**Math 252 -- Calculus II -- Lab 2 -- B. Plassmann**

**Names:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Labs are best if done in your group, during lab time.**

Late labs will be penalized 20%, and will only be accepted up to one week late.

Any group lab turned in by an individual will be penalized 10%.

**Rules:**

Work together:

Everyone works on the same problem at the same time.

Everyone agrees on the solution before you move on.

Remember that you are practicing your mathematical

communication skills!

Turn in one paper per group. Make sure that the paper you turn in is clean, clear, and organized.

**Part 1: Exploring Definite Integrals.**

Consider this function f:



Compute the following, giving your answers in exact form (no weird decimals).

1. 
2. 
3. 
4. 

**Part 2: The Area-So-Far Function**

(based on Stewart Instructor's Guide, 5e)

Consider the constant function .



1. Using geometry, compute .
2. Using geometry, compute .
3. Using geometry, compute .
4. Shade and label this graph of a(t) to show how to find a formula for  for any .

Call this formula , the *area-so-far (starting at 1) function* for a(t).



 = =

Simplify your expression as much as possible.

Consider the function .



1. Using geometry, compute .
2. Using geometry, compute .
3. Shade and label this graph of b(t) to show how to find a formula for  for any .

Call this formula , the *area-so-far (starting at 0) function* for b(t).



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Simplify your expression as much as possible.

Rename the function  as .



1. Using geometry, compute .
2. Using geometry, compute .
3. Shade and label this graph of c(t) to show how to find a formula for  for any .

Call this formula , the *area-so-far (starting at -1) function* for c(t).



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Simplify your expression as much as possible.

**The Punchline:**

We have now computed three different area-so-far functions. Fill in the blanks:

|  |  |  |
| --- | --- | --- |
| *Simplify each expression as much as possible.* | | |
|  |  |  |
|  |  |  |
|  |  |  |

You should notice a very interesting fact about the derivatives of the area-so-far functions -- a fundamentally beautiful property. Describe it in a sentence:

Here's the property we're seeing, written in symbols:



Another way to say the same thing:

The *area-so-far function* is always an anti-derivative of the original function.

**One last question:**

Here is one last graph,  so its *area-so-far (starting at 0) function* is:

.

Shade in the part of the graph that corresponds to D(x):

(label the vertical line as x).



Do NOT try to find a simple formula for . But, using our amazing fact, fill the last blank -- find the derivative of the *area-so-far* function:



***Part 3:***  *A ball is thrown from the top of a 224 foot tall building with an initial velocity of 80 ft/sec. Can we find an equation for the height of the ball as a function of time? Yes, we certainly can, now that we know how to do anti-derivatives.*

Acceleration due to gravity near the surface of the Earth is 32 ft/sec2. Since this force acts downward, we think of it as negative 32 ft/sec2.

 ft/sec2

1. Find the anti-derivative of the acceleration function to find the velocity function. Remember that the initial velocity is 80 ft/sec, so when t=0, your function should equal +80. Include units.



1. Find the anti-derivative of the velocity function to find the position function. Remember that the initial height is 224 ft (that's how tall the building is), so when t=0, your function should equal 224. Include units.



What about in general?

1. Find the anti-derivative of the acceleration function to find the velocity function, using the symbol  for the initial velocity. Use a(t) = -32 ft/sec2. Include units.



1. Find the anti-derivative of the velocity function to find the position function, using the symbol  for the initial height. Include units.



What about in metric units, where acceleration due to gravity on the surface of the Earth is approximately ?

1. Find the anti-derivative of the anti-derivative of the acceleration function to find the velocity and position functions, using the symbol  for the initial velocity, and  for the initial height. Include units.





