

MA 16200  
Exam 1  
02/07/2023  
TEST/QUIZ NUMBER:

**22**

NAME \_\_\_\_\_ YOUR TA'S NAME \_\_\_\_\_

STUDENT ID # \_\_\_\_\_ RECITATION TIME \_\_\_\_\_

You must use a #2 pencil on the scantron answer sheet. Fill in the following on your scantron and blacken the bubbles

1. Your name. If there aren't enough spaces for your name, fill in as much as you can.
2. Section number with a leading zero, e.g. **0302**. (If you don't know your section number, ask your TA.)
3. Test/Quiz number: **22**
4. Student Identification Number: **This is your Purdue ID number with two leading zeros**
5. Blacken in your choice of the correct answer on the scantron answer sheet for questions 1–12.

There are **12** questions, each worth 8 points (you will earn 4 points for filling out your scantron correctly). Do all your work in this exam booklet. Use the back of the test pages for scrap paper. Turn in both the scantron and the exam booklet when you are finished.

If you finish the exam before 8:50pm, you may leave the room after turning in the scantron sheet and the exam booklet. You may not leave the room before 8:20pm. If you don't finish before 8:50pm, you **MUST REMAIN SEATED** until your TA comes and collects your scantron sheet and your exam booklet.

#### EXAM POLICIES

1. Students may not open the exam booklet until instructed to do so.
2. Students must obey the orders and requests by all proctors, TAs, and lecturers.
3. No student may leave in the first 20 min or in the last 10 min of the exam.
4. Books, notes, calculators, or any electronic devices are not allowed on the exam, and they should not even be in sight in the exam room. Students may not look at anybody else's test, and may not communicate with anybody else except, if they have a question, with their TA or lecturer.
5. After time is called, students must put down all writing instruments and remain in their seats, while the TAs will collect the scantrons and the exams.
6. Any violation of these rules and any act of academic dishonesty may result in severe penalties. Additionally, all violators will be reported to the Office of the Dean of Students.

I have read and understand the exam rules stated above:

STUDENT SIGNATURE: \_\_\_\_\_

1. For what value of  $a$  is the vector  $\vec{v} = \langle 5, 8, 3 \rangle$  orthogonal to the vector  $\vec{w} = \langle a, -3, 7 \rangle$ ?

A. 9

B.  $\frac{5}{3}$

C.  $\frac{9}{5}$

D.  $\frac{1}{9}$

E.  $\frac{3}{5}$

2. Find a formula for the volume of the following solid: The region bounded by  $y = \sin(x)$ , the  $x$ -axis,  $x = 0$  and  $x = \frac{\pi}{2}$ , is revolved around the line  $x = -1$ .

A.  $\int_0^{\frac{\pi}{2}} 2\pi(x - 1) \sin(x) dx$

B.  $\int_0^1 \pi \{[\sin^{-1}(y)]^2 - 1\} dy$

C.  $\int_0^1 \pi[\sin^{-1}(y) - 1]^2 dy$

D.  $\int_0^{\frac{\pi}{2}} 2\pi(x + 1) \sin(x) dx$

E.  $\int_0^{\frac{\pi}{2}} 2\pi x \sin(x + 1) dx$

3. A pump handle has a pivot at  $(0, 0, 0)$  and extends to  $P(5, 0, -5)$ . A force  $\vec{\mathbf{F}} = \langle 0, 1, -10 \rangle$  is applied at  $P$ . Find the torque about the pivot.

- A. 50
- B.  $\langle 0, -55, 0 \rangle$
- C.  $5\sqrt{102}$
- D.  $\langle 0, 5, -50 \rangle$
- E.  $\langle 5, 50, 5 \rangle$

4. The point  $(-2, 0, 4)$  lies on a sphere centered at  $(1, 2, 3)$ . What is the radius of the sphere?

- A.  $\sqrt{14}$
- B.  $\sqrt{54}$
- C. 14
- D. 54
- E.  $\sqrt{20}$

5. A force of 60 N is holding a spring 0.3 m from its equilibrium position. How much work is needed to stretch the spring an **additional** 0.2 m, so that it is 0.5 m from equilibrium?

