Math 21C.
Midterm Exam 1
April 23, 2003

Read each question carefully, and answer each question completely.
Show all of your work. No credit will be given for unsupported answers.
Write your solutions clearly and legibly. No credit will be given for illegible solutions.

1. Let $\mathbf{a} = \langle 1, 2, -2 \rangle$ and $\mathbf{b} = \langle -2, 1, 1 \rangle$.

   (a) Find $|\mathbf{a}|$ and $|\mathbf{b}|$.

   (b) Find $\mathbf{a} \cdot \mathbf{b}$.

   (c) Find the cosine of the angle between $\mathbf{a}$ and $\mathbf{b}$.

   (d) Find a unit vector perpendicular to both $\mathbf{a}$ and $\mathbf{b}$.

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2. Consider the two planes given by $6x - 3y + 2z = 2$ and $x + 2y - 2z = 1$.

   (a) Find the cosine of the angle between the two planes.

   (b) Find parametric equations for the line of intersection of the two planes.

3. Find an equation for the plane that passes through the origin $(0,0,0)$ and contains the line $x = 3t$, $y = 1 + t$, $z = 2 - t$.

4. A certain particle has a velocity function $\mathbf{v}(t) = \langle 3, -\sin t, \cos t \rangle$.

   (a) Find the particle's acceleration function $\mathbf{a}(t)$.

   (b) The particle's initial position is $\mathbf{r}(0) = \langle 0, 1, 0 \rangle$. Find the particle's position function $\mathbf{r}(t)$.

   (c) Find the distance the particle travels along its path for $0 \le t \le 2\pi$.