CALCULUS III NAME _____

EXAM I Rec. Instr. _____

SPRING 2003 Rec. Time _____

TO RECEIVE CREDIT YOU MUST SHOW YOUR WORK.

(20) 1) Given the points $P(1,0,1)$, $Q(1,1,0)$ and $R(0,1,4)$ in 3-space.

a) Find the angle, in degrees, at the vertex P of the triangle having vertices P, Q, R.

b) Find the area of the triangle having vertices P, Q and R.

c) Find the equation of the plane containing the points P, Q and R.

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(10) 2.a) Find the equation of the plane which contains the point $P(2, 3, -1)$ and is perpendicular to the line $x = 1 + 4t, y = 2 - t, z = 3t$

b) Find the parametric equations for the line through $P(2, 3, -1)$ which is perpendicular to the plane $3x + 4y - 6z = 24$.

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(20) 3) An object is moing in 3-space according to the parametric equations $x = t^2 + 1$, $y = t^3$, $z = t$ where t is the time. Find, as functions of t

a) position vector $\vec{r} =$

b) velocity vector $\vec{v} =$

c) acceleration vector $\vec{a} =$

d) speed $\dfrac{ds}{dt} =$

e) tangential component of acceleration $a_T =$

f) curvature $\kappa =$

g) normal component of acceleration $a_N =$

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(15) 4) An object is moving in 3-space in such a way that its acceleration vector as a function of the time t is $\vec{a} = 2\vec{i} + (\cos t)\vec{j}$. Suppose you know that at time $t = 0$ its velocity vector is $\vec{v}(0) = \vec{i} + \vec{k}$ and its position vector is $\vec{r}(0) = \vec{i} + \vec{j} + \vec{k}$. Find the velocity vector and the position vector as functions of t. Now give the parametric equations for the motion.

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(15) 5) An object is moving in the plane along the curve $y = \dfrac{1}{x}$, $x > 0$. It is moving from left to right at a constant speed of 4 ft/sec.

a) Find a_T and a_N when the object is at the point $\left(x, \dfrac{1}{x}\right)$.

b) Find the velocity vector and the acceleration vector when the object is at the point $(1, 1)$.

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(20) 6) Carefully sketch the following surfaces.

a) $x^2 - y + z^2 + 1 = 0$

b) $x^2 - y^2 + z^2 = 0$

c) $y^2 + z = 1$

d) $x + y + 2z = 4$