EXAM 2

November 14–16 2007

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 11:00 am on Friday November 16, 2007.
- Remember to include units.
- To receive full credit on these problems you must show your work clearly.

1. Suppose you are going for a walk on a winter day and you suddenly die and fall in a pile of snow. How much snow would your body melt as it cooled off? Assume that your body temperate was 37 degrees Celsius, and that all of your internal energy eventually goes to the snow.

2. A 20 kg child is standing on the edge of a spinning merry-go-round that makes one revolution every 4 seconds. The merry-go-round has a mass of 80 kg and a radius of 2 meters. The child moves so that she is .25 meters from the center of the merry-go-round. How fast is the merry-go-round turning now?

3. A 30 kg avatar[1] flies in a counter-clockwise circle at a constant speed of 50 m/s. The radius of the circle is 700 meters.

   (a) What is the angular speed of the avatar? Be sure to state units for your answer.

   (b) What is the angular momentum of the avatar about the center of the circle?

   (c) What is the acceleration (magnitude and direction) of the avatar when it's flying due North?

   (d) What is the net force (magnitude and direction) acting on the avatar when it's flying due North?

[1] It is a subject of considerable debate as to whether or not avatars have mass and whether or not the laws of physics apply to them. But for the purpose of this exam, let us assume that avatars are physical objects, and hence fully subject to the laws of physics.

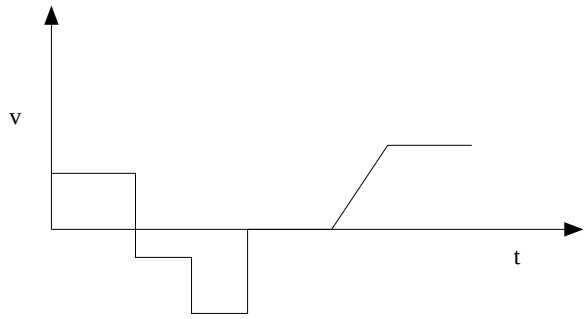

Figure 1:

4. An anguished student hurls a TAB mug skyward. The mug travels in a graceful arc, up and then down. Draw a free-body diagram for the mug when it is moving up, half-way toward the peak of its trajectory.

5. Consider the velocity vs. time plot in Fig. 1. Sketch the position (x) and the acceleration (a) as a function of time.

6. Consider the motion diagram of Fig. 2. The time interval between dots is 0.2 seconds. Estimate the magnitude of the acceleration at point 3.

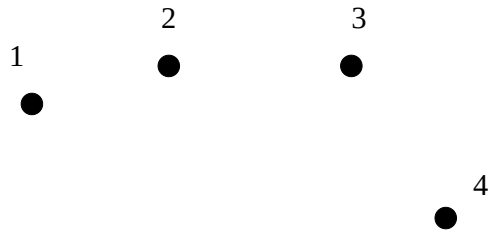

Figure 2: A motion diagram

7. A 50 kg physics student on rollerblades is skating at 5 m/s and runs into a wall. She bounces off the wall with a speed of 3 m/s and a direction directly opposite her original direction. She is in contact with the wall for approximately .15 seconds. What is the force that the wall exerted on the student?

8. To heat your house you decide to leave your toaster on all day long.

   (a) About how much would this cost per day?
   (b) About how many liters of gasoline would you have to burn to get the same amount of energy?
   (c) About how much would this gasoline cost?