CALCULUS III NAME _____

EXAM I Rec. Instr. _____

FALL 2002 Rec. Time _____

TO RECEIVE CREDIT YOU MUST SHOW YOUR WORK.

(25) 1) An object is moving in 3-space according to the parametric equations $x = \sin t$, $y = \sin t$, $z = \sqrt{2}\cos t$ 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) the normal component of acceleration $a_N =$

g) curvature $\kappa =$

Now describe geometrically exactly which curve the object is moving along.

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(20) 2) An object is moving in the plane in such a way that its acceleration vector as a function of time t is $\vec{a} = (-\sin t)\vec{i} + 2t\vec{j}$. Suppose you know that at time $t = 0$ its velocity vector is $\vec{v}(0) = \vec{j}$ and its position vector is $\vec{r}(0) = \vec{i}$.

a) Find the velocity vector and the position vector as functions of t.

b) Give the parametric equations for the motion.

c) Find the tangential component of acceleration as a function of t.

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(25) 3) Given the points $P(1, 0, 2)$, $Q(2, 1, 2)$ and $R(3, -4, 1)$

a) Find the angle (in degrees) at the vertex P of the triangle having vertices P, Q and 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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(15) 4.a) Find a vector which is parallel to the line of intersection of the planes $x + 2y - z = 4$ and $2x + 5y + z = 1$.

b) Give parametric equations for the line through the point $(1, 2, -1)$ which is parallel to the line of intersection of the two planes in part a).

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(15) 5) Sketch accurately the surface determined by each of the following equations

a) $x^2 + y^2 + z^2 = 4$

b) $x^2 + y^2 + z = 4$

c) $x^2 + z = 4$

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