

# EXAM 1

October 13 and 14, 2005

## 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.
  - Unless other arrangements are made, you should get this exam back to me by 5:30 pm on Friday October 14.
  - 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) Find the components of  $\vec{v}_3$  where  $\vec{v}_3 = \vec{v}_1 - 2.5\vec{v}_2$ .
    - (b) Find the magnitude and direction of  $\vec{v}_3$ .
  2. A disgruntled COA student drops a TAB mug off a 30 meter building. Steve Katona 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?
  3. A 60 kg hockey player stands on a sheet of ice. She shoots a 0.5 kg puck due North at 80 miles per hour. After she shoots the puck, what is her speed?
  4. A certain spring has a spring constant of  $k_s = 200 \text{ J/m}^2$ . The spring is compressed 5 cm and then used to shoot a 125 gram marble. With what speed does the spring shoot the marble? I.e., what is the marble's speed when it leaves the spring?

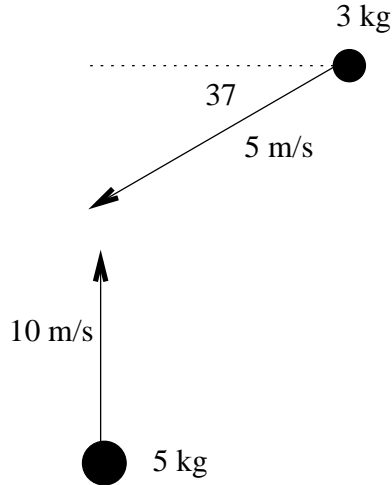


Figure 1:

5. You are on an interplanetary mission looking for signs of human ecologists on the planet Pluto. You are hovering in a spacecraft 100 km above Pluto's surface. As an offering to Plutonian human ecologists, you then drop a Nalgene bottle containing Celestial Seasonings tea. Ignoring friction, what is the speed of the Nalgene right before it lands on the surface of Pluto? The mass of Pluto is around  $1.45 \times 10^{22}$  kg. The radius Pluto is 3500 km.
6. Two pucks collide on a frictionless surface. One puck has a mass of 5 kg and is moving due north at 10 m/s. The second puck has a mass of 3 kg and is moving 5 m/s, 37 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?
7. A 55 kg astronaut is floating in deep space. Three meters away from him there is a 20 kg block of Gouda cheese. What is the center of mass of the astronaut-cheese system?