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| 10-DIGIT PUID | Page 2 | /25 |
| RECITATION INSTRUCTOR | Page 3 | /26 |
| DECIMATION OF C | Page 4 | /33 |
| RECITATION TIME | TOTAL | /100 |

DIRECTIONS

- 1. Write your name, 10-digit PUID, recitation instructor's name and recitation time in the space provided above. Also write your name at the top of pages 2, 3, and 4.
- 2. The test has four (4) pages, including this one.
- 3. Write your answers in the boxes provided.
- 4. You must show sufficient work to justify all answers unless otherwise stated in the problem. Correct answers with inconsistent work may not be given credit.
- 5. Credit for each problem is given in parentheses in the left hand margin.
- 6. No books, notes, calculators, or any electronic devices may be used on this test.
- (10) 1. Let \vec{a} , \vec{b} , \vec{c} be three-dimensional vectors. For each statement below, circle T if the statement is always true, or F if it is not always true.
 - (i) If \vec{a} and \vec{b} are unit vectors and θ is the angle between them, then $\vec{a} \cdot \vec{b} = \cos \theta$

 \mathbf{T} \mathbf{F}

(ii) If $\vec{i} \cdot \vec{b} = \vec{i} \cdot \vec{c}$, then $\vec{b} = \vec{c}$

 \mathbf{T} \mathbf{F}

(iii) If $\vec{a} \cdot \vec{b} = 0$, then $|\vec{a} + \vec{b}|^2 = |\vec{a}|^2 + |\vec{b}|^2$

 \mathbf{T} \mathbf{F}

(iv) The vector $\vec{a} \times (\vec{b} \times \vec{c})$ is always parallel to $\vec{b} \times \vec{c}$

т 1

(v) $(\vec{a} \times \vec{b}) \times \vec{a} = \vec{0}$

T F

(6) 2. Find an equation of the sphere that passes through the origin and whose center is (1,2,3).

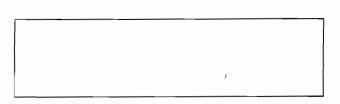
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|------|----|----------------|--|---|-------------|--------------------------------|---------------------------------------|-------------------------|---------------------------------------|
| (4) | 3. | Find t | the values o | of c for which th | e vectors (| $0,2,3\rangle$ and $\langle 2$ | 2, c, - | $2\rangle$ are α | orthogonal. |
| | | | | | | | | | c = |
| (4) | 4. | If $\vec{v} =$ | $\langle 1, 2, 2 \rangle$ an | $\mathbf{d} \ \vec{w} = \langle 1, 0, 1 \rangle,$ | find the an | gle $	heta$ between | \vec{v} an | $d \vec{w}$. | |
| | | | | | | | | | $\theta =$ |
| (4) | 5. | | | | | | | | o force acting at work done by the |
| | | | | | | | | | |
| | | | | | | | | | , |
| (13) | 6. | | | ats $P(1, -2, 1)$, or \rightarrow | Q(-1, 3, 2) | and $R(2, 1, 1)$ |). | | |
| | | (a) Fi | $\operatorname{ind} \overrightarrow{PQ} 	imes \overrightarrow{I}$ | PR. | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | (b) Fi | nd the area | a of the triangle | with verti | ces P, Q, R . | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | (c) Fi | nd two unit | t vectors orthog | onal to the | e plane throu | $\operatorname{gh} \operatorname{th}$ | e point | s P, Q , and R . |
| | | | | | | | | | |

(10) 7. Find the area of the region in the first quadrant bounded by the curves $y = x^3$ and $y = x^2 + 2x$.



(8) 8. Set up, but do not evaluate, an integral for the volume of the solid obtained by rotating about the y-axis, the region bounded by the curves

$$x = \sin y$$
, $0 \le y \le \pi$, and $x = 0$.



(8) 9. Let R be the region bounded by the curves y = x - 3, y = 0, and x = 0. Use the method of disks or washers to set up an integral for the volume of the solid obtained by rotating R about the line y = 2. Do not evaluate the integral.

(8) 10. Let R be the region bounded by the curves $y = x^2$ and $y = 2 - x^2$. Use the method of cylindrical shells to set up an integral for the volume of the solid obtained by rotating R about the line x = 1. Do not evaluate the integral.



(8) 11. If the work required to stretch a spring 1 ft beyond its natural length is 12 ft-lbs, how much work is needed to stretch it 9 in beyond its natural length?



 $(7) \quad 12. \quad \int x^3 \ln x dx =$



(10) 13. First make a substitution and then use integration by parts to evaluate the integral $\int \cos \sqrt{x} \ dx$.