ________________

At the point (2 , ln(2)) the graph is that of
y = (ln (2 + x) - ln (2)) / x limit as x -> 0 ≃ ________________

At the point (3 , ln(3)) the graph is that of
y = (ln (3 + x) - ln (3)) / x limit as x -> 0 ≃ ________________

3. Finally, simply sketch the graph of **y = ln(x)** in the **ZDECM** window. Choose **MATH** from the screen menu, then choose **dy/dx** from the MATH screen menu. TRACE is automatically activated. Move the cursor to x =1 and press **ENTER.** Do the same for each of x = 2 and x = 3. We obtain dy/dx = _______ at x = 1, dy/dx = _______ at x = 2, and dy/dx = _______ at x = 3. What appears to be the relationship between the value of x and that of dy/dx for y = ln (x)?______
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