Math 163

Take-Home Exam 4

Thursday, April 24, 2025

Description

Exam 4 is a two-part take-home exam.

Part 1

Complete the indicated exercises on paper, showing your work in detail.

Part 2

Present your solution to 1-3 problems (Professor's choice). Class time on Thursday April 24 will be devoted for student presentations. Other students *will not* be in the room during presentations.

a) Option a: Present in class.
b) Option b: Present to Dr. Thompson during office hours.

Order of presentations

1. **10 am**: Bazzett Fleming Gordon Hall Lutaj Meckstroth Odegard Rhoades Watson Weber
2. **1 pm**: Gorgos Jobe Lewinski Marta Martin Necula Raich Rosillo Shevy Smith Wright

Grading

1. Written: 70%

- correct, clear & your own work
- your solutions should not look like anyone else's

2. Presentation: 30%

- correct, clear & confident
- while it's ok to look at your notes, you should not have to repeatedly do so.

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Name:
Math 163 Take-Home Exam 4
Date: April 18, 2025
Total Points: 70

Numerical

Numerical approximations are allowed. Solutions may be on paper or in Desmos, python, R, etc.

1. In the following consider the polar curve $r = 3\cos(6\theta) + 1, 0 < \theta < \pi$.
   (1.1) Sketch a graph of the polar curve.
   (1.2) Find the arc length of the curve.
2. Find the area bound by all loops of the polar curve
$$r = 6\cos(\theta) + 6\cos(3\theta) + 6\cos(5\theta) - 6\cos(7\theta) - 6\cos(9\theta)$$
3. Find the surface area of the torus obtained by rotating the circle $x^2 + (y-4)^2 = 49$ about the x-axis.
4. Gabriel's horn is formed by taking the graph of $y = \frac{1}{x}$ about the x-axis.
   (4.1) Find the volume of Gabriel's Horn.
   (4.2) Set up an integral that represents the surface area of Gabriel's Horn.
   (4.3) Show that the surface area of Gabriel's Horn is infinite.
   (4.4) Show that the volume of Gabriel's Horn is finite.

Exact

Solutions are to be exact, and completely on paper. No numerical approximations.

4. Find the area of region in the figure $r = 8\sin(5\theta)$
5. Find the surface area of the solid obtained by revolving the curve
$$y = \sin(3t), x = \cos(3t)$$
about the x-axis.
6. Solve the following initial value problem:
$$\frac{dy}{dx} = \frac{\sin x}{\cos y}, y(0) = \pi$$
7. Solve the following initial value problem:
$$\frac{dy}{dx} = \frac{(y^2+1)\sec^2(x)}{y}, y(0) = 0$$
8. Solve the following initial value problem:
$$y' - 4y = 8x, y(0) = 5$$
9. Solve the following initial value problem:
$$y' - \frac{3}{x}y = 4, y(1) = 7$$