

MA 16200: First Midterm Examination
Fall 2024, Purdue University

Exam version: 01

Name: _____

PUID #: _____

Exam Instruction:

- Follow these instructions carefully. Failure to do so may result in your exam being invalidated and/or an academic integrity violation. All suspected violations of academic integrity will be reported to the Office of the Dean of Students.
- Mark the circle of your recitation section below. Write your name and PUID on the top of this cover page. **DO NOT WRITE ANYTHING ELSE** on this cover page.

	Sec	Time	TA Name
☐	206	7:30AM	Gage Bachmann
☐	109	7:30AM	Lance Daley
☐	904	7:30AM	Luca Mossman
☐	906	7:30AM	Michael Poole
☐	210	7:30AM	Ehan Shah
☐	208	8:30AM	Gage Bachmann
☐	111	8:30AM	Lance Daley
☐	908	8:30AM	Luca Mossman
☐	902	8:30AM	Michael Poole
☐	212	8:30AM	Ehan Shah
☐	224	9:30AM	Niveditha Nerella
☐	216	9:30AM	Claudia Phagan
☐	107	10:30AM	Otto Baier
☐	222	10:30AM	Niveditha Nerella

	Sec	Time	TA Name
☐	214	10:30AM	Claudia Phagan
☐	113	11:30AM	Tausif Ahmed
☐	105	11:30AM	Otto Baier
☐	115	12:30PM	Tausif Ahmed
☐	101	12:30PM	Alexis Cruz Castillo
☐	103	1:30PM	Alexis Cruz Castillo
☐	218	1:30PM	Leo Shen
☐	220	2:30PM	Leo Shen
☐	117	3:30PM	Tiffany Burnett
☐	204	3:30PM	Mohamad Mousa
☐	121	3:30PM	Juliet Raginsky
☐	119	4:30PM	Tiffany Burnett
☐	202	4:30PM	Mohamad Mousa
☐	123	4:30PM	Juliet Raginsky

- This exam consists of 12 questions for a total of 100 points.
- You have exactly one hour to complete the exam.
- Do not open the exam booklet or start writing before the proctor signals the start of the exam.
- Write your PUID on every other page of the exam booklet. This will help us locate your test if the pages become separated. Only do this after the exam starts.
- Additional pages for scratch work can be found at the end of the booklet.
- Calculators, electronic devices, books, or notes are **NOT ALLOWED**.
- Students may not look at anybody else's exam, and may not communicate with anybody else except with their TA or instructor if there is a question.
- **DO NOT DETACH ANY PAGES** from the exam booklet.
- If you finish the exam before 7:25 pm, you may leave the room after turning in the exam booklet. You may not leave the room before 6:50 pm. If you don't finish before 7:25 pm, **YOU MUST REMAIN SEATED** until your TA comes and collects your exam booklet. You must stop working when the proctor signals the end of exam.

Good luck!

Multiple-choice Instruction:

- For multiple choice questions, fill the circles completely with a **#2 PENCIL** for your answer choices. If you need to change your answer choice, erase the mark completely.

DO: ☐ ☒
DON'T: ☒ ☐ ☐ ☐ ☐ ☐

- Partial credits will not be awarded for multiple choice questions.

Fill-in-the-blank Instruction:

- For fill-in-the-blank questions, write your answers in the provided text boxes. Answers written entirely or partially outside of the boxes will not be graded.
- Only write the final answer in text boxes. Intermediate steps and scratch work should be completed in the blank space below each question.
- Write all your answers in one line. Fractions of the form $\frac{X}{Y}$ are okay to include.

DO:

DON'T:

- Partial credits will not be awarded for individual answer boxes. You may get partial credits for fill-in-the-blank questions if there are multiple text boxes in one question.

Common trigonometric identities:

- $\cos(x)^2 + \sin(x)^2 = 1$
- $\sec(x)^2 - \tan(x)^2 = 1$
- $\sin(2x) = 2 \cos(x) \sin(x)$
- $\cos(2x) = \cos(x)^2 - \sin(x)^2$
- $\cos(2x) = 2 \cos(x)^2 - 1$
- $\cos(2x) = 1 - 2 \sin(x)^2$

1. (8 points) Compute the area of the region enclosed in between the curves $y = \sqrt{x}$, $y = 2 - x$, and the x -axis.

- ☐ (A) $2/3$
☐ (B) $7/6$
☐ (C) $1/2$
☐ (D) $9/2$
☐ (E) $1/3$

2. (8 points) A 5 m deep aquarium is full of water. On one of its vertical walls, there is a square viewing window whose side length is 1 m. The lower edge of the window is at the bottom of the aquarium. How much force is exerted on the window due to water pressure?

(Use $\rho = 1000 \text{ kg/m}^3$ for the density of water, and $g = 10 \text{ m/s}^2$ for gravitational acceleration.)

