EXAM 1

Math 103, Spring 2007-2008, Clark Bray.

You have 50 minutes.

No notes, no books, no calculators.

YOU MUST SHOW ALL WORK AND EXPLAIN ALL REASONING
TO RECEIVE CREDIT. CLARITY WILL BE CONSIDERED IN GRADING.

Good luck!

Name _____

ID number_____

1. _____
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"I have adhered to the Duke Community Standard in completing this examination."

Signature: _____

Total Score _____ (/100 points)

1. *(10 pts)* Bob walks 2 miles in the direction that is 30° east of north. From there, he walks 2 miles exactly southeast. How far is he away from the point where he started?

2. *(10 pts)* What is the cosine of the angle between the vector representing Bob's total displacement, and the vector representing the displacement in the first part of his walk?

3. *(10 pts)* Compute the volume of the parallelepiped defined by the three vectors $\vec{u}$, $\vec{v}$, $\vec{w}$, with

$$\vec{u} = \begin{bmatrix} 2 \\ 4 \\ 3 \end{bmatrix} \quad \vec{v} = \begin{bmatrix} 3 \\ 1 \\ 2 \end{bmatrix} \quad \vec{w} = \begin{bmatrix} 1 \\ -5 \\ 1 \end{bmatrix}$$

4. *(10 pts)* Are the vectors in the previous problem listed in right hand rule order? *(Make sure to explain your answer.)*

5. *(10 pts)* Draw a picture of the solution set to the equation

$$x^2 + y^2 + z^2 + 2\sqrt{x^2 + y^2} = 3$$

6. *(10 pts)* Which of the level sets of the function $f(x, y) = (x^2 - y)^2$ can be viewed as the graph of some other function?

7. *(10 pts)* You and Louise are driving with velocity $(30, 10)$ toward a cliff. Seconds before catastrophe you come to your senses and take emergency action, giving your car an acceleration vector of $(-10, -20)$.

   Solve for your car's position as a function of time, assuming that you come to your senses at time $t = 0$, and at the origin.

8. *(10 pts)* The edge of the cliff has equation $x + 2y = 30$. Do you and Louise successfully avoid falling off the cliff?

9. *(10 pts)* Find the curvature of the path, at time $t = 2$, for the curve parametrized by $\vec{r}(t) = (t^2, 3t - 1, 2t)$.

10. *(10 pts)* Find a normal vector for the plane tangent to the graph $z = f(x, y)$ of the function $f(x, y) = x^2y + y^3$ at the point where $x = 1$ and $y = 2$.