NAME _____

STUDENT ID _____

RECITATION INSTRUCTOR _____

RECITATION TIME _____

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DIRECTIONS

1. Write your name, student ID number, 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 five (4) pages, including this one.
3. Write your answers in the boxes provided.
4. You must show sufficient work to justify all answers. 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 or calculators may be used on this test.

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(8) 1. Find the center and radius of the sphere

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

center: (, ,)
radius:

(8) 2. If $\vec{a} = 2\vec{i} - \vec{j} + 3\vec{k}$, find a vector $\vec{b}$ whose length is 8 and whose direction is opposite to that of $\vec{a}$.

$\vec{b} =$

(15) 3. Consider the three points $P(0,0,0)$, $Q(1,1,0)$, and $R\left(\frac{1}{2},\frac{1}{2},z\right)$.

(a) Find $\overrightarrow{PQ} \times \overrightarrow{PR}$ (in terms of z).

(b) Find the area of the triangle PQR (in terms of z).

(c) Find all values of z for which the area of the triangle PQR is equal to 1.

(10) 4. Suppose that the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$ and that $|\vec{a}| = 2$ and $|\vec{b}| = 15$.

(a) Find $\vec{a} \cdot \vec{b}$

(b) Find $|\vec{a} \times \vec{b}|$

(12) 5. Find the area of the region enclosed by the curves $y = |x|$ and $y = 2 - x^2$.

(12) 6. Use the method of washers to find the volume of the solid obtained by rotating about the y-axis the region bounded by the curves $y^2 = x$ and $x = 2y$.

(10) 7. Use the method of cylindrical shells to find the volume of the solid obtained by rotating about the x-axis the region bounded by the lines $y = x$, $y = 2x$ and $y = 2$.

(12) 8. A tank in the shape of the bottom half of a sphere of radius 5 ft has an outlet at the top and is full of water. Set up an integral for the work W required to pump all the water out of the outlet. (Use the fact that water weighs 62.5 lbs/ft^3, and take the axis downwards with the origin at the center of the top of the tank). Do not evaluate the integral.

$W = \int$

(5) 9. The average value of the function $f(x) = \cos x$ on the interval $[0, \pi]$ is

(8) 10. Evaluate the integral $\int xe^{-x}dx$.