This exam contains 3 pages (including this cover page) and 2 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may *not* use your books, notes, or any calculator on this exam.

You are required to show your work on each problem on this exam. The following rules apply:

- **If you use a "theorem" you must indicate this** and explain why the theorem may be applied.

- **Organize your work**, in a reasonably neat and coherent way, in the space provided. Work scattered all over the page without a clear ordering will receive very little credit.

- **Mysterious or unsupported answers will not receive full credit**. A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit; an incorrect answer supported by substantially correct calculations and explanations might still receive partial credit.

- If you need more space, use the back of the pages; clearly indicate when you have done this.

Problem	Points	Score
1	5	
2	5	
Total:	10	

Do not write in the table to the right.

1. (5 points) (Section 13.2 Problem 56) If a curve has the property that the position vector $\mathbf{r}(t)$ is always perpendicular to the tangent vector $\mathbf{r}'(t)$, show that the curve lies on a sphere with center the origin. (Hint: Suppose $\mathbf{r}(t) = < f(t), g(t), h(t) >$, consider the function $D(t) = f(t)^2 + g(t)^2 + h(t)^2$. What does it mean when $\mathbf{r}(t)$ is always perpendicular to $\mathbf{r}'(t)$ and how can we use this fact?)

2. (5 points) (Section 13.4 Problem 22) Show that if a particle moves with constant speed, then the velocity and acceleration vectors are orthogonal. (Hint: Relate the speed to a dot product then differentiate.)