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, 4 and 5.
2. The test has five (5) 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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(5)   1. Let $\vec{a} = \vec{i} + \vec{j}$ and $\vec{b} = -\vec{i} + x\vec{j}$. Find x so that $\vec{a}$ is perpendicular to $\vec{a} - \vec{b}$.

$x =$ [   ]

(10)   2. If $P = (1, 2, 3)$, $Q = (-1, 0, 1)$ and $R = (1, 1, 0)$, find $pr_{\overrightarrow{PQ}} \overrightarrow{PR}$.

[   ]

(5)   3. Let $\vec{a} = 3\vec{i} - 2\vec{j}$ and $\vec{b} = (s-t)\vec{i} + t\vec{j}$. Find s and t so that $\vec{a} + \vec{b} = \vec{i} + \vec{j}$.
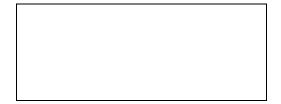
$$s = \quad\quad , t = $$

(4)   4. Let $\vec{a}$ and $\vec{b}$ be unit vectors and let θ be the angle between $\vec{a}$ and $\vec{b}$. For what value of θ in $[0, \pi]$ is $\vec{a} \cdot \vec{b}$ maximum?

(10)   5. Let $\vec{a} = \vec{i} - 3\vec{j} + 2\vec{k}$ and $\vec{b} = -2\vec{i} + \vec{j} - 5\vec{k}$.
   (a) Find a vector perpendicular to both $\vec{a}$ and $\vec{b}$.

   (b) Find a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$ and having positive $\vec{k}$ component.

(10)   6. The points $Q = (1, 0, 0)$ and $R = (-1, 0, 0)$ lie on the unit sphere

$$x^2 + y^2 + z^2 = 1.$$

If $P = (x, y, z)$ is any other point on this sphere, prove that the vectors $\overrightarrow{QP}$ and $\overrightarrow{RP}$ are perpendicular.

(14)   7. Find the following limits:

(a) $\displaystyle\lim_{x \to 0} \frac{\cos(3x) - 1}{x^2}$

(b) $\displaystyle\lim_{x \to \infty} \left(1 - \frac{1}{x}\right)^x$

(24) 8. Evaluate the integrals:

(a) $\int x \sin(3x)\,dx$

$$\boxed{}$$

(b) $\int x \ln x\,dx$

$$\boxed{}$$

(c) $\int \cos^3 x \sin^2 x\,dx$

$$\boxed{}$$

(d) $\int_0^{\frac{\pi}{4}} \cos^2 x\,dx$

$$\boxed{}$$

(18) 9. Evaluate the integrals. PARTIAL CREDIT will not be given unless steps are clearly shown.

(a) $\displaystyle\int \frac{1}{(9-x^2)^{\frac{3}{2}}}\, dx$

(b) $\displaystyle\int_1^{\sqrt{3}} \frac{1}{\sqrt{1+x^2}}\, dx$. [You may need: $\displaystyle\int \sec x\, dx = \ln|\sec x + \tan x| + C$].