

MATH 241, FALL 2001, EXAM 1

PRINT Your Name: \_\_\_\_\_

There are 10 problems on 4 pages. Each problem is worth 10 points. SHOW your work. **CIRCLE** your answer. **NO CALCULATORS!**

1. Graph and describe the graph of  $x^2 + y^2 + z^2 = 1$  in 3-space.
2. Graph and describe the graph of  $x^2 + y^2 = 1$  in 3-space.
3. Graph and describe the graph of  $x^2 + y^2 = 0$  in 3-space.
4. Consider the triangle with vertices  $P = (1, 2, 3)$ ,  $Q = (0, 1, 2)$ , and  $R = (2, 4, 7)$ . Find the angle of this triangle at the vertex  $Q$ .
5. **(There is no partial credit for this problem. Make sure your answer is correct.)** Let  $\vec{a} = 2\vec{i} - \vec{j} + 3\vec{k}$  and  $\vec{b} = 4\vec{i} - 13\vec{j} + 7\vec{k}$ . Find vectors  $\vec{u}$  and  $\vec{v}$  with  $\vec{b} = \vec{u} + \vec{v}$ ,  $\vec{u}$  parallel to  $\vec{a}$ , and  $\vec{v}$  perpendicular to  $\vec{a}$ . (Every number in the answer is an integer. If you have fractions, either you can rid of them or you have made a mistake.)
6. Find the equation of the plane which contains the point  $(1, 3, 2)$  and is perpendicular to the vector  $\vec{N} = 2\vec{i} - 3\vec{j} + 1\vec{k}$ .
7. Find the point on  $(x - 4)^2 + (y - 7)^2 + (z - 8)^2 = 14$  which is closest to  $x + 2y + 3z = 0$ .
8. Find the equation of the sphere whose center is  $(3, 5, 4)$  and which is tangent to the  $yz$ -plane.
9. Find the work done by the force  $\vec{F} = 2\vec{i} - 5\vec{j} + 6\vec{k}$  as it moves an object in a straight line from  $P = (3, 2, 4)$  to  $Q = (9, 4, 6)$ . Force is measured in pounds. Distance is measured in feet.
10. Find the distance from the point  $(4, 5, 6)$  to the  $x$ -axis.