# EXAM 1

11 and 12 October 1999

## Directions

- This exam is open notes, open book.
- You may not collaborate on this exam; do not work with others.
- When you are done with the exam, give it to me or put it in my office. Don't put it in my mailbox.
- Remember to include units.
- To receive full credit on these problems you must show your work clearly.

1. Consider two velocity vectors, $\vec{v_1}$ and $\vec{v_2}$. Let $\vec{v_1}$ have a magnitude of 10m/s and point due north. Let $\vec{v_2}$ have a magnitude of 20m/s and a direction of 37 degrees north of west. (*15 points total*)

   (a) Find $\vec{v_3}$ where $\vec{v_3} = \vec{v_1} - \frac{1}{4}\vec{v_2}$.

   (b) Find the magnitude of $\vec{v_1} - \frac{1}{4}\vec{v_2}$.

   (c) Compute $\vec{v_1} \cdot \vec{v_2}$.

   (d) What is the angle between $\vec{v_3}$ and $\vec{v_2}$?

2. Looking for diamonds, you take a trip to Pluto. Pluto has a mass of $1.5 \times 10^{22}$ kg and a radius of 3500 km. Your spaceship is hovering 10 km above the surface of the cold planet. Is it safe to jump off the spaceship, or will you need a parachute? To answer this question, calculate the speed at which you will hit the planet if you jump off the ship. (*20 points*)

3. Consider a spring with a spring constant $k_s = 100J/m^2$. When relaxed, the spring has a length of 10 cm. In 2 seconds the spring is compressed 3 cm. The spring then shoots a 10 g marble straight up in the air. What is the marble's maximum height? Be careful with units. (*10 points*)

4. When healthy, Pedro Martinez can throw a 115 gram baseball 95 mi/hr. Standing on the ground, could Pedro throw a baseball so that it lands on top of a ten story building? Describe any approximations or assumptions you need to make. Be sure that your method is clear. (*20 points*)

5. Cadillac Mountain is 1500 ft tall. If it were perfectly clear, how far out to sea could you see? (*10 points*)

6. Two pucks collide on a frictionless surface. One puck has a mass of 2 kg and is moving due east at 6 m/s. The second puck has a mass of 3 kg and is moving 4 m/s, 45 degrees south of east. The two pucks collide and stick together. What is the velocity (magnitude and direction) of the two pucks immediately after the collision? (*25 points*)