Section ___________ **Name** ____

TA _________________ **Student Number** __________________________________

Math 126B **Calculus With Analytic Geometry III** **Spring 1995**

MIDTERM EXAM 1

4/19/95

- You may use two $8\frac{1}{2}''$ by $11''$ one-sided pages (or one sheet written on both sides) of your own handwritten notes (no photocopied or printed material), and a small model of an xyz-system. **No Calculators are allowed**. You may leave complex algebraic expressions such as $\sqrt{7^2 + 4.5^2}$ as they are, without simplifying. Simplify numerical expressions to the point where they could be evaluated with a simple calculator.
- There are five problems, each counting 20 points for a total of 100 points. Use the boxes for your answers when possible. Use the remaining blank space on each page for your scratch work. **Show your work**: you must justify every answer.
- Measurements must be made with a ruler, and lines and vectors must be drawn with a ruler. Lines or vectors drawn without a ruler lose 4 points.
- *Tests with wrong or incorrectly spelled TA names or section letters will lose 4 points.*
- *If you have a question during the test, raise your hand and I will come to your seat.*

For grader's use only

1:	
2:	
3:	
4:	
5:	
Total:	

1. The plane α shown below is parallel to the x-axis and passes through points A and B. (As always, units are centimeters.)

(a) Write an equation for α.

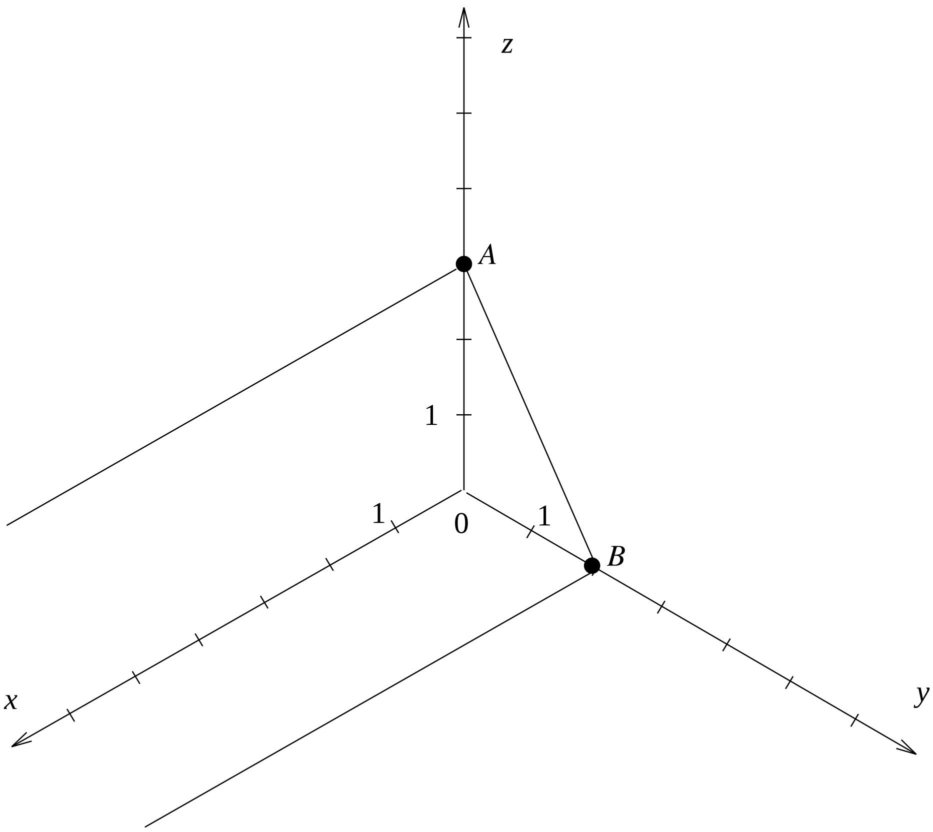
α: $\boxed{}$

(b) Find a normal vector $\vec{n}$ to α.

$\vec{n} = \boxed{}$

(c) Find the distance from the point $Q(3, -3, 1)$ to α.

Distance $= \boxed{}$



2. A particle P is moving at constant speed on a line ℓ in space. At time $t = 0$, its position vector is $\vec{r}(0) = (1, 2, -3)$. At time $t = 1$, its position vector is $\vec{r}(1) = (0, 1, -2)$.

At the same time, another particle Q is moving at constant speed on a different line m. At time $t = 0$, Q is at $(4, 5, -6)$, and at time $t = 1$, Q is at $(4, 5, 6)$.

(a) Do the two particles collide? Write YES or NO in the box, and, as always, show your work.

$\boxed{}$

(b) Do the two lines intersect? (*Hint:* Here time doesn't matter any more. Try using different letters for the two parameters.) Write the point of intersection in the box, or write NONE if they don't intersect.

Intersection: $\boxed{}$

3. A particle P moves through the xy-plane on a curve C. The position vector $\vec{r}(t)$ of P at time t is given by

$$\vec{r}(t) = (x(t), y(t)),$$

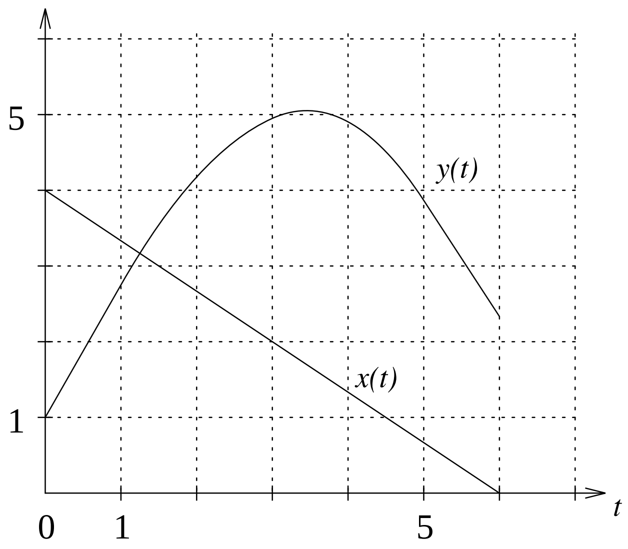
where the functions $x(t)$ and $y(t)$ are given by their graphs below (the curve C itself is *not* shown on the graph).

(a) Write down a parameter representation for the tangent line to C at the point where $t = 4.5$.

Tangent line: $\boxed{}$

(b) The speed of P at time t is the length of the velocity vector: $|\vec{r}\,'(t)|$. We are interested in how the speed changes between the times $t = 3.5$ and $t = 6$. As t increases from $t = 3.5$ to $t = 6$, the speed of P (circle one):

always increases	first increases then decreases	always decreases	first decreases then increases	impossible to tell



4. We define a function of one variable by $F(t) = |(1,2,t) \times (1,t,2)|$.

(a) Find $F(-2)$.

$F(-2) = \boxed{}$

(b) Find a value of t such that $F(t) = 0$. (*Hint:* what vectors have length 0?)

$t = \boxed{}$

(c) Find an equation for the plane α that passes through the origin and to which both $\vec{a} = (1,2,t)$ and $\vec{b} = (1,t,2)$ are parallel (your answer may contain t).

α: $\boxed{}$

5. The vectors $\vec{a}$ and $\vec{b}$ lie in the plane as shown below.

(a) Into the diagram below, draw the vector projection of $\vec{a}$ onto $\vec{b}$, with the same initial point as $\vec{b}$, and label it $\vec{c}$.

(b) Use your ruler to evaluate $\vec{a} \cdot \vec{b}$.

$\vec{a} \cdot \vec{b} = \boxed{}$