MATH 151.02 QUIZ 3 October 21, 2009

SHOW ALL YOUR WORK! GOOD LUCK! NAME: ____________________

1.(5pts.) By using the definition of the derivative, find the derivative of $f(x) = 5x^2 + 9x + 17$ at point $x = 3$.

$$f'(3) = \lim_{h\to 0} \frac{f(3+h) - f(3)}{h} = \lim_{h\to 0} \frac{5(3+h)^2 + 9(3+h) + 17 - (5\cdot 3^2 + 9\cdot 3 + 17)}{h}$$

$$= \lim_{h\to 0} \frac{5(9+6h+h^2) + 27 + 9h + 17 - (45+27+17)}{h} = \lim_{h\to 0} \frac{\cancel{45} + 30h + 5h^2 + \cancel{27} + 9h + \cancel{17} - \cancel{45} - \cancel{27} - \cancel{17}}{h}$$

$$= \lim_{h\to 0} \frac{39h + 5h^2}{h} = \lim_{h\to 0} \frac{\cancel{h}(39+5h)}{\cancel{h}} = \lim_{h\to 0}(39+5h) = 39 + 5\cdot 0 = 39$$

2.(5pts.) Find the following derivatives of the function $f(x) = |x|$, if they exist. If not, explain why a given derivative doesn't exist.

a) $f'(0) = \lim_{h\to 0} \frac{|0+h| - |0|}{h} = \lim_{h\to 0} \frac{|h|}{h}$ This limit does not exist (DNE)

because $\lim_{h\to 0+} \frac{|h|}{h} = \lim_{h\to 0} \frac{h}{h} = \lim_{h\to 0} 1 = 1$

while $\lim_{h\to 0-} \frac{|h|}{h} = \lim_{h\to 0-} \frac{-h}{h} = \lim_{h\to 0-}(-1) = -1$

Since R-H limit and L-H limit are not the same, $f'(0)$ DNE

b) $f'(3) = \lim_{h\to 0} \frac{f(3+h) - f(3)}{h} = \lim_{h\to 0} \frac{|3+h| - |3|}{h} = \lim_{h\to 0} \frac{|3+h| - 3}{h}$

$3+h > 0$ for h close to 0

$$= \lim_{h\to 0} \frac{3+h-3}{h} = \lim_{h\to 0} \frac{h}{h} = \lim_{h\to 0} 1 = 1$$

So, $f'(0) = 1$