Name: ______________________________ **Student Number:** ______________

Math 324A **Advanced Multivariable Calculus I** **Spring 1997**

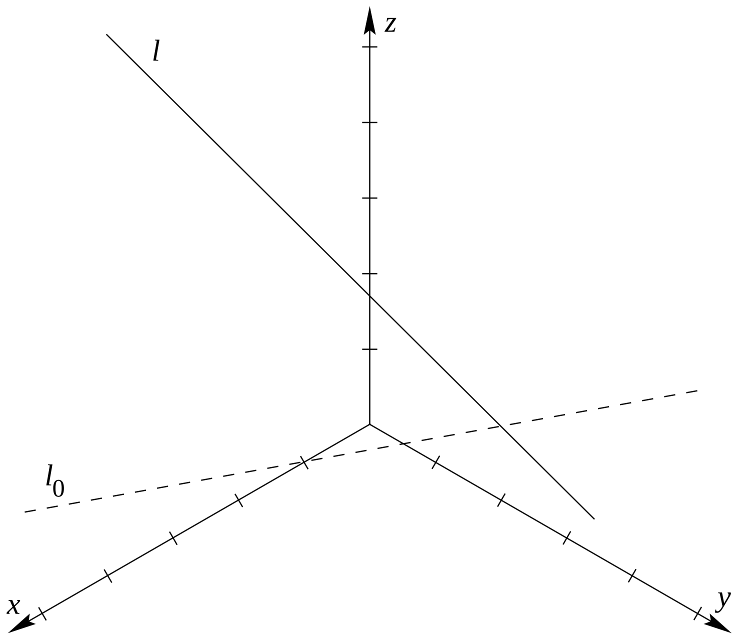
Test #1: 4/4/97

- There are 5 problems at 20 points each, for a total of 100 points.
- You may use two $8\frac{1}{2}'' \times 11''$ one-sided pages (or one sheet written on both sides) of your own handwritten notes (no photocopied or printed material).
- *Show your work:* If your work demonstrates that you had the right idea, you might get partial credit even if your answer is wrong. On the other hand, if your answer is not justified by your work, you might lose points even if your answer is correct. If you need more room, continue your work on the back of the page.
- Use the boxes for answers when possible. Measurements must be made with a ruler, and lines and vectors must be drawn with a ruler.
- Simplify algebraic and numerical expressions in answers to the point where they can be evaluated by a student in a precalculus course with a calculator, but you do not need to take them any further. Leave answers such as $\sqrt{7+(6.8)^2}$ as they are, but work out vector expressions such as dot products and cross products. Calculators are allowed, but you won't need one; it is preferable to leave numerical answers in unsimplified form. Laptop computers are not allowed.
- If you have a question, raise your hand and I will come to your seat.

For grader's use only

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

1. The line l and its shadow l_0 are shown in the picture below.



(a) (5 points) Find the coordinates of a point P where l crosses the xy-plane. If there is no such point, write NONE.

P :

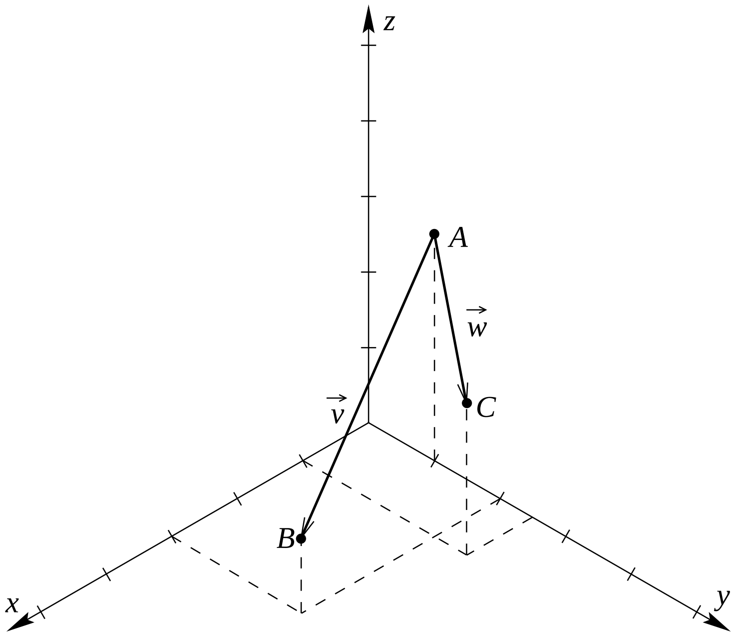
(b) (5 points) Find the coordinates of a point Q where l crosses the xz-plane. If there is no such point, write NONE.

