Math 210, Calculus III **Sample Hour Exam One**

YOU MUST SHOW ALL OF YOUR COMPUTATIONS IN THE EXAM BOOKLET FOR FULL CREDIT

1. (15 pts) Find an equation for the plane which passes through the point $(2, 0, -3)$ and is orthogonal to the line $\langle x, y, z \rangle = \langle 1 - 3t, 5t, 3 - 4t \rangle$.

2. (20 pts) A triangle has vertices at the three points

$$A = (3, 1, -1), \quad B = (2, -1, 1), \quad \text{and} \quad C = (1, 0, -1).$$

(a) Compute the measure of the angle $\angle ABC$. Express your answer in degrees, rounded to the nearest degree.
(b) Find the area of the triangle.

Problems 3 through 6 refer to the position function $\mathbf{r}(t) = \langle 1 + t^3, t + t^2, 3 - 2t \rangle$.

3. (10 pts) Find the velocity $\mathbf{v}(t)$.

4. (10 pts) Find the speed $v(t)$.

5. (10 pts) Find the acceleration $\mathbf{a}(t)$.

6. (10 pts) Find the curvature $\kappa(t)$.

7. (10 pts) Find the arc length of the curve $\mathbf{r}(t) = e^t \mathbf{i} + e^t \cos 2t \mathbf{j} + e^t \sin 2t \mathbf{k}$ for $0 \leq t \leq 2$.

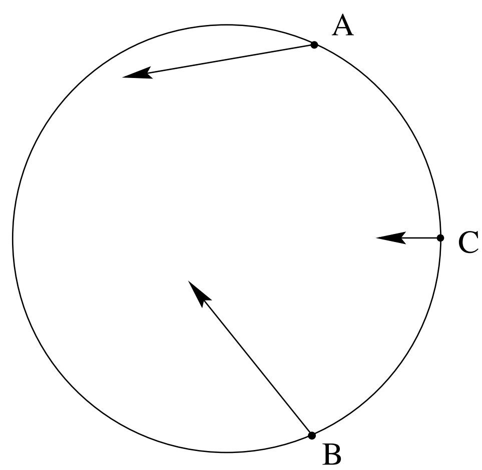
PROBLEM 8 IS ON THE BACK

8. (15pts) A car is driving around the circular track shown below, traveling in the counter-clockwise direction. Its acceleration vectors at the three points A, B and C are represented by arrows in the figure.

(a) At each of the three points A, B and C draw two arrows representing the vector projections of the acceleration vector onto the unit tangent vector $\mathbf{T}$ and onto the the unit normal vector N. (That is, draw $a_T\mathbf{T}$ and $a_N\mathbf{N}$.) Label your arrows clearly.

(b) For each of the three points, indicate whether the car's speed is increasing, decreasing or remaining constant when it passes the point.

(c) At which of the three points is the car moving fastest? Explain how you arrived at your answer.



Acceleration Vectors

DO NOT FORGET TO HAND IN THIS SHEET WITH YOUR EXAM!