MA 16200: First Midterm Examiniation

Fall 2025, Purdue University

Exam version: 01

Name: _____ PUID #: _____

Exam Instructions:

- 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 **AND** the back cover page. **DO NOT WRITE ANYTHING ELSE** on either cover pages.

	Sec	Time	TA Name
◯	121	7:30AM	Jonah Boan
◯	109	7:30AM	Juliet Raginsky
◯	202	7:30AM	Dhruv Wadhwa
◯	123	8:30AM	Jonah Boan
◯	111	8:30AM	Juliet Raginsky
◯	204	8:30AM	Dhruv Wadhwa
◯	902	9:30AM	Luke Miga
◯	212	9:30AM	Kathryn Moran
◯	904	10:30AM	Luke Miga
◯	210	10:30AM	Kathryn Moran
◯	115	11:30AM	Skip Moses
◯	218	11:30AM	Uyen Nguyen
◯	909	11:30AM	Shivang Patel
◯	113	12:30PM	Skip Moses
◯	220	12:30PM	Uyen Nguyen

	Sec	Time	TA Name
◯	910	12:30PM	Shivang Patel
◯	117	12:30PM	Alex Yang
◯	214	1:30PM	Fawzan Ali
◯	208	1:30PM	Oliver Tan
◯	119	1:30PM	Alex Yang
◯	216	2:30PM	Fawzan Ali
◯	206	2:30PM	Oliver Tan
◯	224	3:30PM	Ayo Aitokhuehi
◯	103	3:30PM	Trey Crouch
◯	107	3:30PM	Marissa Munoz
◯	906	3:30PM	Andy Yu
◯	222	4:30PM	Ayo Aitokhuehi
◯	101	4:30PM	Trey Crouch
◯	105	4:30PM	Marissa Munoz
◯	908	4:30PM	Andy Yu

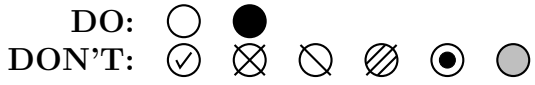
- This exam consists of 12 questions for a total of 100 points.
- You have exactly one hour to complete the exam.
- Do not open the exam booklet or start writing before the proctor signals the start of the exam.
- Additional pages for scratch work can be found at the end of the booklet.
- Calculators, 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.
- If you finish the exam before 8:55 pm, you may leave the room after turning in the exam booklet. You may not leave the room before 8:20 pm. If you don't finish before 8:55 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!

DO NOT DETACH THIS PAGE FROM THE EXAM BOOKLET.

Answer Sheet Instructions:

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



- Mark **EXACTLY ONE** circle for each question. Questions with more than one marked circle will receive no credit.
- Only what you marked on this page will be graded for score.
- Partial credit will not be awarded, unless otherwise indicated by individual questions.

Mark all your answer choices below:

	A	B	C	D	E	F	G	H	I	J
#1	○	○	○	○	○	○	○	○	○	○
#2	○	○	○	○	○	○	○	○	○	○
#3	○	○	○	○	○	○	○	○	○	○
#4	○	○	○	○	○	○	○	○	○	○
#5	○	○	○	○	○	○	○	○	○	○
#6	○	○	○	○	○	○	○	○	○	○

	A	B	C	D	E	F	G	H	I	J
#7	○	○	○	○	○	○	○	○	○	○
#8	○	○	○	○	○	○	○	○	○	○
#9	○	○	○	○	○	○	○	○	○	○
#10	○	○	○	○	○	○	○	○	○	○
#11	○	○	○	○	○	○	○	○	○	○
#12	○	○	○	○	○	○	○	○	○	○

Exam booklet version: ● 01 ○ 02 ○ Alternate ○ Enlarged Text

Make no stray marks in the boxed region above. Do not modify the exam booklet version marking.

DO NOT DETACH THIS PAGE FROM THE EXAM BOOKLET.

Remember to mark all your answer choices on the second cover page!

1. (8 points) Find the area of the region bounded by the curves

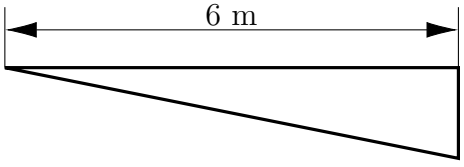
$$y = x^2 \quad \text{and} \quad y = 2x.$$

(A) 20/3
(B) 4/3
(C) 4
(D) 16/3
(E) 1/6

2. (8 points) A zero-entry pool is 6 m long and 6 m wide, with a bottom that slopes uniformly from no depth at one side to a depth of 1 m at the opposite side. A cross section of the pool is sketched below. Assuming the pool is full, how much work is needed to pump all water out of the pool from its top?

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

(A) 60,000 J
(B) 180,000 J
(C) 45,000 J
(D) 90,000 J
(E) 120,000 J



Cross section of the pool
(Figure not sketched to scale)

Remember to mark all your answer choices on the second cover page!

