

MA 16200: First Midterm Examination
Spring 2026, Purdue University

Exam version: Ⓐ

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.
- **VERY IMPORTANT:** Mark Ⓐ for Test Form on the top right corner of your Scantron sheet.
- Select your recitation section below. Write your name and PUID on the top of this cover page. **DO NOT WRITE ANYTHING ELSE** on the cover page.

Sec	Time	TA Name	Sec	Time	TA Name
<input type="radio"/> 0304	1:30PM	Fawzan Ali	<input type="radio"/> 0308	11:30AM	Pedro Morales
<input type="radio"/> 0303	2:30PM	Fawzan Ali	<input type="radio"/> 0307	12:30PM	Pedro Morales
<input type="radio"/> 0302	1:30PM	José Barrientos Lopez	<input type="radio"/> 0107	3:30PM	Skip Moses
<input type="radio"/> 0301	2:30PM	José Barrientos Lopez	<input type="radio"/> 0108	4:30PM	Skip Moses
<input type="radio"/> 0310	12:30PM	Dhruv Bhat	<input type="radio"/> 0311	8:30AM	Shivang Patel
<input type="radio"/> 0309	1:30PM	Dhruv Bhat	<input type="radio"/> 0312	9:30AM	Shivang Patel
<input type="radio"/> 0306	11:30AM	Rose Brickner	<input type="radio"/> 0110	3:30PM	Oliver Tan
<input type="radio"/> 0305	12:30PM	Rose Brickner	<input type="radio"/> 0109	4:30PM	Oliver Tan
<input type="radio"/> 0112	1:30PM	Trey Crouch	<input type="radio"/> 0103	12:30PM	Alex Yang
<input type="radio"/> 0111	2:30PM	Trey Crouch	<input type="radio"/> 0104	1:30PM	Alex Yang
<input type="radio"/> 0102	3:30PM	Luke Miga	<input type="radio"/> 0106	3:30PM	Andy Yu
<input type="radio"/> 0101	4:30PM	Luke Miga	<input type="radio"/> 0105	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.
- Do not detach any page from the exam booklet.
- Additional pages for scratch work can be found every other page in the exam 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!

Remember to mark all your answer choices on the Scantron sheet!

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Remember to mark all your answer choices on the Scantron sheet!

1. (8 points) Let $\vec{u} = \langle 4, 2 \rangle$, $\vec{v} = \langle 2, 2 \rangle$, $\vec{w} = \langle 2, -2 \rangle$. If a and b are scalars satisfying $\vec{u} = a\vec{v} + b\vec{w}$, what is the value of $a + b$?

- (1) $a + b = 3/2$
- (2) $a + b = 2$
- (3) $a + b = 1$
- (4) $a + b = 5/2$
- (5) $a + b = 1/2$

2. (8 points) Compute the arc length of the curve

$$y = x^{3/2}, \quad 0 \leq x \leq 4.$$

- (1) $\frac{2}{27}(10^{3/2} - 1)$
- (2) $\frac{4}{27}(10^{3/2} - 1)$
- (3) $\frac{8}{27}(10^{3/2} - 1)$
- (4) $\frac{16}{27}(10^{3/2} - 1)$
- (5) $\frac{12}{27}(10^{3/2} - 1)$

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3. (12 points) If \vec{v} and \vec{w} are vectors in 3D, which of the following statements about \vec{v} and \vec{w} is/are guaranteed to be true?
- (a) If $\vec{v} \times \vec{w} = \vec{w} \times \vec{v}$, then \vec{v} and \vec{w} are parallel.
 - (b) If $\vec{v} \times \vec{w} = \vec{0}$, then \vec{v} and \vec{w} are orthogonal.
 - (c) If $\vec{v} \times \hat{k} = \vec{w} \times \hat{k}$, then $\vec{v} = \vec{w}$.

Note: Partial credit is possible for this question.

- (1) None of the above
- (2) Only (a)
- (3) Only (b)
- (4) Only (c)
- (5) Only (a) and (b)
- (6) Only (a) and (c)
- (7) Only (b) and (c)
- (8) All of (a), (b), and (c)

4. (8 points) What is the x -component of $\text{proj}_{\vec{v}}(\vec{u})$, where $\vec{u} = \langle 4, -1, 3 \rangle$ and $\vec{v} = \langle 2, 3, -6 \rangle$?
- (1) $-13/49$
 - (2) $-65/49$
 - (3) $-39/49$
 - (4) $-52/49$
 - (5) $-26/49$

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5. (8 points) A spring has a natural length of 1 m. If a 20 N force is required to keep the spring stretched to a length of 1.1 m, how much work in joules is required to further stretch it from 1.1 m to 1.5 m?
- (1) 25 J
 - (2) 12 J
 - (3) 6 J
 - (4) 24 J
 - (5) 104 J

6. (8 points) A semicircular plate with a 2-meter diameter is stuck vertically down into water, with its diameter on top along the surface of water. Compute the force exerted by water on one side of the plate.

Note: Use $\rho = 1000 \text{ kg/m}^3$ for the density of water, and $g = 10 \text{ m/s}^2$ for the acceleration due to gravity.