- A. 9 N·m
- B. 4 N·m
- C. 16 N·m
- D. 2 N·m
- E. 25 N·m

6. A swimming pool has a rectangular base that is 5 m long and 6 m wide. The sides are 2 m high and the pool is half full of water. How much work will it take to empty the pool by pumping the water out over the top of the pool? Write your answer in terms of the gravitational acceleration constant  $g$  and the density of water  $\rho$ .

- A.  $75\rho g$  N·m
- B.  $90\rho g$  N·m
- C.  $60\rho g$  N·m
- D.  $30\rho g$  N·m
- E.  $45\rho g$  N·m

7. Find the area of the region bounded by the curves  $y = 2x$  and  $y = 2x^2 - 2x$ .

- A.  $\frac{8}{3}$
- B.  $\frac{2}{3}$
- C.  $\frac{4}{3}$
- D.  $\frac{32}{3}$
- E.  $\frac{16}{3}$

8. Let  $R$  be the region bounded by the curves  $y = x^{1/4}$  and  $y = x$  between  $x = 0$  and  $x = 1$ . Find the volume of the solid when  $R$  is revolved around the x-axis.

- A.  $\frac{\pi}{3}$
- B.  $\frac{2\pi}{3}$
- C.  $\frac{5\pi}{6}$
- D.  $\frac{\pi}{2}$
- E.  $\frac{\pi}{6}$

9. Let  $\vec{u} = \langle 10, 5 \rangle$  and  $\vec{v} = \langle 2, 6 \rangle$ . Find  $\text{proj}_{\vec{v}}(\vec{u})$ , the orthogonal projection of  $\vec{u}$  onto  $\vec{v}$ .

A.  $\langle 4, 2 \rangle$

B.  $\langle \frac{1}{2}, \frac{3}{2} \rangle$

C.  $\langle 5\sqrt{10}, 15\sqrt{10} \rangle$

D.  $\langle \frac{5}{2}, \frac{15}{2} \rangle$

E.  $\langle 20\sqrt{5}, 10\sqrt{5} \rangle$

10. Find the area of the surface generated when the curve  $y = \sqrt{6x - x^2}$  on the interval  $[1, 2]$  is revolved around the x-axis.

A.  $12\pi$

B.  $6\pi$

C.  $2\pi$

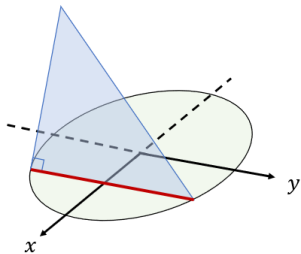
D.  $18\pi$

E.  $3\pi$

11. Define the points  $P(-3, 1)$  and  $Q(1, -2)$ . Which of the following vectors is parallel to  $\overrightarrow{PQ}$  and has magnitude 2?

- A.  $\left\langle \frac{4}{\sqrt{13}}, \frac{6}{\sqrt{13}} \right\rangle$   
 B.  $\left\langle -\frac{4}{\sqrt{5}}, -\frac{2}{\sqrt{5}} \right\rangle$   
 C.  $\left\langle \frac{8}{5}, -\frac{6}{5} \right\rangle$   
 D.  $\left\langle \frac{4}{5}, -\frac{3}{5} \right\rangle$   
 E.  $\left\langle -\frac{2}{\sqrt{5}}, -\frac{1}{\sqrt{5}} \right\rangle$

12. Find the volume of the solid whose base is the disk  $x^2 + y^2 \leq 4$ . The cross sections by planes perpendicular to the  $x$ -axis between  $x = -2$  and  $x = 2$  are isosceles right triangles with one leg in the disk. (Hint: an isosceles right triangle has legs of equal length)



- A.  $\frac{64}{3}$   
 B.  $\frac{20}{3}$   
 C.  $\frac{32}{3}$   
 D.  $\frac{4}{3}$   
 E.  $\frac{8}{3}$

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