Mth 251
Lab §2.1

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Name: _____

Labs are meant to allow you to practice the material we learned in class while you have access to help (either your instructor or the lab assistant or your classmates). You will never turn in the labs, but I will select specific problems from the labs to be presented in a formal Lab Report which will be collected and graded.
I encourage you to work with others and use a calculator when necessary. Write clearly, and if you work with others, make sure that your work is your own. Box all answers/conclusions, show your work, don't forget to include units, and answer any "word problems" with a self-contained sentence. Good luck, and may the Force be with you!

1. Graph each of the following functions.

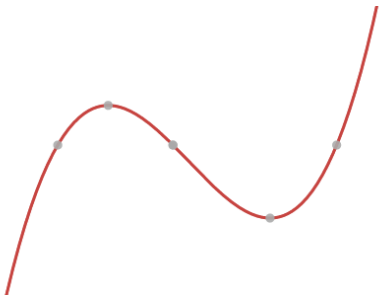
   (a) x
   (b) x^2
   (c) x^3
   (d) $|x|$
   (e) $\dfrac{1}{x}$
   (f) $\sqrt{x}$
   (g) $\sqrt[3]{x}$
   (h) 2^x
   (i) $\left(\dfrac{1}{2}\right)^x$
   (j) e^x
   (k) $\log x$
   (l) $\ln x$
   (m) $\sin x$
   (n) $\cos x$
   (o) $\tan x$
   (p) $\arctan x$

2. For any function $f(x)$, the *difference quotient* we will refer to in this class is $\dfrac{f(x+h)-f(x)}{h}$. For each of the following functions, find its difference quotient and simplify if possible.

   (a) $c(x) = x^3$

   (b) $r(x) = \dfrac{1}{x}$

3. The graph of $y = f(x)$ is provided below. At each of the five points, draw a tangent line to f.



4. Galileo dropped a rock from the Leaning Tower of Pisa, about 55m above ground. The distance traveled by the rock t seconds after it left Galileo's hand is $s(t) = 4.9t^2$ meters.

   (a) Does the rock have a constant velocity or does the velocity change? Justify your conclusion.

   (b) How far does the rock travel in 3 seconds? *Don't forget units!*

   (c) Compute the rock's average velocity over the time interval $[2.5, 3]$. *Do not round.*

   (d) Find the rock's average velocity over the given time intervals.

Interval	Average Velocity
$[2.5, 3]$	
$[2.9, 3]$	
$[2.99, 3]$	
$[2.999, 3]$	

   (e) Using the previous table, estimate the *instantaneous velocity* of the rock after 3 seconds.

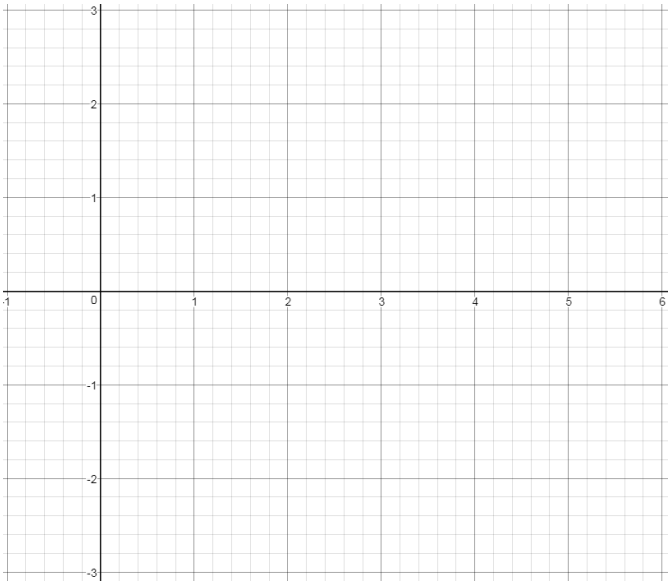
   (f) How far does the rock travel after 10 seconds?

   (g) What do you think is the instantaneous velocity of the rock after 10 seconds?

   (h) How tall is the Leaning Tower of Pisa? Does this change your conclusion for the previous two questions?

5. Let $f(x) = \ln x$. The point $P(1, 0)$ is on the graph of $y = f(x)$.

(a) Graph $y = f(x)$ and plot P on the axes below.



(b) Plot the point $R(e, 1)$. Draw a secant line from P to R. Label this line m_{PR}.

(c) What is the slope of m_{PR}?

(d) Let $Q(x, f(x))$ be a point on the curve $y = f(x)$ that changes as x changes. If m_{PQ} is the secant line on PQ, then the slope of m_{PQ} changes as x changes. Compute the values of the slope of m_{PQ} for the different values of x below (just like in class). Round any values to the nearest hundred-thousandth.

Hint: Slope of $m_{PQ} = \dfrac{f(x) - f(1)}{x - 1}$.

x	Slope of m_{PQ}
2	
1.5	
1.1	
1.01	
1.001	
1.0001	

(e) Using the previous table, estimate the *slope of the tangent line* to $y = f(x)$ at P.

(f) How is this problem the same as the previous two problems?