- ☐ (A) 45000 N
☐ (B) 80000 N
☐ (C) 5000 N
☐ (D) 90000 N
☐ (E) 125000 N

3. (8 points) Evaluate

$$\int_0^{1/2} \frac{1}{(1-x^2)^{3/2}} dx.$$

- ☐ (A) $\frac{1}{2\sqrt{3}} - 1$
- ☐ (B) $\frac{2}{\sqrt{3}}$
- ☐ (C) $\frac{1}{\sqrt{3}} - 1$
- ☐ (D) $\frac{1}{\sqrt{3}}$
- ☐ (E) $\frac{1}{2\sqrt{3}}$

4. (8 points) Find the value of A in the equation

$$\int_1^{e^2} \ln(x)^3 dx = A - \int_1^{e^2} 3 \ln(x)^2 dx.$$

- ☐ (A) 1
- ☐ (B) $e^2 - 1$
- ☐ (C) 2
- ☐ (D) e^2
- ☐ (E) $8e^2$

5. (8 points) Which one of the following is the most appropriate substitution for the integral

$$\int \sqrt{(x+1)(x+5)} dx \quad ?$$

- ☐ (A) $x = 2 \cos(\theta) - 3$
- ☐ (B) $x = 2 \tan(\theta) - 3$
- ☐ (C) $x = \sec(\theta) + 5$
- ☐ (D) $x = 2 \sec(\theta) - 3$
- ☐ (E) $x = \cos(\theta) + 5$

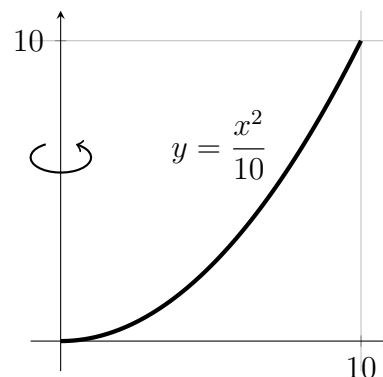
6. (8 points) Evaluate

$$\int_{\pi/6}^{\pi/3} \frac{\tan(x)}{\sec(x)^2} dx.$$

- ☐ (A) $1/2$
- ☐ (B) $4/3$
- ☐ (C) $2/\sqrt{3}$
- ☐ (D) $\ln(3)$
- ☐ (E) $1/4$

7. (8 points) A parabolic cereal bowl is 10 cm tall and 10 cm in radius at the rim. The bowl could be considered the result of revolving the parabola $y = \frac{x^2}{10}$ for $0 \leq x \leq 10$ around the y -axis. Milk is filled to exactly half the interior volume of the bowl. What is the depth of milk?

- ☐ (A) $5\sqrt{2}$ cm
☐ (B) 5 cm
☐ (C) $5\sqrt{3}$ cm
☐ (D) $20/3$ cm
☐ (E) $\sqrt{10}$ cm



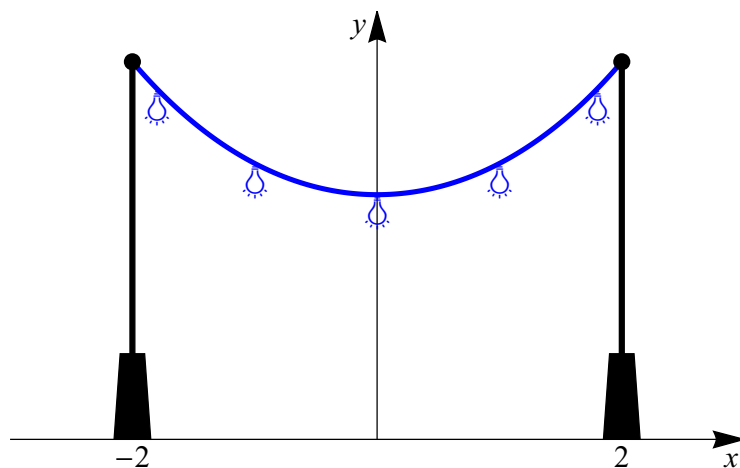
8. (8 points) A thin bar of length 2 m has density $\rho(x) = (x+1)e^{-x}$ kg/m at x meters away from its left end. What is the total mass of the bar?

- ☐ (A) $(2 - 4e^{-2})$ kg
☐ (B) $(1 - 3e^{-2})$ kg
☐ (C) 2 kg
☐ (D) $(1 + 3e^{-2})$ kg
☐ (E) $(2 - 2e^{-2})$ kg

9. (8 points) A string light is set up between two vertical posts in the backyard. If coordinate axes are set up as shown in the figure below, the string light will follow the function

$$f(x) = e^{x/2} + e^{-x/2}$$

between $x = -2$ and $x = 2$ (measured in meters). How long is the portion of the string light hanging in between the posts?



- ☐ (A) $2(e + e^{-1})$ m
☐ (B) $2(e^{1/2} + e^{-1/2})$ m
☐ (C) $2(e^{1/2} + e^{-1/2})$ m
☐ (D) $2(e - e^{-1})$ m
☐ (E) $(e - e^{-1})$ m

10. (8 points) A spring is compressed 0.8 m by a force of 40 N. How much work is needed to further compress it by another 0.4 m?

☐ (A) 20 J

☐ (B) 40 J

○ (C) 36 J

☐ (D) 50 J

○ (E) 16 J

11. (10 points) Find one antiderivative $F(x)$ of the function $f(x) = \cos(x)^3 \sin(x)^2$.

$$F(x) =$$

Instruction: Write down a function that only involves constants, variables, elementary functions, and basic operations (addition, subtraction, multiplication, division, roots, and powers). Simplify as much as you can, but do not worry about the specific form of the answer you get—there could be more than one correct answer for this type of questions.

$(1, 1), \quad (3, 1), \quad (3, 3)$

and rotating it about $x = -1$.

- (a) (4 points) Set up a definite integral that computes the volume of the solid S by slicing it into thin disks/washers.

Volume = $\int$

- (b) (4 points) Set up a definite integral that computes the volume of the solid S with the cylindrical shell method.

Volume = $\int$

- (c) (2 points) Compute the volume of S .

Volume =

Instruction: For parts (a) and (b), include all necessary constants inside of the integrand. Use the variable letters appropriately. You do not need to simplify the expression in your integrand.

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