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. $\boxed{CIRCLE}$ 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 $\overrightarrow{\boldsymbol{a}} = 2\overrightarrow{\boldsymbol{i}} - \overrightarrow{\boldsymbol{j}} + 3\overrightarrow{\boldsymbol{k}}$ and $\overrightarrow{\boldsymbol{b}} = 4\overrightarrow{\boldsymbol{i}} - 13\overrightarrow{\boldsymbol{j}} + 7\overrightarrow{\boldsymbol{k}}$. Find vectors $\overrightarrow{\boldsymbol{u}}$ and $\overrightarrow{\boldsymbol{v}}$ with $\overrightarrow{\boldsymbol{b}} = \overrightarrow{\boldsymbol{u}} + \overrightarrow{\boldsymbol{v}}$, $\overrightarrow{\boldsymbol{u}}$ parallel to $\overrightarrow{\boldsymbol{a}}$, and $\overrightarrow{\boldsymbol{v}}$ perpendicular to $\overrightarrow{\boldsymbol{a}}$. (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 $\overrightarrow{\boldsymbol{N}} = 2\overrightarrow{\boldsymbol{i}} - 3\overrightarrow{\boldsymbol{j}} + 1\overrightarrow{\boldsymbol{k}}$.

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 $\overrightarrow{\boldsymbol{F}} = 2\overrightarrow{\boldsymbol{i}} - 5\overrightarrow{\boldsymbol{j}} + 6\overrightarrow{\boldsymbol{k}}$ 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.