Physics I, Exam 1

College of the Atlantic

October 20–21, 2009

Directions

- This exam is open notes, open book.
- You may not collaborate on this exam; do not work with others. Do not discuss any aspects of this exam with anyone.
- Do not ask the TAs any questions about physics or math while you are taking the exam. If you have any questions, ask me.
- When you are done with the exam, give it to me or put it in my office. Don't put it in my mailbox.
- Unless other arrangements are made, you should get this exam back to me by 8:00pm on Wednesday October 21, 2009.
- 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 a direction of 53 degrees south of west. Let $\vec{v_2}$ have a magnitude of 20m/s and point due east.

   (a) Sketch the two vectors.

   (b) Find the components of $\vec{v_3}$ where $\vec{v_3} = \vec{v_1} - 2.5\vec{v_2}$.

   (c) Find the magnitude and direction of $\vec{v_3}$.

   (d) Find $\vec{v_1} \cdot \vec{v_2}$.

2. When healthy and in his prime, Pedro Martínez could throw a 142 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.

3. 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? Please be sure to draw a clear diagram.

4. A disgruntled COA student drops a TAB mug off a 30 meter building. Don Cass uses a radar gun to measure the speed of the mug right before it shatters into many pieces. He determines that it was moving at 75 miles per hour. With what speed did the student throw the mug off the building?

5. Steve Ressel has sent you on a mission to Pluto to look for lizards. You are hovering in a spacecraft 3 km above Pluto's surface. You need to get to the surface to begin your search. Would it be safe to jump off the spaceship at this altitude? The mass of Pluto is around 1.45×10^{22} kg. The radius of Pluto is 3500 km.

6. A perfectly spherical rock with a radius of 2 meters and a mass of 2350 kg rolls down a smooth hill. The height of the hill is 30 meters. At the top of the hill the rock has a speed of 15 meters/second. What is speed of the rock at the bottom of the hill?

7. The earth spins on its axis once a day.

   (a) What is the earth's angular speed, in radians per second?

   (b) What is the velocity of a person standing on the equator?

   (c) What is the velocity of a person standing on the South Pole?

8. A piece of Aluminum at 200 C is placed in 2 kg of 25 degree Celsius water in a well insulated container. After a while the Aluminum and water are both at 50 C. What is the mass of the Aluminum?