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MATH 251 (Fall 2009) Exam I, Sept 28th

No calculators, books or notes! Show all work and give **complete explanations**. This is 65 min exam is worth 50 points.

(1) [10 pts]

(a) Calculate the projection, $\text{Proj}_{\mathbf{v}}(\mathbf{w})$, of the vector $\mathbf{w} = (1, -2, 5)$ onto the vector $\mathbf{v} = (0, 4, -3)$.

(b) Calculate the volume of the parallelepiped with three adjacent edges given by the vectors $\mathbf{a} = (2, 1, 0)$, $\mathbf{b} = (1, 3, 0)$, and $\mathbf{c} = (1, 2, -4)$.

(2) [12 pts]

(a) Find a vector parametric equation for the line through the point $(1, 2, -1)$ that is normal to the plane $2x - y + 3z = 12$.

(b) Find a parametrization of the plane containing the point $(1, -2, 1)$, $(2, -1, 0)$ and $(3, -2, 2)$.

(3) [12 pts] Consider the quadric surface

$$z^2 = x^2 + 4y^2.$$

Find the equations for the slices (i.e., traces) of this surface in the planes $x = k$, $y = k$, $z = k$ for a few appropriately chosen values of k . Sketch each of these traces in a plane. Then sketch the surface in space.

(4) [10 pts]

(a) Convert the point $(x, y, z) = (1, -1, 1)$ in rectangular coordinates to spherical coordinates. [Hint: You may find it helpful to draw a picture.]

(b) Sketch the graph of the surface whose equation in cylindrical coordinates is $z = 4 - r^2$.

(5) [6 pts] Which of the following statements are *always true* and which are *not always true*. Give reasons for your answers.

(a) $\mathbf{u} \times \mathbf{v} = \mathbf{v} \times \mathbf{u}$

(b) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{u} = 0$

(c) $\mathbf{u} \times \mathbf{u} = |\mathbf{u}|^2$

Pledge: *I have neither given nor received aid on this exam*

Signature: _____