NAME ______________________________

STUDENT ID ______________________________

DIRECTIONS

1. Write your name, student ID number in the in the spaces provided above.
2. The test has five (5) pages, including this one.
3. Write your answers in the boxes where provided.
4. Credit for each problem is given in parentheses in the left hand margin.
5. No books, notes or calculators may be used on this test.

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(15) 1. Find a vector equation for the line containing the points $(-1,1,0)$ and $(-1,1,7)$.

$\vec{r}(t) =$

(20) 2. A particle has velocity $\vec{v} = \cos 2t\vec{i} + \sin t\vec{j} + te^{t^2}\vec{k}$ and passes through the origin when $t = 0$.

(a) Find its acceleration vector.

$\vec{a}(t) =$

(b) Find its position vector $\vec{r}(t)$.

$\vec{r}(t) =$

(20) 3. A particle follows a curve given at each moment in time t by the position vector $\vec{r}(t) = t^2\vec{i} + t\vec{j} + (t^2/2)\vec{k}$.

(a) Find the tangential component a_T of the acceleration.

$a_T =$

(b) Find the normal component a_N of the acceleration.

$a_N =$

(20) 4. For the curve given by $\vec{r}(t) = 3\cos t\vec{i} + 3\sin t\vec{j} + 4t\vec{k}$,

(a) Find the principal unit normal vector $\vec{N}(t)$.

$\vec{N}(t) =$

(d) Find the equation for the osculating plane at $t = 0$.

(15) 5. Sketch the 3 dimensional graph of $y^2 = x^2 + 4z^2$.

(10) 6. Suppose that a position vector $r(t)$ for a smooth curve in three dimensional space is always perpendicular to its velocity vector. Circle the statement below which is correct, and show your reason for choosing it.

A. The curve is a straight line.

B. The curve must be contained in a circle centered at the origin.

C. The curve must be contained in a sphere centered at the origin.

D. The curvature must be 0.

E. The torsion must be 0.