**Math 252 -- Calculus II -- Lab 4 -- B. Plassmann**

**Names:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (include last names!)

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*We agree that everyone whose name is on this lab contributed fairly to the final paper. If someone has not contributed sufficiently, we will take their name off this worksheet, and they should turn in an individual paper.*

**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: Still Integration by Substitution…**

Below are three different integrals, which all happen to have the same answer. You have these jobs:

1. Find each answer, check that they are equal -- getting a decimal by using your calculator is fine. Write at least 6 digits, then " ... "
2. Show algebraically why all three of the areas are equal, by using substitution. You will not be solving the integrals, just changing from one variable to another.
3. On the attached graph paper, make a good graph of the area represented by each of the three integrals. Remember that graphs should be neat, exact, all straight lines drawn with a ruler.
4. Explain why all three areas seem to be the same, by talking about relationships between the graphs.

**(A) **

**(B) **

**(C) **

Using substitution, show that A equals B:

**(A) **



You should end with the integral (B).

Using substitution, show that B equals C:

**(B) **



You should end with the integral (C).

Using substitution, show that C equals A:

**(C) **



You should end with the integral (A).



Why are areas A and B the same?

(A)

(B)



(C)

Why are areas B and C the same?



**Part 2: Practice with Area between Curves**

For each of the following problems,

1. Make a good sketch of the relevant area, remembering to mark scale numbers on the axes.
2. Draw a representative rectangle and label its dimensions.
3. Write out the definite integral that will find the area of the region.
4. Do NOT solve the integral.

**(1)** The area bounded by , , and bounded on the left by the y-axis. Use vertical rectangles.

|  |  |  |
| --- | --- | --- |
| *good sketch, with scale numbers, label both equations.* | *representative rectangle, with labelled dimensions* | *Set up (do not solve!) the correct integral.* |
|  |  |  |

**(2)** The area bounded by , , and bounded on the left by the y-axis. Use horizontal rectangles.

|  |  |  |
| --- | --- | --- |
| *good sketch, with scale numbers, label both equations.* | *representative rectangle, with labelled dimensions* | *Set up (do not solve!) the correct integral.* |
|  |  |  |

**(3)** The area bounded by  and . Find the region that includes the origin.

|  |  |  |
| --- | --- | --- |
| *good sketch, with scale numbers, label both equations.* | *representative rectangle, with labelled dimensions* | *Set up (do not solve!) the correct integral.* |
|  |  |  |

**(4)** The area between , and .

|  |  |  |
| --- | --- | --- |
| *good sketch, with scale numbers, label both equations.* | *representative rectangle, with labelled dimensions* | *Set up (do not solve!) the correct integral.* |
|  |  |  |

**(5)** The area between  and , bounded on the left by the y-axis. You'll have to approximate the coordinates of the intersection point.

|  |  |  |
| --- | --- | --- |
| *good sketch, with scale numbers, label both equations.* | *representative rectangle, with labelled dimensions* | *Set up (do not solve!) the correct integral.* |
|  |  |  |