- (1) $\frac{80,000}{3} \text{ N}$
- (2) $\frac{10,000}{3} \text{ N}$
- (3) $\frac{40,000}{3} \text{ N}$
- (4) $\frac{20,000}{3} \text{ N}$
- (5) $\frac{100,000}{3} \text{ N}$

Remember to mark all your answer choices on the Scantron sheet!

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7. (8 points) Consider the following four points

$$A = (-2, 3, 0), \quad B = (1, -3, 2), \quad C = (2, 0, 0), \quad \text{and} \quad D = (1, \sqrt{2}, -1).$$

Suppose that we have two spheres:

- The first sphere is centered at point A , with point B on the first sphere;
- The second sphere is centered at point C , with point D on the second sphere.

Which one of the following statements about these two spheres is true?

- (1) The spheres do not intersect, and one is enclosed inside of the other.
- (2) The spheres intersect at a circle.
- (3) The spheres do not intersect, and they are outside of each other.
- (4) The spheres intersect at a single point, and they are outside of each other.
- (5) The spheres intersect at a single point, and one is enclosed inside of the other.

8. (8 points) What is the angle θ in between the vectors $\vec{v} = \langle 1, -1, -2 \rangle$ and $\vec{w} = \langle 1, 0, -1 \rangle$?

- (1) $\theta = 5\pi/6$
- (2) $\theta = \pi/6$
- (3) $\theta = \pi/3$
- (4) $\theta = 3\pi/4$
- (5) $\theta = 2\pi/3$

Remember to mark all your answer choices on the Scantron sheet!

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9. (8 points) Find the area of the region bounded by the curves

$$y = 4x - x^2 \quad \text{and} \quad y = x^2.$$

- (1) Area = $4/3$
- (2) Area = $8/3$
- (3) Area = $5/3$
- (4) Area = $16/3$
- (5) Area = 8

10. (8 points) Let S be the solid generated by taking the triangle with vertices at

$$(0, 0), \quad (0, 2), \quad (2, 0)$$

and rotating it about $y = -1$. Compute the volume of the solid S .

- (1) $28\pi/3$
- (2) $7\pi/3$
- (3) $5\pi/3$
- (4) $10\pi/3$
- (5) $20\pi/3$

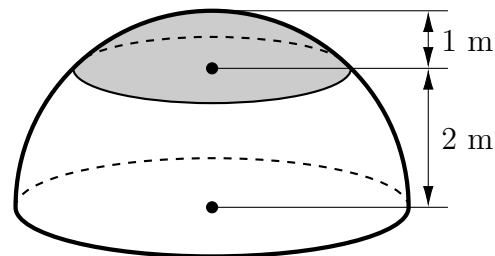
Remember to mark all your answer choices on the Scantron sheet!

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Remember to mark all your answer choices on the Scantron sheet!

11. (8 points) A hemispherical dome has height $h = 3$ m. The top one-third of the dome (in height) needs a paint job. What is the total area that is being painted?

- (1) $6\pi \text{ m}^2$
- (2) $2\pi \text{ m}^2$
- (3) $3\sqrt{3}\pi \text{ m}^2$
- (4) $2\sqrt{3}\pi \text{ m}^2$
- (5) $3\pi \text{ m}^2$



12. (8 points) A loaf of bread is π inches long. Vertical slices perpendicular to its length are semi-circles whose radii at x inches from the left end of the bread are given by the function

$$r(x) = \sqrt{\sin(x)}$$

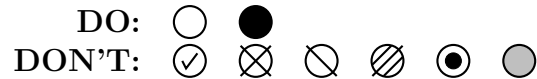
measured in inches. Compute the volume of this loaf of bread.

- (1) 2 in^3
- (2) $\pi^2/4 \text{ in}^3$
- (3) $\pi \text{ in}^3$
- (4) $\pi^4/6 \text{ in}^3$
- (5) $2\pi \text{ in}^3$

Remember to mark all your answer choices on the Scantron sheet!

Scantron Instructions:

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



- Write down the following information on the top of your Scantron sheet.
 - **INSTRUCTOR:** Write down the name of your teaching assistant, which can be found on the front cover.
 - **COURSE:** Write down “MA 162.”
 - **DATE:** Write down today’s date.
 - **TEST:** Don’t worry about this.
 - **SIGNATURE:** Put down your signature.
- **VERY IMPORTANT:** Mark **(A)** for Test Form.
- Write down your name, and fill in the corresponding bubbles.
 - If your name does not fit in the provided space, fill in as much as possible.
 - If your name contains a diacritic (accent), fill in the corresponding letter without the accent mark. For example, fill in **PADME** for Padmé.
 - If your name contains hyphen(s), apostrophe(s), or other special characters, omit the special character and run the letters together. For example, fill in **OBIWAN** for Obi-Wan.
- Fill in the section number of your **RECITATION**, which always starts with a leading zero. This information can be found on the front cover.
- Fill in your PUID number, which always starts with two leading zeros. For example, if your student ID is 12345678 or 012345678, you should fill in **0012345678** for Student ID.
- Mark **EXACTLY ONE** answer for each question. Questions with more than one marked circle will receive no credit.
- Only what you marked on the Scantron sheet will be graded for score.
- Partial credit will not be awarded, unless otherwise indicated by individual questions.

Do not write anything on this page.