Q:

(c) (10 points) Find a parameter representation for l which crosses the xy-plane at time $t = 0$.

l :

2. The vectors $\vec{v} = \overrightarrow{AB}$ and $\vec{w} = \overrightarrow{AC}$ are shown in the diagram below.



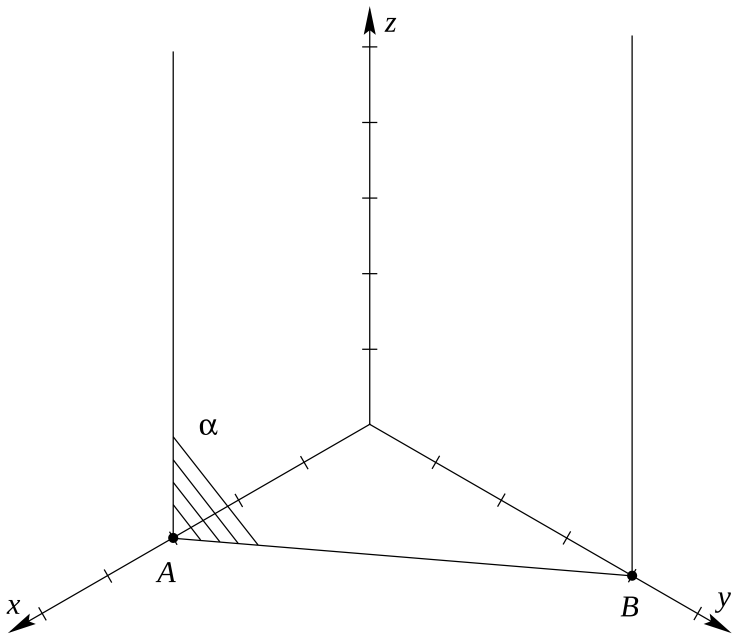
(a) (10 points) Compute $\vec{v} \cdot \vec{w}$.

$\vec{v} \cdot \vec{w} =$ $\boxed{}$

(b) (10 points) Find a scalar c such that the scalar projection of $c\vec{w}$ onto $\vec{v}$ equals -1.

$c =$ $\boxed{}$

3. The plane α shown below is parallel to the z-axis and passes through points A and B.



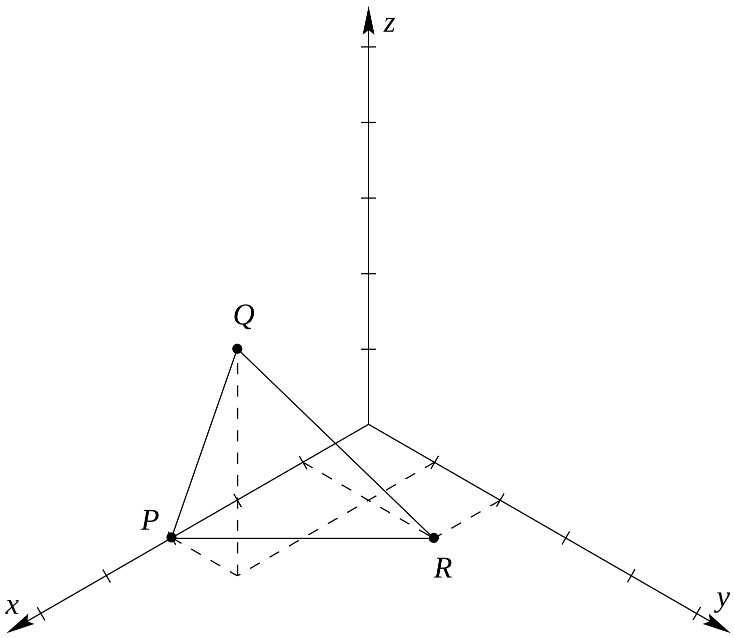
(a) (10 points) Find the components of a unit vector $\vec{n}$ normal to α.

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

(b) (10 points) Write an equation for α.

$\alpha :$ $\boxed{}$

4. The triangle PQR is shown below.



(a) (10 points) Find the components of a vector $\vec{v}$ that is orthogonal to PQR.

$\vec{v} =$ $\boxed{}$

(b) (10 points) Find the area of PQR.

Area= $\boxed{}$

5. A point moves along a curve C in space according to the equation

$$\vec{r}(t) = (t-1, t^3+1, 2t^2).$$

(a) (10 points) Find a time $t = t_0$ such that $\vec{r}\,'(t_0)$ is parallel to the vector $\vec{w} = (-2, -24, 16)$.

$t_0 =$ $\boxed{}$

(b) (10 points) Let P_0 denote the point on C at the time t_0 you found in part (a). Write an equation for the plane α that is normal to C at P_0. (This means α goes through P_0 and is orthogonal to the tangent line of C at P_0.)

$\alpha :$ $\boxed{}$