3. (8 points) Which one of the following integrals equals the arc length of the curve

$$y = e^x - 1, \quad 0 \le x \le 1 \quad ?$$

(A) $\displaystyle\int_0^1 \sqrt{e^{2x} - 1}\, dx$

(B) $\displaystyle\int_0^1 \sqrt{e^{x} + 1}\, dx$

(C) $\displaystyle\int_0^1 \sqrt{e^{2x} + 1}\, dx$

(D) $\displaystyle\int_0^1 e^{x} - 1\, dx$

(E) $\displaystyle\int_0^1 \sqrt{e^{x} - 1}\, dx$

4. (8 points) A solid S has a base that is the circle $x^2 + y^2 = 9$ in the xy-plane. Cross sections of the solid S parallel to the xz-plane are squares. What is the volume of this solid?

(A) 36

(B) $27\pi^2$

(C) 27π

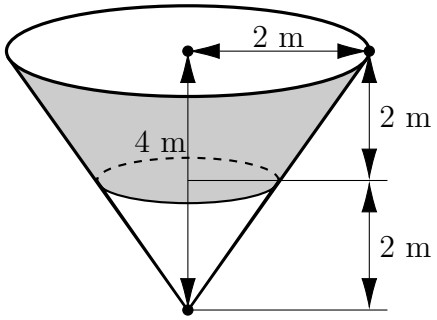
(D) 144

(E) 54π

Remember to mark all your answer choices on the second cover page!

5. (8 points) An inverted conical tank has height $h = 4$ m and base radius $r = 2$ m. The top half of the tank (in height) needs a paint job. What is the total area that is being painted?

(A) $2\sqrt{5}\pi$ m^2
(B) $3\sqrt{5}\pi$ m^2
(C) $6\sqrt{5}\pi$ m^2
(D) $\sqrt{5}\pi$ m^2
(E) $4\sqrt{5}\pi$ m^2



6. (8 points) Find the center C and radius r of the sphere

$$x^2 + y^2 + z^2 + 2y - 4z = 4.$$

(A) Center $C = (0, -1, 2)$; radius $r = 3$
(B) Center $C = (0, 1, -2)$; radius $r = 3$
(C) Center $C = (1, 1, -2)$; radius $r = 2$
(D) Center $C = (0, 2, -4)$; radius $r = 2$
(E) Center $C = (0, -2, 4)$; radius $r = 2$

Remember to mark all your answer choices on the second cover page!

7. (8 points) If $\square ABCD$ is an arbitrary quadrilateral, and if E, F, G, and H are the midpoints of the sides AB, BC, CD, and DA, respectively, which of the following shape is $\square EFGH$ guaranteed to be?

   (A) A square
   (B) A parallelogram
   (C) A trapezoid
   (D) A rhombus
   (E) A rectangle

8. (12 points) If $\vec{v}$ and $\vec{w}$ are vectors in 3D, which of the following equations about $\vec{v}$ and $\vec{w}$ is/are guaranteed to hold?

   (i) $(\vec{v} \times \vec{w}) \cdot \vec{v} = 0$
   (ii) $(\vec{v} \times \vec{w}) + (\vec{w} \times \vec{v}) = \vec{0}$
   (iii) $(\vec{v} \times \vec{w}) \times \vec{w} = \vec{0}$

   Note: Partial credit is possible for this question.

   (A) None of the above
   (B) Only (i)
   (C) Only (ii)
   (D) Only (iii)
   (E) Only (i) and (ii)
   (F) Only (i) and (iii)
   (G) Only (ii) and (iii)
   (H) All of (i), (ii), and (iii)

Remember to mark all your answer choices on the second cover page!

9. (8 points) If S is the solid generated by taking the triangle with vertices at

$$(0,0), \quad (0,1), \quad (1,0),$$

and rotating it about $y = 2$, what is the volume of S?

(A) $2\pi/3$
(B) $4\pi/3$
(C) $8\pi/3$
(D) $\pi/3$
(E) $5\pi/3$

10. (8 points) Compute the area of the parallelogram with vertices at

$$(0,0,0), \quad (1,0,-1), \quad (-1,2,0), \quad \text{and} \quad (0,2,-1).$$

(A) $\sqrt{3}$
(B) 3
(C) 5
(D) $\sqrt{10}$
(E) $\sqrt{5}$

Remember to mark all your answer choices on the second cover page!

11. (8 points) If $\vec{v}$ and $\vec{w}$ are vectors that satisfy

$$|\vec{v}| = 2, \quad |\vec{w}| = \sqrt{3}, \quad \text{and} \quad |\vec{v} + \vec{w}| = 3,$$

what is the value of $\vec{v} \cdot \vec{w}$?

(A) 0
(B) 1
(C) -2
(D) -1
(E) 2

12. (8 points) A force of 40 N is holding a spring 0.1 m from its equilibrium position. How much work is needed to stretch the spring by an *additional* 0.2 m?

(A) 8 J
(B) 18 J
(C) 16 J
(D) 6 J
(E) 2 J

Remember to mark all your answer choices on the second cover page!
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This page is left blank intentionally for scratch work.

Remember to mark all your answer choices on the second cover page!
DO NOT DETACH THIS PAGE FROM THE EXAM BOOKLET.
Write down your name and PUID on this page.

Name: _____ PUID #: _____

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